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Abbreviations and Acronyms

AA	Appropriate Assessment
EIA	Environmental Impact Assessment
ELC	East Lothian Council
FWPM	Fresh Water Pearl Mussel
HRA	Habitats Regulations Appraisal
ICOL	Inch Cape Offshore Limited
LSE	Likely Significant Effect
MS-LOT	Marine Scotland Licensing Operations Team
MW	Megawatt
OfTW	Offshore Transmission Works
OnTW	Onshore Transmission Works
SAC	Special Area of Conservation
SEL	Sound Exposure Level
SNH	Scottish Natural Heritage
TTS	Temporary Threshold Shift
WC	Worst Case
WTG	Wind Turbine Generators

1 Introduction

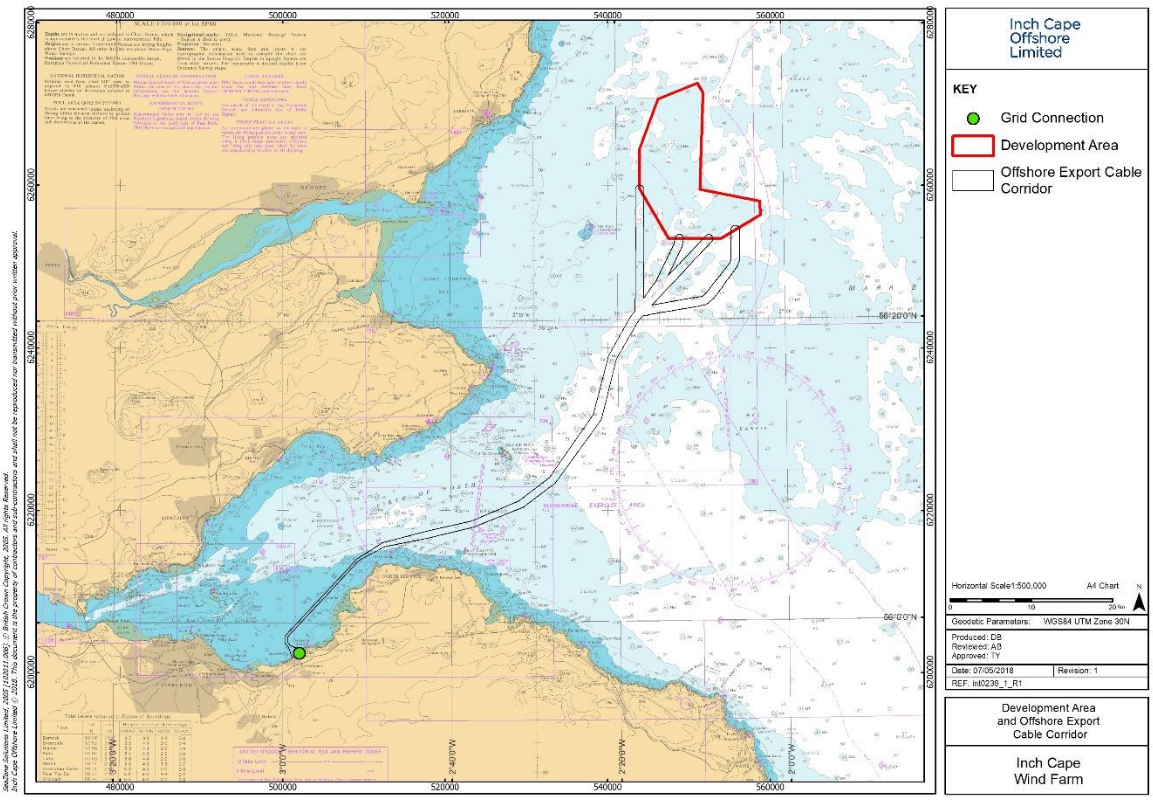
1.1 Background to the Development

1 Inch Cape Offshore Limited (ICOL) is promoting the development of the Inch Cape Wind Farm and associated Offshore Transmission Works (OfTW) (the Development). The Development is in the North Sea, off the east coast of Angus in Scotland. It will comprise an offshore array of Wind Turbine Generators (WTGs), connected to one another by subsea inter-array cables, which connect the WTGs to one or two Offshore Substation Platform(s) (OSPs), where power generated by the WTGs is collected and processed for export through the Offshore Export Cables. Up to two Offshore Export Cables will run to the landfall location at Cockenzie (Figure 1.1).

2 In order to transmit the generated electricity from the Wind Farm to the National Grid, a connection will be made through the OfTW and the Onshore Transmission Works (OnTW).

3 The OnTW includes underground electricity cables and an onshore substation which receives power from the Offshore Export Cables and processes it for transmission to the existing grid network. The Landfall for Export Cables will be near Cockenzie (Figure 1.1). The OnTW lies within the vicinity of the former Cockenzie Power Station and is subject to a separate application to East Lothian Council (ELC).

Figure 1.1: Development Area and Offshore Export Cable Corridor



4 The Development will comprise of an offshore generating station, the Wind Farm, with a capacity of more than one megawatt (MW) which therefore requires Scottish Ministers' consent under Section 36 of the *Electricity Act* (Section 36 Consent) to allow its construction and operation. Under the *Marine (Scotland) Act 2010*, the Development will also require marine licences granted by the Scottish Ministers to allow for the construction and deposition of substances and structures in the sea and on the seabed.

5 A scoping document for the Development was prepared in support of a request for an opinion from Marine Scotland Licensing Operations Team (MS-LOT) as to the scope of the information to be provided within the Development Environmental Impact Assessment (EIA) Report and Habitats Regulation Assessment (HRA). The scoping document was submitted to MS-LOT on 28th April 2017 and an opinion received on 28th July 2017.

6 As part of their response to the scoping document, Scottish Natural Heritage (SNH) advised that any impacts from marine renewables on diadromous fish should now be undertaken via EIA not HRA. The exact wording of SNH's scoping opinion, and associated comments and agreement by Scottish Ministers are provided below:

'SNH advise that any impacts from marine renewables on diadromous fish should now be undertaken via EIA not Habitats Regulations Appraisal (HRA). This is because it is not possible to determine which Special Area of Conservation (SAC) rivers any individuals recorded at sea are coming from or returning to.

The Scottish Ministers accept the advice provided by SNH and any effects on diadromous fish should be considered under EIA. Therefore the Scottish Ministers do not require potential impacts from barrier effects and disturbance or physical injury due to operation of the Inch Cape Wind Farm and construction and operation of the Offshore Transmission Works (OfTW), or the potential impact of direct temporary habitat disturbance from the OfTW to be included in the HRA report.'

7 Whilst ICOL understands the rationale for not including diadromous fish under HRA, during the application process to inform the EIA a review of the HRA carried out for the Inch Cape 2014 Consent was conducted. In doing so it was apparent that should the HRA on diadromous fish ever be required in the future the report to inform an HRA carried out for the Inch Cape 2014 Consent remains valid for the Development, thus is being provided for information. The following provides justification of, the continued validity of the HRA carried out for the Inch Cape 2014 Consent for the Development.

2 HRA Review- Diadromous FIsh

2.1 Review Summary

8 The following review is informed by several key pieces of work, namely:

- The report to inform an Habitats Regulation Assessment carried out for the Inch Cape 2014 Consent
- Underwater noise modelling carried out for this application (*Appendix 9B:Underwater Noise Modelling*); and
- The Salmon Migration Behaviour[1] paper produced in response to the Scottish Minister's Scoping Opinion for this application (*Appendix 9C: Discussion Paper on Salmon Migration Behaviour*).

9 These are supplemented by other data sources as appropriate in order to justify the applicability of the HRA carried out for the Inch Cape 2014 Consent for the Development.

2.2 Impacts Considered

10 Only impacts on barrier effects and physical injury from construction noise are considered in this review as the increase in hammer energy included within the design envelope for this application is the only impact that could lead to greater impacts than previously described. All other elements within the design envelope for this application have reduced the potential for impacts on fish receptors, when compared to the design envelope which was originally assessed. This conclusion was agreed with consultees through Scoping for this application and the approach proposed here is in line with the approach taken for EIA.

2.3 Summary of Inch Cape 2014 Consent HRA Screening

11 The Special Areas of Conservation (SAC), and associated receptors considered in the Inch Cape 2014 Consented HRA screening are as follows:

- River Tay SAC – Atlantic salmon, brook lamprey, river lamprey and sea lamprey;
- River Teith SAC – Atlantic salmon, brook lamprey, river lamprey and sea lamprey;
- River South Esk SAC – Atlantic salmon and Fresh Water Pearl Mussel (FWPM);
- River Dee SAC – Atlantic salmon and FWPM; and
- River Tweed SAC – Atlantic salmon, brook lamprey, river lamprey and sea lamprey

12 Of the above, only Atlantic salmon, Sea Lamprey, and FWPM within the River Tay, River Teith, and River South Esk SAC's were considered to have potential for connectivity and therefore were screened in during the Likely Significant Effect (LSE) test. All other sites and receptors were screened out based upon the following justifications:

[1] This report concludes that the outcomes for salmon as reported in the Inch Cape 2013 ES remains valid and that as part of this application no further assessment on salmon is required.

River Dee SAC – Atlantic Salmon and FWPM

13 The Project is unlikely to affect smolt leaving the River Dee as they are likely to travel in a northerly direction towards their northerly feeding grounds and therefore will not come into contact with the Development Area and Offshore Export Cable Corridor. Adult salmon returning to freshwater habitats to spawn migrate along the coast from the south therefore are unlikely to be affected by noise and SSC from the Wind Farm and OfTW. Freshwater pearl mussels are only found as adult mussels in riverine environments. As their lifecycle rely on migrating salmonids, impacts on salmonids could impact on their populations, however, since no LSE was concluded for the Atlantic salmon population, no LSE on FWPM can also be concluded.

River Tweed SAC – Atlantic Salmon

14 As returning salmon adults are known to migrate from a southerly direction along the east coast, the Project is unlikely to impact the returning adult population. Construction noise has the potential to affect smolts migrating to their northern feeding grounds, however, smolts have been recorded heading further offshore when entering the marine environment and there is no evidence of coastal migration. Due to the range of the species, and the offshore northward direction of migration and the likely temporary use of the area, disturbance from the Project and other offshore wind farm projects is very unlikely to significantly affect the designated River Tweed population of Atlantic salmon.

All Sites - River Lamprey

15 River lamprey migrate downstream to estuaries during the adult phase of the lifecycle and spend the majority of their adult life in estuarine habitats with restricted movements to open sea (Maitland, 2003), rarely leaving estuarine habitats. Populations are concentrated on a relatively small area during spawning, and SNH focus conservation measures within river habitats. There will be no interaction with the designated river lamprey population(s) with the Project due to their proximity to the Development Area and Offshore Export Cable Corridor, including landfall options. As populations are concentrated on a relatively small area during spawning and SNH focus conservation measures within river habitats, the Project will have no effect on spawning individuals during this period.

All sites - Brook Lamprey

16 The life cycle of brook lamprey takes place exclusively in freshwater. As the life cycle of brook lamprey takes place exclusively in freshwater there is no opportunity for interaction with the Project.

2.3.1 Conclusions of Report to Inform Appropriate Assessment

17 The following sites and associated receptors were screened in after the LSE test:

- River Tay SAC – Atlantic salmon and Sea lamprey;
- River Teith SAC – Atlantic salmon sea lamprey;

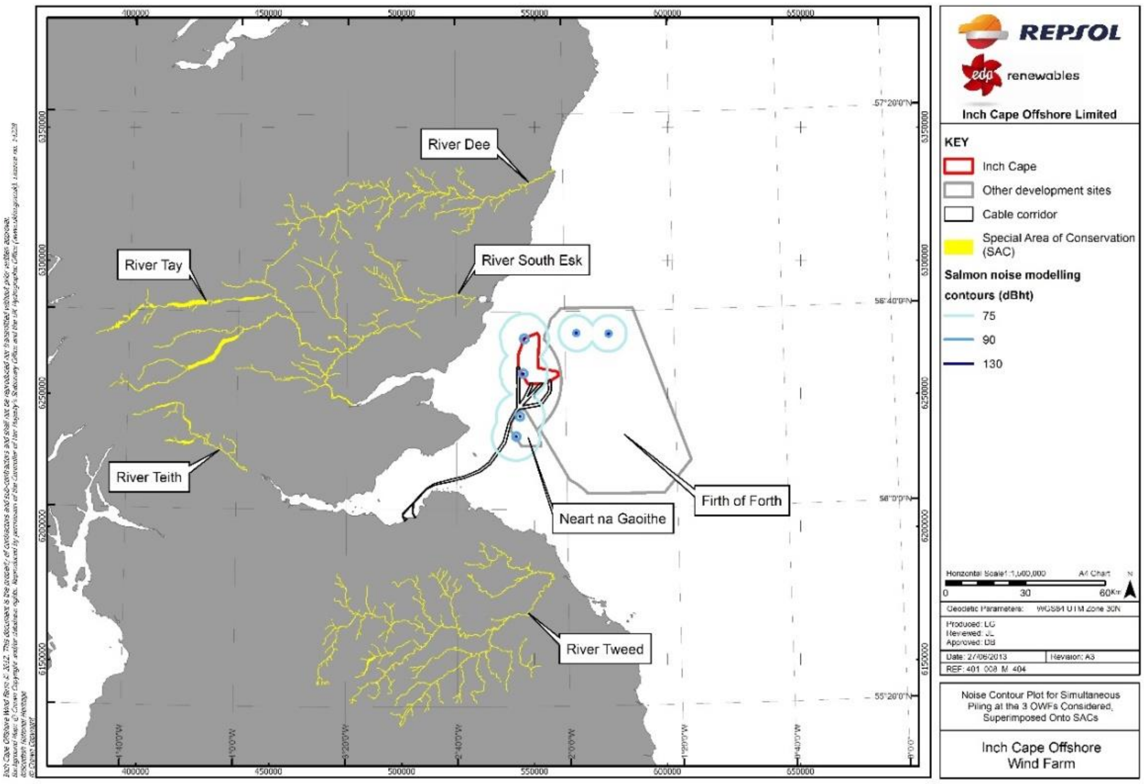
- River South Esk SAC – Atlantic salmon and FWPM;

18 The conclusions of the report to inform the Appropriate Assessment (AA), i.e. as assessed against the conservation objectives of the sites, are presented below.

19 It was considered that increased noise levels during construction/decommissioning have the potential to affect migratory species through the potential for barrier effects to migrating animals. Simultaneous piling at the Neart na Gaoithe Wind Farm and the Project were predicted to form a band of noise 50 km in extent in a north - south direction (Figure 1), detectable to salmon at 75 dB_{ht} i.e. at a level where mild behavioural responses are predicted to occur (for example changes in swimming direction, speed etc.). Simultaneous piling at the Firth of Forth Phase 1 site does not add to this barrier. This barrier covers half of the north - south extent of the sea area in this locale, and although it will not fully obstruct access to and from the SAC rivers, it does have the potential to cause increased energetic cost to migration activities. The extent of potential behavioural effects at 75 dB_{ht}, at the closest point, is six kilometres away from the coastline and therefore species migrating to and from the SAC river estuaries, using the coastal environment, are not likely to encounter construction noise and vibration and therefore will not be displaced or affected in their normal movement.

20 The EIA assessment for the Project alone and in-combination assessment have predicted piling noise, and suspended sediment impacts on migratory fish to be at most moderate adverse and therefore not significant in EIA terms.

Figure 1.2 Noise contour plot for simultaneous cumulative piling superimposed onto salmon designated rivers (Inch Cape 2014 Consent).



21 The following sets out the conclusions of the assessments against the conservation objectives of the three screened in SAC's.

22 <u>River Tay SAC</u>

- Changes in the population of species, including range of genetic types, as a viable component of the Tay SAC are considered to be unlikely and not significant in the short or long term.
- Changes in distribution of the species within the River Tay SAC are considered to be unlikely and not significant in the short or long term.
- Changes in distribution and extent of habitats within the River Tay SAC, supporting the qualifying species, are considered unlikely and not significant in the short or long term.
- Changes in structure and function of supporting habitats supporting the qualifying species of the River Tay SAC are considered unlikely and not significant in the short or long term.
- Significant disturbance of the qualifying species of the River Tay SAC is considered unlikely and not significant in the short or long term.

23 It was predicted that the Project alone or in combination will not affect maintenance of the integrity of the River Tay SAC and that the River Tay SAC will maintain an appropriate contribution to achieving favourable conservation status of the qualifying species.

24 <u>River Teith SAC</u>

- Changes in the population of, including range of genetic types in salmon, as a viable component of the River Teith SAC are considered to be unlikely and not significant in the short or long term.
- Changes in distribution of the species within the River Teith SAC are considered to be unlikely and not significant in the long term.
- Changes in distribution and extent of habitats within the River Teith SAC, supporting the qualifying species, are considered unlikely and not significant in the long term.
- Changes in structure and function of supporting habitats of the qualifying species of the River Teith SAC are considered unlikely and not significant in the short or long term.
- Significant disturbance of the qualifying species of the River Teith SAC is considered unlikely and not significant in the short or long term.

25 It was predicted the Project alone or in-combination will not affect maintenance of the integrity of the River Teith SAC and that the River Teith SAC will maintain an appropriate contribution to achieving favourable conservation status of the qualifying species.

26 <u>River South Esk SAC</u>

- Changes in the River South Esk SAC Atlantic salmon and fresh water pearl mussel population are considered to be unlikely and not significant in the short or long term.

- Changes in distribution of the species within the River South Esk SAC are considered to be unlikely and not significant in the short or long term.
- Changes in distribution and extent of habitats within the River South Esk SAC, supporting the qualifying species, are considered unlikely and not significant in the short or long term.
- Changes in structure and function of supporting habitats supporting the qualifying species of the River South Esk SAC are considered unlikely and not significant in the short or long term.
- Even when considered in-combination, it is considered highly unlikely this will cause significant disturbance to species, and therefore is not significant in the short or long term.
- Changes in structure and function of supporting habitats supporting freshwater pearl mussel host species are considered unlikely and not significant in the short or long term.
- Changes in structure and function of supporting habitats supporting freshwater pearl mussel host species are considered unlikely and not significant in the short or long term.

27 It was predicted the Project alone or in-combination will not affect maintenance of the integrity of the River South Esk SAC and that the River South Esk SAC will maintain an appropriate contribution to achieving favourable conservation status of the qualifying species.

2.4 Validation of Inch Cape 2014 Consent HRA

28 The evidence used to determine no LSE or loss of integrity on the sites considered in the HRA carried out for the Inch Cape 2014 Consent utilised underwater noise monitoring to establish the extent of the impacts. For the Development, new noise modelling was undertaken based upon the current accepted models approaches for fish which differ considerably from the model approach undertaken for the HRA carried out for the Inch Cape 2014 Consent.

29 The updated model is based on published Popper criteria (Popper *et al*., 2014), which sets out Sound Exposure Level (SEL) guidelines for three categories of fishes (Table 1) in terms of their auditory acuity and detection mechanisms. Sound Exposure Levels are a measure of the cumulative sound energy which organisms are exposed to, and at certain thresholds can be considered to cause behavioural or physiological effects. This differs from the dB_{ht} approach which utilised species specific audiograms to determine a response to the absolute sound level emitted by the activity. The effect thresholds considered by Popper *et al.* (2014) are as follows:

- Temporary Threshold Shift (TTS) – short or long-term changes in hearing sensitivity that may or may not reduce fitness. TTS in fish is often used to describe the limit at which behavioural responses are likely to be seen;
- Recoverable injury – injuries, including hair cell damage, minor internal or external hematoma, etc. None of these injuries are likely to result in mortality; and

- Mortality and mortal injury – immediate or delayed death.

30 Due to the differences in hearing capabilities, the SEL's vary according to the category of fish under assessment (Table 2).

Table 1. Fish categories and description (Popper et al., 2014)

Category	Description
1	Fishes without a swim bladder or any other gas filled body cavities. These species are considered to only be sensitive to particle motion and include flatfish species and sandeels.
2	Fishes with swim bladders or other gas filled body cavities which are not involved in hearing. These species are also considered only to be sensitive to particle motion and include salmonids and some pelagic species, such as mackerel.
3	Fishes with swim bladders or other gas filled body cavities which are involved in hearing. These species are considered to be sensitive to both particle motion and sound pressure and include gadoids, such as cod, and some pelagic species, such as herring. Due to their ability to detect the pressure component of underwater noise, the frequency sensitivity ranges of these species and their acuity levels are greater, hence this group is frequently referred to as the 'hearing specialists'.

Table 2. Sound Exposure Level (SEL) criteria (Popper et al., 2014)

Category	Effect at dB SEL_{cum}		
	Mortality/mortal injury	**Recoverable Injury**	**TTS**
1	219	216	186
2	210	203	186
3	207	203	186

31 By using the Popper criteria (Popper *et al.*, 2014), salmon fall into Category 2 (hearing generalist) fish. Lamprey species do not have a swimbladder and are therefore categorised as Category 1 fishes. None of the species considered in the HRA carried out for the Inch Cape 2014 Consent were Category 3 species (i.e. hearing specialists).

32 The revised modelling was undertaken on Category 2 fish as worst case (WC), noting that the TTS effect SEL remains consistent for all categories, and was undertaken for both the pin pile (Figure 2) or monopile scenario (Figure 3).

Figure 1.3 Cumulative exposure effect zones for Category 2 species exposed to highest expected concurrent pin pile piling at Inch Cape, NnG and Seagreen

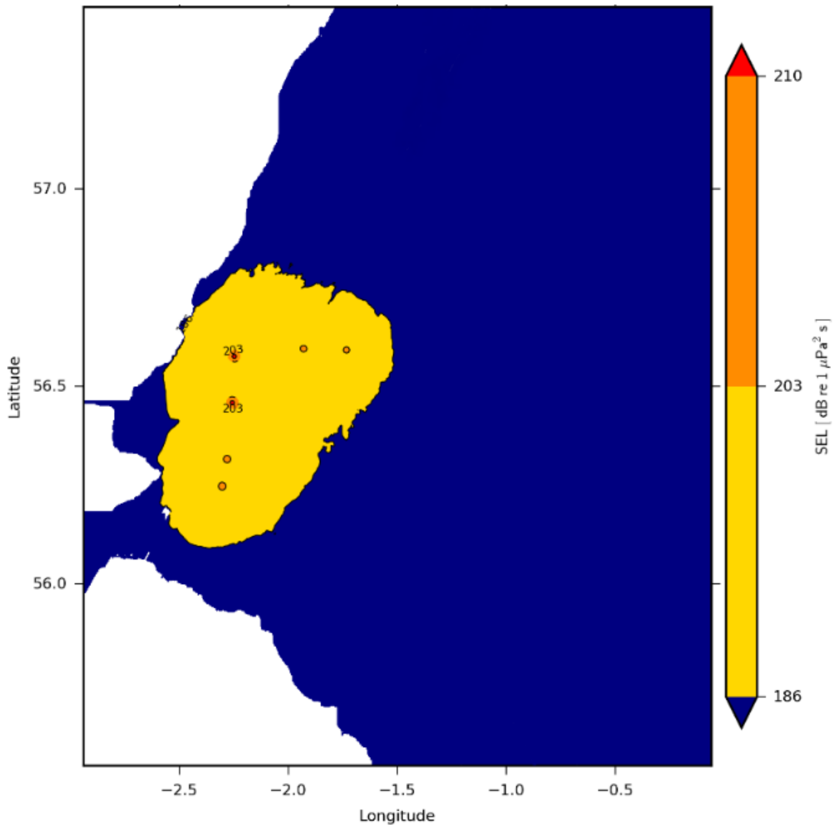
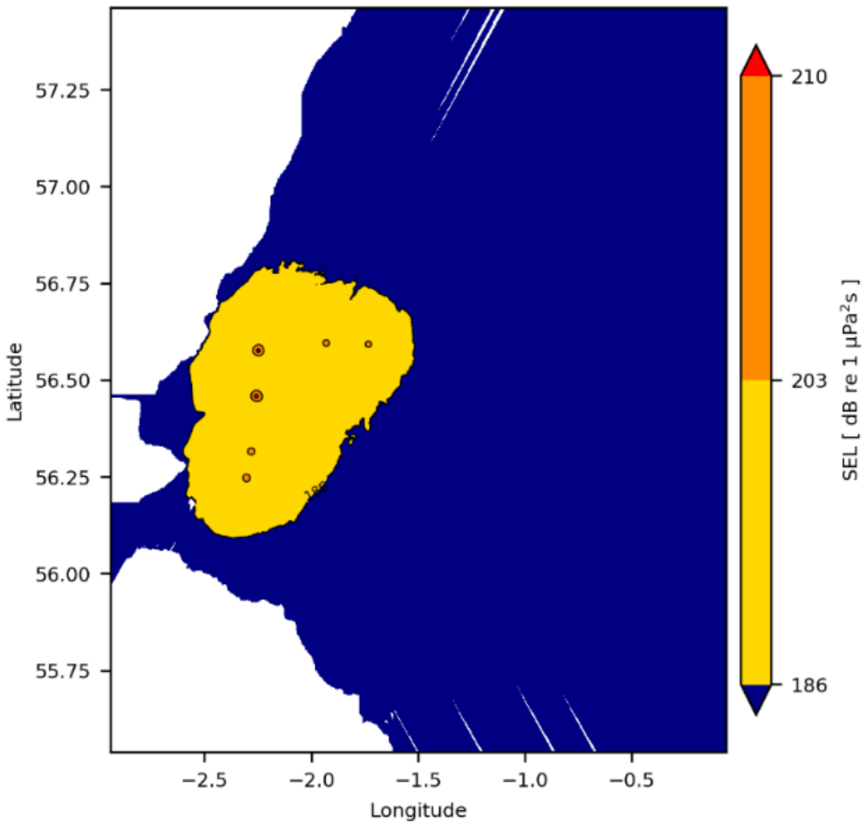


Figure 1.4 Cumulative exposure effect zones for Category 2 species exposed to highest expected concurrent monopile piling at Inch Cape, NnG and Seagreen



33 Noise modelling conducted for the HRA carried out for the Inch Cape 2014 Consent (for impact pilling of pin piles) indicated that injurious effects for salmon were likely to occur less than 0.1 km from the source. The new modelling outputs for pin piles (Figure 2) and monopile (Figure 3) scenarios predict a wider area of affect (Table 3 and Table 4). However it can also be seen that the areas of effect for monopiles are smaller than the predicted areas of effect for pin piles. This is due to the smaller number of piles which results in a reduced cumulative exposure.

Table 3. Impact ranges for effect thresholds during pin pile installation

	Pin piles		
	Mortality/mortal injury	**Recoverable Injury**	**TTS**
Linear Distance (km) ICOL	0.61	1.84	36.18
Area (km^2) ICOL	2.03	16.95	1,736.90
Area (km^2) ICOL, Seagreen, NnG	2.04	29.12	3,584.93

Table 4. Impact ranges for effect thresholds during monopile installation

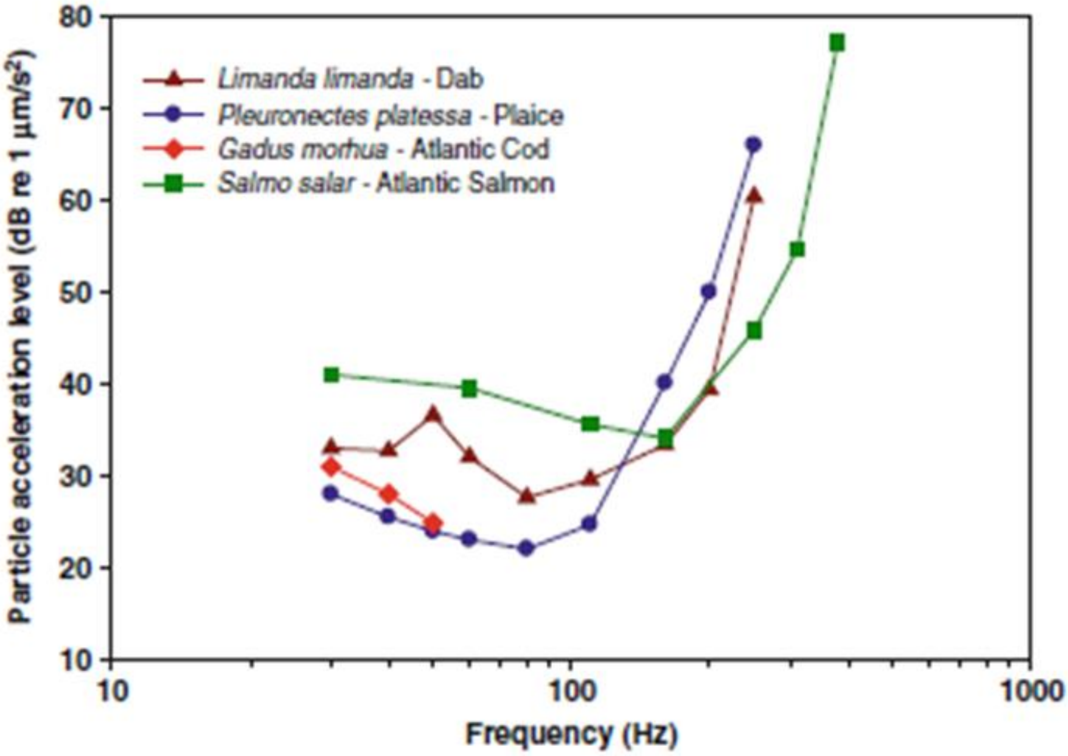
	Monopiles		
	Mortality/mortal injury	**Recoverable Injury**	**TTS**
Linear Distance (km) ICOL	0.58	1.76	35.93
Area (km^2) ICOL	1.79	15.46	1,654.41
Area (km^2) ICOL, Seagreen, NnG	1.80	27.55	3,532.04

34 However, unlike the model used for the HRA carried out for the Inch Cape 2014 Consent, which considered the effects of pin piling noise on salmon, the new model amalgamates receptors into a hearing group which includes a very broad range of fishes. As such, the group level model outputs can be considered highly conservative, and not comparable to the original model outputs.

35 The threshold at which salmon detects sound is relatively low. Comparison of a number of species' audiograms shows salmon to be less sensitive at most frequencies to many fish, including Category 1 fishes such as plaice and dab (Figure 4). This is further evidenced in the literature which shows that salmon are not a noise sensitive species with a poor ability to respond to sound stimuli, with a narrow frequency span, a limited ability to discriminate between sounds, and a low overall sensitivity (Harding *et* al., 2016; Hawkins and Johnstone, 1978). It has also been shown that Marine-phase Atlantic salmon do not experience a

change in physiology when exposed to pile driving noise, and do not perceive pile driving playback noise as a stressor (Harding *et al*., 2016[2]). Furthermore, salmon and lamprey species are used to relatively noisy riverine environments and as such are acclimatised to elevated noise levels (Hawkins and Johnstone 1978, Thomsen *et al.,* 2006).

Figure 4: Comparative audiograms showing lack of sensitivity in Salmon compared to other species (from Popper *et al*., 2014).



36 It is therefore considered that the model overstates the area over which salmon (or Category 1 fish) are likely to be affected, and as the models are not comparable, it is considered that the original modelling is more appropriate for discussing the effects on fish which may not be in the upper quartiles of the hearing ability spectrum for that category. Furthermore, as the cumulative noise energy for installation of monopiles is less than the energy required for pin piles (as modelled for the original development), it is considered that the use of monopiles is within the impact envelope assessed as part of the HRA carried out for the Inch Cape 2014 Consent.

[2] http://www.gov.scot/Resource/0049/00497598.pdf [Accessed: 10/08/18]

3 Conclusion

37 The HRA carried out for the Inch Cape 2014 Consent concluded that the Project, alone or in combination, will not affect maintenance of the integrity of the assessed SAC's and that the SAC's will maintain an appropriate contribution to achieving favourable conservation status of their qualifying species.

