MAINSTREAM RENEWABLE POWER

Neart na Gaoithe Offshore Wind Farm Addendum of Supplementary Environmental Information Marine Mammals Appendix 1: Habitats Regulations Appraisal (Marine Mammal Special Areas of Conservation)

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1 Introduction and Scope of Document

1 This document presents a verification of information on potential impacts on sites of nature conservation importance for bottlenose dolphins, harbour and grey seals from the proposed Neart na Gaoithe offshore wind farm. This has been produced following initial comments and feedback from Marine Scotland Licensing Operations Team (MS-LOT), Scottish Natural Heritage (SNH, e.g., SNH, 2012), Whale and Dolphin Conservation Society (WDCS, 2012) and others, and updates Chapter 11 of the project's original Environmental Statement, submitted to MS-LOT supporting the project's application for consent in July 2012. Furthermore, this document verifies the conclusions made in the July 2012 Environmental Statement (ES), specifically Chapter 11, given the availability of a third year of survey data.

2 This document provides clarification on a number of points to inform HRA and/or an Appropriate Assessment (AA) for Special Areas of Conservation with marine mammal qualifying features (marine mammal SACs), a requirement for the project given the potential connectivity between the project and marine mammal SACs.

2 Legislative and Policy Context

3 Within the EU the key international legislative measures requiring the protection of rare and at-risk habitats and species are the Birds Directive (Directive 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds) and the Habitats Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, as amended). These Directives are intended to fulfil the EU's commitment to international conventions and provide a framework for the designation of a network of protected sites for species and features across all EU member states, known as the 'Natura 2000 network'.

4 Species of nature conservation interest not benefitting from protection within the Natura 2000 network but listed within Annex IV of the Habitats Directive receive a different level of protection; these are known as European Protected Species (EPS).

5 Within Scottish Territorial Waters (STW) the transposing legislation for the Habitats and Birds Directives are the Wildlife and Countryside Act 1981 (as amended), the Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) (the Habitats Regulations) and the Nature Conservation (Scotland) Act 2004.

6 The Habitats Regulations allow for the designation of Natura 2000 areas: Special Areas of Conservation (SACs) which act to protect ecologically vulnerable or valuable habitats and Special Protection Areas (SPAs) for sites which are considered important for bird populations. Under these regulations, the Joint Nature Conservation Committee (JNCC) is responsible for the designation of marine SACs and SPAs beyond 12 nautical miles (NM) and SNH is responsible for marine sites within 12 NM as well as terrestrial sites.

7 The Habitats Regulations implement the Habitats Directive in Scottish Territorial Waters (STW). The Regulations require the competent authority to carry out a Habitats Regulations Appraisal if a project is likely to have a significant effect on a Natura 2000 site. If this is so, then it is required to assess the likelihood of a significant adverse effect on the site's ecological integrity occurring, by carrying out an AA. If the AA finds that such a significant adverse effect is likely to arise then consent for such a project must, other than in exceptional circumstances, be refused.

8 HRA applies to any plan or project with the potential to affect the qualifying interests of a Natura 2000 site, and subsequently, the conservation objectives and integrity of the site. The competent authority, Marine Scotland, has been advised by SNH that an HRA is required for the Neart na Gaoithe project (see SNH, 2010).

9 The requirement for HRA at a project level is further outlined in the Scottish Government's Plan for offshore wind development in territorial waters ('*Blue Seas - Green Energy: A Sectoral Marine Plan for Offshore Wind Energy in Scottish Territorial Waters',* see Marine Scotland, 2011a; 2011b; and 2011c), which also had an accompanying plan-level HRA.

10 SNH (2010) advises that the Conservation (Natural Habitats &c.) Regulations 1994 (as amended) require the competent authority to (from SNH, 2010):

- Determine whether the proposal is directly connected with or necessary to site management for conservation;
- Determine whether the proposal is likely to have a significant effect on the site either individually or in combination with other plans or projects; and
- If so, then make an AA of the implications (of the proposal) for the site in view of that site's conservation objectives. A plan or project can only be consented if it can be ascertained that it will not adversely affect the integrity of a Natura 2000 site (subject to Regulation 49 considerations).

11 The Habitats Regulations require that where a project (or plan) could affect a Natura 2000 site (or its qualifying interests) then the competent authority must consider whether the plan or project is likely to give rise to a significant effect, and if so, make an AA of the implications of the project in view of the site's conservation objectives. This process is known as HRA in the UK, or more widely as an Article 6 Assessment (European Commission (EC), 2002). Marine Scotland, as the competent authority for offshore wind farm developments in Scottish Territorial Waters (STW), and the Scottish Government's statutory nature conservation advisers - Scottish Natural Heritage (SNH) - have confirmed that a project level HRA is required (Marine Scotland, 2011a; 2011b; SNH, 2010).

12 The potential significant impacts of the proposed Neart na Gaoithe offshore wind farm development upon these sites, qualifying features and nature conservation objectives have been assessed and information is summarised in this document as information to inform assessment by the competent authority.

3 The Proposed Development

13 The revised design envelope is described in the Addendum of Supplementary Environmental Information (to which this report is appended). A number of wind turbine design scenarios are currently being considered ranging between 90 5 MW turbines to 73 6.15 MW turbines. For the purposes of this assessment the worst-case scenario is considered to be the installation of 90 5 MW turbines as this will likely have the longest construction period estimated to be over a period of two years and involve the most number of piling operations.

14 The duration of each installation varies depending on the whether the turbines will be installed using piling only ('Drive only') or whether there is a combination of piling and drilling ('Drill-drive-drill'). The most significant impact on marine mammals predicted to occur arises from piling operations. Both installation techniques require piling, although the differences in the duration of piling are slight with the 'Drive only' scenario taking an estimated time of 14.4 hours and the 'drill-drive-drill' scenario taking 13.3 hours (Table 3.1 and Table 3.2). The proportion of time piling occurs during the 'Drive only' scenario is 22% for each turbine compared to 7.0% for 'drive-drill-drive' scenario.

15 For the purposes of this assessment the 'Drive only' scenario is predicted to be the worst-case scenario from the perspective of a significant noise impact. Although overall the installation of a turbine using a 'drill-drive-drill' scenario does take longer, the overall level of noise is lower.

16 It is estimated that the construction of the Neart na Gaoithe offshore wind farm will take two years during which piling operations will occur over a period on 1,296 hours (54 days). Over the course of two years piling will be occurring for approximately 7.3% of the time and for 92.7% of the time there will be no piling taking place.

Table 3.1: 'Drive-drill-drive' scenario predicted piling duration for each jacket foundation with drilling requirements.

Activity	Action	Hours	Hours	Action
Preparation	Move jack-up on position	8	20	Pre-piling
	Lowering and levelling template on position	6		
Pile 1	Position first pile and install hammer	6		
	Hammer 1 pile 1	2	2	Virgin pile drive
	Remove hammer and install drill	4	26.5	Preparation and drilling
	Perform drilling operations	19.5		
	Trip out drill string	3		
	Hammer 2 pile 1	1.3	1.3	Drive after drill
	Remove hammer	3	9	Preparation
Pile 2	Position second pile and install hammer	6		
	Hammer 1 pile 2	2	2	Virgin pile drive
	Remove hammer and install drill	4	26.5	Preparation and drilling
	Perform drilling operations	19.5		
	Trip out drill string	3		
	Hammer 2 pile 2	1.3	1.3	Drive after drill
	Remove hammer	3	9	Preparation
Pile 3	Position third pile and install hammer	6		
	Hammer 1 pile 3	2	2	Virgin pile drive
	Remove hammer and install drill	4	26.5	Preparation and drilling
	Perform drilling operations	19.5		
	Trip out drill string	3		
	Hammer 2 pile 3	1.3	1.3	Drive after drill

Activity	Action	Hours	Hours	Action
	Remove hammer	3	9	Preparation
Pile 4	Position fourth pile and install hammer	6		
	Hammer 1 pile 4	2	2	Virgin pile drive
	Remove hammer and install drill	4	26.5	Preparation and drilling
	Perform drilling operations	19.5		
	Trip out drill string	3		
	Hammer 2 pile 4	1.3	1.3	Drive after drill
	Remove hammer	3	3	Preparation
Potential delay	Estimated weather delay	20	20	-
Total duration – 189.33 hrs **Total duration piling – 13.3 hrs** **Total duration preparation – 156 hrs**				

Table 3.2: 'Drive only' scenario predicted piling duration without drilling requirements.

Activity	Action	Hours	Hours	Action
Preparation	Move jack-up on position	8	20	Preparation
	Lowering and levelling template on position	6		
Pile 1	Position first pile and install hammer	6		
	Hammer 1 Pile 1	3.6	3.6	Virgin pile drive
	Remove hammer	3	9	Preparation
Pile 2	Position second pile and install hammer	6		
	Hammer 1 Pile 2	3.6	3.6	Virgin pile drive
	Remove hammer	3	9	Preparation
Pile 3	Position third pile and install hammer	6		
	Hammer 1 Pile 3	3.6	3.6	Virgin pile drive
	Remove hammer	3	9	Preparation
Pile 4	Position fourth pile and install hammer	6		
	Hammer 1 Pile 4	3.6	3.6	Virgin pile drive
	Remove hammer	3	3	Preparation
Total duration – 64.4 hrs **Total duration piling – 14.4 hrs** **Total duration preparation – 50 hrs**				

4 HRA Approach

4.1 Introduction

17 Information to inform the HRA process was presented in the project ES, Chapter 11: Nature Conservation, as submitted to MS-LOT and its advisers in July 2012. The approach to HRA remains as presented in the project ES.

4.2 Habitats Regulations Appraisal Screening for SACs

18 Screening for SACs that may have connectivity with the proposed development has been undertaken by SNH, who have provided a list of sites and information on likely effects that required consideration under HRA (SNH, 2010). A screening assessment was also undertaken within the ES and identified the sites with qualifying features that could be impacted by the proposed development. These have been taken forward in this assessment.

19 The screening assessment did not identify that the project will cause a likely significant effect on qualifying habitats and therefore no further assessment has been undertaken on impacts on qualifying habitats in SACs that are otherwise considered in this assessment for their qualifying species.

4.2.1 Summary of Sites, Habitats and Species Screened into the Habitats Regulations Appraisal

20 Screening for Special Areas of Conservation (SACs) that may have connectivity with the proposed development has been undertaken by SNH, who have provided a list of sites and information on likely effects that required consideration under HRA (SNH, 2010) (Figure 4.1 and Table 4.1).

21 The relevant sites identified by SNH have qualifying features including migratory species that have the potential to be affected by the project (see SNH, 2010).

4.3 In-Combination Effects on Screened-In SACs

22 Other projects or plans have the potential to affect qualifying features of SACs in combination with potential impacts arising from Neart na Gaoithe. The plans and projects assessed as having potential to impact in combination with the Neart na Gaoithe project are those advised by SNH (2010) and in the Blue Seas - Green Energy HRA AA Information Review (Marine Scotland, 2011c) for each SAC and relevant qualifying feature.

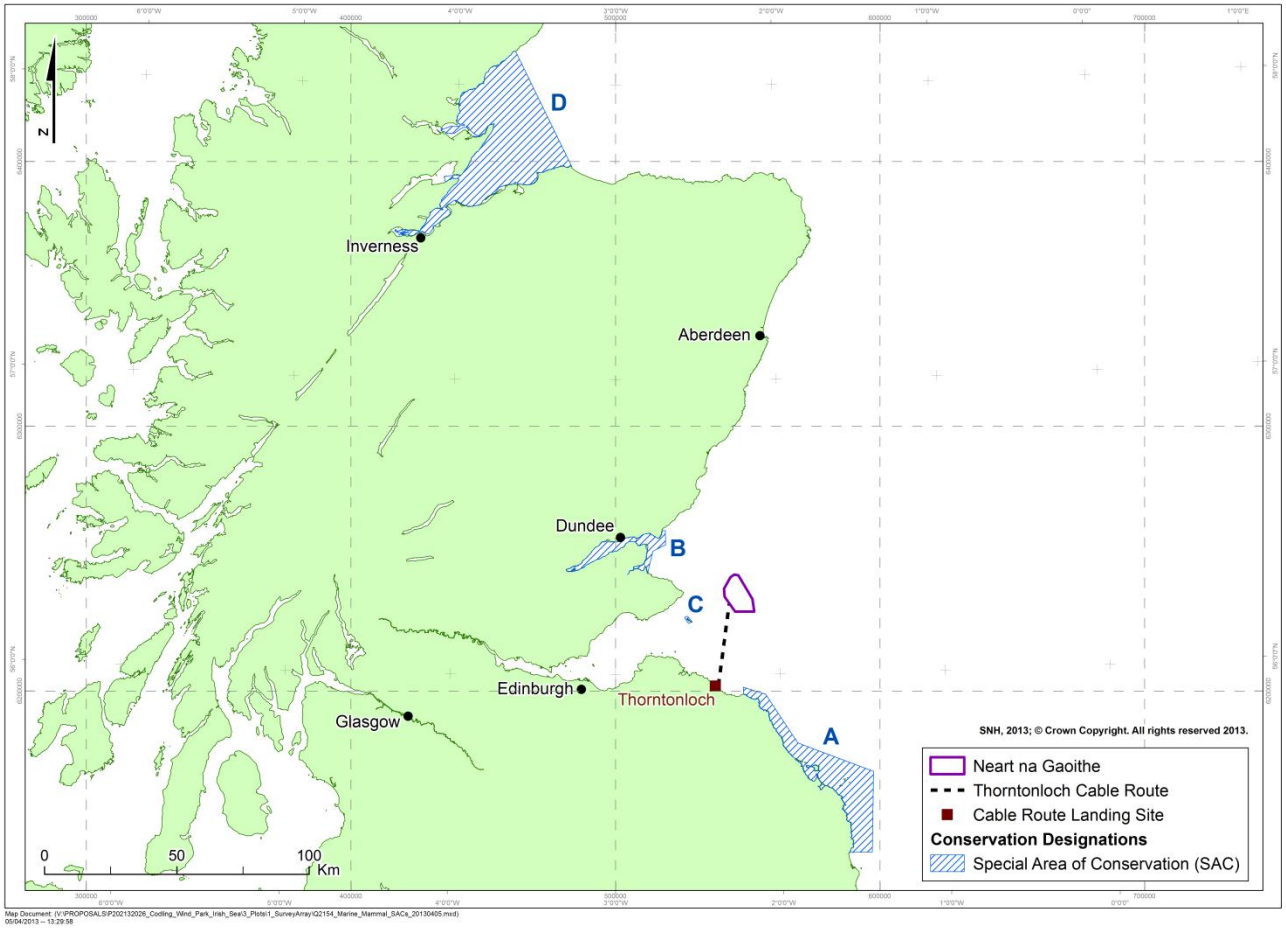

Figure 4.1: Marine mammal SACs with connectivity to the Neart na Gaoithe site (Source: SNH, 2010).

Table 4.1: Marine mammal SACs near the Neart na Gaoithe offshore works area with potential for connectivity given future development of the site, including connecting features (Sources: JNCC, 2011; SNH, 2010).

Figure code	SAC	Site description and reasons for designation (qualifying and other)		Qualifying features with connectivity to Neart na Gaoithe (as advised by SNH, 2010)
		Habitats	Species	
A	**Berwickshire and North Northumberland Coast SAC**	*Annex I qualifying habitats:* Sea inlets; Tidal rivers; Estuaries; Mudflats and sandflats not covered by seawater at low tide; Reefs and sea caves; Lagoons; and Several coastal/terrestrial habitats including salt marshes, pastures, steppes, dunes, sea cliffs and machair.	*Annex II qualifying species* Grey seal *Halichoerus grypus*	Grey seal *H.grypus*
B	**Firth of Tay and Eden Estuary SAC**	*Annex I qualifying habitats:* Estuaries *Other Annex I habitats:* Sandbanks which are slightly covered by sea water all the time; and Mudflats and sandflats not covered by seawater at low tide.	*Annex II qualifying species* Common seal *Phoca vitulina*	Common seal *P. vitulina*
C	**Isle of May SAC**	*Other Annex I habitats:* Reefs	*Annex II qualifying species:* Grey seal *H. grypus* (noted as largest east coast breeding colony in Scotland, 4th largest in the UK)	Grey seal *H. grypus*
D	**Moray Firth SAC**	*Other Annex I habitats:* Sandbanks which are slightly covered by seawater all the time	*Annex II qualifying species:* Bottlenose dolphin *Tursiops truncatus* (noted as the only resident population in the North Sea)	Bottlenose Dolphin *T. truncatus*

5 Summary of Information to Support Appropriate Assessment

23 For the purposes of Habitats Regulations Appraisal, the following section summarises the assessed impacts (LSEs) for marine mammal SACs and their qualifying features and forms the basis of the information to inform an AA.

5.1 Conservation Objectives

24 The HRA has to be carried out in light of the best scientific knowledge in the field, the conservation objectives of the Natura 2000 site and the potential impact on the integrity of the site (EC, 2010). Consequently, the conservation objectives of each site must be known in order to undertake an assessment.

25 The conservation objectives for Scottish SACs are generic across all sites and are for those with qualifying species:

'To avoid deterioration of the habitats of the qualifying species (listed below) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features'; and

'To ensure for the qualifying species that the following are maintained in the long term:

- Population of the species as a viable component of the site;
- Distribution of the species within site;
- Distribution and extent of habitats supporting the species;
- Structure, function and supporting processes of habitats supporting the species; and
- No significant disturbance of the species.'

5.2 Summary of Likely Significant Effects on Screened-In SACs

26 Given the screening undertaken above and advice from SNH (2010), and as outlined in the project ES of July 2012, the following effects have been considered in appraising possible impacts on marine mammal SACs:

- Noise from piling installation for wind turbine jacket foundations;
- Noise from drilling installation wind turbine jacket foundations;
- Noise from vessels during construction & installation, operation & maintenance, decommissioning;
- Presence of vessels during construction/installation and operation/maintenance;
- Electro-magnetic Fields (EMF) from subsea cables; and
- Effects arising in-combination with those from other plans or projects.

5.3 Summary of Screened-In SAC Features / Species and Vulnerabilities

27 This section provides overview information on relevant species, including information on their background ecology and population, as well as their sensitivities and vulnerabilities to the effects outlined above.

5.3.1 Bottlenose Dolphin

28 No bottlenose dolphins were recorded during the three years of the site specific surveys.

29 Bottlenose dolphin has a localised distribution in the UK with two recognised areas of particular concentrations: in Cardigan Bay off west Wales and the Moray Firth in northeast Scotland. Populations are

thought to be largely resident with some localised movements between populations, particularly along the east coast of Scotland (Reid *et al.,* 2003).

30 In Scotland, bottlenose dolphins occur widely along the east coast between the Moray Firth and the Firth of Forth and to a lesser extent along the west coast (refer to Figure 5.1). Bottlenose dolphin is a qualifying species of the Moray Firth SAC.

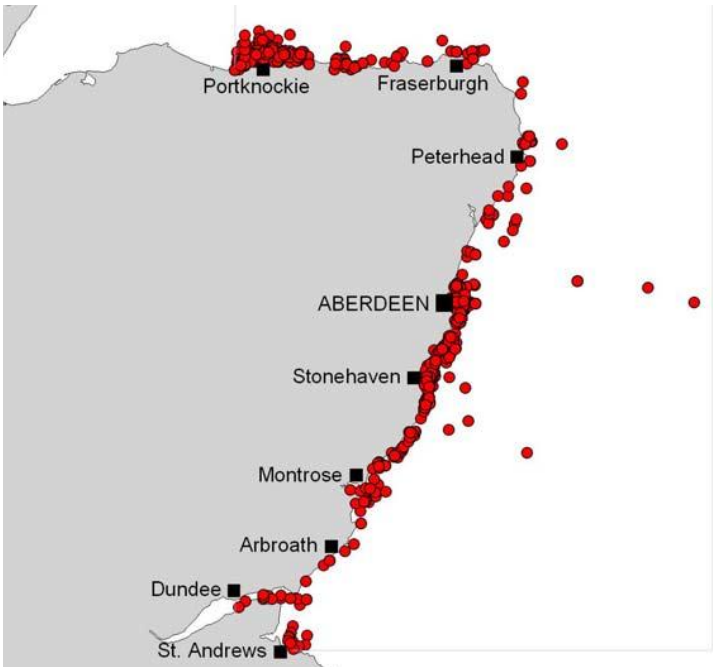

Figure 5.1: Distribution of bottlenose dolphin in East Grampian (Source: Anderwald and Evans, 2010).

31 Bottlenose dolphins are known to occur within the Firth of Tay area. Using photo identification techniques it is recognised that many, if not all, the bottlenose dolphins occurring in the Firth of Tay area are associated with those that occur to the north, along the east coast of Scotland and the Moray Firth including within the SAC (Quick and Cheney, 2011). They are also known to occur, at least occasionally, in the Firth of Forth, but due to the lack of studies carried out in the area, their distribution and abundance in the Firth of Forth are unclear.

32 The main prey items for bottlenose dolphins in the Moray Firth have been reported to be cod, saithe and whiting with some salmon, haddock and cephalopods (Santos *et al*., 2001).

33 The estimated population of bottlenose dolphins in the Moray Firth and the east coast of Scotland is 195 individuals (range 162-253) of which, based on surveys undertaken in 2003, between 81 and 142 bottlenose dolphins might occur in the Tay area (Cheney *et al*., 2012; Quick and Cheney, 2011; Thompson *et al.,* 2011a).

34 Surveys undertaken between 2003 and 2004 and again in 2009 and 2010 indicate that the bottlenose dolphins occurring in the Tay area do so largely within coastal waters and rarely occur far offshore with the majority of sightings within a few kilometres of the coast , Quick and Cheney, 2011). This type of largely coastal distribution matches findings in the Moray Firth where the majority of sightings there are also in inshore coastal waters (Thompson, 2011).

35 Based on data obtained from T-pods placed at two locations near Arbroath and Fife Ness, dolphins occur in the region throughout the year (See Figure 5.2 and Figure 5.3). Over the deployment period in 2007 and 2008, dolphins were detected on 24% of days in Arbroath and 18% of days in Fife Ness. However, both these sites show lower detection rates in comparison with a core site in the SAC (the mouth of the Cromarty Firth) where dolphins were detected on over 70% of days over the same time period (Thompson *et al.,* 2011b). Although, in Fife Ness there was no inter-annual differences in the number of days of

detections between 2007 and 2008 (the years with most data), in Arbroath there were significantly more days with dolphin detections in 2008 (Quick and Cheyney 2011).

36 Although dolphins were detected in Arbroath and Fife Ness on a high proportion of days each year, the time spent in these areas was relatively low, with no difference between the two sites. On the days that dolphins were detected, they were recorded for a median of one hour (range 1-4 hours in 2007 and 1-5 hours in 2008 in Arbroath, and 1-5 hours in 2007 and 2008 in Fife Ness). In comparison, within the core of the Moray Firth SAC (at the mouth of the Cromarty Firth), dolphins were recorded for a median of 4 hours per day, on the days they were detected (range 1 to 16 hours) over the same time period. This suggests that although dolphins regularly visit Arbroath and Fife Ness they do not spend long periods in these areas and may simply be travelling through each area (Quick and Cheyney 2011).

