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## Glossary

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Additional mitigation	Mitigation which is considered after the impact assessment to reduce any significant effects
Cetacean	Whale, dolphin or porpoise
Embedded mitigation	Mitigation which is considered from the outset and included in the impact assessment e.g. soft start to pile driving operations
Geophysical survey systems	Potentially includes, but is not limited to, the following types of equipment: sub-bottom profilers (pingers, sparkers, boomers and chirps), Ultra Short Baseline (USBL) transceivers/ transducers and transponders/ responders/ beacons, scanning sonars and multi beam echo sounders
Potential Biological Removal	The number of individuals that can be removed from a population without causing a decline in the population. For grey and harbour seals in Scotland this is calculated annually by the Sea Mammal Research Unit (SMRU) using the latest seal counts
Phocid seal	Earless or true seal; member of the family Phocidae

## Abbreviations and Acronyms

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AA	Appropriate Assessment
ADD	Acoustic Deterrent Device
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas
CIA	Cumulative Impact Assessment
CMS	Construction Method Statement
C-POD	Chelonia PORpoise Detector
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPS	European Protected Species
ES	Environmental Statement
F3 <sup>1</sup>	Noise modelling location 3 at Inch Cape
F4	Noise modelling location 4 at Inch Cape
FCS	Favourable Conservation Status
FTOWDG	Forth and Tay Offshore Wind Developers Group
HRA	Habitats Regulations Appraisal
IAMMWG	Inter-Agency Marine Mammal Working Group
ICOL	Inch Cape Offshore Limited
iPCoD	Interim Population Consequences of Disturbance
JNCC	Joint Nature Conservation Committee
ML	Most Likely
MMMU	Marine Mammal Management Unit
MMPP	Marine Mammal Protection Plan
MORL	Moray Offshore Renewables Limited
MS-LOT	Marine Scotland Licensing Operations Team

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<sup>1</sup> The nomenclature for the naming of the noise modelling locations for the Development was assigned during the assessment process for the 2013 Inch Cape ES (ICOL, 2013), and has been maintained for clarity during this assessment. F1 and F2 were located within the NnG OWF, and are not referred to specifically within this assessment.

MSS	Marine Scotland Science
MU	Management Unit
NnG	Neart na Gaoithe
NOAA	National Oceanic and Atmospheric Administration
OfTW	Offshore Transmission Works
OSP	Offshore Substation Platform
OSPAR	Oslo and Paris (Conventions)
OWF	Offshore Wind Farm
PBR	Potential Biological Removal
Photo-ID	Photo-identification
PTS	Permanent Threshold Shift
SAC	Special Area of Conservation
SCANS	Small Cetaceans in European Atlantic waters and the North Sea
SCOS	Special Committee on Seals
SEL	Sound Exposure Level
SMRU	Sea Mammal Research Unit
SNCB	Statutory Nature Conservation Body
SNH	Scottish Natural Heritage
SPL	Sound Pressure Level
USBL	Ultra Short Baseline
WC	Worst Case
WDC	Whale and Dolphin Conservation
WTG	Wind Turbine Generator

## 10 Marine Mammals

### 10.1 Introduction

- 1 This chapter presents the assessment of potential impacts on marine mammals predicted to arise from the Inch Cape Wind Farm and associated Offshore Transmission Works (OfTW) (the Development) within the Firths of Forth and Tay.
- 2 The following appendices should be read in conjunction with this chapter, the introductory chapters (1-8) and the marine mammals section of Inch Cape Wind Farm and Offshore Transmission Work Habitats Regulations Appraisal (HRA):
  - *Appendix 9B: Underwater Noise Modelling;*
  - *Appendix 10A: Assessment of Population Level Effects on Bottlenose Dolphins using iPCoD;* and
  - *Appendix 10B: Underwater Noise Modelling using a 1% Conversion Factor.*

### 10.2 Consultation

- 3 Table 10.1 below provides a summary of the responses to the Offshore Scoping Report (Scoping Opinion) that are pertinent to marine mammals, and of subsequent marine mammal workshops and other consultations. These have been taken into consideration in the completion of this assessment, with all points being addressed.
- 4 Following submission of the Offshore Scoping Report (ICOL, 2017), a marine mammals scoping meeting was held on 26 May 2017 and a workshop (to discuss the baseline and impact assessment methodology further) was held on 27 July 2017. A second workshop to discuss the initial outputs of the noise modelling and impact assessment was held on 07 December 2017. Representatives from Marine Scotland Licensing Operations Team (MS-LOT), Marine Scotland Science (MSS), Scottish Natural Heritage (SNH) and Whale and Dolphin Conservation (WDC) attended. The outcomes of these discussions have also been summarised in Table 10.1 below.

**Table 10.1: Consultation responses and actions**

Consultees	Consultation Response	ICOL's Response
Scottish Ministers	The consent granted for the Original Development had an operational period of 25 years, the Revised Development is proposed to be 50 years. On the basis of expert opinion received, the Scottish Ministers consider that, in the majority of cases, the Original Development Environmental Statement (ES) assessment of the effects of a 25 year consent duration is likely to be acceptable. However, the Scottish Ministers are aware that there are inherent uncertainties of modelling population effects which increase with time, and it may not be possible to have	As per MS-LOT's advice (received 15/03/2018), the duration (model run period) of the iPCoD modelling was 25 years. No additional effects (of PTS/ displacement as a result of pile driving) are anticipated beyond the 25 year period over which the simulations were run.

Consultees	Consultation Response	ICOL's Response
	confidence in predicted impacts over a 50 year period for some receptors e.g. marine mammals. Inch Cape Offshore Limited (ICOL) is advised to identify and, if possible, quantify, the uncertainties associated with modelling population effects over different timescales.	
Scottish Ministers	The Scottish Ministers agree that bottlenose dolphin, harbour seal, grey seal, harbour porpoise, minke whale and white beaked dolphin should be included in the Environmental Impact Assessment (EIA).	The assessment has been conducted on these species (see <i>Section 10.6.5</i> ).
Scottish Ministers	The Scottish Ministers agree that there is connectivity between the project and: <ul style="list-style-type: none"> <li>• The Moray Firth Special Area of Conservation (SAC) for bottlenose dolphins;</li> <li>• The Firth of Tay and Eden Estuary SAC for harbour seals;</li> <li>• The Isle of May SAC for grey seals; and</li> <li>• The Berwickshire and North Northumberland Coast SAC for grey seals.</li> </ul> These species and sites should be included in the (HRA).	The assessment has been conducted on these sites (see <i>Section 10.6.2</i> ).
Scottish Ministers	The Scottish Ministers agree that the existing baseline and proposed updates are appropriate. ICOL should take into account the other sources of data discussed at the stakeholder meeting (the Chelonia PORpoise Detector (C-POD <sup>2</sup> ) data from the MSS funded survey of the east coast of Scotland, the Sea Mammal Research Unit (SMRU) photo-identification (Photo-ID) project - which could be used for assessing the proportion of bottlenose dolphin from the Moray Firth SAC which can be expected to be utilising the Firth of Tay at any one time) and ensure that the information they are using is the most up to date.	The data suggested (MSS C-POD data and University of Aberdeen/ SMRU Photo-ID data) were interrogated and options for their inclusion were discussed at the first marine mammals workshop held on 27 July 2017. The bottlenose dolphin baseline has been updated accordingly and is described in <i>Section 10.6</i> .
Scottish Ministers	<b>Cetaceans – reference populations and distributions</b> The Scottish Ministers agree that: <ul style="list-style-type: none"> <li>• The Inter-Agency Marine Mammal Working Group (IAMMWG) (2015) figures for the cetacean reference populations (bottlenose dolphin – Coastal East Scotland, harbour porpoise – North Sea, minke whale and white-</li> </ul>	The IAMMWG (2015) Marine Mammal Management Unit (MMMU) abundance estimates (Table 10.8) have been used as reference populations for the cetacean species (see <i>Section 10.6.6</i> ). The SCANS-III Block R (the SCANS survey area which covers the Development and surrounding area)

<sup>2</sup> A device deployed at sea which uses digital waveform characterisation to select cetacean clicks and log the time, centre frequency, SPL, duration and bandwidth of each click.

Consultees	Consultation Response	ICOL's Response
	<p>beaked dolphin – Celtic and Greater North Seas) and the additional references suggested SNH (Cheney <i>et al.</i>, 2013) should be used;</p> <ul style="list-style-type: none"> <li>• If available, the Small Cetaceans in European Atlantic waters and the North Sea (SCANS) III surveys should be used for abundance estimates as these are the most up to date, if not available then the IAMMWG (2015) guidance should be used;</li> <li>• The most up to date SCANS III survey results for block R should be used to provide a regional abundance estimate for use within the assessment; and</li> <li>• Distribution data on harbour porpoise, minke whale and white-beaked dolphin can be taken from the Original Development ES, unless other more recently published data are available.</li> </ul>	<p>abundance and density estimates (Hammond <i>et al.</i>, 2017) have been presented in Table 10.8 in order to provide additional information regarding cetacean reference populations.</p> <p>Distribution data (density surfaces) for minke whale (Figure 10.5), white-beaked dolphin (Figure 10.7) and harbour porpoise (Figure 10.8) were taken from the 2013 Inch Cape ES (ICOL, 2013); see <i>Section 10.6.6</i>.</p>
MSS, SNH	<p><b>Bottlenose dolphin distribution</b></p> <p>During the workshop on 27<sup>th</sup> July 2017 an approach was agreed which provided an updated version of the distribution used in the original ES. The text of the notes from the workshop states: “Agreement reached to assume, as per the assessment for the Original Development, the reference bottlenose dolphin population (195 individuals) should be split 50:50 between the east coast and the Moray Firth, and that 98 dolphins would be present at the time of piling activities off the east coast. Agreement reached that the 98 individuals assumed to be present off the east coast should be spread evenly across the area inside the 20 m depth contour as defined in the Original Development EIA, excluding areas in the Forth and Inner Tay where bottlenose dolphin are known not to be present. These 98 animals will be spread evenly across the remaining grid cells (thereby increasing the density per grid cell).”</p>	<p>The bottlenose dolphin density surface (Figure 10.2) has been updated in line with discussions during consultation (see Paragraph 26).</p>
Scottish Ministers	<p><b>Seals – reference populations and distributions</b></p> <p>The Scottish Ministers agree that:</p> <ul style="list-style-type: none"> <li>• The Special Committee on Seals (SCOS) east coast seal management unit (MU) and population estimates (ideally for 2016 (SCOS 2017) but alternatively for 2015 (SCOS, 2016)) are used (and taken</li> </ul>	<p>SMRU-derived multipliers have been used to convert the most recent August counts of seals in the East Scotland MU (3,812 grey seals and 368 harbour seals; Duck <i>et al.</i>, 2017) to reference populations (see <i>Section 10.6.6</i>).</p> <p>For the seal density surfaces (Figure 10.9 and Figure 10.10), the usage</p>

Consultees	Consultation Response	ICOL's Response
	<p>as equivalent of the SAC populations); and</p> <ul style="list-style-type: none"> <li>The seal usage maps produced by SMRU are used for distribution data on both species.</li> </ul>	<p>maps produced by SMRU in 2017 (SMRU and Marine Scotland, 2017) have been used; see <i>Section 10.6.6</i>.</p>
Scottish Ministers, MSS	<p>The Scottish Ministers agree that the EIA should focus on disturbance from increased noise (geophysical survey systems) and disturbance/ permanent threshold shift (PTS) from piling.</p> <p>MSS agree it would be helpful to include geophysical surveys in EIA Report although they note that it may be necessary to undertake geophysical surveys prior to a licence or consent being granted e.g. to inform consideration of such a licence or consent. There is therefore potential for geophysical surveys to be considered as part of a stand alone process.</p>	<p>Geophysical surveys were carried out prior to this application, with appropriate EPS licences gained. However, further geophysical surveys may be required as the development progresses. The potential effects resulting from the use of geophysical survey systems have been assessed in <i>Section 10.8.1</i>.</p>
Scottish Ministers, MSS, SNH	<p>The Scottish Ministers consider that the following should be used for the <b>underwater noise modelling and assessment</b>:</p> <ul style="list-style-type: none"> <li>Both instantaneous and cumulative PTS should be presented<sup>3</sup>, modelled for each of the species noted above. ICOL should provide the total number of individuals from each species that may suffer PTS and the number that may be displaced through disturbance;</li> <li>Swim speeds as outlined by SNH (2016) should be used along with information provided by SMRU in relation to bottlenose dolphin swim speeds (which can be used as a proxy for white beaked dolphin);</li> <li>Fleeing should be considered to begin from the start of acoustic deterrent device (ADD) use i.e. 20 minutes before piling starts, and the PTS impacts from ADDs do not need to be considered as the ADDs will not be sufficiently loud to cause PTS for the period of time that they will be used for;</li> <li>PTS thresholds from both Southall <i>et al.</i> (2007) and the National Oceanic and Atmospheric Administration (NOAA) (2016) should be presented (to allow comparability with the Original Development ES (which used Southall</li> </ul>	<p>Both instantaneous and cumulative PTS contours were modelled (see <i>Section 10.7</i> and <i>Section 10.8</i>).</p> <p>The extent of the instantaneous PTS contours was initially used to inform the mitigation methods i.e. the distance out to which animals need to be displaced (by the ADD) prior to commencement of the pile driving soft start – and therefore the length of time the ADD needs to be used for. Subsequent work (see <i>Section 10.5.2</i>), however, revealed that the risk of infringement of EPS legislation was trivial, and that the areas of potential cumulative PTS effect were only slightly larger, without use of an ADD. Therefore, there is no need to use an ADD prior to soft start pile driving. Species-specific swim speeds (taken from SNH (2016) and Bailey and Thompson (2006)) were used (see <i>Paragraph 34</i>).</p> <p>Fleeing was considered to begin from the start of soft start pile driving (see <i>Paragraph 40</i>).</p> <p>The Southall <i>et al.</i> (2007) contours were used when undertaking the assessment (see <i>Section 10.7.1</i> and <i>Section 10.8.1</i>). However the NOAA (2016) noise impact contours were</p>

<sup>3</sup> The instantaneous PTS threshold will inform the mitigation methods, while the cumulative PTS threshold informs any required assessment of population consequences (SNH Response).

Consultees	Consultation Response	ICOL's Response
	<p><i>et al.</i> (2007)) but takes into account that the NOAA criteria are the most up to date scientific information);</p> <ul style="list-style-type: none"> <li>A dose response curve should be used to determine the proportion of animals likely to be disturbed sufficiently to displace them by piling noise. ICOL should take into account the concerns noted above about the use of the Horns Rev II and make use of other relevant data as noted above.</li> </ul>	<p>also used and the number of individuals with the potential to be impacted by PTS onset has also been presented for comparison (Table 10.16 to Table 10.19).</p> <p>A dose-response curve derived using received noise level and harbour porpoise presence data collected by the University of Aberdeen in the Moray Firth in 2017 (Graham <i>et al.</i>, 2017; Figure 10.14) was used to determine the proportion of animals present likely to be displaced.</p> <p>ICOL has provided estimates of the total number of individuals of each species estimated to have the potential to be exposed to noise levels sufficient to induce the onset of PTS and displacement (see <i>Section 10.8.1</i>).</p>
Scottish Ministers, MSS, SNH	<p><b>Species impact assessment</b></p> <p>The Scottish Ministers advise for harbour porpoise, minke whale, white beaked dolphin, harbour seal and grey seal that further assessment is only carried out if the effects of the Revised Development are found to be greater than those assessed for the Original Development. The Scottish Ministers request that, where necessary, the information is provided in a form that means it can be used for the European Protected Species (EPS) process<sup>4</sup> or, where needed, to inform the Appropriate Assessment (AA) as part of an HRA.</p>	<p>The effects of the Development were found to be lesser than those estimated for the assessment to inform the 2013 Inch Cape ES (ICOL, 2013; see <i>Section 10.8.1</i>) – therefore no further assessment (i.e. population level modelling) was carried out for minke whale, white-beaked dolphin, harbour porpoise, grey seal and harbour seal.</p> <p>The information has been provided in a form that means it can be used for the EPS process (numbers of individuals which have the potential to be impacted; see <i>Section 10.8.1</i>) and has been used to draft a Shadow AA (see the HRA Report).</p>
Scottish Ministers, MSS	<p><b>Species impact assessment</b></p> <p>The Scottish Ministers advise that, for bottlenose dolphin, an assessment of the impacts of the Revised Development alone on the East Scotland MU population as well as cumulatively with other developments that may impact on the same population is required. ICOL should ensure that the information provided can be used for an AA in relation to the Moray Firth SAC.</p>	<p>A quantitative assessment of the potential for population level effects has been conducted for bottlenose dolphins (see <i>Section 10.8.1</i> for the Inch Cape only assessment and <i>Section 10.11.1</i> for the cumulative assessment). The best estimate of the abundance of the population which uses the Moray Firth SAC (Cheney <i>et al.</i>, 2013) has been used therefore this information can be used for an AA in relation to the Moray Firth SAC.</p>

<sup>4</sup> SNH advises referring to the joint Statutory Nature Conservation Body (SNCB) guidance to determine the reference populations against which to judge FCS.

Consultees	Consultation Response	ICOL's Response
Scottish Ministers, MSS	<p><b>Population level assessment</b></p> <p>The Scottish Ministers advise that the iPCoD framework is used for species where population level impact assessments are undertaken. The Scottish Ministers request that a comprehensive list of the parameters input and other relevant information to allow MSS to be able to replicate the analysis is provided. As a minimum this must include:</p> <ul style="list-style-type: none"> <li>• The piling schedule;</li> <li>• The demographic parameters;</li> <li>• Starting population size;</li> <li>• Copy of the code used to run the model;</li> <li>• Any quality assurance/ quality control outputs that the software produces.</li> </ul> <p>The Scottish Ministers advise that the results of the assessment using iPCoD should be presented using the metrics provided in the MSS guidance note (<i>Appendix V</i> of the marine mammal Scoping Opinion).</p>	<p>As advised, the iPCoD framework has been used to assess population level impacts on bottlenose dolphins to inform the AA (see <i>Sections 10.8.1, 10.11.1</i> and the HRA Report).</p> <p>A comprehensive list of the parameters input and other relevant information is given in <i>Appendix 10A</i>. This information (input parameter values) is also available as an Excel spreadsheet if required.</p> <p>As advised, the results of the iPCoD assessment have been presented using the metrics provided in the MSS guidance note (<i>Appendix V</i> of the marine mammal Scoping Opinion).</p>
Scottish Ministers, MSS	<p><b>Mitigation</b></p> <p>The Scottish Ministers agree that the embedded mitigation and the consent conditions of the Original Development are appropriate to the potential impact from the Revised Development. There may be a need for further mitigation and associated consent conditions if the increased hammer energy is assessed to have a greater effect than the Original Development.</p> <p>The Scottish Ministers advise that ICOL consider including the use of ADDs as a mitigation after undertaking the initial assessment. This would provide evidence by which to judge the efficacy of the proposed mitigation.</p>	<p>The increased hammer energy was not assessed to have a greater effect than the assessment to inform the 2013 Inch Cape ES (ICOL, 2013; see <i>Section 10.8.1</i>).</p> <p>ICOL does not plan to use an ADD as mitigation (see <i>Section 10.5.2</i>).</p>
Scottish Ministers	<p><b>Cumulative impacts</b></p> <p>The Scottish Ministers agree that the cumulative impacts on marine mammals, with the exception of disturbance from increased noise (geophysical survey systems) and disturbance/ PTS from piling, should be scoped out of the EIA for the Revised Development.</p>	<p>Only the potential for underwater noise impacts has been included in the (qualitative) cumulative impact assessment (CIA) (see <i>Section 10.11</i>).</p>
Scottish Ministers, MSS, SNH	<p>With the addition of the Aberdeen Harbour Expansion project, MSS agree with the list of projects to be included within the CIA that is provided in the Offshore Scoping Report.</p>	<p>All CIA projects listed in the Scoping Opinion and 15/03/2018 e-mail from MS-LOT have been included (see <i>Section 10.11</i>).</p>

Consultees	Consultation Response	ICOL's Response
WDC	Attended scoping meeting and marine mammal workshops but no formal written responses have been provided.	ICOL has drafted this chapter (marine mammals) of the EIA Report in line with the agreements reached at the various meetings and workshops and therefore assumes that WDC is content with the approach taken.
WDC	During the first marine mammals workshop (27 July 2017), WDC stated that it does not support the use of an ADD as mitigation due to the introduction of additional noise into the marine environment.	This standpoint was noted in the minutes of the meeting as requested by WDC. No viable alternative was identified.  However, ICOL does not plan to use an ADD as mitigation (see <i>Section 10.5.2</i> ).
SNH	<b>Population consequences</b> ICOL suggest a further workshop to discuss the initial noise modelling outputs once these are available. Again we welcome this and are happy to participate. We think it should be possible to review these outputs for the revised proposal and broadly compare them against those for the original application. Despite differences in methodology, each form of underwater noise modelling should give the predicted number of animals suffering hearing loss (PTS) and the predicted number of animals disturbed. So a broad comparison should be possible.  This will inform whether or not the revised predictions are any worse than those previously assessed. If not, we will not require any further consideration of population consequences – these were already assessed as acceptable for the consented development. However, in the meantime, we have no issues if Inch Cape wish to further develop their approach to population modelling, on the contingency that it may be required if the piling impacts prove greater than what was previously assessed.	Second marine mammal workshop (to discuss the initial outputs of the noise modelling and impact assessment) held on 07 December 2017.
SNH	<b>Cumulative impacts</b> Any requirements for CIA can be discussed at the second workshop proposed by Inch Cape. This will only be necessary if the piling (underwater noise) impacts are greater than previously assessed. However, in the meantime, we have no issues if Inch Cape wish to further develop their approach to address cumulative impacts. As a first step, we recommend they review the available marine mammals assessment for Aberdeen Harbour expansion works.	A qualitative construction CIA has been undertaken for minke whale, white-beaked dolphin, harbour porpoise, grey seal and harbour seal (see <i>Section 10.11</i> ) as agreed at the second marine mammals workshop. Population level modelling was undertaken for bottlenose dolphin using the interim PCoD framework (see <i>Section 10.11.1</i> ).

Consultees	Consultation Response	ICOL's Response
MS-LOT, SNH, MSS	<p><b>Advice on marine mammal assessment following second workshop</b> (e-mail dated 21 December 2017)</p> <p><b>Noise thresholds:</b> SNH and MSS agree that both NOAA and Southall thresholds should be presented in the EIA report. Therefore Scottish Ministers advise that this should be done.</p> <p><b>Fleeing distance:</b> SNH and MSS both advise use of a fleeing animal model using a 25km fleeing distance. This fleeing distance is based on JNCC guidance. During the workshop held on 7 December, Inch Cape suggested a possible refinement using a 6.8 km fleeing distance. While draft outputs have been presented in this regard, SNH and MSS do not require this information to be submitted in the EIA report. Scottish Ministers advise that a 25 km fleeing distance should be used in the modelling.</p> <p><b>Population modelling &amp; CIA:</b> SNH have advised that they are content with the approach to noise modelling that Inch Cape provided at the workshop on 7 December, followed up with the post-workshop discussion document.</p> <p>SNH have advised that for the new application, all of Inch Cape's estimates of PTS (NOAA and Southall) and displacement are significantly less than those for the consented scheme, and predicted PTS is zero for all species. Having reviewed these predicted noise impacts SNH confirm that they are within the already consented predicted effects and therefore SNH advise that no further population modelling is required for any marine mammal species.</p> <p>SNH have advised that they are happy for Inch Cape to undertake a qualitative discussion of cumulative impacts and suggested that this could be informed by outputs from the population modelling in the HRA for the consented schemes.</p> <p>MSS agree that for minke whales, harbour porpoises, white-beaked dolphins, harbour seals and grey seals that population modelling is not required, and a qualitative cumulative assessment will be appropriate.</p>	<p>Cumulative PTS effect zones (animals fleeing to 25 km) were modelled using both the Southall and the NOAA criteria).</p> <p>A qualitative cumulative assessment was undertaken for minke whale, white-beaked dolphin, harbour porpoise, grey seal and harbour seal.</p> <p>Population level modelling was undertaken for bottlenose dolphin for Inch Cape only (see <i>Section 10.8.1</i>) and cumulative (see <i>Section 10.11.1</i>) using the interim PCoD framework.</p>
	<p>With respect to bottlenose dolphins and the Moray Firth SAC, while MSS agree that the effects from the Inch Cape project are considerably reduced compared with the original application, and alone, would not warrant population modelling, MSS</p>	

Consultees	Consultation Response	ICOL's Response
	<p>consider that a cumulative assessment to inform the HRA process will be more fully informed if population modelling is undertaken. MSS note that SNH suggest that a qualitative assessment can be undertaken by comparing the level of effects modelled in work to support the previous HRAs that have found the effects to the population to be acceptable, including for other projects that have been licensed or consented in the period between the previous wind farm consents being issued and the current time. MSS advise that previous cumulative effects modelling at the population level has been undertaken in a Vortex PVA framework. Although the best available at the time, this has been superseded by the interim Population Consequences of Disturbance (iPCoD) modelling framework. Additionally, iPCoD was referred to in the scoping opinion.</p> <p>For these reasons, MSS recommends that population modelling using iPCoD, and including cumulative scenarios, is undertaken for bottlenose dolphins.</p> <p>Scottish Ministers advise that population modelling (using iPCoD) should be undertaken for bottlenose dolphin for Inch Cape alone and in-combination with the other Forth and Tay and Moray Firth offshore wind farms (OWFs) Although no animals are predicted to be at risk from PTS, some are at risk form disturbance, and Scottish Ministers consider that it will be important to understand the population consequences of this using the current methods in order to inform the AA, particularly from an in-combination perspective. This is consistent with the advice provided in the scoping opinion.</p>	
MS-LOT	<p><b>Clarification on the use of iPCoD</b> (e-mail dated 07 February 2018)</p> <p>The preferred option is for the developers to pass information between each other and come to an agreed set of scenarios for cumulative modelling. Where the required information is available, we would recommend that it is used. However, we are aware that this may not be possible in the timelines required.</p> <p>In the absence of specific and updated information (numbers of animals likely to be exposed to disturbance and PTS), a</p>	<p>It was not possible for the information required for the cumulative modelling to be made available in the timelines required. Therefore ICOL collated information from the previous consents as advised. ICOL also made some assumptions where information was lacking, and asked MS-LOT to confirm whether the proposed approach and parameters (see Table 10.13) were acceptable.</p> <p>Moray West was considered qualitatively using details from the</p>

Consultees	Consultation Response	ICOL's Response
	<p>relatively complete cumulative assessment could be done with the information from the previous consents. Numbers of animals experiencing disturbance or PTS could be taken from the AA for Aberdeen harbour, which includes an appendix detailing the scenarios used. The timelines for work will have to be updated, and we would recommend using the schedules estimated in the scoping reports for each of the developments, unless further information is available directly from other developers.</p> <p>To note, the Aberdeen Harbour AA does not include Moray West, which it may be more appropriate to consider qualitatively if detailed information is not available.</p>	<p>Moray West scoping report (see Table 10.31).</p>
MS-LOT	<p><b>New information from the response to ICOL's proposed approach for undertaking cumulative population modelling (for bottlenose dolphins) using iPCoD</b> (e-mail dated 15 March 2018)</p> <p>SAC/ MU/ starting population for iPCoD = 195 animals (Cheney <i>et al.</i>, 2013).</p> <p>Run modelling from 2017 for 25 years.</p> <p>Either (1) model 15 minutes of ADD use for the first jacket pile only, and assume that animals are stationary during subsequent breaks until the jacket installation is complete or (2) undertake modelling using a different assumption (such as deployment of ADD mitigation for each jacket pile).</p> <p>CIA:</p> <p>NnG and Seagreen Phase 1 may be removed from the iPCoD CIA (these developments predicted that no bottlenose dolphins would experience disturbance or PTS). If updated information is available MS-LOT would recommend that this is used.</p> <p>Any impacts in combination with Aberdeen Bay, Hywind, Kincardine and Forthwind (two turbine) should be considered qualitatively (SNH have previously advised that these four wind farms will not give rise to any significant levels of bottlenose dolphin disturbance).</p> <p>AHEP - the number of animals that could be disturbed by blasting at AHEP could be up to 53, which is all of the animals thought to use the area between Aberdeen and Stonehaven. No animals were considered to be exposed to noise levels sufficient to cause PTS. Impact piling does not need to be included in the assessment since AHEP</p>	<p>The cumulative population modelling (for bottlenose dolphins) was carried out as agreed with MS-LOT.</p> <p>Updated information (from the March 2018 EIA Report for the Revised Design Neart na Gaoithe (NnG) OWF) was used for NnG as advised (see Table 10.13).</p>

Consultees	Consultation Response	ICOL's Response
	<p>have now undertaken to use rotary piling. It is our understanding that blasting works have yet to commence at the project, but are likely to do so in 2018. The level of effects modelled in the AA means that disturbance of 53 animals leads to the removal of 2 calves from the population. We are aware that iPCoD will model this in a different way, but would suggest that the likely scale of effects would be expected to be of the same order.</p> <p>Three scenarios should be considered: 1. baseline, 2. ICOL only, 3. cumulative (considering the relevant Forth and Tay developments, Moray Firth developments and AHEP). Please note the metrics that were requested for population estimation simulation</p>	
	<p>in the scoping opinion. iPCoD - SMRU Consulting's advice in the iPCoD manual, where they recommend that the demographic stochasticity remain at 500 should be followed.</p>	
MS-LOT, SNH, MSS	<p><b>Comments during the Gatecheck process:</b></p> <p><b>ADDs:</b> In the scoping opinion, Ministers advise ICOL not to assess ADDs as embedded mitigation, rather to carry out the initial assessment without the ADDs and then to consider them as mitigation. The information provided at Gatecheck does not appear to have followed this advice. We would require certainty that ADDs would be used for this to be the case as our advice would change if there is a possibility ADDs would not be used. The information provided states it is "likely" they will be used which is not the level of certainty we would suggest for embedded mitigation.</p>	
		<p>Additional underwater noise modelling was carried out to assess the risk of infringement of EPS legislation (instantaneous PTS) and differences in the PTS contours with and without use of an ADD (see section 10.5.2). The risk of infringement of EPS legislation is considered trivial, and areas of potential effect from cumulative PTS were only slightly larger without use of an ADD, i.e. if only soft start pile driving is conducted (see Figure 10.1 and Figure 10.2). These small increases in cumulative PTS contours made no/ only slight difference(s) to the numbers of individuals estimated to have the potential to be impacted by PTS onset, and no difference to the per cent of the reference populations (see Table 10.7).</p> <p>Therefore there is no need to use an ADD prior to soft start pile driving. Because the differences in cumulative PTS predictions were so small, the full suite of modelling described in this chapter (and <i>Appendix 9A: Herring Spawning Study</i>) has not been remodelled in the absence of ADD use. The existing modelling is</p>

Consultees	Consultation Response	ICOL's Response
		considered to be appropriate for the marine mammal assessment.
	<p><b>Conversion Factor (CF):</b> We have concerns regarding the conversion factor used in the source model calculation. Our view is that the use of 0.5% conversion factor returns estimated source levels that are lower than expected. We therefore advise that a conversion factor of 1% is used in the noise model in instead of the 0.5% which has been used in the information provided at Gatecheck. If the conversion factor of 0.5% is preferred, we would need to see full justification as to the reasons why the 0.5% conversion factor is appropriate for ICOL. Our recommendation of 1% follows our advice for the BOWL Piling Strategy and will improve our ability to compare the differences in estimated impacts between developments.</p>	<p>Additional noise modelling using a CF of 1 % was carried out in order that the effect of any potential differences on the assessment for marine mammals (which was conducted using a CF of 0.5 %) could be assessed (see <i>Appendix 10B</i>).</p> <p>Although the noise impact contours modelled using a CF of 1 % differed from those modelled using a CF of 0.5 %, the findings of the assessment remain largely unchanged.</p> <p>Therefore, the modelling carried out using the 0.5 % CF and described in this chapter is considered to be appropriate for the marine mammal assessment.</p>
	<p><b>Shape of PTS zones:</b> The predicted cumulative PTS zones form unusual shapes. We appreciate that bathymetry and underwater features will affect the shape of the zones, but it would be good to get some clarification of why the modelling shows such strange patterns. Are these realistic? Or are they just an artefact of the model?</p>	<p>The odd patterns are a consequence of the fleeing behaviour assumptions agreed during consultation and incorporated in the model. For example, low frequency cetaceans will flee along straight lines as long as they are less than 25 km from the source, but they will not get into less than 10 m of water. When they encounter shallow water they will change direction (attempting to go sideways left or right 45 degrees, or 90 degrees if 45 is not possible, or even 45 degrees backwards – so that they do not get trapped). Thus their trajectory when interacting with shallow water can be quite complex and two whales starting from two adjacent points might end up in rather different places – hence the odd alternating patterns which can be observed near the coast. The pattern of sound propagation is also affected by bathymetry and sediment type.</p> <p>SNH and MSS required further explanation regarding the ‘pizza slice’ shapes resulting from the modelling. This was addressed during a call on the 08/08/2018 between MS-LOT, MSS, SNH, Natural Power, Cefas and ICOL when Cefas provided further explanations on the reason behind the shapes and how this was predominantly in relation to the</p>

Consultees	Consultation Response	ICOL's Response
		<p>pattern of the sound propagation. It was noted that environmental factors (predominantly bathymetry and sediment type) coupled with the agreed assumptions (e.g. regarding fleeing behaviour) resulted in these shapes. SNH and MSS were content with the explanation provided and it was agreed that no further information on the matter was required and that the explanation provided by email to MS-LOT on 31/07/2018 would be included in the gap analysis spreadsheet when the application is submitted.</p>
	<p><b>Cumulative assessment (Seagreen):</b> The quantitative cumulative assessment does not include Seagreen, as no PTS was predicted and a very low disturbance of BND in the 2014 consent. We (SNH) seek clarification on whether the potential impacts from the new 2017 Seagreen application, which may be higher due to the use of monopiles, have been considered. It would be useful to clarify whether this assessment was considered and, if scoped out, the rationale for that decision. We (SNH) agree that the quantitative cumulative assessment does not include Moray West.</p>	<p>As agreed during consultation (see above in this table - cumulative assessment), Seagreen Phase 1 was not included in the iPCoD CIA because the numbers of animals predicted to experience PTS and/ or displacement from pile driving noise (including installation of monopiles) on the Seagreen site were not available to ICOL due to the stage Seagreen is at in their submission. The numbers were requested directly (by e-mail to SSE) but were not able to be provided in the timelines required. Therefore, as advised by MS LOT, MS Science and SNH (e-mail dated 15/03/2018 in response to ICOL's 'proposed approach to undertaking cumulative population modelling' letter dated 19/02/2018), Seagreen Phase 1 was removed from the iPCoD CIA on the grounds that, with the current best information available in the public domain, this development predicted that no bottlenose dolphins would experience disturbance or PTS (this information was taken from the AA for the Aberdeen Harbour Expansion Project (AHEP)). This is supported by one of MSS' Gatecheck comments as follows, "MSS acknowledge that the Seagreen 2017 application will use monopiles and that the potential impacts may be higher, however, the details of the revised mono-piling is not in the public domain and as such MSS are content that the cumulative assessment has used the current best information available, as per the</p>

Consultees	Consultation Response	ICOL's Response
		advice provided by MSS to MS-LOT on 1st March, 2018".
	<b>Cumulative assessment (Aberdeen Harbour Expansion Project (AHEP)):</b> The cumulative assessment only includes 6 days of blasting at Aberdeen Harbour – this is less than we anticipated. It would be useful to understand why this blasting schedule has been used and how realistic it might be.	The cumulative level population modelling for bottlenose dolphins using iPCoD has been re-run using a revised blasting schedule for AHEP – 16 bouts of blasting instead of three (see Table 10.13 in <i>Section 10.7.1</i> and <i>Appendix 10A</i> ).