38 Following the update of the Design Envelope for the Development, additional modelling has been undertaken to assess the impacts of the new Design Envelope. On review however, the poor hearing ability of salmon means that the new modelling overstates the impact on this species and as such it is considered that the original modelling outputs are more appropriate to the evaluation of this species. Furthermore, as the cumulative noise energy for installation of monopiles is less than the energy required for pin piles (as modelled for the original development), it is considered that the use of monopiles is within the impact envelope assessed as part of the HRA carried out for the Inch Cape 2014 Consent.

39 Taking the above review into consideration it can be considered that the conclusions of the HRA carried out for the Inch Cape 2014 Consent remain valid, both for the project alone and in combination, and no further assessment is required (Table 5).

Table 5. Conclusions of HRA review

Designated Site (and screened in features)	Conclusions of HRA review in regards to the Project	Conclusions of HRA review in regards to the Project in combination with other projects
River Tay SAC (Atlantic Salmon and Sea Lamprey)	No effect on the integrity of the site and the site will maintain an appropriate contribution to achieving favourable conservation status of the qualifying species.	No effect on the integrity of the site and the site will maintain an appropriate contribution to achieving favourable conservation status of the qualifying species.
River Teith SAC (Atlantic Salmon and Sea Lamprey)	No effect on the integrity of the site and the site will maintain an appropriate contribution to achieving favourable conservation status of the qualifying species.	No effect on the integrity of the site and the site will maintain an appropriate contribution to achieving favourable conservation status of the qualifying species.
River South Esk SAC (Atlantic Salmon and FWPM)	No effect on the integrity of the site and the site will maintain an appropriate contribution to achieving favourable conservation status of the qualifying species.	No effect on the integrity of the site and the site will maintain an appropriate contribution to achieving favourable conservation status of the qualifying species.

References

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13.13 Habitats Regulations Appraisal (HRA)

372 The purpose of this section is to inform the HRA process following available and relevant guidance in assessing potential impacts which may arise during the construction, operation and decommissioning of the offshore elements of the Project (the Wind Farm and OfTW) by:

a) Identifying relevant Natura sites which include migratory fish and associated species as notified interest features and for which there is potential connectivity from an impact from the construction, operation and decommissioning activities associated with the Wind Farm and OfTW;

b) Identifying likely significant effects (LSE) associated with the construction, operation and decommissioning of the Wind Farm and OfTW; and

c) Considering potential impacts in relation to notified interest features of identified Natura sites in relation to their conservation objectives.

373 This report represents a review of available literature, modelling outputs, and Impact Assessment based upon the Project Design Envelope. This HRA report has been based on Marine Scotland's Scoping Opinion (9 March 2011), consultation with stakeholders and a review of available literature including Marine Scotland's review of migratory fish routes (Malcolm *et al.*, 2010) and the outcomes of the Project impact assessment.

13.13.1 Habitats Regulation Appraisal Process

374 This information has been prepared following the process described in *Section 4.8* and has been prepared to inform an Appropriate Assessment to be carried out by the Scottish Ministers, acting through Marine Scotland, in respect of the Project.

<u>In-combination Effects</u>

375 The Habitats Regulations require that the LSE and an HRA test is undertaken in relation to the potential effects which may arise from the plan or project alone or in-combination with other existing (or foreseeable) developments/activities.

376 In considering whether a plan or project either alone or in-combination is likely to have a significant effect it is necessary to consider the influences on the site which have affected, and are continuing to affect, the condition of the conservation objectives. The current condition of the interest feature(s) may be a reflection of the in-combination effects on them.

377 Where a feature for which the site has been selected as being of European importance is already in unfavourable condition or critical thresholds are being exceeded (or is subject to cumulative effects which will lead to either of these being the case), any additional plan or project which, either alone or in-combination, adds to these levels is likely to have a significant effect on the European Site.

13.13.2 Likely Significant Effect Assessment

378 European Commission guidance (2001) recommends that screening for LSE should fulfil the following steps and ICOL proposes to follow this process:

1. Determine whether the plan (or policy) is directly connected with or necessary for the management of Natura 2000 sites;
2. Describe the plan and describe and characterise any other plans or projects which, in-combination, have the potential for having significant effects on Natura 2000 sites;
3. Identify the potential effects on Natura 2000 sites; and
4. Assess the likely significance of any effects on Natura 2000 sites.

Step 1: Determine Whether the Plan is Directly Connected with or Necessary for the Management of Natura 2000 Sites

379 The Project is not considered necessary for the management of a European Marine Site though the benefits of renewable energy developments are well documented and are detailed in *Chapter 8: Benefits of the Project*.

Step 2: Describe the Plan and Describe and Characterise any Other Plans or Projects Which, In-combination, Have the Potential for Having Significant Effects on Natura 2000 Sites

Project Details

380 The migratory fish assessment contained within this HRA document includes the Inch Cape Offshore Wind Farm and associated OfTW.

381 The details of the Project are described in *Chapter 7*, with the parameters and scenarios relevant to the Natural Fish assessment found in *Section 13.3.* The key components of the offshore Project Design Envelope, as set out in Table 13.2 and Table 13.3, have the potential to affect the magnitude of effects that the offshore Project may have on migratory fish receptors. Identifying a worst-case scenario based on these components is integral to conducting a robust and meaningful HRA.

Relevant In-combination Impacts Assessed for Likely Significant Effect

382 In addition to assessing the cumulative impact of the Project, the HRA also assesses potential in-combination effects which may arise from other, existing (or foreseeable) developments/activities. The developments considered under this HRA (detailed in *Chapter 4, Section 4.7* and in *Section 13.9*) were determined through consultation with regulators.

Step 3: Identify the Potential Effects on Natura 2000 Sites

Designations Relevant to the HRA

383 Annex II migratory fish such as Atlantic salmon, river lamprey and sea lamprey represent qualifying interest features of several SACs along the east coast of Scotland. Although none of these species were captured in the fish surveys at the Development Area and Offshore Export Cable Corridor, the marine phase of these species life cycle is known to have a wide distribution, and it is therefore assumed that they may migrate through the Development Area and Offshore Export Cable Corridor at some point in their life cycle. FWPM are not present at the Development Area and Offshore Export Cable Corridor as adults, however this species rely on migrating anadromous salmonids during the glochidial stage of their life cycle when the larvae attach to the gills of passing fish (see *Appendix 13A* for full details). Therefore, impacts to salmon migration could affect their population. The Project has the potential for both direct and indirect effects on salmon, river lamprey and sea lamprey and also indirect effects on the FWPM population in Scottish east coast rivers and so has also been considered in this exercise.

384 Consultation with Marine Scotland, Joint Nature Conservation Committee (JNCC) and SNH identified potential SACs to be considered further. SACs identified were:

- River Tay SAC – Atlantic salmon, brook lamprey, river lamprey and sea lamprey;
- River Teith SAC – Atlantic salmon, brook lamprey, river lamprey and sea lamprey; and
- River South Esk SAC – Atlantic salmon and FWPM.

385 In addition to the SACs identified above, the screening stage has also highlighted other SACs along the north-east coast of Britain that were identified through consultation with fisheries organisations, to reflect the migratory patterns and foraging range of some of the Annex II species considered, namely:

- River Dee SAC – Atlantic salmon and FWPM; and
- River Tweed SAC – Atlantic salmon, brook lamprey, river lamprey and sea lamprey.

386 It is noted that several of the river SACs are designated for features additional to migratory fish (Table 13.58) such as otters or freshwater habitats. As there is no connectivity between these features and the Development Area and Offshore Export Cable Corridor for these species, there can be no LSE or adverse effect on site integrity arising from these features. Therefore they are not considered further in this HRA.

387 The conservation objectives of sites Designated for migratory fish are:

- 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.

Table 13.58: Conservation Objectives of Sites Designated for Migratory Fish

Site	Specific conservation objectives:	Designated feature
River South Esk SAC	Population of the species, including range of genetic types for salmon, 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. No significant disturbance of the species. Distribution and viability of freshwater pearl mussel host species. Structure, function and supporting processes of habitats supporting freshwater pearl mussel host species.	Atlantic salmon Freshwater pearl mussel
River Dee SAC	Population of the species, including range of genetic types for salmon, 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. No significant disturbance of the species. Distribution and viability of freshwater pearl mussel host species. Structure, function and supporting processes of habitats supporting freshwater pearl mussel host species.	Atlantic salmon Freshwater pearl mussel Otter (*Lutra lutra*)
River Tay SAC	Population of the species, including range of genetic types for salmon, as a viable component of the site. Distribution of the species within site. Distribution and extent of habitats supporting the species.	Atlantic salmon Brook lamprey River lamprey Sea lamprey

Site	Specific conservation objectives:	Designated feature
	Structure, function and supporting processes of habitats supporting the species. No significant disturbance of the species.	Otter Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*
Teith SAC	Population of the species, including range of genetic types for salmon, 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. No significant disturbance of the species.	Atlantic salmon Brook lamprey River lamprey Sea lamprey
River Tweed SAC	Population of the species, including range of genetic types for salmon, 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. No significant disturbance of the species.	Atlantic salmon Brook lamprey River lamprey Sea lamprey Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation

388 Throughout this chapter all potential effects of the offshore components of the Project on migratory fish were assessed and it is this assessment which has been used to inform the preliminary impact assessment conducted as part of this HRA exercise. They key potential effects are summarised below (Table 13.59 and Table 13.60).

Table 13.59: Potential Effects on Migratory Fish Species – Works in the Development Area

Potential Effect	Description of Effect
Construction/Decommissioning	
Barrier effects, disturbance or physical injury associated with construction noise	Noise from construction activities (piling particularly) will result in increased levels of noise which may act as a barrier to migration to and from natal rivers, as a result of avoidance behaviour.
Indirect disturbance as a result of sediment deposition and temporary increases in SSC	Construction activities will mobilise and deposit sediments, therefore increasing suspended sediments in the water column which may act as a barrier to migration as a result of avoidance responses.
Direct temporary habitat disturbance	Temporary habitat loss arising from construction activities may potentially reduce area of available habitat for foraging during migration.
Operation/Maintenance*	
Behavioural responses to EMF associated with cabling	Migratory fish are known to use the earth's magnetic field as an aid to navigation; therefore EMF arising from inter-array could in theory act as a barrier to migration.
Long term loss of original habitat	Long term habitat loss arising from the Wind Farm and OfTW footprint may potentially reduce the area of available habitat for foraging during migration.
Disturbance or physical injury associated with operational noise	Increases to background noise have the potential to cause changes in behaviour and could have masking effects on navigation.
*No impact on SAC species was predicted during EIA as a result of creation of new habitat. The scale of effect on SAC species from temporary habitat disturbance via O&M activities was considered to be so minor that it was not likely to contribute an LSE on any Designated Sites. These two effects have therefore been excluded from HRA.	

Table 13.60: Potential Effects on Migratory Fish Species – Works in the Offshore Export Cable Corridor

Potential Effect	Description of Effect
Construction/Decommissioning	
Disturbance or physical injury associated with construction noise	Migratory fish are known to use sound as an aid to navigation. During cable laying, noise is produced by the motion of the plough or trencher through the seabed, and increased noise could in theory act as a barrier to migration.

Potential Effect	Description of Effect
Construction/Decommissioning	
Direct temporary habitat disturbance via Export Cable installation	Temporary habitat loss arising from cable laying activities may potentially reduce area of available habitat for foraging during migration.
Operation/Maintenance*	
Behavioural responses to EMF associated with cabling (Export Cable)	Migratory fish are known to use the earth's magnetic field as an aid to navigation; therefore EMF arising from the Export Cable could in theory act as a barrier to migration.
Long term loss of original habitat (Export Cable)	Cable protection would change original habitat which may potentially reduce area of available habitat for foraging during migration.
*No impact on SAC species was predicted during EIA as a result of creation of new habitat. The scale of effect on SAC species from temporary habitat disturbance via O&M activities was considered to be so minor that it was not likely to contribute an LSE on any Designated Sites. These two effects have therefore been excluded from HRA.	

Step 4: Assess the Likely Significance of Any Effects on Natura 2000 Sites

389 For each of the European sites, a judgement for each of the relevant notified interest features has been made to determine whether there are any LSE arising from the Project's construction, operation or decommissioning (Table 13.61) either alone or in-combination with the projects listed in *Section 13.9*.

Table 13.61: LSE Assessment for European Sites which are within the Potential Zone of Ecological Impact of the Project in Combination with Other Projects for Migratory Fish and Associated Species

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
River Tay SAC	37	Atlantic salmon (*Salmo salar*), sea lamprey (*Petromyzn marinus*), river lamprey (*Lampetra fluviatilis*), brook lamprey (*Lampetra planeri*).	All Favourable Maintained	Atlantic salmon - The River Tay supports a high-quality Atlantic salmon population, with rod catch returns showing that the Tay is consistently one of the top three salmon rivers in Scotland.	Atlantic Salmon is an anadromous species that migrates between freshwater spawning grounds and feeding grounds in the northern Atlantic. Little is known about the migration of smolt leaving Scottish east coast rivers, however they are likely to travel in a northerly and easterly direction en route to feeding grounds around Greenland (Malcolm *et al*., 2010). Smolt leaving rivers in other counties have been recorded moving quickly to deeper more offshore waters when entering the marine environment, with no evidence for coastal migration and there is no reason to believe that Scottish smolt	**Construction Phase** Increased noise, SSC and temporary habitat disturbance during construction, have the potential to affect smolts, grilse and adult salmon migrating to and from the River Tay SAC. Noise modelling conducted for the Development Area (for impact pilling) indicates an area of approximately 14 km^2 may be affected by noise levels that would create a strong avoidance reaction in salmon (90 dBht) and 475 km^2 affected by noise levels that would potentially create mild avoidance reactions (75 dBht) assuming two piling vessels operate simultaneously. Noise modelling conducted for general cable construction indicates no avoidance or significant behavioural reactions of salmon (Nedwell *et al*., 2003) thus despite noise being detectable along the Offshore Export Cable Corridor, no effects on migration are predicted. Despite this species being a hearing generalist, due to the likely direction of migration of adults and smolt (i.e. northwards and offshore	Atlantic salmon (Y)

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
					would behave differently. It is postulated that smolt may migrate over a broad area unless there are areas of strong coastal currents (Malcolm *et al.*, 2010). Adults returning to rivers on the east coast of Scotland are predominately multi sea winter adults and return migration routes are likely to be across a broad front. Adult spawners are believed to enter east coast Scottish rivers from the south (migrating up the coast from Northumberland - Malcolm *et al.*, 2010). The swim bladder of salmon plays no part in the hearing of the species, and Hawkins and Johnstone (1978) found salmon to show low sensitivity to noise.	respectively), and the position of the Development Area relative to the mouth of the River Tay, a behavioural response caused by construction noise on River Tay SAC populations cannot be ruled out. Increased suspended sediments in the water column may act as a barrier to migration as a result of avoidance responses. Studies on salmon demonstrate an avoidance threshold of 100 $mgkg^{-1}$ over one hour. Salmon, however as partially estuarine species are likely to commonly tolerate increases in suspended sediments and as such be pre-adapted to this impact. Additionally, studies have shown that unless a whole body of water is blocked, migration will not be significantly affected (ABPmer, 2011). This impact is not predicted to significantly impact the Tay salmon population, due to temporary nature of both the impact and subsequent potential avoidance, and level of pre-adaptation to increased SSC.	

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
					Furthermore, salmon are used to relatively noisy riverine environments, providing for some pre-adaption to elevated noise levels (Hawkins and Johnstone, 1978; Thomsen *et al*., 2006).	**Operational Phase** Operational noise from offshore wind farms has been reported to be in the region of 2 dB noisier than the surrounding sea environment (Nedwell *et al*., 2007). The relatively low frequency of operational noise (WTGs and vessels) will only have avoidance impacts in the immediate vicinity of source, e.g. one metre or below for hearing specialists' such as herring detailed in *Chapter 11*. Species with a poor sensitivity to noise, such as salmon, are likely to show a lesser response to operational noise, and as such migratory routes of the River Tay Atlantic salmon are not predicted to be impacted over the duration of the operational phase. The Project will result in long term habitat loss of 2.47 km^2. Given the range of this species and the fact that it is predicted to forage across a wide range of habitats, any habitat loss arising from the Project is insignificant in relation to the amount of similar habitat across the wider region. EMF effects caused by the Offshore Export Cable during operation may	

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
						result in limited interaction with the River Tay population of Atlantic salmon. However, salmon are reported to swim in the upper 10 m of the water column, and thus it is considered that EMF impacts to salmon from subsea cables will not be present due to their attenuation in water depths greater than 20 m (Gill and Bartlett, 2010). Salmon from the Tay SAC also may come into contact with above impacts arising from the construction and operation of the Firth of Forth Phase 1 and Neart na Gaoithe projects and their cable routes. The on-going offshore wind and other projects, in-combination with the Project, are remote enough to not increase ambient noise levels and suspended sediments within the Development Area and Offshore Export Cable Corridor.	
				Sea lamprey - No selection information is available as they are cited as a qualifying feature but not a primary reason for	Little is known about the distribution of sea lamprey during the adult phase of their life cycle when they leave the river and disperse into coastal and offshore environments.	Increased noise, SSC, habitat disturbance and EMF have the potential to affect sea lamprey migrating to and from the River Tay SAC during construction and operation of the Project.	Sea lamprey (Y)

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
				selection of the site.	Sea lamprey may range widely following migration to sea, and no specific directions or routes have been identified. Records have been reported in shallow coastal waters and deep offshore waters suggesting they have a wide range and utilise a range of habitat types (Maitland, 2003). Sea lampreys do not appear to home to their natal streams, but instead are thought to be attracted to spawning areas by chemical cues released by conspecific larvae (Li *et al.*, 1995; Bjerselius *et al.*, 2000; Vrieze and Sorensen, 2001, cited in Watt, 2008). They do not possess specialist sensory organs such as otoliths or a swim bladder suggesting that the species are hearing	No audiogram exists for sea lamprey; however, as they do not possess specialist sensory organs such as otoliths or a swim bladder, for the purposes of this assessment it is assumed that sea lamprey are hearing generalists. The likely attenuation of construction noise in water may result in avoidance of sea lamprey from the noise footprint; however, this will be temporary in duration, and localised in extent representing a relatively small part of the species natural range, as sea lamprey may range widely following migration to sea and do not spend their entire life cycle in the marine environments. Increased SSC in the water column may act as a barrier to migration as a result of avoidance responses. However, as partially estuarine species, sea lamprey are likely to tolerate increases in suspended sediments and as such be pre-adapted to this impact. Therefore this impact is not predicted to be significant. Given the range of this species and the fact that it is predicted to forage across a wide range of habitats, any habitat loss arising from the Project is	

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
					generalists. Sea lamprey are reported as having a relatively low detection threshold to the iE fields generated from subsea cables, although are able to detect fields as low as 10 µVm^{-1} (in line with other migratory fish – 8-25 µVm^{-1}), however no evidence of response to B fields exists (Gill and Bartlett, 2010). The fields produced from the Export Cable are therefore likely to be within the detectable range of this species, with detectable fields attenuating within 20 m of the Export Cable.	insignificant in relation to the amount of similar habitat across the wider region. Gill and Bartlett (2010) report that there is evidence of a weak response of sea lamprey to electric E-fields but not to magnetic B-fields. As there will be cabling onshore to the north and south of the Tay estuary (as a result of the Project in-combination with other projects in the area), a barrier effect from EMF may occur. Although no behavioural responses have been observed in sea lampreys in relation to detectable iE fields, it is considered that this species variable swimming depth will avoid barrier effects of this impact along the Offshore Export Cable Corridor, with detectable fields attenuating within 20 m of the Export Cable. Furthermore, as the Offshore Export Cable Corridor represents only a very small area of this species entire range, interactions are likely to be rare. As a result of this, the magnitude of this effect is considered to be negligible. Sea lamprey from the Tay SAC also may come into contact with above impacts arising from the construction and operation of the Firth of Forth Phase 1	

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
						and Neart na Gaoithe projects and their cable routes. The on-going offshore projects are remote enough to not increase ambient noise levels and suspended sediments within the Development Area and Offshore Export Cable Corridor.	
				River lamprey - No selection information is available as they are cited as a qualifying feature but not a primary reason for selection of the site.	River lamprey migrate downstream to estuaries during the adult phase of the lifecycle and spend the majority of their adult life in estuarine habitats with restricted movements to open sea (Maitland, 2003), rarely leaving estuarine habitats. Populations are concentrated on a relatively small area during spawning, and SNH (2011) focus conservation measures within river habitats.	There will be no interaction with the designated river lamprey population with the Project due to its proximity to the Development Area, Offshore Export Cable Corridor including landfall options. As populations are concentrated on a relatively small area during spawning and SNH (2011) focus conservation measures within river habitats, the Project will have no effect on spawning individuals during this period.	River lamprey (N)

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
				Brook lamprey- No selection information is available; they are cited as a qualifying feature but not a primary reason for selection of the site.	The life cycle of brook lamprey takes place exclusively in freshwater.	As the life cycle of brook lamprey takes place exclusively in freshwater there is no opportunity for interaction with the Project.	Brook lamprey (N)
River South Esk SAC	24	Atlantic salmon (*Salmo salar*), freshwater pearl mussel (*Margaritifera margaritifera*).	Atlantic salmon – unfavourable recovering.	Atlantic salmon - The River South Esk supports a large, high-quality population in a river draining a moderate-sized catchment on the east coast of Scotland. The high proportion of the South Esk which is accessible to salmon and the range of ecological conditions in the	See species specific information for River Tay SAC (above).	**Construction Phase** Increased noise, SSC and temporary habitat disturbance have the potential to affect smolts, grilse and adult salmon migrating to and from the River South Esk SAC during construction. Noise modelling conducted for the Development Area and Offshore Export Cable Corridor works indicates that despite this species being a hearing generalist (see information above in River Tay SAC), due to the likely direction of migration of adults and smolt (i.e. northwards and offshore respectively), and the position of the Development Area relative to the mouth of the South Esk, a behavioural response caused by construction noise	Atlantic salmon (Y)

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
				river allows it to support the full range of life-history types found in Scotland, with sub-populations of spring, summer salmon and grilse all being present.		on the salmon population cannot be ruled out. Increased SSC in the water column may act as a barrier to migration as a result of avoidance responses, however this effect is not predicted to significantly impact the South Esk population of salmon, due to the temporary nature of both the effect and subsequent potential avoidance impact, and level of pre-adaptation to changing SSC (see information above in River Tay SAC). **Operational Phase** Species with a poor sensitivity to noise, such as salmon, are unlikely to show significant response to operational noise (see information above in River Tay SAC), and as such migratory routes of the South Esk salmon are not predicted to be impacted over the duration of the operation phase. Given the range of this species and the fact that it is predicted to forage across a wide range of habitats, any habitat loss arising from the Project is insignificant in relation to the amount of similar habitat across the wider region. EMF effects caused by the Offshore	

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
						Export Cable during operation may result in limited interaction with adult salmon returning to the River South Esk from the south. However, due to the attenuation of EMF in deeper waters and the swimming position of salmon (see information above for River Tay SAC), EMF impacts on River South Esk populations are considered to be insignificant. Salmon from the River South Esk SAC may also come into contact with above impacts arising from the construction and operation of the Firth of Forth Phase 1 and Neart na Gaoithe projects. The on-going offshore projects are remote enough to not increase ambient noise levels and suspended sediments within the Development Area and Offshore Export Cable Corridor.	
			Freshwater pearl mussel – unfavourable declining.	These are abundant in the River South Esk, representing the south-eastern range of the species in Scotland. The FWPM	This species spend their entire life cycle in freshwater habitats, adults, however, during spawning young larvae released by females, attach to the gills of anadromous salmonids for survival. This is	Freshwater pearl mussel are only found as adult mussels in riverine environments only, they will only come into contact with the offshore elements of the Project as parasites on salmon gills. There is little information on the impacts of effects on freshwater pearl mussel larvae, however as their lifecycle rely on migrating salmonids an	Freshwater pearl mussel (Y)

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
				population is most abundant in the middle reaches of the river where they attain densities > 20 m^2. The conservation importance of the site is further increased by the abundance of juveniles which comprise approximately 20% of the population.	known as the glochidial phase of their lifecycle. Populations of FWPM require healthy salmonid populations for survival.	impacts on salmonids could impact on their populations. Therefore, any impacts (from construction and operation) on salmon migration are directly applicable to freshwater pearl mussel populations. Since there is a LSE on the designated Atlantic salmon population, the possibility of a LSE on freshwater pearl mussels cannot be ruled out.	
River Teith SAC	109	River lamprey (*Lampetra fluviatilis*), Brook lamprey (*Lampetra planeri*), Sea lamprey (*Petromyzon marinus*), Atlantic salmon	Atlantic salmon – unfavourable recovering.	Atlantic salmon- No selection information is available as they are cited as a qualifying feature but not a primary reason for selection of the site.	See species specific information in River Tay SAC (above).	**Construction Phase** Increased noise, SSC and temporary habitat disturbance have the potential to affect smolts, grilse and adult salmon migrating to and from the River Teith SAC during construction. Due to the position of the River Teith in relation to the development it is likely that different stages of the life cycle of salmon may be affected by different impacts of the Project.	Atlantic salmon (Y)

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
		(*Salmo salar*).				Noise modelling conducted for the Development Area (see information above in River Tay SAC for details) indicates that behavioural response could be experienced by smolt migrating from the River Teith towards their northern feeding grounds. Increasing SSC in the water column from both Wind Farm and OfTW construction (see information above for River Tay SAC salmon) may act as a barrier to migration as a result of avoidance responses, however this impact is not considered to significantly impact the River Teith population of salmon, due to temporary nature of both the impact and subsequent potential avoidance, and level of pre-adaptation to changing SSC. **Operational Phase** Species with a poor sensitivity to noise, such as salmon, are unlikely to show significant response to operational noise (see information above in River Tay SAC for details), and as such, migratory routes of the River Teith salmon are not predicted to be impacted over the duration of the	

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
						operation phase. Given the range of this species and the fact that it is predicted to forage across a wide range of habitats, any habitat loss arising from the Project is insignificant in relation to the amount of similar habitat across the wider region. EMF effects caused by the Project during operation may result in limited interaction with adult salmon returning to the South Esk from the south (smolt head north). However, due to the attenuation of EMF in deeper waters and the swimming position of salmon (see information above in River Tay SAC), EMF impacts on River Teith population are considered to be negligible. Salmon from the River Teith SAC may also come into contact with above impacts arising from the construction and operation of the Firth of Forth Phase 1 and Neart na Gaoithe projects and their cable routes. The other project are remote enough to not increase ambient noise levels and suspended sediments within the Project areas.	

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
			All lamprey species – favourable maintained, The conservation importance of the River Teith is increased by the fact that, unlike many British rivers, it supports populations of all three lamprey species.	River lamprey – the River Teith supports a strong population. The river lacks any significant artificial barriers to migration, has good water quality and the necessary habitat types (extensive gravel beds and marginal silt beds) to support the river lamprey's full life-cycle.	See species specific information above.	There will be no interaction with the designated river lamprey population with the Project due to its proximity to the Development Area, Offshore Export Cable Corridor including landfall options. As populations are concentrated on a relatively small area during spawning and SNH (2011) focus conservation measures within river habitats, the Project will have no effect on spawning individuals during this period.	River lamprey (N)
				Brook lamprey – The river system supports a strong population that have been recorded from the headwaters downstream to the lower reaches. The river provides	See species specific information above.	As the life cycle of brook lamprey takes place exclusively in freshwater, there is no opportunity for interaction with the Wind Farm and OfTW.	Brook lamprey (N)

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
				excellent habitat with usually pristine water quality, well-vegetated banks and a substantially unaltered river channel			
				Sea lamprey – the River Teith represents part of the east coast range in the UK. Young sea lampreys have been recorded throughout the lower reaches of the main river.	See species specific information above.	Increased noise, SSC, habitat disturbance and EMF have the potential to affect sea lamprey migrating to and from the River Teith SAC during construction and operation of the Wind Farm and OfTW. Due to sea lamprey status as likely hearing generalists, the attenuation of construction noise, and the temporary and localised nature of this impact within a broad species range (see information above relating to River Tay population), it is unlikely that construction noise will impact upon this migratory species. However, due to the lack of knowledge about this species' adult life history, and relative proximity to the Development Area and Offshore Export Cable Corridor, an impact on the River Teith population cannot be ruled	Sea lamprey (Y)

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
						out. Increasing suspended sediments in the water column may act as a barrier to migration as a result of avoidance responses. However, as partially estuarine species, sea lamprey are likely to commonly tolerate increases in suspended sediments and as such be pre-adapted to this impact. Gill and Bartlett (2010) report that there is evidence of a weak response of sea lamprey to electric E-fields but not to magnetic B-fields. As there will be cabling onshore to the north and south of the River Teith estuary (as a result of cabling from the Project and other wind farm projects in the region) a barrier effect may occur. Due to the swimming behaviour of this species, attenuation of EMF, and the likely range of this species (see information above in River Tay above for details), an effect of EMF on the Teith population is considered unlikely, although it cannot be ruled out. The other on-going offshore projects are remote enough to not increase ambient noise levels and suspended sediments within the Development	

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
						Area and Offshore Export Cable Corridor.	
River Dee SAC	45	Atlantic Salmon (*Salmo salar*), Freshwater pearl mussel (*Margaritifera margaritifera*).	Atlantic salmon – favourable maintained.	Atlantic salmon - The River Dee supports a high-quality population in a river draining a large catchment on the east coast of Scotland. The river supports the full range of life-history types found in Scotland, with sub-populations of spring, summer salmon and grilse all being present. The headwaters which drain the southern Cairngorm and northern Grampian mountains are particularly important for	See species specific information above.	**Construction Phase** Construction noise, habitat disturbance and increased SSC are unlikely to affect smolt leaving the River Dee as they are likely to travel in a northerly direction towards their northerly feeding grounds and therefore not come into contact with the Development Area and Offshore Export Cable Corridor. Adult salmon returning to freshwater habitats to spawn migrate along the coast from the south therefore are unlikely to be affected by noise and SSC from the Wind Farm and OfTW. **Operational Phase** Species with a poor sensitivity to noise, such as salmon, are unlikely to show significant response to operational noise, and as such migratory routes of the River Dee salmon are not predicted to be impacted over the duration of the operation phase. Given the range of this species and the fact that it is predicted to forage across a wide range of habitats, any habitat loss arising from the Project is	Atlantic salmon (N)

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
				multi sea-winter spring salmon.		considered insignificant in relation to the amount of similar habitat across the wider region. EMF effects caused by the Export Cable during operation may result in limited interaction with adult salmon returning to the River Dee from the south. However, due to the attenuation of EMF in deeper waters and the swimming position of salmon, EMF impacts on River Dee population are considered to be insignificant. The cable routes from the Firth of Forth Phase 1 and Neart na Gaoithe projects also have the potential to interact with returning adult salmon from the River Dee SAC. The other on-going offshore projects are remote enough to not increase ambient noise levels and suspended sediments within the Development Area and Offshore Export Cable Corridor.	
			Freshwater pearl mussel – unfavourable no change.	Freshwater pearl mussel – The River Dee supports a functional	See species specific information above.	Freshwater pearl mussels are only found as adult mussels in riverine environments, they will only come into contact with the offshore elements of the Project as parasites on salmon gills.	Freshwater pearl mussel (N)

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
				population recorded from a location approximately 30 km from the river source to approximately six to seven kilometres upstream from its mouth. Juveniles make up approximately 30% of the recorded population, among the highest proportions recorded in Scotland. This indicates that the population is recruiting strongly and is one of the most important in the UK.		There is little information on the impacts of effects on freshwater pearl mussel larvae, however as their lifecycle rely on migrating salmonids, impacts on salmonids could impact on their populations. Therefore, any impacts (from construction and operation) on salmon migration are directly applicable to freshwater pearl mussel populations Since no LSE were concluded for the Atlantic salmon population, no LSE on freshwater pearl mussels can be concluded.	