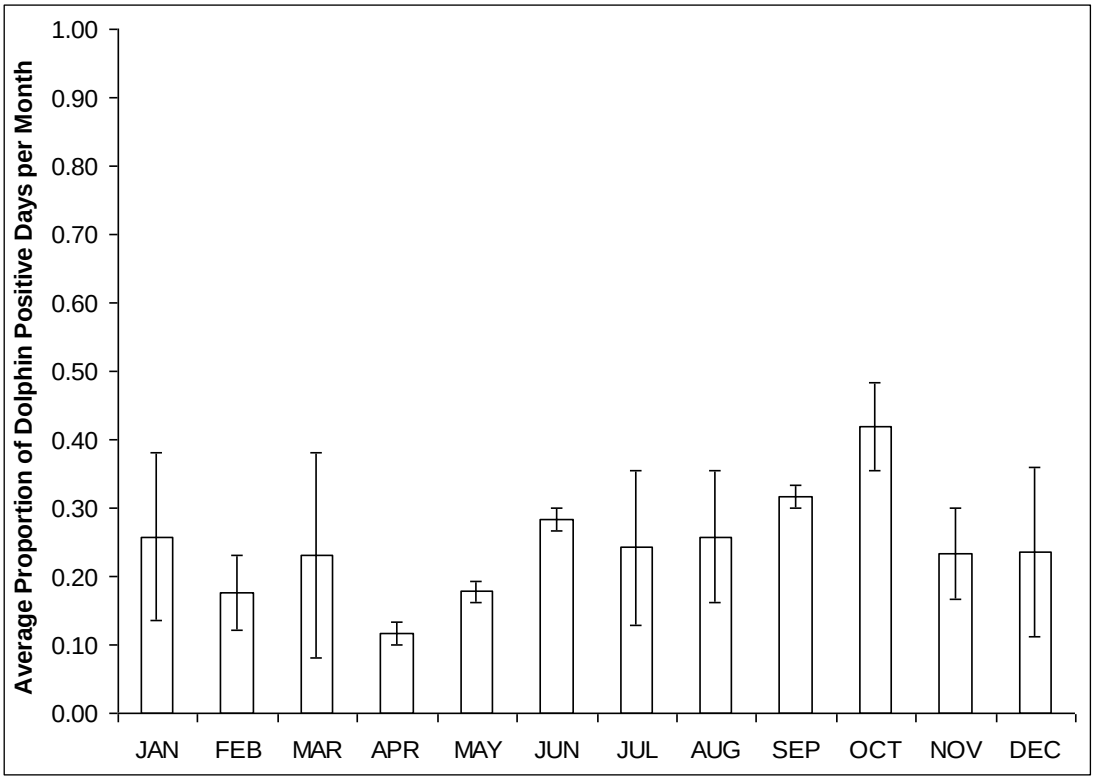

Figure 5.2: The average proportion of dolphin positive days in each month (+/- SE) for T-pod sites at Arbroath for the entire T-pod deployment period (Source: Quick and Cheney, 2011).

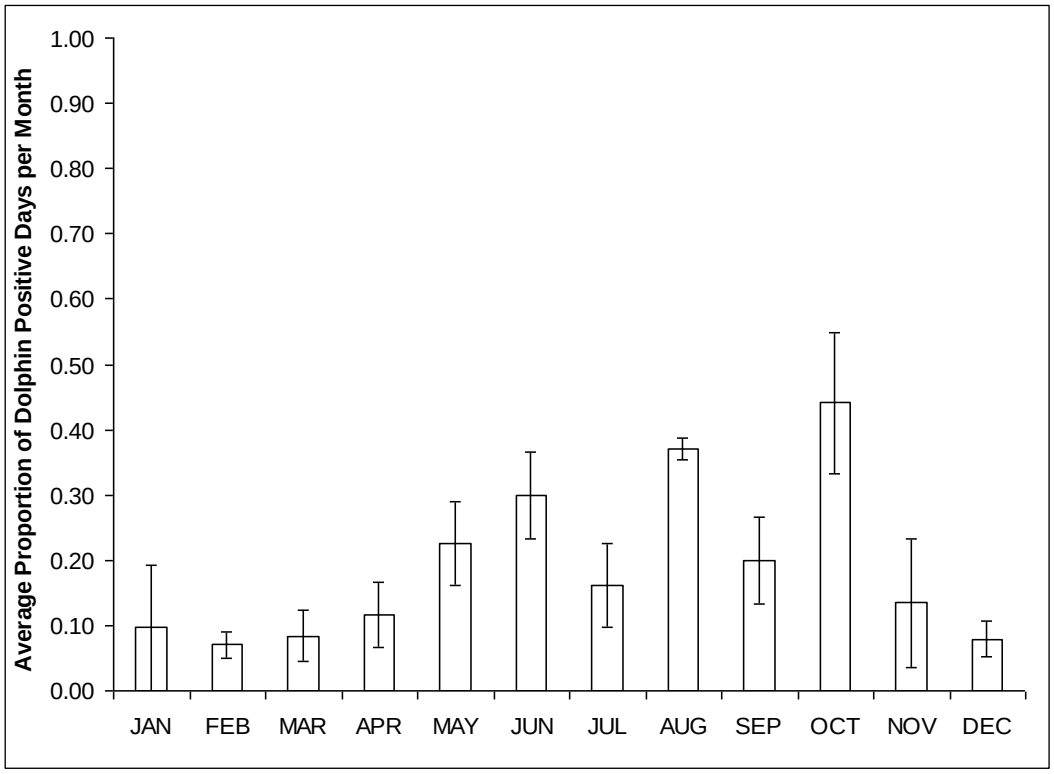

Figure 5.3: The average proportion of dolphin positive days in each month (+/- SE) for T-pod sites at Fife Ness for the entire T-pod deployment period (Source: Quick and Cheney, 2011).

5.3.2 Harbour Seal

37 Harbour seals were infrequently recorded from site specific surveys undertaken over three years. A total of six harbour seals were recorded Year 1, 17 in Year 2 and 18 in Year 3 (See Table 5.1).

Table 5.1: Number of harbour seals recorded within the offshore site and buffer zone from three years of site specific surveys.

Species	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Year 1: offshore site	1	1	0	0	0	0	0	0	0	0	0	0	**2**
Year 1: buffer	1	2	0	1	0	0	0	0	0	0	0	0	**4**
Year 2: offshore site	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Year 2: offshore site	0	0	2	1	1	3	4	2	0	2	0	2	**17**
Year 3: offshore site	2	0	0	0	0	0	1	0	0	0	0	0	**3**
Year 3: offshore site	2	0	1	4	0	3	2	0	1	1	1	0	**15**
Monthly total	6	3	3	6	1	6	7	2	1	3	1	2	41

38 The Year 3 data verifies the results from Years 1 and 2, with similar low numbers of harbour seals recorded; a total of 18 across the year. Lowest numbers across all three years occurred between June and October, with marginally higher numbers during the winter months. However, no more than four harbour seals were recorded during any one survey with numbers overall low and the difference between months being just two or three individuals (Figure 5.4).

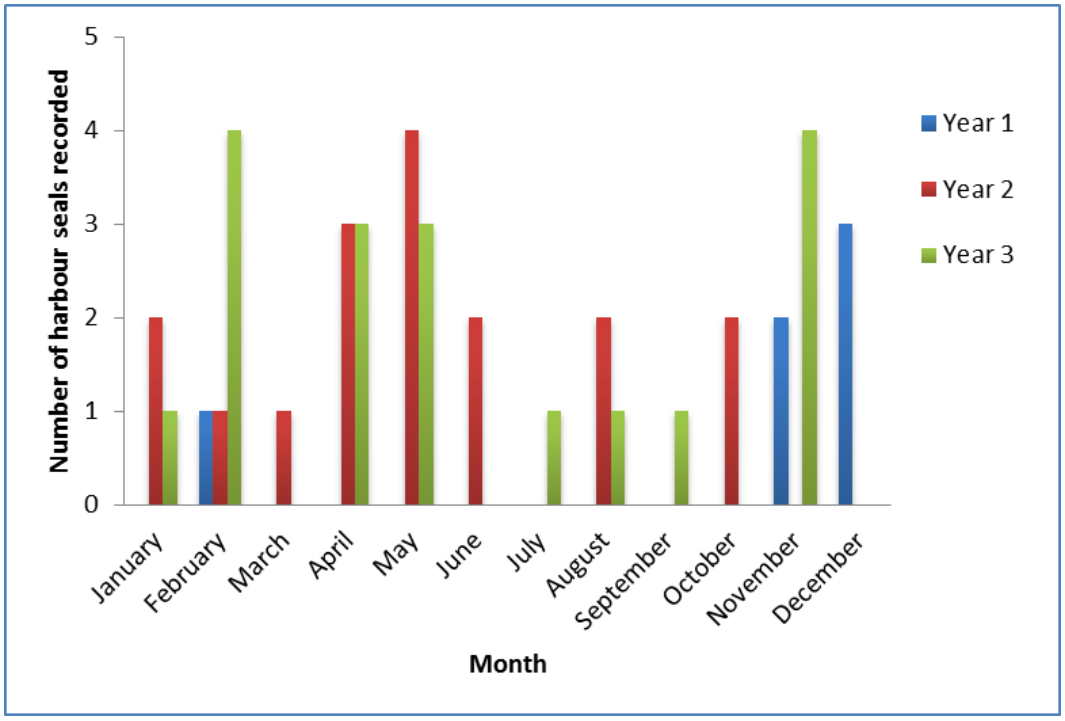

Figure 5.4: Total number of harbour seals recorded from boat-based surveys across three years of surveys.

39 In Scotland harbour seals are widespread around the west coast, the Hebrides and Northern Isles. On the east coast they are present in the Firth of Tay and Moray Firth area and further south to The Wash. Most harbour seals in southeast Scotland haul-out along the Angus, Fife and Lothian coasts, which hold approximately 2% of the UK population (Sparling *et al.,* 2011). Since 1997 there has been a wide spread decline in the number of harbour seals in the UK with significant reductions at most haul-out sites. In the region overall numbers recorded have decreased from 749 to 487 individuals between 1997 and 2007.

40 The Firth of Tay and Eden Estuary SAC lies approximately 30 km from the proposed development. As with most harbour seal sites, it has recorded a decrease in the number of harbour seals present, with a 84% decrease in the population between 2000 and 2012 (Table 5.2).

Table 5.2: The number of harbour seals in the Firth of Forth and Eden Estuary SAC since 2000 (Source: Sparling et al., 2011).

Site	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010
Eden Estuary	267	341	93	78	88	90	99	83	22	36
Abertay and Tentsmuir point	153	167	53	126	53	34	32	50	8	9
Upper Tay	115	51	83	134	85	91	62	49	45	41
Broughty Ferry and Buddon Ness	165	109	232	121	97	127	68	40	36	38
Firth of Tay and Eden Estuary SAC total	**700**	**668**	**461**	**459**	**323**	**342**	**261**	**222**	**111**	**124**

41 Since the submission of the ES, further data on the population of harbour seals in the Firth of Forth and Eden Estuary have been published and have reported a count of 77 individuals in August 2011 (Duck & Morris 2012).

42 Based on the current population decline, and assuming a future exponential decline in the Firth of Tay and Eden Estuary population, the harbour seal population has the potential to be close to extinction in the next ten years. If the decline is linear then the population will decrease at a significantly greater rate (Figure 5.5). The cause of the decline in the harbour seal population is unknown.

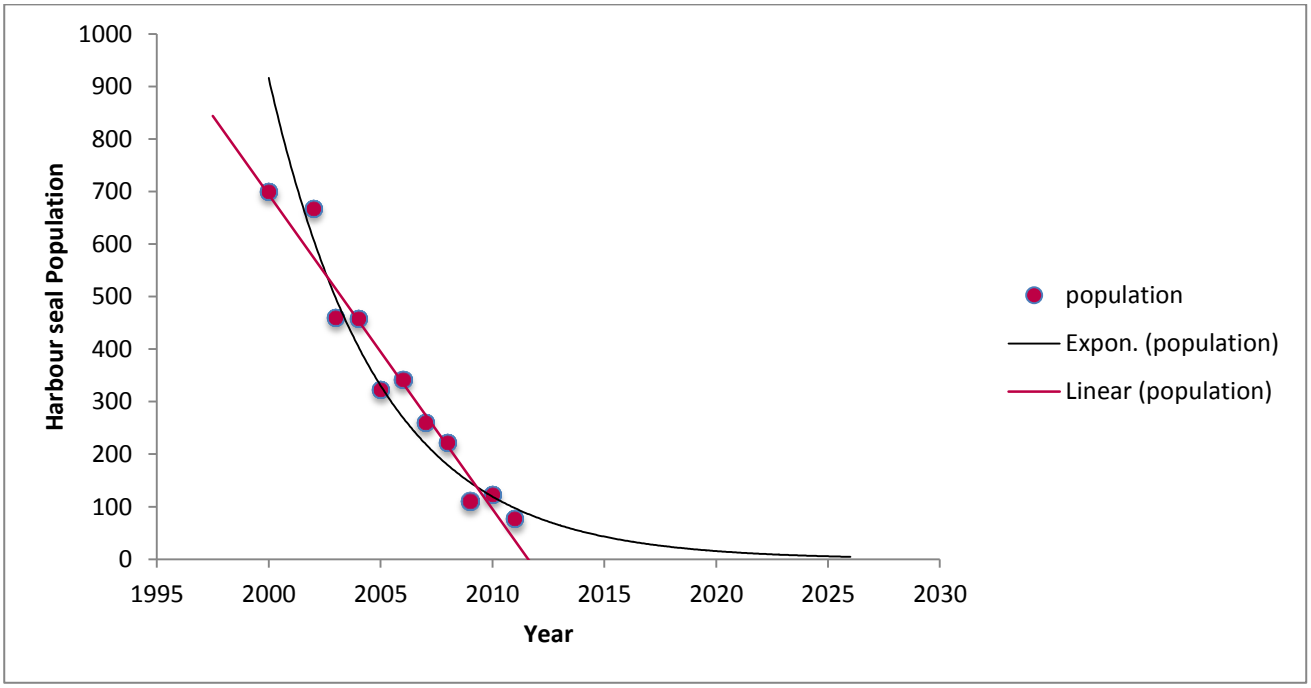

Figure 5.5: Firth of Tay and Eden Estuary harbour seal population 2000 to 2011 (Source: Sparling *et al.*, 2011; Duck & Morris 2012).

43 Harbour seals normally feed within 60 km around their haul-out sites, and take a wide variety of prey including sandeels, cod, haddock, whiting, ling, herring and sprat, flatfish, octopus and squid. There are some seasonal and regional variations to this, with sandeels, octopus, whiting, flounder and cod being prey items for harbour seals in northeast Scotland and sandeels and salmonids being prey items for harbour seals in the Tay Estuary (Sparling *et al.,* 2011; SCOS, 2005; Tollit and Thompson, 1996).

44 Tagging studies of harbour seals indicate that they remain largely in nearshore waters with relatively infrequent occurrences in the Neart na Gaoithe offshore site (Sparling *et al.*, 2011; Figure 5.6 and Figure 5.7). The tagging results identify key offshore foraging areas, which occur in the nearshore waters of the Firth of Forth and Firth of Tay area and further offshore approximately to the northeast of the offshore site. Pupping occurs during June and July followed by moulting during August. During this period harbour seals remain closer to their haul-out sites.

45 The results from the tagging studies and site specific surveys indicate that the Neart na Gaoithe offshore site is infrequently used by harbour seals but the nearshore coastal waters and areas to the north are extensively used by seals from the Firth of Tay and Eden Estuary SAC.

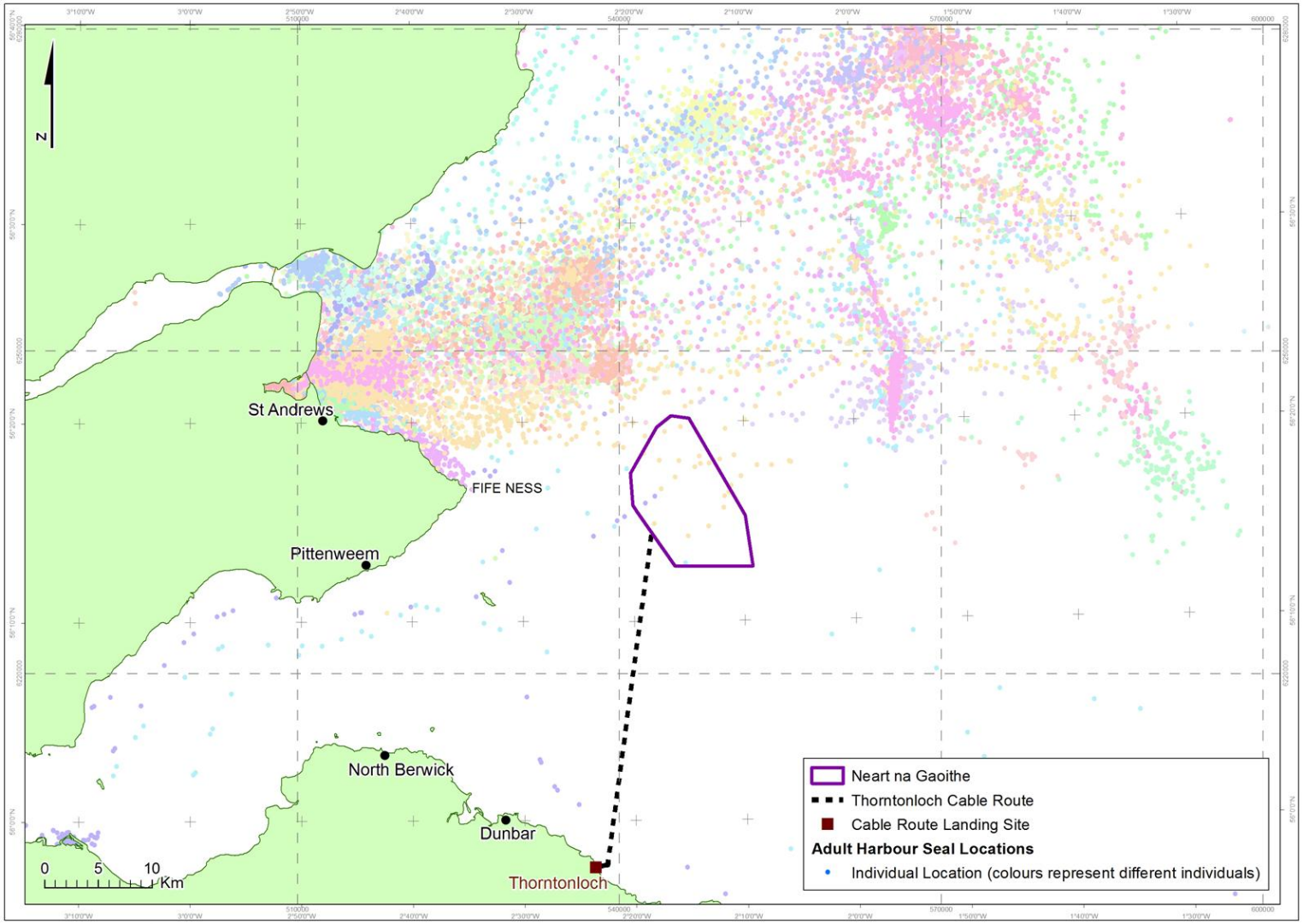

Figure 5.6: The locations of adult harbour seals in 2001 – 2008 in the Firth of Forth and Firth of Tay area.

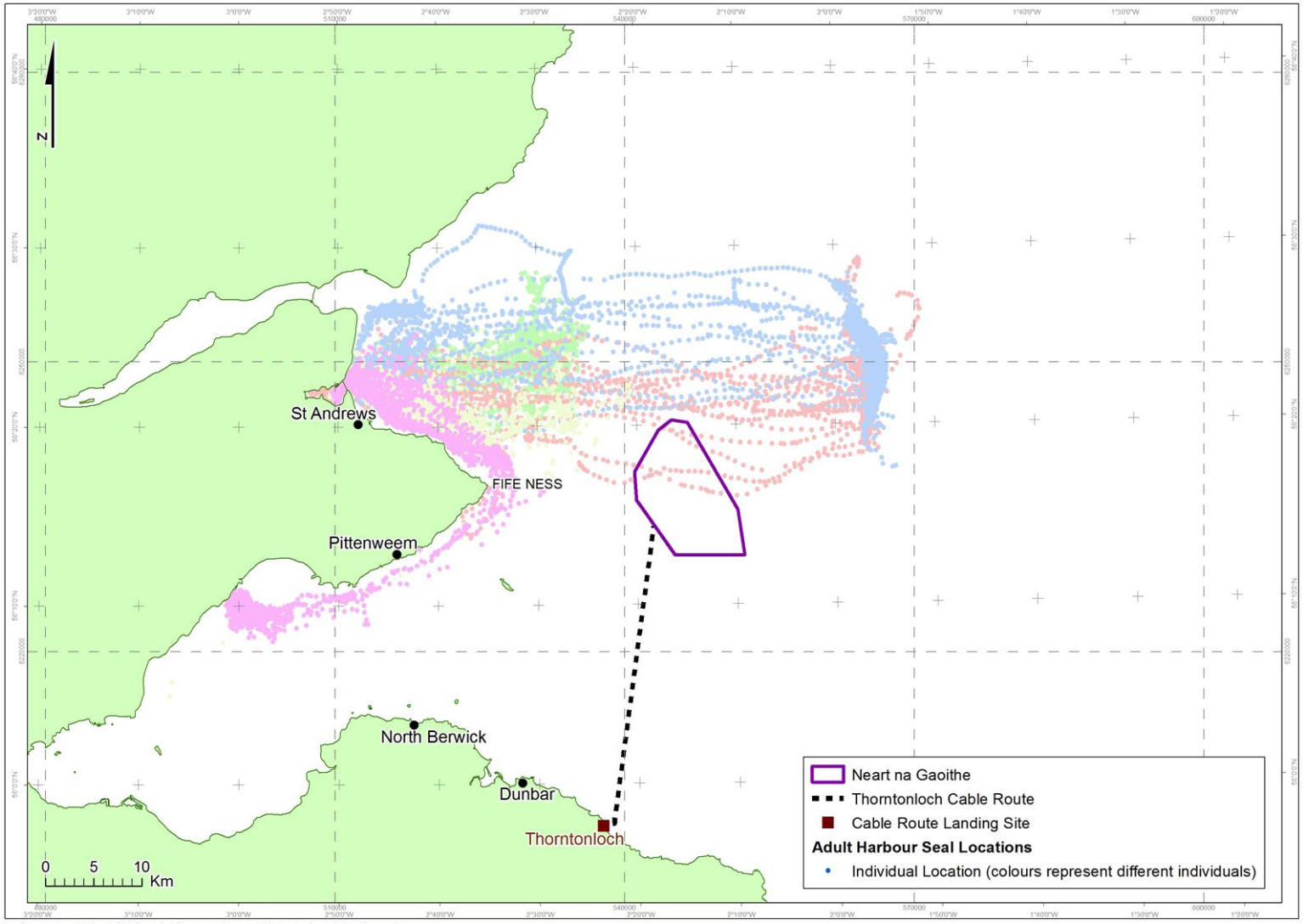

Figure 5.7: The locations of adult harbour seals in 2011 in the Firth of Forth and Firth of Tay area

5.3.3 Grey Seal

46 Grey seal was the second commonest marine mammal in the study area. Numbers of grey seals recorded across all three years were fairly similar with 43 grey seals recorded in Year 1, 58 in Year 2 and 39 in Year 3 (Table 5.3).