### 10.3 Scope of Assessment

- 5 As part of this application Inch Cape Offshore Limited (ICOL) has drawn on the detail presented in the Offshore Scoping Report (ICOL, 2017) and subsequent Scoping Opinion from MS-LOT, and on the matters discussed during the scoping meeting and marine mammal workshops, to agree on those potential impacts that may lead to a significant effect (Table 10.2). Therefore, this chapter focusses on those potential impacts on marine mammals that have been agreed throughout this process as being necessary to be assessed (Table 10.2).
- 6 For clarity, those impacts that have been agreed to be scoped out of the EIA are included in Table 10.3 below. For further information reference should be made to the Offshore Scoping Report and the Scoping Opinion which can be found on Marine Scotland's website<sup>5</sup>.

**Table 10.2: Scope of Assessment covered in this Chapter**

Potential Impact	Scope of Assessment	Reason
<b>Construction (&amp; Decommissioning) Phase</b>		
Displacement/PTS from piling	Bottlenose dolphin, harbour seal, grey seal, harbour porpoise, minke whale and white beaked dolphin	Maximum hammer capacity has increased due to the increased knowledge in ground conditions and availability in hammer technology.
Disturbance from increased noise from geophysical survey systems	Bottlenose dolphin, harbour seal, grey seal, harbour porpoise, minke whale and white beaked dolphin	Current knowledge has shown that noise from some geophysical survey systems used during the course of preparatory work for cable laying, scour protection installation and other ground intrusive works has the potential to induce the onset of PTS and/ or disturb/ displace animals (depending on the frequencies and source levels of the equipment used).

**Table 10.3: Impacts scoped out of this Chapter**

<sup>5</sup> At the time of writing these documents can be found here:  
<http://www.gov.scot/Topics/marine/Licensing/marine/scoping/ICOLRevised-2017> [Accessed 08/05/2018]

Potential Impact	Justification for Scoping out of the EIA
Construction (& Decommissioning) Phase	
Disturbance from increased noise (excluding piling and noise associated with geophysical survey)	Agreed by MS-LOT in their Scoping Opinion that this potential impact does not need to be assessed in the EIA as it is unlikely to lead to significant effects.
Collision risk and barrier effect from increased vessel movement	
Use of ducted propellers leading to risk of corkscrew injury	
Accidental pollution events	
Changes in availability of prey species	
Operation & Maintenance Phase	
Disturbance from increased anthropogenic noise (non-piling) i.e. operational noise	Agreed by MS-LOT in their Scoping Opinion that this potential impact does not need to be assessed in the EIA as it is unlikely to lead to significant effects.
Collision risk and barrier effect from increased vessel movement	
Use of ducted propellers leading to risk of corkscrew injury	
Loss of habitat	
Creation of habitat	
Effects of EMF	
Toxic contamination	
Changes in availability of prey species	

## 10.4 Regulations and Guidance

7 Marine mammals in waters are protected by the following legislation:

- *The Convention for the Protection of the Marine Environment of the North-East Atlantic* (Oslo and Paris Conventions (OSPAR)). Since 1972, the OPSAR Convention has worked to identify threats to the marine environment through organised programs and measures to ensure national action. The OSPAR Convention assesses which species and habitats require protection due to being threatened and/or experiencing a decline in population. This list includes harbour porpoise. Also contained within the Convention are a series of annexes dealing with pollution from anthropogenic sources, including underwater noise pollution;

- *Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas 1994* (ASCOBANS). ASCOBANS entered into force in 1994 under the auspices of the Convention on Migratory Species (or Bonn Convention), with additional areas (the north-east Atlantic and Irish Sea) included in the Convention in 2008. The aim of the Convention is to promote cooperation between parties with a view to maintaining the Favourable Conservation Status (FCS) of small cetaceans throughout the agreement area;
- *Council Directive 92/43/EEC on the Conservation of Natural Habitats and Wild Flora and Fauna 1992* (Habitats Directive). The aim is to maintain or restore natural habitats and species to a FCS. The Directive introduced a range of measures including the development of a network of protected sites for listed habitats (Annex I) and species (Annex II). In addition, strict protection is afforded to species (including all cetaceans) listed on Annex IV of the Directive with all of these species whose natural range includes UK waters being known as European Protected Species (EPS).
- *The Habitats Directive* has been transposed into Scottish law in territorial waters (within 12 nm) with the *Conservation (Natural Habitats, &c.) Regulations 1994* (as amended in Scotland) and in offshore waters via the *Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007*; and
- In relation to seal conservation, the *Marine (Scotland) Act 2010* replaces the *Conservation of Seals Act 1970* in Scottish waters. Under Part 6 of the new Act, it is an offence to kill, injure or take a seal at any time of year, except to alleviate suffering or where a licence has been issued to do so by Marine Scotland. Under the Act it is also an offence to harass seals at haul-out sites.

8 The following guidance documents have been used in the preparation of this assessment:

- *The protection of marine EPS from injury and disturbance: Guidance for Scottish inshore waters* (Marine Scotland and SNH, 2014);
- *The protection of marine EPS from injury and disturbance: Guidance for the marine area in England and Wales and the UK offshore marine area* (JNCC, 2010);
- *Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise* (JNCC, 2010a); and
- *JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys* (JNCC, 2017).

## 10.5 Design Envelope and Embedded Mitigation

### 10.5.1 Design Envelope

- 9 A description of the Wind Farm and OfTW Design Envelope is presented in *Chapter 7: Description of the Development*. Guidance received from Marine Scotland and SNH (in meetings) confirmed that a most likely (ML) scenario (for pile driving noise) should be considered in the impact assessment for marine mammals, contextualised with a description of a worst case (WC) scenario and how frequently WC is likely to be encountered. The

geophysical and geotechnical survey campaigns that have been conducted across the Development Area have enabled ICOL to develop a ground model of the sediments present. This ground model has been utilised in a study into the blow energies that are likely to be required to drive pin piles into the sediment to the required depth to secure the foundations. The study has revealed that up to 20% of the site may require higher blow energies to drive the pin piles to the required depth than within the remaining 80%. Thus the ML blow energy profile represents the soft start and ramp up to full power required to drive the pile into the sediment across 80% of the site, while the WC represents the increased blow energy required to drive the pile within the remaining 20% of the site.

- 10 The assessment for the Development has been undertaken upon the WC scenario, with the caveat that this situation across the whole site is not credible. The assessment therefore also provides the impact assessment for the ML scenario with which to contextualise the more likely scale of effects from driving the piles to secure the foundation structures.
- 11 Key parameters for the ML and WC scenarios relevant to the marine mammal impact assessment (i.e. for pile driving and use of geophysical survey systems) are detailed in Table 10.4 and Table 10.5 (Development Area – pin piles and monopiles, respectively) and Table 10.6 (Offshore Export Cable Corridor) below.
- 12 The marine mammal assessment is based on two key parameters in the Design Envelope – blow energy and ‘foundation installation and associated site preparation’ (duration; see Table 10.4 and Table 10.5 below).
- 13 The parameters (for blow energy and piling duration) assessed in the 2013 Inch Cape ES (ICOL, 2013) were consented without amendment therefore the previous ES is a complete assessment of the consented scheme on marine mammals.
- 14 For the Development the parameter for piling duration has reduced from two years (as considered in the assessment for the 2013 Inch Cape ES) to up to nine months<sup>6</sup>. When undertaking population modelling, improvements in assessment methodology have enabled these nine months to be refined down to days (76 days for pin piles, 74 days for monopiles; see Table 10.13), rather than years, of disturbance as considered in the original modelling undertaken for the 2013 Inch Cape ES. The reasons for this are increased understanding of return times and the ability to incorporate this into the population level modelling.
- 15 The WC blow energy per pile for the Development is increased when compared to the assessment for the 2013 Inch Cape ES and is set out in Table 10.4 (pin piles) and Table 10.5 (monopiles) below.

**Table 10.4: Pin pile scenario definition - Development Area**

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<sup>6</sup> This is an indicative period in the project description and may not be consecutive. It is considered that 76 days within the nine month period represents a reasonable WC for the purposes of marine mammals.

Potential impact	Design Envelope scenario assessed						
Construction phase							
Displacement/ PTS from piling (pin piles)	Scenario	Most probable blow energies (80% of locations)			Highest expected blow energy (20% of locations)		
	Pin pile diameter (mm)	2438			2438		
	Hammer capacity (kJ)	2400			2400		
	Max blow energy (kJ)	1080 (45%)			2160 (90%)		
	Total piling duration (hours/ pin pile)	2.5			2.6		
	Ramp-up details	Time (min)	Efficiency (% of max blow energy)	Average strike rate (blows/ sec)	Time (min)	Efficiency (% of max blow energy)	Average strike rate (blows/ sec)
		20 <sup>7</sup>	11% (264 kJ)	0.33	20	11% (264 kJ)	0.33
		20	20% (480 kJ)	0.58	20	20% (480 kJ)	0.58
		10	30% (720 kJ)	0.58	10	30% (720 kJ)	0.58
		100	45% (1080 kJ)	0.58	106	90% (2160 kJ)	0.58
Total number of pin piles	244			60			
Disturbance from increased noise from geophysical survey systems	190 km of Inter-array Cable to be installed, with a cable corridor disturbed width of up to 15 m. Geophysical survey systems (potentially including, but not limited to, sub-bottom profilers (pingers, sparkers, boomers and chirps), Ultra Short Baseline (USBL) transceivers/ transducers and transponders/responders/beacons, scanning sonars and multi beam echo sounders) may be used.						

<sup>7</sup> This row represents the 20 minute pile driving soft start period.

**Table 10.5: Monopile scenario definition - Development Area**

Potential impact	Design Envelope scenario assessed						
Construction phase							
Displacement/ PTS from piling (monopiles)	Scenario	Most probable blow energies (80% of locations)			Highest expected blow energy (20% of locations)		
	Monopile diameter (mm)	12,000			12,000		
	Hammer capacity (kJ)	5,000			5,000		
	Max blow energy (kJ)	2,250 (45%)			4,500 (90%)		
	Total piling duration (hours/ monopile )	4			6		
	Ramp-up details	Time (min )	Efficiency (% of max blow energy)	Average strike rate (blows/ sec)	Time (min )	Efficiency (% of max blow energy)	Average strike rate (blows/ sec)
		30 <sup>8</sup>	10% (500 kJ)	0.29	30	10% (500 kJ)	0.29
		20	20% (1,000 kJ)	0.58	20	20% (1,000 kJ)	0.58
		10	30% (1,500 kJ)	0.58	10	30% (1,500 kJ)	0.58
		180	45% (2,250 kJ)	0.58	300	90% (4,500 kJ)	0.58
Total number of monopiles	59			15			
Disturbance from increased noise from geophysical survey systems	190 km of Inter-array Cable to be installed, with a cable corridor disturbed width of up to 15 m. Geophysical survey systems (potentially including, but not limited to, sub-bottom profilers (pingers, sparkers, boomers and chirps), USBL transceivers/ transducers and transponders/ responders/ beacons, scanning sonars and multi beam echo sounders) may be used.						

<sup>8</sup> This row represents the 30 minute pile driving soft start period.

**Table 10.6: Scenario definition - Offshore Export Cable Corridor**

Potential Impact	Design Envelope Scenario Assessed
<b>Construction Phase</b>	
Disturbance from increased noise from geophysical survey systems	Maximum length for each of the two Offshore Export Cables is approximately 83.3 km. Each Offshore Export Cable will be installed in a separate trench resulting in two trenches in total. Geophysical survey systems (potentially including, but not limited to, sub-bottom profilers (pingers, sparkers, boomers and chirps), USBL transceivers/ transducers and transponders/ responders/ beacons, scanning sonars and multi beam echo sounders) may be used.

### 10.5.2 Embedded Mitigation

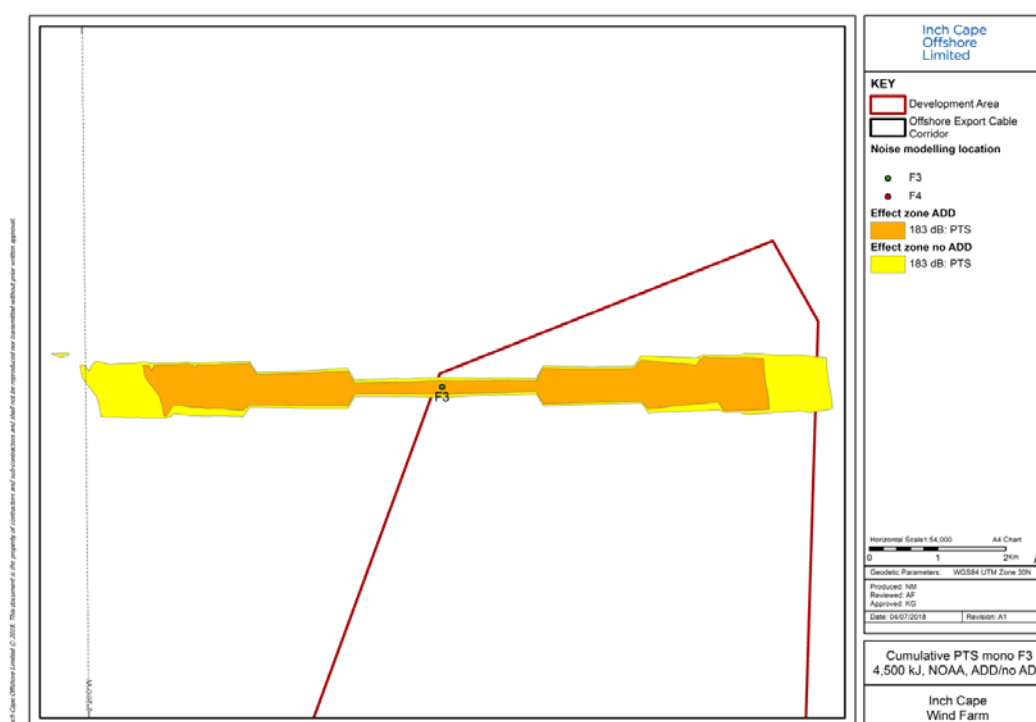
16 The assessment of effects on marine mammals has taken into account the following mitigation measures:

- Implementation of marine mammal protection plans (MMPPs) for pile driving and use of geophysical survey systems, which will be finalised in the construction method statement (CMS)/ environmental management plan (EMP). While the MMPP for use of geophysical survey systems (during route preparation for, and installation of, the Inter-array and Offshore Export Cables) is likely to reflect current guidance (JNCC, 2017), the MMPP for pile driving is likely to advocate use of a pile driving soft start (to ensure that marine mammals are not harmed by instantaneous PTS; see ramp-up details in Table 10.4 and Table 10.5) only.
- During construction of the Beatrice OWF in 2017, an ADD (rather than Marine Mammal Observers (MMOs)/ Passive Acoustic Monitoring (PAM) operators (JNCC, 2010a)) was used in addition to a pile driving soft start. Modelling of instantaneous PTS contours for each species group assessed was undertaken for blow energies expected to be required during soft start of piling, and is presented in *Appendix 9B*. All of the scenarios modelled for the peak SPL criterion for instantaneous PTS at an initial hammer energy of 500 kJ had effect ranges  $\leq 50$  m (maximum was 50 m for harbour porpoise). The full list of scenarios and corresponding impact ranges are provided in Table 9B.12 of *Appendix 9B*.

The risk of a marine mammal being exposed to sufficient noise to induce instantaneous PTS from the initiation of soft start is therefore considered negligible, and risk of infringement of EPS legislation trivial (not likely to result in an offence being committed). Therefore, because the benefit of introducing additional noise into the system (by using an ADD as mitigation for marine mammals) is negligible, ICOL does not intend to use an ADD (or MMOs/ PAM operators) as marine mammal mitigation prior to soft start pile driving, i.e. the only marine mammal mitigation which will be used for pile driving is a pile driving soft start.

- Cumulative PTS modelling conducted prior to Gatecheck was undertaken to include a 15 min ADD use prior to initiation of soft start (as conducted for Beatrice OWF). In order to establish if removal of the 15 min ADD use had a material effect on these cumulative PTS contours (and thus the resultant assessment), the underwater noise modelling of the scenario/ species/ criteria that had the largest effect<sup>9</sup> was re-run without the pre-soft start ADD use. The outputs of this modelling indicate that the areas of potential effect for PTS are likely to be only slightly larger if only soft start pile driving (i.e. no ADD use) is conducted (Figure 10.1 and Figure 10.2). This was also the case when a 1 % CF<sup>10</sup> was used (Figure 10.3 and Figure 10.4). These small increases in the area of potential effect make no/ only slight difference(s) to the number of individuals estimated to have the potential to be impacted by PTS onset (Table 10.7). In terms of the per cent of the reference populations with the potential to be impacted, these small increases in the area of potential effect as a result of not using an ADD make no difference to the estimates (Table 10.7). The assessments undertaken for PTS from piling presented within this chapter (from modelled scenarios **with** ADD) are therefore considered appropriate for the assessment of impacts **without** ADD prior to initiation of soft start.

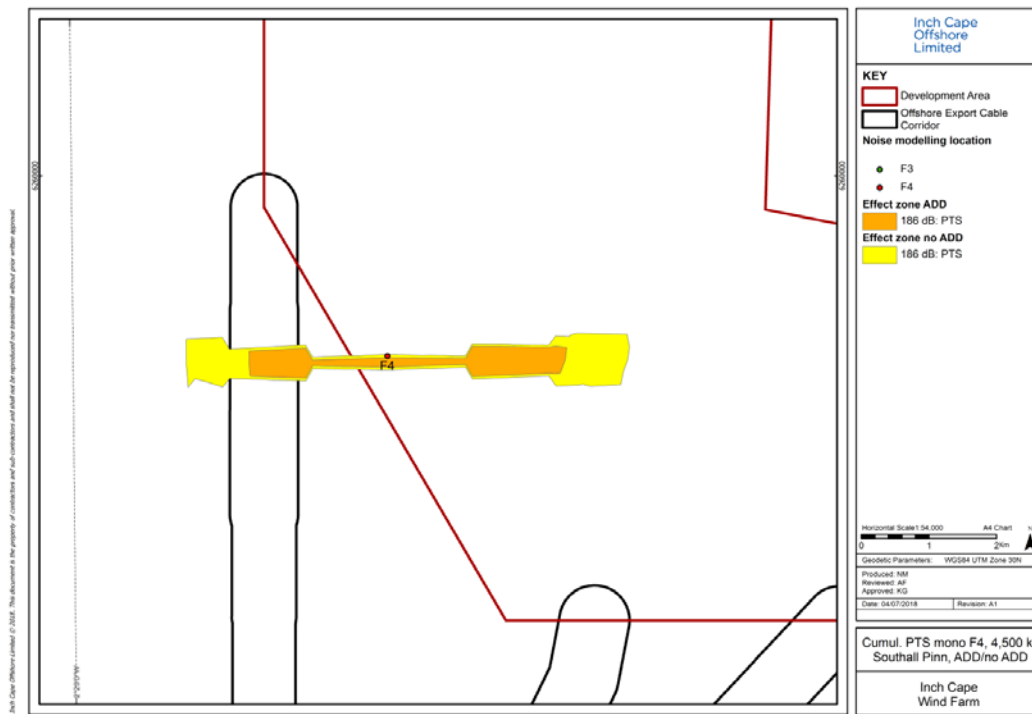
**Figure 10.1: Cumulative PTS effect zones for minke whale exposed to piling of a single monopile foundation with a maximum hammer energy of 4,500 kJ at noise modelling location 3 (F3), NOAA criteria**



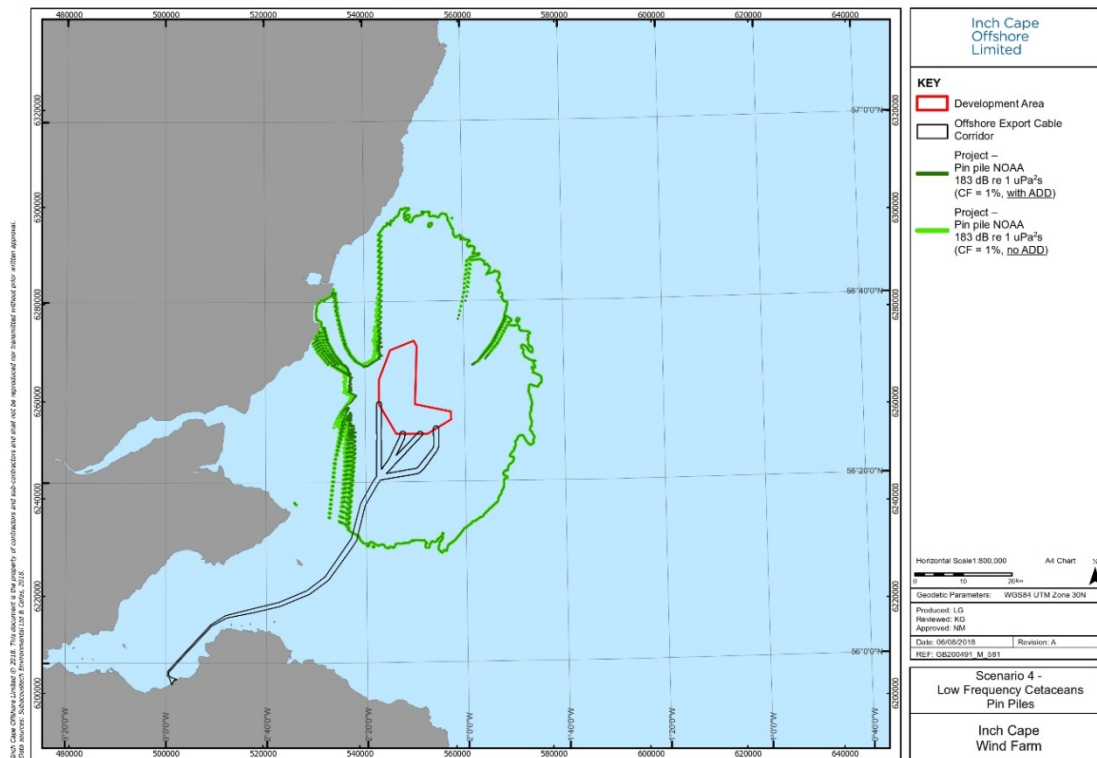
<sup>9</sup> Scenario 2 (WC) for monopile foundations for low frequency cetaceans using the NOAA criteria and for phocid seals in water using the Southall criteria; see Table 10.17.

<sup>10</sup> This work is described in *Appendix 10B*.

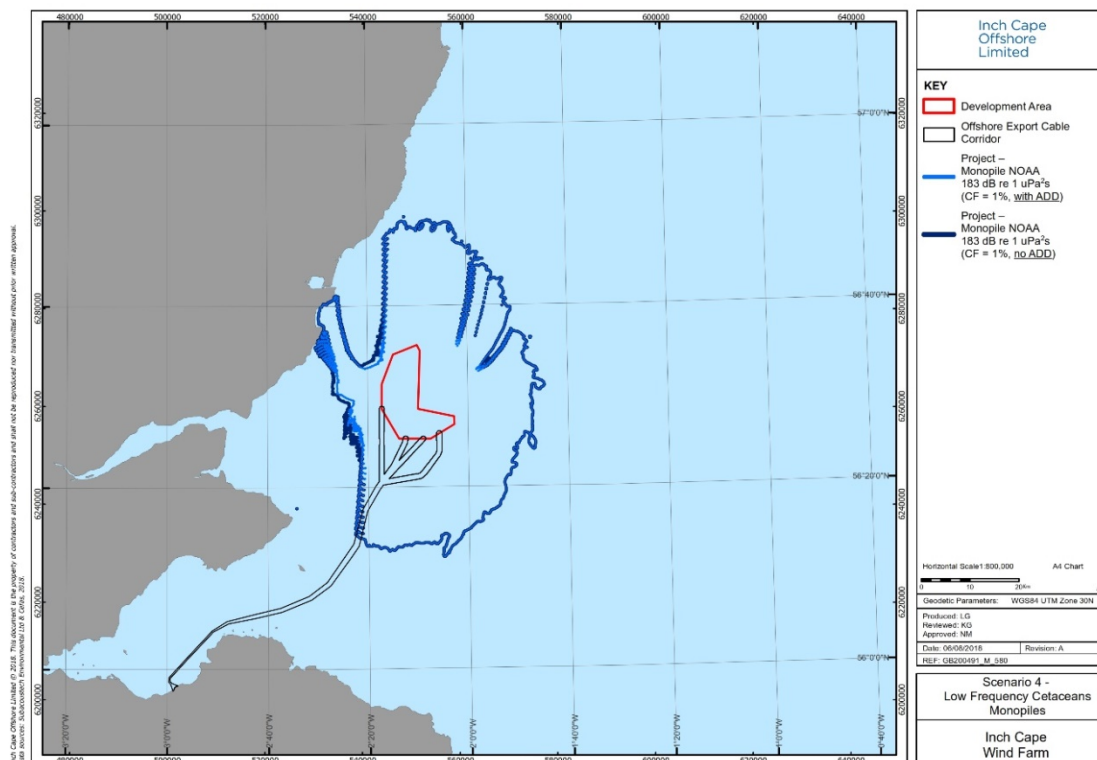
**Figure 10.2: Cumulative PTS effect zones for grey and harbour seal exposed to piling of a single monopile foundation with a maximum hammer energy of 4,500 kJ at location noise modelling location 4 (F4), Southall criteria**



**Figure 10.3: Modelled received noise levels (dB re 1  $\mu$ Pa<sup>2</sup>s) for PTS from pile driving under Scenario 4 for low frequency cetaceans for pin piles with and without use of an ADD**



**Figure 10.4: Modelled received noise levels (dB re 1  $\mu$ Pa<sup>2</sup>s) for PTS from pile driving under Scenario 4 for low frequency cetaceans for monopiles with and without use of an ADD**



**Table 10.7: The number of individuals (n) and per cent of reference population (%) with the potential to be impacted by PTS onset due to underwater noise from pile driving at Inch Cape (WC, single location/ vessel, monopiles) for the three species/ criteria combinations that had the largest effect**

Species (criteria)	2014 Inch Cape Consent		Development with ADD		Development without ADD	
	n	%	n	%	n	%
Minke whale (NOAA)	16	<0.1	0.3 (0.1-1.3)	<0.1	0.4 (0.1-2.2)	<0.1
Grey seal (Southall)	613	8.6	0.4 (0.1-0.6)	<0.1	0.9 (0.3-1.4)	<0.1
Harbour seal (Southall)	59	9.2	<0.1 (<0.1-<0.1)	<0.1	<0.1 (<0.1-0.1)	<0.1

### 10.5.3 Proposed Consent Conditions Including Monitoring Plans

- 17 As well as the embedded mitigation measures, ICOL proposes to commit to the purpose of the relevant consent conditions granted for the 2014 Inch Cape Consent, as they are still relevant to this application. This will provide reassurance to stakeholders that the relevant issues will be addressed and secured by way of appropriate conditions.
- 18 ICOL recognises that the wording and detail of the consent conditions will be at the discretion of the Scottish Ministers. For marine mammal interests, ICOL propose that the consent conditions address matters surrounding, but not limited to, the following:
  - Production of a Piling Strategy (in the event that piled foundations are to be used);
  - Production of a Construction Programme;
  - Production of a Project EMP;
  - Production of an Environmental Monitoring Programme; and
  - Appointment of an Ecological Clerk of Works (ECOW).
- 19 Further to this, should the Scottish Ministers continue the Forth and Tay Regional Advisory Group (FTRAG) and establish a Scottish Strategic Marine Environment Group (SSMEG), ICOL will continue to participate as required.

## 10.6 Baseline Environment

### 10.6.1 Study Area

- 20 The Study Area for marine mammals encompasses the Development Area and Offshore Export Cable Corridor (which is shown in the figures). The surrounding area has also been considered because the effects of increased noise due to pile driving have the potential to be far-reaching (see *Appendix 9A*).

### 10.6.2 Designated Sites

- 21 As agreed with stakeholders (see Table 10.1), the following Natura 2000 sites which include marine mammals as notified interest features, and for which there is potential connectivity with an impact from the construction and decommissioning activities associated with the Wind Farm and OfTW, are considered relevant:

- Berwickshire and North Northumberland Coast SAC (grey seal);
- Firth of Tay and Eden Estuary SAC (harbour seal);
- Isle of May SAC (grey seal); and
- Moray Firth SAC (bottlenose dolphin).

### 10.6.3 Data Sources

- 22 A variety of marine mammal datasets have been used to inform the EIA Report. Data were drawn from site-specific surveys, studies commissioned by ICOL and from a desktop review of publicly available information. Those datasets considered to be relevant are listed in Table 10.8 below.

**Table 10.8: Marine mammal data sources**

Dataset	Coverage	Data use	Date
<i>ICOL-commissioned site-specific surveys and studies</i>			
Boat-based surveys (Canning, 2012)	Within the Development Area and 4 km buffer	Estimation of animal density (fed into the integrated cetacean analysis work)	2010-2012
Seal baseline report (Sparling <i>et al.</i> , 2012)	Outer Firths of Forth and Tay and surrounding area	Usage of the Forth and Tay area by seals, connectivity with local SACs	Up to 2012

Dataset	Coverage	Data use	Date
<i>External/ pre-existing broader scale data and studies</i>			
The Crown Estate (TCE) aerial surveys (Grellier and Lacey, 2012)	Outer Firths of Forth and Tay and surrounding area (covering the Scottish Territorial Waters (STW) and Round 3 sites)	Estimation of encounter rates and animal density (fed into the integrated cetacean analysis work)	2009-2010
SMRU seal counts (Duck <i>et al.</i> , 2017)	East Scotland MU	Estimation of reference population size	2016
SMRU seal usage maps (which use count and telemetry data; SMRU and Marine Scotland, 2017)	Northern North Sea (UK side)	Density maps	1991-2016 telemetry data; count data from 2015
Forth and Tay Offshore Wind Developers Group (FTOWDG) bottlenose dolphin surveys (Quick and Cheney, 2011)	Firth of Tay and St Andrews Bay	Informed predictions of animal density	2009-2010
East coast bottlenose dolphin surveys (Quick <i>et al.</i> , 2014)	Tayside and Fife	Distribution and density of bottlenose dolphins outwith the Moray Firth	Mainly 2009-2013
Integrated cetacean analysis for the three FTOWDG sites (Mackenzie <i>et al.</i> , 2012)	Outer Firths of Forth and Tay and surrounding area	Estimation of animal density for harbour porpoise, white-beaked dolphin and minke whale	2012
MUs for cetaceans in UK waters (IAMMWG, 2015)	UK waters	Cetacean reference populations	2015
SCANS-III (Hammond <i>et al.</i> , 2017)	European Atlantic waters	Additional information regarding cetacean reference populations	Survey conducted in 2016

Dataset	Coverage	Data use	Date
Bottlenose dolphin photo-ID (University of Aberdeen)	East coast of Scotland	Reference population (Cheney <i>et al.</i> , 2013); predicting animal density (along with information from Hastie <i>et al.</i> (2003), Culloch and Robinson (2008) and Robinson <i>et al.</i> (2007))	1989-present
Swim speed data (minke whale, harbour porpoise, grey seal and harbour seal (SNH, 2016); bottlenose dolphin (Bailey and Thompson, 2006))	UK	Flee speeds for underwater noise modelling	2009 (minke whale), 2003-2004 (bottlenose dolphin), 1995 (harbour porpoise), 2015 (grey seal), 2015 (harbour seal)

#### 10.6.4 Overview of baseline

- 23 The baseline environment for assessment includes the receptors, reference populations and densities presented in the following three sections. Any updates to the baseline which was presented in the 2013 Inch Cape ES (ICOL, 2013) have been agreed in consultation with Marine Scotland and SNH and are detailed in Table 10.1.