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
River Tweed SAC	63	Atlantic salmon (*Salmo salar*), sea lamprey (*Petromyzon marinus*), river lamprey (*Lampetra fluviatilis*), brook lamprey (*Lampetra planeri*).	Atlantic salmon – unfavourable recovering.	The River Tweed supports a very large, high-quality Atlantic salmon population in a river which drains a large catchment on the east coast of the UK, with sub-catchments in both Scotland and England. The high proportion of the River Tweed accessible to salmon, and the variety of habitat conditions in the river, has resulted in the Scottish section of the river supporting the full range of salmon life-history types, with sub-populations of spring, summer	See species specific information above.	As returning adults are known to migrate from a southerly direction along the east coast, noise, increased SSC, habitat loss and EMF from the Development Area and Offshore Export Cable Corridor are unlikely to impact the returning adult population. Construction noise has the potential to affect smolts migrating to their northern feeding grounds, however, smolts have been recorded heading further offshore when entering the marine environment and there is no evidence of coastal migration. Due to the range of the species, and the offshore northward direction of migration and the likely temporary use of the area, disturbance from the Project and other offshore wind farm projects is very unlikely to significantly affect the designated River Tweed population of Atlantic salmon.	Atlantic salmon (N)

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
				salmon and grilse all being present. In recent years, the salmon catch in the River Tweed is the highest in Scotland, with up to 15% of all salmon caught.			
			All lamprey species – unfavourable no change.	Sea lamprey - No selection information is available as they are cited as a qualifying feature but not a primary reason for selection of the site.	See species specific information above.	Due to the distance of the River Tweed SAC from the Development Area and Offshore Export Cable Corridor, and the likely range of the species, increased noise, SSC, habitat disturbance and EMF, effects are considered unlikely to impact upon the sea lamprey population.	Sea lamprey (N)
				River lamprey - No selection information is available as they are cited as a qualifying feature but not a primary reason for selection of the	See species specific information above.	There will be no interaction with the designated river lamprey population and the Wind Farm and OfTW due to the distance of the Project from the populations. As populations are concentrated in relatively small areas during spawning SNH (2011) focus conservation measures within river habitats. The Wind Farm and OfTW will	River lamprey (N)

European Site Name	Distance to the Development Area (km)	Relevant Qualifying interest	Status	Species and Reason for Selection	Information on Species biology/life history	Potential impact of the Project or in-combination.	Likely Significant Effect? (Y/N)
				site.		have no effect on spawning individuals during this period.	
				Brook lamprey - No selection information is available as they are cited as a qualifying feature but not a primary reason for selection of the site.	See species specific information above.	The life cycle of brook lamprey takes place exclusively in freshwater, therefore, there is no opportunity for interaction with the Project.	Brook lamprey (N)

390 Based on the conclusions in Table 13.61 above impacts on Atlantic salmon, freshwater pearl mussels and sea lamprey will be the focus of the Appropriate Assessment.

13.13.3 Appropriate Assessment

391 An assessment of the potential impacts on Annex II fish species (defined as the "SAC qualifying features" receptor group in this chapter) resulting from the construction, O&M, or decommissioning of the Project and in-combination with other projects in the area, is provided within this chapter (see *Section 13.6 – 13.9* above). A summary of the predicted significance of impacts assessed within this chapter is provided in Table 13.62 below.

Table 13.62: Summary of Potential Effects on SAC Fish Species, from the EIA Assessment for the Project Related Activities In-combination with Other Projects

Potential Effect	Predicted significance of effect	
	Project	In-combination
Construction and Decommissioning Phases		
Barrier effects, disturbance or physical injury associated with construction noise	(Mortality and injury) = Minor/Moderate (Behavioral responses) = Moderate	(Mortality and injury) = Minor/Moderate (Behavioral responses) = Moderate
Direct temporary habitat disturbance	Minor/Moderate	Minor/Moderate
Indirect disturbance as a result of sediment deposition and temporary increases in SSC	Minor/Moderate	Minor/Moderate
Operation and Maintenance Phases		
Behavioural responses to EMF associated with cabling	Moderate	Moderate
Long term loss of original habitat	Minor/Moderate	Minor/Moderate
Disturbance or physical injury associated with operational noise	(Mortality and injury) = Minor/Moderate (Behavioural responses) = Moderate	Minor/Moderate

392 Potential effects on the prey species sandeels were also assessed within this chapter, as per scoping opinions. Analysis of the habitat suitability (*Appendix 13B*) within the Development Area shows the area to have very little habitat of prime suitability, and distinct areas, especially in the north of the Development Area, are identified as subprime habitat. The Offshore Export Cable

Corridor has only one site which shows suitability for sandeels, situated towards the offshore section of the corridor. The remainder of the Offshore Export Cable Corridor shows unsuitable habitat for sandeels, with the sediments being predominantly muddy sands. Due to the wide foraging areas of migratory fish, which may feed on this prey species, the small spatial scale of the impact in relation to the North Sea population of sandeels, and the relatively small areas of prime sandeel habitat within the Development Area and Offshore Export Cable Corridor, the effect of habitat disturbance on sandeels is considered to be of negligible magnitude, and impacts on sandeels are not further presented for assessment within the HRA.

393 Impacts on benthic habitats have been assessed in *Chapter 12*. Predicted impacts have been identified as being limited to the Development Area and Offshore Export Cable Corridor and significant far field effects are not expected. As there is no direct overlap with the SACs and the Development Area and Offshore Export Cable Corridor, impacts on habitats are not further presented for assessment within the HRA.

394 Due to these degrees of uncertainty surrounding estimation of impact on fish and shellfish held throughout academia and industry, the assessment incorporates a series of conservative assumptions about the potential impacts of noise on fish and shellfish. Table 13.63 provides details of the assumptions relevant to this assessment and why they represent an appropriate degree of conservatism to inform an Appropriate Assessment.

Table 13.63: Key Assumptions Made During the Fish and Shellfish Impact Assessment and their Degree of Conservatism

Impact	Assumption	Degree of conservatism
Construction phase		
Barrier effects, disturbance or physical injury associated with construction noise.	Noise modelling locations represent worst case noise scenarios for SAC qualifying feature species.	This approach introduces an inherent conservatism over the duration of the construction phase. Two piling locations closest to the sensitive receptors (SACs) have been chosen and affects modelled to occur for two years. This is an overestimation of effect as the majority of piling will be more distant than these most sensitive locations, and the piling will not be constant throughout the two year period.
	Audiograms for salmon are suitable surrogates for other SAC qualifying species.	No audiogram exists for sea lamprey; however, they do not possess any specialist sensory organs such as otoliths or a swim bladder suggesting that the species has lower hearing thresholds than that of salmon. Using salmon (a species with a swim bladder) as a surrogate for lamprey is therefore likely to produce an overestimation of associated effect upon the lamprey population.
Indirect disturbance as a result of sediment deposition and temporary	SSC modelling represents worst case sediment plume scenarios for SAC qualifying feature species.	The elevated levels of SSC predicted to occur during preparation of GBS foundations (of 213 WTGs, five OSPs and three met masts) are considered to be an over estimation based on worst case scenarios during construction (i.e. substrate type across the whole Development Area, and height at which dredged material is released). Conservatism is inherent to the modelling scenario; therefore, this is

Impact	Assumption	Degree of conservatism
increases in SSC.		carried through to the assessment of impacts on SAC qualifying feature species. Furthermore, SAC qualifying feature species spend part of their life cycle in riverine environments which are often highly turbid. Therefore these species are considered to have a degree of preadaptation to temporary increases in SSC.
Direct temporary habitat disturbance.	SAC qualifying feature species with a marine phase in their life history may use the Development Area and Offshore Export Cable Corridor as a foraging ground and/or pass through it on migrations to and from SACs.	This assumption introduces conservatism throughout both the construction and operational phases of the Project, as although there is uncertainty surrounding the migratory pathways taken by SAC qualifying feature species, these species are known to migrate over large distances. In the case of salmon, smolt are likely to travel in a northerly and easterly direction en route to feeding grounds around Greenland (Malcolm *et al*., 2010), and when leaving rivers they have been recorded moving quickly to deeper more offshore waters with no evidence for coastal migration. Furthermore, return migration routes of adult salmon returning to rivers on the east coast of Scotland are likely to be across a broad front, and are believed to enter east coast Scottish rivers from the south (migrating up the coast from Northumberland - Malcolm *et al.* (2010). Given the likely range of foraging area available for these species and the evidence to suggest rapid movement of smolt offshore, the assumption that these species use the Development Area is conservative. No specific migratory directions or routes have been identified for sea lamprey. However records have been reported in shallow coastal waters and deep offshore waters suggesting they, like salmon, range widely following migration to sea, and utilise a range of habitat types (Maitland, 2003). The assumption that these species use the Development Area is therefore also conservative.
Operational Phase		
Behavioural responses to EMF associated with cabling.	All migratory SAC qualifying feature species may be impacted by EMF (both B and iE fields).	Salmon are sensitive to magnetic (B) fields as they are known to use them (along with other senses) to navigate. However, the assumption that this may result in a change in their behaviour is conservative as studies of the behavioural reactions to B fields have been inconclusive, and indicate that it is unlikely that magnetic cues are solely relied upon for navigation, (Lohman *et al*., 2008). Furthermore, although there may be small behavioural changes in swimming behaviour of chum salmon, magnetic fields do not significantly affect migration patterns (Yano *et al*., 1997), and salmon are reported to predominately swim in the upper 10 m of the water column (Malcolm *et al*., 2010), and it is considered that EMF impacts to salmon from subsea cables will not be present in water depths greater than 20 m due to the attenuation of EMF in seawater (Gill and Bartlett,

Impact	Assumption	Degree of conservatism
		2010). Sea lamprey are reported as having a low detection threshold to the iE fields generated from subsea cables. They are able to detect fields down to 10 µV/m^{-1}, however, no evidence of response to B fields exists (Gill and Bartlett, 2010). Although information on the iE field for the inter-array cables has not been modelled, assuming similar values to the Kentish flats offshore wind farm predicted, iE fields of 2.5 µV/m. This would be below that detectable by sea lamprey.
	SAC qualifying feature species with a marine phase in their life history will pass through the Development Area.	As stated above, the assumption that SAC qualifying feature species pass through the Development Area (and therefore will interact with EMF produced by inter-array cables) introduces conservatism throughout both the operational and construction phase of the Wind Farm, as there is uncertainty surrounding the migratory pathways taken by these species (see 'Direct temporary substrate loss').
Long term habitat loss.	SAC qualifying feature species with a marine phase in their life history may use the Development Area and Offshore Export Cable Corridor as a foraging ground and/or pass through it on migrations to and from SACs.	As stated above, the assumption that SAC qualifying feature species utilise the Development Area and Offshore Export Cable Corridor as a foraging ground and/or pass through on migrations to and from SACs is conservative due to uncertainties in their migratory routes (see 'Direct temporary substrate loss').
Disturbance or physical injury associated with operational noise.	SAC qualifying feature species will be sensitive to operational noise within the Development Area.	This is a conservative assumption. Although a review by Wahlberg and Westerberg (2005) concluded that operational noise from an offshore wind farm would be detectable out to 25 km from source for salmon, the species specific noise modelling undertaken for the piling in the Development Area showed salmon to be the least sensitive of the fish species modelled for operational noise, and as for the other species, predicted an avoidance range of less than one metre from the WTGs. The relatively low frequency of operational noise (WTGs and vessels) will only have avoidance impacts in the immediate vicinity of source, e.g. one metre or below for hearing specialists' such as herring detailed in *Chapter 11*. Species with a poor sensitivity to noise, such as salmon, are likely to show a lesser response to operational noise.

395 Terminology used in this assessment is based on that suggested by the Intergovernmental Panel on Climate Change (IPCC) as agreed on consultation with regulators. Definitions provided by the IPCC for levels of confidence in an assessment can be found in Table 13.64 and Table 13.65 below.

Table 13.64: Definition for the Likelihood of a Defined Outcome Having Occurred or Occurring in the Future, as Defined by the IPCC

Terminology	Likelihood of occurrence/outcome
Virtually certain	>99% probability of occurrence
Very likely	>90% probability of occurrence
Likely	>66% probability of occurrence
About as likely as not	33-66% probability of occurrence
Unlikely	<33% probability of occurrence
Very unlikely	<10% probability of occurrence
Exceptionally unlikely	<1% probability of occurrence

Table 13.65: Quantitatively Calibrated Levels of Confidence Used in this Assessment as Defined by the IPCC

Terminology	Degree of confidence in being correct
Very high confidence	At least 9 out of 10 chance of being correct
High confidence	About 8 out of 10 chance
Medium confidence	About 5 out of 10 chance
Low confidence	About 2 out of 10 chance
Very low confidence	Less than 1 out of 10 chance

396 Assignation of these confidence and likelihood values within the context of this assessment takes into account the conservative assumptions detailed in Table 13.63. It is considered that the sum of all these assumptions represents an overly conservative model, and that predicted impacts to the level of those described in the assessments are possible and not probable. Confidence that 'likely' impacts (Table 13.64 above) are within the ranges predicted by the models used is therefore 'high' or 'very high' (Table 13.65 above) for the assessment undertaken below.

397 As part of the EIA for designated sites, and to provide information to the competent authority, the following tables (Table 13.66 to Table 13.68) summarise the effects the Project and other projects may have on SACs under investigation. This has been carried out in respect of generic criterion of the conservation objectives. Where no LSE have been identified for a SAC, the site has not been carried forward into the Appropriate Assessment.

398 The following assessments are based upon information from a number of studies, and expert judgement. Where uncertainty prevents a confident prediction of impact this has been indicated with a lower confidence score. They are informed by the conclusions in *Section 13.9*.

Table 13.66: Assessment of the Conservation Objectives of the River Tay SAC from the Project Related Activities and In Conjunction with Other Projects ('In-combination')

Criterion	River Tay SAC Qualifying Migratory Species: Atlantic salmon, brook lamprey, river lamprey and sea lamprey
	Assessment
Population of the species, including range of genetic types for salmon, as a viable component of the site.	Increased noise levels during construction/decommissioning have the potential to affect Atlantic salmon and sea lamprey populations within the Tay SAC through the potential for barrier effects to migrating animals. No interactions of increased SSC levels produced via construction or decommissioning processes from the projects considered are predicted by the coastal processes assessment, and as such no cumulative barrier to migration is predicted to arise from this impact. Simultaneous piling at the Neart na Gaoithe wind farm and the Project are predicted to form a band of noise 50 km in extent in a north - south direction, detectable to salmon at 75 dB_{ht} i.e. at a level where mild behavioural responses are predicted to occur (for example changes in swimming direction, speed etc.). Simultaneous piling at the Firth of Forth Phase 1 site does not add to this barrier. This barrier covers half of the north - south extent of the sea area in this locale, and although it will not fully obstruct access to and from the Tay, it does have the potential to cause increased energetic cost to migration activities. The extent of potential behavioural effects at 75 dB_{ht}, at the closest point, is six kilometres away from the coastline and therefore species migrating to and from the Tay estuary, using the coastal environment, are not likely to encounter construction noise and vibration and therefore will not be displaced or affected in their normal movement. Due to the range of the species, the predominately northerly direction of migration, and the likely temporary use of the Project areas, acoustic disturbance and suspended sediment increases are not considered likely to significantly affect the population of Atlantic salmon or sea lamprey. The EIA assessment for the Project only and cumulative assessment have predicted noise piling, and increases in suspended sediment impacts on migratory fish to be at **most moderate adverse and therefore not significant in EIA terms**. During operation, it is possible that EMF from the Export Cable or inter-array cables may create barrier effects in close proximity to the River Tay SAC. Although it has been hypothesised that salmon may be disorientated during their return spawning migrations, Atlantic salmon and sea lamprey will only pass Project areas intermittently during migrations. In addition, the scale at which an individual will experience this effect will be only in close proximity to the Export Cables. The cumulative impact of EMF from cables from the Project and other projects considered in this assessment, is judged to be of **moderate significance and not significant in EIA terms**. There is no predicted potential impact on brook lamprey or river lamprey from the Project as there is no route to connectivity between the Project areas and these notified interests of the River Tay SAC.

Criterion	River Tay SAC Qualifying Migratory Species: Atlantic salmon, brook lamprey, river lamprey and sea lamprey Assessment
	• Changes in the population of species (Atlantic salmon, sea lamprey, brook lamprey, river lamprey), including range of genetic types in salmon, as a viable component of the Tay SAC are considered to be **unlikely** and **not significant** in the short or long term. • Confidence level: **High.**
Distribution of the species within site.	• The primary impacts which may change distribution of Atlantic salmon and sea lamprey within the SAC are barrier effects caused by increased suspended sediment, and increased anthropogenic noise levels during construction due to piling activities. Salmon and sea lamprey migrations are wide ranging, and suspended sediment increase is considered likely to cause only short term localised avoidance. The EIA assessments of Project alone cumulatively have predicted suspended sediment and noise impacts of piling on migratory fish to be at **most moderate adverse and therefore not significant.** There is no predicted impact on brook lamprey or river lamprey as there is no route to impact between the Project areas and the SAC. Changes in distribution of the species within the River Tay SAC are considered to be **unlikely and not significant** in the short or long term. • Confidence level: **High.**
Distribution and extent of habitats supporting the species.	Predictions made within this EIA as set-out above, indicate that habitat loss is insignificant for migratory species due to their potential range, and the fact that the River Tay SAC, the Project and other projects do not overlap. There is no predicted impact on brook lamprey, or river lamprey as there is no route to impact between the Project areas and the SAC. • Changes in distribution and extent of habitats within the River Tay SAC, supporting the qualifying species, are considered unlikely and **not significant** in the short or long term. • Confidence Level**: Very High.**
Structure, function and supporting processes of habitats supporting the species.	Predictions made within this EIA as set-out above, indicate that habitat loss is insignificant for migratory species due to their potential range, and the fact that the River Tay SAC, the Project and other projects do not overlap. • Changes in structure and function of supporting habitats supporting the qualifying species of the River Tay SAC are considered unlikely and **not significant** in the short or long term. • Confidence Level: **Very High.**

Criterion	River Tay SAC Qualifying Migratory Species: Atlantic salmon, brook lamprey, river lamprey and sea lamprey
	Assessment
No significant disturbance of the species.	The primary impact is considered to be increased noise from piling during construction, however the 90 dB_{ht} (salmon) noise contour for salmon do not extend to the River Tay SAC. Noise disturbance at sea has the potential to disturb some species associated with the SAC, in particular Atlantic salmon and sea lamprey migrating to and from the SAC, however is not predicted to form a barrier to movement. Due to the range of the species, the predominately northerly direction of migration, and the likely temporary use of the area, acoustic disturbance is not considered likely to significantly affect the population of Atlantic salmon or sea lamprey. There is no predicted impact on brook lamprey or river lamprey as there is no route to impact between the Project areas and the SAC. The EIA assessment for the Project alone and the cumulative assessment have predicted piling noise, and suspended sediment impacts on migratory fish to be at **most moderate adverse and therefore not significant** in EIA terms. • All other potential impacts on Atlantic salmon and sea lamprey were predicted to be of at worst moderate significance, as a result of the receptor groups' high sensitivity, assigned due to conservation importance, rather than sensitivity to the impact in question. The impact is therefore is **not significant** in the short or long term. • Confidence Level: **High.** **Even when considered in combination it is considered highly unlikely that these will cause significant disturbance to species.** There is no predicted impact on brook lamprey or river lamprey as there is no route to impact between the Project areas and the SAC. Significant disturbance of the qualifying species of the River Tay SAC is considered unlikely and not significant in the short or long term. **Confidence level: High.**

399 **It is predicted that the Project alone or in combination will not affect maintenance of the integrity of the River Tay SAC and that the River Tay SAC will maintain an appropriate contribution to achieving favourable conservation status of the qualifying species.**

Table 13.67: Assessment of the Conservation Objectives of the River South Esk SAC, the Project Related Activities and In Conjunction with Other Projects ('In-combination')

Criterion	River South Esk Qualifying Migratory Species: Atlantic salmon and Fresh water pearl mussels
	Assessment
Population of the species, including range of genetic types for salmon, as a viable component of the site.	Increased noise levels during construction/decommissioning have the potential to affect Atlantic salmon within the River South Esk SAC through the potential for barrier effects to migrating species. No interactions of increased SSC levels produced via construction or decommissioning processes from the projects considered are predicted by the coastal processes assessment, and as such no cumulative barrier to migration is predicted to arise from this impact. Simultaneous piling at the Neart na Gaoithe site and the Project is predicted to form a band of noise 50 km in extent in a north-south direction, detectable to salmon at 75 dB_{ht} (salmon) i.e. at a level where mild behavioural responses are predicted to occur (e.g. changes in swimming direction, speed etc.). Simultaneous piling at the Firth of Forth Phase 1 site does not add to this barrier. This barrier covers half of the north - south extent of the sea area in this locale, and although it will not fully obstruct access to and from the River South Esk, it does have the potential to cause increased energetic cost to migration activities. The extent of behavioural effects, at 75 dB_{ht} (salmon) at the closest point, is six kilometres away from the coastline and therefore species migrating to and from the River South Esk, using the coastal environment are not likely to encounter construction noise and vibration and therefore will not be displaced or affected in their normal movement. Due to the range of the species, the predominately northerly direction of migration, and the likely temporary use of the area, acoustic disturbance and suspended sediment are not considered likely to significantly affect the population of Atlantic salmon. The EIA assessment for the Project alone and in-combination assessment have predicted piling noise, and suspended sediment impacts on migratory fish to be at **most moderate adverse and therefore not significant in EIA terms**. During operation, it is possible that EMF from the Export Cable or inter-array cables may create barrier effects in close proximity to the River South Esk SAC. Although it has been hypothesised that salmon may be disorientated during their return spawning migrations, Atlantic salmon will only pass Project areas intermittently during migrations. In addition, the scale at which an individual will experience this effect will be only in close proximity to the Export Cables. The cumulative impact of EMF from cables from the Project and other projects considered in this assessment, is judged to be of **moderate significance and not significant in EIA terms**. As freshwater pearl mussel rely on migrating salmonids during the glochidial stage of their lifecycle when the larvae attach to the gills of passing fish, effects on salmon populations will be reflected in freshwater pearl mussel distribution. As changes in the River South Esk SAC Atlantic salmon populations are considered to be unlikely and not significant in the long term it can be concluded that effects on populations of freshwater pearl mussel will be of a similar or lesser magnitude.

Criterion	River South Esk Qualifying Migratory Species: Atlantic salmon and Fresh water pearl mussels
	Assessment
	• Changes in the River South Esk SAC Atlantic salmon and fresh water pearl mussel population are considered to be **unlikely and not significant** in the short or long term. • Confidence level: **High.**
Distribution of the species within site.	The primary impacts which may change distribution of Atlantic salmon within the SAC are barrier effects caused by increased suspended sediment and increased anthropogenic noise levels during construction due to piling activities. Salmon migrations are wide ranging and SSC increase is considered likely to cause only short term localised avoidance. The EIA assessments of the Project alone and in-combination have predicted SSC and noise impacts of piling on migratory fish to be at worse **moderate adverse and therefore not significant.** As freshwater pearl mussel rely on migrating salmonids during the glochidial stage of their lifecycle when the larvae attach to the gills of passing fish, effects on salmon distribution may be reflected in freshwater pearl mussel distribution. As changes in the distribution of the River South Esk SAC population of Atlantic salmon are considered to be unlikely, it can be concluded that effects on populations of freshwater pearl mussel will be of a similar or lesser magnitude. • Changes in distribution of the species within the River South Esk SAC are considered to be **unlikely and not significant** in the short or long term. • Confidence level: **High.**
Distribution and extent of habitats supporting the species.	Predictions made within this EIA as set-out above indicate that habitat loss is insignificant for migratory species due to their potential range, and the SAC and the Project and other projects do not overlap. As freshwater pearl mussel rely on migrating salmonids during the glochidial stage of their lifecycle when the larvae attach to the gills of passing fish, effects on salmon populations will be reflected in freshwater pearl mussel distribution. As changes in habitat distribution of River South Esk SAC, Atlantic salmon are considered not significant, it can be concluded that effects on populations of freshwater pearl mussel will be of a similar or lesser magnitude, therefore: • Changes in distribution and extent of habitats within the River South Esk SAC, supporting the qualifying species, are considered unlikely and **not significant** in the short or long term**.** • Confidence Level**: Very High.**

<table>
<tr><th rowspan="2">Criterion</th><th>River South Esk Qualifying Migratory Species: Atlantic salmon and Fresh water pearl mussels</th></tr>
<tr><th>Assessment</th></tr>
<tr><td>Structure, function and supporting processes of habitats supporting the species.</td><td>Predictions made within this EIA as set-out above, indicate that habitat loss is insignificant for migratory species due to their potential range, and the fact that the SAC and the Project and other projects do not overlap.

As freshwater pearl mussels rely on migrating salmonids during the glochidial stage of their lifecycle when the larvae attach to the gills of passing fish, effects on salmon populations will be reflected in freshwater pearl mussel distribution. As changes in structure and function of supporting habitats of River South Esk SAC, Atlantic salmon are considered not significant, it can be concluded that effects on populations of freshwater pearl mussels will be of a similar or lesser magnitude.

• Changes in structure and function of supporting habitats supporting the qualifying species of the River South Esk SAC are considered unlikely and not significant in the short or long term.

• Confidence Level: Very High.</td></tr>
<tr><td>No significant disturbance of the species.</td><td>The primary impact is considered to be increased noise from piling during construction, however the 90 dB_{ht} (salmon) noise contour for salmon do not extend to the River South Esk SAC. Noise disturbance at sea has the potential to disturb some animals associated with the SAC, (i.e. Atlantic salmon) migrating to and from the site, however is not predicted to form a barrier to movement.

Due to the range of the species, the predominately northerly direction of migration, and the likely temporary use of the area, acoustic disturbance is not considered likely to significantly affect the population of Atlantic Salmon.

The EIA assessment for Project alone and the cumulative assessment have predicted noise piling, and SSC impacts on migratory fish to be at most moderate adverse and therefore not significant in EIA terms.

All other potential impacts on Atlantic salmon were predicted to be of at worst moderate significance, as a result of the receptor groups' High sensitivity, assigned due to conservation importance, rather than sensitivity to the impacts in question. As freshwater pearl mussels rely on migrating salmonids no significant disturbance is predicted for this species.

• Even when considered in combination, it is considered highly unlikely this will cause significant disturbance to species, and therefore is not significant in the short or long term.

• Confidence Level: High.</td></tr>
</table>

Criterion	River South Esk Qualifying Migratory Species: Atlantic salmon and Fresh water pearl mussels **Assessment**
Distribution and viability of freshwater pearl mussel host species.	As freshwater pearl mussel rely on migrating salmonids during the glochidial stage of their lifecycle when the larvae attach to the gills of passing fish, effects on salmon populations will be reflected in freshwater pearl mussel distribution. As changes in structure and function of supporting habitats of River South Esk SAC Atlantic salmon are considered not significant, it can be concluded that effects on populations of freshwater pearl mussel will be of a similar or lesser magnitude. • Changes in structure and function of supporting habitats supporting freshwater pearl mussel host species are considered unlikely and **not significant** in the short or long term**.** • Confidence Level: **High.**
Changes in structure, function and supporting processes of habitats supporting freshwater pearl mussel host species.	As there is no connectivity between the freshwater habitats and the Development Area and Offshore Export Cable Corridor there is no possibility that the construction/operation/decommissioning effects could result in a changes in structure, function and supporting processes of habitats supporting freshwater pearl mussel host species. • Changes in structure and function of supporting habitats supporting freshwater pearl mussel host species are considered unlikely and **not significant** in the short or long term**.** • Confidence Level: **High.**

400 **It is predicted the Project will not affect maintenance of the integrity of the River South Esk SAC and that the River South Esk SAC will maintain an appropriate contribution to achieving favourable conservation status of the qualifying species.**

Table 13.68: Assessment of the Conservation Objectives of the River Teith SAC, the Project Related Activities and In Conjunction with Other Projects ('In-combination')

<table>
<tr><th rowspan="2">Criterion</th><th>River Teith SAC Qualifying Migratory Species: Atlantic salmon, brook lamprey, river lamprey and sea lamprey</th></tr>
<tr><th>Assessment</th></tr>
<tr><td>Population of the species, including range of genetic types for salmon, as a viable component of the site.</td><td>Increased noise levels during construction/decommissioning have the potential to affect Atlantic salmon and sea lamprey populations within the River Teith SAC through the potential for barrier effects to migrating animals.

No interactions of increased SSC levels produced via construction or decommissioning processes from the projects considered are predicted by the coastal processes assessment, and as such no cumulative barrier to migration is predicted to arise from this impact

Simultaneous piling at the Neart na Gaoithe site and the Project areas is predicted to form a band of noise 50 km in extent in a north - south direction, detectable to salmon at 75 dB_{ht} i.e. at a level where mild behavioural responses are predicted to occur (for example changes in swimming direction, speed etc.). Simultaneous piling at the Firth of Forth Phase 1 site does not add to this barrier. This barrier covers half of the north - south extent of the sea area in this locale, and although it will not fully obstruct access to and from the River Teith SAC, it does have the potential to cause increased energetic cost to migration activities. The extent of potential behavioural effects at 75 dB_{ht} (salmon) at the closest point, is six kilometres away from the coastline and therefore species migrating to and from the Teith estuary using the coastal environment, are not likely to encounter construction noise and vibration and therefore will not be displaced or affected in their normal movement.

Due to the range of the species, the predominately northerly direction of migration, and the likely temporary use of the area, acoustic disturbance and suspended sediment are not considered likely to significantly affect the population of Atlantic salmon or sea lamprey. The EIA assessment for the Project alone and cumulative assessments have predicted noise piling, and suspended sediment impacts on migratory fish to be at most moderate adverse and therefore not significant in EIA terms.
During operation, it is possible that EMF from the Export Cable or inter-array cables may create barrier effects in close proximity to the Teith SAC. Although it has been hypothesised that salmon may be disorientated during their return spawning migrations, Atlantic salmon and sea lamprey will only pass Project areas intermittently during migrations. In addition, the scale at which an individual will experience this effect will be only in close proximity to the Export Cables. The cumulative impact of EMF from cables from the Project and other projects considered in this assessment, is judged to be of moderate significance and not significant in EIA terms. There is no predicted potential impact on brook lamprey or river lamprey from the Wind Farm and OfTW as there is no route to connectivity between the Project area and these notified interests of the SAC.
Changes in the population of species (Atlantic salmon, sea lamprey, brook lamprey, river lamprey), including range of genetic types in salmon, as a viable component of the River Teith SAC are considered to be unlikely and not significant in the short or long term.
Confidence level: High.</td></tr>
</table>

Criterion	River Teith SAC Qualifying Migratory Species: Atlantic salmon, brook lamprey, river lamprey and sea lamprey
	Assessment
Distribution of the species within site.	The primary impacts which may change distribution of Atlantic salmon and sea lamprey within the SAC are barrier effects caused by increased suspended sediment and increased anthropogenic noise levels during construction due to piling activities. Salmon and sea lamprey migrations are wide ranging, and SSC increase is considered likely to cause only short term localised avoidance. The EIA assessments of the Project alone and cumulatively have predicted suspended sediment and noise impacts of piling on migratory fish to be at worse **moderate adverse and therefore not significant.** There is no predicted impact on brook lamprey or river lamprey as there is no route to impact between the Project areas and the SAC. • Changes in distribution of the species within the River Teith SAC are considered to be **unlikely and not significant in the long term.** • Confidence level: **High.**
Distribution and extent of habitats supporting the species.	Predictions made within this EIA as set-out above indicate that habitat loss is insignificant for migratory species due to their potential range and the fact that the SAC and the Project areas and other project areas do not overlap. There is no predicted impact on brook lamprey, or river lamprey as there is no route to impact between the Project areas and the SAC. • Changes in distribution and extent of habitats within the River Teith SAC, supporting the qualifying species, are considered unlikely and **not significant in the long term.** • Confidence Level**: Very High.**
Structure, function and supporting processes of habitats supporting the species.	• Predictions made within this EIA as set-out above, indicate that habitat loss is insignificant for migratory species due to their potential range, and the fact that the SAC and the Project areas and other project areas do not overlap. Changes in structure and function of supporting habitats of the qualifying species of the River Teith SAC are considered unlikely and **not significant** in the short or long term. • Confidence Level: **Very High.**

<table>
<tr><th rowspan="2">Criterion</th><th>River Teith SAC Qualifying Migratory Species: Atlantic salmon, brook lamprey, river lamprey and sea lamprey</th></tr>
<tr><th>Assessment</th></tr>
<tr><td>No significant disturbance of the species.</td><td>The primary impact is considered to be increased noise from piling during construction, however the 90 dB noise contour for salmon do not extend to the River Teith SAC. Noise disturbance at sea from piling has the potential to disturb some animals associated with the SAC, in particular Atlantic salmon and sea lamprey migrating to and from the SAC, however is not predicted to form a barrier to movement.