Table 5.3: Total number of grey seals recorded from three years of site specific surveys at Neart na Gaoithe.

Species	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Year 1: offshore site	0	0	0	0	1	0	0	0	0	1	0	0	**2**
Year 1: buffer	3	2	0	0	13	4	1	1	0	1	0	16	**41**
Year 2: offshore site	0	0	0	1	0	0	0	0	3	1	0	1	**6**
Year 2: buffer site	0	3	1	6	6	0	7	1	4	9	7	8	**52**
Year 3: offshore site	0	0	2	1	3	0	0	0	0	0	1	0	**7**
Year 3: buffer site	4	0	4	3	8	9	0	0	2	0	1	1	**32**
Monthly total	7	5	7	11	31	13	8	2	9	12	9	26	**140**

47 The data from the three years of surveys indicates seasonal peaks during spring and autumn and lower numbers during the summer, particularly in June (Figure 5.8).

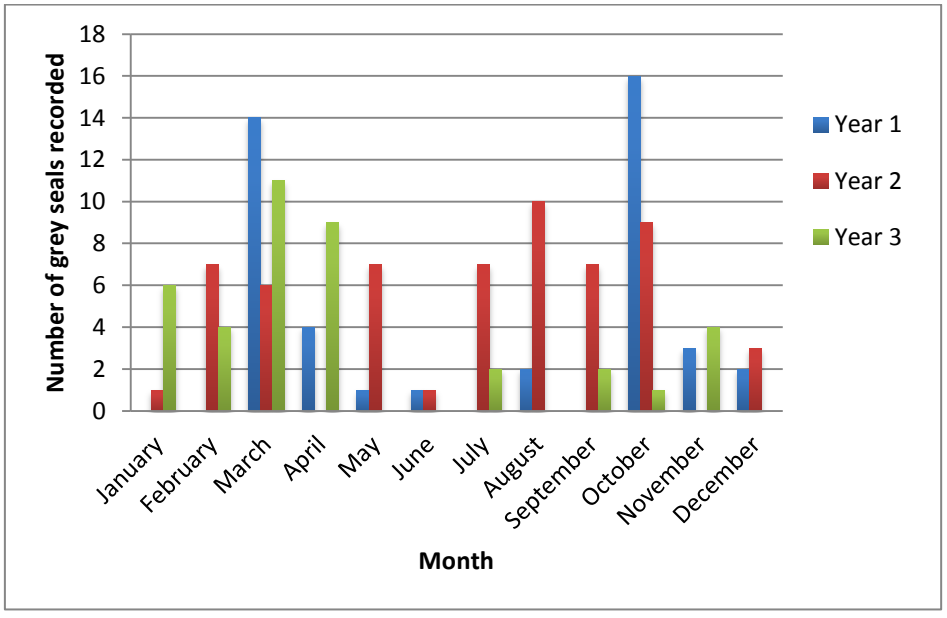

Figure 5.8: Total number of grey seals recorded from boat-based surveys across three years.

48 The grey seal is the larger of the two species of seal that breed around the coast of the British Isles. About 39% of the world population of grey seals is found in Britain, with over 90% of British grey seals breeding in Scotland, mostly in the Hebrides and Orkney (Special Committee on Seals (SCOS), 2005). Elsewhere, they occur in Shetland and along the north and east coasts of the UK and in the southwest. Major grey seal colonies on the east coast of Scotland and England include the Isle of May, Fast Castle and the Farne

Islands, which between them hold 12% of the UK grey seal population. The population of grey seals (based on the number of pups produced) is increasing at all three sites (refer to Table 5.4) (Sparling *et al.,* 2011).

Table 5.4: Grey seal pup production estimates for breeding colonies on the northeast coast of England and southeast coast of Scotland for the last decade (Source: Sparling et al., 2011).

Colony	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Isle of May	1,766	2,133	1,932	1,977	1,882	1,953	1,954	1,827	1,751	1,875	2,065
Fast Castle	268	381	321	532	717	659	764	804	1,005	1,265	1,715
Firth of Forth Islands	-	-	-	-	86	72	110	171	206	247	267
Farne Islands	843	1,171	1,247	1,200	1,266	1,133	1,138	1,254	1,164	1,318	1,346
Total	2,877	3,685	3,500	3,709	3,951	3,817	3,966	4,056	4,126	4,705	5,393

49 Total counts of grey seals hauled-out along the east coast of Scotland and northeast England are presented in Table 5.5 and indicate a peak population during July of 6,498 grey seals at haul-out sites. However, as not all grey seals are at haul-out sites at the same time the actual population will be greater than this. Based on the numbers hauled-out and the number of pups, the grey seal population in the region is 14,047 (9,330 - 19,906) grey seals depending on time of year (Sparling *et al.,* 2011).

Table 5.5: Total counts of grey seals hauled-out during monthly aerial surveys in April-September 2008 (Source: Sparling et al., 2011).

Haul-out Region	April	May	June	July	August	September	Mean
Northeast Scotland	278	346	163	698	95	305	315
Abertay	980	1,001	2,037	1,609	866	1,663	1,359
Farne Islands	2,415	2,358	3,443	4,191	2,370	2,079	2,809
Total	**3,673**	**3,705**	**5,643**	**6,498**	**3,331**	**4,047**	**4,483**

50 Pupping occurs during November and December and during this period grey seals remain largely onshore or in nearshore waters. Outside this period, grey seals are more widespread, occurring more frequently in offshore foraging areas. Grey seals forage in areas that are up to at least 100 m deep and that tend to have gravel/sand seabed sediments, which are the preferred burrowing habitat of their primary prey, sandeels. Grey seal foraging movements are on two geographical scales; long and distant trips from one haul-out site to another; and local repeated trips to specific offshore areas. Long-term telemetry studies show that grey seals occur regularly in the waters around the Neart na Gaoithe site (Hammond *et al.,* 2004).

51 Within the Firth of Forth and Firth of Tay area, results from tagging studies indicate that both adult grey seals and pups occur widely with relatively high occurrence in the nearshore area and further offshore in areas to the north of Neart na Gaoithe (Figure 5.9 and Figure 5.10).

52 Density surface modelling using data obtained from Neart na Gaoithe and the wider Firth of Forth and Firth of Tay area indicates that highest densities of grey seal occur near to the haul-out sites in the Firth of Tay area and off northeast England. Further offshore highest densities occur to the north and east of Neart na Gaoithe with relatively low densities in the proposed offshore site (Figure 5.11) (Gordon 2012; Sparling *et al.*, 2012a).

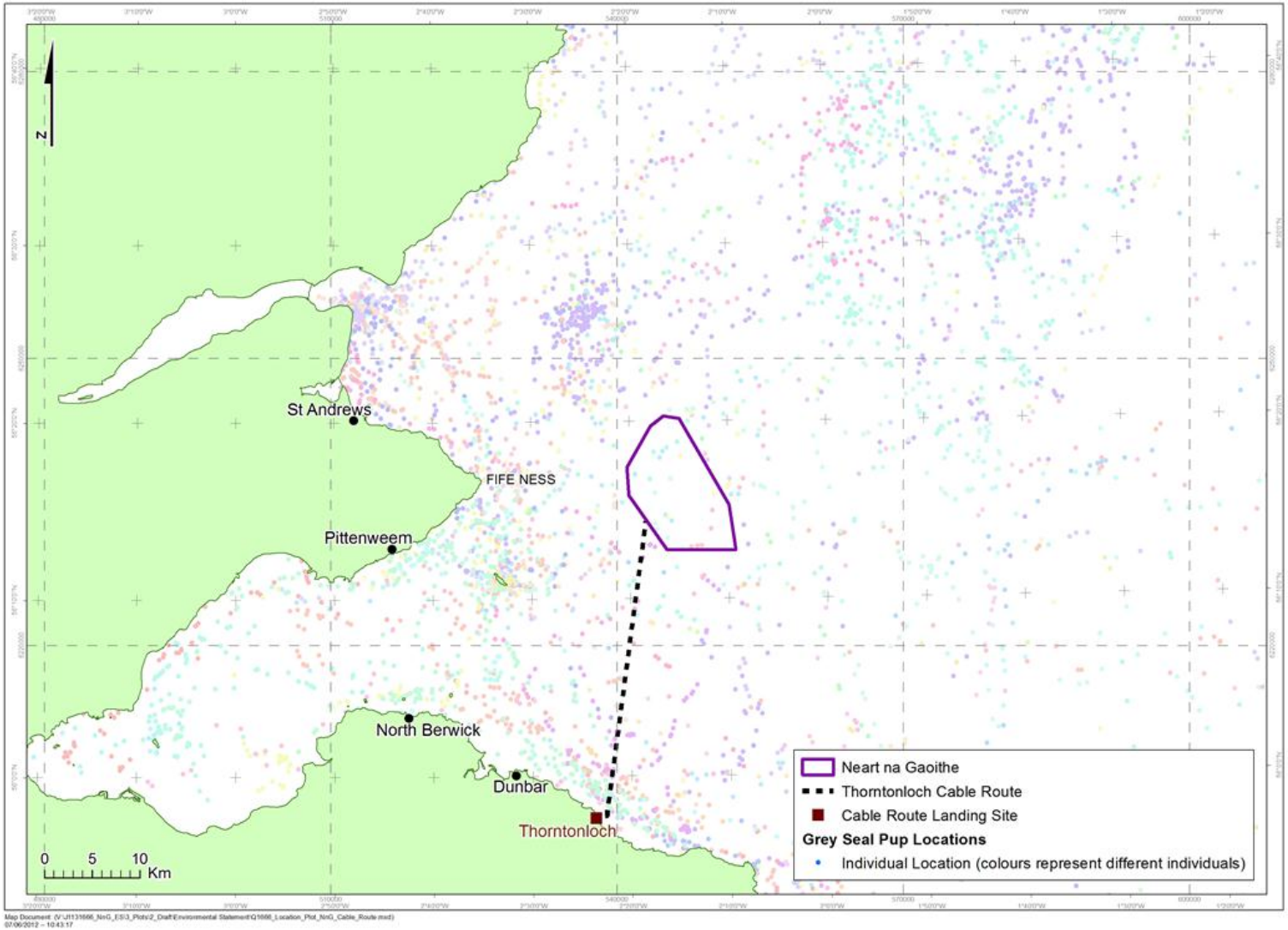

Figure 5.9: The locations of grey seal adults in the Firth of Forth and Firth of Tay area in 2011 (Source Sparling *et al*., 2011).

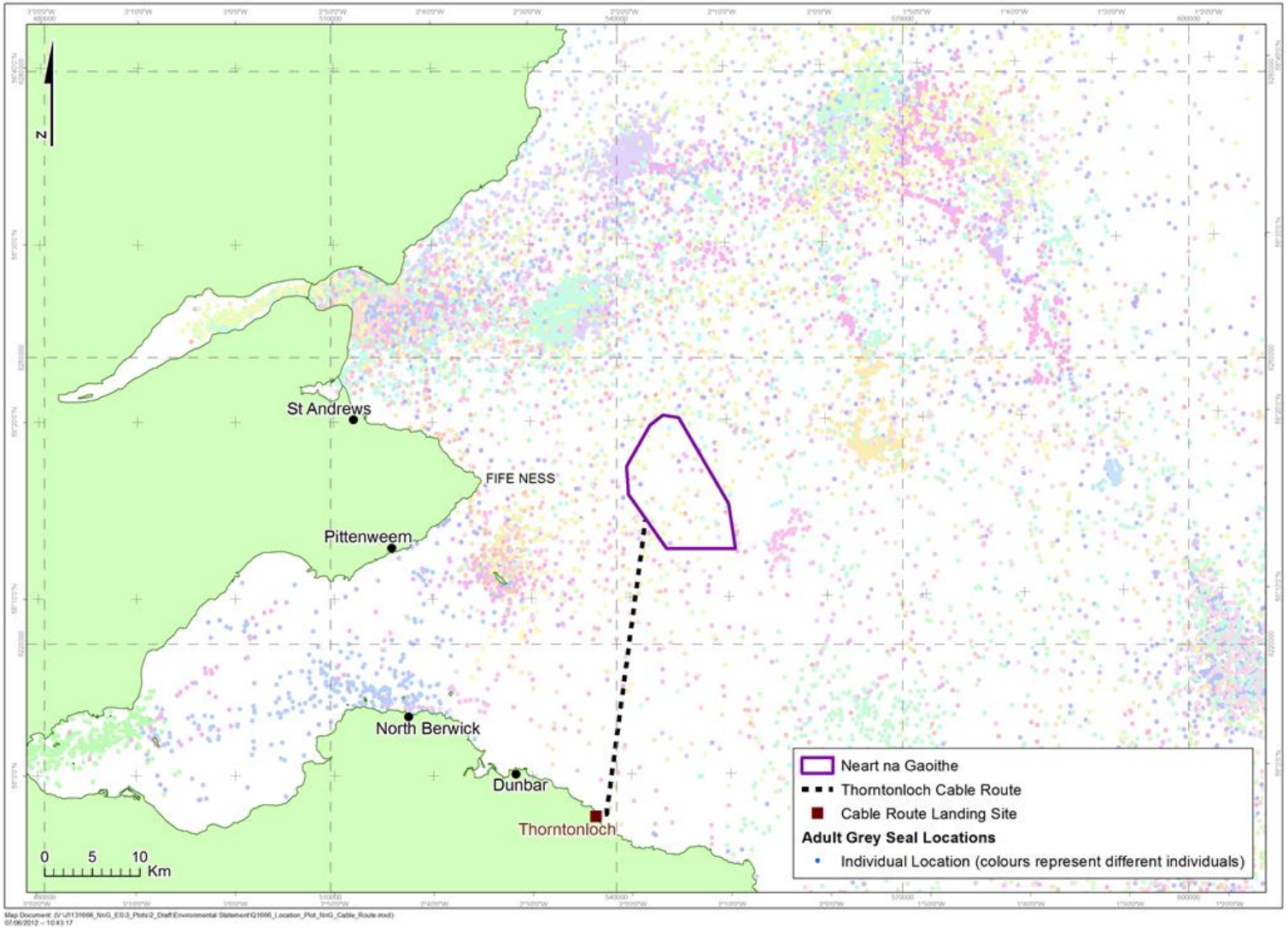

Figure 5.10: The locations of grey seal pups in the Firth of Forth and Firth of Tay area in 2011 (Source Sparling *et al*., 2011).

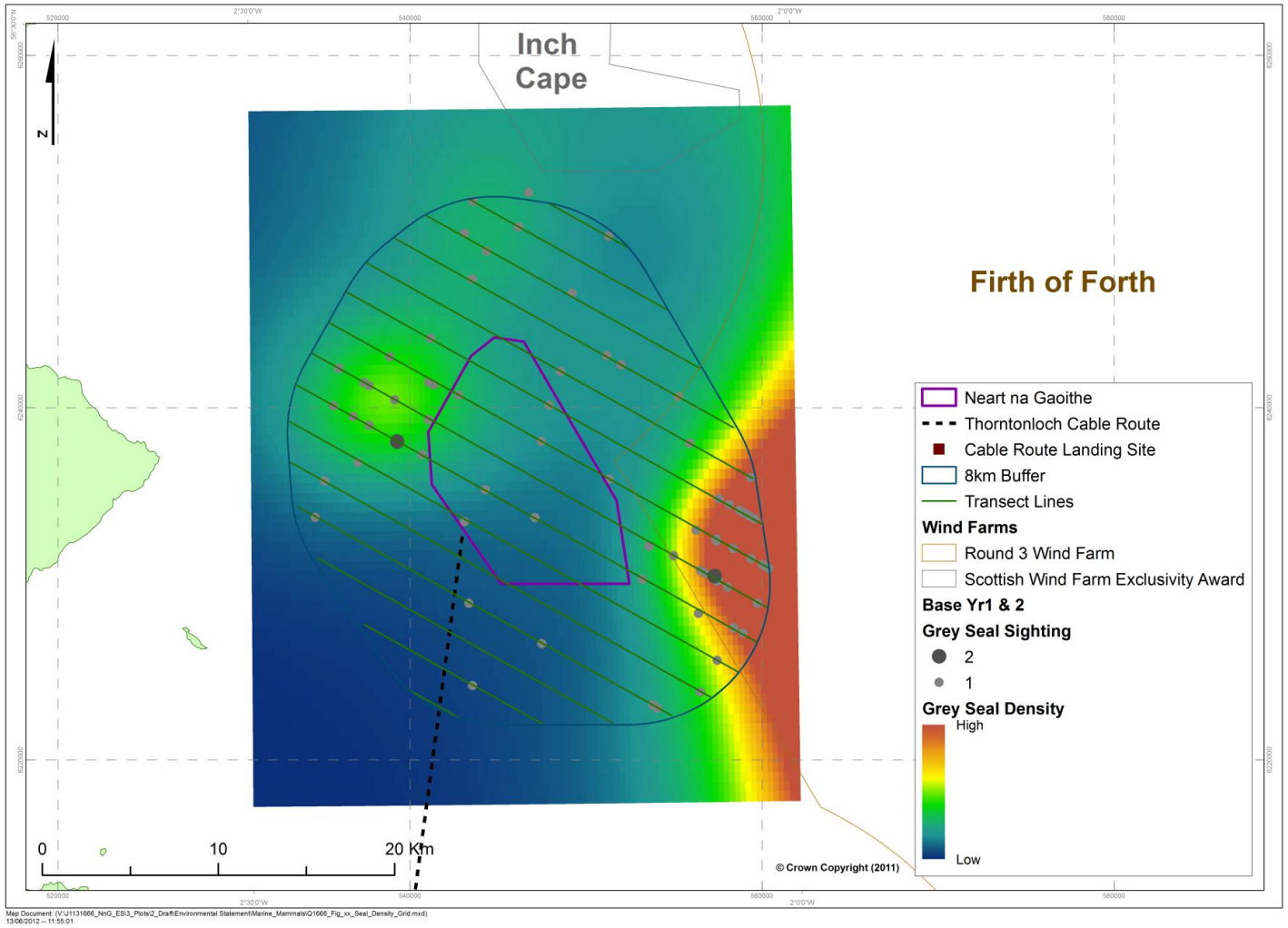

Figure 5.11: Grey seal density in the Neart na Gaoithe offshore site (Source Gordon, 2012).

5.4 Appraisal Methodology

53 The HRA has been undertaken using site specific survey data collected over a period of three years, relevant reports commissioned specifically to inform the impact assessment, published literature and the project's 'drive-drill-drive' and 'drive only' scenarios, which are within the project's design envelope (as described in Table 3.1 and Table 3.2).

54 The approach to assessing possible impacts on marine mammal SACs is as presented in the original July 2012 documentation. Each effect is considered against each relevant qualifying feature given the potential for an impact. The potential for impact is assessed according to the source-pathway-receptor approach, as presented in the ES.

55 The data from the site specific surveys undertaken at Neart na Gaoithe identified harbour porpoise, minke whale, grey seal and harbour seal as being the most regularly occurring marine mammals in the area, albeit in relatively low numbers (Table 5.6). However, it is recognised that there is potential for sound, particularly from pile driving, to propagate relatively large distances in the marine environment compared to other noise sources. Consequently, there is the potential for sound to travel across a wider area than that surveyed, impacting marine mammals that were only infrequently or not recorded during the surveys. In particular, this may include bottlenose dolphins, which are observed in the coastal waters of the Firth of Tay and Firth of Forth although they have not been recorded in the study area during the boat-based surveys or aerial surveys.

Table 5.6: Total number of marine mammals recorded during three years of site specific surveys.

Species	Year 1	Year 2	Year 3	Total
Harbour porpoise	89	83	107	**279**
Minke whale	2	10	2	**14**
White-beaked dolphin	0	16	8	**24**
Unidentified dolphin	5	1	3	**9**
Orca	0	1	0	**1**
Grey seal	43	58	39	**140**
Harbour seal	6	17	18	**41**
Unidentified seal	6	6	5	**17**

56 For the purposes of this assessment, the following potential impacts from noise are predicted from the thresholds modelled based on published literature (e.g. Nedwell *et al.,* 2005; Nedwell *et al.,* 2007a, Thompson *et al.,* 2011b):

- Levels greater than 130 dBht are considered to cause a PTS;
- Levels at 90 dBht are considered to cause 100% displacement, meaning all individuals will remain outwith the 90 dBht zone of impact for the duration of the activities. There is potential for some TTS to occur within this area; and
- Levels at 75 dBht may cause some behavioural changes including up to an approximate 60% displacement of all individuals within the zone of impact (Thompson *et al*., 2011).

57 Effects are summarised for each relevant receptor and possible impact. Effects are based on based on published information and results from modelling undertaken for the ES, which included the following:

- Metocean and hydrodynamic modelling to estimate changes to scour, SSC and plumes during installation and operation and maintenance stages; and
- Underwater noise propagation modelling to estimate changes in underwater noise and noise profiles for relevant fish species during installation activities (piling).

58 Estimates of vessel movement and other physical effects, such as noise arising from drilling operations, were not explicitly modelled for the purposes of the ES and a quantitative and/or qualitative estimates have been made on these effects as necessary and as presented in the project ES.

5.5 Noise

59 Within the ES, underwater noise, as compared to physical effects, has been identified as having the potential to cause the most significant impact on marine mammals. The main source of noise likely to cause a significant or adverse effect is from driven piling operations that will occur during the construction phase. Driven piling will take place either as a single operation in the 'drive only' scenario or in two stages in the 'drive-drill-drive' scenario:

- **'Drive-drill-drive':** This scenario will occur in areas at Neart na Gaoithe where there is an underlying layer of bedrock, which covers the majority of the proposed offshore site. Following the initial driven piling into the seabed for a period of up to 120 minutes, drilling will take place for up to 12.5 hours, followed by a final 90 minute period of piling (refer to Table 3.1). Three or four piles might be required for each turbine with each pile being 2.5 m in diameter, with maximum hammer energy of 1,200 kj. All turbines could potentially be installed based on the 'drive-drill-drive' scenario and it is the most likely installation scenario for the majority of turbines.
- **'Drive only':** This scenario may occur in areas of the Neart na Gaoithe offshore site where there is no bedrock and therefore no drilling is required. Drilling into areas without bedrock may cause liquefaction of the seabed and cause the underlying seabed to become unstable and unsuitable for the installation of turbines. Driven piling of turbines into areas without bedrock is considered to be the only practical option. In the event of turbines being installed under the 'drive only' scenario the piles will be 3.5 m in diameter with maximum hammer energy of 1,635 kj. A period of soft start up to 114 minutes may be undertaken (refer to Table 3.2). The 'drive only' scenario is the least likely option with a predicted 16 piles installed using piling only.

60 Other sources of noise may arise from vessel activity during the construction, operation and decommissioning aspects of the development. The level of noise arising from vessel activity is significantly lower than that arising from piling operations. Shipping noise is continuous and varies depending on the type of vessel being used. Larger vessels tend to produce lower frequency noise compared to smaller vessels (OSPAR, 2009). However, the level of noise will vary depending on the vessel's activity, with vessels equipped with dynamic positioning systems producing the greatest sound levels (OSPAR, 2009).