#### 10.6.5 Receptors

- 24 The potential for impact on the most common species recorded off the Firths of Forth and Tay has been assessed. These are as follows:
- Minke whale (*Balaenoptera acutorostrata*);
  - Bottlenose dolphin (*Tursiops truncatus*);
  - White-beaked dolphin (*Lagenorhynchus albirostris*);
  - Harbour porpoise (*Phocoena phocoena*);
  - Grey seal (*Halichoerus grypus*); and
  - Harbour seal (*Phoca vitulina*).
- 25 Impacts on less commonly occurring species are unlikely to lead to significant effects, therefore are not assessed within the EIA Report. It should be noted that any mitigation appropriate for those species assessed will also be considered relevant for the less commonly occurring species, further minimising any impacts to these species.

**10.6.6 Development Area and Offshore Export Cable Corridor Baseline**

26 The marine mammal baseline has been compiled using the data sources detailed in Table 10.8.

**Reference Populations**

27 Reference populations for the species being assessed are given in Table 10.9. In line with the Scoping Opinion:

- The IAMMWG (2015) MU abundances have been used as reference populations for the cetaceans; and
- For seals, SMRU-derived multipliers<sup>11</sup> have been used to convert the most recent publicly available August counts of seals in the East Scotland MU (3,812 grey seals and 368 harbour seals; Duck *et al.*, 2017) to reference populations.

28 SCANS-III (see Table 10.7 for survey date and coverage) Block R abundance and density estimates (Hammond *et al.*, 2017) have also been presented in Table 10.9.

**Table 10.9: Marine mammal reference populations**

Species	MU	Abundance of Animals in MU(Reference Population)	SCANS-III Block R abundance estimate	
			Abundance	Density (animals per km <sup>2</sup> )
Minke whale	Celtic and Greater North Seas	23,528 (13,989-39,572)	2,498 (604- 6,791)	0.039
Bottlenose dolphin	Coastal East Scotland	195 (162-253)	1,924 (0-5,048)	0.030
White-beaked dolphin	Celtic and Greater North Seas	15,895 (9,107-27,743)	15,694 (3,022-33,340)	0.243
Harbour porpoise	North Sea	227,298 (176,360-292,948)	38,646 (20,584-66,524)	0.599
Grey seal	East Scotland	15,950 (13,329-19,854)	-	-
Harbour seal	East Scotland	511 (418-681)	-	-

<sup>11</sup> 0.239 (0.192-0.286) for grey seals (Russell *et al.*, 2016) and 0.72 (0.54-0.88) for harbour seals (Loneragan *et al.*, 2011).

**Density Surfaces**

- 29 Density surfaces for the species being assessed are given in Figure 10.5 to Figure 10.10. A 5 x 5 km grid system has been used and therefore grid cell values represent the number of animals per 25 km<sup>2</sup>. The values are therefore greater than the SCANS-III density estimates shown in Table 10.8 which are expressed as the number of animals per km<sup>2</sup>.
- 30 In line with the Scoping Opinion, data from the integrated cetacean analysis (Mackenzie *et al.*, 2012) have been used for minke whale (Figure 10.5), white-beaked dolphin (Figure 10.7) and harbour porpoise (Figure 10.8). For grid cells outwith the extent of these surveys, a surface average (the average value across the predicted density surface and the mean of the associated uncertainty intervals) has been used.
- 31 In line with discussions at the first marine mammals workshop, the bottlenose dolphin population (195 individuals; Cheney *et al.*, 2013) was assumed to be split 50:50 between the east coast (from Rattray Head south) and the Moray Firth (Cape Wrath to Rattray Head). The 20 m depth contour was used to differentiate between the 'coastal strip' (where bottlenose dolphins tend to be encountered) and the 'non-coastal strip' (where bottlenose dolphins tend not to be encountered). The choice of the 20 m depth contour as this differentiation was informed by data from the south side of the Moray Firth where > 95 per cent of sightings made were within the 20 m depth contour (Culloch and Robinson, 2008; Robinson *et al.*, 2007). The 98 individuals assumed to be present on the east coast (i.e. 50 per cent of the population of 195 individuals) were spread evenly across the area inside the 20 m depth contour. Zero density was used outwith the 20 m depth contour and within the Forth and Inner Tay (where bottlenose dolphin are known not to regularly be present) (see Figure 10.6).
- 32 For seals (Figure 10.9 and Figure 10.10) the seal usage maps produced by SMRU in 2017 (SMRU and Marine Scotland, 2017) have been used.

Figure 10.5: Minke whale density

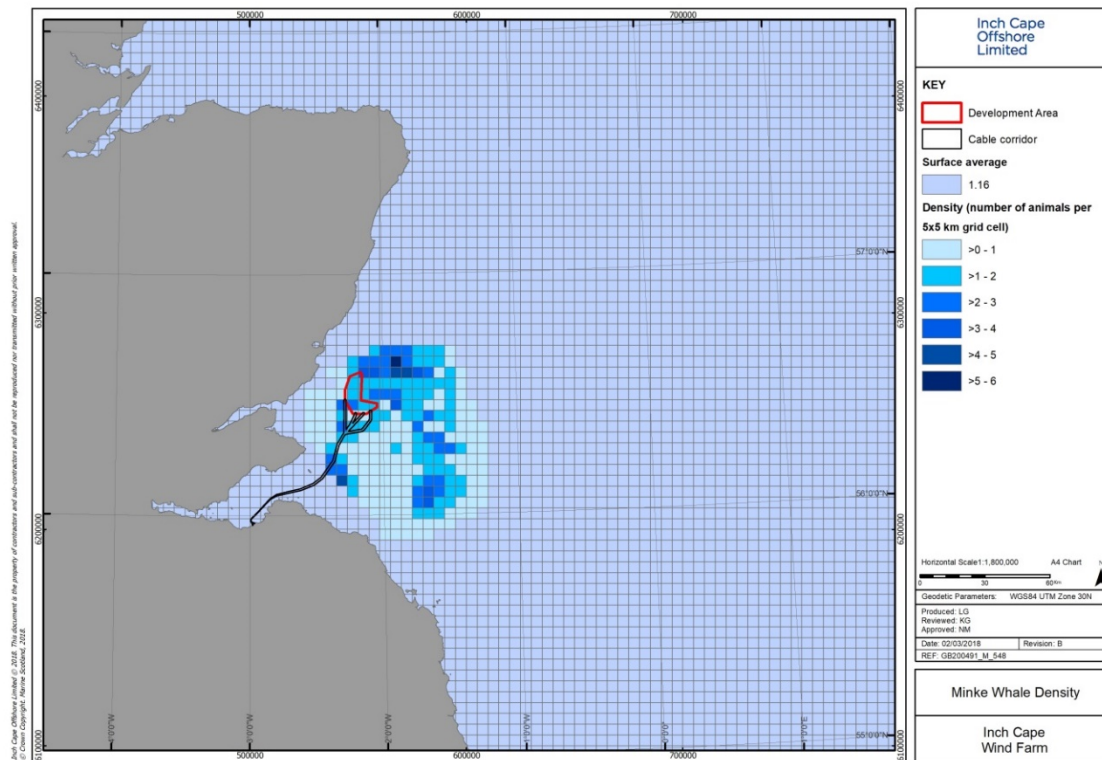


Figure 10.6: Bottlenose dolphin density

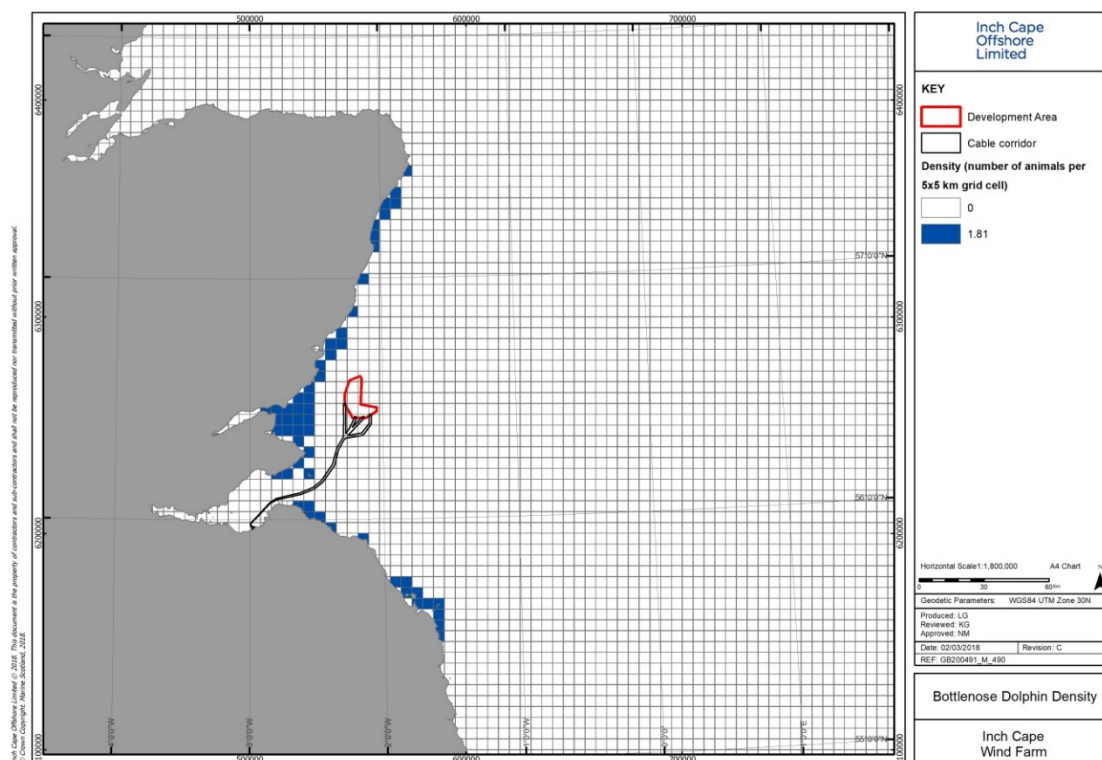


Figure 10.7: White-beaked dolphin density

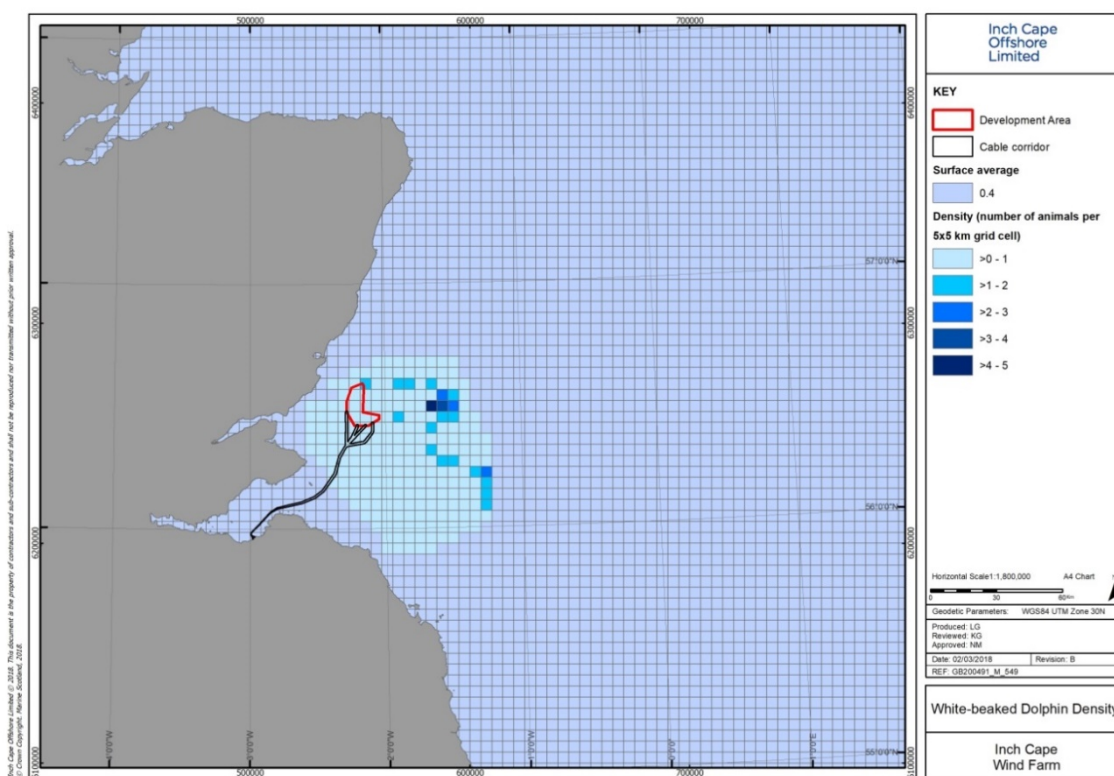


Figure 10.8: Harbour porpoise density

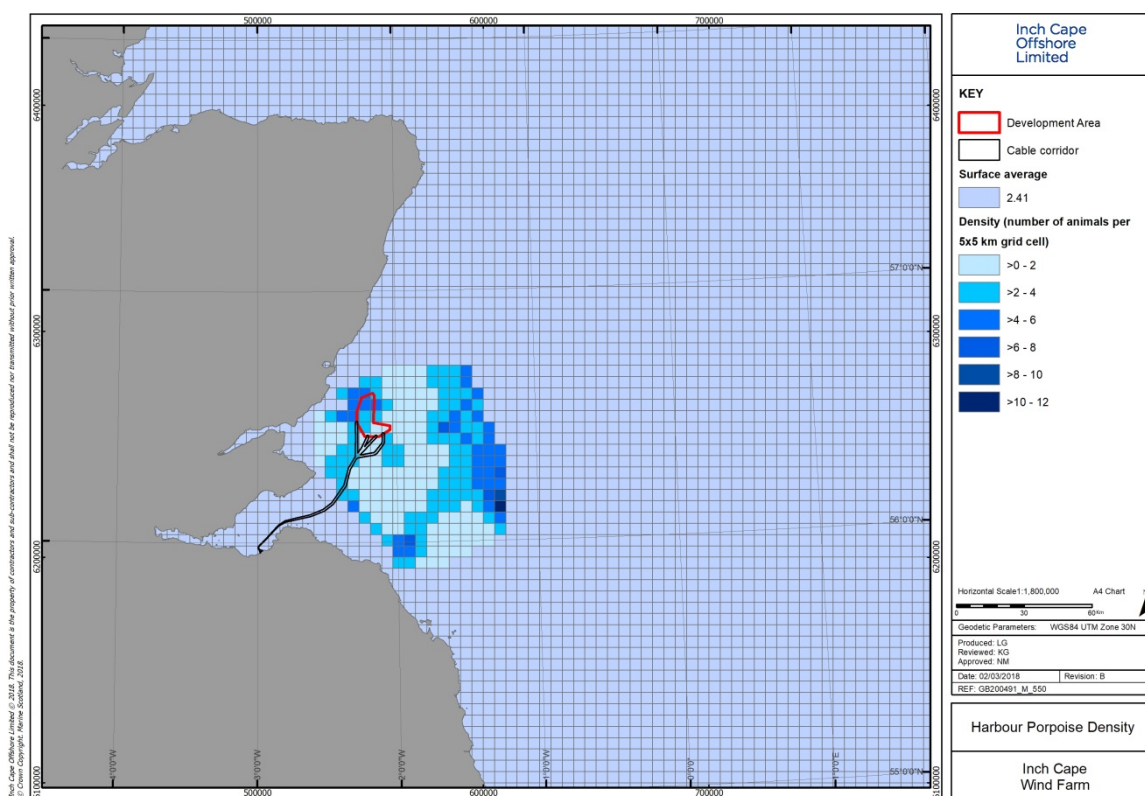


Figure 10.9: Grey seal density

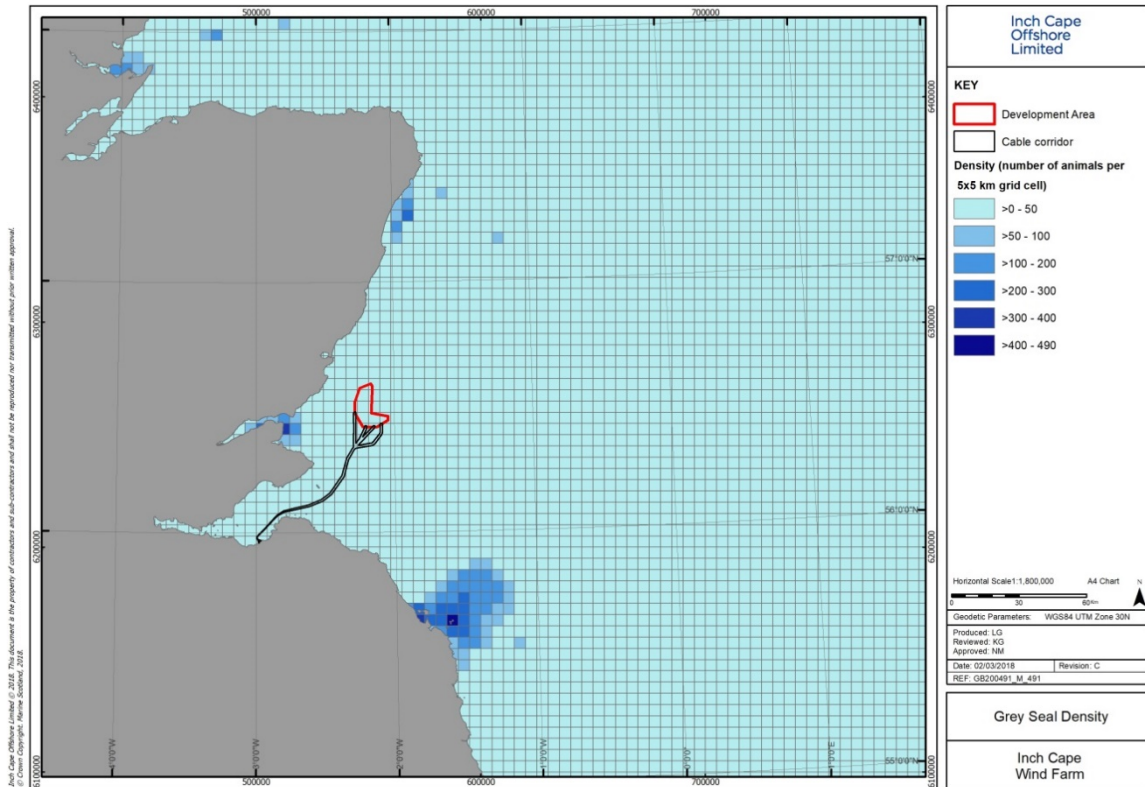
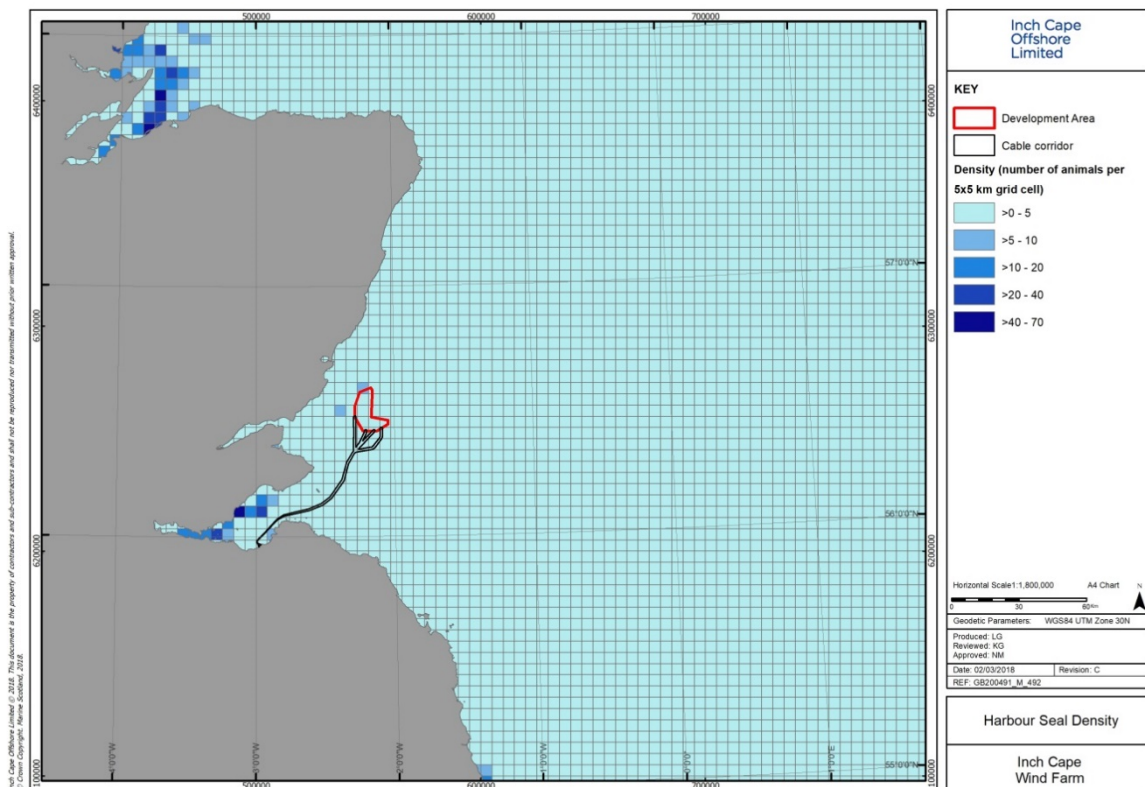


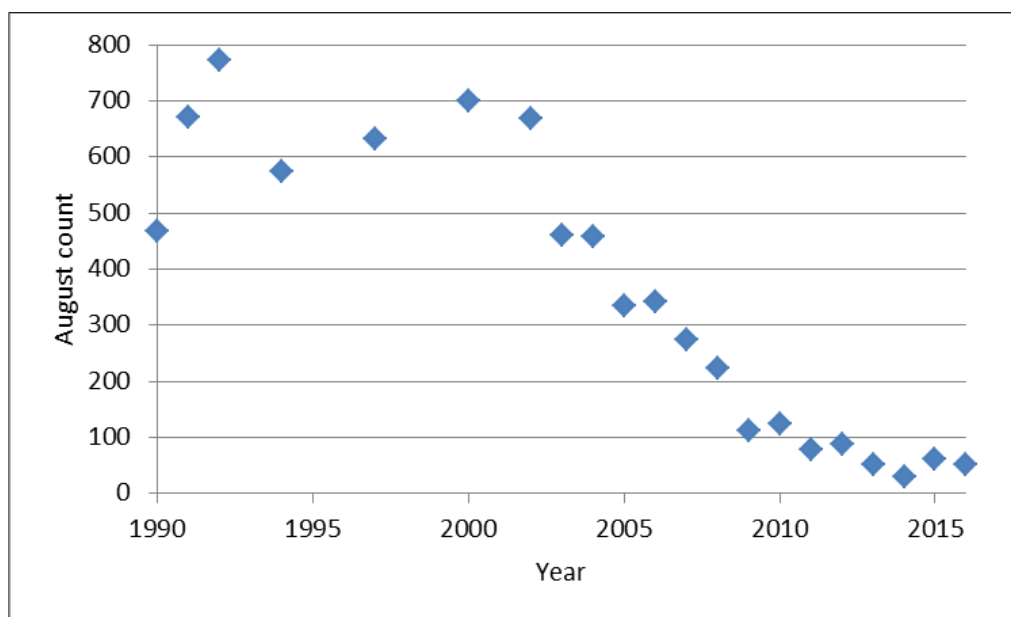
Figure 10.10: Harbour seal density



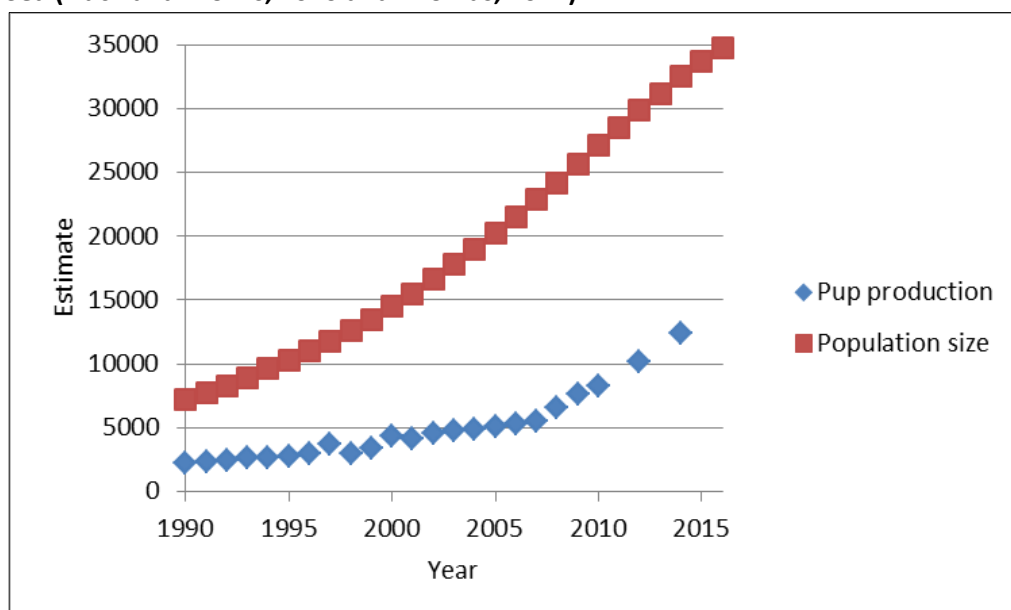
### 10.6.7 Baseline without the Development

- 33 Changes to the baseline shown in *Section 10.6.6* are likely to occur for some species even if the Development is not progressed. Although there is a lack of information on trends in the abundance of the cetacean species which use the Forth and Tay area, information on seals shows that harbour seal abundance in the Firth of Tay and Eden Estuary SAC is currently decreasing (see Figure 10.11 below) while both grey seal pup production and total population size in the North Sea are increasing (see Figure 10.12 below).

**Figure 10.11: August counts of harbour seals in the Firth of Tay and Eden Estuary SAC (Duck *et al.*, 2017)**



**Figure 10.12: Estimates of grey seal pup production and total population size in the North Sea (Duck and Morris, 2016 and Thomas, 2017)**



## **10.7 Assessment Methodology**

- 34 The aim of this assessment is to identify, predict and evaluate potential impacts and significant effects on marine mammals arising from the piling and the use of geophysical survey systems associated with the Development.
- 35 Through the consultation process (see *Section 10.2*), it was agreed with MS-LOT, MSS, SNH and the WDC that the effects identified by the assessment carried out for the 2013 Inch Cape ES (ICOL, 2013), should also be presented in comparison to this assessment. This was to allow consultees to contextualise those impacts that were assessed as not significant in the 2013 Inch Cape ES, and ultimately deemed acceptable by the Scottish Ministers (see *Section 10.5.1*).

### **10.7.1 Piling Impact Assessment Methodology**

- 36 The five stages to the methodology used for this assessment of potential impacts of pile driving noise on marine mammals are as follows:
- Description of the spatial distribution of marine mammals;
  - Assessment of the spatial distribution of piling noise under different scenarios;
  - Integration of the marine mammal and piling noise spatial distributions to estimate the numbers of animals which have the potential to be impacted;
  - Comparison of the numbers of animals which have the potential to be impacted with the numbers from the 2013 Inch Cape ES (ICOL, 2013); and
  - Prediction of population level effects for bottlenose dolphins (not required for the other species, as agreed through consultation (see Table 10.1), unless the numbers of animals which have the potential to be impacted by PTS and/ or displacement as a result of the Development are greater than those from the assessment to inform the 2013 Inch Cape ES (ICOL, 2013)).

#### **Description of the spatial distribution of marine mammals**

- 37 Description of the spatial distribution of the six receptors, i.e. production of a density surface for each species, is described in *Section 10.6.6* (Density Surfaces).

#### **Assessment of the spatial distribution of piling noise**

- 38 Predicted noise propagation from the four different pile driving scenarios detailed in Table 10.10 was modelled by the Centre for Environment, Fisheries and Aquatic Sciences (Cefas) (see *Appendix 9A*).

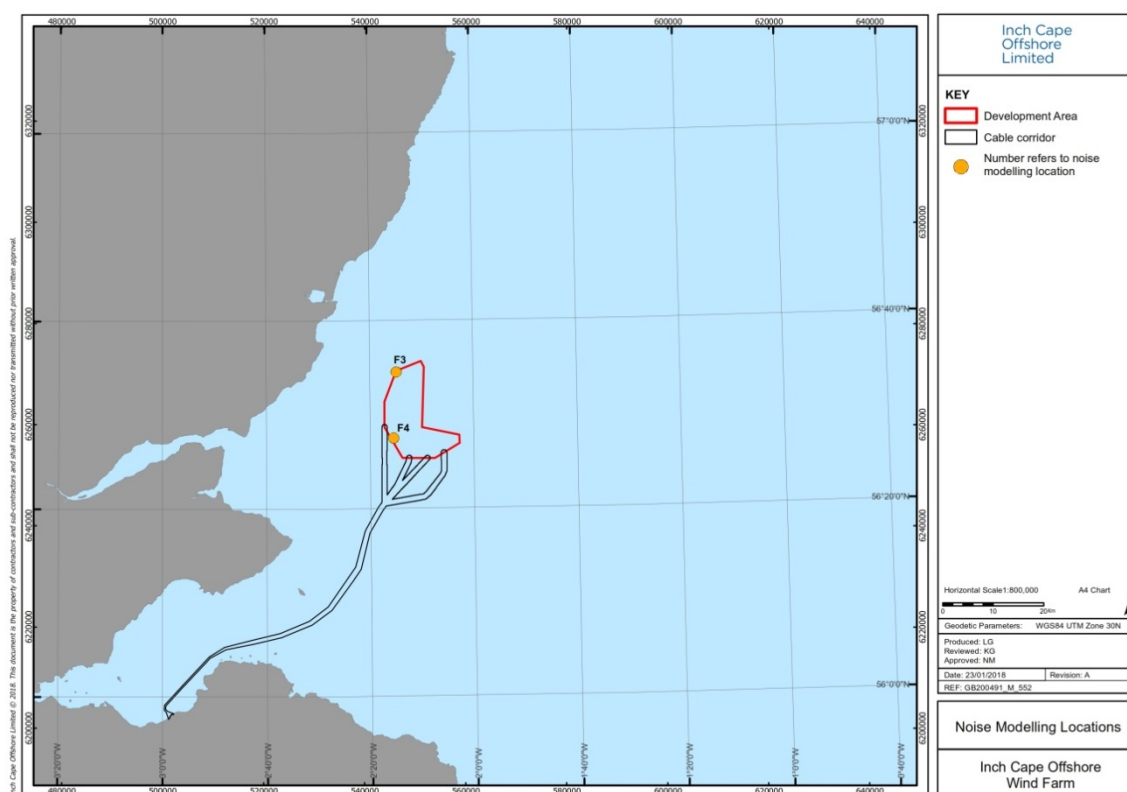
**Table 10.10: Details of the scenarios used for predicting the impacts of noise from pile driving on marine mammals<sup>12</sup>**

Scenario		Description	Location	Species modelled	Blow energy	Number of pin piles per 24 h period	Number of monopiles per 24 h period
ML	1a	Piling at a single location (1 vessel)	F3	Minke whale Bottlenose dolphin Harbour porpoise	Most Probable	4	1
	1b		F4	White-beaked dolphin Harbour seal Grey seal			
WC	2a		F3	Minke whale Bottlenose dolphin Harbour porpoise	Highest Expected	6	1
	2b		F4	White-beaked dolphin Harbour seal Grey seal			
ML	3	Piling at 2 locations (2 vessels)	F3+F4	All	Most Probable	8	2
WC	4				Highest Expected	12	2

39 The noise modelling locations used, F3 and F4, are shown in Figure 10.13. The ‘most sensitive’ location (that closest to areas of greatest animal density) was used for each species. This was location F3 for minke whale, bottlenose dolphin and harbour porpoise (giving rise to the ‘a’ suffixes for the single location scenarios (scenario 1 and scenario 2)) and location F4 for white-beaked dolphin, grey seal and harbour seal (giving rise to the ‘b’ suffixes for the single location scenarios (scenario 1 and scenario 2); see Table 10.9).