Due to the range of the species, the predominately northerly direction of migration, and the likely temporary use of the area, acoustic disturbance is not considered likely to significantly affect the population of Atlantic salmon or sea lamprey. There is no predicted impact on brook lamprey or river lamprey as there is no route to impact between the Project areas and the SAC.

The EIA assessment for the Project alone and the in-combination assessment have predicted noise piling, and suspended sediment impacts on migratory fish to be at most moderate adverse and therefore not significant in EIA terms. All other potential impacts on Atlantic salmon and sea lamprey were predicted to be of at worst moderate significance, as a result of the receptor groups' high sensitivity, assigned due to conservation importance, rather than sensitivity to the impacts in question.

Even when considered in combination it is considered highly unlikely this will cause significant disturbance to species.

• There is no predicted impact on brook lamprey or river lamprey as there is no route to impact between the Project areas and the SAC.
• Significant disturbance of the qualifying species of the River Teith SAC is considered unlikely and not significant in the short or long term.
• Confidence level: High.</td></tr>
</table>

401 **It is predicted the Project will not affect maintenance of the integrity of the River Teith SAC and that the River Teith SAC will maintain an appropriate contribution to achieving favourable conservation status of the qualifying species.**

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Abbreviations and Acronyms

CA	Competent Authority
EIA	Environmental Impact Assessment
ES	Environmental Statement
HRA	Habitats Regulations Appraisal
ICOL	Inch Cape Offshore Limited
JNCC	Joint Nature Conservation Committee
LSE	Likely Significant Effect
ML	Most Likely
MS LOT	Marine Scotland Licensing Operations Team
OfTW	Offshore Transmission Works
OnTW	Onshore Transmission Works
PTS	permanent threshold shift
SAC	Special Area of Conservation
WC	Worst Case
WTG	Wind Turbine Generators

1 Introduction

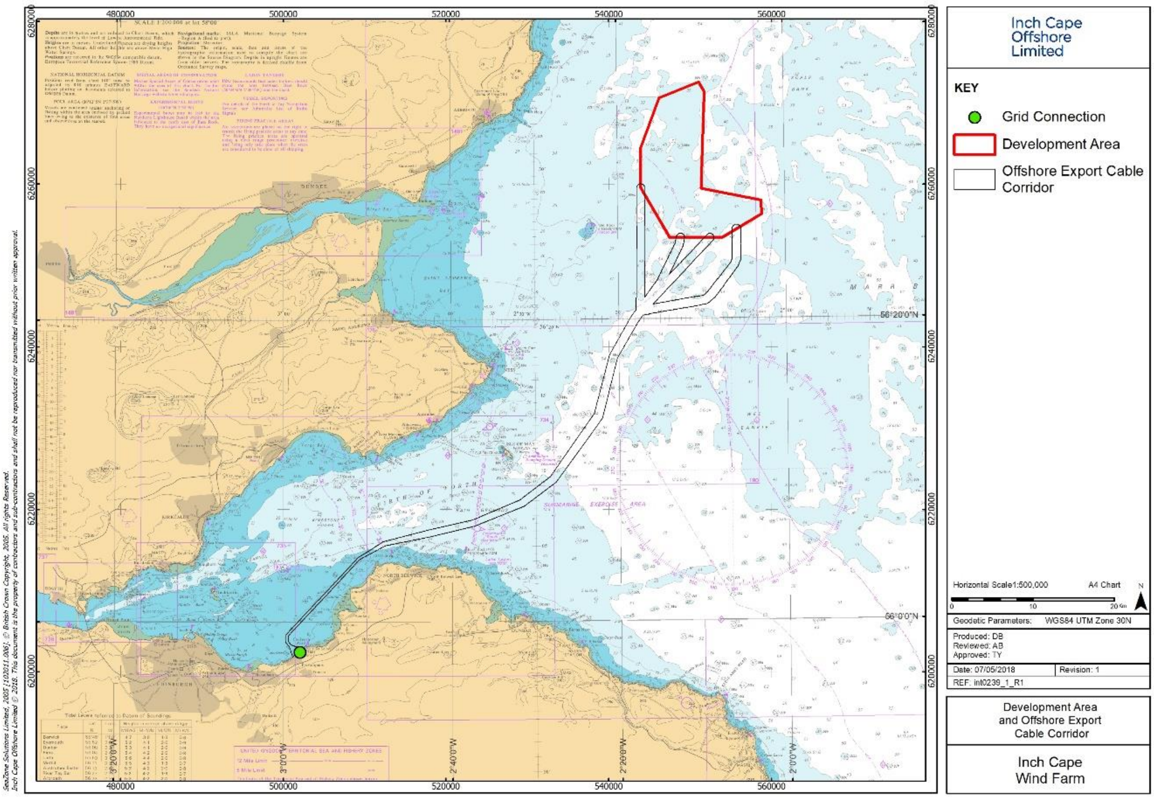
1.1 Background to the Development

1 Inch Cape Offshore Limited (ICOL) is promoting the development of the Inch Cape Wind Farm and associated Transmission Works. The Wind Farm and Offshore Transmission Works (OfTW), the Development, is in the North Sea, off the east coast of Angus in Scotland. It will be comprised of an offshore array of Wind Turbine Generators (WTGs), connected to one another by subsea inter-array cables, which will in turn connect the WTGs to one or two Offshore Substation Platform(s) (OSPs), where power generated by the WTGs is transformed and subsequently carried to an onshore landfall location via Offshore Export Cables (*Figure 1.1*).

2 In order to transmit the generated electricity from the Wind Farm to the National Grid, a connection will be made through the OfTW and the Onshore Transmission Works (OnTW).

3 The OnTW includes underground electricity cables and an onshore substation which receives power from the Offshore Export Cables and processes it for transmission to the existing grid network. The Landfall for Export Cables will be near Cockenzie (*Figure 1.1*). The OnTW lies within the vicinity of the former Cockenzie Power Station.

Figure 1.1: Development Area and Offshore Export Cable Corridor



4 The Development will comprise of an offshore generating station, the Wind Farm, with a capacity of more than one megawatt (MW) which therefore requires Scottish Ministers' consent under Section 36 of the *Electricity Act* (Section 36 *Consent*) to allow its construction and operation. Under the *Marine (Scotland) Act 2010*, the Development will also require marine licences granted by the Scottish Ministers to allow for the construction and deposition of substances and structures in the sea and on the seabed. The OnTW is subject to a separate application to East Lothian Council (ICOL, 2018a).

5 The Environmental Impact Assessment (EIA) process provides an understanding of, among other things, the biological processes operating in (and in the vicinity of) the Development Area and Offshore Export Cable Corridor and those that may be impacted by the proposed Development. These processes are fully assessed in the EIA Report for the Development and readers are guided there for further details (ICOL, 2018b).

6 The impacts identified through the EIA process have shown potential for impacts on European designated sites (Natura 2000 sites) and features. As such ICOL has produced this Habitats Regulations Appraisal (HRA) report to inform the planning process and to assist the Competent Authority (CA) in carrying out an Appropriate Assessment (AA) for the Wind Farm and associated Transmission Works.

7 The purpose of this document is to provide sufficient information to enable the CA (in this case Marine Scotland Licensing Operations Team (MS LOT) acting on behalf of the Scottish Ministers) to conclude that there will not be an adverse effect on the integrity of any European sites (for marine mammals this is Special Areas of Conservation (SACs)) which include marine mammals as notified interest features as a result of the Development.

2 HRA Report

2.1 HRA Process

8 The HRA process derives from the requirements of specific European Directives that implement their requirements into UK and Scottish law. Thus, the HRA process covers features designated under the *Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora* (the 'Habitats Directive') as implemented by the *Conservation of Habitats and Species Regulations 2010* (the Habitats Regulations) and the *Conservation of Offshore Marine Habitats and Species Regulations 2017*

9 The Habitats Regulations require that wherever a project (that is not directly connected with or necessary to the management of a European (Natura 2000) site) has the potential to have a Likely Significant Effect (LSE) on the Conservation Objectives of the site (alone or in-combination with other plans or projects) then an AA must be undertaken by the CA. The AA must be carried out before consent can be given for the project.

10 An HRA is a four-stage process which can be summarised as:

- HRA Stage 1 – Screening: Screening for no LSE (alone or in-combination with other projects or plans);
- HRA Stage 2 – AA: Assessment of implications of identified LSEs on the Conservation Objectives of a Natura 2000 site to ascertain that the proposal will not adversely affect its integrity;
- HRA Stage 3 – Assessment of Alternatives: Where it cannot be ascertained that the proposal will not adversely affect the integrity of a Natura 2000 site, alternative solutions must be considered; and
- HRA Stage 4 – Assessment of Imperative Reasons of Overriding Public Interest (IROPI; where no alternatives are identified.)

11 All four stages work in sequence, consecutively, and are referred to simply as the HRA process, although if it is possible to reach a conclusion of no adverse effects on site integrity (with mitigation, if appropriate) then Stages 3 and 4 are not required. This clearly distinguishes the whole HRA process from the one step within it that is referred to simply as the AA.

2.2 European Sites Potentially affected by the Development

12 Before the HRA process can begin, there must be an exercise to identify those European sites which are potentially affected by the project to consider in the HRA.

13 As per the Inch Cape Wind Farm Scoping Report (ICOL, 2017), four European sites which include marine mammals as qualifying species, and for which there is potential connectivity with an impact from the construction and decommissioning activities associated with the Wind Farm and OfTW (Development), are considered relevant to the HRA; see *Table 2.1*.

Table 2.1: Natura 2000 sites (SACs which include marine mammals as qualifying species) considered relevant to HRA

Site	Qualifying species	Latest assessed condition[1]
Berwickshire and North Northumberland Coast SAC	Grey seal (*Halichoerus grypus*)	Favourable Maintained
Firth of Tay and Eden Estuary SAC	Harbour seal[2] (*Phoca vitulina*)	Unfavourable Declining
Isle of May SAC	Grey seal (*Halichoerus grypus*)	Favourable Maintained
Moray Firth SAC	Bottlenose dolphin (*Tursiops truncatus*)	Favourable Recovered

14 The conservation objectives (for the qualifying species) for each of the four sites are as follows:

- 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; and
- To ensure for the qualifying species that the following are maintained in the long term[3]:
  - 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.

2.3 Likely Significant Effect (LSE) Assessment

15 Screening for potential LSE was undertaken (for each of the four relevant Natura sites which include marine mammals as qualifying species) in the Inch Cape Wind Farm Scoping Report (ICOL, 2017).

16 The following key potential effects were considered:

- Displacement/permanent threshold shift (PTS) from piling; and
- Disturbance from increased noise from geophysical survey systems.

[1] Information taken from https://gateway.snh.gov.uk/sitelink/. [Accessed 08/05/2018]
[2] Also known as common seal.
[3] For the Moray Firth SAC, this sentence reads 'To ensure for the qualifying species that the following are established then maintained in the long term'.

17 It was not possible to conclude no LSE for either potential effect at this stage therefore all four Natura sites were taken forward to the next stage (AA).

3 Summary of the Findings of the EIA Report

18 Some of the information which is used to assess whether an effect is significant for the purposes of the EIA Report prepared by ICOL (ICOL, 2018b) is also relevant to the distinct Habitats Regulations Appraisal to be undertaken by MS-LOT on behalf of the Scottish Ministers. That information is summarised here with full details presented in *Chapter 10: Marine Mammals* of the EIA Report:

- PTS from piling: The residual effects of PTS on all marine mammal species from piling at the Development are predicted to be of minor significance (see *Table 3.1*). This is because they are predicted to be medium term in duration (construction years) and low in magnitude (with mitigation less than ten per cent of the species' reference populations will be affected). In addition, the residual effects of PTS from piling at the Development are predicted to be less than those which were assessed as not significant in the 2013 Inch Cape Environmental Statement (ES) (ICOL, 2013) and deemed acceptable for the 2014 Inch Cape Consent.
- Displacement from piling: The residual effects of displacement on all marine mammal species from piling at the Development are predicted to be of minor significance (see *Table 3.1*). This is because they are predicted to be medium term in duration (construction years) and low in magnitude (with mitigation less than ten per cent of the species' reference populations will be affected). In addition, the residual effects of displacement from piling at the Development are predicted to be less than those which were assessed as not significant in the 2013 Inch Cape ES (ICOL, 2013) and deemed acceptable for the 2014 Inch Cape Consent.
- Population level modelling: Displacement from pile driving at Inch Cape is unlikely to affect the size or growth of the bottlenose dolphin population off the east coast of Scotland (see *Chapter 10, Section 10.8.1*). While displacement from pile driving/ blasting at the cumulative projects may affect the size and growth of the bottlenose dolphin population off the east coast of Scotland, the outputs from iPCoD suggest that the size of this effect is likely to be small (see *Chapter 10, Section 10.11.1*). The precision of estimates from the current monitoring programme for this population (and other similar populations) suggest that an effect of this size is unlikely to be detectable.
- PTS from increased noise from geophysical survey systems: The residual effects of PTS on all marine mammal species from use of geophysical survey systems at the Development are predicted to be of minor significance (see *Table 3.1*). This is because they are predicted to be medium term in duration (construction years) and low in magnitude (with mitigation no animals, i.e. less than ten per cent of the species' reference populations, will be affected).
- Disturbance from increased noise from geophysical survey systems: The residual effects of disturbance on all marine mammal species from use of geophysical survey systems at the Development are predicted to be of minor significance (see *Table 3.1*). This is because they are predicted to be medium term in duration (construction years) and low in magnitude (less than ten per cent of the species' reference populations will be affected).

In terms of mitigation, current best practice will be used; at the moment this is adoption of the Joint Nature Conservation Committee (JNCC) guidelines for minimising the risk of injury to marine mammals from geophysical surveys (JNCC, 2017) i.e. the use of soft starts where possible (i.e. if equipment specifications allow).

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

20 The assessment for the Development has been undertaken upon the worst case scenario, with the caveat that this situation across the whole site is not credible. The assessment therefore also provides the impact assessment for the most likely scenario with which to contextualise the more likely scale of effects from piling driving to secure the foundation structures.

21 The difference between the most likely and worst case scenarios is principally one of maximum blow energy, with the worst case scenario potentially utilising a maximum blow energy in the order of twice that of the most likely piling scenarios for both pin piles and monopiles. The full details of the piling strategy are provided in *Section 10.5.1* of *Chapter 10* in the EIA Report.

Table 3.1: Summary of the findings of the EIA for SAC species – Development alone

Potential impact		Project	Pile type	Criteria	Number of bottlenose dolphins with the potential to be impacted				Number of grey seals with the potential to be impacted				Number of harbour seals with the potential to be impacted			
					One vessel		Two vessels		One vessel		Two vessels		One vessel		Two vessels	
					ML[4]	WC	ML	WC	ML	WC	ML	WC	ML	WC	ML	WC
Displacement/ PTS from piling	PTS	2013 Inch Cape ES	Pin piles	Southall *et al.*	1.2	1.7	1.9	2.9	478	613	647	822	47	59	65	78
			Significance		Minor				Minor to moderate				Minor to moderate			
		Development	Pin piles	Southall *et al.*	0	0	0	0	0	0	0.8	12.1	0	0	<0.1	0.6
				NOAA	0	0	0	0	0	0	0	0	0	0	0	0
			Monopiles	Southall *et al.*	0	0	0	0	0	0.4	3.2	47	0	<0.1	0.2	1.5
				NOAA	0	0	0	0	0	0	0	0	0	0	0	0
			Significance		Minor				Minor				Minor			
	Displacement	2013 Inch Cape ES	Pin piles		15		19		3058		3212		322		340	
			Significance		Moderate				Major				Major			
		Development	Pin piles		4	5	4	6	431	675	533	810	9	12	14	17
			Monopiles		5	7	6	8	692	1058	830	1236	12	15	17	20

[4] Key parameters for the ML and WC scenarios relevant to the marine mammal impact assessment (i.e. for pile driving and use of geophysical survey systems) are detailed in Table 10.4 and Table 10.5 of the EIA Report.

			Significance	Minor	Minor	Minor
Disturbance from increased noise from geophysical survey systems	PTS	2013 Inch Cape ES		Not assessed		
		Development		Minor		
	Disturbance	2013 Inch Cape ES		Not assessed		
		Development		Minor		

4 Shadow Appropriate Assessment (shadow AA)

22 The purpose of this section is to assess the implications of identified LSEs from the Development (displacement/ PTS from piling and disturbance from increased noise from geophysical survey systems) on the conservation objectives of the four relevant European sites (see *Table 2.1* above) to ascertain whether the Development has the potential to adversely affect site integrity, thereby providing sufficient information to enable MS LOT to undertake an Appropriate Assessment (AA).

23 The following tables (*Table 4.1* to *Table 4.4*) summarise the effects the Development is predicted to have on the conservation objectives of the four relevant SACs for marine mammals (detailed in *Table 2.1*) either alone or in combination with other plans/ projects.

Table 4.1: Berwickshire and North Northumberland Coast SAC (qualifying species is grey seal)

Conservation Objective	Assessment
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	The potential effects of displacement/PTS from piling and disturbance from increased noise from geophysical survey systems on grey seals were predicted to be of minor significance for the Development, both alone and in combination with other plans/ projects (see *Section 3*). The shadow AA for the 2013 Inch Cape ES (ICOL, 2013) assumed that 25 per cent of the animals predicted to develop PTS (478-822 individuals; see *Table 3.1*) were lost from the population or 'harvested'. This equated to removal of between 120 and 206 individuals, which is equivalent to between 14 to 23 per cent of 2018's East Scotland Management Unit Potential Biological Removal (PBR; 882 grey seals; Thompson *et al*., 2017). Current estimates of the number of grey seals which have the potential to be exposed to noise levels sufficient to induce the onset of PTS from the Development vary between zero and 47 individuals (see *Table 3.1*). Using the same assumptions as made for the assessment to inform the 2013 Inch Cape ES (ICOL, 2013) with respect to assumed mortality consequences from PTS (that 25 per cent of the animals predicted to develop PTS were lost from the population or 'harvested'), this would equate to between zero and 12 individuals, and represent up to two per cent of the 2018 East Scotland Management Unit PBR. Grey seals travel extensively and use a wide range of habitats including multiple foraging areas and haul out sites. Displacement is therefore not expected to have the same effect on grey seals as it might have on a species which does not travel so extensively. It is considered unlikely that temporary displacement will have a long-term impact at the population level. The general trend in grey seal pup production at the Berwickshire and North Northumberland Coast SAC (and at other colonies in the North Sea; see *Chapter 10, Section 10.6.7*) is increasing (SCOS, 2017).

Conservation Objective	Assessment
	It is therefore considered that the long-term viability of the grey seal population using the Berwickshire and North Northumberland Coast SAC is unlikely to be adversely affected by the Development.
Distribution of the species within site	The potential effects of displacement from piling and disturbance from increased noise from geophysical survey systems on grey seals were predicted to be of minor significance for the Development, both alone and in combination with other plans/projects. The most likely response (to increased noise) will be temporary behavioural avoidance (there is evidence that short-term disturbance caused by a commercial two-dimensional seismic survey does not lead to long-term displacement of harbour porpoises (Thompson *et al*., 2013) and harbour seals were distributed as per the non-piling scenario within two hours of cessation of pile driving within the Wash (Russell *et al*., 2016)). While some individuals may be temporarily displaced from preferred foraging areas and transit routes, it is likely that they will find suitable alternative foraging habitat. Therefore any changes to the distribution of the species within the site are likely to be short-term.
Distribution and extent of habitats supporting the species	No change anticipated as a result of increased underwater noise.
Structure, function and supporting processes of habitats supporting the species	No change anticipated as a result of increased underwater noise.
No significant disturbance of the species	The potential effects of displacement from piling and disturbance from increased noise from geophysical survey systems on grey seals were predicted to be of minor significance for the Development, both alone and in combination with other plans/ projects. Although classed as medium-term (i.e. during the construction year), the most likely response (to increased noise) will be temporary behavioural avoidance i.e. animals are likely to be displaced during piling but not during construction as a whole (as per Russell *et al*. (2016) who found that harbour seals were distributed as per the non-piling scenario within two hours of cessation of pile driving). Grey and harbour seals are both phocid (true) seals whose generalised hearing range is 50 Hz to 86 kHz (Southall *et al*., 2007; NOAA, 2016). Although individual species' hearing ranges are typically not as broad as the generalised range for the functional hearing group, there is no reason to assume that grey seals will respond to noise from pile driving differently compared to harbour seals. Therefore, no significant disturbance of the species is anticipated.

24 It is predicted that the Development, either alone or in combination with other plans/ projects, will not cause deterioration of the habitats of the qualifying species (grey seal) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site (Berwickshire and North Northumberland Coast SAC) is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features in the long term.

Table 4.2: Firth of Tay and Eden Estuary SAC (qualifying species is harbour seal)

Conservation Objective	Assessment
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	As can be seen from *Table 2.1*, the population of harbour seals is not currently a viable component of the site (latest assessed condition[5] = unfavourable declining). Harbour seal abundance in the Firth of Tay and Eden Estuary SAC has been decreasing for the last fifteen years (see *Chapter 10, Section 10.6.7*), and the 2016 count represents a 90 per cent decrease from the mean counts recorded between 1990 and 2002 (SCOS, 2017). The cause of the decline is unknown (Lonergan and Thompson, 2012) but potential causes are thought to include infectious/ non-infectious disease, biotoxin exposure, nutritional stress, shooting, spatial and ecological overlap with other marine mammals, human disturbance, trauma/predation and fisheries interactions (Hall and Kershaw, 2012). The potential effects of displacement/ PTS from piling and disturbance from increased noise from geophysical survey systems on harbour seals were predicted to be of minor significance for the Development, both alone and in combination with other plans/ projects. The estimated number of individuals which had the potential to be affected was less for the Development than for the assessment to inform the 2013 Inch Cape ES (ICOL, 2013) for all four construction scenarios for both PTS and displacement (see *Table 3.1*). Population modelling undertaken to inform the 2013 Inch Cape ES indicated little difference between the baseline and construction scenarios (ICOL, 2013). Therefore, given that the estimated number of individuals which had the potential to be affected was less for the Development than for the assessment to inform the 2013 Inch Cape ES (ICOL, 2013), it is also likely that there will be no discernible population level effects of piling activity on the size of the East Scotland Management Unit harbour seal population. The factors causing the decline of the harbour seal population which uses the Firth of Tay and Eden Estuary SAC (see *Chapter 10, Section 10.6.7*) are unknown but are considered to be unrelated to potential impacts from existing underwater noise. It is therefore considered that the long-term viability of the harbour seal population using the Firth of Tay and Eden Estuary SAC is unlikely to be adversely affected by the Development.

[5] Information taken from https://gateway.snh.gov.uk/sitelink/ (last accessed 24/04/2018).

Conservation Objective	Assessment
Distribution of the species within site	The potential effects of displacement from piling and disturbance from increased noise from geophysical survey systems on harbour seals were predicted to be of minor significance for the Development, both alone and in combination with other plans/projects. The most likely response (to increased noise) will be temporary behavioural avoidance (Russell *et al*. (2016a) found that harbour seals were distributed as per the non-piling scenario within two hours of cessation of pile driving within the Wash). While some individuals may be temporarily displaced from preferred foraging areas and transit routes, it is likely that they will find suitable alternative foraging habitat within the Forth and Tay area. Therefore, any changes to the distribution of the species within the site are likely to be short-term and not broad scale.
Distribution and extent of habitats supporting the species	No change anticipated as a result of increased underwater noise.
Structure, function and supporting processes of habitats supporting the species	No change anticipated as a result of increased underwater noise.
No significant disturbance of the species	The potential effects of displacement from piling and disturbance from increased noise from geophysical survey systems on harbour seals were predicted to be of minor significance for the Development, both alone and in combination with other plans/projects. Although classed as medium-term (i.e. during the construction year), the most likely response (to increased noise) will be temporary behavioural avoidance i.e. animals are likely to be displaced during piling but not during construction as a whole (as per Russell *et al*. (2016) who found that harbour seals were distributed as per the non-piling scenario within two hours of cessation of pile driving). Therefore, no significant disturbance of the species is anticipated.

25 It is predicted that the Development, either alone or in combination with other plans/projects, will not cause deterioration of the habitats of the qualifying species (harbour seal) or significant disturbance to the qualifying species. The Development (alone or in combination with other plans/projects) will not therefore adversely affect the integrity of the site (Firth of Tay and Eden Estuary SAC). Whilst it is unlikely that the site will achieve favourable conservation status for harbour seals in the long term, the impacts associated with (construction of) the Development are not predicted to have a bearing on this outcome.

Table 4.3: Isle of May SAC (qualifying species is grey seal)

Conservation Objective	**Assessment**
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	The potential effects of displacement/ PTS from piling and disturbance from increased noise from geophysical survey systems on grey seals were predicted to be of minor significance for the Development, both alone and in combination with other plans/ projects. The shadow AA for the 2013 Inch Cape ES (ICOL, 2013) assumed that 25 per cent of the animals predicted to develop PTS (478-822 individuals; see *Table 3.1*) were lost from the population or 'harvested'. This equated to removal of between 120 and 206 individuals, which is equivalent to between 14 to 23 per cent of 2018's East Scotland Management Unit PBR (882 grey seals; Thompson *et al*., 2017). Current estimates of the number of grey seals which have the potential to be exposed to noise levels sufficient to induce the onset of PTS from the Development vary between zero and 47 individuals (see *Table 3.1*). Using the same assumptions as made for the assessment to inform the 2013 Inch Cape ES (ICOL, 2013) with respect to assumed mortality consequences from PTS (that 25 per cent of the animals predicted to develop PTS were lost from the population or 'harvested'), this would equate to between zero and 12 individuals, and represent up to 2 per cent of the 2018 East Scotland Management Unit PBR. Grey seals travel extensively and use a wide range of habitats including multiple foraging areas and haul out sites. Displacement is therefore not expected to have the same effect on grey seals as it might have on a species which does not travel so extensively. It is considered unlikely that temporary displacement will have a long-term impact at the population level. The general trend in grey seal pup production at the Isle of May SAC (and at other colonies in the North Sea; see *Chapter 10, Section 10.6.7*) is increasing (Duck and Morris, 2016). It is therefore considered that the long-term viability of the grey seal population using the Isle of May SAC is unlikely to be adversely affected by the Development.
Distribution of the species within site	The potential effects of displacement from piling and disturbance from increased noise from geophysical survey systems on grey seals were predicted to be of minor significance for the Development, both alone and in combination with other plans/ projects. The most likely response (to increased noise) will be temporary behavioural avoidance (there is evidence that short-term disturbance caused by a commercial two-dimensional seismic survey does not lead to long-term displacement of harbour porpoises (Thompson *et al*., 2013) and harbour seals were distributed as per the non-piling scenario within two hours of cessation of pile driving within the Wash (Russell *et al*., 2016)). While some individuals may be temporarily displaced from preferred foraging areas and transit routes, it is likely that they will find suitable alternative foraging habitat. Therefore, any changes to the distribution of the species within the site are likely to be short-term.

Conservation Objective	Assessment
Distribution and extent of habitats supporting the species	No change anticipated as a result of increased underwater noise.
Structure, function and supporting processes of habitats supporting the species	No change anticipated as a result of increased underwater noise.
No significant disturbance of the species	The potential effects of displacement from piling and disturbance from increased noise from geophysical survey systems on grey seals were predicted to be of minor significance for the Development, both alone and in combination with other plans/ projects. Although classed as medium-term (i.e. during the construction year), the most likely response (to increased noise) will be temporary behavioural avoidance i.e. animals are likely to be displaced during piling but not during construction as a whole (as per Russell *et al*. (2016) who found that harbour seals were distributed as per the non-piling scenario within two hours of cessation of pile driving). Grey and harbour seals are both phocid (true) seals whose generalised hearing range is 50 Hz to 86 kHz (Southall *et al*., 2007; NOAA, 2016). Although individual species' hearing ranges are typically not as broad as the generalised range for the functional hearing group, there is no reason to assume that grey seals will respond to noise from pile driving differently compared to harbour seals. Therefore, no significant disturbance of the species is anticipated.

26 It is predicted that the Development, either alone or in combination with other plans/ projects, will not cause deterioration of the habitats of the qualifying species (grey seal) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site (Isle of May SAC) is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features in the long term.

Table 4.4: Moray Firth SAC (qualifying species is bottlenose dolphin)

Conservation Objective	Assessment
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	The potential effects of displacement/PTS from piling and disturbance from increased noise from geophysical survey systems on bottlenose dolphins were predicted to be of minor significance for the Development, both alone and in combination with other plans/projects. The estimated number of individuals which had the potential to be affected was less for the Development than for the assessment to inform the 2013 Inch Cape ES (ICOL, 2013) for all four construction scenarios for both PTS and displacement (see *Table 3.1*). Population level modelling indicated that displacement[6] from pile driving is unlikely to affect the size or growth of the bottlenose dolphin population off the east coast of Scotland (for any of the six Inch Cape only or cumulative scenarios; see *Section 3*). It is therefore considered that the long-term viability of the bottlenose dolphin population using the Moray Firth SAC is unlikely to be adversely affected by the Development, either alone or in combination with other plans/projects.
Distribution of the species within site	The potential effects of displacement from piling and disturbance from increased noise from geophysical survey systems on bottlenose dolphins were predicted to be of minor significance for the Development, both alone and in combination with other plans/projects (see *Section 3*). The most likely response (to increased noise) will be temporary behavioural avoidance (as per Graham *et al*. (2017)'s study). While some individuals may be temporarily displaced, it is likely that they will increase their use of alternative habitat relatively locally (as they did in Graham *et al*. (2017)'s study which was conducted in the Moray Firth). Therefore, any changes to the distribution of the species within the site are likely to be short-term.
Distribution and extent of habitats supporting the species	No change anticipated as a result of increased underwater noise.
Structure, function and supporting processes of habitats supporting the species	No change anticipated as a result of increased underwater noise.

[6] The number of bottlenose dolphins estimated to be affected by PTS was zero (see *Table 3.1*).