61 Supply and maintenance vessels produce sound source levels of between 130 and 160 dB re 1 μPa, with frequencies of between 20 Hz and 10 kHz. Most of the acoustic energy from vessels is below 1 kHz, typically within the 50-300 Hz (Genesis, 2012). Consequently, vessels have greater potential to impact seals and baleen whales that are more sensitive to low frequency sounds (Okeanos, 2008). Thruster noise from DP vessels has been recorded to increase sound levels in the spectrum from 3 Hz to 30 Hz (Nedwell and Edwards, 2004).

5.5.1 Potential Impacts from Sound

62 The potential impacts from sound are discussed in the project ES. Below is a summary of the potential effects that may occur on marine mammals and their prey species.

63 It is recognised that there are four main types of potential effects:

- Fatal effects caused by significant levels of noise in close proximity to the receptor;

- Hearing impairment, which might either be permanent, (and referred to as a Permanent Threshold Shift (PTS)) or temporary, (Temporary Threshold Shift (TTS)). These can impact on the ability of the marine mammal to communicate, forage or avoid predators;
- Behavioural effects such as avoidance, displacement from suitable feeding or breeding areas, changes in travelling routes; and
- Secondary impacts caused by the direct effects of noise on potential prey causing an overall loss of available prey.

5.5.1.1 *Fatal Effects*

64 If source peak pressure levels from the piling operations are high enough, there is the potential to cause a lethal effect on marine mammals. Studies suggest that potentially lethal effects can occur to marine mammals (seals and otters) when the peak pressure level is greater than 246 or 252 dB re. 1 µPa (Parvin *et al.*, 2007).

65 Damage to soft organs and tissues can occur when the peak pressure level is greater than 220 dB re. 1 µPa (Parvin *et al*., 2007).

5.5.1.2 *Hearing Damage*

66 Underwater sound has the potential to cause hearing damage in marine mammals. This can be either be a PTS, in which case there is no recovery in hearing over time or TTS, when the hearing will return to its former capability often within hours or a few days (Southall *et al.,* 2007). The potential for either of these conditions to occur is dependent on the hearing bandwidth of the animal, duty cycle and duration of the exposure (Southall *et al*., 2007, OSPAR, 2009).

67 Sound exposure levels (SEL) is a measure of the energy of sound that can be useful when assessing potential physiological impacts, in particular from activities that may cause a period of prolonged noise exposure and cumulatively with other sound sources, e.g., ongoing piling activities. Sound exposure levels (SEL) with the potential to cause PTS or TTS for cetaceans and pinnipeds based on the Southall *et al.* (2007) criteria are presented in Table 5.7.

68 A recent review of the potential SEL for pinnipeds has suggested that the use of 186 dB re 1 μPa^2s SEL M-weighted limit is not supported by the available data and that the use of a 198 dB re 1 μPa^2s SEL M-weighted limit may be more appropriate (Thompson and Hastie, 2011). However, this assessment and the noise modelling used to inform it are based on the more precautionary 186 dB re 1 μPa^2s SEL M-weighted limit.

69 Studies undertaken on bottlenose dolphins suggest that TTS can occur from mid-frequency sounds of 224 dB re. 1 µPa and last for up to 40 minutes (Finneran *et al*., 2002) and between 193 to 201 dB re. 1 µPa (Parvin *et al*., 2007). For harbour porpoise, TTS has been reported to occur at received sound levels of 199.7 dB re. 1 µPa (Lucke *et al.,* 2009).

Table 5.7: Sound exposure levels for cetaceans and pinnipeds (Source: Southall et al., 2007).

Exposure levels	Cetaceans and pinnipeds
230 dB re 1 µPa (peak)	PTS Auditory injury onset (cetaceans)
224 dB re 1 µPa (Peak)	TTS onset (cetaceans)
218 dB re 1 µPa (Peak)	PTS Auditory injury onset (pinnipeds)
212 dB re 1 µPa (Peak)	TTS onset (pinnipeds)
198 dB re 1 μPa^2s SEL M-weighted	PTS Auditory injury onset (cetaceans)

Exposure levels	Cetaceans and pinnipeds
186 dB re 1 µPa^{2}s SEL M-weighted	PTS Auditory injury onset (pinnipeds)
183 dB re 1 µPa^{2}s SEL M-weighted	TTS onset (cetaceans)
171 dB re 1 µPa^{2}s SEL M-weighted	TTS onset (pinnipeds)

70 The potential TTS is predicted to occur for a relatively short duration, presuming the sound levels causing the hearing damage remain the same. However, prolonged levels of sound that cause TTS may, over time, cause PTS. It is predicted that the marine mammals will move away due to hearing discomfort or an inability to communicate or feed effectively. Should this occur, the sound levels received are reduced, but there is a displacement effect which may be high and may be total, resulting in no mammals in the area in a worst case scenario.

5.5.1.3 Behavioural Change

71 Potential changes in behaviour may occur depending on the sound source levels and the species' and individuals' sensitivities. Behavioural changes can vary and, for example, be changes in swimming direction, diving duration, reduced communication and avoidance of an area.

72 Masking effects may also cause changes in behaviour as the level of sound may impair the detection of echolocation clicks and other sounds that species use to communicate or detect prey, which may cause them to alter their behaviour.

73 Changes in behaviour arising from noise impacts may be easily detectable, such as a significant displacement from an area. Studies undertaken in Denmark during piling operations indicated that harbour porpoise might be displaced at distances of 20 km or further during piling operations involving monopiles (Tougaard *et al*., 2003). Other studies undertaken in the Moray Firth during the construction of the Beatrice demonstrator project wind turbines also recorded a decrease in porpoise activity during the piling activities but not at sites 40 km away. However, the Beatrice demonstrator project wind turbines were jacket type turbines and consequently the diameter of the piles, at 1.8 m, was smaller than a single monopile (ICES, 2010). Other changes in behaviour, e.g. stress, may be more difficult to detect and go unnoticed (OSPAR, 2009). Behavioural effects have been observed using play-back experiments based on sound arising from operating wind farms on harbour porpoise and harbour seals. The results from these experiments indicated that there may be some avoidance behaviour due to operating wind turbines (Koschinski *et al.,* 2003).

5.5.1.4 Secondary Effects

74 There is the potential for impacts on prey species to affect marine mammals, in particular possible impacts from noise on fish species.

75 The main prey items for the majority of the marine mammals recorded within the study area are fish, although some non-fish prey items such as cephalopods will also be taken by the marine mammals. The main prey items recorded for marine mammals in the region are sandeel, herring, cod and haddock (Greenstreet *et al*., 2006).

76 Sandeel are not considered to be hearing specialists and have poor hearing capabilities but are likely to be sensitive to particle motion. Noise modelling undertaken for the project ES using piling scenarios (refer to Chapter 15 of the ES: Fish and Shellfish Ecology) indicate that sandeel are expected to strongly avoid a maximum area of 0.2 km radius from the pile, for a 3.5 m and 2.5 m diameter pile. The radius of significant avoidance behaviour is likely to extend up to 2 km (3.5 m diameter pile) and 1.4 km (2.5 m diameter pile). It is predicted that there is likely to be an impact of minor significance on sandeel from increased underwater noise in the installation phase of the project and it is no anticipated that this will result in a significant impact on sandeel predators such as marine mammals.

77 Fish belonging to the family Gadidae, e.g., whiting, saithe, cod and haddock are thought to be moderately sensitive to noise (Nedwell *et al.,* 2007). Studies undertaken during seismic surveys indicate that saithe may

leave the area but may return shortly afterwards (Løkkeborg *et al.,* 2010). Predicted levels of behavioural impact from existing offshore wind farms for cod have ranged from 1.6 km and 20 km (Nedwell *et al*., 2007a).

78 Construction surveys from existing wind farms have indicated that fish numbers present within operating wind farms are at least similar to those prior to construction and may be higher (e.g. Jensen *et al.,* 2006; Leonhard and Pederson, 2006; Lindeboom *et al.,* 2011, Leonhard *et al*., 2011). Consequently no long-term impacts on fish on which marine mammals prey are predicted following cessation of construction activities.

5.5.2 Duration of Potential Noise Impacts

5.5.2.1 Construction

79 Studies undertaken using T-pods to detect harbour porpoises during the construction of Horns Rev I and Horns Rev II offshore wind farms reported significant decreases in the number of acoustic detections recorded during pile driving activities. The decrease in the number of detections lasted for up to six hours at Horns Reef I and 48 hrs at Horns Reef II (Brandt *et al*., 2009, Tougaard *et al.,* 2006). Further studies undertaken at the Alpha Ventus test station indicated that there was a decrease of harbour porpoise up to 20 km from the wind farm for up to one to two days (Lucke, 2010).

80 There is limited information on the impacts from pile driving on seals. Studies undertaken during vibro-piling at Nysted in Denmark recorded a decrease of between 20% and 60% in the number of seals at haul-out sites during days when construction activities were undertaken (Carstensen *et al*., 2006). Elsewhere, studies undertaken at the Dutch Egmond aan Zee offshore wind farm used data loggers to track the location of seals during pile driving construction activities and found that seals were not present within 40 km of the wind farm location during the construction period (ICES, 2010).

5.5.2.2 Operation

81 During the lifetime of the project, which is expected to be 25 years, there will be some noise arising from the turbines. Any impacts are likely to last for the duration of the project unless there is a degree of acclimatisation and therefore any initial impacts are likely to decline over time.

5.5.2.3 Decommissioning

82 There are no details as to the method of removal of the turbines at the time of decommissioning. Removal techniques are likely to include the use of cutting tools and heavy lift vessels. The duration of potential impacts are likely to be for the duration of the decommissioning programme. The nature and magnitude of impacts will be similar to vessel impacts arising during construction.

5.5.3 Noise Modelling

83 Details of the noise modelling undertaken to assist in the assessment of potential impacts piling operations at three proposed offshore wind farms (Neart na Gaoithe, Inch Cape and Firth of Forth Round 3 Zone 2) in the Firth of Forth and Firth of Tay area are presented in the Project ES. The results from the modelling relevant to inform an HRA are summarised here.

84 Two noise models were used in EIA

5.5.3.1 INSPIRE Modelling

85 The Impulse Noise Sound Propagation and Impact Range Estimator (INSPIRE) model has been used to calculate both species-specific hearing thresholds, dBht and SEL.

86 The INSPIRE model uses species-specific hearing thresholds (dBht), which take into account sound being perceived differently by different species. As sound sources may contain frequencies that are beyond the hearing range of individual species, the perceived noise levels are often lower than unweighted levels. As well as calculating the SEL variation with range, the INSPIRE model incorporates a “fleeing animal receptor” extension, which enables the amount of noise an animal receives as it is moves away from a piling operation to be calculated. This feature enables the calculation of the nearest distance from a pile from which an animal must start fleeing.

87 For each of the two installation scenarios, three hearing thresholds have been modelled: 75 dBht and 90 dBht and 130 dBht. It is recognised that predicting how individuals respond to sound is problematic and behaviour is highly variable and dependent on various factors, including the sensitivity of each individual affected or the attractiveness of the area to an individual. A good foraging area may cause the animal to be more tolerant of the noise and enter or remain in the area, compared to a site with relatively poor foraging potential when the animal may be more likely to avoid the area.

88 The following responses are predicted from the thresholds modelled based on published literature (e.g. Nedwell *et al.,* 2005; Nedwell *et al.,* 2007b):

- At 75 dBht sound may be heard by the marine mammal and might cause some behavioural responses such as some avoidance behaviour. The level of behavioural response will decrease the further from the sound source the receptor is. Dose response curves based on studies of harbour porpoise for harbour porpoise indicate that approximately 60% of the population at risk of a behavioural response may be impacted (Thompson *et al*., 2011);
- At 90 dBht significant avoidance behaviour is predicted; and
- At 130 dBht there is the potential for TTS and the onset of traumatic hearing damage (PTS) to occur.

89 By applying a M-weighting filter a weighting can be applied specific to differing marine mammal hearing sensitivities based on 'low', 'medium' or 'high' categories (Southall *et al*., 2007). The SEL modelling also considers potential avoidance reaction of the receptor and assumes that the marine mammal will move away from the sound.

90 In order to determine potential effects on marine mammals over time, SEL modelling has been undertaken for the Neart na Gaoithe project, both on its own and cumulatively with Inch Cape and Firth of Forth Round 3, Zone 2 offshore wind farms.

91 The results from the SEL modelling indicate that the distance that PTS may occur for all cetaceans was very localised and in all cases within 100 m of the sound source. For pinnipeds, based on weighted exposure levels of 186 dB re 1 $\mu Pa^2/s$ (M_{pw}) a potential impact up to 8.2 km away may occur from the pile driving activities. At 198 dB re 1 $\mu Pa^2/s$ (M_{pw}) the potential distance an impact capable of causing PTS was reduced to 100 m.

5.5.3.2 SAFESIMM Modelling

92 The second model used to determine PTS, TTS and behavioural responses uses SAFESIMM (Statistical Algorithms For Estimating the Sonar Influence on Marine Megafauna) algorithm developed by SMRU Ltd (Sparling *et al*., 2012a). SAFESIMM provides estimates of the number of animals of each species of marine mammal that may experience PTS and TTS from a particular sound field using species-specific response curves and estimates of the expected densities of marine mammal species at each location. The model does not presume that all individuals within a certain area of potential impact will be affected to the same extent. SAFESIMM modelling has been undertaken for Neart na Gaoithe both alone and in-combination with Inch Cape and Firth of Forth offshore wind farms for harbour porpoise, bottlenose dolphin, grey seal and harbour seal (See ES: Appendix 13.2: SMRU Ltd Report –SAFESIMM Report).

5.5.3.3 Cumulative Noise Modelling

93 Outputs from dBht modelling are not suitable for assessing cumulative impacts as dBht is based on an instantaneous impact and cannot be used for assessing impacts from multiple locations. The use of M-weighted SEL is suitable for multiple sound sources and consequently this approach to cumulative noise modelling has been followed to assess the potential cumulative impacts.

5.5.4 Noise Modelling Outputs

94 The outputs from the noise modelling for species relevant to an HRA are presented in the tables below (Table 5.8 to Table 5.10).

Table 5.8: Outputs from noise modelling undertaken for Neart na Gaoithe.

Species	Construction Option	Impact	dBht		SEL		SAFESIMM
			Area (km^2)	No. Impacted	Area (km^2)	No. Impacted	No. Impacted
Bottlenose dolphin **Mid-frequency**	'Drive-drill-drive'	PTS	0.3	-	<0.1	<1	0
		Total displacement/TTS	451.9	-	-	-	6
		60% Partial displacement/Behaviour	2,567.8	-	-	-	124
	'Drive only'	PTS	0.4	-	<0.1	<1	0
		Total displacement/TTS	555.5	-	-	-	1
		60% Partial displacement/Behaviour	2,898.5	-	-	-	116
Grey seal **Pinniped-frequency**	'Drive-drill-drive'	PTS	0.1	<1	196.8	27	453
		Total displacement/TTS	689.6	96	-	-	1,833
		60% Partial displacement/Behaviour	3,550	298	-	-	5,483
	'Drive only'	PTS	0.1	<1	128.1	18	235
		Total displacement/TTS	813.8	113	-	-	1,263
		60% Partial displacement/Behaviour	4,133	347	-	-	4,404
Harbour seal **Pinniped-frequency**	'Drive-drill-drive'	PTS	0.1	-	196.8	-	41
		Total displacement/TTS	689.6	-	-	-	152
		60% Partial displacement/Behaviour	3,550	-	-	-	314
	'Drive only'	PTS	0.1	-	128.1	-	18
		Total displacement/TTS	813.8	-	-	-	95
		60% Partial displacement/Behaviour	4,133	-	-	-	283

95 The area of potential affect arising from the cumulative noise modelling undertaken are presented in Table 5.9 and Table 5.10.

Table 5.9: Potential area of cumulative impact at which PTS may occur based on M-weighted SEL modelling.

Hearing Type	re 1 µPa^2/s	Area of Impact (km^2)	Maximum Radius (km)
High frequency cetaceans	198.0	3.4	2.2
Low frequency cetaceans	198.0	32.2	8.4
Mid frequency cetaceans	198.0	3.9	2.2
Pinnipeds (in water)	186.0	2,462.5	31.6
	198.0	37.9	8.0

Table 5.10: Cumulative impact outputs from noise modelling undertaken for Neart na Gaoithe based on 'drill-drive-drill' scenario.

Species	SEL		SAFESIMM		
	Auditory injury		PTS	TTS	Partial displacement/ behaviour
	Area (km^2)	No. Impacted	No. Impacted	No. Impacted	No. Impacted
Bottlenose dolphin	3.9	<1	0	6	124
Grey seal	2,462.6	344	722	2,579	6,163
Harbour seal	-	-	72	206	305

5.6 Other Potential Impacts

96 Aside from impacts arising from noise there is potential for effects on marine mammals from other sources. The following summarises the main potential impacts that could affect marine mammals.

5.6.1 Electromagnetic Fields

97 Other potential impacts may occur from electromagnetic fields (EMF) arising from cables. There is circumstantial evidence to suggest that marine mammals may be able to detect electromagnetic fields from subsea cables. There are two elements of an electromagnetic field: the E 'electric' field which remains within the cable and B 'magnetic' field which can be detected beyond the cable (Gill *et al.*, 2009). However, no studies have detected any impact from EMF on marine mammals (Scottish Executive, 2007).

98 The strength of the magnetic field varies but is generally very localised in nature and returns to below background levels within 20 m of the cable if the cable is buried to 1 m, which removes much of the stronger magnetic fields (Gill *et al.,* 2009*;* Scottish Executive, 2007). Further, the rate of change in polarity of the electromagnetic field emitted by a cable is reported to be too rapid to be detected by a marine mammal (Normandeau *et al.,* 2011).

99 Studies undertaken on bottlenose dolphin predict that they are unlikely to be able to detect the electromagnetic fields emitted from a buried AC cable greater than 2 m away. Any effect will therefore be localised (Normandeau *et al.,* 2011). The localised effect of magnetic fields means that in order for a marine mammal to detect it, if at all, it will need to be within very close proximity to the cable. The impact, if any, will be negligible as the marine mammal may swim away from the cable without any likely significant effects.

5.6.2 Physical Impacts

100 A relatively recently identified impact from vessels, and a topic subject to ongoing-research, is the apparent increase in impacts between seals and certain types of ships using ducted propellers. Since 2008 a total of 15 seals have been found ashore along Eastern Scotland with skin lacerations caused by what is thought to be the use of ducted propellers on vessels. A further 42 have been found along North Norfolk and some in Northern Ireland (JNCC, 2011). This is likely to be a significant under-estimate on the real number of mortalities (JNCC 2011). The cause of the impact is unknown but it is linked to certain types of azimuth thruster or ducted propeller, which are commonly used offshore (JNCC, 2011).

101 During the construction, operation and decommissioning of the proposed development a wide range of vessels will be used, many of which use ducted propellers order to undertake safe and effective operations. The number and type of ducted propellers used vary across vessels. A construction support vessel will have between four and five thrusters split between bow and stern that may be ducted or azimuth types (Fugro, 2012). Some vessels have gratings over the ducted propellers that may help reduce the risk of seal injury.

6 Designated Sites – SACs

6.1 Firth of Tay and Eden Estuary SAC

6.1.1 Firth of Tay and Eden Estuary Site Information

102 Site overview information for the Firth of Tay and Eden Estuary SAC is provided in Table 6.1 below.

Table 6.1: Firth of Tay and Eden Estuary SAC site information.

Topic	Information
Qualifying feature with connectivity to Neart na Gaoithe	● Harbour seal *P. vitulina*
Conservation objectives of qualifying feature	To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving Favourable Conservation Status for each of the qualifying features. To ensure for the qualifying species that the following are established then maintained in the long term: ● Population of the species as a viable component of the site; ● Distribution of the species within site; ● Distribution and extent of habitats supporting the species; ● Structure, function and supporting processes of habitats supporting the species; and ● No significant disturbance of the species.
Current status of qualifying feature	The current population of harbour seals is 124 individuals and at the time of designation was 600 individuals. Harbour seals are considered to be in unfavourable and declining condition. Harbour seals associated with the Firth of Tay and Eden Estuary SAC are known to occur throughout the Forth Tay area but most frequently occur in the nearshore waters of the Tay and Eden estuaries and offshore waters to the north of Neart na Gaoithe. There is very good evidence of a strong linkage between the harbour seals associated with the SAC and those recorded offshore. The harbour seal population in the Firth of Tay and Eden Estuary has undergone significant population decline in the last 10 years, decreasing from 600 individuals to 124 in 2010. The cause of the decline is unknown but if it continues at the current rate, the SAC population is predicted to be near extinction within the next 10 years. Within the Neart na Gaoithe offshore site two harbour seals were recorded and a further 21 harbour seals were recorded in the buffer zone.

6.1.2 Firth of Tay and Eden Estuary SAC - Impacts on Harbour Seal

6.1.2.1 Noise from 'drive' only installation for wind turbine jacket foundations

103 Results from noise modelling indicate that there is the potential for sound arising from pile driving to remain above the 90 dBht threshold up to 15 km from the sound source and cover an area of approximately

682 km^2 (See Figure 6.1). Sound may remain above the 75 dBht threshold out to approximately 47.1 km. The total area where the potential for sound levels to be above 75 dBht but below 90 dBht is 3,581 km^2.

6.1.2.2 Noise from 'drive-drill-drive' installation wind turbine jacket foundations

104 Modelling results indicate that there is the potential for sound arising from pile driving to remain above 90 dBht threshold up to 16.1 km and remain above 75 dBht out to 50.3 km. The total area of potential impact is between 813.8 km2 and 4,133 km^2 (See Figure 6.2).

6.1.2.2.1 Permanent threshold shift

105 The results from the SEL noise modelling indicate that the risk of PTS varies considerably depending on the exposure level selected. For seals, Southall *et al.* (2007) recommend the use of 186 dB dB re 1 µPa^2/s (M_{pw}) although this is considered precautionary and the use of 198 dB dB re 1 µPa^2/s (M_{pw}) may be more appropriate.

106 Based on the use of SEL of 186 dB re 1 µPa^2/s (M_{pw}) for PTS to occur, harbour seals will have to be within 8.2 km of the piling activities when operations start.

107 Based on the use of SELs of 198 dB re 1 µPa^2/s (M_{pw}) for PTS to occur, harbour seals will have to be within 100 m of the piling activities when operations start.

108 The output from noise modelling based SEL indicate a relatively localised area of impact. Not enough harbour seals were recorded to calculate densities, although based on the very low number of sightings the densities will also be very low. Consequently, few, if any, harbour seals will be impacted from PTS. Based on the outputs from SAFESIMM modelling indicate that between 18 and 41 harbour seals may receive levels of sound capable of causing PTS. This is based on a precautionary dose response curve and therefore is predicted to be a worst case scenario.

109 The regional population of harbour seal is 376 individuals (Sparling *et al*., 2011). Therefore, between 4.7% and 10.9% of the regional harbour seal population is at risk of receiving SELs that may cause PTS.

110 Developers in the Moray Firth have commissioned studies, known as the Moray Firth Framework, to assess the potential impacts PTS may have on harbour seals (Thompson et al., 2012). The study was based on harbour seals within the Moray Firth and may not be directly comparable to potential impacts on harbour seals in Firth of Tay but do provide an indication as to the level of impacts that might be expected from PTS on harbour seals from developments being undertaken in the Firth of Tay region. The Moray Firth Framework is based on an M-weighted 198 db, as used in the SAFESIMM model, and assumes that instead of 100% mortality on harbour seals arising from the effects of PTS, that there is instead a potential 25% mortality rate on those impacted and a reduction in breeding success on 100% of the harbour seals impacted (Thompson et al., 2012). Based on the results from the Moray Firth Framework of those predicted to be impacted there will be a loss of between 4.5 and 10.25 harbour seals from the population due to PTS. The loss of between 4.5 and 10.25 individuals is 1.2% and 2.7% of the regional seal population.