<sup>12</sup> See Table 10.4 for information on the most probable and highest expected blow energy parameters.

Figure 10.13: Noise modelling locations



40 **For PTS onset**, a fleeing animal model was used. Fleeing was considered to begin from the start of soft start pile driving. The following species-specific flee speeds, based on literature values and agreement with stakeholders reached during the first marine mammal workshop on the 27<sup>th</sup> of July 2017, were used:

- Minke whale  $2.1 \text{ m.s}^{-1}$  (SNH, 2016);
- Bottlenose dolphin (Bailey and Thompson, 2006) and white-beaked dolphin  $1.52 \text{ m.s}^{-1}$ ;
- Harbour porpoise  $1.4 \text{ m.s}^{-1}$  (SNH, 2016);
- Grey seal  $1.8 \text{ m.s}^{-1}$  (SNH, 2016); and
- Harbour seal  $1.8 \text{ m.s}^{-1}$  (SNH, 2016).

41 The auditory injury criteria or thresholds for pulsed sound (i.e. pile driving noise and noise from geophysical survey systems) are shown in Table 10.11 below. Although the NOAA (2016) noise impact contours<sup>13</sup> have been presented for comparison, the Southall et al. (2007) contours were used when undertaking the assessment as agreed with stakeholders (see Table 10.1). This is because the Southall *et al.* (2007) contours were used when undertaking the assessment for the 2013 Inch Cape ES (ICOL, 2013) and therefore are presented in order to provide comparison.

<sup>13</sup> Use of the NOAA criteria is more conservative (than use of the Southall criteria) for low frequency cetaceans and high frequency cetaceans, and less conservative for mid frequency cetaceans and phocid seals.

**Table 10.11: Auditory injury criteria for pulsed sound**

	Low frequency cetaceans (minke whale)	Mid frequency cetaceans (bottlenose dolphin, white-beaked dolphin)	High frequency cetaceans (harbour porpoise)	Phocid seals in water (grey seal, harbour seal)
<b>Sound Pressure Level (SPL; dB re 1 <math>\mu</math>Pa) – used to assess the potential for injury to occur instantaneously</b>				
Southall <i>et al.</i> (2007)	230	230	230	218
NOAA (2016)	219	230	202	218
<b>Sound Exposure Level (SEL; dB re 1 <math>\mu</math>Pa<sup>2</sup>-s) – used to assess whether the total energy that an animal receives as it flees the area will cumulatively lead to an effect over the period of time assessed (24 hours)</b>				
Southall <i>et al.</i> (2007)	198	198	198	186
NOAA (2016)	183	185	155	185

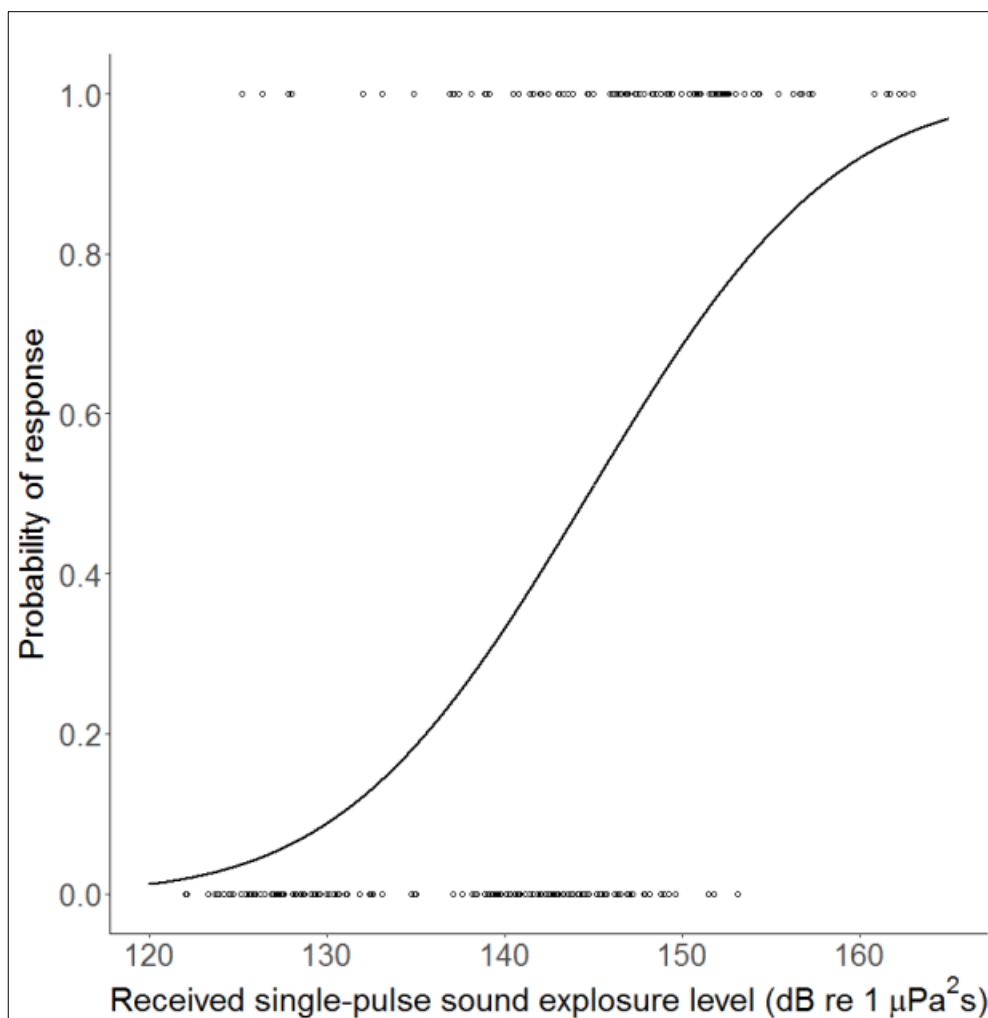
- 42 Both instantaneous and cumulative PTS contours for each of the four functional hearing groups noted in Table 10.10 above were modelled. The extent of the instantaneous PTS contours was initially used to inform the mitigation methods. The threshold currently used by Joint Nature Conservation Committee (JNCC) for management of the Southern North Sea SAC - animals fleeing to 25 km - was used when modelling the cumulative PTS contours. This fleeing distance was agreed with stakeholders in communications following the second marine mammal workshop on the 7<sup>th</sup> of December. The extent of the cumulative PTS contours was used to assign a SEL value to each 5 x 5 km grid cell. Where more than one contour crossed a grid cell, the proportion of the grid cell covered by each contour was calculated.
- 43 For displacement, received noise levels (dB re 1  $\mu$ Pa<sup>2</sup>s) from the four different pile driving scenarios (Table 10.9) were modelled. The extent of the contours was used to assign a mean received level to each 5 x 5 km grid cell.

**Integration of the marine mammal and piling noise spatial distributions to estimate the numbers of individuals which have the potential to be impacted**

- 44 For PTS onset, the cumulative PTS contours and species-specific density surfaces were used to estimate the number of individuals of each species which have the potential to be exposed to levels of noise sufficient to induce the onset of PTS.

- 45 For displacement, a dose-response curve (Figure 10.14) was used to determine the number of individuals (as a proportion of those present in each 5 x 5 km grid cell) likely to be disturbed sufficiently by the noise level received in that grid cell to induce displacement. The values for each grid cell were then summed to give predictions (or 'best estimates') of numbers of individuals of each species responding under each scenario.

**Figure 10.14: Dose-response curve derived using received noise level and harbour porpoise presence data collected by the University of Aberdeen in the Moray Firth in 2017 (figure taken from Graham *et al.*, 2017)**



**Comparison of the numbers of individuals which have the potential to be impacted with the numbers from the assessment to inform the 2013 Inch Cape ES (ICOL, 2013)**

- 46 The numbers of individuals which have the potential to be impacted were compared with the numbers which had the potential to be impacted by the assessment to inform the 2013 Inch Cape ES (summarised in Table 10.12 for PTS onset and Table 10.13 for displacement).

**Table 10.12: The number of individuals which had the potential to be impacted by PTS onset (at 186 dB re 1  $\mu\text{Pa}^2\text{-s}$  for seals and 198 dB re 1  $\mu\text{Pa}^2\text{-s}$  for cetaceans) by the assessment to inform the 2013 Inch Cape ES (ICOL, 2013)**

Species	Piling at a single location (one vessel)		Piling at two locations (two vessels)	
	ML	WC	ML	WC
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Minke whale	13	16	19	24
Bottlenose dolphin	1.2	1.7	1.9	2.9
White-beaked dolphin	7	8	11	13
Harbour porpoise	16	20	24	30
Grey seal	478	613	647	822
Harbour seal	47	59	65	78

**Table 10.13: The number of individuals which had the potential to be displaced (out to 50  $\text{dB}_{\text{ht}}$ ) by the assessment to inform the 2013 Inch Cape ES (ICOL, 2013)<sup>14</sup>**

Species	Piling at a single location (one vessel) i.e. scenarios 1 and 2	Piling at two locations (two vessels) i.e. scenarios 3 and 4
Minke whale	500 (15-4514)	543 (17-4846)
Bottlenose dolphin	15 (1-22)	19 (1-27)
White-beaked dolphin	43 (1-284)	51 (2-330)
Harbour porpoise	486 (22-1728)	556 (29-1934)
Grey seal	3058 (211-4469)	3212 (244-4682)
Harbour seal	322 (32-416)	340 (49-435)

<sup>14</sup> The figures in brackets represent the 95% confidence intervals for each scenario assessed.

**Prediction of population level effects for bottlenose dolphins**

- 47 Population level effects of PTS and displacement on bottlenose dolphins were explored using the updated version 3 iPCoD framework code<sup>15</sup> (see *Appendix 10A* for details).
- 48 In summary, six different construction scenarios (A-F) were considered against baseline scenarios (where no impacts were modelled):
- A. Inch Cape only pin piles – single vessel WC;
  - B. Inch Cape only pin piles – two vessels WC;
  - C. Inch Cape only monopiles – single vessel WC;
  - D. Inch Cape only monopiles – two vessels WC;
  - E. Cumulative (with pin piles being used at Inch Cape); and
  - F. Cumulative (with monopiles being used at Inch Cape<sup>16</sup>).
- 49 For Inch Cape only, numbers (of dolphins with the potential to be displaced<sup>17</sup>) from the WC scenarios were used (i.e. scenario 2 for single vessel and scenario 4 for two vessels; see Table 10.9).
- 50 Where there was a choice for cumulative, numbers (of dolphins with PTS and/ or displacement) from the ML single vessel scenarios were used for each project (i.e. scenario 1 for Inch Cape; see Table 10.9).
- 51 The input parameters used can be found in Table 10.14 below. Project documents (see final 'Reference' row) were consulted and the best available information was used to infer piling (and blasting) schedules.

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<sup>15</sup> Received via e-mail to Natural Power from SMRU Consulting on the 13/03/2018.

<sup>16</sup> Monopiles, rather than pin piles, are considered to represent the WC for Inch Cape due to the greater number of bottlenose dolphins predicted to have the potential to be disturbed/ displaced (5 for monopiles, 4 for pin piles).

<sup>17</sup> No PTS was predicted for bottlenose dolphins.

Table 10.14: Input parameters for the bottlenose dolphin population modelling which was carried out using iPCoD

Type of Parameter	Parameter		Forth and Tay OWF projects			Aberdeen Harbour Expansion Project	Moray Firth OWF projects	
			Inch Cape		Neart na Gaoithe		Moray East (formerly MORL)	Beatrice (also known as BOWL)
			Pin piles	Monopiles				
Biological	Number of bottlenose dolphins with PTS		0	0	0	0	0	0
	Number of bottlenose dolphins disturbed/ displaced	Inch Cape only (WC)	5 (single vessel) 6 (two vessels)	7 (single vessel) 8 (two vessels)	2	53	17	19
		Cumulative (WC of the single vessel ML scenarios, i.e. monopiles)	5					
	Reference		Chapter 10 of Inch Cape’s Revised Design EIA report (2018)		Table 8.36 of the NnG OWF EIA Report (March 2018)	Aberdeen Harbour Expansion Project AA (2016)	Scenario E in Table 7.6 of <i>Appendix 7.3A</i> of the MORL ES (2012)	
Construction	Noise generating activity		Pile driving		Pile driving	Blasting	Pile driving	Pile driving
	Year(s)		2021		2021	2018	2020 2021	Start date: 27/03/3017

Type of Parameter	Parameter	Forth and Tay OWF projects			Aberdeen Harbour Expansion Project	Moray Firth OWF projects	
		Inch Cape		Neart na Gaoithe		Moray East (formerly MORL)	Beatrice (also known as BOWL)
		Pin piles	Monopiles				
							End date: 31/10/2017
	Number of events (piles/ blasts)	304 pin piles (72 4-legged jackets and 2 8-legged OSPs/ OTMs)	74 monopiles (72 WTG monopiles and 2 OSP monopiles)	344 piles (54 6-legged jackets and 2 8-legged OSPs)	145 days of works including 16 bouts of blasting	548 piles (137 4-legged jackets)	352 pin piles (84 4-legged jackets and 2 8-legged OTMs)
	Days per WTG/ blasting	2 (1 with piling, 1 with no piling)	2 (1 with piling, 1 with no piling)	2 (both with piling as jackets are 6- rather than 4-legged	2	Assume same as Beatrice	2 (1 with piling, 1 with no piling)
	Days between WTGs/ blasting	Assume same as Beatrice i.e. 1	1	1	7	Assume same as Beatrice	1
	Piling/ blasting schedule <sup>18</sup>	1 0 0...	1 0 0...	1 1 0...	0 0 0 0 0 0 0 1 1	1 0 0...	1 0 0 1 0

<sup>18</sup> A '1' denotes a day with piling/blasting, a '0' denotes a day with no piling/blasting.

Type of Parameter	Parameter	Forth and Tay OWF projects			Aberdeen Harbour Expansion Project	Moray Firth OWF projects	
		Inch Cape		Neart na Gaoithe		Moray East (formerly MORL)	Beatrice (also known as BOWL)
		Pin piles	Monopiles				
					0 0 0 0 0 0 1 1  0 0 0 0 0 0 1 1...		1 0 0  1 0...
	Reference	Inch Cape Wind Farm Offshore Scoping Report (2017); Chapter 10 of Inch Cape’s Revised Design EIA report (2018); Beatrice’s Piling Operation Notice to Mariners wc 27/03/2017		NnG OWF EIA Report (March 2018)	Aberdeen Harbour Expansion Project AA (2016); Chapters 3, 7, 11 and 14 of the Aberdeen Harbour Expansion Project CMS (2017)	Moray East Offshore Windfarm – Alternative Design Parameters Scoping Report (March 2017); Beatrice’s Piling Operation Notice to Mariners wc 27/03/2017	BOWL Piling Strategy (Rev 5.0, March 2017); Piling Operation Notice to Mariners wc 27/03/2017

### 10.7.2 Geophysical Survey Systems Impact Assessment Methodology

52 A qualitative assessment using best available information was undertaken.

### 10.7.3 Sensitivity of Receptor

53 Given the level of legal protection afforded to all of the marine mammals likely to be encountered within the Firths of Forth and Tay, all species of marine mammal (both cetaceans and phocid seals) are considered to be of high sensitivity in this assessment.

### 10.7.4 Magnitude of Impact

54 In order to be consistent with the 2013 Inch Cape ES (ICOL, 2013), magnitude has been assessed using a scale that experts consider to be measurable if change is within a population size (Moray Offshore Renewables Limited (MORL), 2012 (marine mammals chapter) – see Table 10.15). Due to the large confidence intervals of population size estimates for marine mammals within UK waters, a change of 20 per cent was considered measurable.

**Table 10.15: Classification of Magnitude of Impact**

Magnitude	Definition
High	>20% of population
Moderate	10-20% of population
Low	<10% of population

### 10.7.5 Method for Assigning Significance of Effect

55 The long-term duration criteria used in Table 10.16 below (25 years) is considered appropriate due to the potential for one to two generations of marine mammal species to be affected during the impact period, therefore long-term effects with respect to population change (if any) will be evident during this time. It is considered that if potential effects from construction activity are not evident after a 25-year modelling period, they would not be evident over a greater period of time (for example over a 50-year modelling period). This long-term duration criteria also concurs with conservation assessments, including those used by the International Union for Conservation of Nature (IUCN) where a 25-year time scale is applied when considering conservation status. This will be relevant to all marine mammal species considered in this assessment.

**Table 10.16: Criteria Used for Predicting Significance of Effects**

Magnitude	Duration of Impact		
	Short Term (Days)	Medium Term (Construction Years)	Long term (detectable after 25 years)
High (>20% of population)	Moderate/ Major	Major	Major
Medium (10-20% of population)	Minor	Moderate	Moderate
Low (<10% of population)	Negligible	Minor	Minor

- 56 For the purposes of this assessment those residual positive and negative effects indicated as major and moderate/ major are considered significant.

## 10.8 Impact Assessment - Development Area

### 10.8.1 Effects of Construction

#### Displacement/ PTS from piling

##### Instantaneous PTS

- 57 All of the scenarios modelled for the peak SPL criterion for instantaneous PTS from soft start blow energies (at an initial hammer energy of 500 kJ) had effect ranges  $\leq 50$  m (maximum was 50 m for harbour porpoise). The full list of scenarios and corresponding impact ranges are provided in Table 9B.12 of *Appendix 9B*.

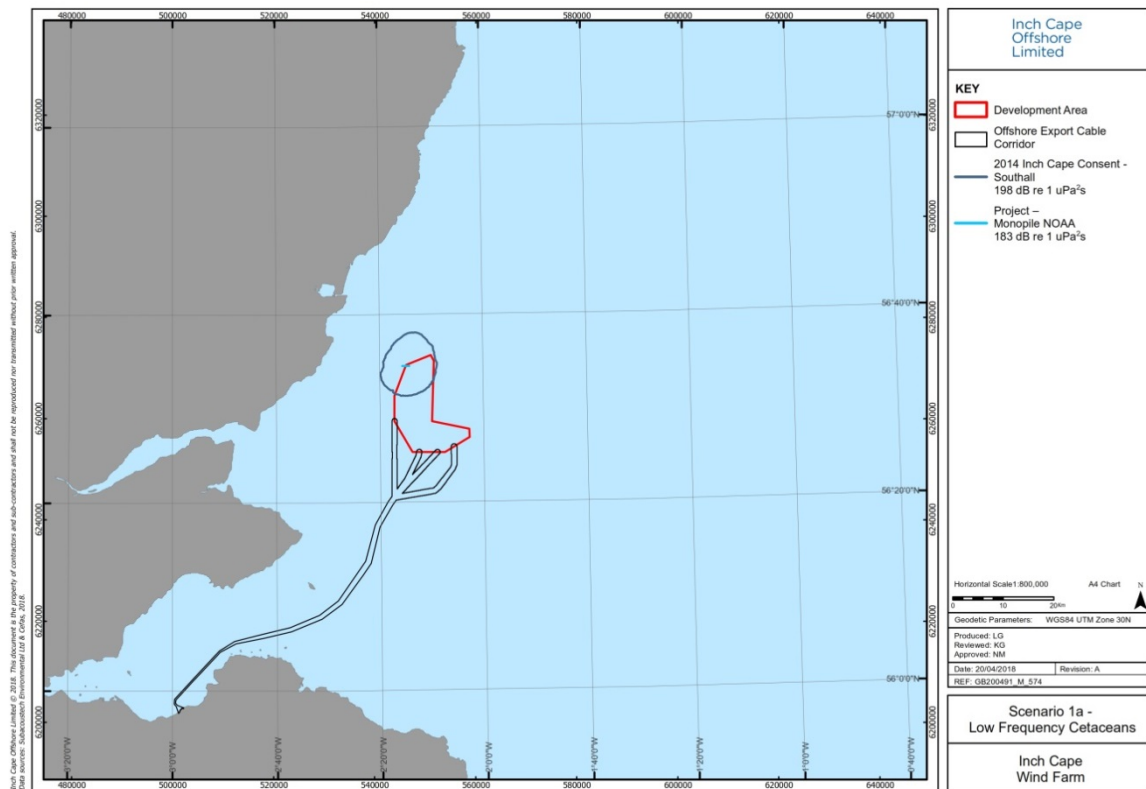
##### Cumulative PTS

- 58 As agreed through the Scoping process and subsequent meetings (see *Section 10.2* and Table 10.1 for full details), modelled received noise levels for scenarios for which there were PTS contours (using either the Southall *et al.* (2007) or the NOAA (2016) criteria) have been mapped. The corresponding 2013 Inch Cape ES contours (ICOL, 2013) have also been mapped so that they can be easily compared. The contours arising from use of the Southall *et al.* (2007) criteria for PTS have been used within the quantitative assessment in order to directly compare the potential PTS impacts arising from piling within the assessment to inform the 2013 Inch Cape ES footprint with those from this current application. It should be noted that:
- There were no PTS contours for some species group/ scenario combinations (mid frequency cetaceans for scenarios 1-4, high frequency cetaceans for scenarios 1-3, and phocid seals in water for scenario 1); and
  - The scenario 4 contours for low frequency cetaceans (Figure 10.18) and phocid seals in water (Figure 10.22) look different to the others due to the way fleeing behaviour and

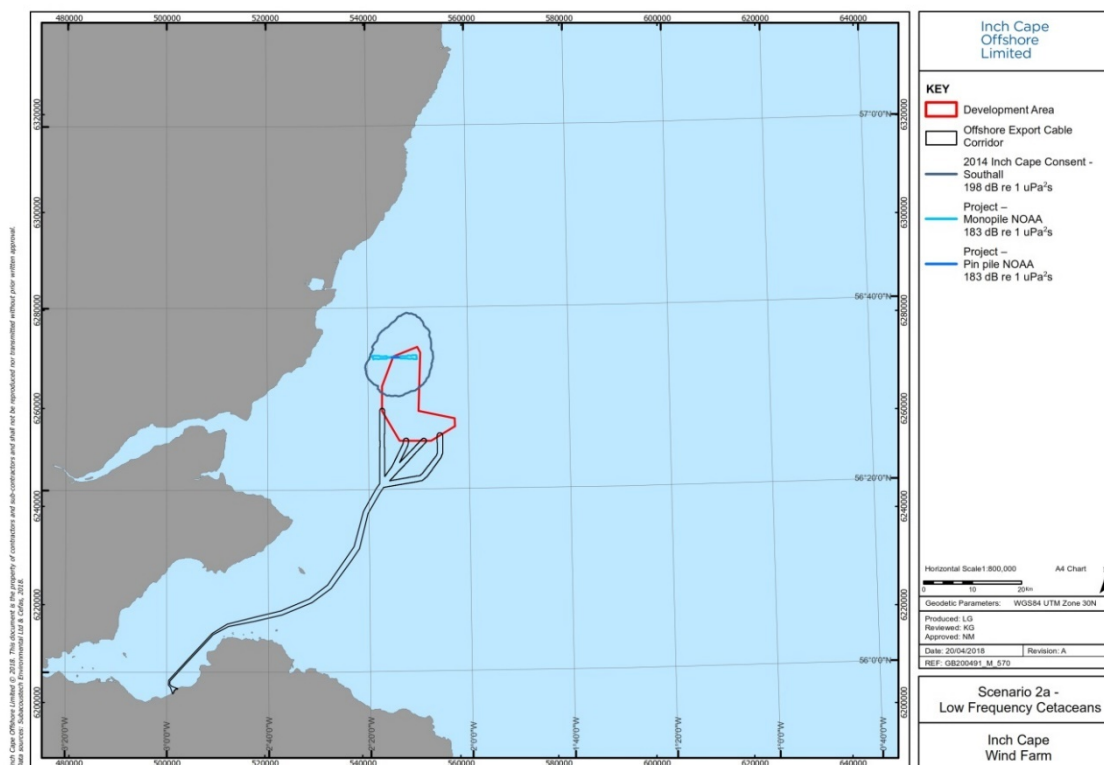
(shallow) water depth interact in the model when considering noise from more than one location (see *Appendix 9A*).

- 59 The modelled received noise levels for PTS for the Development (for both pin piles and monopiles, see Table 10.4 and Table 10.5 respectively for parameters) were smaller than those modelled for the assessment to inform the 2013 Inch Cape ES (ICOL, 2013) in all cases (see Figure 10.15 to Figure 10.22). Where contours for a species or scenario have not been presented, they were too small to be generated (see *Paragraph 68* above).

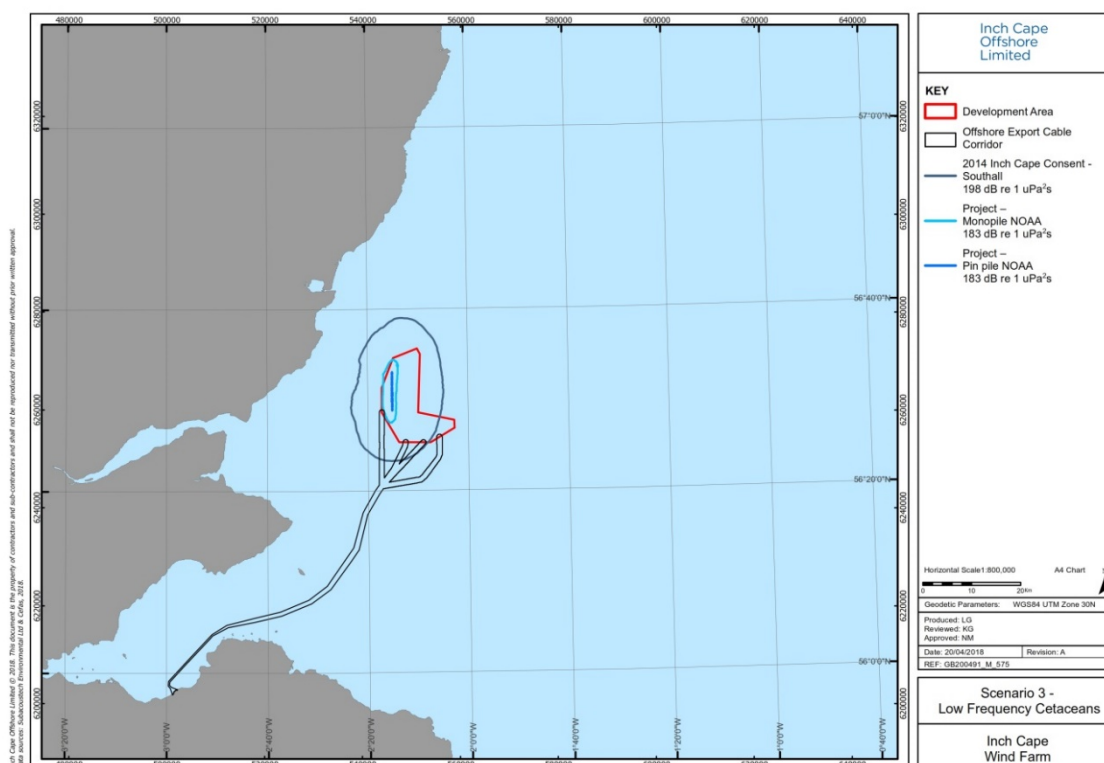
**Figure 10.15: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for PTS from pile driving under Scenario 1a for low frequency cetaceans**



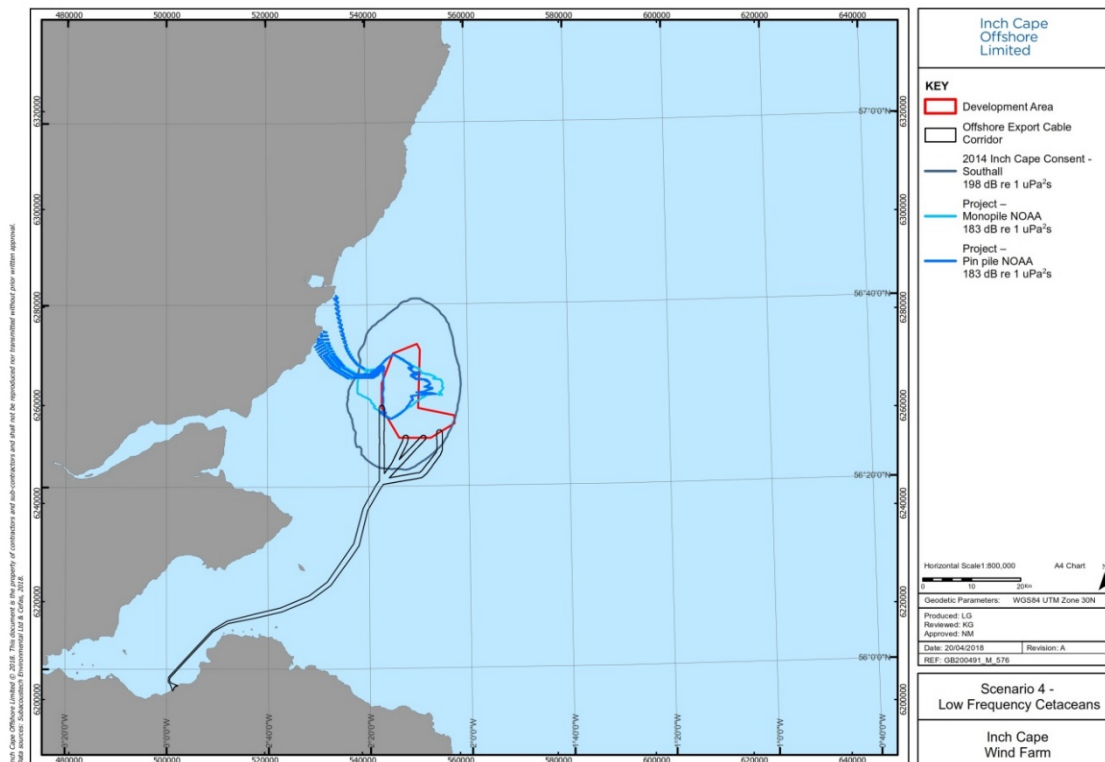
**Figure 10.16: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for PTS from pile driving under Scenario 2a for low frequency cetaceans**



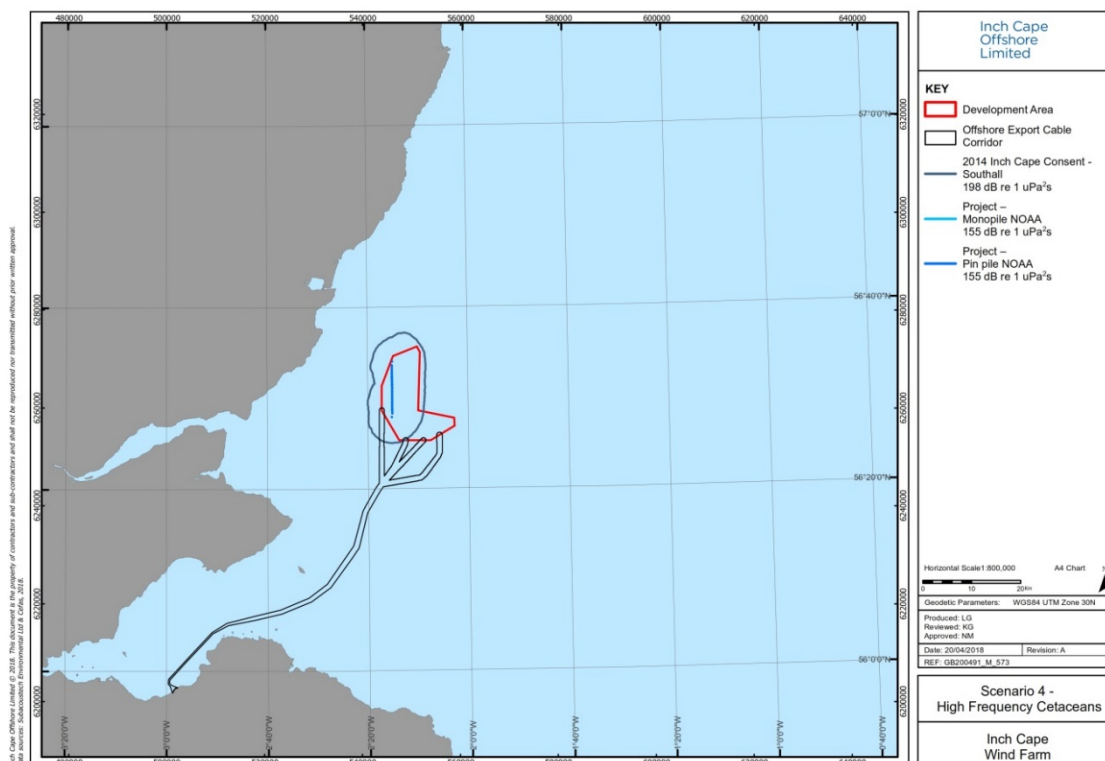
**Figure 10.17: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for PTS from pile driving under Scenario 3 for low frequency cetaceans**