Conservation Objective	Assessment
No significant disturbance of the species	The potential effects of displacement from piling and disturbance from increased noise from geophysical survey systems on bottlenose dolphins were predicted to be of minor significance for the Development, both alone and in combination with other plans/ projects. Although classed as medium-term (i.e. during the construction year), the most likely response (to increased noise) will be temporary behavioural avoidance (as per Graham *et al*. (2017)'s study). While some individuals may be temporarily displaced, it is likely that they will increase their use of alternative habitat relatively locally (as they did in Graham *et al*. (2017)'s study which was conducted in the Moray Firth). Therefore, no significant disturbance of the species is anticipated.

27 It is predicted that the Development, either alone or in combination with other plans/projects, will not cause deterioration of the habitats of the qualifying species (bottlenose dolphin) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site (Moray Firth SAC) is maintained and the site makes an appropriate contribution to achieving favourable conservation status for each of the qualifying features in the long term.

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Abbreviations and Acronyms

AA	Appropriate Assessment
BDMPS	Biologically Defined Minimum Population Scale
CA	Competent Authority
CEH	Centre for Ecology and Hydrology
CIV	Cable Installation Vessel
CRM	Collision Risk Model
EIA	Environmental Impact Assessment
ELC	East Lothian Council
HRA	Habitats Regulations Appraisal
ICOL	Inch Cape Offshore Limited
IROPI	Imperative Reasons of Overriding Public Interest
JNCC	Joint Nature Conservation Committee
LSE	Likely Significant Effect
MS	Marine Scotland
MSS	Marine Scotland Science
MS-LOT	Marine Scotland Licensing Operations Team
MW	Megawatt
NNR	National Nature Reserve
OfTW	Offshore Transmission Works
OnTW	Onshore Transmission Works
OREC	Offshore Renewable Energy Catapult
OSP	Offshore Substation Platform
PCH	Potential Collision Height
pSPA	proposed Special Protection Area
PVA	Population Viability Analysis

ROV	Remotely Operated Vehicle
RSPB	Royal Society for the Protection of Birds
SMP	Seabird Monitoring Programme
SNCB	Statutory Nature Conservation Body
SNH	Scottish Natural Heritage
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
UNFCCC	United Nations Framework Convention on Climate Change
WTG	Wind Turbine Generator

1 Introduction

1.1 Background to the Development

1 Inch Cape Offshore Limited (ICOL) is promoting the development of the Inch Cape Wind Farm and associated Transmission Works. The Wind Farm and Offshore Transmission Works (OfTW), which together comprise the Development, is in the North Sea, off the east coast of Angus in Scotland. It will comprise an offshore array of Wind Turbine Generators (WTGs), connected to one another by subsea inter-array cables, which will in turn connect the WTGs to one or two Offshore Substation Platform(s) (OSPs), where power generated by the WTGs is transformed and subsequently carried to an onshore landfall location via Offshore Export Cables (Figure 1.1).

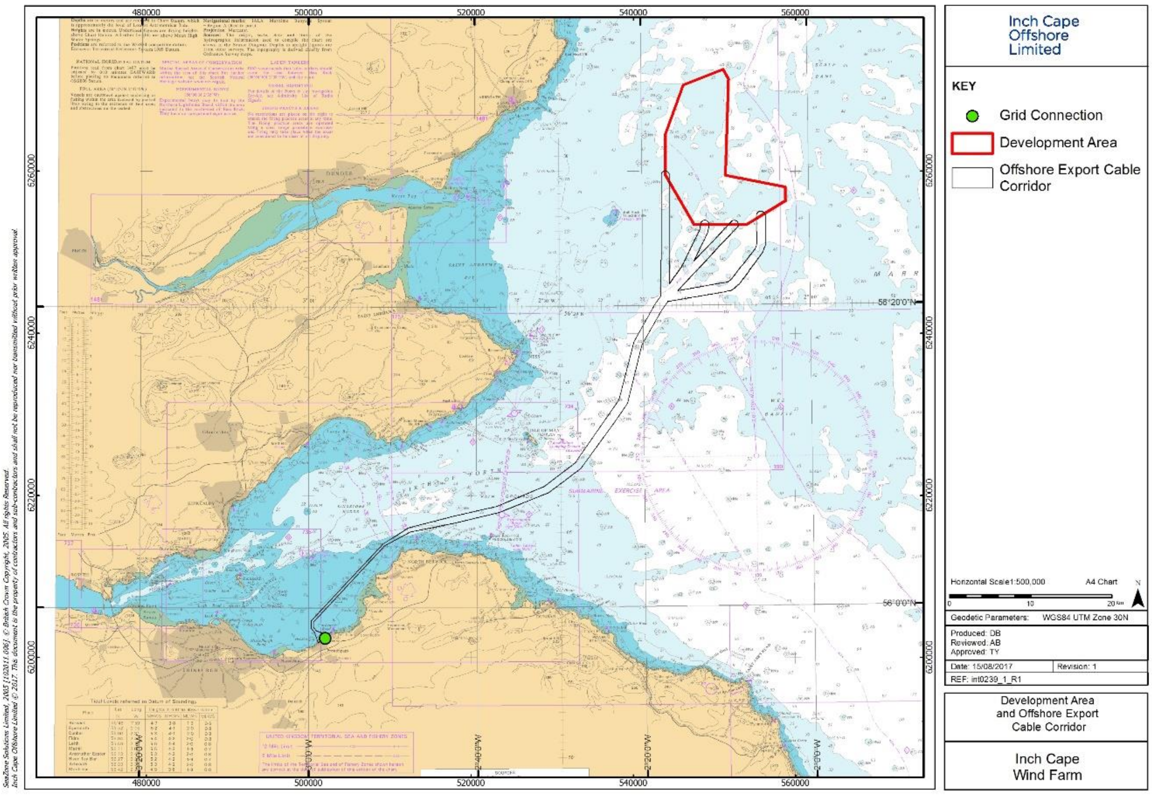
2 In order to transmit the generated electricity from the wind farm to the National Grid, a connection will be made through the OfTW and the Onshore Transmission Works (OnTW). The OnTW includes underground electricity cables and an onshore substation which receives power from the Offshore Export Cables and processes it for transmission to the existing grid network. The Landfall for Export Cables will be near Cockenzie (Figure 1.1). The OnTW lies within the vicinity of the former Cockenzie Power Station and is subject to a separate application to East Lothian Council (ELC).

3 With a capacity of more than one megawatt (MW), the Development will require Scottish Ministers' consent under Section 36 of the *Electricity Act* (Section 36 Consent) to allow its construction and operation. Under the *Marine (Scotland) Act 2010*, the Development will also require marine licences granted by the Scottish Ministers to allow for the construction and deposition of substances and structures in the sea and on the seabed.

4 The Environmental Impact Assessment (EIA) process provides an understanding of, among other things, the biological processes operating within (and in the vicinity of) the Development Area, Offshore Export Cable Corridor and Onshore Application Site and those that may be impacted by the proposed Development and OnTW. These processes are fully assessed in the EIA Reports for the Development and OnTW and readers are guided there for further details (ICOL, 2018a, b).

5 The impacts identified through the EIA process have shown potential for impacts on European designated sites (Natura 2000 sites) and features. As such ICOL have produced this Habitats Regulations Appraisal (HRA) report to inform the planning process and to assist the Competent Authority (CA) in carrying out an Appropriate Assessment (AA) for the Development.

Figure 1.1: Development Area and Offshore Export Cable Corridor



1.2 The Habitats Regulations Appraisal (HRA) Report

6 The purpose of this HRA report is to provide sufficient information to the Scottish Ministers, as the CA, on the potential for Likely Significant Effects (LSE) on European (and Ramsar) sites as a result of the Development.

7 The HRA process derives from the requirements of specific European Directives that implement their requirements into UK and Scottish law. Thus the HRA process covers features designated under the *Council Directive 2009/147/EC on the Conservation of Wild Birds* (the 'Birds Directive') and *Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora* (the 'Habitats Directive') as implemented by the *Conservation of Habitats and Species Regulations 2010* (the Habitats Regulations), the *Conservation of Offshore Marine Habitats and Species Regulations 2017* and the *Wildlife and Countryside Act 1981* (as amended).

8 This HRA report therefore covers potential effects upon:

- Special Protection Areas (SPAs) and proposed SPAs (pSPAs) and their qualifying features; and
- Wetlands of International Importance (Ramsar) sites and their qualifying features.

1.2.1 Structure of the Report

9 This report comprises a number of sections which encompass the different stages of the HRA process, including some which incorporate information that has been consulted on previously as separate documents over the course of the application. The report covers:

- *Section 1: Introduction*, covering background, methodology and process.
- *Section 2: Identification of SPAs potentially affected by the Development* to be considered in the HRA report.
- *Section 3: HRA screening*. This section covers the Offshore Scoping Report (ICOL, 2017) which presented the outcomes of the HRA screening process (provided as an appendix of the Offshore Scoping Report), whereby Natura 2000 sites identified to be considered in the HRA report were identified and appropriate methods for assessing effects on sites proposed. Based on the information presented within the document, ICOL sought agreement with the Scottish Government and their statutory advisors on the scope of the HRA report. This section also covers the Scoping Opinion and consultation responses from the various stakeholders.
- *Section 4: The information to inform the AA* for the Natura 2000 sites and associated qualifying features for which the potential for LSE cannot be ruled out.
- *Section 5: Conclusions.*

1.3 HRA Methodology and Process

1.3.1 HRA Stages

10 The Habitats Regulations require that wherever a project (that is not directly connected with or necessary to the management of a Natura 2000 site) has the potential to have a LSE on the Conservation Objectives of the site (alone or in-combination with other plans or projects) then an AA must be undertaken by the CA. The AA must be carried out before consent can be given for the project.

11 Before the HRA process can begin, there must be an exercise to identify those European sites which are potentially affected by the project to consider in the HRA. For the Development, this process is described in *Section 2* below.

12 An HRA is a four-stage process which can be summarised as:

- HRA Stage 1 – Screening: Screening for no LSE (alone or in-combination with other projects or plans);
- HRA Stage 2 – AA: Assessment of implications of identified LSEs on the Conservation Objectives of a Natura 2000 site to ascertain that the proposal will not adversely affect its integrity;

- HRA Stage 3 – Assessment of Alternatives: Where it cannot be ascertained that the proposal will not adversely affect the integrity of a Natura 2000 site, alternative solutions must be considered; and
- HRA Stage 4 – Assessment of Imperative Reasons of Overriding Public Interest (IROPI; where no alternatives are identified.)

13 All four stages work in sequence, consecutively, and are referred to simply as the HRA process, although if it is possible to reach a conclusion of no adverse effects on site integrity (with mitigation, if appropriate) then Stages 3 and 4 are not required. This clearly distinguishes the whole HRA process from the one step within it that is referred to simply as the AA.

14 This document leads the reader through the process as viewed by ICOL following careful deliberation and consultation. It draws on content from the ICOL screening and scoping documentation that has already been published (ICOL, 2017), and reflects these as Stage 1 of the HRA process.

1.3.2 In-combination Assessment

15 The identification of plans and projects to include in the in-combination assessment has been based on:

- Projects that are under construction;
- Permitted application(s) not yet implemented;
- Submitted application(s) not yet determined, including the proposed Neart na Gaoithe and Seagreen Alpha and Bravo wind farms which are expected to be submitted at approximately the same time as the application for the Development;
- All refusals subject to appeal procedures not yet determined; and
- Projects on the National Infrastructure's programme of projects.

16 The types of projects that could potentially be considered for the in-combination assessment include:

- Offshore wind farms;
- Onshore wind farms;
- Marine aggregate extraction;
- Oil and gas exploration and extraction;
- Sub-sea cables and pipelines;
- Commercial shipping and recreational boating activities;
- Commercial (and recreational) marine fishing activity; and
- Onshore major residential, commercial and industrial development.

17 Ultimately, the approach ICOL has taken to the selection of projects to include in the in-combination assessment has been determined through consideration of the impacts and

species that the Scoping Opinion advised should be included in the assessment, together with the advice given in the Scoping Opinion on the approaches to use in the assessment of the in-combination impacts.

2 Identification of SPAs Potentially Affected by the Development

18 Each SPA qualifying feature is considered separately for the purposes of identifying those SPAs that may be affected by the Development. This is because each feature, due to its distribution, ecology and sensitivity to change, has its own likelihood of being affected by the Development. It only requires one qualifying feature to be identified in the process for the SPA to be screened in.

19 This high-level screening identifies likely impacts resulting from the proposed construction, operation and decommissioning of the Development. This process provides an easy to follow assessment route between impact sources and potentially sensitive receptors ensuring a transparent assessment. The parameters are defined as follows:

- Source – the origin of a potential impact (noting that one source may have several pathways and receptors);
- Pathway – the means by which the effect of the activity could impact a receptor; and
- Receptor – the element of the receiving environment that is impacted.

20 Where there is no pathway (or the pathway is so long that the effect from the source has dissipated before reaching the receptor) there is justification for the screening out of that particular receptor.

21 To determine the Natura 2000 sites to be considered in relation to the potential for LSE, sites were first reviewed and were included for consideration if they fulfilled one or more of the following criteria:

- A component of the Development directly overlaps a site whose interest features include a species of bird;
- The distance between the Development and a site with a bird interest feature is within the range for which there could be an interaction i.e. the pathway is not too long. For seabirds in the breeding season this element of the screening process was informed by tracking data from SPA breeding colonies (Daunt *et al.*, 2011a, b) and published information on foraging ranges (Thaxter *et al*., 2012, Wakefield *et al.*, 2013);
- The distance between the Development and resources on which the interest feature depends (e.g. an indirect effect acting though prey or access to habitat) is within the range for which there could be an interaction i.e. the pathway is not too long; and,
- Evidence that a migratory route passes through the Development WTG array for bird species migrating to and/or from protected sites. This was informed by published information on migration routes, principally Wright *et al.,* (2012).

22 The above review was undertaken in conjunction with consideration of the EIA and HRA undertaken for the 2013 Inch Cape Environmental Statement (ES) (ICOL, 2013). These assessments were concerned with a design for which all ornithological impacts other than the indirect effects via noise impacts on prey as a result of piling were greater than, or equivalent to, those for the worst case design for the Development (ICOL, 2017). Given this, consideration

was limited to those sites included in the previous assessment, except in cases of SPAs having been designated, or at least proposed, since the time of the previous assessment (see *Section 3.3*).

23 Through this process the following Natura 2000 sites were included for consideration in the HRA screening exercise:

- Forth Islands SPA;
- Fowlsheugh SPA;
- St Abb's Head to Fast Castle SPA;
- Buchan Ness to Collieston Coast SPA;
- Firth of Forth SPA;
- Outer Firth of Forth and St Andrews bay Complex pSPA; and
- Other SPAs for which bird species that are identified as having migratory routes passing through the Development Area are qualifying features.

24 Of the above sites, the Firth of Forth SPA is also a Ramsar site.

3 HRA Screening

3.1 Introduction to HRA Screening

25 An HRA Screening Report was produced to assist the CA with their appraisal of no LSE upon Natura 2000 sites and was provided to Marine Scotland Licensing Operations Team (MS-LOT) as a part of the Scoping Report for the Development (ICOL, 2017). Thus, the Scoping Report and HRA Screening Report were within a single document, which has enabled the HRA Screening to benefit from the consideration by (and associated comments from) the consultees.

26 The objective of the screening assessment was to:

- Review the sites for which LSE could not be excluded in the MS AA (Marine Scotland, 2014);
- Identify any new Natura 2000 sites (and qualifying features of interest) that may have been designated, or put forward for consideration, since the HRA assessment undertaken for the 2013 Inch Cape ES (including any proposed sites);
- Review all the above gathered information and data, to determine whether the Development will have no LSE upon any Natura 2000 sites; and
- Undertake an in-combination assessment for these Natura 2000 sites (and qualifying features of interest), taking into consideration other reasonably foreseeable plans and projects.

27 The HRA Screening Report was provided to MS-LOT for further consultation with statutory advisors and key stakeholders (ICOL, 2017). The HRA Screening Report is summarised here.

28 Article 6(3) of the *Habitats Directive [92/43/EEC]* states, “Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives.”

29 It is therefore necessary, in the first instance, to determine whether it is possible to conclude that there is no LSE on the site. Where it is not possible to conclude this, an AA needs to be carried out by the CA. The European Court of Justice ruling in the case of Waddenzee (Case C-127/02) stated that an AA of a project is necessary, “if it cannot be excluded, on the basis of objective information, that it will have a significant effect on the site." It is therefore clear that if it cannot be objectively ruled out, then an effect is likely. The test is therefore negative, and embeds precaution within it.

30 Regulation 48 of the *Habitats Regulations* states that an AA must be undertaken by the CA before any decision to give consent for any plan or project that is not directly connected with or necessary to the [conservation] management of a European site and which could significantly affect that site (either alone or in combination with other reasonably foreseeable

plans or projects). An AA is required for all plans or projects "likely to have a significant effect" on a Natura 2000 site and applies only to the qualifying interests of the site.

31 In order to determine whether no LSE can be concluded, it is necessary to consider three aspects: connectivity, a route to impact and non-trivial abundance. Connectivity is the presence of the qualifying feature of a SPA in the zone of influence of a project, and is considered above in relation to the identification of those Natura 2000 sites with the potential for LSE. Where connectivity cannot be objectively ruled out for any one qualifying feature, LSE cannot be excluded for that site on this basis. However, if there is connectivity, but no route to impact on the qualifying feature, then it may still be possible to objectively conclude no LSE. Finally, if the abundance of a qualifying feature is trivial, it may be argued that no LSE can be concluded, as the Conservation Objectives of the site will not be compromised. What constitutes trivial abundance will vary between features based on their population size. For a very numerous feature (e.g. gannet in the Forth Islands SPA) only a small number of birds (tens) may be sufficient to conclude abundance is trivial, whereas for a very rare feature (e.g. roseate tern in the Forth Islands SPA), even one or two birds may be considered non-trivial.

3.2 Route to Impact

32 The three different phases of the Development (construction, operation and maintenance, and decommissioning) will have different potential effects on SPA protected bird populations. It is assumed that the potential effects during the decommissioning phase will be equivalent to, and potentially lower than, the worst case effects for the construction phase (with the approach to decommissioning described in *Section 7.12, Chapter 7: Description of Development* (ICOL, 2018b). The main potential effect from construction and decommissioning is one of disturbance, which is short term, temporary and reversible.

33 Based upon the findings of the previous assessment presented in the 2013 Inch Cape ES (ICOL, 2013), together with the consideration of these findings in the context of the 2017 design (as detailed in *Chapter 7* (ICOL, 2018b)) and the advice of the Scoping Opinion (see *Section 3.6.2* below), the potential effects from construction and decommissioning have been scoped out of the current assessment except in relation to the Offshore Export Cable and the Outer Firth of Forth and St Andrews Bay Complex pSPA. In this case the spatial overlap between the Offshore Export Cable Corridor and the pSPA meant that there was a potential route to impact on the qualifying features of this pSPA during construction (and decommissioning) as a result of direct disturbance/displacement, indirect disturbance of seabed habitats and/or prey species of seabirds and loss of seabed habitats.

34 The main source of potential impact to SPA protected bird populations from the Development is considered to be the operations and maintenance phase. During this phase, there are three main potential sources of impact to SPA protected bird populations:

- Collision risk – birds that fly through the rotor swept area of the WTGs are at risk from being struck by the moving WTG blades. It is assumed that all birds that are struck by a blade are killed. Thus, there is a direct mortality effect on the populations concerned;

- Displacement – the presence of the wind farm may result in fewer birds using the Development Area and a buffer around it. This can be for a variety of reasons, including neophobia and habitat loss. Ultimately, this is simply the change in the density of birds using the area before and after construction of the WTGs; and
- Barrier effects – birds that undertake regular flights through the area of wind farm (and associated buffer) may circumvent the wind farm, following its construction. This results in increased energy expenditure, which may potentially result in reduced fecundity or survival.

35 These potential impacts are all associated with the wind farm. In addition to the above, potential routes to impact during the operations and maintenance phase were identified in relation to the Offshore Export Cable and the Outer Firth of Forth and St Andrews Bay Complex pSPA as a result of direct disturbance/displacement during repair and reburial, indirect disturbance of seabed habitats and/or prey species of seabirds during cable maintenance and loss of seabed habitats.

3.3 Potential Connectivity in Relation to the SPA Qualifying Features

36 The basis for identifying SPAs (and Ramsar sites) with connectivity to the Development is set out in *Section 2* above, with this leading to the identification of several Natura 2000 sites for inclusion in HRA screening (as listed in *Section 2*). In addition, there is potential connectivity with a wide range of unidentified sites due to the Development Area being on the migratory routes of several Annex 1 and migratory species that may be SPA qualifying features. The direct connectivity of these features to individual SPAs is unknown, because these species could, hypothetically, be migrating through the Development Area to a number of different SPAs.

37 The species which are SPA qualifying species, and which have potential for connectivity to the Development during migration only are presented in Table 3.1, according to whether they were recorded during the boat-based surveys used to inform the baseline for the Development Area[1].

[1] The full list of bird species recorded during the boat-based surveys is given in the Scoping Report (ICOL, 2017).

Table 3.1 SPA qualifying features with connectivity to the Development Area during migration only.

Qualifying features observed during boat-based surveys	Qualifying features not observed during boat-based surveys
Taiga bean goose, Pink-footed goose, Svalbard barnacle goose, Tufted duck, Purple sandpiper, Arctic skua, Great skua.	Icelandic greylag goose, Svalbard light-bellied brent goose, Wigeon, Teal, Pintail, Pochard, Scaup, Long-tailed duck, Common scoter, Velvet scoter, Hen harrier, Osprey, Corncrake, Oystercatcher, Dotterel, Golden plover, Grey plover, Sanderling, Dunlin (*Calidris alpina alpina*), Ruff, Snipe, Icelandic black-tailed godwit, Bar-tailed godwit, Whimbrel, Curlew, Greenshank, Wood sandpiper, Redshank (*Tringa totanus robusta* and *T. totanus*), Turnstone, Red-necked phalarope.

38 For the remaining sites identified in *Section 2*, connectivity with the Development is considered in relation to each of the individual qualifying features, for the purposes of identifying those which are relevant to the consideration of LSE (Table 3.2). For the breeding seabird colony SPAs (i.e. Forth Islands, Fowlsheugh, St Abb's Head to Fast Castle and Buchan Ness to Collieston Coast), the determination of connectivity to the Wind Farm is as detailed in *Appendix 11B: Apportioning Effects to SPA Colonies During the Breeding and Non-Breeding Seasons*. A small number of the qualifying features from these SPAs were identified as having connectivity to the Wind Farm in the Scoping Report (ICOL, 2017) but not in Table 3.2 below. This is because connectivity was determined using the mean maximum foraging range plus 1 standard deviation in the Scoping Report (as for the HRA assessment undertaken for the 2013 Inch Cape ES; ICOL, 2013). However, the advice of the Scoping Opinion was that the mean maximum foraging range should be used instead.

Table 3.2 Qualifying features of SPAs and pSPAs in relation to connectivity to the Wind Farm and OfTW.

Species	Forth Islands SPA		Fowlsheugh SPA		St Abb's Head to Fast Castle SPA		Buchan Ness to Collieston Coast SPA		Outer Firth of Forth and St Andrews Bay Complex pSPA		Firth of Forth SPA	
	Qualifying feature	Connec-tivitiy	Qualifying feature	Connec-tivitiy	Qualifying feature	Connec-tivitiy	Qualifying feature	Connec-tivitiy	Qualifying feature	Connec-tivitiy[1]	Qualifying feature	Connec-tivitiy[1]
Kittiwake	X[2]	X	X	X	X[2]	X	X[2]		X[2]	X		
Herring gull	X[2]	X	X[2]	X	X[2]	X	X[2]		X[2]	X		
Guillemot	X[2]	X	X	X	X[2]	X	X[2]	X	X[2]	X		
Razorbill	X[2]	X	X[2]	X	X[2]	X[3]			X[2]	X		
Shag	X	X[3]			X[2]		X[2]		X	X		
Fulmar	X[2]	X	X[2]	X			X[2]	X				
Gannet	X	X							X	X		
Common tern	X	X[3]							X	X		
Arctic tern	X	X[3]							X	X		
Roseate tern	X	X[3]										
Sandwich tern	X	X[3]										
Puffin	X	X							X[2]	X		

Species	Forth Islands SPA		Fowlsheugh SPA		St Abb's Head to Fast Castle SPA		Buchan Ness to Collieston Coast SPA		Outer Firth of Forth and St Andrews Bay Complex pSPA		Firth of Forth SPA	
	Qualifying feature	Connec-tivitiy	Qualifying feature	Connec-tivitiy	Qualifying feature	Connec-tivitiy	Qualifying feature	Connec-tivitiy	Qualifying feature	Connec-tivitiy[1]	Qualifying feature	Connec-tivitiy[1]
Lesser black-backed gull	X	X										
Cormorant	X[2]	X[3]									X	
Shelduck											X	
Wigeon											X	X
Eider									X	X	X	
Long-tailed duck									X[2]	X	X	X
Common scoter									X[2]	X	X	X
Velvet scoter									X[2]	X	X	X
Goldeneye									X[2]	X	X	
Red-breasted merganser									X[2]	X	X	
Red-throated diver									X	X	X	
Slavonian grebe									X	X	X	
Manx shearwater									X	X		

Species	Forth Islands SPA		Fowlsheugh SPA		St Abb's Head to Fast Castle SPA		Buchan Ness to Collieston Coast SPA		Outer Firth of Forth and St Andrews Bay Complex pSPA		Firth of Forth SPA	
	Qualifying feature	Connec-tivitiy	Qualifying feature	Connec-tivitiy	Qualifying feature	Connec-tivitiy	Qualifying feature	Connec-tivitiy	Qualifying feature	Connec-tivitiy[1]	Qualifying feature	Connec-tivitiy[1]
Little gull									X	X		
Common gull									X[2]	X		
Mallard											X	
Scaup											X	X
Great crested grebe											X	
Oystercatcher											X	X
Ringed plover											X	
Golden plover											X	X
Grey plover											X	X
Lapwing											X	
Curlew											X	X
Knot											X	
Dunlin (*Calidris aplina alpina*)											X	X

Species	Forth Islands SPA		Fowlsheugh SPA		St Abb's Head to Fast Castle SPA		Buchan Ness to Collieston Coast SPA		Outer Firth of Forth and St Andrews Bay Complex pSPA		Firth of Forth SPA	
	Qualifying feature	**Connec-tivitiy**	**Qualifying feature**	**Connec-tivitiy**	**Qualifying feature**	**Connec-tivitiy**	**Qualifying feature**	**Connec-tivitiy**	**Qualifying feature**	**Connec-tivitiy[1]**	**Qualifying feature**	**Connec-tivitiy[1]**
Dunlin (*Calidris aplina schinzii*)											X	
Bar-tailed godwit											X	X
Redshank											X	X
Turnstone											X	X
Black-headed gull									X[2]	X		
Sandwich tern											X	
Pink-footed goose											X	X

[1]Connectivity with the qualifying features of the Outer Firth of Forth and St Andrews Bay Complex pSPA is limited to the Offshore Export Cable Corridor because there is no spatial overlap with the Development Area (whilst for the breeding seabird qualifying features the assessment is based upon that for the breeding colony SPAs, as advised in the Scoping Opinion – see *Section 3.6.1* below). Connectivity with the qualifying features of the Firth of Forth SPA is limited to those features with migratory routes passing through the Development Area (because this is the only potential connectivity between the Wind Farm and this SPA, whilst the only route to impact that is identified from the Offshore Export Cable Corridor is via the spatial overlap between this and the Outer Firth of Forth and St Andrews Bay Complex pSPA – see *Section 3.2* above).

[2]Indicates features that are named components of an assemblage feature, as opposed to a qualifying feature in their own right. These features have been included in this report for information.

[3]These qualifying features are not considered to have connectivity with the Wind Farm because the Development Area is beyond the mean maximum foraging range (Thaxter *et al.,* 2012). Therefore, the only connectivity is with the Offshore Export Cable Corridor for which the only route to impact is via the spatial overlap of this with the Outer Firth of Forth and St Andrews Bay Complex pSPA (see *Section 3.2* above).

3.4 SPA Information

39 There are several key pieces of information on the SPAs themselves that are needed to undertake a HRA. These include the:

- Qualifying features of the site;
- Site condition of each qualifying feature;
- Cited population size; and
- Conservation Objectives of the site.

40 The current population size is also important and forms the basis for the impact assessment itself. However, this needs to be considered in the context of the cited population size. The Conservation Objectives for SPAs are to, broadly, maintain the population size at or above the cited population size, as a minimum. Site condition is an assessment by the relevant countryside agency (in this case Scottish Natural Heritage (SNH)) on whether the condition targets set out in the Conservation Objectives have been met. These are provided by the Joint Nature Conservation Committee (JNCC) and described as:

- Favourable – maintained. An interest feature should be recorded as maintained when its Conservation Objectives were being met at the previous assessment, and are still being met;
- Favourable – recovered. An interest feature can be recorded as having recovered if it has regained favourable condition, having been recorded as unfavourable on the previous assessment;
- Unfavourable – recovering. An interest feature can be recorded as recovering after damage if it has begun to show, or is continuing to show, a trend towards favourable condition;
- Unfavourable – no change. An interest feature may be retained in a more-or-less steady state by repeated or continuing damage; it is unfavourable but neither declining nor recovering. In rare cases, an interest feature might not be able to regain its original condition following a damaging activity, but a new stable state might be achieved;
- Unfavourable – declining. Decline is another possible consequence of a damaging activity. In this case, recovery is possible and may occur either spontaneously or if suitable management input is made;
- Partially destroyed. It is possible to destroy sections or areas of certain features or to destroy parts of sites with no hope of reinstatement because part of the feature itself, or the habitat or processes essential to support it, has been removed or irretrievably altered; and
- Destroyed. The recording of a feature as destroyed will indicate the entire interest feature has been affected to such an extent that there is no hope of recovery, perhaps because its supporting habitat or processes have been removed or irretrievably altered.

41 The qualifying feature (or interest feature) is the combination of the Annex I and migratory species, or assemblage, identified as important, and the season in which this importance occurs (for instance, a qualifying feature of the Forth Islands SPA is kittiwake in the breeding season).

42 The Conservation Objectives for all designated SPAs in Scotland are currently the same, and are as follows:

"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

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*
- *No significant disturbance of the species"*

43 However, the process of identifying the SPAs that will need to be assessed in the HRA also identified the Outer Firth of Forth and St Andrews Bay Complex pSPA. While this site has not formally been designated, it is provided equal protection to designated SPAs by UK and Scottish Government policy. There is, yet, no site condition information available for this pSPA and the draft Conservation Objectives for this site are different to those listed above (SNH and JNCC, 2016a). These are:

"To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, subject to natural change, thus ensuring that the integrity of the site is maintained in the long-term and it continues to make an appropriate contribution to achieving the aims of the Birds Directive for each of the qualifying species.

Marine bird species are exposed to a range of wider drivers of change. Some of these are natural (e.g. population fluctuations/ shifts or habitat changes resulting from natural processes) and are not a direct result of human influences. Such changes in the qualifying species' distribution and use of the site which are brought about by entirely natural drivers, directly or indirectly, are considered compatible with the site's conservation objectives.

There may also be wider ranging anthropogenic impacts driving change within the site, such as climate change or in some cases fisheries stock management, which cannot be managed effectively at site level.

In reality any assessment of whether a change is natural will need to be assessed in the context of each individual site.

This contribution will be achieved through delivering the following objectives for each of the site's qualifying features:

a) Avoid significant mortality, injury and disturbance of the qualifying features, so that the distribution of the species and ability to use the site are maintained in the long-term;

The purpose of this objective is to avoid significant mortality, injury or disturbance of qualifying species that negatively affect the site on a long-term basis. Such an impact would have a detrimental effect on the contribution that this site makes to the maintenance of qualifying species at appropriate levels (Article 2 of the Birds Directive) in their natural range in UK waters and therefore should be avoided.