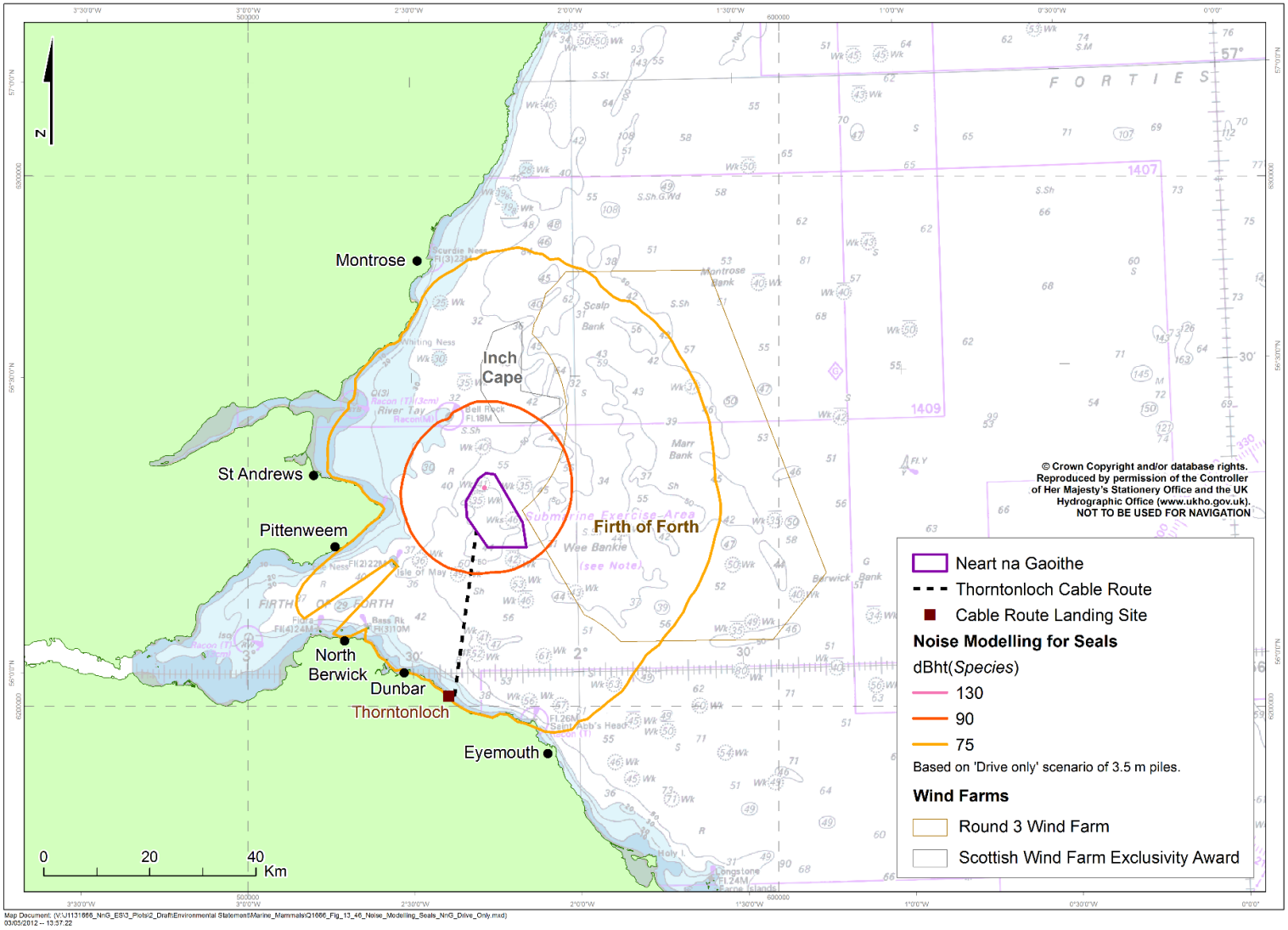

Figure 6.1: Noise modelling results for seals based on 'drive only' scenario of 3.5 m piles.

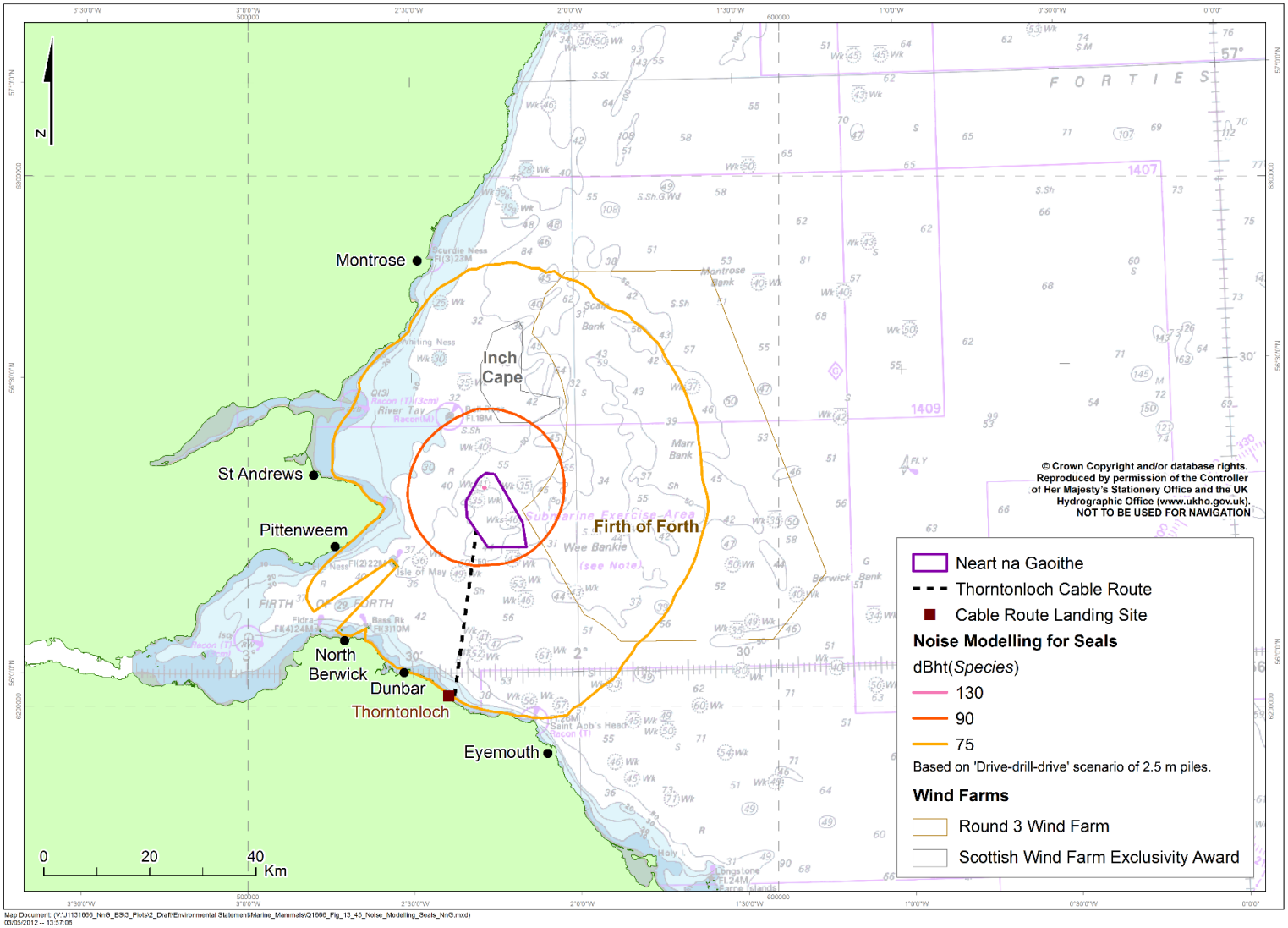

Figure 6.2: Noise modelling results for Seals based on 'drive-drill-drive' scenario of 2.5 m piles.

111 The Firth of Tay and Eden Estuary SAC harbour seal population is smaller than that of the regional SAC population. The latest available counts from 2011 reported a population of 77 harbour seals in the SAC. The potential loss of of between 4.5 and 10.25 individuals is therefore between 6% and 13.3% of the SAC population. In 2010 the SAC population was 124 individuals and the population has decreased by 38% within one year.

112 The number of harbour seals recorded from boat-based surveys within the study area and 8 km buffer area was very low with a total of 23 individuals over 2 years of surveys. The low number of sightings indicates that harbour seals are scarce in the study area. This is further supported by results from tagging studies that show the majority of harbour seals occur in the coastal waters to the west or in near-shore waters to the north. Depending on the SEL threshold selected, the zone of potential PTS impact is within the area surveyed at between 100 m and 8.2 km. Based on the low number of sightings and the results from the tracking data it is not thought that between 4.7% and 10% of the regional harbour seal population will be within the area at the commencement of piling as indicated by the results from SAFESIMM.

113 It is recognised that there is potential for PTS to occur on some harbour seals within the vicinity of the construction activities. Mitigation measures in place include the possible use of acoustic mitigation devices designed to deter seals from the area of potential impact and will reduce the risk of any harbour seals receiving sound levels that could cause PTS.

6.1.2.2.2 Total displacement and temporary threshold shift

114 Total displacement of seals may occur out to 15 km from the piling operations and cover an area of 682 km^2.

115 Outputs from SAFESIMM modelling indicate that between 95 and 152 harbour seals may receive levels of sound capable of causing TTS. Based on the regional population of 376 harbour seals, between 25% and 40% of the regional harbour seal population may receive sound levels that could cause TTS and/or displacement.

116 Based on the latest Firth of Tay and Eden Estuary population counts in 2011, when 77 harbour seals were recorded between 123% and 197% of the SAC population may be impacted. It is possible that not all harbour seals at risk of being impacted are from the Forth of Tay and Eden Estuary. However, tagging studies do show regular movements of harbour seals to areas to the north of the Neart na Gaoithe offshore site (Figure 5.6 and Figure 5.7). The outputs from the SAFESIMM model are based on historical harbour seal data presented in Sparling *et al*. (2011) to inform densities from which it calculates number of individuals impacted (Sparling *et al.,* 2012). Consequently, the number of individuals predicted to be impacted using SAFESIMM over estimates the impact on the current, much reduced, SAC population.

117 The duration of TTS on harbour seals is predicted to be for less than 24 hours (Kastak *et al.,* 2005) but will depend on the duration that the harbour seal experiences sound at levels that can cause TTS.

118 Harbour seals are not hearing specialists and do not use sound to detect prey. They have good vision in clear waters and sensitive mystacilia vibrissae to locate prey in waters with poor visibility and therefore the temporary loss of hearing would not affect the ability of harbour seals to forage effectively (Dehnhardt and Kaminski, 1995).

6.1.2.2.3 Behavioural change and partial displacement

119 The 'drive-drill-drive' scenario modelled, predicts a potential for some behavioural effect or partial displacement to occur out to 47 km from the piling operations and cover an area of 3,585 km^2. Under the 'drive only' scenario for 16 piles, some displacement may occur out to 50.3 km and cover an area of 4,133 km^2.

120 Outputs from SAFESIMM modelling indicate that between 283 and 314 harbour seals may receive levels of sound capable of causing behavioural change. Based on the regional populations between 75% and 83% of harbour seals may receive sound levels that could cause behavioural effects.

121 Results from site tagging studies, and density surface modelling and site specific surveys (presented in the ES) all indicate that harbour seals are scarce within the proposed Neart na Gaoithe offshore site. They also

indicate that harbour seals forage mainly within the nearshore coastal waters of the Firth of Forth and Firth of Tay area or to the north and east and in particular over shallower sandbanks.

122 Within the Tay and Eden estuaries, harbour seals breed and are a qualifying species of the Firth of Forth and Tay and Eden Estuary SAC. Harbour seals pup during June and July and the pups enter the sea very shortly after birth; following pupping the adults moult during August. Harbour seals tend to forage in relatively inshore waters but can make regular foraging trips further offshore to suitable feeding areas. One such area is clearly identifiable to the north of Neart na Gaoithe based on the 2011 tagging data but, although still present, is less obvious in the years between 2001 and 2008 when harbour seal distribution occurred more frequently further north (refer to Figure 5.6 and Figure 5.7). This suggests that although harbour seals may use regular feeding areas there is, across years, variation in the level and extent of usage as, presumably, harbour seals forage at other suitable feeding locations. Similar foraging behaviour patterns have been identified at other UK harbour seal populations (Sharples *et al.,* 2008). This pattern of behaviour indicates that harbour seals are opportunistic feeders relocating to areas with high prey availability.

123 The effect of causing displacement may vary depending on season. The period of main sensitivity is predicted to be during the pupping season of June and July when females give birth at regular haul-out sites. Pups enter the water very shortly after birth, often within a tidal cycle and may spend up to 40% of their time in the water (Bekkby and Bjorge, 2000; Bowen *et al*., 1999). Pups remain with their mothers until weaning approximately 25 days after birth. A mother will monitor her pup by listening to its particular vocalization (in both air and water) (Renouf, 1984). If this call were masked or partially masked by noise then the mother may be less able to monitor its pup. However, Madsen *et al*. (2006) suggest that since the underwater sounds of seals cover more frequencies than turbine noises and generally have more energy above the frequencies of turbine noise then the masking effect is likely to be relatively minor. A study of bearded seals (*Erignathus barbatus*) suggested that they shift the frequency of their tonal calls to reduce the masking effects of noise (Terhune, 1999) and it has been suggested that other seals may be able to compensate for masking in a similar way (Terhune, 1999). During this period pups and adults remain largely within a few kilometres of the haul-out sites, as the pups need to rest more frequently than adults (Bekkby and Bjorge, 2000, Thompson *et al.,* 1994).

124 Following weaning, pups and adults become less reliant on the breeding area and increase their foraging range further offshore shore.

125 During the pupping season, harbour seals may avoid the haul-out sites due to displacement effects. If so, pregnant females will have to relocate to other alternative, potentially less suitable, pupping locations. Should this occur then there might be an increase in juvenile mortality.

126 The construction period during which turbine foundations will be installed is predicted to last between 12 and 18 months, therefore the risk of displacement effects moving harbour seals away from Firth of Tay pupping areas will potentially occur over one or two seasons. Should this occur, then there will potentially be a temporary adverse effect on Firth of Tay and Eden Estuary SAC pupping areas during which time harbour seals will relocate to alternative pupping grounds.

127 Harbour seals haul out on a regular basis at near-shore sites with a moderate level of fidelity (London *et al*., 2012) and offshore movements are typically limited to within 60 km from their primary haul out site (Thompson *et al.,* 1996; Peterson *et al*. 2012). Harbour seals within the Firth of Tay and Eden Estuary travel relatively locally to forage and show a very high degree of site fidelity Sparling *et al*. (2012).

128 Harbour seals prey on a wide variety of species including sandeels, whiting, flounder, cod and other fish species (SCOS, 2005; Tollit and Thompson, 1996). They are opportunistic feeders and can adapt to foraging on alternative prey if their prey availability changes. The main prey species for harbour seals in the Tay Estuary area are sandeels and salmonids (Sparling *et al*., 2012a) neither of which are hearing specialists and both have a relatively localised potential displacement area. The impacts of piling on other prey may mean that fin fish species, particularly those with swim bladders, such as herring, may avoid the area. However, noise modelling indicates only localised effects on species such as sandeels. Consequently, it is predicted that there will be potential prey available in the area during the period of construction and displaced harbour seals will be able to forage during construction activities.

129 Data from existing offshore wind farms indicate that harbour seals may avoid the offshore site during construction. Studies undertaken in Denmark at Nysted Offshore Wind Farm identified a reduction in the use of haul-out sites of between 20 and 60% during the installation of a turbine 10 km away (Teilmann *et al.*, 2006) and that they may avoid the area out to 40 km (ICES, 2010). No effects on the harbour seal populations were found following completion of the construction activities. At Scroby Sands offshore wind farm there was a decrease in the number of harbour seals for a period of 2 years at haul-out sites within 2 km of the piling operations. Since the commencement of the operation of the wind farm, the number of harbour seals has increased but remains below the pre-construction population levels. The reason may be due to the construction piling activities, increased vessel traffic or inter-specific competition with grey seals; populations of which have increased in numbers since the time of construction (Skeate *et al.,* 2012).

130 Data from existing offshore wind farms and the potential for harbour seals to forage opportunistically elsewhere together indicate that the impacts from displacement and changes in behaviour will last for the duration of the foundation construction period but populations are predicted to return to natural levels following cessation of piling operations.

6.1.2.3 Noise from vessels during construction, operation and decommissioning

131 Noise levels arising from drilling operations vary depending on whether the drilling is undertaken from a floating platform such as drill ship or semi-submersible drill rig or whether they are from a fixed installation such a drilling rig. There are no data on noise levels from jack-up drilling rigs but are expected to be similar to similar to those arising from drilling platforms. Typically sound levels are higher from drill ships where noise the machinery is contained within the hull and contains a large surface area to radiate from. Drill ships can generate sound pressure levels of up to 195 dB (rms) re 1µPa@1m and continuous low frequency noise of between 100 to 400 Hz. Those from drill rigs have been reported to be up to 162 dB (rms) re 1µPa@1m (Genesis, 2012).

132 Vessel noise varies across different vessel types and, in particular the size of the vessel. Larger vessels typically produce sound levels at lower frequencies than smaller high powered propeller driven craft, which often exceed larger vessel noise in the frequencies above 1 kHz. Typically vessel noise is within the 50-300 Hz band and is the dominant noise source in deeper water between 20- 500 Hz. Noise source levels are typically lower for smaller vessels between 160 to 175 db (re 1µPa) and increasing to between 180-190 dB (re 1µPa) for larger vessels of greater than 100 m in length (Genesis, 2012).

133 Noise levels from these activities are typically lower than those arising from piling activities and although they may be more continuous than intermittent piling events the magnitude of the impact is significantly lower.

6.1.2.4 Presence of vessels during construction, operation and decommissioning

134 The presence of vessels during the lifetime of the project may cause a very localised disturbance or displacement effect. Potentially the main impact arising from the vessels will be from possible physical impacts, specifically those arising from interactions between harbour seals and vessels thrusters.

6.1.2.5 Physical Impacts

135 There is the potential for a physical impact on harbour seals from thrusters used by vessels during the construction, operation and decommissioning stages of the development.

136 Based on the current information, the risk of an impact in the Firth of Forth and Firth of Tay area is primarily with harbour seals, in particular during the summer months. There have been a number of recorded deaths of harbour seals in the Tay and Eden area (Thompson *et al.*, 2010b). The number of harbour seals occurring in the Neart na Gaoithe offshore site is relatively low with the majority of movements occurring to the north (refer to Figure 5.6 and Figure 5.7). Only five harbour seals were recorded within the offshore site (refer to Table 5.1). Therefore, the risk of an interaction with a vessel operating within the Neart na Gaoithe offshore site is low. However, if female harbour seals are attracted to the sound from ducted propellers then there is an increased risk of harbour seals being attracted into the area, although over what distance this attraction effect would be seen is not known.

137 The frequency of interactions between seals and ducted propellers is unknown and is subject to ongoing research. However, the low numbers of seals recorded in the Neart na Gaoithe offshore site indicates that the risk of an interaction is low and the magnitude of any effect is predicted to be negligible.

138 Potential mitigation measures will be developed at the time and included within the Environmental Management Plan and will be in line with industry best practice.

139 A monitoring programme will be developed and may potentially use marine mammal observers and or cameras to observe operations immediately prior to and during activities that are using thrusters considered to be of risk. The use of acoustic deterrents may also be considered.

6.1.3 Firth of Tay and Eden Estuary SAC - Cumulative and In-Combination Impacts

140 Potential in-combination impacts on harbour seals may arise from the proposed development of offshore wind farms at Inch Cape, Firth of Forth and Neart na Gaoithe. The precise periods of construction for the projects are not currently known, although there is the potential for some periods of overlapping piling activities to be undertaken in the region.

141 Noise modelling has been undertaken across all three development sites and assumes that piling will occur simultaneously at all three sites.

6.1.3.1 Cumulative Permanent Threshold Shift

142 Results from M-weighted SEL modelling based on pinniped frequency are presented in Figure 6.8

143 The cumulative area across the three discrete areas of potential impact within which there is the potential for PTS to occur is 2,462.6 km^2 and radiates out to a maximum of 31.6 km.

144 Outputs from SAFESIMM modelling indicate that up to 72 harbour seals may receive levels of sound capable of causing PTS.

145 The regional population of harbour seal is 376 individuals from the Scottish Borders to Fraserburgh (Sparling *et al*., 2011) and therefore up to 19% of the regional harbour seal population is at risk of receiving SELs that may cause PTS.

146 If all harbour seals impacted are from the Firth of Tay and Eden Estuary SAC then, based on the latest counts form 2011, 93% of the harbour seal population may be impacted. However, as previously noted, the SAFESIMM model is based on data collected when the population was significantly higher than it is now and therefore over estimates the scale of any impact.

147 If (as is predicted by the Moray Firth Framework studies) 25% of the harbour seal population that is impacted subsequently dies due to PTS, then 18 harbour seals may be impacted from in-combination affects arising from piling activities. This is 23% of the 2011 population and 14% of the 2010 population.

6.1.3.2 Cumulative Temporary Threshold Shift

148 Outputs from SAFESIMM modelling indicate that up to 206 harbour seals may receive levels of sound capable of causing TTS (refer to Table 5.10).

149 Based on the regional populations, up to 54.5% of harbour seals may receive sound levels that could cause TTS. Based on the 2011 Firth of Tay and Eden Estuary harbour seal population of 77 individuals or the 124 individuals in 2010 over 100% of the population may be impacted by TTS.

6.1.3.3 In-combination Behavioural Change/Displacement

150 Outputs from SAFESIMM modelling indicate that up to 305 harbour seals may receive levels of sound capable of causing some behavioural change (refer to Table 5.10).

151 Based on the regional populations, up to 81% of harbour seals may receive sound levels that could cause behavioural change and/or displacement and over 100% of the SAC population.