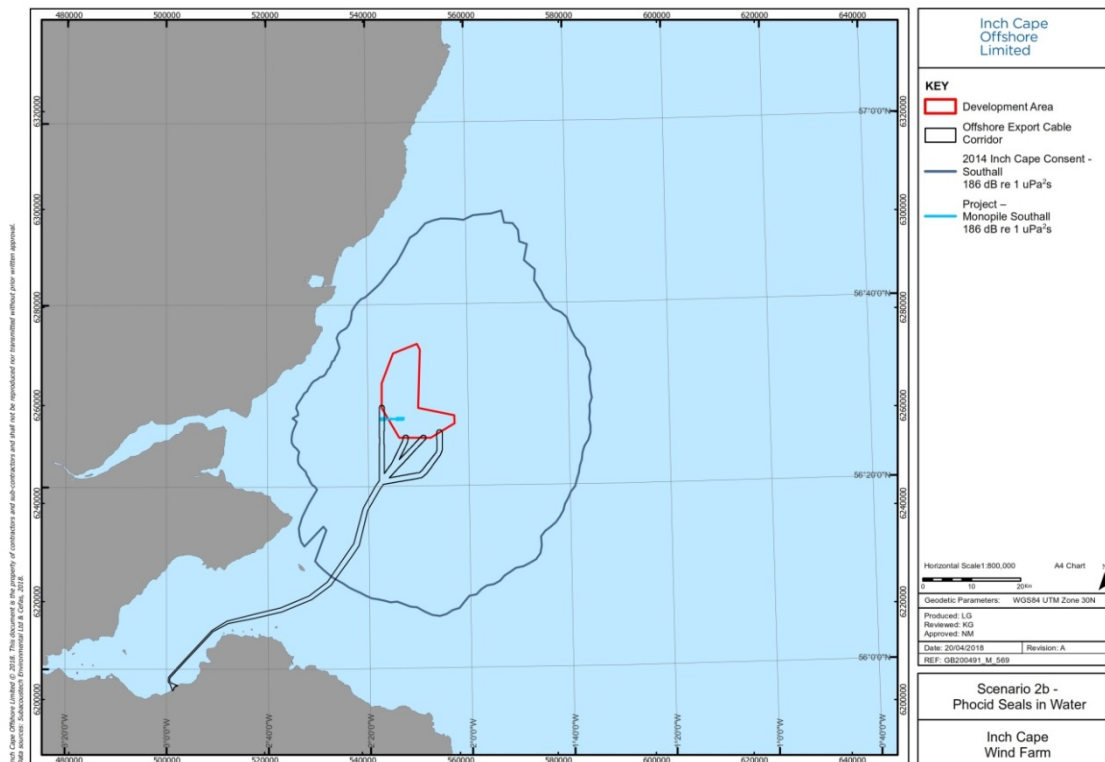
**Figure 10.18: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for PTS from pile driving under Scenario 4 for low frequency cetaceans**



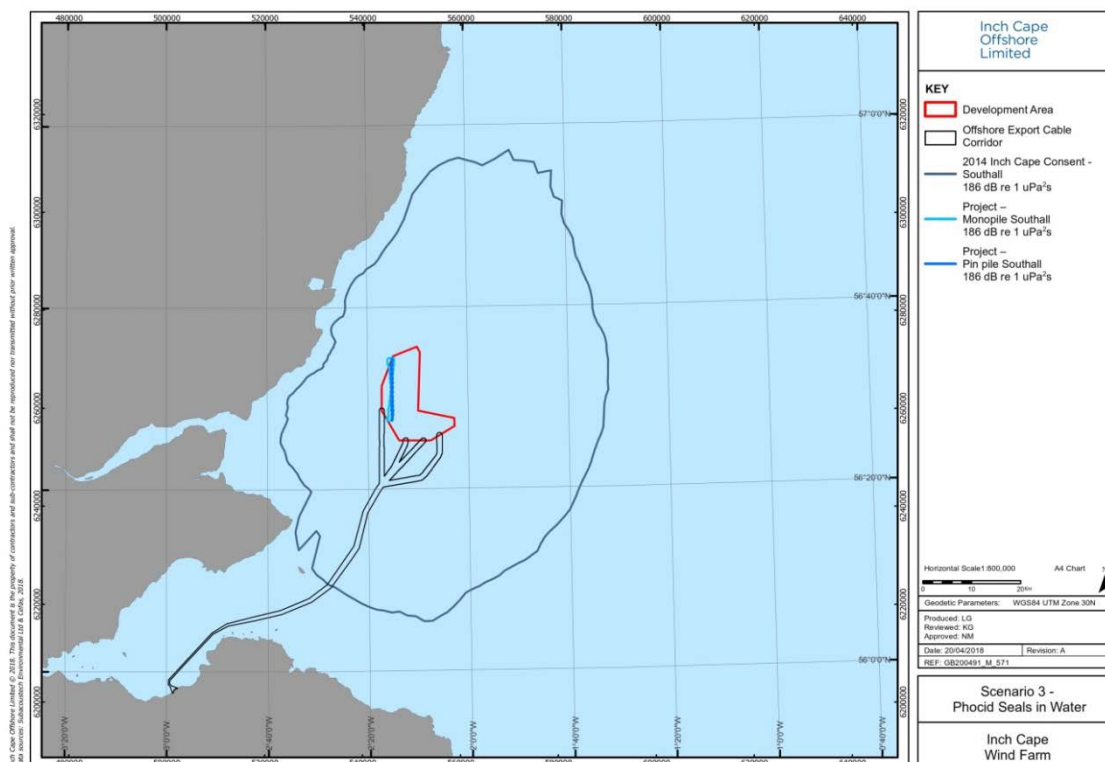
**Figure 10.19: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for PTS from pile driving under Scenario 4 for high frequency cetaceans**



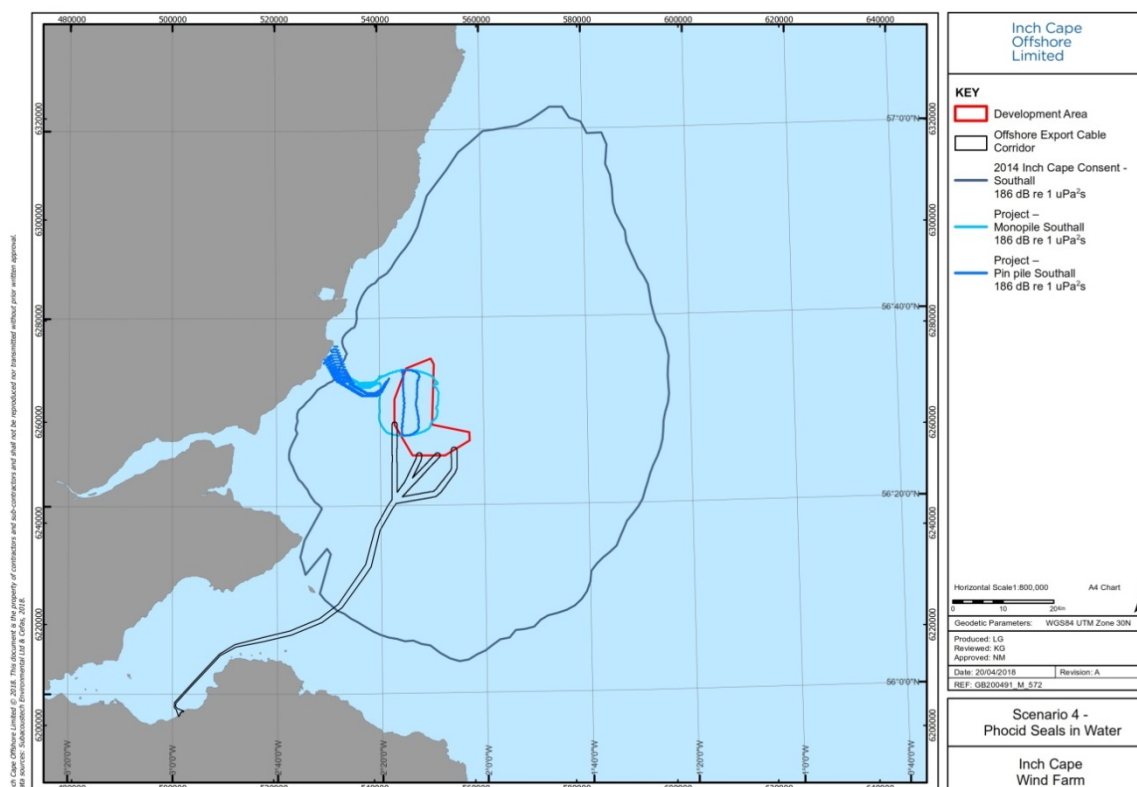
**Figure 10.20: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for PTS from pile driving under Scenario 2b for phocid seals in water**



**Figure 10.21: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for PTS from pile driving under Scenario 3 for phocid seals in water**



**Figure 10.22: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for PTS from pile driving under Scenario 4 for phocid seals in water**



60 Table 10.17 to Table 10.20 show the estimates of the numbers of individuals of each species (and per cent of reference population) which have the potential to be exposed to noise levels sufficient to induce the onset of PTS due to underwater noise from pile driving according to all four pile driving scenarios (Table 10.9) for both pin piles and monopiles. This is with mitigation (see Section 10.5.2).

**Table 10.17: The number of individuals (n) and per cent of reference population (%) with the potential to be impacted by PTS onset due to underwater noise from pile driving at a single location (one vessel) for the assessment to inform the 2013 Inch Cape ES (ICOL, 2013) and the Development – Scenario 1 (ML) – for both pin piles and monopiles**

Species	2013 Inch Cape ES		Development (pin piles)				Development (monopiles)			
			Southall <i>et al.</i>		NOAA		Southall <i>et al.</i>		NOAA	
	n	%	n	%	n	%	n	%	n	%
Minke whale	13	<0.1	0	0	0	0	0	0	<0.1 (<0.1 – 0.1)	0
Bottlenose dolphin	1.2	0.6	0	0	0	0	0	0	0	0

Species	2013 Inch Cape ES		Development (pin piles)				Development (monopiles)			
			Southall <i>et al.</i>		NOAA		Southall <i>et al.</i>		NOAA	
	n	%	n	%	n	%	n	%	n	%
White-beaked dolphin	7	<0.1	0	0	0	0	0	0	0	0
Harbour porpoise	16	<0.1	0	0	0	0	0	0	0	0
Grey seal	478	6.7	0	0	0	0	0	0	0	0
Harbour seal	47	7.4	0	0	0	0	0	0	0	0

**Table 10.18: The number of individuals (n) and per cent of reference population (%) with the potential to be impacted by PTS onset due to underwater noise from pile driving at a single location (one vessel) for the assessment to inform the 2013 Inch Cape ES (ICOL, 2013) and the Development – Scenario 2 (WC) – for both pin piles and monopiles**

Species	2013 Inch Cape ES		Development (pin piles)				Development (monopiles)			
			Southall <i>et al.</i>		NOAA		Southall <i>et al.</i>		NOAA	
	n	%	n	%	n	%	n	%	n	%
Minke whale	16	<0.1	0	0	<0.1 (<0.1 - <0.1)	0	0	0	0.3 (0.1 - 1.3)	<0.1
Bottlenose dolphin	1.7	0.9	0	0	0	0	0	0	0	0
White-beaked dolphin	8	<0.1	0	0	0	0	0	0	0	0
Harbour porpoise	20	<0.1	0	0	0	0	0	0	0	0
Grey seal	613	8.6	0	0	0	0	0.4 (0.1 - 0.6)	<0.1	0	0
Harbour seal	59	9.2	0	0	0	0	<0.1 (<0.1 - <0.1)	<0.1	0	0

**Table 10.19: The number of individuals (n) and per cent of reference population (%) with the potential to be impacted by PTS onset due to underwater noise from concurrent pile driving at two locations (two vessels) for the assessment to inform the 2013 Inch Cape ES (ICOL, 2013) and the Development – Scenario 3 (ML) – for both pin piles and monopiles**

Species	2013 Inch Cape ES		Development (pin piles)				Development (monopiles)			
			Southall <i>et al.</i>		NOAA		Southall <i>et al.</i>		NOAA	
	n	%	n	%	n	%	n	%	n	%
Minke whale	19	<0.1	0	0	0.1 (<0.1 - 0.1)	<0.1	0	0	1.7 (0.5 - 4.2)	<0.1
Bottlenose dolphin	1.9	1	0	0	0	0	0	0	0	0
White-beaked dolphin	11	<0.1	0	0	0	0	0	0	0	0
Harbour porpoise	24	<0.1	0	0	0	0	0	0	0	0
Grey seal	647	9.1	0.8 (0.2 - 1.4)	0.01	0	0	3.2 (0.9 - 5.4)	<0.1	0	0
Harbour seal	65	10.2	<0.1 (<0.1 - 0.1)	<0.1	0	0	0.2 (0.0 - 0.4)	<0.1	0	0

**Table 10.20: The number of individuals (n) and per cent of reference population (%) with the potential to be impacted by PTS onset due to underwater noise from concurrent pile driving at two locations (two vessels) for the assessment to inform the 2013 Inch Cape ES (ICOL, 2013) and the Development – Scenario 4 (WC) – for both pin piles and monopiles**

Species	2013 Inch Cape ES		Development (pin piles)				Development (monopiles)			
			Southall <i>et al.</i>		NOAA		Southall <i>et al.</i>		NOAA	
	n	%	n	%	n	%	n	%	n	%
Minke whale	24	<0.1	0	0	4.3 (1.4 - 11.5)	<0.1	0	0	6.7 (2.3 - 20.1)	<0.1
Bottlenose dolphin	2.9	1.5	0	0	0	0	0	0	0	0
White-beaked dolphin	13	<0.1	0	0	0	0	0	0	0	0
Harbour porpoise	30	<0.1	0	0	0.1 (<0.1 - 0.1)	<0.1	0	0	0.1 (0.0 - 0.1)	<0.1
Grey seal	822	11.6	12.1 (3.4 - 20.9)	0.1	0	0	47.0 (13.3 - 80.7)	0.3	0	0
Harbour seal	78	12.2	0.6 (0.1 - 1.1)	0.1	0	0	1.5 (0.3 - 2.7)	0.3	0	0

- 61 The estimated number of individuals which had the potential to be exposed to noise levels sufficient to induce the onset of PTS was less for the Development than for the assessment to inform the 2013 Inch Cape ES (ICOL, 2013) in all cases (using either the Southall *et al.* (2007) or the NOAA (2016) criteria). For minke whale and harbour porpoise, the number of individuals impacted is greater when using the NOAA (2016) criteria. However, the numbers are comparable to those estimated when using the Southall *et al.* (2007) criteria. Although Southall *et al.* (2007) was used for the assessment (see *Paragraph 53*), use of the NOAA (2016) criteria leads to the same conclusions.
- 62 In 89/96 cases, the number of individuals estimated to have the potential to be exposed to noise levels sufficient to induce the onset of PTS was either zero or less than one. This is due

to developments in noise modelling (Farcas *et al.*, 2016) which have confirmed that the assumptions made in the 2013 Inch Cape ES (ICOL, 2013) were overly conservative.

- 63 In the remaining 7/96 cases, the number of individuals estimated to have the potential to be exposed to noise levels sufficient to induce the onset of PTS was 1.5 harbour seals, and ranged from 1.7 to 6.7 for minke whales and 3.2 to 47 for grey seals.
- 64 With the exception of scenario 4 for both seal species (0.3 per cent; see Table 10.19), the per cent of the reference population with the potential to be impacted by PTS onset due to underwater noise from pile driving at Inch Cape was  $\leq 0.1$  per cent.
- 65 Using the criteria for predicting the significance of effects (see Table 10.15), the effects of PTS on all marine mammal species from piling (of either pin piles or monopiles) are predicted to be of minor significance (see Table 10.20). This is because they are predicted to be medium term in duration (construction years) and low in magnitude (with mitigation less than one per cent of the species' reference populations are estimated to have the potential to be affected).
- 66 Therefore, the effects of PTS from piling (either pin piles or monopiles) within the Development Area are predicted to be of minor significance (see Table 10.20). In addition, they are less than or equal to<sup>19</sup> those which were assessed as not significant in the 2013 Inch Cape ES (ICOL, 2013) and deemed acceptable for the 2014 Inch Cape Consent (see Table 10.21).

**Table 10.21: The significance of the potential effects of PTS from piling on marine mammals**

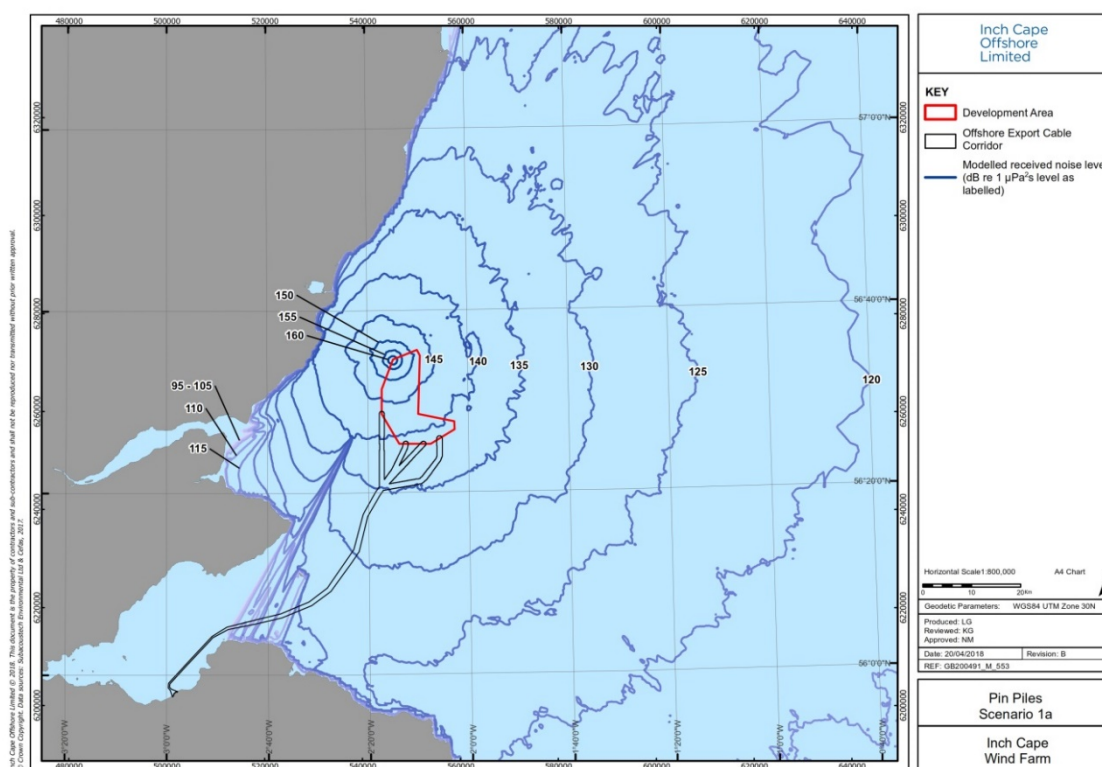
Species	2013 Inch Cape ES	Development
Minke whale	Minor	Minor
Bottlenose dolphin	Minor	Minor
White-beaked dolphin	Minor	Minor
Harbour porpoise	Minor	Minor
Grey seal	Minor to moderate	Minor
Harbour seal	Minor to moderate	Minor

<sup>19</sup> While the significance of the potential effects of PTS from piling are less than or equal to those which were assessed as not significant in the 2013 Inch Cape ES (see Table 10.20), the number of individuals with the potential to be impacted (by PTS onset due to underwater noise from pile driving) is less in this assessment (than it was in the assessment to inform the 2013 Inch Cape ES) for all species (see Table 10.16 to Table 10.19 inclusive).

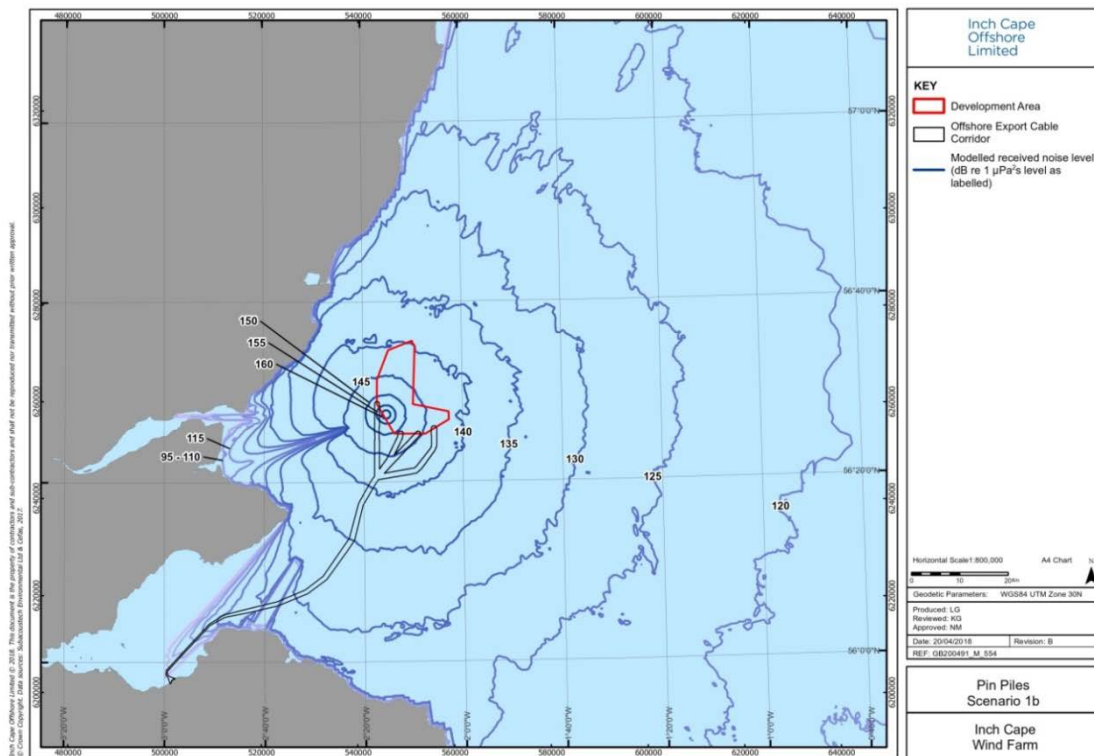
Displacement

- 67 The modelled noise impact contours for displacement (received noise levels, dB re 1  $\mu\text{Pa}^2\text{s}$ ) are shown in Figure 10.23 to Figure 10.28 for pin piles and Figure 10.29 to Figure 10.34 for monopiles for each of the different pile driving scenarios (see Table 10.10 for details). These figures represent the greatest extent of noise propagation likely to result from the maximum blow energy achieved in each scenario assessed. Thus these figures represent propagated noise from piling with mitigation (see Section 10.5.2).

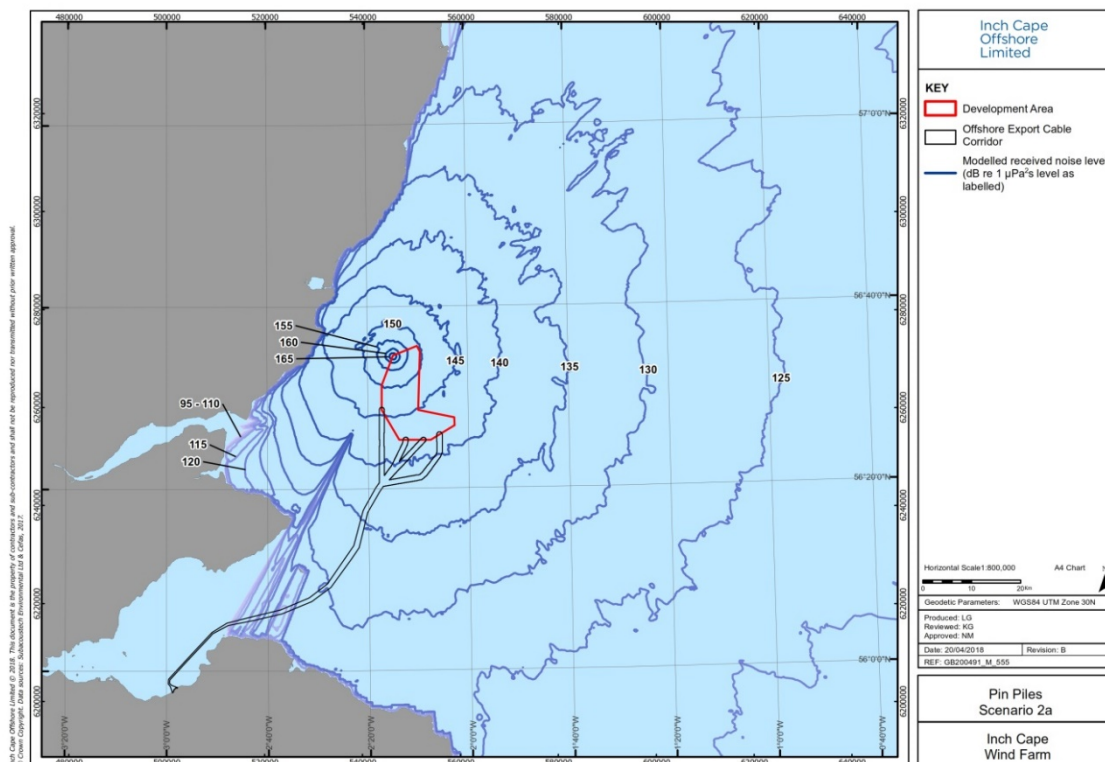
**Figure 10.23: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for displacement from pin pile driving under Scenario 1a**



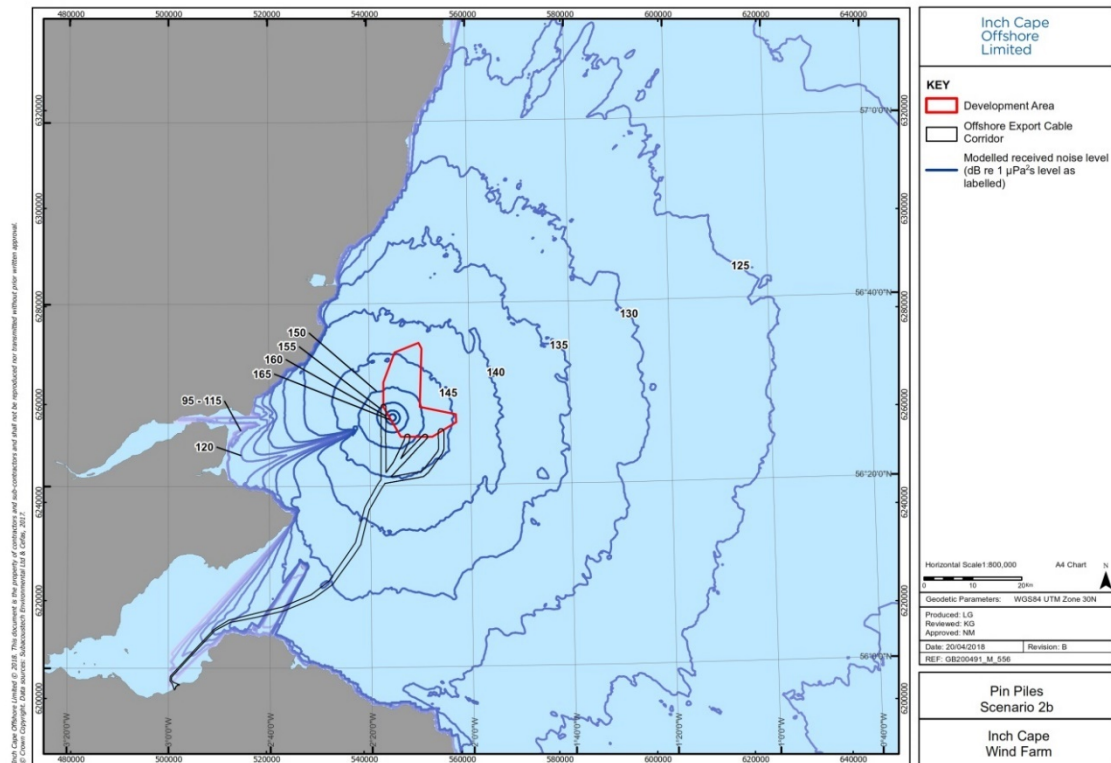
**Figure 10.24: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for displacement from pin pile driving under Scenario 1b**



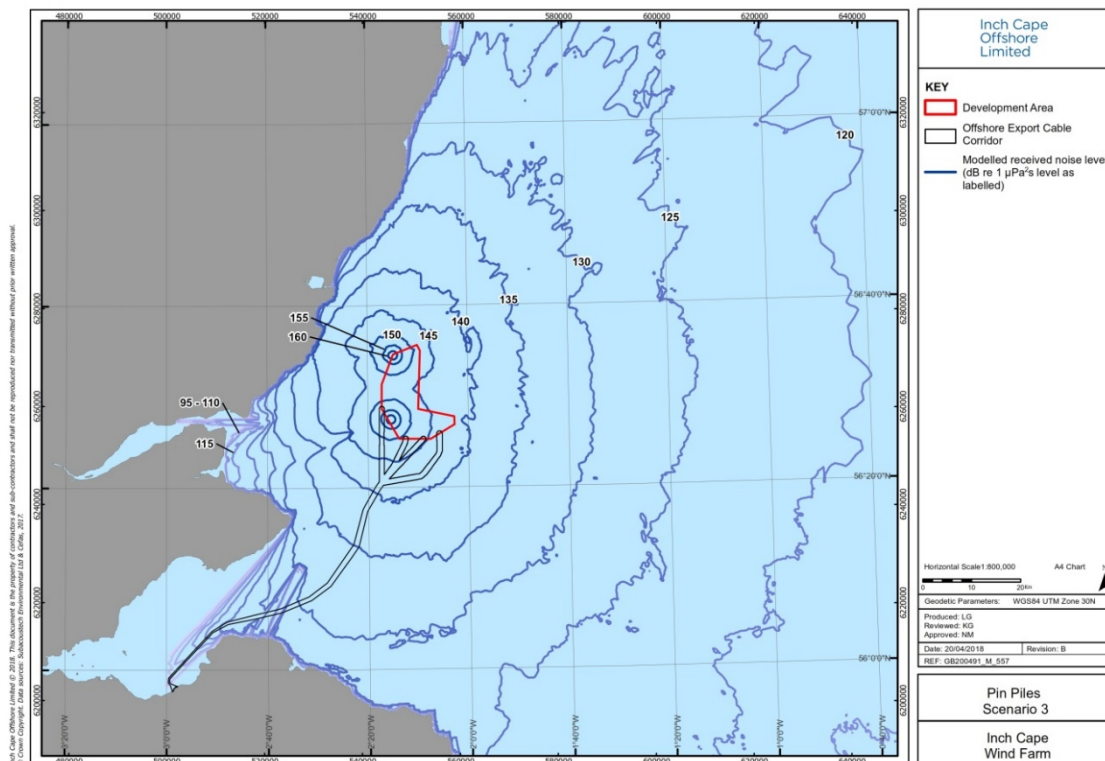
**Figure 10.25: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for displacement from pin pile driving under Scenario 2a**



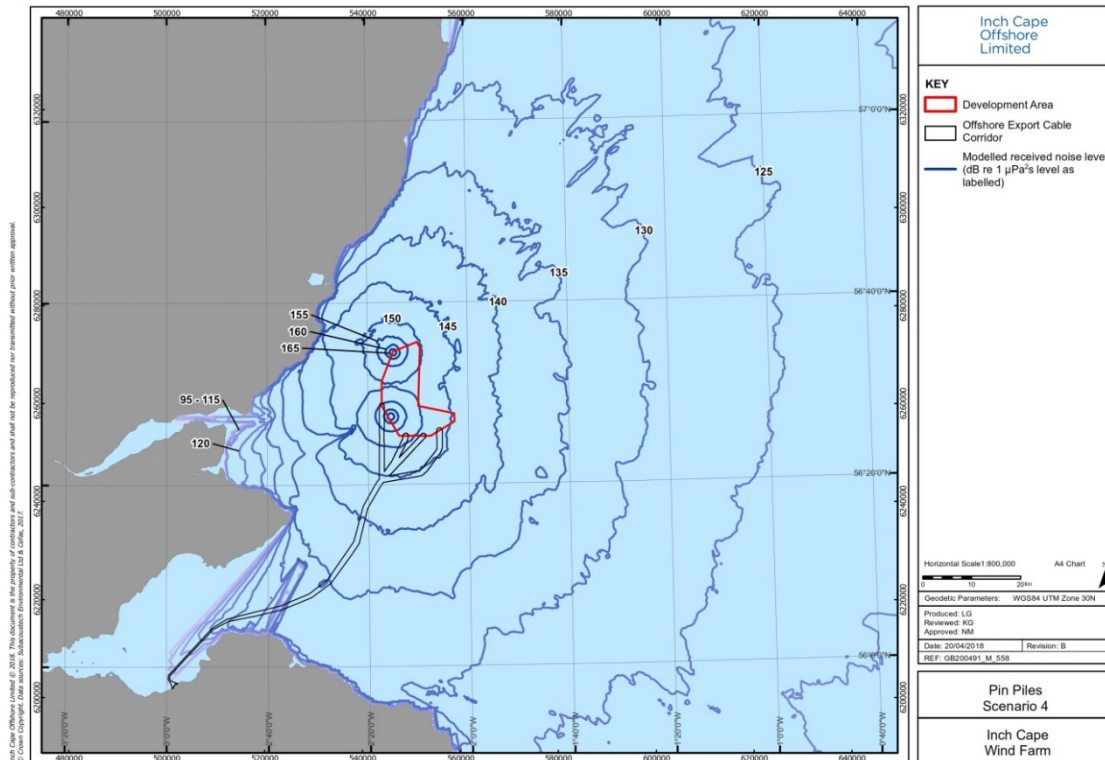
**Figure 10.26: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for displacement from pin pile driving under Scenario 2b**