This site supports 1% or more of the GB population of red-throated diver, Slavonian grebe, long-tailed duck, common scoter, velvet scoter, common goldeneye, red-breasted merganser, common guillemot, Atlantic puffin, black-legged kittiwake, Arctic tern, common tern, herring gull, black-headed gull, common gull and Manx shearwater. It also supports 1% or more of the biogeographical population of common eider, Northern gannet and European shag and is an important multispecies area supporting over 20,000 non-breeding waterfowl and over 20,000 breeding and non-breeding seabirds, including razorbill. The non-breeding population of seabirds also supports the largest Scottish population of little gull. For this site "significant" is taken to mean anthropogenic mortality, injury or disturbance that affect the qualifying species distribution and use within the site such that recovery cannot be expected or effects can be considered lasting. An appropriate timeframe for recovery will need to be considered in the context of the life history traits of the species and the impact pathways being assessed.

All birds require energy which they obtain from food, to survive and to breed. Significant disturbance can include displacement and barrier effects on the species. Where such disturbance is brought about by human activities which affect the qualifying species' distribution and use of the site, such that their ability to survive and/or breed is compromised in the long-term, it is considered significant.

For each qualifying species, the ability to use the site should be maintained.

Further advice on ecological use of the site including: occupancy, foraging areas, flightless moulting periods and appropriate recovery timeframes will be provided in policy guidance to support the interpretation of the conservation objectives.

b) To maintain the habitats and food resources of the qualifying features in favourable condition.

The qualifying bird species using the site require sufficient food resource to be available. The qualifying species can eat a variety of pelagic and benthic prey and these should be maintained at a level able to support species populations. Some of these prey species have particular habitat requirements and where this is the case, the site needs to be managed to ensure the extent and quality of the habitats are sufficient to maintain these prey species."

44 This information is summarised in Table 3.3 to Table 3.8 for each of the SPAs with connectivity to the Development that are assessed by the HRA.

Table 3.3 Forth Islands SPA qualifying feature information.

Qualifying feature	Season	Site condition	Cited population size	Population unit
Gannet	Breeding	Favourable Maintained	21,600	Pairs
Shag	Breeding	Unfavourable Recovering	2,400	Pairs
Puffin	Breeding	Favourable Maintained	14,000	Pairs
Sandwich tern	Breeding	Unfavourable Declining	440	Pairs
Common tern	Breeding	Favourable Maintained	334	Pairs
Roseate tern	Breeding	Unfavourable Declining	8	Pairs
Arctic tern	Breeding	Favourable Declining	540	Pairs
Seabird assemblage	Breeding	Unfavourable Declining	90,000	Individuals
Fulmar*	Breeding	Favourable Maintained	798	Pairs
Cormorant*	Breeding	Favourable Declining	200	Pairs
Razorbill*	Breeding	Favourable Maintained	1,400	Pairs
Guillemot*	Breeding	Favourable Maintained	16,000	Pairs
Kittiwake*	Breeding	Unfavourable Declining	8,400	Pairs
Lesser black-backed gull	Breeding	Favourable Maintained	1,500	Pairs
Herring gull*	Breeding	Favourable Maintained	6,600	Pairs
* Assemblage named feature only				

Table 3.4 Fowlsheugh SPA qualifying feature information.

Qualifying feature	Season	Site condition	Cited population size	Population unit
Seabird assemblage	Breeding	Favourable Maintained	145,000	Individuals
Fulmar*	Breeding	Favourable Maintained	1,170	Pairs
Razorbill*	Breeding	Favourable Maintained	5,800	Individuals

Qualifying feature	Season	Site condition	Cited population size	Population unit
Guillemot	Breeding	Favourable Maintained	56,450	Individuals
Kittiwake	Breeding	Favourable Maintained	36,650	Pairs
Herring gull*	Breeding	Unfavourable Declining	3,190	Pairs
* Assemblage named feature only				

Table 3.5 St Abb's Head to Fast Castle SPA qualifying feature information.

Qualifying feature	Season	Site condition	Cited population size	Population unit
Seabird assemblage	Breeding	Unfavourable Declining	79,560	Individuals
Shag*	Breeding	Unfavourable Declining	560	Pairs
Razorbill*	Breeding	Favourable Maintained	2,180	Individuals
Guillemot*	Breeding	Favourable Maintained	31,750	Individuals
Kittiwake*	Breeding	Unfavourable Declining	21,170	Pairs
Herring gull*	Breeding	Unfavourable Declining	1,160	Pairs
* Assemblage named feature only				

Table 3.6 Buchan Ness to Collieston Coast SPA qualifying feature information.

Qualifying feature	Season	Site condition	Cited population size	Population unit
Seabird assemblage	Breeding	Unfavourable No change	95,000	Individuals
Fulmar*	Breeding	Unfavourable Declining	1,765	Pairs
Shag*	Breeding	Unfavourable No change	1,045	Pairs
Guillemot*	Breeding	Favourable Declining	8,640	Pairs
Kittiwake*	Breeding	Unfavourable No change	30,452	Pairs
Herring gull*	Breeding	Unfavourable No change	4,292	Pairs
* Assemblage named feature only				

Table 3.7 Firth of Forth SPA qualifying feature information.

Qualifying feature	Season	Site condition	Cited population size	Population unit
Pink-footed goose	Non-breeding	Favourable Maintained	10,852	Individuals
Shelduck	Non-breeding	Favourable Declining	4,509	Individuals
Mallard	Non-breeding	Unfavourable Declining	2,564	Individuals
Red-throated diver	Non-breeding	Favourable Maintained	90	Individuals
Sandwich tern	Passage	Favourable Declining	1,617	Individuals
Bar-tailed godwit	Non-breeding	Favourable Declining	1,974	Individuals
Golden plover	Non-breeding	Favourable Maintained	2,949	Individuals
Knot	Non-breeding	Unfavourable Declining	9,258	Individuals
Slavonian grebe	Non-breeding	Favourable Declining	84	Individuals
Turnstone	Non-breeding	Favourable Maintained	860	Individuals
Redshank	Non-breeding	Favourable Maintained	4,341	Individuals
Waterfowl assemblage	Non-breeding	Favourable Declining	95,000	Individuals
Wigeon*	Non-breeding	Favourable Recovered	2,139	Individuals
Scaup*	Non-breeding	Unfavourable Declining	437	Individuals
Eider*	Non-breeding	Favourable Declining	9,400	Individuals
Long-tailed duck*	Non-breeding	Unfavourable Declining	1,045	Individuals
Common scoter*	Non-breeding	Unfavourable Declining	2,880	Individuals

Qualifying feature	Season	Site condition	Cited population size	Population unit
Velvet scoter*	Non-breeding	Favourable Maintained	635	Individuals
Goldeneye*	Non-breeding	Unfavourable Declining	3,004	Individuals
Red-breasted merganser*	Non-breeding	Favourable Declining	670	Individuals
Cormorant*	Non-breeding	Favourable Maintained	682	Individuals
Great crested grebe*	Non-breeding	Unfavourable Declining	720	Individuals
Oystercatcher*	Non-breeding	Favourable Maintained	7,846	Individuals
Grey plover*	Non-breeding	Favourable Declining	724	Individuals
Lapwing*	Non-breeding	Favourable Maintained	4,148	Individuals
Ringed plover*	Non-breeding	Favourable Maintained	328	Individuals
Curlew*	Non-breeding	Favourable Maintained	1,928	Individuals
Dunlin*	Non-breeding	Favourable Declining	9,514	Individuals
* Assemblage named feature only				

Table 3.8 Outer Firth of Forth and St Andrews Bay Complex pSPA qualifying feature information.

Qualifying feature	Season	Site condition[1]	Cited population size	Population unit
Eider	Non-breeding	n/a	21,546	Individuals
Red-throated diver	Non-breeding	n/a	851	Individuals
Gannet	Breeding	n/a	from adjacent colonies	

Qualifying feature	Season	Site condition[1]	Cited population size	Population unit
Shag	Breeding	n/a	from adjacent colonies	
Slavonian grebe	Non-breeding	n/a	30	Individuals
Common tern	Non-breeding	n/a	from adjacent colonies	
Arctic tern	Non-breeding	n/a	from adjacent colonies	
Little gull	Non-breeding	n/a	126	Individuals
Waterfowl assemblage	Non-breeding	n/a	not stated	
Long-tailed duck[2]	Non-breeding	n/a	1,948	Individuals
Common scoter[2]	Non-breeding	n/a	4,677	Individuals
Velvet scoter[2]	Non-breeding	n/a	775	Individuals
Goldeneye[2]	Non-breeding	n/a	589	Individuals
Red-breasted merganser[2]	Non-breeding	n/a	369	Individuals
Seabird assemblage	Breeding	n/a	not stated	
Manx shearwater[2]	Breeding	n/a	2,885	Individuals
Puffin[2]	Breeding	n/a	61,086	Individuals
Guillemot[2]	Breeding	n/a	28,123	Individuals
Kittiwake[2]	Breeding	n/a	12,020	Individuals
Herring gull[2]	Breeding	n/a	3,044	Individuals
Seabird assemblage	Non-breeding	n/a	not stated	
Shag[2]	Non-breeding	n/a	2,426	Individuals

Qualifying feature	Season	Site condition[1]	Cited population size	Population unit
Razorbill[2]	Non-breeding	n/a	5,481	Individuals
Guillemot[2]	Non-breeding	n/a	21,968	Individuals
Kittiwake[2]	Non-breeding	n/a	3,191	Individuals
Black-headed gull[2]	Non-breeding	n/a	26,835	Individuals
Common gull[2]	Non-breeding	n/a	14,647	Individuals
Herring gull[2]	Non-breeding	n/a	12,313	Individuals
[1]No site condition information is currently available for this pSPA. [2]Assemblage named feature only				

3.5 No LSE Test

45 For migratory species only, determining no LSE was relatively straightforward in relation to all but four of the species of relevance. The analysis carried out for Marine Scotland (MS) on the strategic collision risk to migratory species that are SPA qualifying features (Table 3.1) indicated that the overall collision risk from existing and proposed offshore wind farms in Scottish waters was small relative to the respective population sizes (Table 3.9, WWT Consulting, 2014).This enabled a conclusion of no LSE for all sites for which these qualifying features were relevant, except where the qualifying species included one or more of:

- Breeding osprey;
- Breeding corncrake;
- Wintering purple sandpiper; and
- Whimbrel.

46 The HRA screening exercise presented in the Scoping Report (ICOL, 2017) considered that there was insufficient information to conclude no LSE in relation to these qualifying features at that stage. However, subsequent scoping advice from SNH was that there were no outstanding concerns in relation to these four species and that they had been addressed in the strategic collision risk report (WWT Consulting, 2014). This report presents a 'worst case' collision risk assessment and includes several wind farms in the assessment which have since been withdrawn, whilst others are in the process of refining their design envelopes. As such, the SNH advice was that the Wind Farm presented no significant risk to these species as a

result of collisions, either alone or in-combination (*Section 11.2.1, Chapter 11: Ornithology* (ICOL, 2018b)). Following on from this advice, the Scoping Opinion did not identify that assessments were required for SPAs for which these four species are qualifying features. Consequently, a conclusion of no LSE can be reached for all of the SPAs with these species as qualifying features.

47 In relation to the Firth of Forth SPA (and Ramsar site), the HRA screening was also unable to conclude no LSE at the time of producing the Scoping Report. However, with consideration of the advice provided in the Scoping Opinion and relating to the routes to impact (see *Section 3.2* above), the potential for LSE is only in relation to those qualifying features which have migratory routes passing through the Development Area (Table 3.2). Given the above conclusions concerning the potential collision risk to migratory species, it is possible to conclude no LSE for the Firth of Forth SPA (and Ramsar site).

Table 3.9 Estimated collision mortality from all Scottish offshore wind farms in relation to the population sizes in the UK SPA suite and the UK in total.

Qualifying feature	Total collisions (all offshore wind farms in Scotland)	Citation total SPA suite	UK population size	Population unit
Icelandic greylag goose	95	57,519	81,900	Individuals
Taiga bean goose	3	448	400	Individuals
Pink-footed goose	804	155,582	241,000	Individuals
Svalbard barnacle goose	177	13,595	22,000	Individuals
Svalbard light-bellied brent goose	<1	1,844	2,900	Individuals
Wigeon	90	224,338	426,000	Individuals
Teal	39	68,433	197,000	Individuals
Pintail	9	19,021	28,180	Individuals
Pochard	7	32,489	85,500	Individuals
Tufted duck	70	24,947	120,000	Individuals
Scaup	3	3,229	9,200	Individuals
Long-tailed duck	7	796	16,250	Individuals
Common scoter	2	3,422	50,000	Individuals
Velvet scoter	1	639	3,000	Individuals
Hen harrier	1	244	750	Individuals

Qualifying feature	**Total collisions (all offshore wind farms in Scotland)**	**Citation total SPA suite**	**UK population size**	**Population unit**
Osprey	6	39	148	Pairs
Corncrake	38	204	589	Pairs
Oystercatcher	65	194,898	338,700	Individuals
Dotterel	6	469	750	Pairs
Golden plover	33	67,233	310,000	Individuals
Grey plover	8	38,842	53,300	Individuals
Sanderling	22	13,028	20,700	Individuals
Dunlin *Calidris alpina alpina*	474	420,758	657,000	Individuals
Dunlin *Calidris alpina schinzii*	18	6,812	9,150	Individuals
Purple sandpiper	n/a	1,973	17,760	Individuals
Ruff	5	316	700	Individuals
Snipe	1	2,097	100,000	Individuals
Icelandic black-tailed godwit	51	8,973	15,860	Individuals
Bar-tailed godwit	70	39,386	65,430	Individuals
Whimbrel	671	612	3,840	Pairs
Curlew	207	50,206	164,700	Individuals
Greenshank	1	408	701	Individuals
Wood sandpiper	<1	10	8	Pairs
Redshank *Tringa totanus robusta* and *T. tetanus totanus*	327	58,167	125,800	Individuals
Turnstone	30	10,200	52,390	Individuals
Red-necked phalarope	0	30	16	Pairs
Arctic skua	2	780	3,200	Pairs
Great skua	42	6,262	8,500	Pairs

48 For the remaining SPAs and pSPA for which connectivity has been established, four are breeding seabird colony SPAs, whilst the pSPA is to protect the waters used by feeding, moulting and roosting wintering and non-breeding wildfowl, gulls and seabirds, as well as the offshore foraging and roosting areas of a range of breeding seabirds (see *Section 3.4* above). It was not possible rule out the potential for LSE for these sites during the HRA screening undertaken at the time of producing the Scoping Report (ICOL, 2017). Following the consultation process and consideration of the Scoping Opinion, this remains the case (although the information on the potential routes to impact and the qualifying features of these SPAs and pSPA which have connectivity to the Development has been refined – Table 3.2). These sites are:

- Forth Islands;
- Fowlsheugh;
- St Abb's Head to Fast Castle;
- Buchan Ness to Collieston Coast; and,
- Outer Firth of Forth and St Andrews Bay Complex

49 For these SPAs and pSPA, this HRA report more carefully considers the level and importance of impacts from the Development. Information to inform AAs by all CAs is provided in *Section 4* below, along with a shadow AA.

3.6 Scoping Opinion and Consultation on HRA Screening

3.6.1 Consultation Process

50 Consultation has been an ongoing process, but has been formalised at certain junctures in line with Scottish Government planning guidance and policy. Following production of the Scoping Report (ICOL, 2017), this consultation process included:

- A meeting held by MS-LOT on 26 May 2017, involving Marine Scotland Science (MSS), SNH, the Royal Society for the Protection of Birds (RSPB) and ICOL, to facilitate early engagement and structured discussion between these stakeholders and ICOL (with discussions covering a range of key topics concerned with the Development and the proposed approach and methodology to be taken to the assessment (as described in *Section 11.2.1 , Chapter 11* (ICOL, 2018b));
- Production of the formal Scoping Opinion for ornithology from MS-LOT, incorporating the scoping advice of SNH and RSPB, as well as a summary of discussions between MSS, SNH and RSPB on the issues pertaining to the scope of the assessment (with the Scoping Opinion being received on 28 July 2017, although the ornithology addendum was not issued until 10 August 2018); and
- A workshop on 7 March 2018 attended by MS-LOT, MSS, SNH and RSPB, at which ICOL presented the details of the approach and methods used in the assessment, together with the main findings from the assessment.

51 Following receipt of the initial scoping response on ornithology received on the 10 August 2017, further correspondence with MS-LOT was undertaken by ICOL to seek clarification on several points, as well as a small number of further, new, queries that emerged during the course of undertaking the assessment. This correspondence comprised letters of clarification from ICOL to MS-LOT sent on 29 August 2017, 19 September 2017, 11 October 2017 (dated 6 October 2017), 26 October 2017, with associated responses received on 8 and 29 September 2017, 17 October 2017, and 3 November 2017, respectively. Additional to these letters, there was associated email correspondence. This concerned; (i) the colony count data provided by SNH in their scoping advice (with emails sent from ICOL to MS-LOT on 28 September 2017, 17 October 2017, 28 November 2017, and 5 and 11 December 2017 and respective responses received on 29 September 2017, 19 October 2017, 30 November 2017, 8 and 18 December 2017); (ii) the methods for calculating non-breeding season effects (with emails from MS-LOT to ICOL on 1, 8 and 30 November 2017, and from ICOL to MS-LOT on 8 and 28 November 2017); and (iii) the development and availability of the MS-LOT Apportioning Tool (email from MS-LOT to ICOL of 7 November 2017)[2]. The initial response and subsequent clarifications comprised the final Scoping Opinion for ornithology and are referred to in this document as such.

52 A detailed summary of the key issues covered by the Scoping Opinion and of the final outcome of the correspondence incorporated within the Scoping Opinion is provided in the *Section 11.2.1, Chapter 11* (ICOL, 2018b).

3.6.2 Scoping Opinion Recommendations and LSE

53 As outlined above (*Section 2*), the worst case design for the Development was associated with ornithological impacts that were less than or equivalent to those assessed in the HRA undertaken for 2013 Inch Cape ES (ICOL, 2013), with the exception of the indirect effects via noise impacts on prey as a result of piling. On this basis it was therefore possible for the conclusions in relation to LSE for the Development to be focussed on those SPAs and qualifying features where LSE cannot be ruled out.

54 As detailed above (*Section 3.5*), although the HRA screening undertaken as part of the Scoping Report (ICOL, 2017) was unable to conclude no LSE in relation to the Firth of Forth SPA and SPAs which were associated with four migratory species, the subsequent information and advice presented in the Scoping Opinion enabled a conclusion of no LSE in those instances. For the remaining SPAs and pSPAs for which it was not possible to conclude no LSE in the HRA screening, the advice of the Scoping Opinion was that all of these sites should be included in the assessment. Specifically, the Scoping Opinion advised that the assessment should include the following SPAs/pSPAs and qualifying features:

- Forth Islands SPA – gannet, kittiwake, herring gull, puffin, guillemot and razorbill
- Fowlsheugh SPA - kittiwake, herring gull, guillemot and razorbill

[2] At the time of writing, all correspondence is available at http://www.gov.scot/Topics/marine/Licensing/marine/scoping/ICOLRevised-2017/OrnithologyQ-092017.[Accessed: 08/08/18]

- St Abb's Head to Fast Castle SPA – should be scoped in due to connectivity
- Buchan Ness to Collieston Coast SPA - should be scoped in due to connectivity
- Outer Firth of Forth and St Andrews Bay Complex pSPA – gannet, kittiwake, herring gull, puffin, guillemot and razorbill but noting that the assessment carried out for these species at the four breeding colony SPAs in this list should also be used for the assessment of the pSPA species.

55 In relation to the above sites and qualifying features, the Scoping Opinion considered that the impacts of relevance were collision risk, and displacement and barrier effects, and that for the existing breeding colony SPAs the primary focus of the assessment should be in relation to the Conservation Objective to maintain "the population of the species as a viable component of the site". A conclusion of no LSE is possible for the other qualifying features of the four breeding colony SPAs due to either (or both):

- Known low vulnerability to collisions (as a result of low flight heights (Johnston *et al.*, 2014a, b)) and displacement and barrier effects (as a result of their large foraging ranges (Thaxter *et al.*, 2012)).
- Low abundance in the Development Area and/or at most minor predicted effects from the Development, as established in the HRA assessment undertaken for the 2013 Inch Cape ES (ICOL, 2013).

56 For the qualifying features of the Outer Firth of Forth and St Andrews Bay Complex pSPA not identified in the above list, it was initially advised that there was no need for additional assessment due to the lack of spatial overlap between the Development Area and pSPA. However, during the course of the further correspondence undertaken as part of the Scoping Opinion, a need for assessment was identified in relation to the Offshore Export Cable Corridor where this overlapped with the pSPA[3]. This advice outlined that the following information was required to help inform an AA for the pSPA:

- Extent and route of the Offshore Export Cable Corridors and number of cables;
- Duration and method of cable deployment including start and finish dates;
- Type and number of vessels involved in cable laying operations;
- Habitat mapping within the cable corridor and the likely prey species of pSPA interests where the cable route crosses the pSPA;
- Use of any cable protection materials – type, location and method of deployment;
- Schedule of operational maintenance checks, types of vessels, and duration and timing; and
- Any proposed mitigation and inclusion of a draft cable laying plan and cable maintenance plan.

57 This part of the assessment is presented in *Section 4.6* below.

[3] Letter of 08 September 2017 from MS-LOT to ICOL, including advice provided by SNH.

3.6.3 In-combination Assessment

58 In terms of the in-combination assessments, the Scoping Opinion advised the following for each of the species for which assessments were required in relation to the impacts from collisions, and displacement and barrier effects.

- Gannet: in-combination impacts to be considered with the other three Forth and Tay wind farms for both; (i) the worst case of the 2014 consented and 2017 designs[4]; and (ii) the 2017 design for each of the other Forth and Tay wind farms. In terms of the non-breeding season impacts, these were to be considered for the Forth and Tay wind farms in isolation and in-combination with other UK North Sea and Channel wind farms[3]. The scenario incorporating all UK North Sea and Channel wind farms was to use only the worst case of the 2014 consented and 2017 designs for each of the other Forth and Tay wind farms. The calculation of the non-breeding season collisions should follow the approach used in the assessment for East Anglia THREE (Royal HaskoningDHV *et al.*, 2015, MacArthur Green, 2015a)[5]. Finally, qualitative consideration was to be given to impacts from other wind farms within mean maximum foraging range of the Forth Islands SPA gannet population. All in-combination assessments were to use the 2017 design for the Wind Farm.
- Kittiwake: in-combination impacts to be considered with the other three Forth and Tay wind farms for both; (i) the worst case of the 2014 and 2017 designs; and (ii) the 2017 design for each of the other Forth and Tay wind farms. In terms of the non-breeding season collisions, these were to be considered for the Forth and Tay wind farms in isolation and in-combination with other UK North Sea wind farms[3]. The scenario incorporating all UK North Sea wind farms was to use only the worst case of the 2014 consented and 2017 designs for each of the other Forth and Tay wind farms. The calculation of the non-breeding season collisions should follow the approach used in the assessment for East Anglia THREE (Royal HaskoningDHV *et al.*, 2015, MacArthur Green, 2015b)[5]. Impacts from displacement and barrier effects were to be estimated quantitatively for the breeding period only, with the in-combination assessment considering the other three Forth and Tay wind farms. Each of the in-combination scenarios were to be considered for collisions only and collisions and displacement and barrier effect combined. Finally, qualitative consideration was to be given to impacts from other wind farms within mean maximum foraging range of the relevant SPA population, and to impacts from displacement and barrier effects during the non-breeding period. All in-combination assessments were to use the 2017 design for the Wind Farm.
- Herring gull: in-combination impacts to be considered with the other three Forth and Tay wind farms for both; (i) the worst case of the 2014 and 2017 designs; and (ii) the 2017 design for each of the other Forth and Tay wind farms. Qualitative consideration to be given to impacts from other wind farms within mean maximum foraging range of the relevant SPA population. All in-combination assessments were to use the 2017 design for the Wind Farm.

[4] The 2017 designs for the other Forth and Tay wind farms are based upon the information supplied by the respected developers on the updated designs.
[5] Emails of 8 November 2017 from ICOL to MS-LOT, and from MS-LOT to ICOL.

- Guillemot, razorbill and puffin: in-combination impacts to be considered with the other three Forth and Tay wind farms. Given that potential impacts were only in relation to displacement and barrier effects, the differences between the 2014 consented and 2017 designs were not relevant. Qualitative consideration to be given to impacts from other wind farms within mean maximum foraging range of the relevant SPA population.

3.7 Conclusions in Relation to LSE

59 On the basis of the HRA screening undertaken as part of the Scoping Report (ICOL, 2017), together with the outcome of the subsequent consultation process and the advice of the Scoping Opinion, no LSE could be concluded for all but four SPAs and one pSPA. These sites are identified in Table 3.10 below, along with the qualifying features of relevance in relation to each of these SPAs and the pSPA. The location of these SPAs and the pSPA in relation to the Development and the other Forth and Tay wind farms are shown in Figure 3.1.

60 Given the relationships between the sites and qualifying features identified in Table 3.2 and the potential impacts from the Development (outlined in *Section 3.6.2* above), the focus of the assessment for the four breeding seabird colony SPAs is on the Conservation Objective to maintain, in the long term, the "population of the species as a viable component of the site".

61 The Conservation Objectives to maintain in the long term the "distribution of the species within site", the "distribution and extent of habitats supporting the species", and the "structure, function and supporting processes of habitats supporting the species" apply to the site itself and not to areas beyond the boundary of the site. As such, the Development, alone and in-combination, cannot impact on these Conservation Objectives for these breeding colony SPAs because all the works associated with the construction, operation and maintenance, and decommissioning of the Development are sufficiently remote from the boundary of the site. The Conservation Objective to maintain in the long term "no significant disturbance of the species" is encompassed by the assessment of the first Conservation Objective, to maintain the "population of the species as a viable component of the site" (because disturbance would only be considered significant if it caused an adverse effect on the population viability of the qualifying features of the SPA).

62 However, for the pSPA both of the Conservation Objectives to "avoid significant mortality, injury and disturbance of the qualifying features" and "to maintain the habitats and food resources of the qualifying features" are relevant to the assessment, given the spatial overlap between the Offshore Export Cable Corridor and the pSPA and, hence, potential for direct disturbance to qualifying features and effects on habitats and prey.

63 Further analysis is provided in *Section 4*, focussing on the above Conservation Objectives for each of the SPAs and the pSPA and including the information required for CAs to undertake their AAs.

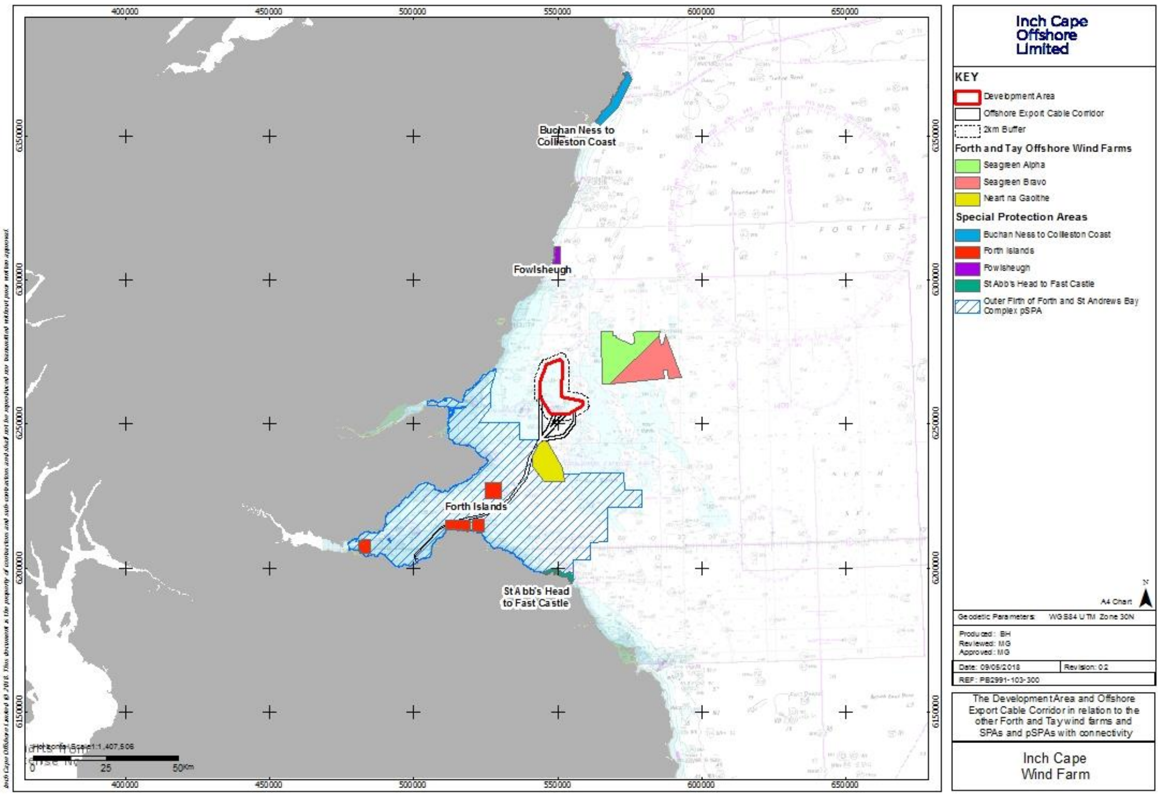
Table 3.10 SPAs and qualifying features where no LSE could not be concluded.

Designated sites	Qualifying features[1]

Forth Islands SPA	Gannet, kittiwake[2], herring gull[2], puffin, guillemot[2], razorbill[2], breeding seabird assemblage
Fowlsheugh SPA	Kittiwake, herring gull[2], guillemot, razorbill[2], breeding seabird assemblage
St Abb's Head to Fast Castle SPA	Kittiwake[2], herring gull[2], guillemot[2], breeding seabird assemblage
Buchan Ness to Collieston Coast SPA	Guillemot[2], breeding seabird assemblage
Outer Firth of Forth and St Andrews Bay Complex pSPA	All qualifying species in relation to the Offshore Export Cable Corridor. (Gannet, kittiwake[2], herring gull[2], puffin[2], guillemot[2] and razorbill[2] in relation to the Wind Farm but noting that the assessment carried out for these species at the breeding colony SPAs applies to the pSPA species, and a separate assessment for the pSPA is not required (as advised in the Scoping Opinion)).

[1]Based on the advice of the Scoping Opinion together with the information on connectivity of each SPA population to the Development Area as defined in Table 3.4.
[2]Indicates features that are named components of an assemblage feature, as opposed to a qualifying feature in their own right.

Figure 3.1: The Development Area and Offshore Export Cable Corridor in relation to the other Forth and Tay wind farms and the SPAs and pSPAs with connectivity



4 Information to Inform the Appropriate Assessment

4.1 Forth Islands SPA

64 The Forth Islands SPA consists of multi-island seabird colonies in the Firth of Forth. The whole SPA is south-west of the Development Area, with the Isle of May being the closest island. The other islands in the SPA are Inchmickery, Fidra, The Lamb, Craigleith and Bass Rock, which were classified in April 1990, plus Long Craig, an extension to the site, classified in February 2004. The SPA is underpinned by the following Sites of Special Scientific Interest (SSSIs): Long Craig, Inchmickery, Forth Islands, Bass Rock and the Isle of May. There is a seaward extension from each island of the SPA extending approximately two kilometres into the marine environment.