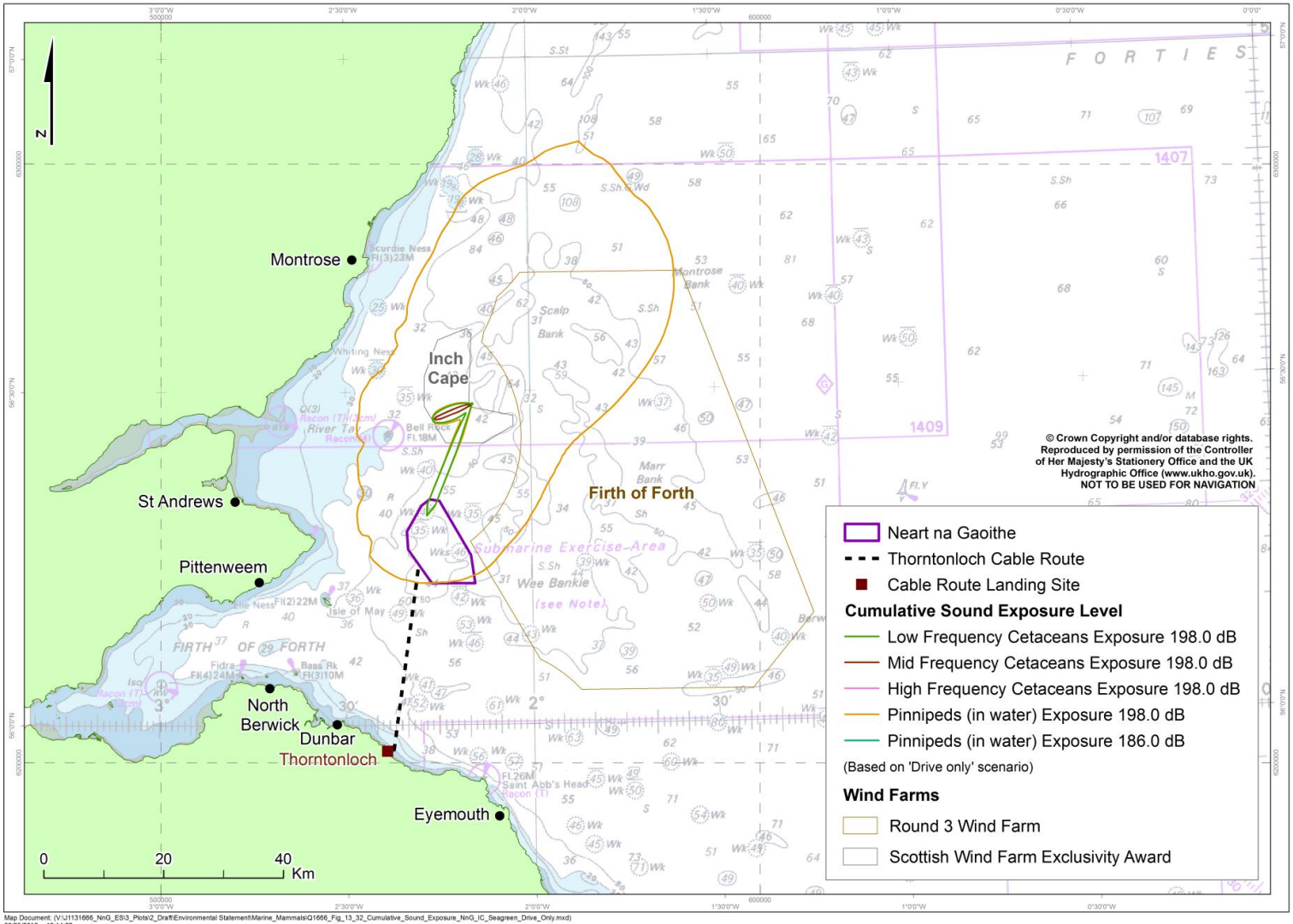

Figure 6.3: Cumulative SEL contours based on 'drive only' scenario.

6.1.3.4 *In-combination impacts*

152 The potential effects from the in-combination impacts arising on harbour seal from the three proposed offshore developments are similar to those described under Neart na Gaoithe on its own. The scale of the impacts, particularly those for potential PTS, are greater however.

153 Seals that may suffer from PTS will permanently lose their ability to hear. Although hearing may not be important for foraging it is likely to have significance in communication and predator avoidance and therefore individuals that suffer PTS may either fail to breed or have significantly greater mortality rates.

154 There is predicted to be a higher number of harbour seals at risk of TTS cumulatively than from Neart na Gaoithe on its own. Should all three developments be undertaking piling simultaneously then up to 25% of the regional population of harbour seals could suffer TTS. The impacts from TTS on each individual harbour seal are similar to those arising from Neart na Gaoithe on its own, but the scale of impact on the population is greater.

155 SAFESIMM modelling predicts a similar level of in-combination impact from all three developments as that from Neart na Gaoithe on its own as although the potential area of effect across all three developments is greater, the number of individuals affected remains similar. Therefore, the cumulative impact across all three developments is similar in effect to any one single development on its own, although the duration of the impact will be longer.

156 In-combination impacts arising from potential developments in the Moray Firth include the Moray Firth Offshore Wind Farm and the Beatrice Offshore Wind Farm. Results from the Beatrice Offshore Wind Farm impact assessment are available (BOWL, 2012). Additional potential cumulative impacts are from the EOWDC (AOWFL, 2011).

157 Results from cumulative noise modelling for Beatrice Offshore Wind Farm and Moray Firth Offshore Wind Farm indicate that the total radius for PTS to occur on harbour seal is 2.5 km and for potential behavioural effects it is 59 km (BOWL, 2012). The modelling undertaken indicates that cumulatively less than ten harbour seals may be impacted by PTS and 1,126 may demonstrate some behavioural or avoidance responses (BOWL, 2012).

158 The area of potential effect does not overlap with potential zone of effect from the Firth of Tay developments and therefore no direct in-combination impacts are predicted to occur.

6.1.4 Firth of Tay and Eden Estuary SAC - Conclusions

159 It is predicted that there will be an impact on the harbour seals that are qualifying species for the Firth of Tay and Eden Estuary SAC from Neart na Gaoithe on its own and in-combination with other plans or projects. It is recognised that the population of harbour seals within the SAC is undergoing a significant decline that will, if continuing on the current trajectory cause the total loss of the SAC population within a few years. Unless the unknown cause of the current harbour seal population decline is identified and the current population decline stopped, the additional impacts from the proposed developments will not cause an adverse effect that will alter the predicted near future population of the SAC harbour seal population.

6.2 Isle of May SAC

6.2.1 Isle of May SAC Site Information

160 Site overview information for the Isle of May SAC is provided in Table 6.2 below.

Table 6.2: Isle of May SAC site information.

Topic	Information
Qualifying feature with connectivity to Neart na Gaoithe	● Grey seal *H. grypus*
Conservation objectives of qualifying feature	To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving Favourable Conservation Status for each of the qualifying features. To ensure for the qualifying species that the following are established then maintained in the long term: ● Population of the species as a viable component of the site; ● Distribution of the species within site; ● Distribution and extent of habitats supporting the species; ● Structure, function and supporting processes of habitats supporting the species; and ● No significant disturbance of the species.
Current status of qualifying feature	The current population (based on pup production) for grey seals at the Isle of May SAC is 2,065 individuals and the population is considered to be in favourable and maintained condition. Grey seals associated with the Isle of May SAC are known to occur throughout the Forth Tay area but most frequently occur in the nearshore waters around the Isle of May and further offshore to the southeast, north and northwest of Neart na Gaoithe. There is very good evidence of a strong linkage between the grey seals associated with the SAC and those recorded offshore. The grey seal population (based on the number of pups) at the Isle of May SAC has remained relatively stable over the last 10 years with counts of between 1,700 and 2,000 individuals. A total of 140 grey seals were recorded from site specific surveys, of which 15 were in the proposed offshore site.

6.2.2 Isle of May SAC - Impacts on Grey Seal

6.2.2.1 Noise from piling 'drive' only installation for wind turbine jacket foundations

161 Results from noise modelling indicate that there is the potential for sound arising from pile driving to remain above the 90 dBht threshold up to 15 km from the sound source and cover an area of approximately 682 km^2. Sound may remain above the 75 dBht threshold out to approximately 47.1 km. The total area where the potential for sound levels to be above 75 dBht but below 90 dBht is 3,581 km^2.

6.2.2.2 Noise from 'drive-drill-drive' installation for wind turbine jacket foundations

162 Modelling results indicate that there is the potential for sound arising from pile driving to remain above 90 dBht threshold up to 16.1 km and remain above 75 dBht out to 50.3 km. The total area of potential impact is between 813.8 km^2 and 4,133 km^2.

6.2.2.2.1 Permanent threshold shift

163 The results from the INSPIRE dBht thresholds indicate that the potential area within which a seal may be impacted that could cause PTS is 0.096 km^2.

164 SEL noise modelling based on a sound exposure level of 186 dB re 1 μPa^2s SEL M-weighted, indicates that for PTS to occur, grey seals will have to be within 6.7 km of the piling activities when operations start for PTS to occur. Based on densities obtained from site specific surveys it is estimated that between 18 and 27 grey seals may be impacted.

165 Based on a SEL of 198 dB re 1 μPa^2s SEL M-weighted then it is predicted PTS will only impact grey seals within 100 m of the piling activities and therefore no, or very few, grey seals are at risk of PTS.

166 Outputs from SAFESIMM modelling indicate that between 235 and 453 grey seals may receive levels of sound capable of causing PTS.

167 There is a significant difference in the results from the two modelling exercises undertaken. The SAFESIMM modelling is very precautionary and is based on densities higher than those recorded within the offshore site and buffer areas. It does not assume that all individuals flee and that they remain in the zone of effect that can cause PTS. The dose response curve also assumes a higher sensitivity to SELs than may be experienced in reality. Consequently, the numbers predicted to be impacted by SAFESIMM are greater than those which presume that all individuals avoid the area of potential effect.

168 The regional population of grey seals is 14,047 (9,330-19,906) (Sparling *et al*., 2011). Therefore, up to 3.2% of the regional grey seal population is at risk of receiving SELs that may cause PTS.

169 The Isle of May SAC grey seal population is unknown. For the purposes of this assessment the 'population' is based on the number of pups recorded each year which, in 2009, was 2,065 individuals and should all those predicted to be impacted be from this population then between 11.3% and 21.9% of the SAC population may be impacted.

170 The number of grey seals predicted by SAFESIMM modelling to receive levels of sound capable of causing PTS is relatively high. The predicted area of impact is likely to be localised and the numbers at risk lower than predicted by SAFESIMM.

171 The use of suitable mitigation measures will reduce the risk of any seals within the area of risk of PTS. Potential mitigation measures include the use of acoustic mitigation devices (AMD) designed such that marine mammals will avoid the area of potential risk without causing physical damage.

6.2.2.2.2 Total displacement and temporary threshold shift

172 Total displacement of grey seals may occur out to 15 km from the piling operations and cover an area of 682 km^2. Based on a density of grey seals of 0.14 per/km^{-2} across the area of potential impact, it is estimated that 95 grey seals may be displaced during potential pile driving operations under the 'drive-drill-drive' scenario. Under the 'drive only' scenario it is predicted that that up to 113 grey seals may be displaced (refer to Table 5.8).

173 Outputs from SAFESIMM modelling indicate that between 1,263 and 1,833 grey seals may receive levels of sound capable of causing TTS. Based on the regional populations, up to 13% of grey seals may suffer TTS and/or displacement. Based on the Isle of May SAC population then between 61.1% and 88.7% of the SAC population may be impacted.

174 The use of site specific density data obtained from 12 months of surveys undertaken over the offshore site including buffer and covering an area of 1,525 km^2 (Gordon 2012) may, in this instance, be more appropriate than the use tracking data that indicates densities of between 0.5 and 10 grey seals per km^2 (Sparling *et al*. 2011). Field observations recorded few grey seals with a total of 140 sightings from 36 surveys undertaken over a period of three years. If densities of up to 10 seals per km^2 were within the site

then more sightings may be expected to have occurred. It is therefore predicted that the number of grey seals that may be impacted will be closer to site specific obtained total of 95 individuals as opposed to up to 1,833 seals predicted by SAFESIMM.

175 It is predicted that any grey seals that receive levels of sound capable of causing TTS will avoid the area. Consequently, the duration at which individual seals are at risk will be short as they avoid the area and become displaced.

176 Grey seals are not hearing specialists and do not use sound to detect prey. They have good vision in clear waters and sensitive mystacilia vibrissae to locate prey in waters with poor visibility and therefore the temporary loss of hearing may not affect the ability of grey seals to forage effectively (Miersch *et al.*, 2011). The predicted duration of any TTS is less than 24 hours (Kastak *et al.,* 2005).

6.2.2.2.3 Behavioural change and partial displacement

177 The 'drive-drill-drive' scenario modelled predicts a potential for some behavioural effect or partial displacement to occur out to 47 km from the piling operations and cover an area of 3,585 km^2. Under the 'drive only' scenario for four jackets and up to 16 piles, some displacement may occur out to 50.3 km and cover an area of 4,133 km^2.

178 Based on a higher density of grey seals of 0.14 per/km^{-2} across the area of potential impact, it is estimated that up to 347 grey seals may show some behavioural change and or displacement under the 'drive-drill-drive' scenario. Under the 'drive only' scenario it is predicted that up to 298 grey seals may be displaced. Up to 2.4% of the regional grey seal population may be impacted..

179 Combining 90 dBht figures and 75 dBht figures, the total number of grey seal predicted to be displaced is 442 individuals on the worse-case 'drive-only' scenario; 3.1% of the regional population of 14,047 individuals. If all 442 individuals that may be displaced are on individuals from the Isle of May SAC then 21.4% of the population may be affected.

180 Outputs from SAFESIMM modelling indicate that between 4,403 and 5,483 grey seals may receive levels of sound capable of causing behavioural change.

181 The outputs from SAFESIM modelling suggest that up to 39% of regional population of grey seals may receive sound levels that could cause behavioural effects.

182 Based on the Isle of May SAC population of 2,065 individuals (based on pup production) then over 100% of the population may be impacted.

Table 6.3: Predicted number of grey seals displaced from pile driving operations.

Grey Seal	Sound Level			
	90 dBht		75 dBht	
	Area (km^2)	No. impacted	Area (km^2)	No. impacted
'Drive-drill-drive'	689.6	96	3,550	298
'Drive only'	813.8	113	4,133	347
Note: the number impacted is based on the highest predicted density of 0.14/km^2 and 60% displacement occurring within the area of audibility of between 75 dBht and 90 dBht.				

183 Results from site tagging studies, density surface modelling and site specific surveys, indicate that grey seals are scarce within the proposed Neart na Gaoithe offshore site. They also indicate that grey seals forage widely between Shetland and northeast England. In the Firth of Forth and Firth of Tay area grey seals are widely dispersed with pups occurring in more inshore waters compared to adults. Concentrations of grey seals occur in patches to the north, northeast and southeast of Neart na Gaoithe.

184 Within the region the main grey seal haul-outs are on the Isle of May, Fast Castle (Berwickshire) and the Farne Islands off Northumberland. The population in the region has increased significantly in recent years and is currently estimated to be between 9,000 and 19,900 grey seals depending on time of year and survey methods (Sparling *et al*., 2011).

185 Grey seals pup from August to the end of December with those on the Isle May being predominantly from October onwards. Pups and females remain on the haul-out beaches until the pups have weaned up to 23 days after birth. After weaning the pups may remain in the colony for a further two weeks (Thompson and Duck, 2010). Prior to pupping there is a gradual increase in the numbers occurring in nearshore waters adjacent to the haul-out beaches (SNH, 2006). Following breeding, grey seals undergo a moult in January and February (SNH, 2006).

186 Grey seals forage widely, feeding on variety of benthic and fish prey species. Within the Firth of Forth and Firth of Tay area, concentrations occur near to the Tay Estuary and to the north and northeast of Neart na Gaoithe. There is a small localised patch of higher concentrations near to the south east of the Neart na Gaoithe offshore site.

187 The potential impacts on individual grey seals from noise will vary depending on individuals' sensitivities and habituation to noise. Furthermore, studies suggest that the response to noise by seals may depend on whether the sound is sudden and causes a startle response or more gradual and allows habituation to occur and not cause a startle response. Where sound levels are increased more gradually there is a reduced level of displacement (Gotz & Janik, 2011).

188 The potential effect of causing a displacement may vary depending on the season. The period of main sensitivity is predicted to be during the pupping season from October to December when the majority of grey seals are near to the coastal haul-out sites. The lowest numbers were recorded within the study area during this period. Unlike harbour seals, during the breeding season grey seals remain largely ashore.

189 Displacement effects may mean that during the pupping season grey seals may avoid the haul-out sites. If so, pregnant females will have to relocate to other alternative, potentially less suitable, pupping locations. Should this occur then there might be an increase in juvenile mortality. During the 1970s and 1980s, disturbance from culling of grey seals on the Farne Islands caused extensive relocation of pregnant seals to other areas with significant increases in grey seal populations on the Isle of May and this is likely to have caused the initial start of the colony at Donna Nook in Lincolnshire. Since the cessation of culling and disturbance activities on the Farne Islands the population of grey seals has rapidly increased (Thompson and Duck, 2010). Consequently, it is predicted that any displacement effects will cause temporary relocation of grey seals to other haul-out sites but they will return to existing natural levels following the completion of foundation installation.

190 The construction period during which turbine foundations will be installed is predicted to last between 12 and 18 months, therefore the displacement effects away from pupping areas are likely only to occur over one season or possibly two. Should this occur then there will be a temporary adverse effect at the pupping areas during which time grey seals will relocate to alternative pupping grounds.

191 Outside the breeding season, grey seal distribution offshore is predicted to be associated with optimal foraging areas. However, grey seals are opportunistic feeders and can adapt to foraging on alternative prey if their prey availability changes. The impacts of piling on their prey may mean that fin fish species, particularly those considered to be hearing specialists such as herring, may avoid the area. However, noise modelling indicates only localised effects on species such as sandeels (See ES Chapter 15: Fish and Shellfish Ecology) and so it is predicted that there will be potential prey available in the area during the period of construction. Grey seals should therefore be able to find food during construction activities.

192 Data from existing offshore wind farms indicate that grey seals may avoid the offshore site during construction but may return following cessation of construction activities. At North Hoyle, grey seals were counted at non-breeding haul-out sites 10 km away before during and after construction and changes in the number of seals were reported. The study concluded that there appeared to be no direct effect on the grey seals from construction activity (SMRU, 2009).

193 At Scroby Sands offshore wind farm there was an increase in the number of grey seals at haul-out sites within 2 km of the piling operations during the construction period (although no direct observations were made during piling operations) and post-construction period (SMRU, 2009).

194 The potential for grey seals to forage opportunistically elsewhere and data from existing wind farms indicate that the impacts from displacement and changes in behaviour will last for the duration of the foundation construction period but populations are predicted to return to natural levels following cessation of piling operations.

6.2.2.3 Noise from vessels during construction, operation and decommissioning

195 Noise levels arising from drilling operations vary depending on whether the drilling is undertaken from a floating platform such as drill ship or semi-submersible drill rig or whether they are from a fixed installation such a drilling rig. There are no data on noise levels from jack-up drilling rigs but are expected to be similar to similar to those arising from drilling platforms. Typically sound levels are higher from drill ships where noise the machinery is contained within the hull and contains a large surface area to radiate from. Drill ships can generate sound pressure levels of up to 195 dB (rms) re 1µPa@1m and continuous low frequency noise of between 100 to 400 Hz. Those from drill rigs have been reported to be up to 162 dB (rms) re 1µPa@1m (Genesis, 2012).

196 Vessel noise varies across different vessel types and, in particular the size of the vessel. Larger vessels typically produce sound levels at lower frequencies than smaller high powered propeller driven craft, which often exceed larger vessel noise in the frequencies above 1 kHz. Typically vessel noise is within the 50-300 Hz band and is the dominant noise source in deeper water between 20- 500 Hz. Noise source levels are typically lower for smaller vessels between 160 to 175 db (re 1µPa) and increasing to between 180-190 dB (re 1µPa) for larger vessels of greater than 100 m in length (Genesis, 2012).

197 Noise levels from these activities are typically lower than those arising from piling activities and although they may be more continuous than intermittent piling events the magnitude of the impact is significantly lower.

6.2.2.4 Presence of vessels during construction/installation and operation/maintenance

198 The presence of vessels during the lifetime of the project may cause a very localised disturbance or displacement effect. Potentially the main impact arising from the vessels will be from possible physical impacts, specifically those arising from interactions between grey seals and vessels thrusters.

6.2.2.5 Physical impact

199 There is the potential for a physical impact on grey seals from thrusters used by vessels during the construction, operation and decommissioning stages of the development.

200 Low numbers of grey seals were recorded in the study area, with 15 being recorded within the offshore site over the course of 3 years of surveys (refer to Table 5.3). Tagging studies indicate that the Neart na Gaoithe offshore site has a relatively low level of usage compared to elsewhere in the Firth of Forth and Firth of Tay area (refer to Figure 5.9 and Figure 5.10) and therefore the risk of an interaction is relatively low.

201 The frequency of interactions between seals and ducted propellers is unknown and is subject to ongoing research. However, the low numbers of seals recorded in the Neart na Gaoithe offshore site indicates that the risk of an interaction is low and the magnitude of any effect is predicted to be negligible.

6.2.3 Isle of May SAC - Cumulative and In-Combination Impacts

202 Potential cumulative impacts on grey seals may arise from the proposed development of offshore wind farms at Inch Cape, Firth of Forth and Neart na Gaoithe. The precise periods of construction for the projects are not currently known, although there is the potential for some periods of overlapping piling activities to be undertaken in the region.

203 Noise modelling has been undertaken across all three development sites and assumes that piling will occur simultaneously at all three sites.

6.2.3.1 *In-combination permanent threshold shift*

204 The cumulative area across the three discrete areas of potential impact within which there is the potential for PTS to occur is 2,462.6 km^2 and radiates out to a maximum of 31.6 km. Based on the site specific density for grey seal it is predicted that up to 344 grey seals may be affected.

205 Outputs from SAFESIMM modelling indicate that up to 733 grey seals may receive levels of sound capable of causing PTS.

206 The regional population of grey seal is 14,047 (9,330-19,906) (Sparling *et al*., 2011). Therefore, 5% of the regional grey seal population is at risk of receiving sound exposure at levels that may cause PTS.

207 The Isle of May SAC population is 2,065 individuals (based on pup production) and therefore, if all those impacted are from the SAC then between 16.6% and 35.4% of the population may be impacted.

6.2.3.2 *In-combination temporary threshold shift*

208 Outputs from SAFESIMM modelling indicate that up to 2,579 grey seals may receive levels of sound capable of causing TTS (refer to Table 5.10). Based on the regional populations, up to 18.3% of grey seals may receive sound levels that could cause TTS and over 100% of the SAC population.

6.2.3.3 *In-combination behavioural change and partial displacement*

209 Outputs from SAFESIMM modelling indicate that up to 6,163 grey seals may receive levels of sound capable of causing some behavioural change.

210 Based on the regional populations, up to 43% of the grey seal population may be displaced during construction activities. Based on the SAC population over 100% of the population may be impacted.

6.2.3.4 *In-combination impacts*

211 The potential effects from the in-combination impacts on grey seal from the three proposed offshore developments are similar to those described under Neart na Gaoithe on its own. The scale of the cumulative impact, particularly for PTS is greater.

212 Grey seals that suffer from PTS will permanently lose their ability to hear and although hearing may not be important for foraging it is likely to have significance in communication and predator avoidance. Individuals that suffer PTS may either fail to breed or have significantly greater mortality rates. Consequently, the significance of the impact may be moderate.

213 There is predicted to be a higher number of grey seals at risk of TTS cumulatively than from Neart na Gaoithe on its own. Should all three developments be undertaking piling simultaneously then up to 18.3% of the regional population of grey seals could suffer TTS. The impacts from TTS on each individual grey seal are similar to those arising from Neart na Gaoithe on its own and likely to last no longer than 24 hrs (Kastak *et al.,* 2005) but the scale of impact on the population is greater.