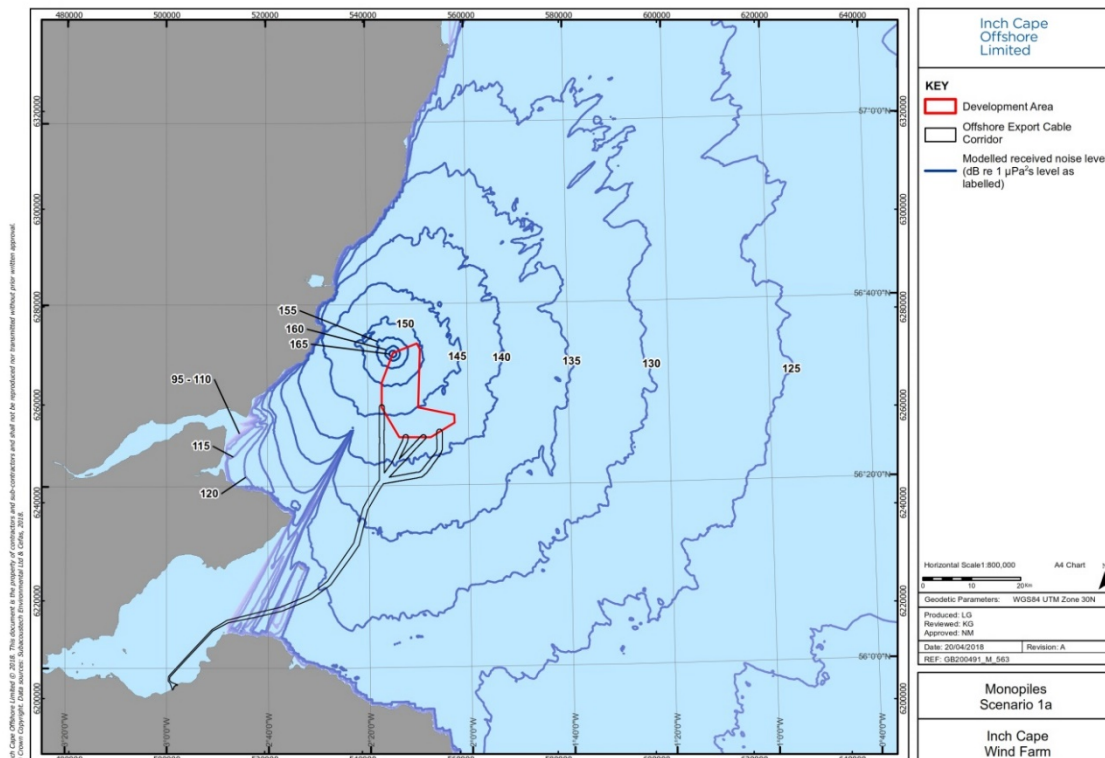
**Figure 10.27: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for displacement from pin pile driving under Scenario 3**



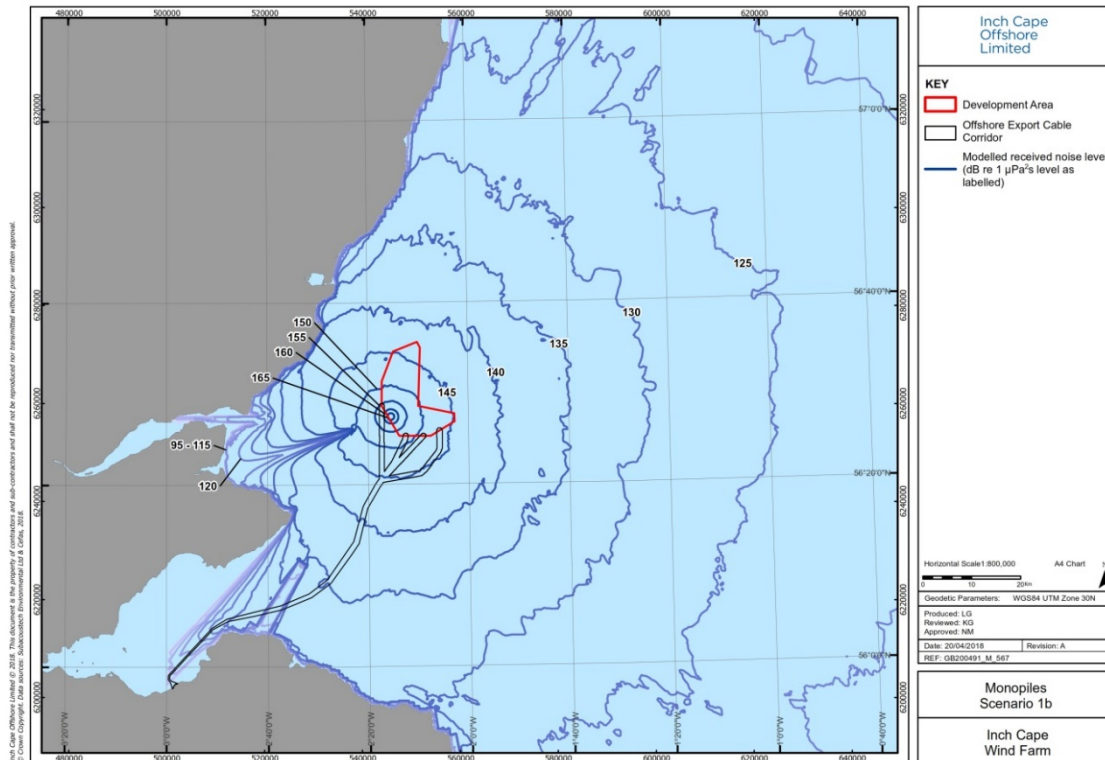
**Figure 10.28: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for displacement from pin pile driving under Scenario 4**



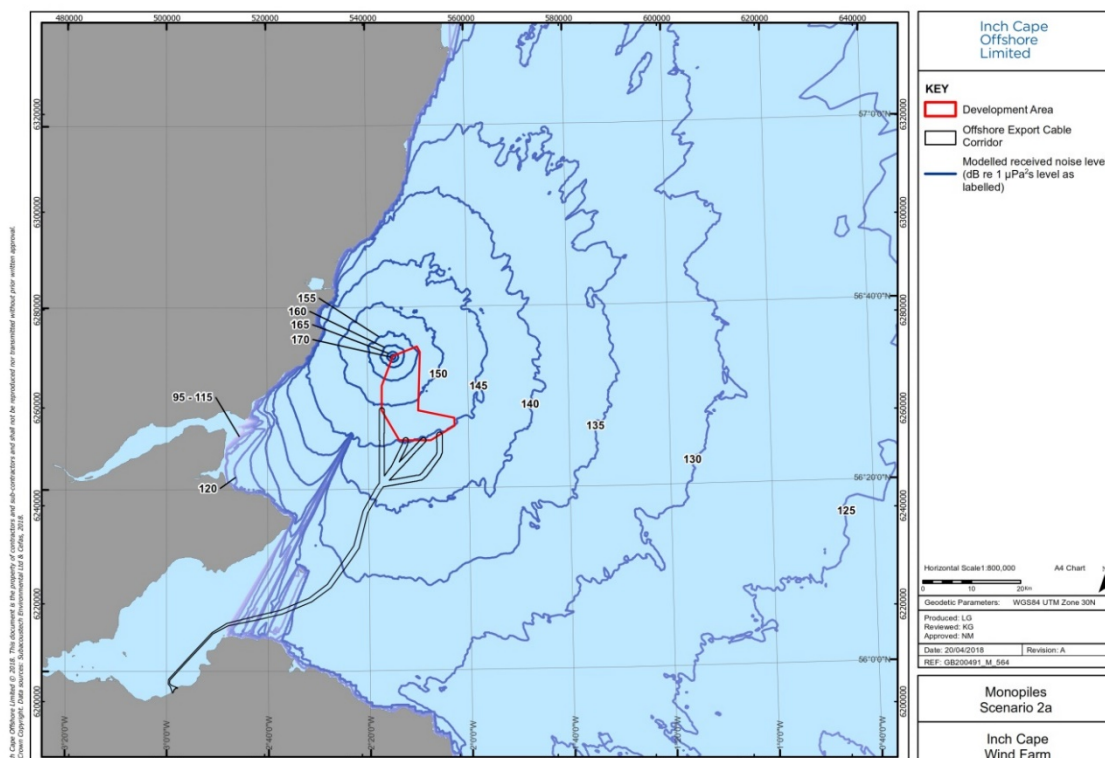
**Figure 10.29: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for displacement from monopile driving under Scenario 1a**



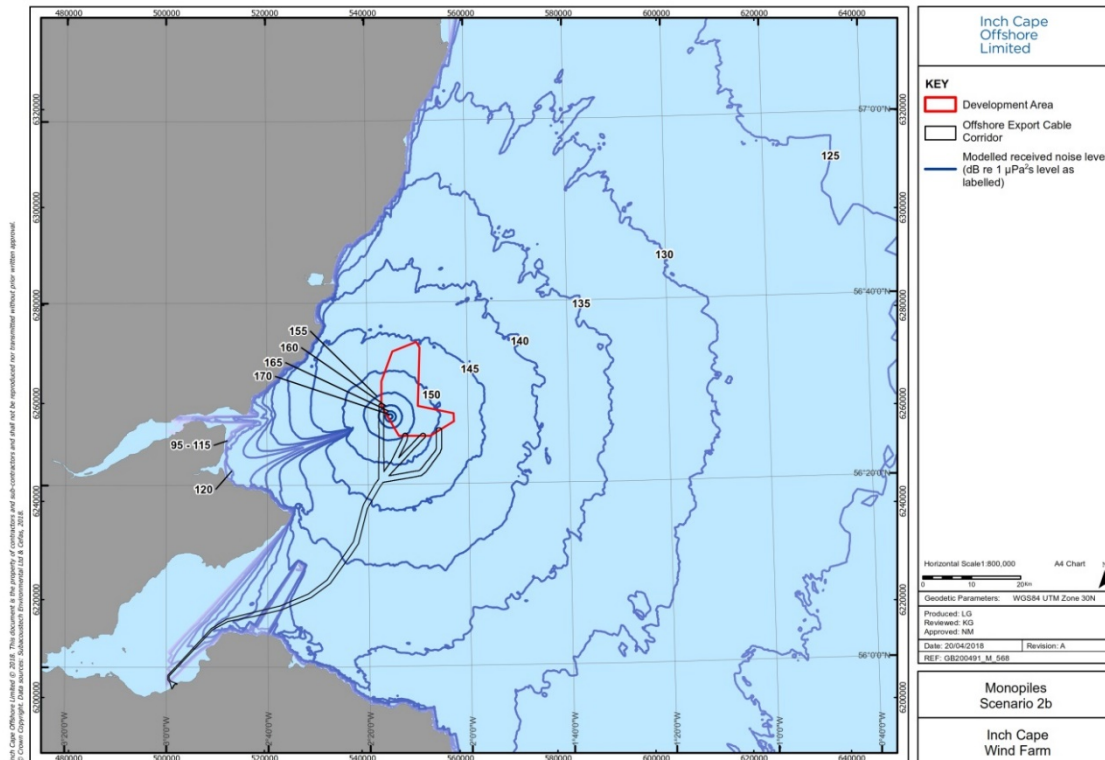
**Figure 10.30: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for displacement from monopile driving under Scenario 1b**



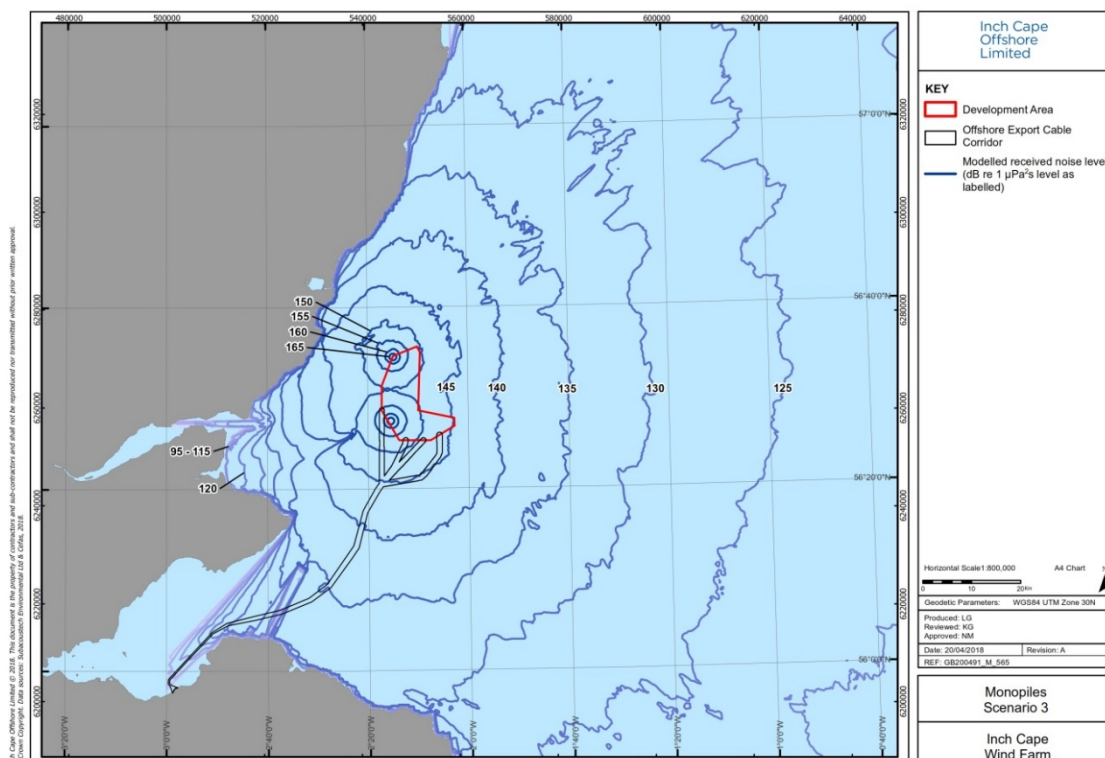
**Figure 10.31: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for displacement from monopile driving under Scenario 2a**



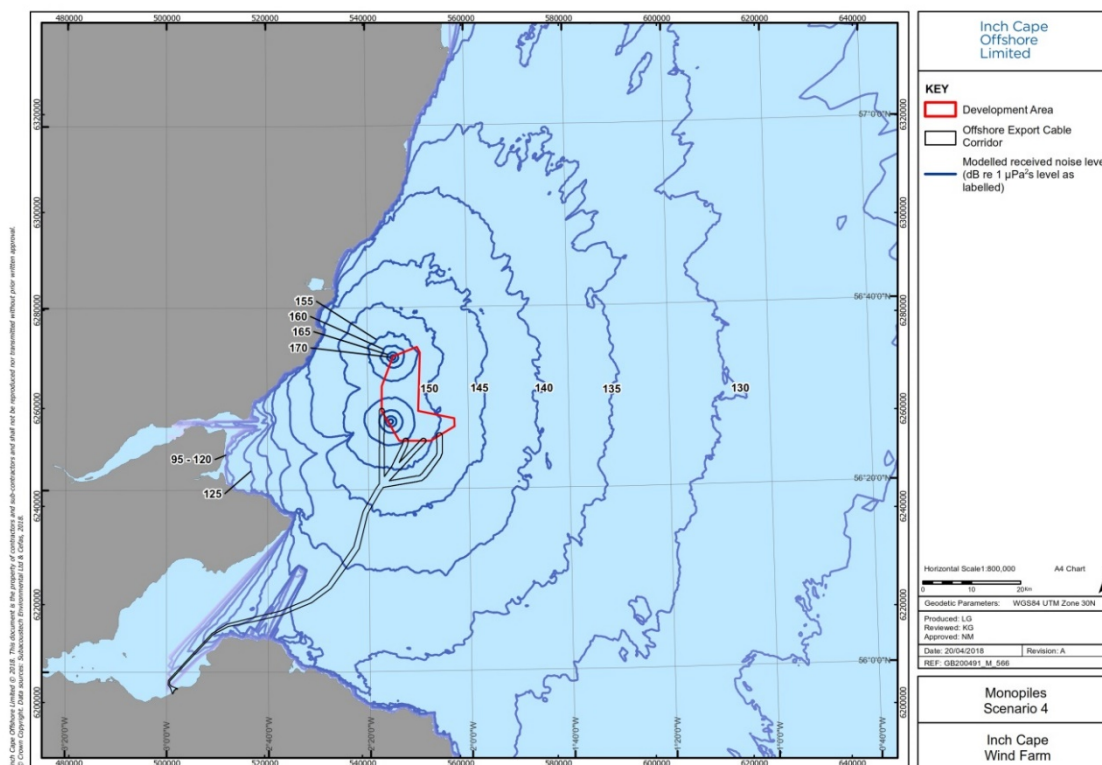
**Figure 10.32: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for displacement from monopile driving under Scenario 2b**



**Figure 10.33: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for displacement from monopile driving under Scenario 3**



**Figure 10.34: Modelled received noise levels (dB re 1  $\mu\text{Pa}^2\text{s}$ ) for displacement from monopile driving under Scenario 4**



68 Table 10.22 to Table 10.25 show the estimates of the numbers of individuals of each species (and per cent of reference population) which have the potential to be displaced due to underwater noise from pile driving according to all four pile driving scenarios (Table 10.10). It should be noted that the ML and WC estimates for the assessment carried out for the 2013 Inch Cape ES (ICOL, 2013) were the same because the only difference in the pile driving parameters between the two scenarios was duration (displacement modelling is based on the maximum blow energy, not duration). This is why the same data are presented in the 2013 Inch Cape ES column of Table 10.22 (ML for single location piling) and Table 10.23 (WC for single location piling), and Table 10.24 (ML for piling at two locations) and Table 10.25 (WC for piling at two locations).

**Table 10.22: The number of individuals (n) and per cent of reference population (%) with the potential to be displaced due to underwater noise from pile driving at a single location (one vessel) for the assessment to inform the 2013 Inch Cape ES (ICOL, 2013) and the Development<sup>20</sup> – Scenario 1 (ML) – for both pin piles and monopiles**

Species	2013 Inch Cape ES		Development			
			Pin piles		Monopiles	
	n	%	n	%	n	%
Minke whale	500 (15-4514)	0.3	63 (21 - 310)	0.3 <sup>21</sup>	96 (31 - 491)	0.4
Bottlenose dolphin	15 (1-22)	7.7	4 (3 - 4)	2.1	5 (4 - 7)	2.6
White-beaked dolphin	43 (1-284)	0.2	16 (7 - 64)	0.1	26 (10 - 104)	0.2
Harbour porpoise	486 (22-1728)	0.3	117 (63 - 251)	0.1	179 (96 - 390)	0.1
Grey seal	3058 (211-4469)	43	431 (165 - 697)	2.7	692 (267 - 1118)	4.3
Harbour seal	322 (32-416)	50.5	9 (2 - 17)	1.8	12 (2 - 22)	2.3

**Table 10.23: The number of individuals (n) and per cent of reference population (%) with the potential to be displaced due to underwater noise from pile driving at a single location (one vessel) for the assessment to inform the 2013 Inch Cape ES (ICOL, 2013) and the Development<sup>22</sup> – Scenario 2 (WC) – for both pin piles and monopiles**

Species	2013 Inch Cape ES		Development			
			Pin piles		Monopiles	
	n	%	n	%	n	%
Minke whale	500 (15-4514)	0.3	93 (30 - 479)	0.4	138 (49 - 736)	0.6

<sup>20</sup> The figures in brackets represent numbers of individuals estimated using the 95% confidence intervals of the density surfaces.

<sup>21</sup> Reference population has changed from the 2013 Inch Cape ES (ICOL, 2013). See Table 10.8 and Paragraph 70.

<sup>22</sup> The figures in brackets represent the numbers of individuals estimated using the 95% confidence intervals of the density surfaces.

Species	2013 Inch Cape ES		Development			
			Pin piles		Monopiles	
	n	%	n	%	n	%
Bottlenose dolphin	15 (1-22)	7.7	5 (4 - 6)	2.6	7 (6 - 9)	3.6
White-beaked dolphin	43 (1-284)	0.2	25 (10 - 101)	0.2 <sup>23</sup>	39 (17 - 161)	0.2
Harbour porpoise	486 (22-1728)	0.3	175 (93 - 381)	0.1	261 (139 - 578)	0.1
Grey seal	3058 (211-4469)	43	675 (260 - 1090)	4.2	1058 (411 - 1705)	6.6
Harbour seal	322 (32-416)	50.5	12 (2 - 22)	2.3	15 (2 - 28)	2.9

**Table 10.24: The number of individuals (n) and per cent of reference population (%) with the potential to be displaced due to underwater noise from concurrent pile driving at two locations (two vessels) for the assessment to inform the 2013 Inch Cape Consent (ICOL, 2013) and the Development<sup>24</sup> – Scenario 3 (ML) – for both pin piles and monopiles**

Species	2013 Inch Cape ES		Development			
			Pin piles		Monopiles	
	n	%	n	%	n	%
Minke whale	543 (17-4846)	0.3	76 (24 - 368)	0.3	112 (40 - 573)	0.5
Bottlenose dolphin	19 (1-27)	9.7	4 (4 - 5)	2.1	6 (5 - 8)	3.1
White-beaked dolphin	51 (2-330)	0.2	21 (9 - 87)	0.1	33 (15 - 135)	0.2
Harbour porpoise	556 (29-1934)	0.3	142 (75 - 300)	0.1	212 (112 - 458)	0.1

<sup>23</sup> Reference population has changed from the 2013 Inch Cape ES (ICOL, 2013). See Table 10.9.

<sup>24</sup> The figures in brackets represent the numbers of individuals estimated using the 95% confidence intervals of the density surfaces.

Species	2013 Inch Cape ES		Development			
			Pin piles		Monopiles	
	n	%	n	%	n	%
Grey seal	3212 (244-4682)	45.2	533 (199 - 867)	3.3	830 (314 - 1346)	5.2
Harbour seal	340 (49-435)	53.3	14 (2 - 26)	2.7	17 (2 - 31)	3.3

**Table 10.25: The number of individuals (n) and per cent of reference population (%) with the potential to be displaced due to underwater noise from concurrent pile driving at two locations (two vessels) for the assessment to inform the 2013 Inch Cape ES (ICOL, 2013) and the Development<sup>25</sup> – Scenario 4 (WC) – for both pin piles and monopiles**

Species	2013 Inch Cape ES		Development			
			Pin piles		Monopiles	
	n	%	n	%	n	%
Minke whale	543 (17-4846)	0.3	110 (35 - 560)	0.5	158 (56 - 848)	0.7
Bottlenose dolphin	19 (1-27)	9.7	6 (5 - 7)	3.1	8 (7 - 11)	4.1
White-beaked dolphin	51 (2-330)	0.2	32 (13 - 130)	0.2	48 (20 - 198)	0.3
Harbour porpoise	556 (29-1934)	0.3	207 (109 - 447)	0.1	302 (160 - 665)	0.1
Grey seal	3212 (244-4682)	45.2	810 (306 - 1314)	5.1	1236 (471 - 2001)	7.7
Harbour seal	340 (49-435)	53.3	17 (2 - 31)	3.3	20 (3 - 36)	3.9

69 For every species/scenario combination, the estimated number of individuals which had the potential to be displaced was less for the Development than for the assessment to inform the 2013 Inch Cape ES (ICOL, 2013). In 26 of the 48 cases, the estimated numbers were at least an

<sup>25</sup> The figures in brackets represent the numbers of individuals estimated using the 95% confidence intervals of the density surfaces.

order of magnitude lower for the Development. This is due to developments in noise modelling (Farcas *et al.*, 2016) and use of the University of Aberdeen's Moray Firth harbour porpoise dose-response curve (Graham *et al.*, 2017; see Figure 10.14) which have confirmed that the assumptions made in the 2013 Inch Cape ES (ICOL, 2013) were overly conservative.

- 70 When these numbers were expressed as percentages of reference populations they were less for the Development than for the assessment to inform the 2013 Inch Cape ES (ICOL, 2013) in 41 of the 48 cases. In the other seven cases, the very slightly greater percentages came about because different (smaller) minke whale and white-beaked dolphin reference populations were used (the Celtic and Greater North Seas MMMU<sup>26</sup> instead of all four IWC-defined stocks in the North Atlantic for minke whale<sup>27</sup> and the eastern North Atlantic stock for white-beaked dolphin<sup>28</sup>).
- 71 Using the criteria for predicting the significance of effects (see Table 10.15), the effects of displacement on all marine mammal species from piling (of either pin piles or monopiles) at the Development are predicted to be of minor significance (see Table 10.25). This is because they are predicted to be medium term in duration (construction years) and low in magnitude (with mitigation  $\leq 5.1$  and 7.7 per cent of the species' reference populations are estimated to have the potential to be affected for pin piles and monopiles respectively).
- 72 Therefore, the effects of displacement from piling (either pin piles or monopiles) at the Development are predicted to be of minor significance (see Table 10.25). In addition they are less than those which were assessed as not significant in the 2013 Inch Cape ES (ICOL, 2013) and deemed acceptable for the 2014 Inch Cape Consent (see Table 10.26).

**Table 10.26: The significance of the potential effects of displacement from piling on marine mammals**

Species	2013 Inch Cape ES	Development
Minke whale	Minor	Minor
Bottlenose dolphin	Moderate	Minor
White-beaked dolphin	Minor	Minor
Harbour porpoise	Minor	Minor
Grey seal	Major	Minor
Harbour seal	Major	Minor

- 73 As agreed with the stakeholders at the second marine mammal workshop (see Table 10.1), as the numbers of individual animals modelled to receive noise sufficient to induce PTS onset and/ or be displaced by piling noise is lower for the Development than for the assessment to inform the 2013 Inch Cape ES (ICOL, 2013), population level modelling has not been undertaken for minke whale, white-beaked dolphin, harbour porpoise, grey seal or harbour

<sup>26</sup> 23,528 minke whales and 15,895 white-beaked dolphins.

<sup>27</sup> 181,922 animals (2013 Inch Cape ES (ICOL, 2013)).

<sup>28</sup> 22,664 animals (2013 Inch Cape ES (ICOL, 2013)).

seal. Where conducted, population level modelling illustrated that impacts arising from the assessment to inform the 2013 Inch Cape ES (ICOL, 2013) would be minor in the long-term, and impacts from the Development are predicted to be lower than this and not significant.

Population level modelling (bottlenose dolphin)

- 74 As agreed during consultation with MS-LOT (see Table 10.1), population level modelling was undertaken for bottlenose dolphin (see *Appendix 10A* for details) to inform the AA. As advised, interim PCoD (rather than VORTEX which was used in the assessment to inform the 2013 Inch Cape ES; ICOL, 2013) was used. PTS was not considered because the number of bottlenose dolphins with the potential to be impacted by PTS onset due to underwater noise from pile driving was zero for each scenario (Table 10.16, Table 10.17, Table 10.18 and Table 10.19). The number of bottlenose dolphins with the potential to be displaced due to underwater noise from pile driving was not equal to zero (Table 10.21, Table 10.22, Table 10.23 and Table 10.24) therefore displacement was considered.
- 75 For each model run, the median predicted population size at each year of simulation was plotted with 95% confidence intervals for the undisturbed and disturbed populations (see Figure 10.35, Figure 10.37, Figure 10.39 and Figure 10.41). It is important to note that this is presented to facilitate comparisons among the scenarios rather than to make quantitative predictions regarding the likely bottlenose dolphin population size at any time. For each of the four scenarios, it is very difficult to differentiate between predicted bottlenose dolphin population growth with no displacement (undisturbed population) and with displacement (disturbed population). This suggests that displacement from piling is unlikely to affect population growth.
- 76 Several metrics requested by MS-LOT were tabulated (see Table 10.27). The median ratio of disturbed to undisturbed growth rate, and disturbed to undisturbed population size, was equal to one for each of the four scenarios. This indicates that, on average, the disturbance levels experienced by the population have no impact on population size over the 25 year period modelled. Furthermore, the end population size of the disturbed population is the same as, or just one or two individuals less than, that of the undisturbed population in each of the four scenarios modelled (see Table 10.27, Figure 10.36, Figure 10.38, Figure 10.40 and Figure 10.42). This also indicates no impact on population size over the 25 year period modelled.
- 77 In conclusion, displacement from pile driving at Inch Cape is unlikely to affect the size or growth of the bottlenose dolphin population off the east coast of Scotland (for any of the four scenarios).

**Table 10.27: Predicted changes in bottlenose dolphin population size and growth rate under the four Inch Cape only construction scenarios (A to D). Bracketed values represent the median difference in the disturbed and undisturbed growth rates and population sizes**

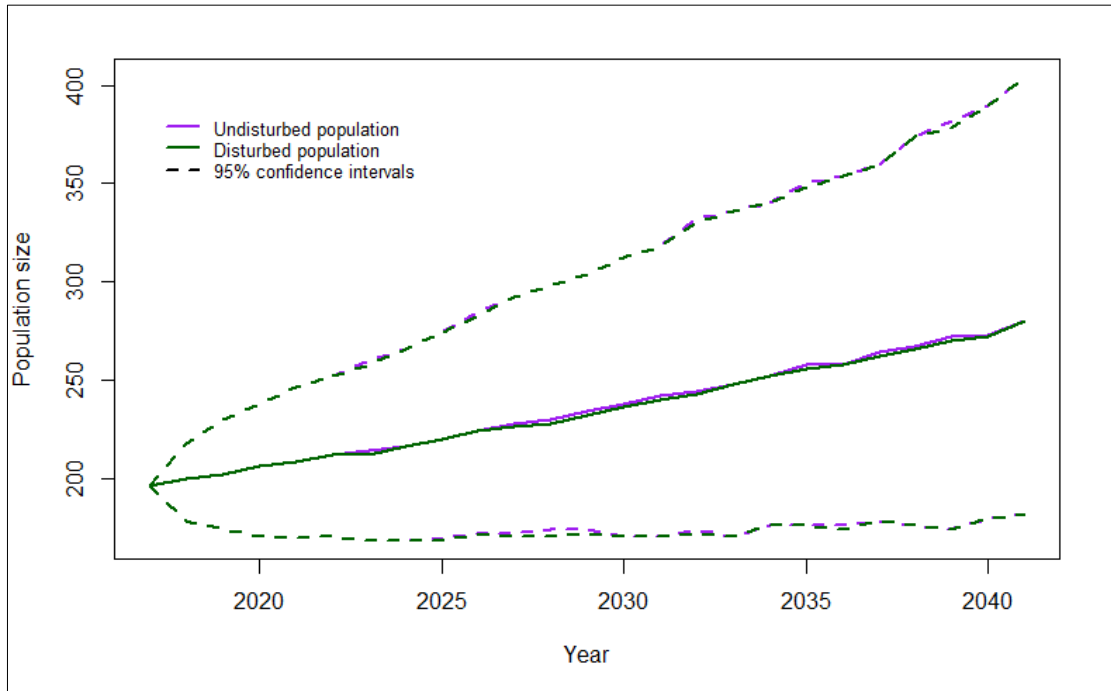
Scenario			Median ratio of disturbed to undisturbed growth rate <sup>29</sup>	Median ratio of disturbed to undisturbed population size <sup>30</sup>	Centile for the undisturbed population that matches the 50 <sup>th</sup> centile for the disturbed population <sup>31</sup>	Median end population size
Pin piles	Single piling vessel	Undisturbed	1.00	1.00	0.50	284
		Scenario A	1.00 (0.00)	1.00 (0.00)	0.49	282
	Two piling vessels	Undisturbed	1.00	1.00	0.50	284
		Scenario B	1.00 (0.00)	1.00 (0.00)	0.50	284
Monopiles	Single piling vessel	Undisturbed	1.00	1.00	0.50	280
		Scenario C	1.00 (0.00)	1.00 (0.00)	0.49	278
	Two piling vessels	Undisturbed	1.00	1.00	0.50	280
		Scenario D	1.00 (0.00)	1.00 (0.00)	0.49	279

<sup>29</sup> A value of 1 indicates that, on average, the disturbance levels experienced by the population have no impact on population growth over the 25 year period modelled.