65 There are four Annex I qualifying features in the SPA: breeding Arctic, Sandwich, roseate, and common terns. In addition, there are four migratory species that are qualifying features (gannet, shag, lesser black-backed gull and puffin) and an assemblage of more than 20,000 seabirds. The seabird assemblage regularly supports more than 90,000 breeding seabirds with the following named features: razorbill, guillemot, kittiwake, herring gull, cormorant, gannet, lesser black-backed gull, puffin, fulmar, Arctic tern, common tern, roseate tern and Sandwich tern. Of these named features, fulmar, cormorant, razorbill, guillemot, kittiwake, lesser black-backed gull and herring gull are assemblage features only. Further information on the qualifying features is available in Table 3.3.

66 The Conservation Objectives of the site are shown in *Section 3*.

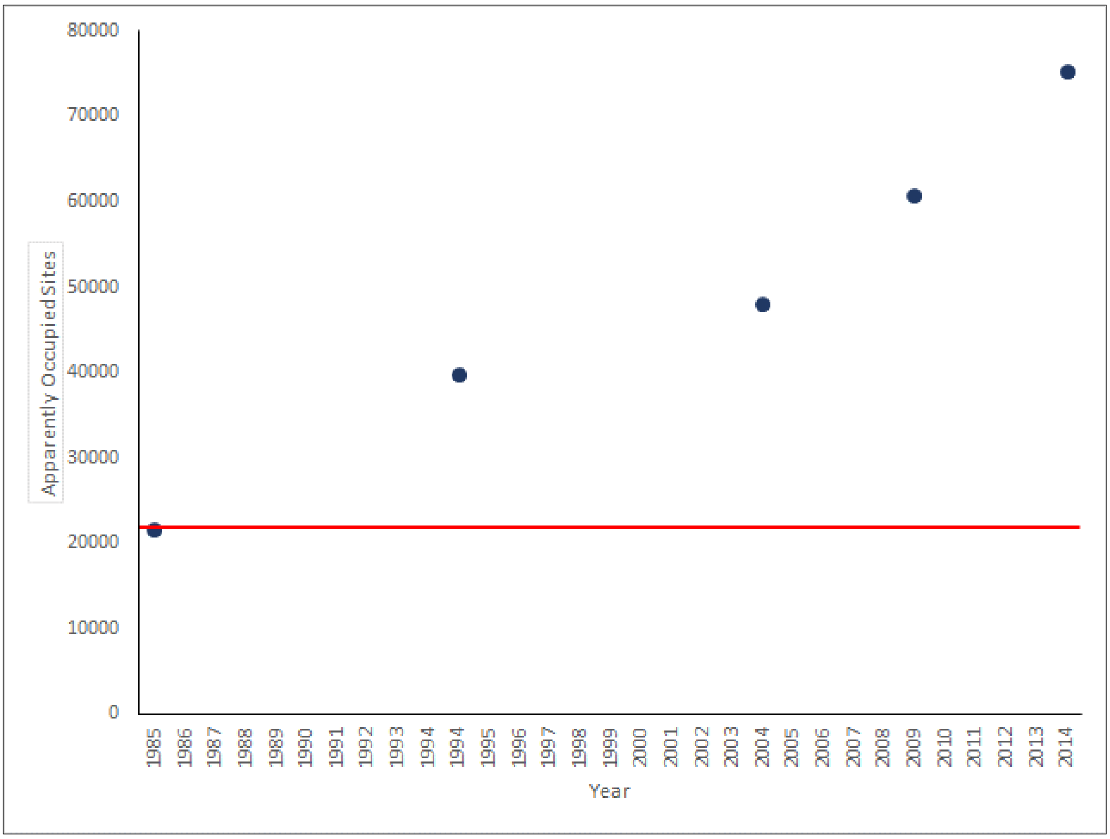
67 The HRA screening and consultation with MS-LOT and their statutory advisors, SNH, identified the species that resulted in a conclusion of no LSE not being possible. These were gannet, kittiwake, herring gull, puffin, guillemot and razorbill. The information below provides information on each of these species for the CA to carry out their AA on the Forth Islands SPA.

4.1.1 Gannet Population

68 Gannets only occur in the North Atlantic, nesting in relatively high latitudes and wintering south of their breeding sites. Most gannets nest in the eastern Atlantic, with the majority (60 – 70 per cent) of birds breeding in colonies around Great Britain. Other gannet colonies occur in France, Ireland, Norway, Faroe Islands and Iceland. Gannets forage entirely at sea on fish, including discards from fishing boats, and have very long foraging ranges when breeding (Thaxter *et al.,* 2012). Gannet from the Forth Islands SPA forage across a large portion of the North Sea (Cleasby *et al.,* 2015), though their foraging range shows little overlap with those of other colonies (Wakefield *et al.,* 2013).

69 The largest gannet colony in the world occurs on Bass Rock, in the Forth Islands SPA (Murray *et al.,*2014). Gannet populations, including on the Bass Rock (Figure 4.1), have increased substantially through the 20th and 21st centuries, with expansion at existing colonies and the development of new colonies occurring (Mitchell *et al.,* 2004). It is likely that the colony on Bass Rock is at, or very close too, saturation, with further increases being limited by available space on the island.

Figure 4.1 Forth Islands SPA gannet population trend between 1985 and 2014. The red line shows the population size at designation (21,600 pairs).



Potential impacts on the gannet population

70 The Development Area, OfTW and associated buffers[6] do not overlap with the Forth Islands SPA. Consequently, the potential impacts on its gannet population will only occur as a result of individuals from the colony occurring in the Development Area. The impact of concern identified in the Scoping Opinion from MS-LOT was from collisions of gannets with operational WTG blades. Data collected from boat-based surveys of the Development Area and buffer (*Appendix 11A: Offshore Ornithology Baseline Survey Report*) and tracking data on gannets indicate that there is a potential for collisions to occur (Cleasby *et al.,* 2015).

71 Tracking data from the Bass Rock (Cleasby *et al.,* 2015), show that breeding gannets from the Forth Islands SPA occur within the Development Area and buffer, and also within the areas of other proposed wind farms in the Forth and Tay and elsewhere in the North Sea. The breeding period for gannet is defined as mid-March to September, following the advice of the Scoping Opinion.

72 During migration gannets from the Forth Islands SPA move south to winter at sea from the Bay of Biscay south to the seas off west Africa, returning north in the spring (Fort *et al.,* 2012). Therefore, there is the potential for birds to pass through other offshore wind farms in the

[6] The assessment uses a two kilometre buffer around the Development Area, and the Offshore Export Cable will occur within the Offshore Export Cable Corridor (providing a buffer area around the cable location).

North Sea and English Channel during both autumn and spring passage periods (defined as October to November and December to mid-March, respectively, following the advice of the Scoping Opinion).

73 In their Scoping Opinion, MS-LOT recommended using the Biologically Defined Minimum Population Scale (BDMPS) to apportion the estimated collisions from the wind farms in the UK North Sea and Channel to the Forth Islands SPA population during the autumn and spring passage periods (Furness, 2015). However, following correspondence between ICOL, SNH and MS-LOT[7], it was agreed to follow the approach used in the East Anglia THREE assessment, which is based upon the BDMPS but with modifications to the estimates of some breeding population sizes and assumed passage flight directions (MacArthur Green, 2015a, Royal HaskoningDHV *et al.,* 2015).

74 In addition, it was advised in the Scoping Opinion[8] that collision estimates for the wind farms in the UK North Sea and Channel should be amended from those presented in the East Anglia THREE assessment (Royal HaskoningDHV *et al.,* 2015) according to the report on Estimates of Ornithological Headroom in Offshore Wind Farm Collision Mortality (MacArthur Green, 2017). However, for the Development and each of the other three Forth and Tay wind farms, the passage period collision estimates were as calculated in the CRMs for the current assessment (see below).

75 The full details of the methods and approach used to apportion the estimated collisions from wind farms in the UK North Sea and Channel to the Forth Islands SPA gannet population during the autumn and spring passage periods are detailed in *Appendix 11B*.

Predicted collision impacts alone and in-combination

Estimation of impacts

76 Collision risk models (CRMs) were undertaken using the Band (2012) model to predict the number of birds at risk from collisions both for Development-alone and in-combination scenarios. Following the Scoping Opinion from MS-LOT, the assessment for gannet was based on option 2 of the CRM, but with option 1 of the CRM also presented for the Development-alone. Option 2 of the CRM uses the generic flight height data from Johnston *et al.,* (2014a,b), whilst option 1 uses the site-specific flight height data, as collected during the baseline surveys of the Development Area and four kilometre buffer (subsequently referred to as the Survey Area)[9] (*Appendix 11C: Estimation of the Development-alone and Cumulative Collision Risk).* An avoidance rate of 98.9 per cent was used with both CRM options. Thus, the approach in relation to CRM options and avoidance rate was in accordance with the Scoping Opinion and followed the available Statutory Nature Conservation Bodies (SNCBs) advice (SNCBs, 2014).

[7] Emails of 1 and 8 November 2017 from MS-LOT to ICOL, and of 8 November 2017 from ICOL to MS-LOT.
[8] Email of 01 November 2017 from MS-LOT to ICOL.
[9] Baseline surveys extended across a four kilometre buffer on the basis of the advice from SNH, although the subsequent assessment was undertaken in relation to the Development Area and two kilometre buffer, as advised in the Scoping Opinion.

77 In terms of designs for the Wind Farm, the worst-case scenario for gannet collision risk was represented by the 40 WTG design, which is detailed in *Appendix 11C.* Therefore, it is the estimates from this design that are presented in this report and used to inform the AA. For the in-combination assessment, both the 2014 and 2017 designs of the other three Forth and Tay wind farms (i.e. Neart na Gaoithe, Seagreen Alpha and Seagreen Bravo) were considered. The 2014 design represented the worst case for each proposed development and is used for the in-combination assessment, although the in-combination estimates as calculated using the 2017 designs for these proposed developments are also presented. The 2017 designs for the other three Forth and Tay wind farms were based on the information provided by the respective developers. Full details of the CRM methods, inputs and resulting estimates are provided in *Appendix 11C*.

78 The Development-alone and in-combination CRM predictions calculated for the breeding period were apportioned between the Forth Islands SPA population and the Troup Head colony population, as outlined above and detailed in *Appendix 11B*. Troup Head is the only gannet colony other than the Bass Rock within mean maximum foraging range of the Development Area and two kilometre buffer, which is also the case for the other three wind farms plus their associated two kilometre buffers (*Appendix 11B*). The apportioning calculations were undertaken separately for the Development Area and two kilometre buffer, and for Neart na Gaoithe (plus buffer) and Seagreen Alpha and Bravo combined (plus buffer). The two Seagreen sites were combined for the purposes of the apportioning calculations because they are contiguous along their longest boundary. On the basis of these calculations, the percentage of the breeding period impacts to gannets from the Development and each of the other three Forth and Tay wind farms attributed to the Forth Islands SPA population were as follows:

- The Development – 99.6 per cent
- Neart na Gaoithe –99.9 per cent
- Seagreen Alpha and Bravo – 98.7 per cent

79 Collision estimates were apportioned to age classes on the basis of the plumage characteristics of gannets recorded during the 'at-sea' baseline surveys for the Survey Area[9] (*Appendix 11A*) and for each of the other Forth and Tay wind farms (*Appendix 11C*). Thus, apportioning to age classes was based upon data specific to each wind farm. The number of adult collisions during the breeding period was also amended according to an assumed 10 per cent sabbatical rate amongst the breeding adult birds, as advised in the Scoping Opinion (*Appendix 11C*).

80 Development-alone collision estimates were produced by summing the breeding period estimate with the estimates derived for the autumn and spring passage periods (as calculated using the amended BDMPS approach – see above).

81 In-combination collision estimates were also produced by summing the breeding period estimate with the estimates derived for the autumn and spring passage periods, and were undertaken for the following scenarios:

- The Development with the worst-case of the 2014 and 2017 designs for each of the other three Forth and Tay wind farms
- The Development with the 2017 designs for each of the other three Forth and Tay wind farms
- The Development with the worst-case of the 2014 and 2017 designs for each of the other three Forth and Tay wind farms, and the passage period estimates from the other wind farms in the UK North Sea and Channel

82 In addition, qualitative consideration was given to the breeding period collisions arising from other wind farms within mean maximum foraging range of the Forth Islands SPA.

Estimated impacts

Development-alone

83 The predicted impacts on gannets from the Development-alone were mostly on the breeding adult population, with 98 collisions of adult birds per annum estimated by option 2 of the CRM, of which 94 were estimated to occur during the breeding period, as opposed to the passage periods (Table 4.1). The predicted number of collisions from the Development-alone on breeding adult birds is small compared with the current (150,518 individuals) and citation (42,200 individuals) population sizes (0.07 per cent and 0.23 per cent respectively).

84 Collision estimates for gannet by option 1 of the CRM were less than half those estimated by option 2 (Table 4.1). As detailed in *Appendix 11C*, this difference results from the lower percentage of gannets estimated to be at potential collision height (PCH) by the site-specific data than by the generic data. The site-specific flight height estimates are based upon a large sample-size and there is relatively strong statistical support for the observed differences in the site-specific and generic flight height estimates (*Appendix 11C*). Furthermore, the difference between the site-specific and generic estimates is such as to make systematic bias in the recording of the gannet flight heights during the baseline surveys an unlikely explanation for this difference (*Appendix 11C*), whilst it has been established that between-site variability in gannet flight heights is high (Johnston *et al.,* 2014a,b).

85 Consequently, it is considered likely that the use of the option 2 CRM will overestimate the Development-alone collisions and will result in a highly precautionary assessment.

Table 4.1 Estimated collision impacts from the Development-alone on the gannet population at Forth Islands SPA. Estimates based on a 98.9% avoidance rate.

Model option	Seasonal period	Estimated number of collisions		
		Breeding adults[1]	Immature birds	Juvenile birds
2	Breeding	94	2	1
	Autumn passage[2]	1.6	<0.1	0.1
	Spring passage[2]	2.4	<0.1	0.0
1	Breeding	40	1	0
	Autumn passage[2]	0.3	<0.1	<0.1
	Spring passage[2]	0.6	<0.1	0.0

[1]The number of adult collisions during the breeding period is reduced by 10 % to account for an assumed 10 % sabbatical rate amongst the adults (as advised in the Scoping Opinion).
[2]Passage period collision estimates presented to 1 decimal place because of the nature of the apportioning calculation (*Appendix 11B*).

In-combination

86 The predicted in-combination impacts for the Development with the other Forth and Tay wind farms were considerably higher than for the Development-alone (Table 4.2). The 2014 designs were the worst-case for each of the other Forth and Tay wind farms, and these all gave considerably higher collision estimates than those associated with the Development. The 2017 design for Neart na Gaoithe gave substantially lower collision estimates than the 2014 design for this wind farm (with consequent reductions in the in-combination estimate for this scenario). The reductions between the 2014 and 2017 designs for each of the Seagreen sites were limited to a single adult collision during the breeding period (Table 4.2).

87 As with impacts from the Development-alone, the vast majority of the collisions were attributed to breeding adults in the breeding period (i.e. 659 and 546 for the 2014 and 2017 design scenarios, respectively), with the largest percentage of these from the Seagreen Alpha wind farm (at 37 and 44 per cent for the 2014 and 2017 design scenarios, respectively). The estimated in-combination collisions of breeding adults from the Forth and Tay wind farms remains relatively small compared to the current and citation SPA population size, at 0.46 and 0.38 per cent of the current population (for the 2014 and 2017 design scenarios, respectively) and 1.65 and 1.37 per cent of the citation population (for the 2014 and 2017 design scenarios, respectively).

Table 4.2 In-combination collisions estimates for the Forth Islands SPA gannet population for the Development and the other three Forth and Tay wind farms, for both the 2014 and 2017 designs of the other Forth and Tay wind farms.

Wind farm	Seasonal period	Estimated number of collisions (based on option 2 with a 98.9 % avoidance rate)					
		2014 designs for other developments and 2017 design for the Development			2017 designs for other developments and the Development		
		Breeding adults[1]	Immatures	Juveniles[2]	Breeding adults[1]	Immatures	Juveniles[2]
Inch Cape[3]	Breeding	94	2	1	94	2	1
Neart na Gaoithe		171	5	1	60	2	0
Seagreen Alpha		240	6	2	240	6	2
Seagreen Bravo		153	3	1	152	3	1
Inch Cape[3]	Autumn passage[4]	1.6	<0.1	<0.1	1.6	<0.1	0.1
Neart na Gaoithe		4.4	<0.1	0.2	1.6	<0.1	0.1
Seagreen Alpha		3.3	0.1	0.3	3.3	0.1	0.3
Seagreen Bravo		4.2	<0.1	0.1	4.2	<0.1	0.1
Inch Cape[3]	Spring passage[4]	2.4	0.1	0.0	2.4	0.1	0.0
Neart na Gaoithe		8.5	0.2	0.0	3.0	0.1	0.0
Seagreen Alpha		7.3	0.3	0.0	7.3	0.3	0.0
Seagreen Bravo		7.9	0.1	0.0	7.9	0.1	0.0

Wind farm	Seasonal period	Estimated number of collisions (based on option 2 with a 98.9 % avoidance rate)					
		2014 designs for other developments and 2017 design for the Development			2017 designs for other developments and the Development		
		Breeding adults[1]	Immatures	Juveniles[2]	Breeding adults[1]	Immatures	Juveniles[2]
TOTAL	**All seasons combined**	**698**	**17**	**6**	**577**	**14**	**5**

[1]The number of adult collisions during the breeding period is reduced by 10 % to account for an assumed 10 % sabbatical rate amongst the adults (as advised in the Scoping Opinion).
[2]Juveniles were not distinguished from other immatures in the data from the 'at-sea' surveys for the other Forth and Tay wind farms, so the number of juvenile collisions at these wind farms is estimated by applying the ratio of immatures to juveniles for the relevant seasonal period as recorded at Inch Cape.
[3]Only the 2017 design is considered for the Development, with collision estimates as in Table 4.1.
[4]Passage period collision estimates presented to 1 decimal place because of the nature of the apportioning calculation (*Appendix 11B*).

88 The final in-combination scenario that was considered involved the collision estimates for the Development with the 2014 designs for each of the other three Forth and Tay wind farms (the 2014 design being the worst-case for each of these wind farms), plus the passage period collision estimates from other wind farms in the UK North Sea and Channel. The inclusion of collision estimates from the other UK North Sea and Channel wind farms substantially increased the impacts during the passage periods, particularly for autumn (when 63 per cent of the Forth Islands SPA population is assumed to migrate through the North Sea, as opposed to 27 per cent in spring – *Appendix 11B*). However, the total impacts estimated during the autumn and spring passage periods remained considerably smaller than the breeding season impacts, with the combined passage period adult collisions being less than 20 per cent of the adult collisions estimated during the breeding period (Table 4.3).

89 Overall, the total predicted in-combination impact on adult gannets from the Forth Islands SPA was 775 birds per annum, when the worst-case design for the other Forth and Tay wind farms was assumed and when passage period collision estimates from other UK North Sea and Channel wind farms were included (Table 4.3). This remains a relatively small percentage of the Forth Islands SPA population size currently (0.5%) and at citation (1.8%).

Table 4.3 Estimated in-combination collisions for Forth Islands SPA gannet population for the Development and the 2014 designs of the other three Forth and Tay wind farms (as derived from Table 4.2)[1] combined with the passage period collisions from other UK North Sea and Channel wind farms.

Wind farms	Seasonal period	Estimated number of collisions		
		Breeding adults[2]	Immature birds	Juvenile birds[3]
Forth and Tay	Breeding	659	16	5
Forth and Tay	Autumn passage[4]	13.5	0.3	0.6
Other UK North Sea and Channel		56.3	26.6	19.5
Total autumn passage		**69.8**	**26.9**	**20.1**
Forth and Tay	Spring passage[4]	26.1	0.6	0.0
Other UK North Sea and Channel		20.2	16.5	0.0
Total spring passage		**46.3**	**17.1**	0.0
TOTAL	**All seasons**	**775**	**60**	**25**

[1]The 2014 design represents the worst-case of the 2014 and 2017 designs for each of the other three Forth and Tay wind farms.
[2]The number of adult collisions during the breeding period is reduced by 10 % to account for an assumed 10 % sabbatical rate amongst the adults (as advised in the Scoping Opinion).

[3]Juveniles were not distinguished from other immatures in the data from the 'at-sea' surveys for the other Forth and Tay wind farms, so the number of juvenile collisions at these wind farms is estimated by applying the ratio of immatures to juveniles for the relevant seasonal period as recorded at Inch Cape.
[4]Passage period collision estimates presented to 1 decimal place because of the nature of the apportioning calculation (*Appendix 11B*).

Collisions from other wind farms within foraging range

90 A number of other offshore wind farms occur within mean maximum foraging range of the Forth Islands SPA gannet population, most being small-scale developments or else located at the edge of the mean maximum foraging range (as defined by Thaxter *et al.,* 2012). The advice from the Scoping Opinion was to consider the breeding season effects from these wind farms qualitatively.

91 These wind farms are:

- Aberdeen Offshore Wind Farm;
- Blyth Offshore Demonstrator;
- Offshore Renewable Energy Catapult (OREC), Levenmouth Demonstration Turbine (was Fife Energy Park Offshore Demonstration Wind Turbine);
- Hywind Scotland Pilot Park;
- Kincardine Floating Offshore Wind Farm;
- Teesside Offshore Wind Farm;
- Beatrice Offshore Wind Farm;
- Moray East Offshore Wind Farm (referred to as Telford, Stevenson and Maccoll Offshore Wind Farms); and
- Moray West Offshore Wind Farm (referred to as Moray Offshore Western Development Area).

92 In addition to the above, consideration was also given to the Dogger Bank Creyke Beck A and Creyke Beck B wind farms because tracking studies have indicated that gannets from the Forth Islands SPA do make some, limited, use of these areas, although they are beyond the mean maximum foraging range (Wakefield *et al.,* 2013).

93 Of these, the wind farms within the Moray Firth (i.e. the Beatrice and the Moray East and West sites) are unlikely to be used by Forth Islands SPA gannets during the breeding period. Extensive tracking data shows that the Forth Islands SPA gannets rarely enter the Moray Firth, which is likely to be used by birds from the Troup Head colony and from larger colonies to the north of this area (Wakefield *et al.,* 2013).

94 For the other wind farms listed above, breeding period collision estimates were extracted from the East Anglia THREE assessment (Royal HaskoningDHV *et al.,* 2015), updated in accordance with the report on Estimates of Ornithological Headroom in Offshore Wind Farm

collision mortality (MacArthur Green, 2017) as described in *Appendix 11B*, for the Aberdeen Offshore Wind Farm, the Blyth Offshore Demonstrator, Dogger Bank Creyke Beck A and B, and Teesside Offshore Wind Farm. Collision estimates for the remaining sites were extracted from the relevant assessment documentation and AAs. This gave estimates of the following numbers of collisions per annum:

- Aberdeen Offshore Wind Farm - 3.4 collisions from all sources and age classes;
- Blyth Offshore Demonstrator - 3.5 collisions from all sources and age classes;
- OREC- zero;
- Hywind Scotland Pilot Park - four collisions apportioned to the Forth Islands SPA;
- Kincardine Floating Offshore Wind Farm - Two collisions apportioned to the Forth Islands SPA;
- Dogger Bank Creyke Beck A and B - 5.6 collisions from all sources and age classes; and
- Teesside Offshore Wind Farm - 3.3 collisions from all sources and age classes.

95 For the Aberdeen Offshore Wind Farm, it is likely that the collisions are attributable to both the Forth Islands SPA and the Troup Head colony (with the latter being in closest proximity but with analyses of 'colony foraging ranges' suggesting that the area lies within the range of the birds from the Forth Islands, although these analyses do not incorporate data from the Troup Head colony – Wakefield *et al.,* 2013). Both the Dogger Bank sites and the Teesside Offshore Wind Farm are likely to be used by birds from both the Flamborough Head and Filey Coast pSPA population (which is closer to these sites) and the Forth Islands SPA population (Wakefield *et al.,* 2013).

96 If it assumed that 50 per cent of the collisions from the Aberdeen Offshore Wind Farm, Dogger Bank Creyke Beck A and B wind farms, and Teesside Offshore Wind Farm are attributable to the Forth Islands SPA and if the age distribution from 'at sea' surveys for the Development (97 per cent adults) is applied to these collisions, this gives a total of six collisions from these four wind farms. Adding this to the collision estimates for the Hywind, Kincardine and Blyth sites gives a total of 15 collisions from the above wind farms to adult gannets from the Forth Islands SPA population during the breeding period.

97 This additional mortality is extremely small relative to the Forth Islands SPA current population size (representing 0.01 per cent) and makes a small addition only to the total collision estimates on which the assessment is based for the worst-case in-combination scenario (i.e. 775 to 875 collisions – see Tables 4.4 and 4.5).

<u>Population Viability Analysis of the gannet population</u>

98 PVA was used to determine the effects of the predicted collision impacts from the Development-alone, and in-combination, on the Forth Islands SPA gannet population. For the purposes of assessing the population-level impacts on the basis of the PVA, all collision estimates were derived from option 2 of the CRM, whilst the in-combination impacts used the

2014 designs of the other three Forth and Tay wind farms (as these represented the worst-case for each of these wind farms – Table 4.2).

99 The Forth Islands SPA gannet population model produced for the current assessment was a stochastic, density independent, matrix model, developed from the previous population models for the UK and Bass Rock gannet populations (WWT Consulting, 2012, MacArthur Green, 2014). The starting point population size used the 2014 estimate for the Bass Rock population (Murray *et al.,* 2014), with the numbers of birds attributed to the immature age classes calculated by applying the stable age distribution from the population model to the estimated number of breeding adults. Further details of the model are provided in *Appendix 11E: Population Viability Analyses*.

100 Predicted population trends under baseline conditions were projected over both 25 and 50 year timescales. Additional mortality was incorporated at intervals of 25 individuals up to a maximum of 1500 (and in such a way that the additional mortality remains proportional to population-size as this changes through the course of the projection), with the collision estimates for the Development-alone and in-combination scenarios matched to the closest higher additional mortality value.

101 The additional mortality values incorporated into the PVA assumed a 97:3 ratio of adults to immatures. This ratio was based upon the age distribution determined from the 'at-sea' survey data for the Development and the other three Forth and Tay wind farms during the breeding period, and is appropriate to both the Development-alone and Forth and Tay wind farm in-combination scenarios (*Appendix 11C*). However, only 90 per cent of the total gannet collisions estimated for the in-combination scenario which incorporates passage collisions from the other UK North Sea and Channel were attributed to the adult age class. Therefore, the additional mortality as applied in the PVA will overestimate impacts relative to the equivalent collision estimate for this in-combination scenario due to the greater weighting towards the adult age class.

102 The PVA assumed that impacts began at the start of the projection period (i.e. essentially 2014, as the year of the estimate on which the starting population-size is based) and did not allow for any intervening period to account for the likely timing of the start of the Development operation period. However, this is likely to lead to precautionary conclusions, given that the model predicted continued growth of the population (see below).

103 Outputs from the PVA were summarised according to the median predicted population-sizes at the end of the projection period, and the three metrics which the Scoping Opinion advised should be used for the interpretation of outputs and which have been shown to have relatively low sensitivity to factors such as varying population status and the mis-specification of the demographic rates underpinning the population model (Cook and Robinson 2015, Jitlal *et al.,* 2017). These metrics are:

- The counterfactual of population-size – the median of the ratio of the end-point size of the impacted to un-impacted (or baseline) population, expressed as a proportion;

- The counterfactual of population growth rate - the median of the ratio of the annual growth rate of the impacted to un-impacted population, expressed as a proportion; and
- The centile of the un-impacted population that matches the median (i.e. 50th centile) of the impacted population (based upon the distribution of the end-point population-sizes generated by the multiple replications of the model runs, the value should always be less than 50 because the median for the impacted population is not expected to exceed that for the un-impacted population).

104 The PVA projected population growth for the Forth Islands SPA gannet population with and without impacts for the Development-alone and in-combination scenarios. The median end population size for each modelled impact (Table 4.4) was higher than the current SPA population size (150,518 individuals), and the projected population size at 50 years was always larger than the projected population size at 25 years (Table 4.4). The PVA metrics (Table 4.5) show that for the Development-alone, the counterfactual of population size was close to one after both 25 years (0.983) and 50 years (0.967), indicating that the predicted impacts on the population were small. These counterfactual values were smaller for the in-combination scenarios but still indicated relatively small predicted reductions in end population size for the Forth and Tay in-combination assessment after both 25 years (0.914) and 50 years (0.835). Even with the additional passage period collision estimates from the other UK North Sea and Channel wind farms included as part of the in-combination assessment, the counterfactual of population size for the precautionary higher additional mortality of 850 birds represented only a 10 per cent reduction in the 25-year projected population size (0.903) and less than a 20 per cent reduction in the 50-year projected population size (0.809).

105 The counterfactual of the population growth rate for the Development-alone showed minimal reduction (with a value of 0.999), whilst for both of the in-combination scenarios the reduction remained small, as represented by a value of 0.996 in both cases (Table 4.5).

106 The centile metric showed considerable change between the Development-alone and in-combination scenarios (Table 4.5). For the Development-alone, the end population size centile was relatively high after both 25 years (41st centile) and 50 years (37th centile), indicating a considerable overlap between the distributions of the predicted impacted and un-impacted population sizes and, hence, a reasonable likelihood of the impacted population being similar in size to the un-impacted population even after 50 years.

107 The Forth and Tay wind farms in-combination end population size centiles were 12 after 25 years and five after 50 years. With the passage collision estimates from the other UK North Sea and Channel wind farms included within the in-combination, these values were reduced further to between nine and 11 after 25 years and two and four after 50 years (Table 4.5). Thus, for the in-combination scenarios there was little overlap in the distribution of the predicted impacted and un-impacted end population sizes, suggesting a high likelihood of the impacted population being smaller than the un-impacted population after 25 and 50 years. The PVA outputs produced in current assessment provided some evidence that this metric may be sensitive to the modelling approach used, and specifically to the variation associated with model predictions (*Appendix 11E*). The modelling approach used for the Forth Islands SPA gannet population differed to that for the other SPA populations modelled in the

assessment, and this may have contributed to the low centile values obtained for the Forth Islands SPA gannet population (at least relative to those for the other SPA populations - see below).

108 The population projections in all cases showed that the end population size was much greater than the population size at citation (21,600 pairs), and therefore the effects of the Development-alone, and in-combination, would not result in the conservation status of the Forth Islands SPA gannet population being in unfavourable condition. Furthermore, it should be borne in mind that the metrics for the Development-alone were derived from a PVA based upon the option 2 collision estimates, which are more than twice as high as those generated by the option 1 CRM. As outlined in *Appendix 11C*, there are good reasons for considering the site-specific flight heights (and hence the option 1 collision estimates) to be representative of gannet behaviour within the Development Area and two kilometre buffer.

Table 4.4 Projected end population sizes of the Forth Islands SPA gannet population after 25 and 50 years for baseline, Development-alone and two in-combination scenarios.

Scenario	Additional mortality[1]	Median number of breeding adults (2.5 - 97.5 centiles)	
		25 years	50 years
Baseline	0	172,530 (148,172 – 199,825)	199,491 (160,083 – 245,839)
Development-alone	125	169,653 (145,724 – 196,717)	192,824 (154,739 – 240,072)
In-combination – Development with other Forth and Tay wind farms	725	157,743 (136,486 – 183,310)	166,484 (134,418 – 207,195)
In-combination – Development with other Forth and Tay wind farms plus passage collisions from other UK North Sea and Channel wind farms[2]	775	157,431 (135,594 – 182,889)	164,856 (133,329 – 203,748)
	875	155,709 (134,025 – 180,952)	161,355 (128,926 – 199,296)

[1]The value represents the starting-point additional mortality, which then varies in proportion to changes in population-size through the projection period. The additional mortality is apportioned in a ratio of 97:3 breeding adults to immatures.
[2]Two values for additional mortality are considered, with the lower value matching the mortality to breeding adult birds and the higher value matching the total mortality across all age classes. Outputs are presented for this range because only 90 % of the collisions for this scenario are attributed to adults (so the true predicted impact lies within the range shown).