214 SAFESIMM modelling predicts a similar level of cumulative impact from all three developments as that from Neart na Gaoithe on its own. Although the potential area of effect across all three developments is greater, the number of individuals affected remains similar. The cumulative impact across all three developments is therefore similar in effect to any one single development on its own. However, the duration of the effect will last longer as all three potential developments progress and there are periods of overlapping activity.

6.2.4 Isle of May SAC - Conclusions

215 It is concluded that there will be an impact on grey seals from the Isle of May SAC from Neart na Gaoithe on its own and in-combination with other plans or projects. Low numbers of grey seal are predicted to receive sound levels that will cause physical injury or mortality; higher numbers are predicted to be displaced. Grey seals from the SAC occur widely and those that may be displaced will be able to relocate to other suitable foraging locations. There may be an impact on grey seals during the breeding period, which is estimated to occur for a single season and should this occur, those affected will be able to relocate to other breeding locations and return the following season. The population of grey seals at the SAC is in a favourable condition and the predicted level of impact will not cause an adverse effect on the integrity of the Isle of May SAC from noise related impacts on grey seals.

6.3 Berwickshire and North Northumberland Coast SAC

6.3.1 Berwickshire and North Northumberland Coast SAC Site Information

216 Site overview information for the Berwickshire and North Northumberland Coast SAC is provided in Table 6.4 below.

Table 6.4: Berwickshire and North Northumberland Coast SAC site information.

Topic	Information
Qualifying feature with connectivity to Neart na Gaoithe	● Grey seal *H. grypus*
Conservation objectives of qualifying feature	To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving Favourable Conservation Status for each of the qualifying features. To ensure for the qualifying species that the following are established then maintained in the long term: ● Population of the species as a viable component of the site; ● Distribution of the species within site; ● Distribution and extent of habitats supporting the species; ● Structure, function and supporting processes of habitats supporting the species; and ● No significant disturbance of the species.
Current status of qualifying feature	The current population for grey seals at the Berwickshire and North Northumberland Coast SAC is 3,061 individuals (based on number of pups) (Table 5.4. Fast Castle and Farne Islands populations). Grey seals associated with the SAC are known to occur in the area but will mostly occur in the waters adjacent to the breeding sites, particularly during the breeding period. Grey seals are know to roam widely and there evidence of a linkage between the grey seals associated with the SAC and those recorded offshore. The grey seal population (based on the number of pups) at the Berwickshire and North Northumberland Coast SAC has increased significantly, particularly at Fast Castle where the number of pups produced has increased from 268 (1999) to 1,715 (2009). A total of 140 grey seals were recorded from site specific surveys, of which 15 were in the proposed offshore site.

217 Evidence from tagging studies indicate that grey seals from Berwickshire and North Northumberland Coast SAC can occur within the area of potential noise impacts from Neart na Gaoithe (Sparling *et al.* 2011). Grey seals from this site contribute to the regional population.

6.3.2 Berwickshire and North Northumberland Coast SAC – Impacts on Grey Seal

218 The potential impacts on grey seals from Berwickshire and North Northumberland Coast SAC are similar to those from the Isle of May SAC (refer to Section 1.1). They are not repeated here.

219 The site lies further from the proposed development area and it is predicted that there will be a lower risk of grey seals from the SAC being within the area of potential impacts than those from the Isle of May. Although they can occur in the area, it is not possible to quantify what proportion of the grey seal population may occur during any particular part of the year and therefore it is not possible to determine what proportion of the population may be impacted.

6.3.3 Berwickshire and North Northumberland Coast SAC – Conclusions

220 The conclusions are based on the Isle of May assessment and that the population is increasing and in a favourable condition.

221 It is concluded that there will be an impact on grey seals from the Berwickshire and North Northumberland Coast SAC from Neart na Gaoithe on its own and in-combination with other plans or projects. Low numbers of grey seal are predicted to receive sound levels that will cause physical injury or mortality; higher numbers are predicted to be displaced. Grey seals from the SAC occur widely and those that may be displaced will be able to relocate to other suitable foraging locations. The population of grey seals at the SAC are in a favourable condition and the predicted level of impact will not cause an adverse effect on the integrity of the Berwickshire and North Northumberland Coast SAC from noise related impacts on grey seals.

6.4 Moray Firth SAC

6.4.1 Moray Firth SAC Site Information

222 Site overview information for the Moray Firth SAC is provided in Table 6.5 below.

Table 6.5: Moray Firth SAC site information.

Topic	Information
Qualifying feature with connectivity to Neart na Gaoithe	● Bottlenose dolphin *T. truncatus*
Conservation objectives of qualifying feature	To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving Favourable Conservation Status for each of the qualifying features. To ensure for the qualifying species that the following are established then maintained in the long term: ● Population of the species as a viable component of the site; ● Distribution of the species within site; ● Distribution and extent of habitats supporting the species; ● Structure, function and supporting processes of habitats supporting the species; and ● No significant disturbance of the species.
Current status of qualifying feature	Bottlenose dolphins are in considered to be in unfavourable and recovering population. Bottlenose dolphins associated with Moray Firth SAC are known to forage widely with good evidence of a strong linkage between the individuals known to occur within the SAC and sites elsewhere along the nearshore waters of the east coast of Scotland, including the Forth and Tay area. No bottlenose dolphins have been recorded from 2 years of boat-based surveys or from nearly 1 year of aerial surveys within the proposed Neart na Gaoithe development or buffer area. Consequently, the distribution of bottlenose dolphins along the east coast of Scotland is primarily coastal and is one population estimated to be totalling 193 (range 162-245) individuals or 195 (range 162-253) individuals from different studies (see Chapter 13: Marine Mammals for more information). At the time of designation the population was 130 individuals.

223 Bottlenose dolphins were not recorded from any of the boat-based surveys undertaken at Neart na Gaoithe. However, they do occur in the Firth of Tay area and are within the range of potential impact from noise arising from piling activities.

224 With no sightings of bottlenose dolphins during the three years of surveys, it is not possible to calculate site specific densities. However, densities covering various parts of the Scottish east coast bottlenose dolphin population have been estimated.

225 Results from SCANS II surveys covering zone V (that includes the Firth if Forth area) estimate a density of 0.0008 bottlenose dolphin/km^2 (SCANS II). The SCANS surveys covered extensively offshore areas where lowest densities of bottlenose dolphins may be predicted to occur. Consequently, this density is likely to underestimate the density of bottlenose dolphins within the area of affect.

226 Estimates of bottlenose dolphin densities have been made based on surveys undertaken in the Firth of Forth and Firth of Tay areas. The results indicate that densities of between 0.28 and 0.35 bottlenose dolphins may occur in the nearshore waters (Quick and Cheney 2011). These densities assume an even

distribution of bottlenose dolphins over an area of 319 km^2 and consider only the coastal waters and therefore over-estimate the density of bottlenose dolphins within the area of affect.

227 It is predicted that the actual density of bottlenose dolphins within the area impacted will vary with densities close to those reported by SCANS II surveys occurring over the large proportion of the impacted area and densities estimated by Quick and Cheney (2011) occurring in the relatively small area of impact in the nearshore coastal waters.

228 The hearing thresholds for bottlenose dolphin have been one of the best studied for any cetacean, the results from which are presented in Figure 6.4. Bottlenose dolphins are mid-frequency hearing specialists particularly between 15 to 130 kHz (Southall *et al.,* 2007; David, 2006).

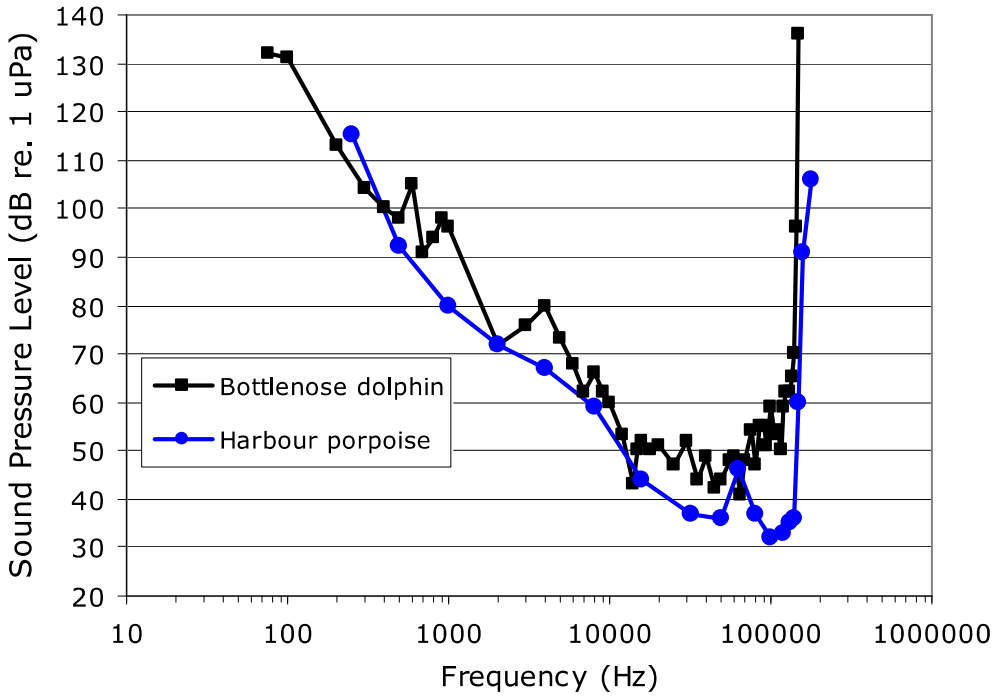

Figure 6.4: Bottlenose dolphin and harbour porpoise hearing thresholds (Source: Kongsberg, 2010).

6.4.2 Impacts on Bottlenose Dolphin

6.4.2.1 Behavioural Change and Partial Displacement

229 The distribution of bottlenose dolphin along the east coast of Scotland is near to the coast, with few sightings of bottlenose dolphins reported far from shore. The aerial surveys undertaken by The Crown Estate reported only one dolphin beyond 12 NM from the coast and there have been no sightings in the study area from 3 years of surveys (Macleod and Sparling, 2011). Studies in the Moray Firth and in the seas close to northeast Scotland have rarely recorded bottlenose dolphin more than a few kilometres from the coast and although this may, in part, be a reflection of survey coverage, it indicates that bottlenose dolphins remain largely inshore along the east coast of Scotland (Thompson *et al.,* 2010c; Anderwald and Evans, 2010; Reid *et al.,* 2003).

230 Any displacement will cause the bottlenose dolphins to move either to the north or south, although they are predicted to remain coastal. Displaced bottlenose dolphins will be able to forage and communicate when outside the zone of effect. There is potential for increased intra-specific competition during the construction period, but as bottlenose dolphins occur widely along the coast (as shown in Figure 5.1) any that are displaced will be able to move elsewhere.

6.4.2.2 Noise from 'drive' only installation for wind turbine jacket foundations

231 Modelling undertaken based on the 'drive only' scenario indicates that there is the potential for sound arising from pile driving to remain above 90 dBht threshold up to 13.3 km and 38.9 km at 75 dBht. The total area of potential impact is between 555.5 km^2 and 2,898 km^2.

6.4.2.3 Noise from 'drive-drill-drive' installation wind turbine jacket foundations

232 Results from noise modelling based on the 'drive-drill-drive' scenario indicate that there is the potential for sound arising from pile driving to remain above the 90 dBht threshold up to 12 km from the sound source and cover an area of approximately 451 km^2.

233 Noise modelling predicts that sound may remain above the 75 dBht threshold out to approximately 35.5 km in nearshore waters. The total area where there is potential for sound levels to be above 75 dBht but below 90 dBht is 2,568 km^2.

6.4.2.3.1 Permanent threshold shift

234 The results from the SEL noise modelling indicate that for PTS to occur, bottlenose dolphins will have to be within 100 m of the piling activities when operations start. Bottlenose dolphins have not been recorded in the area and along with the relatively small area of potential impact it is unlikely that any will be present within this zone at the start of operations. Industry best practice mitigation measures, agreed through the Environmental Management Plan.

6.4.2.3.2 Temporary threshold shift

235 Modelling predicts that total displacement may occur out to 13.3 km from the piling operations based on a 'drive-only' scenario. Results using SAFESIMM predict that a total of six bottlenose dolphins may receive levels of noise that could cause TTS.

236 No bottlenose dolphins were recorded within 8 km of the proposed offshore site and aerial surveys undertaken by The Crown Estate recorded only one bottlenose dolphin outwith 12 nm from the coast and two within 12 nm (Macleod and Sparling, 2011). Therefore, site specific data indicate that the risk of any bottlenose dolphin being within range of activities that could cause TTS is remote.

237 Bottlenose dolphins in Firth of Forth and Firth of Tay area rarely occur further than 12 km from the coast with most records within a few kilometres from the coast (Quick and Cheney, 2011). The noise modelling undertaken indicates that the potential area within which total avoidance may occur is no closer than 6 km from the coast at Fife Ness and more than 20 km from the Tay Estuary. Therefore, the majority of the area of usage in the Tay area by bottlenose dolphins is outside the zone of effect where total displacement is predicted to occur. It is predicted that few, if any bottlenose dolphins will be impacted by noise that will cause either total displacement or TTS.

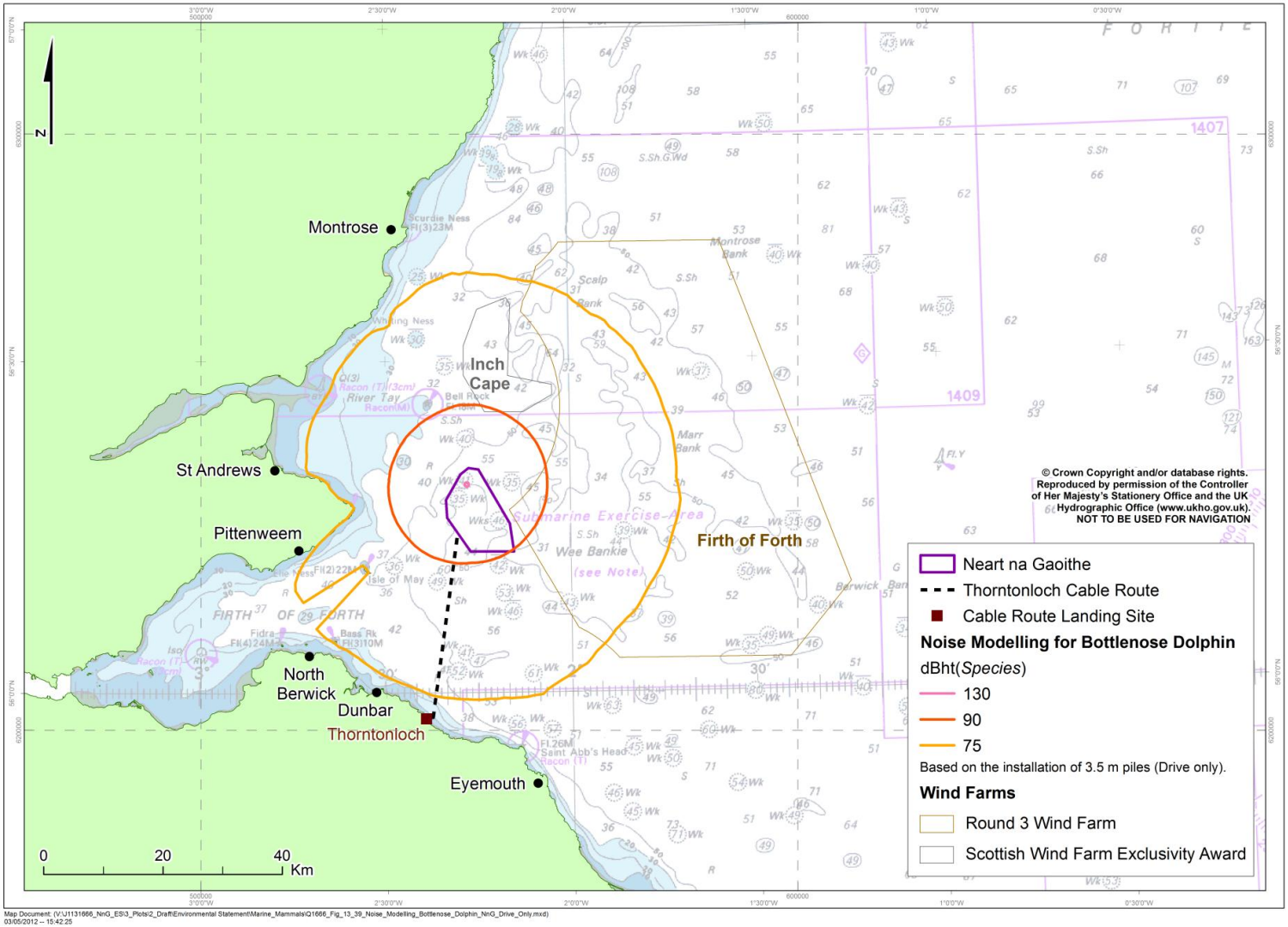

Figure 6.5: Noise modelling results for bottlenose dolphin based on the installation of 3.5 m piles (drive only).

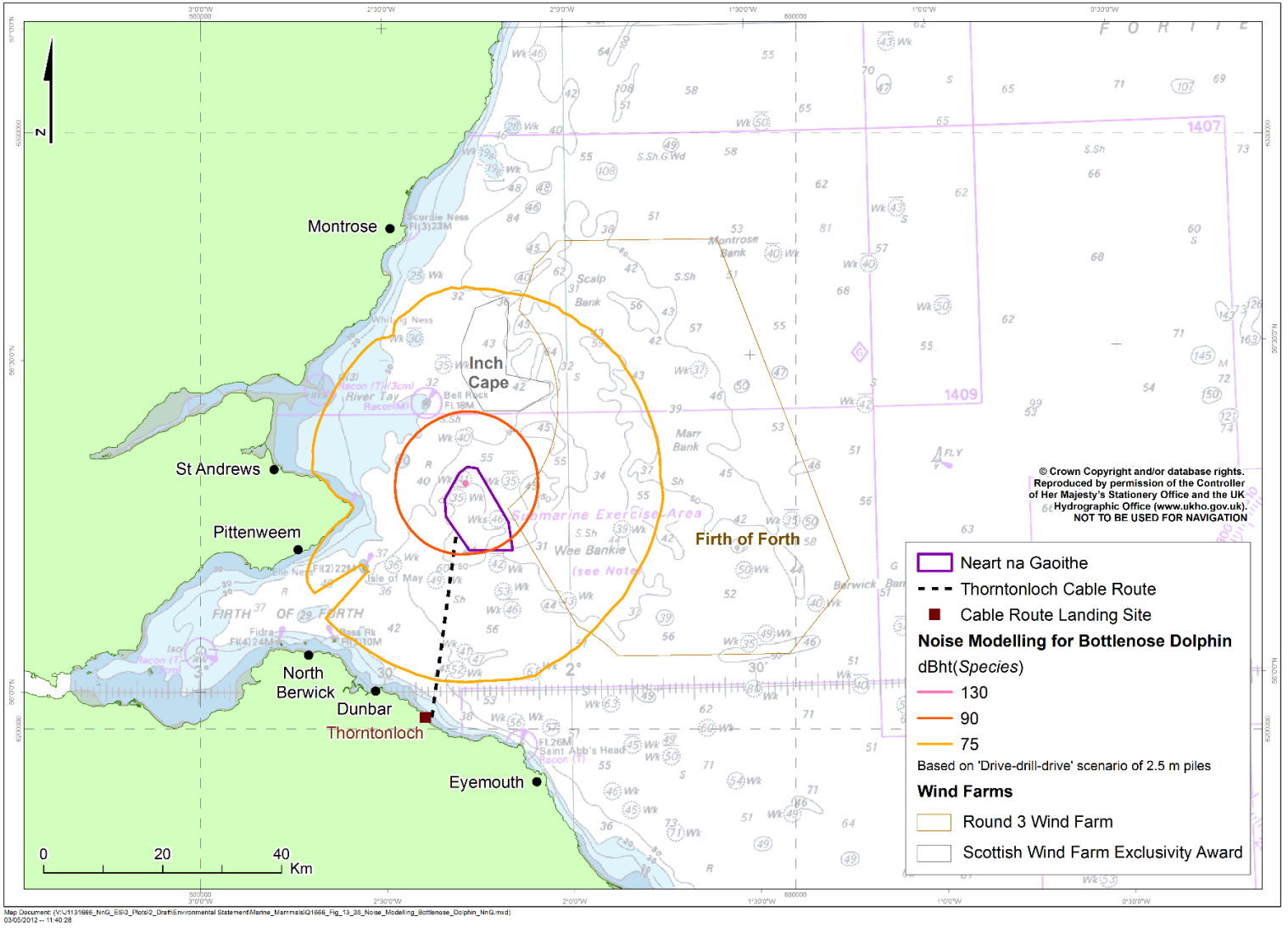

Figure 6.6: Noise modelling results for bottlenose dolphin based on 'drive-drill-drive' scenario of 2.5 m piles.

6.4.2.3.3 Behavioural change and partial displacement

238 Modelling predicts that there is potential for some behavioural effect or partial displacement to occur out to between 35 km and 39 km from the piling operations and cover an area of up to 2,898.5 km^2.

239 Results from the SAFESIMM modelling indicate that up to 124 bottlenose dolphins may exhibit some avoidance behaviour (Sparling *et al.,* 2012).

240 The area of potential behavioural change and partial displacement extends closer to shore than the area of total displacement and there is a potential for some bottlenose dolphins to be affected, particularly those occurring near Fife Ness. Should this occur, bottlenose dolphins may avoid swimming through the area or alter their behaviour, e.g. by reducing vocalisation or by changing feeding patterns. The consequences of this are difficult to predict as no studies identifying impacts from the construction of offshore wind farms on bottlenose dolphin have been published (e.g. Michel *et al*., 2007; Thomsen *et al*., 2006; Lucke *et al*., 2006;).

241 The results from both the 'drive-drill-drive' and 'drive-only' scenarios indicate that the levels of sound at which up to 60% of bottlenose dolphins may be affected do not reach the coast except for Fife Ness (refer to Figure 6.5 and Figure 6.6). Consequently, for bottlenose dolphins travelling between the Tay Estuary and the Moray Firth SAC the sound from piling activities will still be audible to bottlenose dolphins in the area of the Tay Estuary but are below that which are predicted to cause and displacement or behavioural changes (refer to Figure 6.7).

242 The results of the noise modelling are based on the installation of a pile at the closest point to the coast and therefore the one that is most likely to have the greatest impact on the coastal population of bottlenose dolphins, in the Firth of Tay, i.e. worst-case scenario has been modelled. The results indicate that the level of sound from the installation of the closest turbine will not cause significant displacement or behavioural effects from the closest piling event. The majority of turbines are situated further offshore than the one considered in this assessment and spaced up to 1 km apart. Consequently, the area of coastal waters impacted by the installation of the majority of turbines will be lower than modelled and the worst-case scenario will occur for the short duration of installing turbine along the perimeter of the site boundary.

243 The duration at which highest coastal impacts will occur will be relatively small compared to the overall construction period. Piling will occur over a period of 13 to 15 hrs (refer to Table 3.1 and Table 3.2) after which the next turbine, which will be approximately at least 1 km away, will be installed. Consequently, the duration of impacts likely to cause maximum impact will be over a relatively short timescale and turbines installed further offshore will have a lower impact on the bottlenose dolphins.