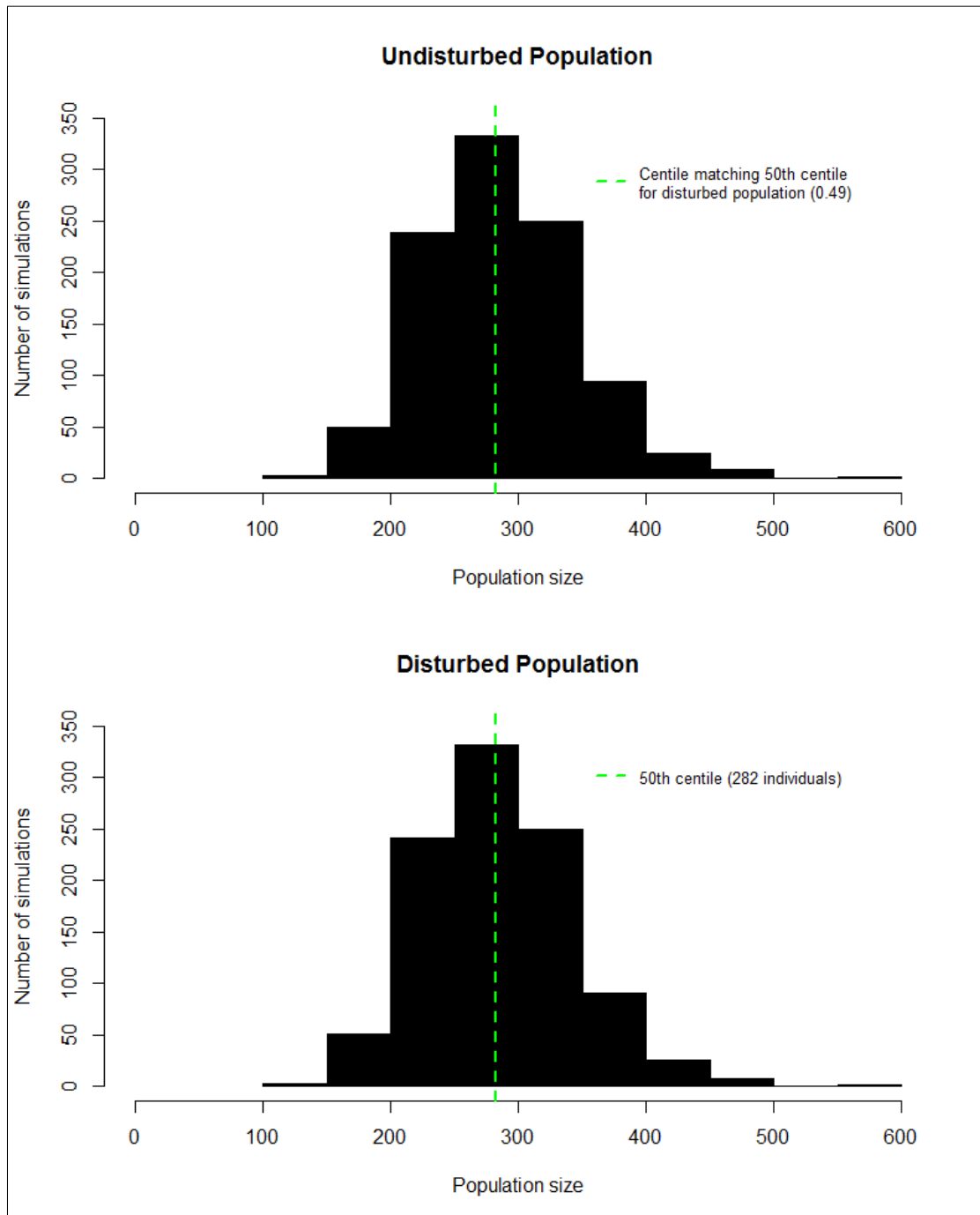
<sup>30</sup> A value of 1 indicates that, on average, the disturbance levels experienced by the population have no impact on population size over the 25 year period modelled.

<sup>31</sup> Because the end population size of the disturbed population is expected to be less than that of the undisturbed population, this value is expected to be less than 0.5. A value of 0.5 indicates no impact on population size over the 25 year period modelled. This is the most sensitive of the three metrics presented. The distributions of population sizes for both the undisturbed and disturbed populations were also plotted as histograms.

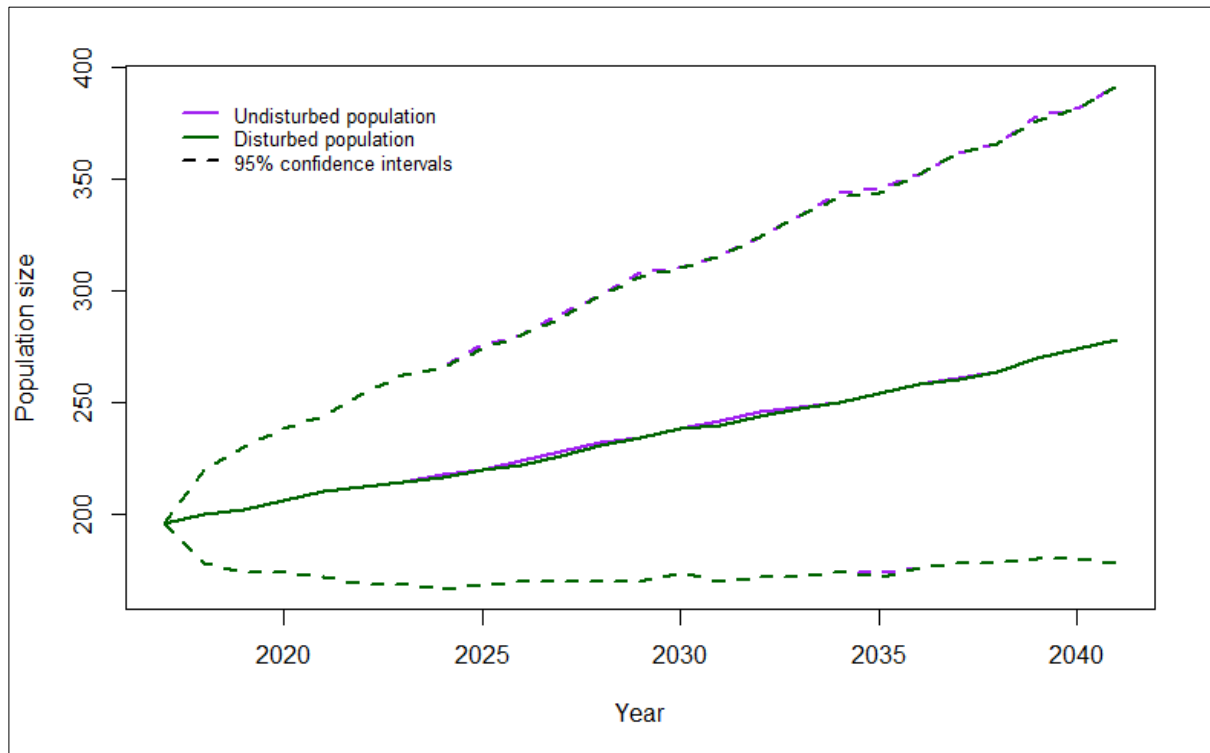
**Figure 10.35: Predicted bottlenose dolphin population growth over 25 years with no displacement (undisturbed population) and with displacement (disturbed population) associated with piling pin piles at Inch Cape using a single piling vessel (Scenario A)**



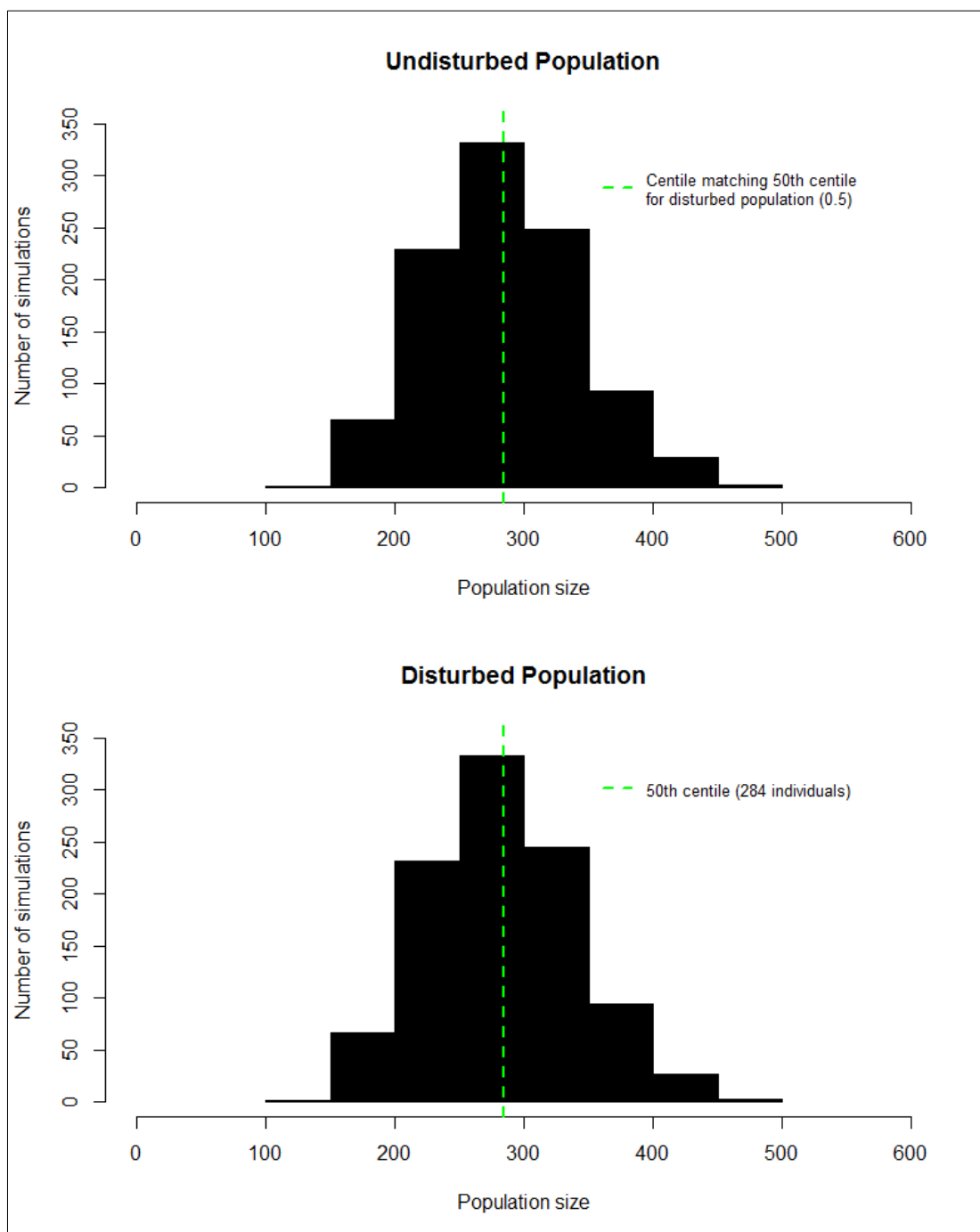
**Figure 10.36: Distribution of predicted bottlenose dolphin sizes after 25 years with no displacement (undisturbed population) and with displacement (disturbed population) associated with piling pin piles at Inch Cape using a single piling vessel (Scenario A)**



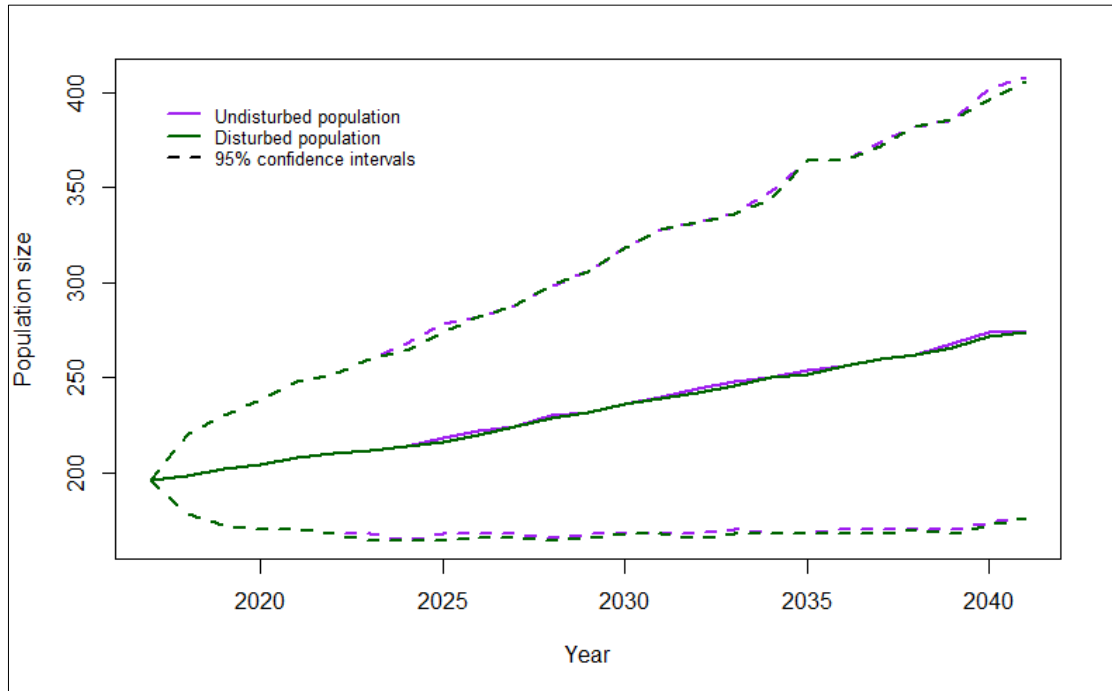
**Figure 10.37: Predicted bottlenose dolphin population growth over 25 years with no displacement (undisturbed population) and with displacement (disturbed population) associated with piling pin piles at Inch Cape using two piling vessels (Scenario B)**



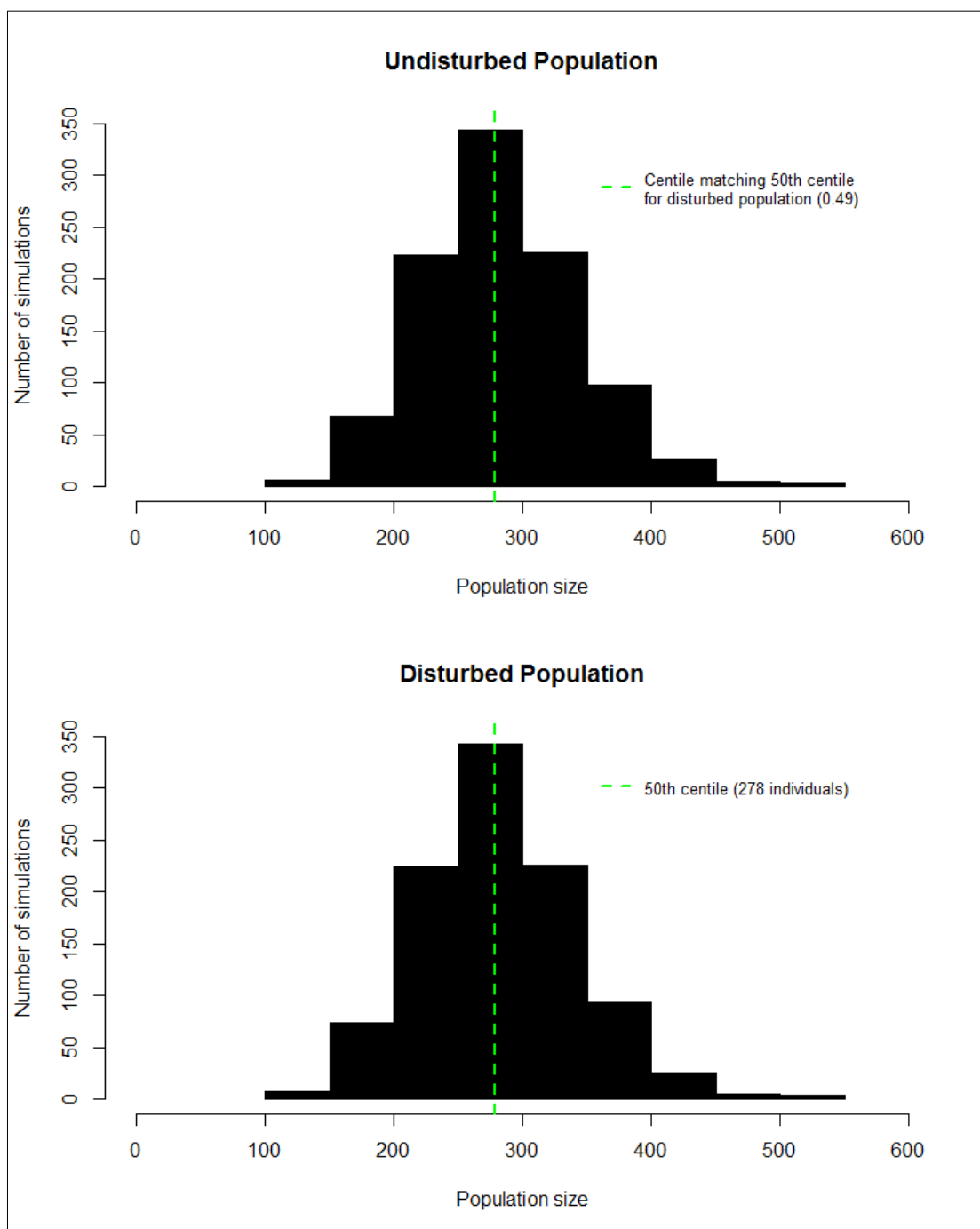
**Figure 10.38: Distribution of predicted bottlenose dolphin sizes after 25 years with no displacement (undisturbed population) and with displacement (disturbed population) associated with piling pin piles at Inch Cape using two piling vessels (Scenario B)**



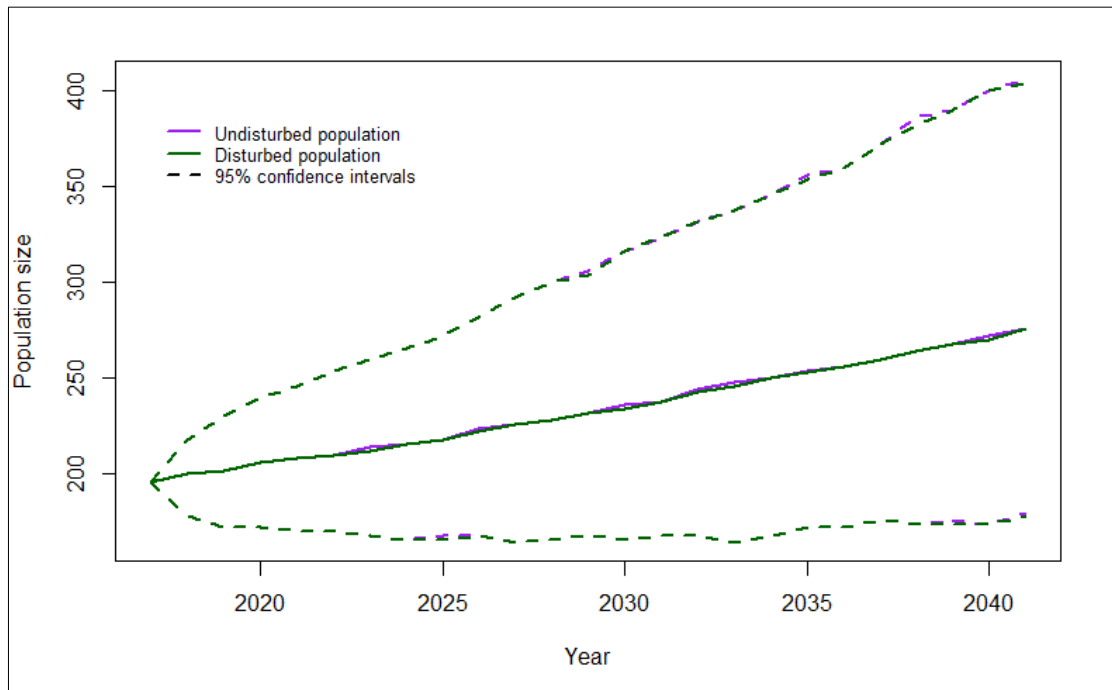
**Figure 10.39: Predicted bottlenose dolphin population growth over 25 years with no displacement (undisturbed population) and with displacement (disturbed population) associated with piling monopiles at Inch Cape using a single piling vessel (Scenario C)**



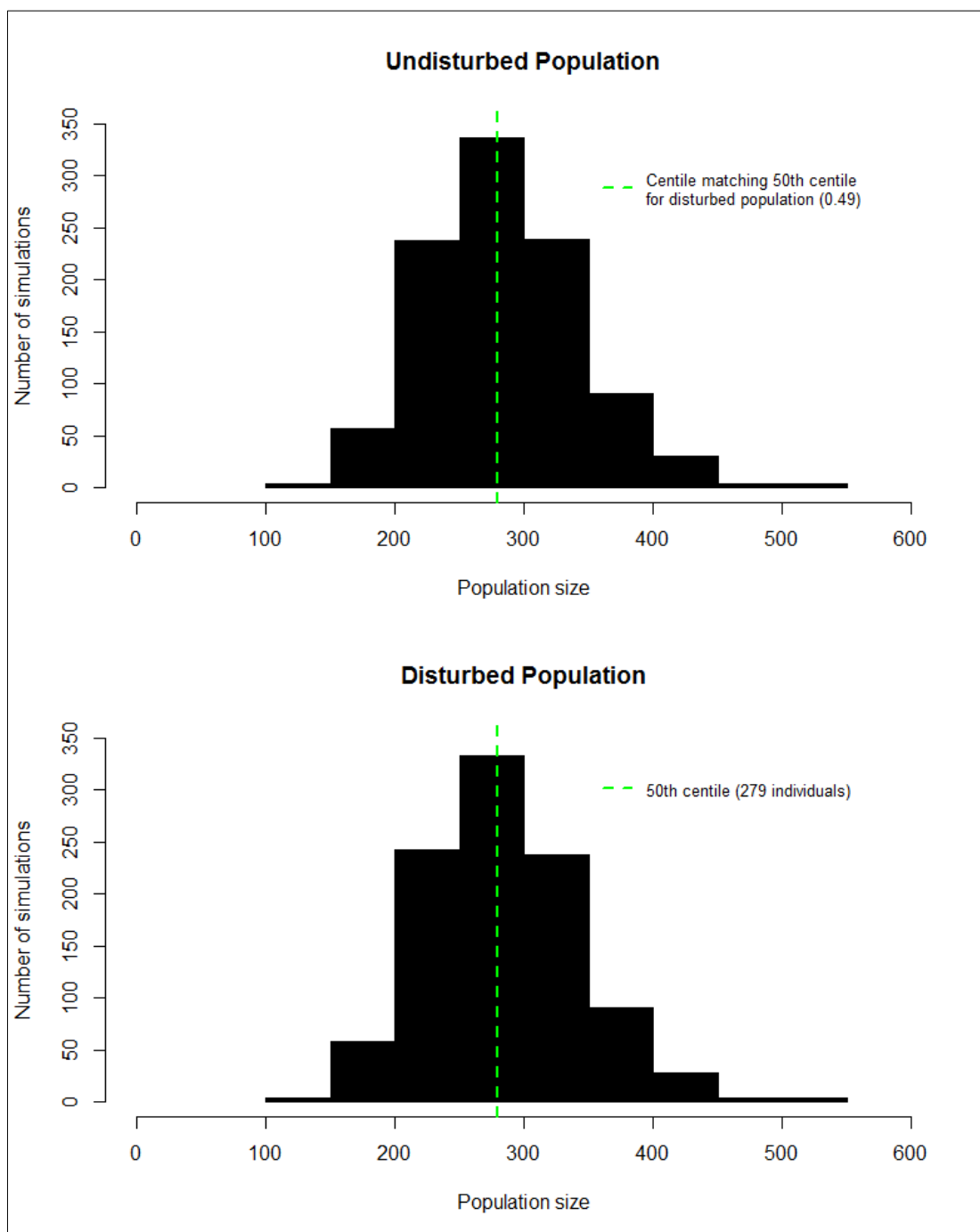
**Figure 10.40: Distribution of predicted bottlenose dolphin sizes after 25 years with no displacement (undisturbed population) and with displacement (disturbed population) associated with piling monopiles at Inch Cape using a single piling vessel (Scenario C)**



**Figure 10.41: Predicted bottlenose dolphin population growth over 25 years with no displacement (undisturbed population) and with displacement (disturbed population) associated with piling monopiles at Inch Cape using two piling vessels (Scenario D)**



**Figure 10.42: Distribution of predicted bottlenose dolphin sizes after 25 years with no displacement (undisturbed population) and with displacement (disturbed population) associated with piling monopiles at Inch Cape using two piling vessels (Scenario D)**



#### **Disturbance from increased noise from geophysical survey systems**

- 78 For the purposes of this assessment, the term 'geophysical survey systems' potentially includes, but is not limited to, the following types of equipment: sub-bottom profilers (pingers, sparkers, boomers and chirps), USBL transceivers/transducers and transponders/responders/beacons, scanning sonars and multi beam echo sounders.

- 79 Geophysical survey systems are routinely used during activities associated with cable laying e.g. pre- and post-lay surveys, trenching, cable laying, backfill and rock placement.
- 80 Construction vessels will utilise positioning equipment including USBL transceivers/transducers and transponders/responders/beacons for the duration of the construction phase. Cable lay activity makes up only part of the construction programme but it will require the use of scanning sonars and multi-beam echo sounders in addition to the vessel positioning equipment listed above.

#### PTS

- 81 The sound emitted by some geophysical survey systems has the potential to induce the onset of PTS if source levels are high. In such cases, current best practice will be used; at the moment this is adoption of the JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC, 2017) i.e. pre-work searches to ensure that no marine mammals are present within the zone of potential effect when work commences and the use of soft starts where possible (i.e. if equipment specifications allow). Therefore, with mitigation, there is no potential for the sound emitted by geophysical survey systems to induce the onset of PTS. It should be noted that the JNCC guidelines state that “multi-beam surveys in shallower waters (<200m) are not subject to these requirements as it is thought the higher frequencies typically used fall outside the hearing frequencies of cetaceans and the sounds produced are likely to attenuate more quickly than the lower frequencies used in deeper waters. JNCC do not, therefore, advise that mitigation is required for multi-beam surveys in shallow waters”. This is also assumed to be the case for the sounds produced by other high frequency equipment.
- 82 Using the criteria for predicting the significance of effects (see Table 10.15), the effects of PTS on all marine mammal species from use of geophysical survey systems at the Development are predicted to be of minor significance (see Table 10.27). This is because they are predicted to be medium term in duration (construction years) and low in magnitude (with mitigation no animals, i.e. less than ten per cent of the species’ reference populations, will be affected).

#### Disturbance

- 83 The sound emitted by some geophysical survey systems has the potential to disturb marine mammals if the frequency/ frequencies used are audible to them<sup>32</sup>.
- 84 The ML response will be temporary behavioural avoidance (there is evidence that short-term disturbance caused by a commercial two-dimensional seismic survey does not lead to long-term displacement of harbour porpoises in the Moray Firth; Thompson *et al.*, 2013).
- 85 The only available information on disturbance from geophysical survey noise comes from Thompson *et al.* (2013), who found evidence of harbour porpoise group responses (to airgun noise) over ranges of 5-10 km. However, because this was a high energy survey for oil and gas,

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<sup>32</sup> The estimated auditory bandwidth (kHz) of low frequency cetaceans is 0.007-35, mid frequency cetaceans is 0.15-160, high frequency cetaceans is 0.2-180 and phocid seals in water is 0.075-86 (Southall *et al.*, 2007; NOAA, 2016).

the findings are not considered to be equivalent to those thought likely in response to use of the geophysical survey systems proposed here (peak to peak source levels from the seismic survey were estimated to be 242-253 dB re 1  $\mu$ Pa at 1 m, while source levels from typical sub-bottom profilers, USBL transceivers/transducers and transponders/responders/ beacons, scanning sonars and multi beam echo sounders range from 149 to 225 dB re 1  $\mu$ Pa at 1 m). The temporary displacement observed from the seismic survey within the Moray Firth is therefore considered to be overly precautionary for use as a proxy for displacement likely from the geophysical survey equipment used during activities associated with cable laying.

- 86 With the lack of information available to inform a detailed assessment, but considering the confidence that the impacts will be lower than those observed from seismic surveys, it has been assumed that the effects of disturbance due to increased noise from geophysical survey systems will be less than those from piling (which have been assessed in *Paragraphs 81 to 91*).
- 87 Therefore, using the criteria for predicting the significance of effects (see Table 10.16), the effects of disturbance on all marine mammal species from use of geophysical survey systems at the Development are predicted to be of minor significance (see Table 10.28). This is because they are predicted to be medium term in duration (construction years) and low in magnitude (less than ten per cent of the species' reference populations will be affected). Impacts from geophysical survey systems were not assessed in the Inch Cape 2013 ES.

**Table 10.28: The significance of the potential impacts of geophysical survey systems on marine mammals**

Species	Development	
	PTS	Disturbance
All marine mammals	Minor	Minor

- 88 It should be noted that prior to construction starting, an EPS Risk Assessment for construction of the Development will be conducted to determine whether an EPS licence will be required (in relation to the potential for disturbance). Current guidance will be used; at the moment this is the Marine Scotland and SNH guidance for Scottish inshore waters (Marine Scotland and SNH, 2014). The EPS risk assessment will cover all activities associated with the offshore construction programme. It is thought at this juncture that a licence may be required for piling and the use of geophysical survey systems.

### 10.8.2 Effects of Decommissioning

- 89 The potential effects of decommissioning the Wind Turbine Generators (WTGs) and Offshore Substation Platforms (OSPs) are considered to be equivalent to and potentially lower than those associated with the construction phase i.e. of minor significance. This is because it is expected that underwater noise levels will be substantially lower during decommissioning than construction because decommissioning will not involve pile driving.

90 The geophysical survey systems required for decommissioning are expected to be the same as those used during the construction phase, the potential effects of decommissioning the Inter-array Cables are therefore considered to be equivalent to those associated with the construction phase i.e. of minor significance.

91 The approach to decommissioning is described in *Chapter 7 (Section 7.12)*.

## **10.9 Impact Assessment - Offshore Export Cable Corridor**

### **10.9.1 Effects of Construction**

#### **Disturbance from increased noise from geophysical survey systems**

92 The assessment undertaken for installing the Inter-array Cables (see *Paragraphs 111 to 120 in Section 10.8.1*) is equally applicable to any Offshore Export Cable work i.e. the potential effects of both PTS and disturbance on all marine mammal species from use of geophysical survey systems are predicted to be of minor significance.

93 As noted in *Paragraph 118*, an EPS Risk Assessment for construction of the Development will be conducted to determine whether an EPS licence will be required (in relation to the potential for disturbance due to the sound emitted by some systems). Current guidance will be used; at the moment this is the Marine Scotland and SNH guidance for Scottish inshore waters (Marine Scotland and SNH, 2014).

### **10.9.2 Effects of Decommissioning**

94 The assessment undertaken for decommissioning the Inter-array Cables (see *Paragraphs 120 to 121 in Section 10.8.2*) is equally applicable to any Offshore Export Cable work i.e. the potential effects of both PTS and disturbance on all marine mammal species from use of geophysical survey systems are predicted to be of minor significance.

95 The approach to decommissioning is described in *Chapter 7 (Section 7.12)*

## **10.10 Impact Assessment - Development and Onshore Transmission Works (OnTW)**

96 The potential effects of displacement/ PTS from piling during construction of the Development will be the same as those from the Wind Farm alone i.e. of minor significance. In addition they are less than those which were assessed as not significant in the 2013 Inch Cape ES (ICOL, 2013) and deemed acceptable for the 2014 Inch Cape Consent (see *Section 10.8*).

97 The potential effects of disturbance from increased noise from geophysical survey systems during construction and/ or decommissioning of the Development will be the sum of those from the Wind Farm (see *Section 10.8*) and the OnTW (see *Section 10.9*), and are considered to be of minor significance.

98 As noted in *Paragraph 118*, an EPS Risk Assessment for construction of the Development will be conducted to determine whether an EPS licence will be required (in relation to the potential for disturbance). Current guidance will be used; at the moment this is the Marine

Scotland and SNH guidance for Scottish inshore waters (Marine Scotland and SNH, 2014). The EPS risk assessment will cover all activities associated with the offshore construction programme (no marine mammal impacts are anticipated from the Onshore Transmission Works associated with the Development). It is thought at this juncture that an EPS licence may be required for piling and the use of geophysical survey systems.

99 The approach to decommissioning is described in *Chapter 7 (Section 7.12)*

### **10.11 Cumulative Impact Assessment**

100 As advised in the Scoping Opinion and subsequent consultation (see Table 10.1):

- Only the potential for underwater noise impacts has been included in the CIA. Therefore, projects which were listed in the Scoping Opinion but for which no/ or negligible levels of underwater noise are predicted have been identified as being unlikely to exert a cumulative impact, and have not been assessed (i.e. scoped out of the cumulative assessment; see Table 10.29 below for details); and
- The following projects were considered in the CIA :
  - Neart na Gaoithe OWF;
  - Beatrice OWF;
  - Moray East OWF;
  - Aberdeen Harbour Expansion Project;
  - Seagreen Phase 1 OWF;
  - Moray West OWF;
  - Aberdeen Bay OWF (also known as the European Offshore Wind Deployment Centre);
  - Hywind Scotland Pilot Park Project;
  - Kincardine OWF; and
  - Forthwind OWF, Methil.

**Table 10.29: Projects not assessed in (i.e. scoped out of) the CIA**

<b>Project</b>	<b>Location</b>	<b>Details</b>	<b>Timescale</b>	<b>Potential effects on marine mammals</b>
Meteorological Mast – Seagreen Phase 1 OWF	Forth and Tay	A floating LiDAR was installed	2017	None (no pile driving undertaken)
Rosyth International Container Terminal	Forth	Creation of an international (two-ship) container terminal	Scoping Report submitted in 2014	Unlikely (no or negligible levels of underwater noise predicted)
Grangemouth Renewable Energy Plant	Forth	Biomass combined heat and power plant	Unknown	Unlikely (no or negligible levels of underwater noise predicted)
Rosyth Renewable Energy Plant	Forth	Biomass plant	Unknown	Unlikely (no or negligible levels of underwater noise predicted)
Dundee Renewable Energy Plant	Tay	Biomass plant	Plans withdrawn	None (plans withdrawn)
Cockenzie Combined Cycle Gas Turbine Power Station	Forth	Coal-fired power station closed in 2013	Unknown	Unlikely (no or negligible levels of underwater noise predicted)
Captain Clean Energy Project (Caledonia Clean Energy Project), Grangemouth	Forth	Natural gas feedstock power plant with integrated CO <sub>2</sub> capture facilities	Start-up would be in the 2020s	Unlikely (no or negligible levels of underwater noise predicted)
Coastal Improvement Works at the mouth of the Barry Burn, Carnoustie	Tay	Replacement of existing tank blocks and sand dunes with rock armour and provision of retaining wall	Unknown	Unlikely (no or negligible levels of underwater noise predicted)
Victoria and Albert Museum at Dundee (Dundee Waterfront Development)	Tay	Waterfront redevelopment	Museum due to open in 2018	Unlikely (no or negligible levels of underwater noise predicted)
Port of Dundee Expansion	Tay	Land reclamation (by infilling) project Construction may involve either caissons or piling	EIA Scoping and HRA Screening undertaken in 2013	None (project appears to be on hold)

Project	Location	Details	Timescale	Potential effects on marine mammals
Edinburgh Harbour Master Plan (Edinburgh Waterfront Development)	Forth	Unknown	Unknown	Unlikely (no or negligible levels of underwater noise predicted)

- 101 As agreed at the second marine mammal workshop (see Table 10.1), for the purposes of the EIA, a qualitative assessment has been carried out for minke whale, white-beaked dolphin, harbour porpoise, grey seal and harbour seal i.e. all species except bottlenose dolphin. This qualitative assessment has taken into account the population level assessments and modelling of the consequences of impacts from pile driving at five OWF projects situated off the east coast of Scotland (Inch Cape, Seagreen Alpha and Bravo, NnG, Beatrice and MORL Eastern Development Area) which were undertaken to inform the 2013 Inch Cape ES (ICOL, 2013).
- 102 As agreed during consultation with MS-LOT, population level modelling was undertaken for bottlenose dolphin (see *Appendix 10A*) to inform the AA. As advised by the Scottish Ministers, interim PCoD (rather than VORTEX which was used in the assessment to inform the 2013 Inch Cape ES; ICOL, 2013) was used.

#### 10.11.1 Effects of Construction

- 103 As provided in Table 10.14 above, offshore construction of the Development is anticipated to commence in 2021. The offshore construction activities will occur over approximately two years. The main offshore construction activities, and their anticipated durations and illustrative dates, are outlined in Table 10.30 below. It is likely that pile driving will be undertaken in 2021.

**Table 10.30: Main construction activities along with anticipated durations and the illustrative programme**

Main construction activity	Anticipated duration (months)	Illustrative programme
Pre-construction surveys	6	2018
Foundation installation	Up to 9	2021
Inter-array Cable installation and commissioning	12	2021 and 2022
Installation of substructures	6 to 9	2022
Installation and commissioning of WTGs	6 to 9	2023

Installation and commissioning of OSPs	6	2022
Offshore Export Cable installation	9	2022

**Qualitative assessment (minke whale, white-beaked dolphin, harbour porpoise, grey seal, harbour seal)**

- 104 The 2013 Inch Cape ES (ICOL, 2013) presented population modelling (for harbour seal) of the consequences of impacts from pile driving at five projects situated off the east coast of Scotland. It also included a comparison of the number of grey seals potentially affected against the Potential Biological Removal (PBR) for that year. Both sequential and concurrent piling (of the projects) were taken into account. The PTS and displacement impacts which were used to populate the harbour seal model, and inform the grey seal PBR comparison, were estimated using methodologies which are now considered to be overly precautionary. As shown above in *Section 10.8.1*, revised noise modelling and use of the dose-response curve of Graham *et al.* (2017) have led to a substantial reduction in the number of individuals of each species estimated to be impacted by PTS and displacement compared to the assessment to inform the 2013 Inch Cape ES (ICOL, 2013). Using the best practice assessment methodology available at the time (2013), cumulative long-term population level effects were deemed acceptable for the east coast projects through the consents issued for all five projects. Due to the substantial reduction in the number of individuals of each species which have been estimated to be impacted by the current Development, the potential for cumulative long-term population level effects is considered to be within the footprint of that assessed in 2013, and to be minor.
- 105 The predicted impacts upon minke whale, white-beaked dolphin and harbour porpoise were not assessed at the population level within the 2013 Inch Cape ES (ICOL, 2013). Instead, impacts were considered qualitatively against estimates of population size. As the number of individual animals of each species predicted to experience PTS and displacement effects from the Development are substantially less than those from the assessment to inform the 2013 Inch Cape ES (ICOL, 2013), the effects are considered to be within those predicted for the 2014 Inch Cape Consent, and thus acceptable at a cumulative level.

**Quantitative assessment (bottlenose dolphin)**

- 106 As agreed during consultation (see Table 10.1), population level modelling using the interim PCoD framework was undertaken for bottlenose dolphin (see Appendix 10A for details) to inform the AA. PTS was not considered because the number of bottlenose dolphins with the potential to be impacted by PTS onset due to underwater noise from pile driving/ blasting was zero for each of the five projects considered (see Table 10.14). The number of bottlenose dolphins with the potential to be displaced due to underwater noise from pile driving/ blasting varied from two to 53 (Table 10.14) therefore displacement was considered.

- 107 For both model runs, the median predicted population size at each year of simulation was plotted with 95% confidence intervals for the undisturbed and disturbed populations (see Figure 10.43 and Figure 10.44). Although predicted bottlenose dolphin population growth with displacement (disturbed population) can be differentiated from predicted bottlenose dolphin population growth with no displacement (undisturbed population), disturbed population growth follows the same trajectory as undisturbed population growth in the years after construction/ displacement (which have been modelled to occur between 2017 and 2021 inclusive; see Table 10.14). The end population size of the disturbed population is similar to (95 per cent of) that of the undisturbed population in each of the two scenarios modelled (see Table 10.31, Figure 10.44 and Figure 10.46).
- 108 Several metrics requested by MS-LOT were tabulated (see Table 10.31). The median ratio of disturbed to undisturbed growth rate, and disturbed to undisturbed population size, was equal to one for each of the two scenarios. This indicates that, on average, the disturbance levels experienced by the population have no impact on population size over the 25 year period modelled.
- 109 In conclusion, displacement from pile driving/ blasting may affect the size and growth of the bottlenose dolphin population off the east coast of Scotland. However, the outputs from iPCoD suggest that the size of this effect is likely to be small. The precision of estimates from the current monitoring programme for this population (and other similar populations) suggest that an effect of this size is unlikely to be detectable.

**Table 10.31: Predicted changes in bottlenose dolphin population size and growth rate under the two cumulative construction scenarios (E and F)**

Scenario		Median ratio of disturbed to undisturbed growth rate <sup>33</sup>	Median ratio of disturbed to undisturbed population size <sup>34</sup>	Centile for the undisturbed population that matches the 50 <sup>th</sup> centile for the disturbed population <sup>35</sup>	Median end population size
Construction of five projects off the east coast of Scotland including piling <b>pin piles</b> at Inch Cape	Undisturbed	1.00	1.00	0.50	276
	Scenario E	1.00 (0.00)	1.00 (0.00)	0.40	264

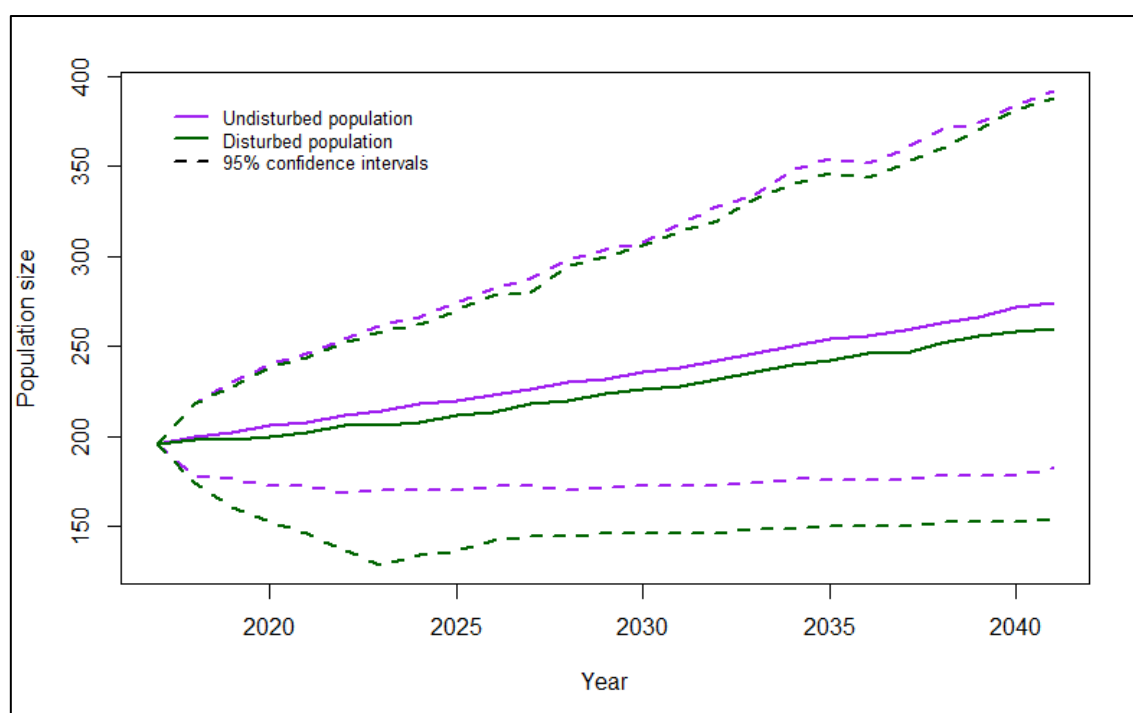
<sup>33</sup> A value of 1 indicates that, on average, the disturbance levels experienced by the population have no impact on population growth over the 25 year period modelled.

<sup>34</sup> A value of 1 indicates that, on average, the disturbance levels experienced by the population have no impact on population size over the 25 year period modelled.

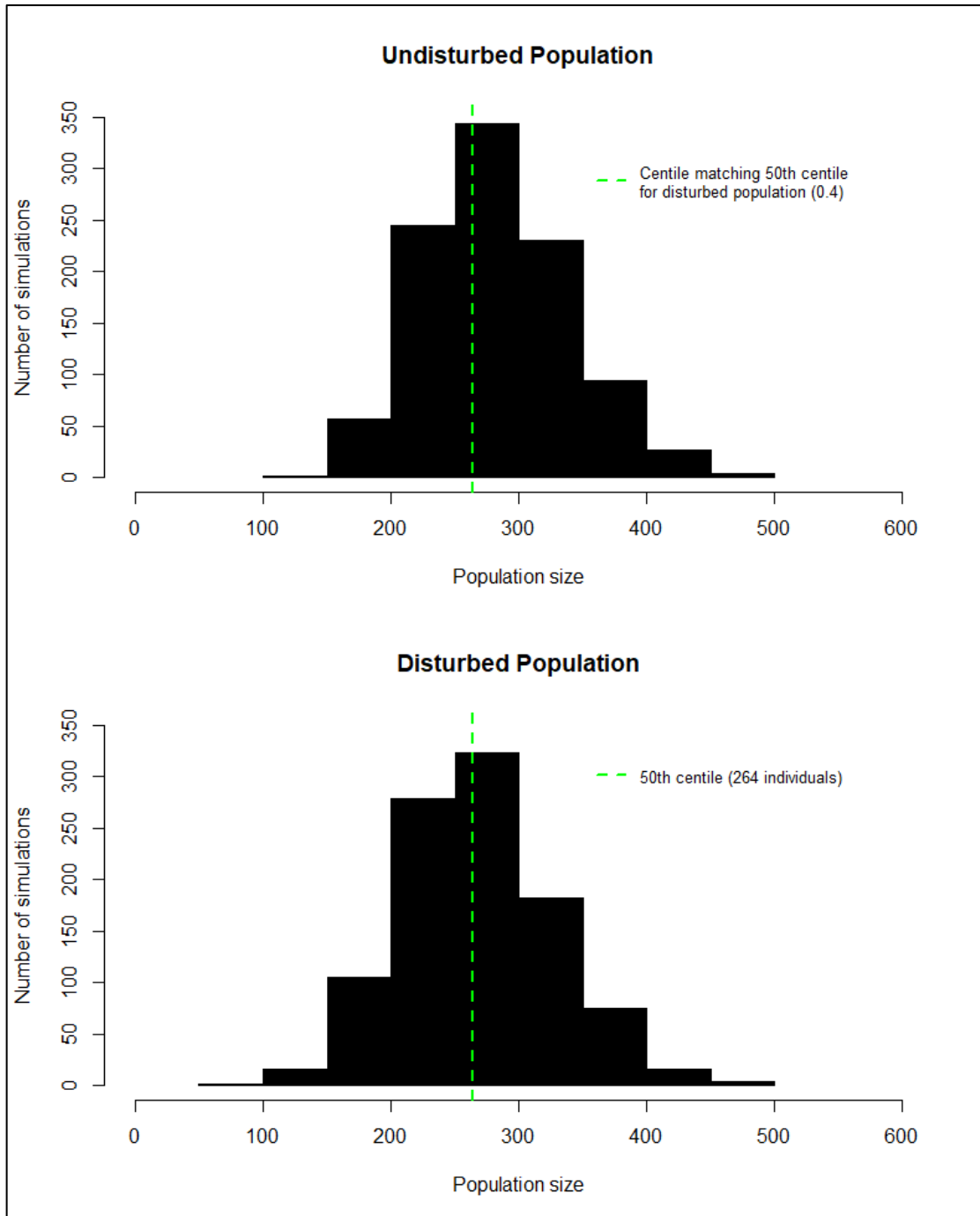
<sup>35</sup> Because the end population size of the disturbed population is expected to be less than that of the undisturbed population, this value is expected to be less than 0.5. A value of 0.5 indicates no impact on population size over the 25 year period modelled. This is the most sensitive of the three metrics presented. The distributions of population sizes for both the disturbed and undisturbed populations were also plotted as histograms.

Construction of five projects off the east coast of Scotland including piling <b>monopiles</b> at Inch Cape	Undisturbed	1.00	1.00	0.50	282
	Scenario F	1.00 (0.00)	1.00 (0.00)	0.41	268

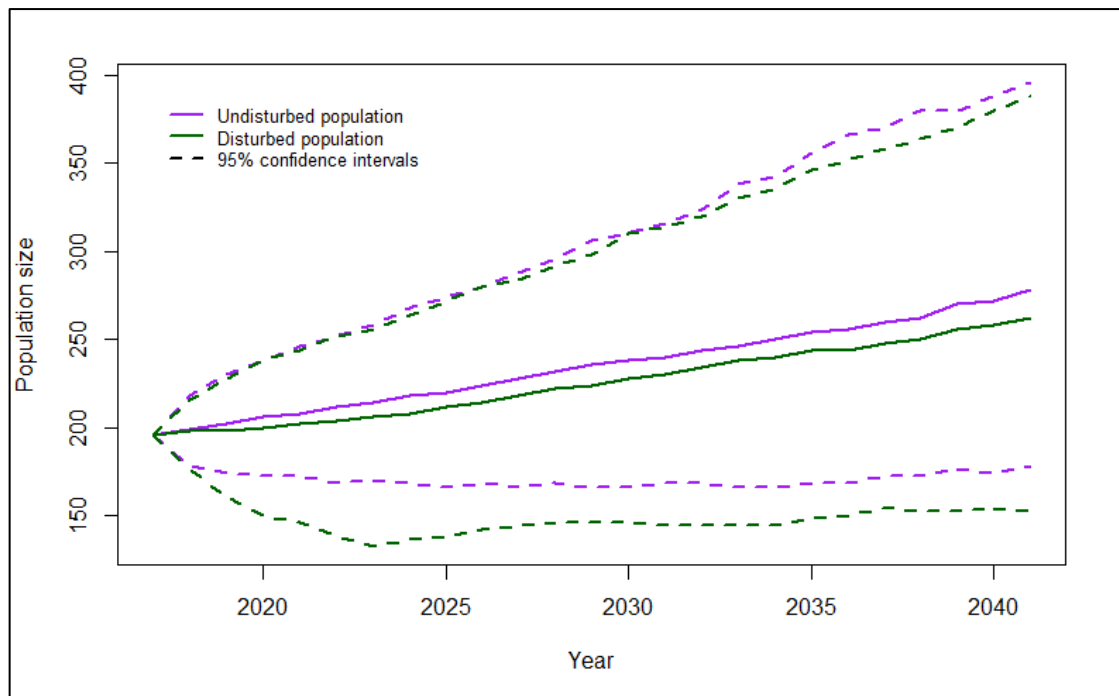
**Figure 10.43: Predicted bottlenose dolphin population growth over 25 years with no displacement (undisturbed population) and with displacement (disturbed population) associated with the construction of five projects off the east coast of Scotland including piling pin piles at Inch Cape (Scenario E)**



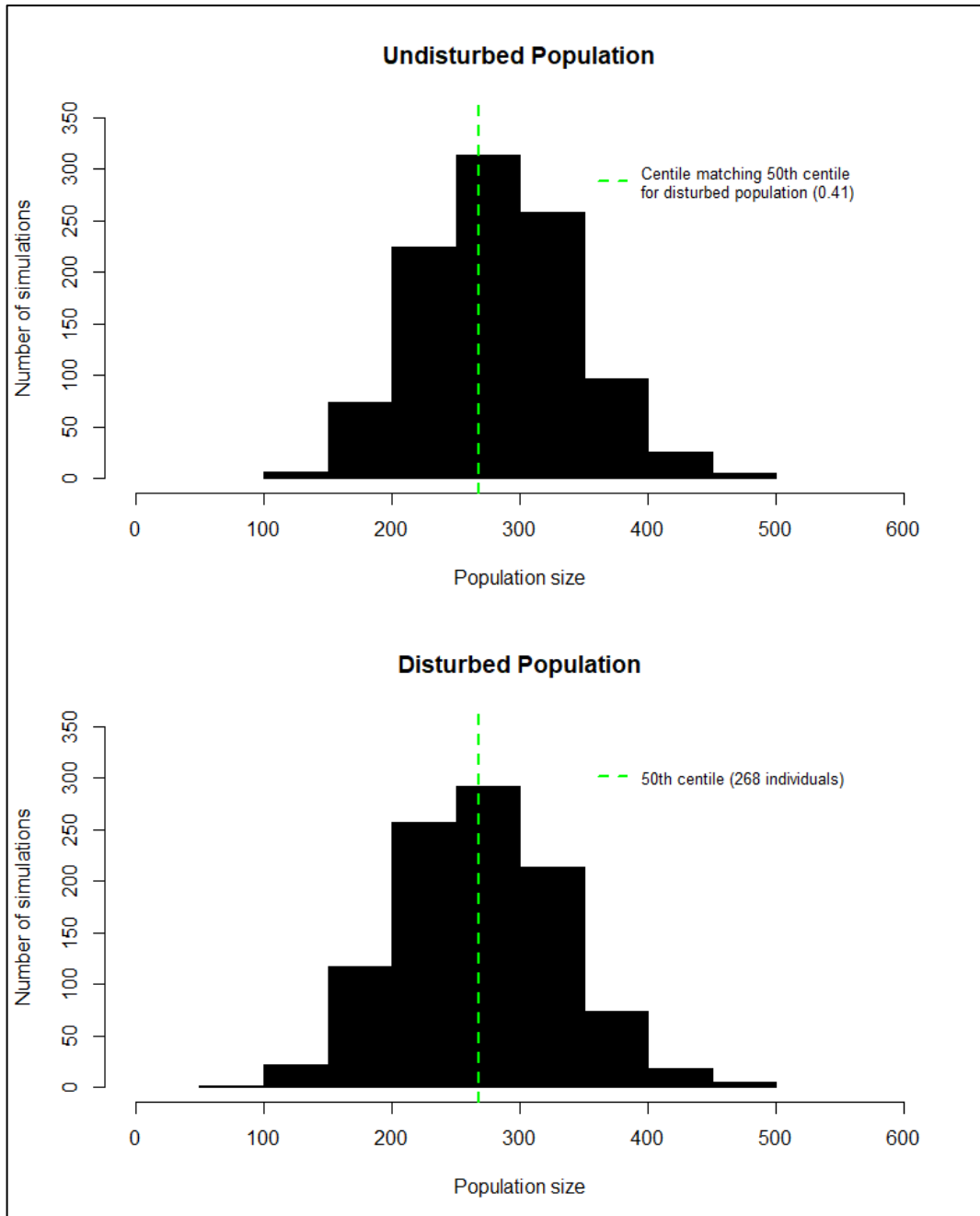
**Figure 10.44: Distribution of predicted bottlenose dolphin sizes after 25 years with no displacement (undisturbed population) and with displacement (disturbed population) associated with the construction of five projects off the east coast of Scotland including piling pin piles at Inch Cape (Scenario E)**



**Figure 10.45: Predicted bottlenose dolphin population growth over 25 years with no displacement (undisturbed population) and with displacement (disturbed population) associated with the construction of five projects off the east coast of Scotland including piling monopiles at Inch Cape (Scenario F)**



**Figure 10.46: Distribution of predicted bottlenose dolphin sizes after 25 years with no displacement (undisturbed population) and with displacement (disturbed population) associated with the construction of five projects off the east coast of Scotland including piling monopiles at Inch Cape (Scenario F)**



110 The findings of the CIA have been described in Table 10.32 below.

**Table 10.32: Findings of the CIA**

Project	Location	Details	Timescale	Potential effects on marine mammals	Significance	Justification
<b>Projects for which a quantitative cumulative assessment was carried out for bottlenose dolphins</b>						
Neart na Gaoithe OWF	Forth and Tay	54 WTGs (6-legged jackets with drilled and/ or piled foundations)	Piling in 2021	Displacement from piling  Disturbance from increased noise from geophysical survey systems	Minor	Bottlenose dolphin: Displacement from cumulative pile driving and blasting may affect the size and growth of the bottlenose dolphin population. However, the iPCoD outputs suggest that the size of this effect is likely to be small.  Other species: Revised noise modelling and use of the dose-response curve of Graham <i>et al.</i> (2017) have led to a substantial reduction in the number of individuals estimated to be impacted by PTS and displacement compared to the assessment used to inform the 2013 Inch Cape ES (ICOL, 2013), for which long-term cumulative effects of (piling) noise were considered to be minor for all species.
Beatrice OWF	Moray Firth	84 WTGs (4-legged jackets with piled foundations)	Under construction (piling undertaken in 2017)	Displacement from piling  Disturbance from increased noise from geophysical survey systems		
Moray East OWF	Moray Firth	Up to 137 WTGs (4-legged jackets with gravity base or piled foundations)	It is expected that offshore construction will take place in 2020 and 2021	Displacement from piling  Disturbance from increased noise from geophysical survey systems		

Project	Location	Details	Timescale	Potential effects on marine mammals	Significance	Justification
Aberdeen Harbour Expansion Project	Aberdeenshire	Construction of two breakwaters, quaysides and associated infrastructure  Large-scale capital dredge and sea disposal	Blasting in 2018	Disturbance due to underwater noise from blasting (piling has not been considered because a rotary bored cast-in-situ method will be used i.e. no impact piling)		
<b>Projects for which a qualitative cumulative assessment was carried out</b>						
Seagreen Phase 1 OWF	Forth and Tay	70-120 WTGs  Monopiles, pin-piled jackets, suction caisson jackets and gravity base structures are being considered	It is expected that offshore construction will begin in 2022 and take 36 months	Displacement from piling  Disturbance from increased noise from geophysical survey systems	Minor	The ML response will be temporary behavioural avoidance. The distance of the Seagreen site(s) to the coastal strip is greater than that of Inch Cape. Displacement from piling noise is likely to be substantially less than that predicted for Inch Cape <sup>36</sup> , and thus not considered likely to exert a detectable consequence upon the bottlenose dolphin population.

<sup>36</sup> It should be noted that no bottlenose dolphins were predicted to suffer displacement/PTS from piling (*Aberdeen Harbour Expansion Project AA*, 2016).

Project	Location	Details	Timescale	Potential effects on marine mammals	Significance	Justification
Moray West OWF	Moray Firth	Up to 90 WTGs Gravity base structures and/ or steel lattice jackets with pin piles or suction caissons and/ or suction caissons and/ or monopiles	It is anticipated that a phased installation process would begin in 2022	Displacement from piling Disturbance from increased noise from geophysical survey systems	Minor	The potential effects are likely to be similar to (or less than) those estimated for Moray East OWF. Although the projects are in close proximity, the ground conditions at Moray West are thought to be softer than those at Moray East. Although Moray West is situated closer to the coast (where bottlenose dolphins are primarily distributed), the PTS and displacement impacts for Moray East were estimated using methodologies which are now considered to be overly precautionary.
Aberdeen Bay OWF (also known as the European Offshore Wind Deployment Centre)	Aberdeenshire	Eleven WTGs (3-legged jackets with suction bucket foundations)	Under construction	Disturbance from increased noise from geophysical survey systems	Not significant	Unlikely (no or negligible levels of underwater noise predicted).
Hywind Scotland Pilot Park	Aberdeenshire	Five floating WTGs	Fully commissioned	Disturbance from increased noise from geophysical survey systems	Not significant	Unlikely (no or negligible levels of underwater noise predicted).

Project	Location	Details	Timescale	Potential effects on marine mammals	Significance	Justification
Kincardine OWF	Aberdeenshire	Seven floating WTGs	Consent authorised	Disturbance from increased noise from geophysical survey systems	Not significant	Unlikely (no or negligible levels of underwater noise predicted).
Forthwind Offshore Wind Demonstration Project	Forth	Two WTGs (jackets which form the tower as well as the foundation)	Consent authorised	Disturbance from increased noise from geophysical survey systems	Not significant	Unlikely (no or negligible levels of underwater noise predicted).

111 In summary, the cumulative assessment has identified no significant impacts from the Development in combination with any other plans/ projects:

- For four of the ten projects considered (Aberdeen Bay OWF, Hywind Scotland Pilot Park, Kincardine OWF and Forthwind Offshore Wind Demonstration Project), either no or negligible levels of underwater noise are predicted therefore the potential for a significant cumulative level impact is unlikely;
- For two of the ten projects considered (Seagreen Phase 1 OWF and Moray West OWF), the ML response will be temporary behavioural avoidance; and
- For four of the ten projects considered (NnG OWF, Beatrice OWF, Moray East OWF and Aberdeen Harbour Expansion Project), revised noise modelling and use of Graham *et al.* (2017)'s dose-response curve have led to a substantial reduction in the number of individuals estimated to be impacted by PTS and displacement compared to the assessment used to inform the 2013 Inch Cape ES (ICOL, 2013), for which long-term cumulative effects of (piling) noise were considered to be minor for all species. Displacement (from cumulative pile driving and blasting) may affect the size and growth of the bottlenose dolphin population however the size of this effect is likely to be small.

#### 10.11.2 Effects of Decommissioning

112 Only those offshore wind projects which were scoped in to the cumulative assessment for construction (see Table 10.31) have been considered here.

113 The potential effects of decommissioning WTGs and OSPs are considered to be equivalent to and potentially lower than those associated with the construction phase. This is because it is expected that underwater noise levels will be substantially lower during decommissioning than construction because decommissioning will not involve pile driving.

114 Should geophysical survey systems be required during decommissioning, the potential effects of decommissioning the Inter-array and Offshore Export Cables are considered to be equivalent to those associated with the construction phase.

115 The approach to decommissioning is described in *Chapter 7 (Section 7.12)*

### 10.12 Impact Interactions

#### 10.12.1 Development Alone

116 Marine mammals which have been temporarily displaced as a result of increased underwater noise from pile driving and/ or geophysical survey systems (see *Section 10.8.1*) will be unavailable to be impacted by other, more localised, potential impacts such as changes in prey availability, increased sediment in the water column, collision risk and accidental pollution events (see Table 10.3). There is therefore, little chance for animals to experience such localised impacts when displaced from the wider area, and therefore experience impact interactions with that of temporary displacement from underwater noise.

### 10.12.2 Cumulative with Other Projects

- 117 Other cumulative projects assessed either did not overlap temporally with the Development, or included piling within their Design Envelope. If piling was included in the Design Envelope, the assessment described in *Paragraph 151* applies. For projects that do not include piling within their Design Envelope, impacts are considered to be short-term, temporary, localised and within the coastal strip distant from the Development Area. Animals are more likely to use similar alternative habitat when at sea rather than congregate in development sites in estuaries where these projects tend to be located. There is therefore little chance for animals to experience impact interactions with that of temporary displacement from underwater noise from the Development.

### 10.13 Additional Mitigation

- 118 No additional mitigation is proposed.

### 10.14 Conclusion and Residual Effects

#### 10.14.1 Development Area

- 119 The residual effects, taking account of embedded mitigation (*Section 10.5.2*), from piling and use of geophysical survey systems at the Development are summarised in the bullets and Table 10.33 below:
- PTS from piling: The residual effects of PTS on all marine mammal species from piling at the Development are predicted to be of minor significance. This is because they are predicted to be medium term in duration (construction years) and low in magnitude (with mitigation less than ten per cent of the species' reference populations will be affected). In addition, the residual effects of PTS from piling at the Development are predicted to be less than those which were assessed as not significant in the 2013 Inch Cape ES (ICOL, 2013) and deemed acceptable for the 2014 Inch Cape Consent.
  - Displacement from piling: The residual effects of displacement on all marine mammal species from piling at the Development are predicted to be of minor significance. This is because they are predicted to be medium term in duration (construction years) and low in magnitude (with mitigation less than ten per cent of the species' reference populations will be affected). In addition, the residual effects of displacement from piling at the Development are predicted to be less than those which were assessed as not significant in the 2013 Inch Cape ES (ICOL, 2013) and deemed acceptable for the 2014 Inch Cape Consent.
  - Population level modelling: Displacement from pile driving at Inch Cape is unlikely to affect the size or growth of the bottlenose dolphin population off the east coast of Scotland. While displacement from pile driving/blasting at the cumulative projects may affect the size and growth of the bottlenose dolphin population off the east coast of Scotland, the outputs from iPCoD suggest that the size of this effect is likely to be small. The precision of estimates from the current monitoring programme for this population

(and other similar populations) suggest that an effect of this size is unlikely to be detectable.

- PTS from increased noise from geophysical survey systems: The residual effects of PTS on all marine mammal species from use of geophysical survey systems at the Development are predicted to be of minor significance. This is because they are predicted to be medium term in duration (construction years) and low in magnitude (with mitigation no animals, i.e. less than ten per cent of the species' reference populations, will be affected).
- Disturbance from increased noise from geophysical survey systems: The residual effects of disturbance on all marine mammal species from use of geophysical survey systems at the Development are predicted to be of minor significance. This is because they are predicted to be medium term in duration (construction years) and low in magnitude (less than ten per cent of the species' reference populations will be affected).
- In terms of mitigation, current best practice will be used; at the moment this is adoption of the JNCC guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC, 2017) i.e. pre-work searches to ensure that no marine mammals are present within the zone of potential effect when work commences and the use of soft starts where possible (i.e. if equipment specifications allow).

120 It should be noted that an EPS Risk Assessment for all envisaged activities associated with the construction of the Development will be conducted to determine whether an EPS licence will be required (in relation to the potential for disturbance). Current guidance will be used; at the moment this is the Marine Scotland and SNH guidance for Scottish inshore waters (Marine Scotland and SNH, 2014). The following activities will be assessed: Piling; use of geophysical survey systems.

**Table 10.33: Summary of effects – Development Area**

Impact	Receptor	Effect
<b>Construction (&amp; Decommissioning)</b>		
Displacement/ PTS from piling	All marine mammals	Minor
Disturbance from increased noise from geophysical survey systems	All marine mammals	Minor

#### 10.14.2 Offshore Export Cable Corridor

121 In summary, the residual effects, taking account of embedded mitigation (*Section 10.5.2*), of PTS and disturbance on all marine mammal species from increased noise from geophysical survey systems used within the Offshore Export Cable Corridor are predicted to be of minor significance (see also Table 10.34 below).

122 It should be noted that an EPS Risk Assessment for all envisaged activities associated with the construction of the Development will be conducted to determine whether an EPS licence will

be required (in relation to the potential for disturbance due to the sound emitted by some systems). Current guidance will be used; at the moment this is the Marine Scotland and SNH guidance for Scottish inshore waters (Marine Scotland and SNH, 2014).

**Table 10.34: Summary of effects – Offshore Export Cable Corridor**

Impact	Receptor	Effect
<b>Construction (&amp; Decommissioning)</b>		
Disturbance from increased noise from geophysical survey systems	All marine mammals	Minor

#### 10.14.3 Cumulative Impacts

- 123 In summary, the cumulative assessment has identified no significant impacts from Inch Cape in combination with any other plans/ projects.

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