244 The levels of sound in the area where the majority of bottlenose dolphins occur are at levels that are unlikely to cause total displacement and bottlenose dolphins can move through or into the area. Masking of whistles and clicks could occur within the area of potential behavioural change. There is potential for masking effects to occur between 10 km and 15 km for sounds at 9 KHz, but closer for sounds at higher frequencies (David, 2006). Results from studies undertaken during the construction of the Beatrice demonstrator project in the Moray Firth were inconclusive, although they did indicate that dolphins remained in the wider area. There was insufficient data to assess whether there were any near-field effects (Thompson *et al*., 2010a).

245 Partial displacement may occur along the coast of Fife Ness but based on the modelling results displacement is not predicted to occur across the wider area including the Tay Estuary. The potential for a localised partial displacement will not cause an adverse effect.

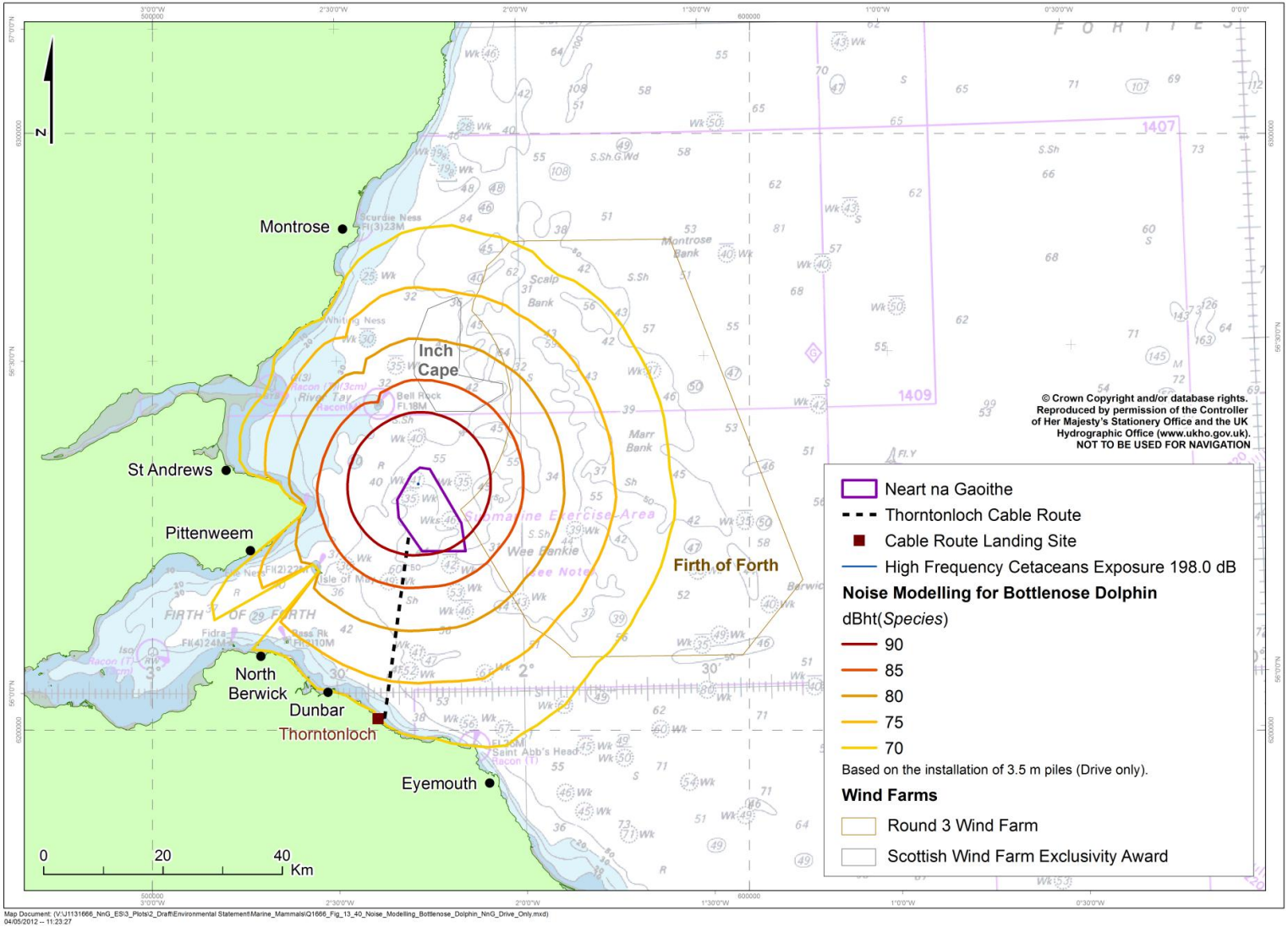

Figure 6.7: Noise modelling contours from 90 dBht to 70 dBht for bottlenose dolphin based on the installation of 3.5 m piles (drive only).

6.4.2.4 *Noise from vessels during construction, operation and decommissioning*

246 The vessels likely to be used during construction, operation and decommissioning are described in the Environmental Statement Chapter 5: Project Description. Due to the wide range of activities being undertaken a variety of vessels will be used, each producing different operational noise.

247 Noise arising from vessel activities may cause masking effects, displacement or behavioural changes such as increased vocalisation related to vessel activity (Lucke *et al*., 2006, Genesis 2012).

248 Although sounds arising from vessel activity may be audible to coastal populations of bottlenose dolphin (Thomsen *et al*., 2006) the zone within which a potential behavioural response may occur is predicted to be outside any area where bottlenose dolphins are known to occur in Firth of Tay and Firth of Forth area and therefore there will be no adverse effect on bottlenose dolphins arising from sound from vessel activity.

6.4.3 Moray Firth SAC - Cumulative and In-Combination Impacts

249 Potential in-combination impacts on bottlenose dolphin may arise from the proposed development of offshore wind farms at Inch Cape, Firth of Forth and Neart na Gaoithe in Firth of Forth and Firth of Tay and other wind farms to the north, including those in the Moray Firth and in Aberdeen Bay. The precise periods of construction for the projects are not currently known, although there is the potential for periods of overlapping piling activities to be undertaken in the region.

250 In-combination noise modelling has been undertaken across all three offshore sites and assumes that piling will occur simultaneously at all three sites.

6.4.3.1 *In-combination Permanent Threshold Shift*

251 The results of the cumulative noise modelling for mid frequency specialists, such as dolphins, are presented in Figure 6.9.

252 The cumulative area across the three discrete areas of potential impact within which there is the potential for PTS to occur is 3.3 km^2. No bottlenose dolphins were recorded in the area of proposed development by the aerial surveys and none were recorded from boat-based surveys at Neart na Gaoithe or at Seagreen Project Alpha and Bravo (Seagreen 2012). Industry best practice mitigation measures, agreed through the Environmental Management Plan, will be in place prior to and during any piling activities.

6.4.3.2 *In-combination Temporary Threshold Shift*

253 Results from SAFESIMM modelling indicate that up to six bottlenose dolphins may receive levels of sound that could cause TTS. Should that occur, it is predicted that TTS will last for a short period of time until the individual moves to areas with reduced sound levels. Studies show that this is not likely to be longer than a few hours (Parvin *et al.,* 2007; Finneran *et al.,* 2002). During this period of TTS, individuals are likely to have reduced foraging and communication capability but the predicted duration of the potential impact is short.

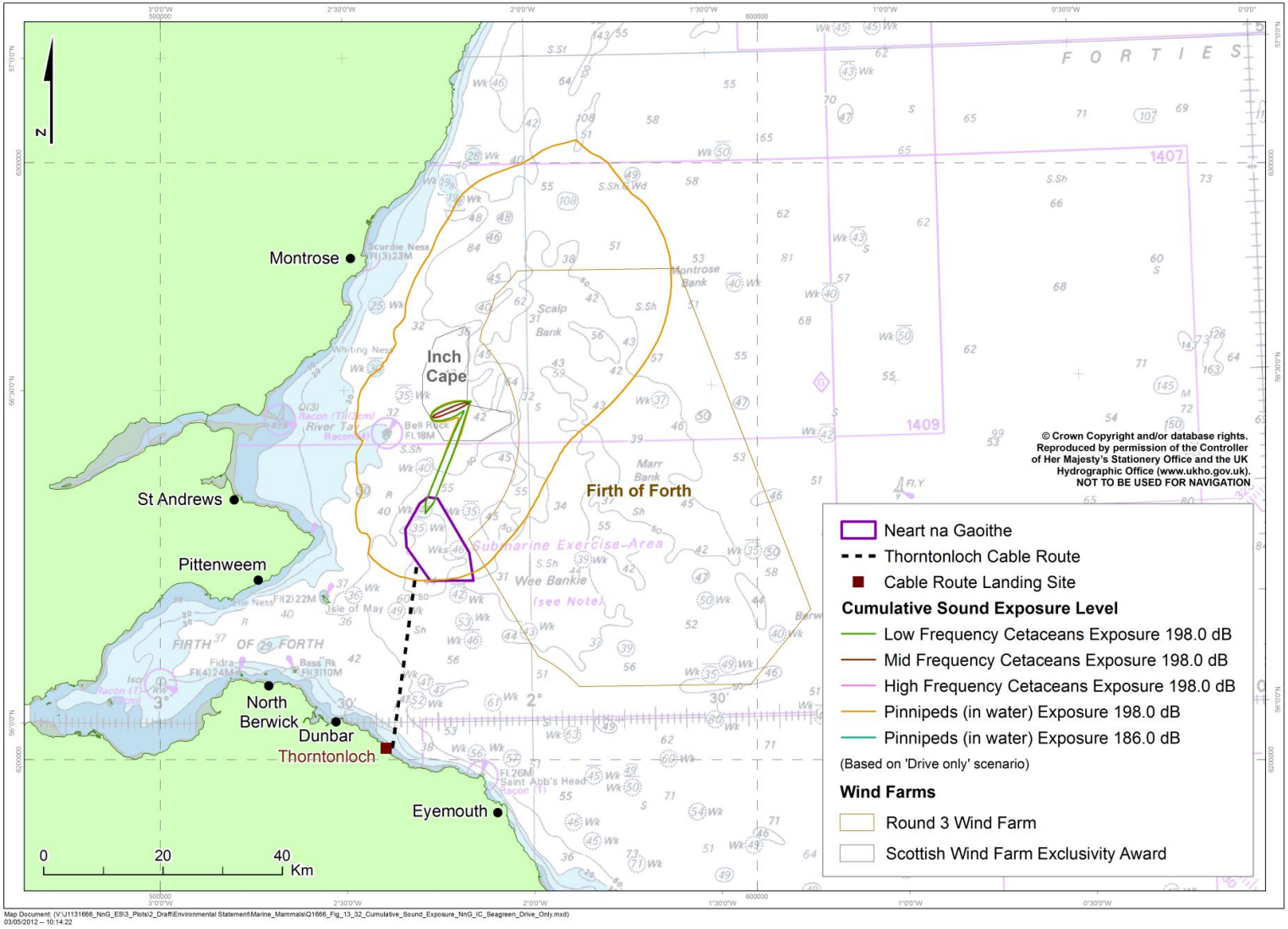

Figure 6.8: Cumulative SEL contours based on 'drive only' scenario.

6.4.3.3 *In-combination Behavioural Change and Partial Displacement*

254 It is not possible to predict with certainty the changes in behaviour that may occur, but these may include reduced foraging, increased vocalisation and increased avoidance of the area.

255 Results from the SAFESIMM modelling indicate that up to 124 bottlenose dolphins may exhibit some avoidance behaviour from the cumulative impacts of piling (Sparling *et al.,* 2012).

256 Bottlenose dolphins in the Tay are known to be from the same population as those that occur in the Moray Firth and there is a regular passage of individuals along the east coast of Scotland between the two sites (Quick and Cheney, 2011). In areas where the levels of sound are such that there is predicted to be avoidance then there is the potential for the cumulative sound levels to reduce the level of interaction of bottlenose dolphins between the Moray Firth and the Tay Estuary.

257 Bottlenose dolphins occur in the Firth of Forth and Firth of Tay area throughout the year. Numbers present appear to increase during the summer and peak during the autumn, then reduce during the late winter and spring periods (Figure 5.2 and Figure 5.3).

258 The level of sound occurring along the coast between Arbroath and Fife Ness from Neart na Gaoithe is below that predicted to be at levels below which displacement effects will occur, i.e. below the 75 dBht level; although the in-combination impacts predict that there will be some partial displacement effect.

259 Bottlenose dolphins occur widely along the coast between the Firth of Tay and the Moray Firth (Figure 5.1) and those that may be displaced will relocate to other areas where bottlenose dolphins occur, in particular in the Moray Firth or Aberdeen Bay. There are currently two proposed offshore wind farm developments in the Moray Firth (Beatrice Offshore Wind Farm and Moray Firth Offshore Wind Farm) and one test centre in Aberdeen Bay. These may also be undertaking installation activities during the period when Neart Na Gaoithe, Inch Cape and Seagreen Projects Alpha and Bravo are also undergoing construction. Should this occur then it is predicted that there is the potential for an in-combination impact on bottlenose dolphins in both the Moray Firth and Firth of Tay areas.

260 The timing of the construction activities may be such that the period of cumulative piling will be significantly lower than predicted by SAFESIMM modelling and therefore the potential cumulative impacts also lower. Currently, the timing of the scheduled construction periods are uncertain but based on current predicted schedules, this may mean that there is a period of less than 12 months during which one or more of the Firth of Forth and Firth of Tay developments may be being constructed at the time of Neart na Gaoithe.

261 The SAFESIMM modelling predicts little or no additional cumulative impact arising from construction activities if one or more Firth of Forth and Firth of Tay developments occur simultaneously. However, this may in part be due to the spatial range that the model predicted potential impacts, particularly to the north of the Neart na Gaoithe offshore site, which was limited by a lack of available data to provide density estimates (Sparling *et al.,* 2012). It is thought that areas to the north that could be impacted also have bottlenose dolphins present. The proportion of east coast of Scotland bottlenose dolphin population that could be impacted may therefore be higher than the 124 predicted using SAFESIMM.

262 Bottlenose dolphins that may be displaced will, based on their wide ranging coastal distribution (Figure 5.1), be able to relocate elsewhere for the duration of the construction activity. However, it is not known whether the Firth of Tay area is of significant importance to bottlenose dolphins. Photo identification studies have shown strong links between the Moray Firth and the Firth of Tay area. The numbers of sightings between both locations in any single year indicate that there is potential for displaced dolphins to relocate northwards.

263 The proposed EOWDC in Aberdeen Bay is composed of eleven turbines, some of which will be installed by pile driving. Results from noise modelling indicate that behavioural impacts may arise up to 16 km from the piling activities (AOWFL, 2011) and therefore there will not be any overlap in significant noise thresholds with Neart na Gaoithe. However, it is predicted that all bottlenose dolphins from within that range during construction will be displaced and locate to sites elsewhere to the north or south. The bottlenose dolphins may move into the area of potential effect with Neart na Gaoithe.

264 The duration of piling activity during EOWDC is predicted to last no longer than 24 hours for each turbine and four or less turbines may be installed using piling and so the duration of impacts is likely to be less than four days. The current schedule is for construction activity to commence in 2014 and therefore there is a risk of a period of overlapping construction activity. However, the duration of this potential cumulative impact is low and the distance between the Neart na Gaoithe and the proposed EOWDC is in excess of 100 km. The risk of a cumulative impact arising between the two projects is therefore considered low.

265 There are currently two proposed offshore wind farms in the Moray Firth: the Beatrice Offshore Wind Farm and the Moray Firth Offshore Wind Farm.

266 Results from cumulative noise modelling for Beatrice Offshore Wind Farm and Moray Firth Offshore Wind Farm indicate that the total radius for PTS to occur on bottlenose dolphin is 0.5 km and 43.4 km for potential behavioural effects (BOWL, 2012). The modelling undertaken indicates that there is potential for displacement of bottlenose dolphins within the Moray Firth and that individuals displaced may relocate elsewhere (BOWL, 2012).

267 The area of potential effect does not overlap with the potential zone of effect from the Firth of Tay developers and therefore no direct in-combination impacts are predicted to occur. However, it is recognised that bottlenose dolphins in the Moray Firth and those in the Firth of Tay area are largely one population and that should bottlenose dolphins be simultaneously displaced from both areas as predicted by the noise models then there is potential for an in-combination behavioural impact.

268 The in-combination impacts on bottlenose dolphins in the Moray Firth arising from the construction of Beatrice and Moray Firth offshore wind farms are predicted to displace between 35 and 81 bottlenose dolphins depending on the construction scenario. The worst-case of displacing up to 81 bottlenose dolphins presumes both wind farms will be constructing at the same time over a period of two years (MORL 2012).

269 Behavioural effects and level of displacement will vary with individuals and there is potential for some habituation to occur (Thomsen *et al*., 2006). However, the scale and duration of potential displacement is such that the magnitude of any displacement effects may be high as the bottlenose dolphin is vulnerable to piling noise.

6.4.4 Moray Firth SAC- Conclusions

270 Bottlenose dolphins are a qualifying feature for the Moray Firth SAC which lies approximately 165km to the north of Neart na Gaoithe. The bottlenose dolphins from the SAC are known to occur in the inshore waters of the Firth of Tay and Firth of Forth estuaries.

271 No bottlenose dolphins were recorded during three years of site specific surveys and therefore they are not known to occur within the proposed development area or adjacent waters.

272 The results from noise modelling undertaken indicate that temporary threshold shift or displacement from piling operations during the construction period.

273 The assessment demonstrates that there is a very low risk of any bottlenose dolphin being impacted by noise levels arising from piling activities from Neart na Gaoithe on its own that could cause injury or a permanent threshold shift. There is potential for up six bottlenose dolphins to be impacted by noise that could cause a temporary threshold shift, but these impacts will be temporary. Noise arising from the construction of Neart na Gaoithe on its own may cause a localised partial displacement or behavioural response to bottlenose dolphins in the coastal waters around Fife Ness. The area where partial displacement may occur is relatively small compared to the wider distribution of bottlenose dolphins in the region and noise levels along the coast of Firth of Tay are below those that might be reasonably predicted to cause displacement impacts, i.e. below 70 dBht.

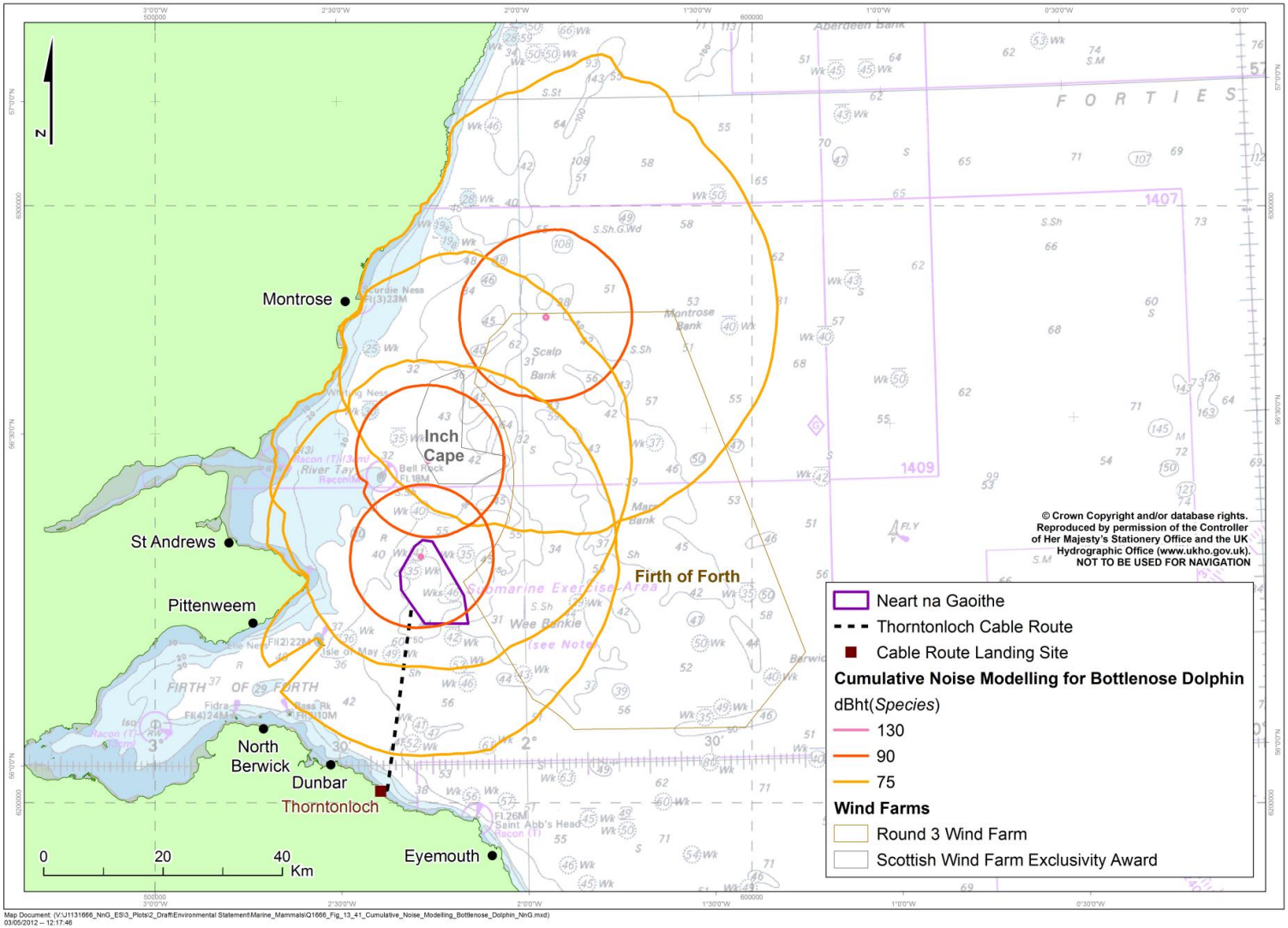

Figure 6.9: Firth of Tay developments cumulative noise modelling results for bottlenose dolphin.

274 The assessment has identified a number of other proposed developments that could cause an in-combination impact. Noise modelling undertaken indicates a potential wider area of impact than from Neart na Gaoithe on its own. Levels of noise that could cause PTS or TTS are very localised. Partial displacement and or behavioural effects on bottlenose dolphin are predicted to occur more extensively along the coast including in the Firth of Tay and to the north. Additional impacts may also occur from proposed projects in the Moray Firth. It is predicted that a proportion of the bottlenose dolphin population will be displaced from in-combination impacts arising from proposed developments in both the Moray Firth and the Firth of Tay areas. Displaced dolphins will be able to relocate to other coastal areas during the period of construction and will return once the works have been completed.

275 The scale and extent of the impacts will depend on the finalised selected construction techniques from each of the other developments and the timing and duration of the construction period.

276 It is concluded that the level of impact predicted from Neart na Gaoithe on its own will not affect the conservation status of the species, nor the conservation objectives of the site and therefore there will be no adverse effect on the integrity of the Moray Firth SAC from noise related impacts on bottlenose dolphins.

277 There is uncertainty over the extent and duration of any in-combination impacts with other Forth and Tay developments however, Marine Scotland should have further details following submission of the Inch Cape Offshore Limited application to allow an appropriate assessment to be undertaken.

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