Table 4.5 PVA metrics for the Forth Islands SPA gannet population after 25 and 50 years for the Development-alone and two in-combination scenarios.

	Additional mortality[1]	Counterfactual of end population size		Counterfactual of population growth rate[2]	Centile of baseline population matching the median of the impacted population	
		25 years	50 years	25 and 50 years	25 years	50 years
Baseline	0	1.000	1.000	1.000	50	50
Development-alone	125	0.983	0.967	0.999	41	37
In-combination – Development with other Forth and Tay wind farms	725	0.914	0.835	0.996	12	5
In-combination– Development with other Forth and Tay wind farms plus passage collisions from other UK North Sea and Channel wind farms[3]	775	0.912	0.826	0.996	11	4
	875	0.903	0.809	0.996	9	2

[1]The value represents the starting-point additional mortality, which then varies in proportion to changes in population-size through the projection period. The additional mortality is apportioned in a ratio of 97:3 breeding adults to immatures.
[2]The value of this metric does not vary according to the length of the projection period.
[3]Two values for additional mortality are considered, with the lower value matching the mortality to breeding adult birds and the higher value matching the total mortality across all age classes. Outputs are presented for this range because only 90 % of the collisions for this scenario are attributed to adults (so the true predicted impact lies within the range shown).

Conclusion

109 The predicted impacts from the Development-alone and in-combination collisions were small, and the outputs from the PVA indicate relatively small predicted population-level effects, although the centile metric suggests a high likelihood of these effects occurring (but noting the possible limitations with this metric associated with the use of different modelling approaches – *Appendix 11E*). Accounting for the impacts from the other wind farms within

foraging range of the Forth Islands SPA which were considered qualitatively does not affect this conclusion. The Forth Islands SPA gannet population is predicted to continue to increase, irrespective of the predicted collision mortality (whether from the Development-alone or in-combination scenarios). Therefore, the Conservation Objective of the SPA, to maintain the "population of the species as a viable component of the site", would not be compromised for the gannet population. It should therefore be possible for the CA to conclude, beyond reasonable scientific doubt, that the Development-alone, and in-combination, will have no adverse effect on site integrity as a consequence of the effects on the SPA gannet population.

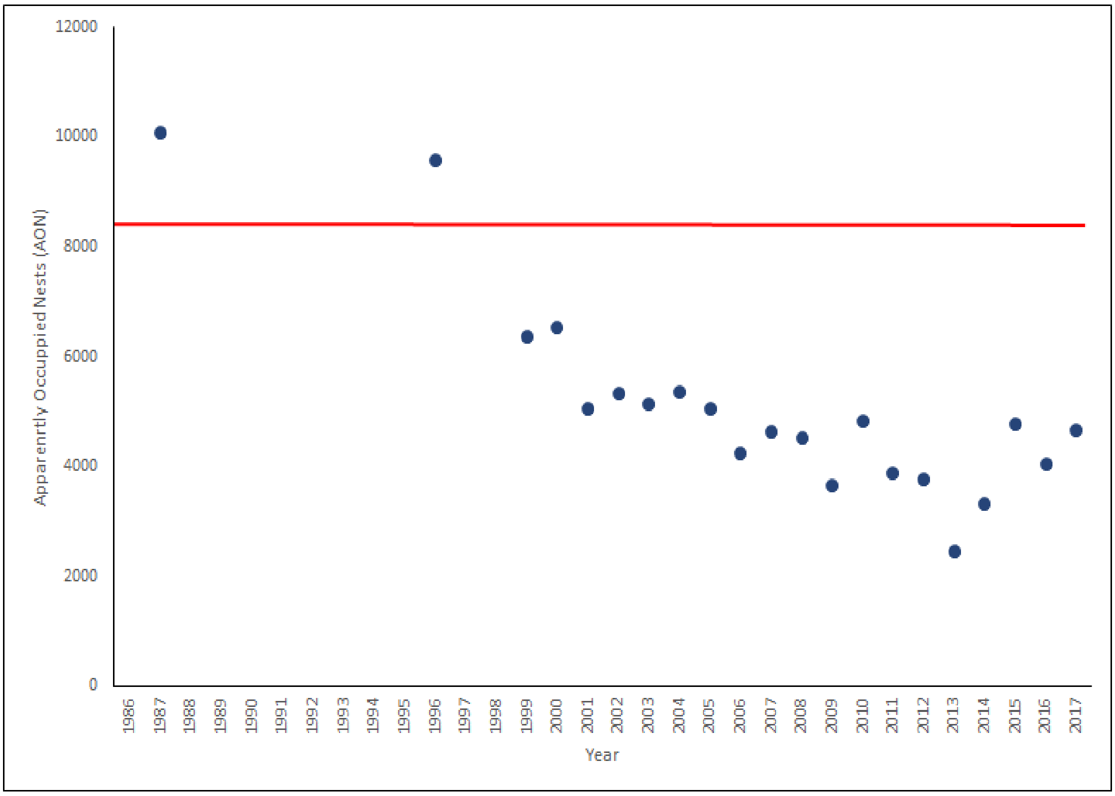
4.1.2 Kittiwake Population

110 Kittiwakes breed in relatively high northern latitudes in colonies, often with other species of seabird, and in Europe colonies occur from northern Portugal to the north coast of Scandinavia and Iceland. Kittiwakes forage entirely at sea on small shoaling fish, often sandeels, the availability of which can be very important in determining breeding success of North Sea colonies (Lewis *et al.,* 2001).

111 The Forth Islands SPA kittiwake population is distributed across several islands in the Firth of Forth. The largest colony occurs on the Isle of May, with smaller colonies on Craigleith, Bass Rock, Fidra and The Lamb. The Isle of May colony is about 75 per cent of the SPA total. The kittiwake population size has declined since the SPA was designated (Figure 4.2), with the SPA counts being below the cited population size in all but two years since the mid-1980s. The count data shown in Figure 4.2 are largely from the JNCC Seabird Monitoring Programme (SMP) database[10] [], with the 2017 count as provided in the SNH scoping advice[11] and the 2016 count for the Isle of May having been extracted from the Isle of May National Nature Reserve (NNR) blog[12] . These recent data demonstrate that there are suggestions of the beginnings of recovery in the SPA population size.

[10] At http://jncc.defra.gov.uk/smp/Default.aspx [Accessed: 08/08/18]
[11]Email of 08 December from MS-LOT to ICOL, with attached table of SPA colony counts as provided by SNH.
[12] https://isleofmaynnr.wordpress.com/ [Accessed: 08/08/18]

Figure 4.2 Kittiwake population trend at the Forth Islands SPA between 1986 and 2017. The red line shows the population size at designation (8,400 pairs).



<u>**Potential impacts on the kittiwake population**</u>

112 The Development Area, OfTW and associated buffers[6] do not overlap with the Forth Islands SPA. Consequently, the potential impacts on its kittiwake population will only occur as a result of individuals from the colony occurring in the Development Area. In relation to kittiwakes, the impacts of concern identified in the Scoping Opinion from MS-LOT were from collisions with operational WTG blades, displacement from the Development Area and two kilometre buffer, and barrier effects (with the latter two effects subsequently considered together). Data collected on kittiwakes indicate that there is a potential for collisions and displacement to occur (Centre for Ecology and Hydrology (CEH), 2011, and data collected from boat-based surveys from the Development Area and buffer - *Appendix 11A*). From published information on kittiwake foraging ranges generally (Thaxter *et al.,* 2012) and tracking from the Isle of May specifically (CEH, 2011), it is very likely that during the breeding period kittiwakes from the Forth Islands SPA occur within the Development Area and two kilometre buffer, as well as within the proposed development areas of other wind farms in the Forth and Tay. The breeding period for kittiwake is defined as mid-April to August, following the advice of the Scoping Opinion.

113 In the non-breeding season kittiwakes are largely pelagic, with birds from some colonies wintering as far west as the coast of eastern Canada (Frederiksen *et al.,* 2011), though most kittiwakes breeding on the North Sea coast likely winter in the North Sea and Celtic Sea. Therefore, it is likely that there is the potential for birds from the Forth Islands SPA population

to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to December and January to mid-April, respectively, following the advice of the Scoping Opinion). In their Scoping Opinion, MS-LOT recommended using the BDMPS to apportion the estimated collisions from UK North Sea wind farms to the Forth Islands SPA population during the autumn and spring passage periods (Furness, 2015). Following correspondence between ICOL, SNH and MS-LOT[7], the approach adopted followed that used to apportion passage period collisions to the Flamborough Head and Filey Coast pSPA kittiwake population in the assessment for the East Anglia THREE wind farm (MacArthur Green, 2015b, Royal HaskoningDHV *et al.,* 2015), which was in turn based upon the BDMPS approach.

114 In addition, it was advised in the Scoping Opinion[7] that collision estimates for the wind farms in the UK North Sea should be amended from those presented in the East Anglia THREE assessment (Royal HaskoningDHV *et al.,* 2015) according to the report on Estimates of Ornithological Headroom in Offshore Wind Farm Collision Mortality (MacArthur Green, 2017). However, for the Development and the each of the other three Forth and Tay wind farms, the passage period collision estimates were as calculated in the CRMs for the current assessment (see below). The full details of the methods and approach used to apportion the estimated collisions from wind farms in the UK North Sea to the Forth Islands SPA kittiwake population are detailed in *Appendix 11B*.

115 In relation to displacement during the non-breeding period, MS-LOT advised in their Scoping Opinion that effects should be considered qualitatively.

<u>Predicted collision impacts alone and in-combination</u>

<u>Estimation of impacts</u>

116 CRMs were undertaken using the Band (2012) model to predict the number of birds at risk from collisions both for the Development-alone and in-combination scenarios. Following the scoping opinion from MS-LOT, the assessment for kittiwake was based on option 2 of the CRM, but with outputs from option 1 of the CRM also presented for the Development-alone. As detailed above for gannet, option 2 of the CRM uses the generic flight height data from Johnston *et al.,* (2014a,b), whilst option 1 uses the site-specific flight height data, as collected during baseline surveys of the Survey Area[9] (*Appendix 11C*). An avoidance rate of 98.9 per cent was used with both CRM options. Thus, the approach in relation to CRM options and avoidance rate was in accordance with the Scoping Opinion and followed the available Statutory Nature Conservation Body (SNCB) advice (SNCBs, 2014).

117 In terms of designs for the Wind Farm, the worst-case scenario for kittiwake collision risk was represented by the 40 WTG design, which is detailed in *Appendix 11C.* Therefore, it is the collision estimates from this design that are presented in this report and used to inform the AA. For the in-combination assessment, both the 2014 and 2017 designs of the other three Forth and Tay wind farms were considered in relation to collision risk. The 2014 design represented the worst-case for each proposed development and is used for the in-combination assessment, although the in-combination collision estimates as calculated using

the 2017 designs for these proposed developments are also presented. The 2017 designs for the other three Forth and Tay wind farms were based on the information provided by the respective developers. Full details of the CRM methods, inputs and resulting estimates are provided in *Appendix 11C*.

118 The Development-alone and in-combination CRM predictions calculated for the breeding period were apportioned between the different SPA and non-SPA colonies, as outlined above and detailed in *Appendix 11B*. The apportioning calculations were undertaken separately for the Development Area and two kilometre buffer, and for Neart na Gaoithe (plus buffer) and Seagreen Alpha and Bravo combined (plus buffer). The two Seagreen sites were combined for the purposes of the apportioning calculations because they are contiguous along their longest boundary. On the basis of these calculations, the percentage of the breeding period impacts to kittiwakes from the Development and each of the other three Forth and Tay wind farms attributed to the Forth Islands SPA population were as follows:

- The Development – 21.0 per cent
- Neart na Gaoithe – 67.9 per cent
- Seagreen Alpha and Bravo – 9.1 per cent

119 Collision estimates were apportioned to age classes on the basis of the plumage characteristics of kittiwakes recorded during the ‘at-sea’ baseline surveys for the Survey Area[9] (*Appendix 11A*) and for each of the other Forth and Tay wind farms (*Appendix 11C*). Thus, apportioning to age classes was based upon data specific to each wind farm. The number of adult collisions during the breeding period was also amended according to an assumed 10 per cent sabbatical rate amongst the breeding adult birds, as advised in the Scoping Opinion (*Appendix 11C).*

120 Development-alone collision estimates were produced by summing the breeding period estimate with the estimates derived for the autumn and spring passage periods (as calculated using the amended BDMPS approach – see above).

121 In-combination collision estimates were also produced by summing the breeding period estimate with the estimates derived for the autumn and spring passage periods, and were undertaken for the following scenarios:

- The Development with the worst-case of the 2014 and 2017 designs for each of the other three Forth and Tay wind farms;
- The Development with the 2017 designs for each of the other three Forth and Tay wind farms; and
- The Development with the worst-case of the 2014 and 2017 designs for each of the other three Forth and Tay wind farms, and the passage period estimates from the other wind farms in the UK North Sea.

122 In addition, qualitative consideration was given to the breeding period collisions arising from other wind farms within mean maximum foraging range of the Forth Islands SPA.

<u>*Estimated collision impacts*</u>

Development-alone

123 The predicted impacts on the Forth Islands SPA kittiwakes from the Development-alone were small, and mostly on the breeding adult population, with a predicted seven adults and one sub-adult per annum estimated to collide by option 2 of the CRM (Table 4.6). The estimated collision mortality was essentially limited to the breeding period (with only fractions of a bird estimated to collide during passage periods. The predicted number of collisions from the Development-alone on breeding adult birds is small compared with the current (9,326 individuals) and citation (16,800 individuals) population sizes (representing 0.08 per cent and 0.04 per cent of these population sizes, respectively).

124 The breeding period collision estimates for kittiwake from option 1 of the CRM were very low (*Appendix 11C*). Following apportioning and rounding to the nearest integer they equated to zero collisions for the Forth Islands SPA population (Table 4.6). As detailed in *Appendix 11C*, this difference results from the lower percentage of kittiwakes estimated to be at PCH by the site-specific data than by the generic data (with this difference most pronounced during the breeding period). The site-specific flight height estimates are based upon a large sample-size and there is relatively strong statistical support for the observed differences in the site-specific and generic flight height estimates (*Appendix 11C*). Furthermore, the difference between the site-specific and generic estimates is such as to make systematic bias in the recording of the kittiwake flight heights during the baseline surveys a highly unlikely explanation for this difference (*Appendix 11C*), whilst it has been established that between-site variability in kittiwake flight heights is high (Johnston *et al.,* 2014a,b).

125 Consequently, it is considered likely that the use of the option 2 CRM will overestimate the Development-alone collisions and will result in a highly precautionary assessment.

Table 4.6 Estimated collision impacts from the Development-alone on the kittiwake population at Forth Islands SPA. Estimates based on a 98.9% avoidance rate.

Model option	Seasonal period	Estimated number of collisions	
		Breeding adults[1]	Sub-adult birds[2]
2	Breeding	7	1
	Autumn passage[3]	0.1	0.1
	Spring passage[3]	<0.1	<0.1
1	Breeding	0	0
	Autumn passage[3]	0.1	0.1
	Spring passage[3]	<0.1	<0.1

[1]The number of adult collisions during the breeding period is reduced by 10 % to account for an assumed 10 % sabbatical rate amongst the adults (as advised in the Scoping Opinion).
[2]Juveniles are not distinguished within the sub-adult age class because they were only recorded in the data from the baseline surveys for the Development and are also not distinguished in the collision estimates from the other UK North Sea wind farms (*Appendix 11B*, Royal HaskoningDHV *et al.,* 2015).
[3]Passage period collision estimates presented to 1 decimal place because of the nature of the apportioning calculation (*Appendix 11B*).

In-combination

126 The estimated in-combination collisions for the Development with the other Forth and Tay wind farms were approximately three to five times higher than for the Development-alone, depending on whether the 2014 or 2017 designs of the other wind farms were considered (Table 4.7). The 2014 designs were the worst-case for each of the other Forth and Tay wind farms, and these all gave similar or higher collision estimates than those associated with the Development. The 2017 design for Neart na Gaoithe gave substantially lower collision estimates than the 2014 design for this wind farm (with consequent reductions in the in-combination estimate for this scenario), but the reductions between the 2014 and 2017 designs for each of the Seagreen sites were limited to fractions of a bird during the breeding period and did not affect the collision estimate (Table 4.7).

127 As with collision impacts from the Development-alone, the vast majority of the collisions were attributed to breeding adults in the breeding period (29 and 23 per annum for the 2014 and 2017 design scenarios, respectively), with the Neart na Gaoithe wind farm accounting for the largest percentage of these (35 per cent) in the 2014 design scenario but the smallest percentage (17 per cent) in the 2017 design scenario. The estimated in-combination collisions of breeding adults from the Forth and Tay wind farms remains relatively small compared to the current and citation SPA population size, at 0.33 and 0.26 per cent of the current population size (for the 2014 and 2017 design scenarios, respectively) and 0.18 and 0.14 per cent of the citation population size (for the 2014 and 2017 design scenarios, respectively).

Table 4.7 In-combination collisions estimates for the Forth Islands SPA kittiwake population for the Development and the other three Forth and Tay wind farms, for both the 2014 and 2017 designs of the other Forth and Tay wind farms.

Wind farm	Seasonal period	Estimated number of collisions (based on option 2 with a 98.9 % avoidance rate)			
		2014 designs for other developments and 2017 for the Development		2017 designs for other developments and the Development	
		Breeding adults[1]	Sub-adults[2]	Breeding adults[1]	Sub-adults[2]
Inch Cape[3]	Breeding	7	1	7	1
Neart na Gaoithe		10	1	4	0
Seagreen Alpha		6	0	6	1
Seagreen Bravo		6	0	6	0
Inch Cape[3]	Autumn passage[4]	0.1	0.1	0.1	0.1
Neart na Gaoithe		0.2	0.1	0.1	<0.1
Seagreen Alpha		0.4	0.2	0.4	0.2
Seagreen Bravo		0.2	0.1	0.2	0.1
Inch Cape[3]	Spring passage[4]	<0.1	<0.1	<0.1	<0.1
Neart na Gaoithe		<0.1	<0.1	<0.1	<0.1
Seagreen Alpha		0.2	0.1	0.2	0.1
Seagreen Bravo		0.3	0.1	0.3	0.1
TOTAL	**All seasons combined[5]**	**31**	**3**	**24**	**2**

[1]The number of adult collisions during the breeding period is reduced by 10 % to account for an assumed 10 % sabbatical rate amongst the adults (as advised in the Scoping Opinion).
[2]Sub-adult is used because juveniles were distinguished from the sub-adult age class only in the data from the baseline surveys for the Development and were also not distinguished in the collision estimates from the other UK North Sea wind farms (*Appendix 11B*, Royal HaskoningDHV *et al.,* 2015).
[3]Only the 2017 design is considered for the Development, with collision estimates as in Table 4.6.
[4]Passage period collision estimates presented to 1 decimal place because of the nature of the apportioning calculation (*Appendix 11B*).
[5]Totals may differ by a small amount from the summed numbers in the above table cells due to rounding errors.

128 The final in-combination scenario that was considered involved the collision estimates for the Development with the 2014 designs for each of the other three Forth and Tay wind farms (the 2014 design being the worst-case for each of these wind farms), plus the passage period

collision estimates from other wind farms in the UK North Sea. The inclusion of the collision estimates from the other UK North Sea wind farms substantially increased the impacts during both passage periods, although the combined passage period collisions of adult birds still represented only 21 per cent of the total adult collisions (Table 4.8).

129 Overall, the total predicted in-combination collision mortality to adult kittiwakes from the Forth Islands SPA was 37 birds per annum, when the worst-case design for the other Forth and Tay wind farms was assumed and when passage period collision estimates from other UK North Sea wind farms were included (Table 4.8). This remains a relatively small proportion of the Forth Islands SPA population size currently (0.40 per cent) and at citation (0.22 per cent).

Table 4.8 Estimated in-combination collisions for the Forth Islands SPA kittiwake population for the Development and the 2014 designs of the other three Forth and Tay wind farms (as derived from Table 4.7)[1] combined with the passage period collisions from other UK North Sea wind farms.

Wind farms	Seasonal period	Estimated number of collisions	
		Breeding adults[2]	Sub-adult birds[3]
Forth and Tay	Breeding	29	2
Forth and Tay	Autumn passage[4]	0.9	0.5
Other UK North Sea		2.9	1.3
Total autumn passage		**3.8**	**1.8**
Forth and Tay	Spring passage[4]	0.6	0.2
Other UK North Sea		3.4	1.5
Total spring passage		**4.0**	**1.8**
TOTAL	**All seasons**	**37**	**6**

[1]The 2014 design represents the worst-case of the 2014 and 2017 designs for each of the other three Forth and Tay wind farms.
[2]The number of adult collisions during the breeding period is reduced by 10 % to account for an assumed 10 % sabbatical rate amongst the adults (as advised in the Scoping Opinion).
[3]Juveniles are not distinguished within the sub-adult age class because they were only recorded in the data from the baseline surveys for the Development and are also not distinguished in the collision estimates from the other UK North Sea wind farms (*Appendix 11B*, Royal HaskoningDHV *et al.,* 2015).
[4]Passage period collision estimates presented to 1 decimal place because of the nature of the apportioning calculation (*Appendix 11B*) and totals may differ by a small amount from the summed numbers in the above cells due to rounding errors.

<u>Predicted displacement impacts alone and in-combination</u>

Estimation of impacts

130 The SNCB matrix approach (SNCBs, 2017) provided the main basis for estimating impacts from displacement (as advised in the Scoping Opinion[13]), and was used to estimate the additional mortality attributable to the Forth Islands SPA kittiwake population as a result of displacement (and barrier effects) during the breeding period. Following the advice of the Scoping Opinion, the mortality from displacement was calculated using the peak breeding period population size, averaged over the two years of survey, for the Development Area and two kilometre buffer (combining birds on the water and in flight). A displacement rate of 30 per cent was applied to this mean peak estimate, with two per cent of the displaced birds assumed to die. The estimated mortality from displacement, as calculated by the matrix approach, was apportioned to the Forth Islands SPA population and across the population age classes in the same way as for the breeding period collision estimates (see above).

131 For the Development-alone, the mean peak population estimate was 3,866 birds, of which 93 per cent were adults (3,595 birds) and 21.0 per cent were from the Forth Islands SPA (755 birds) and 10 per cent were birds on sabbatical (giving 680 adult birds from the Forth Islands SPA population). Applying the advised 30 per cent displacement rate and two per cent mortality rate, gives an estimated mortality of four adult birds per annum (Table 4.9). This predicted displacement mortality from the Development-alone on breeding adult birds is very small compared with the current (9,326 individuals) and citation (16,800 individuals) population sizes (0.04 per cent and 0.02 per cent, respectively).

[13] Letter of 03 November 2017 from MS-LOT to ICOL.

Table 4.9 Displacement matrix for adult kittiwakes from the Forth Islands SPA in the breeding season. Based on mean peak abundance apportioned to adult birds from the Forth Islands SPA. Recommended displacement rate and mortality rate is shown in green, and the resulting displacement mortality in dark green.

		DISPLACEMENT										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
MORTALITY	0%	0	0	0	0	0	0	0	0	0	0	0
	1%	0	1	1	2	3	3	4	5	5	6	7
	2%	0	1	3	4	5	7	8	10	11	12	14
	3%	0	2	4	6	8	10	12	14	16	18	20
	4%	0	3	5	8	11	14	16	19	22	24	27
	5%	0	3	7	10	14	17	20	24	27	31	34
	10%	0	7	14	20	27	34	41	48	54	61	68
	15%	0	10	20	31	41	51	61	71	82	92	102
	20%	0	14	27	41	54	68	82	95	109	122	136
	30%	0	20	41	61	82	102	122	143	163	184	204
	40%	0	27	54	82	109	136	163	190	218	245	272
	50%	0	34	68	102	136	170	204	238	272	306	340
	60%	0	41	82	122	163	204	245	286	326	367	408
	70%	0	48	95	143	190	238	286	333	381	428	476
	80%	0	54	109	163	218	272	326	381	435	490	544
	90%	0	61	122	184	245	306	367	428	490	551	612
	100%	0	68	136	204	272	340	408	476	544	612	680

132 The displacement matrix predictions for the Development in-combination with the other three Forth and Tay wind farms were apportioned between SPA colonies and between age classes (Table 4.10). The predicted in-combination mortality from displacement of Forth Islands SPA kittiwakes during the breeding period is more than three times greater than for the Development-alone, with a total estimated mortality of 14 breeding adults and one sub-adult bird (Table 4.10). This level of additional mortality remains small compared with the current (9,326 individuals) and citation (16,800 individuals) population sizes (with the adult mortality representing 0.15 per cent and 0.08 per cent, respectively).

Table 4.10 Estimated mortality of Forth Islands SPA kittiwakes in the breeding period as a result of displacement from the Development in-combination with the other three Forth and Tay wind farms.

Project	Mean peak estimate (individuals)	Adult proportion[1]	SPA proportion	Sabbatical proportion	Additional mortality	
					Breeding adults	Sub-adults
Inch Cape	3,866	0.93	0.210	0.10	4.1	0.3
Neart na Gaoithe	2,164	0.93	0.679		7.4	0.6
Seagreen Alpha	2,220	0.93	0.091		1.0	0.1
Seagreen Bravo	2,707	0.95	0.091		1.2	0.1
TOTAL	10,957	-	-	-	13.7	1.1

[1]Based on data from site surveys (*Appendix 11A* and *11C*).

133 The Scoping Opinion from MS-LOT requested that a qualitative assessment of displacement of kittiwakes in the non-breeding period was provided. As discussed above, evidence from geo-locator tracking of kittiwakes from colonies around the North Atlantic have shown that kittiwakes occur across a large sea area from the Barents Sea to Canada (Frederiksen *et al.,* 2011). Details from Frederiksen *et al.,* (2011) predicted that almost half of the winter population of kittiwakes in the North Sea were from colonies around the North Sea. So, it seems likely that half of the adult kittiwakes from the Forth Islands SPA colonies also spend the non-breeding seasons in the North Sea. However, the remaining (approximately) half of the birds winter in areas from the Celtic-Biscay shelf to eastern Canada. It is also clear that birds from the Isle of May colony spread out using increasingly large sea areas as the winter progresses. Therefore, from these data, it is reasonable to conclude that kittiwakes from the Forth Islands SPA are not dependent on any particular area and use large areas of sea, and therefore the likely effects of displacement from offshore wind farms in the North Sea, or elsewhere, during the non-breeding period are likely to have little or no effect on the Forth Islands SPA population.

Alternative approaches to estimating impacts

134 The Scoping Opinion also advised that the impacts from displacement and barrier effects should be estimated using individual-based modelling approaches, to provide context to the estimates produced by the SNCB matrix approach for each of the SPA populations of relevance (i.e. using the SeabORD model and the earlier Searle *et al*., 2014 model).

135 At the time of undertaking the work for the assessment, the SeabORD model had not yet been published[14]. Therefore, ICOL commissioned the CEH to run the unpublished SeabORD model in relation to the Development, alone and in-combination with the other three Forth and Tay wind farms. Additionally, consideration was given to the estimates from the existing Searle *et al.,* (2014) model. The details of this modelling and of the comparisons between the impacts predicted by the respective methods are provided in *Appendix 11D: Estimation of the Development-alone and Cumulative Effects from Displacement and Barrier Effects*.

136 Considerable variability was associated with the predicted impacts from the individual-based modelling approaches, with the uncertainties estimated for the SeabORD predictions being large and the predicted impacts for some SPA populations showing marked differences between models and according to the underpinning model assumptions. The SeabORD estimates were invariably greater than those produced by the SNCB matrix for the Forth Islands SPA populations for both the Development-alone and in-combination (by an order of magnitude in most cases), but this pattern was not consistent across other SPA populations.

137 Extrapolations from the SeabORD estimates of adult mortality from displacement and barrier effects suggested that unrealistically high rates of displacement and/or mortality amongst displaced birds were required to match the population estimates recorded on the Development Area and two kilometre buffer (as well as on the other Forth and Tay wind farm sites). Similarly, based on the rates of displacement and of mortality amongst displaced birds advised in the Scoping Opinion, the use of the Development Area (and the other Forth and Tay wind farms) would have to be unrealistically high amongst some SPA populations (notably from the Forth Islands SPA) to match the adult mortality estimated by SeabORD.

138 The level of knowledge and understanding of the biology underpinning the effects of displacement and barrier effects on breeding seabird populations at the current time may be insufficient to enable the reliable prediction of impacts using these sophisticated modelling approaches. In contrast to the SeabORD model, the matrix approach relies upon qualitative consideration of what is likely to be biologically plausible in terms of rates of displacement and of mortality amongst displaced birds, with there being broad consensus on these rates amongst the range of expertise on which the Scoping Opinion relied. The matrix approach combines this information with (precautionary) estimates of bird abundance from the actual sites of interest (*Appendix 11D*). Given this, it is considered that the matrix approach remains a more suitable method for estimating impacts from displacement and barrier effects at the current time.

<u>Predicted combined collision risk and displacement impacts alone and in-combination</u>

139 The combined predicted impacts from collisions and displacement were assumed to be additive. Thus, the combined impact from the Development-alone was an additional mortality of 11 adult birds per annum (and approximately one sub-adult bird per annum) from the Forth Islands SPA (Table 4.11). Combining collision and displacement impacts for the in-combination scenario comprising the Development with the other three Forth and Tay wind farms gave an

[14] The SeabORD model remains unpublished at the time of writing.

additional mortality of 45 adult and four sub-adult birds per annum, whilst the worst-case in-combination scenario (which also incorporated the passage period collisions from the other UK North Sea wind farms) gave an overall additional mortality of 51 adult and seven sub-adult birds per annum (Table 4.11).

140 These mortality estimates for the different in-combination scenarios with impacts from collisions and displacement combined represent relatively small proportions of the current (9,326 individuals) and citation (16,800 individuals) population sizes (at 0.48 – 0.55 per cent and 0.27 – 0.30 per cent, respectively, for the adult mortality).

Table 4.11 Combined predicted collision plus displacement mortality to the Forth Islands SPA kittiwake population for the Development-alone and two in-combination scenarios. Both in-combination scenarios use the 2014 designs for each the other three Forth and Tay wind farms.

Scenario	Season	Breeding adults[1]	Sub-adults[1]
Development-alone	Breeding	11	1
	Autumn passage[2]	0.1	0.1
	Spring passage[2]	<0.1	<0.1
In-combination – Development with other Forth and Tay wind farms	Breeding	43	3
	Autumn passage[2]	0.9	0.5
	Spring passage[2]	0.6	0.2
In-combination – Development with other Forth and Tay wind farms plus passage collisions from other UK North Sea wind farms	Breeding	43	3
	Autumn passage[2]	3.8	1.8
	Spring passage[2]	4.0	1.8

[1]The estimated additional mortality values are derived from those provided in Tables 4.8 and 4.10 but may differ slightly to the summed totals from these earlier tables due to rounding errors.
[2]Passage period collision estimates presented to 1 decimal place because of the nature of the apportioning calculation (*Appendix 11B*).

__Impacts from other wind farms within foraging range__

141 As detailed above for the Forth Islands SPA gannet population, several offshore wind farms other than Neart na Gaoithe and Seagreen Alpha and Bravo occur within mean maximum foraging range of breeding kittiwakes from the Forth Islands SPA (as defined by Thaxter *et al.,* 2012). The advice from the Scoping Opinion was to consider the breeding season effects from these wind farms qualitatively.

142 These wind farms are:

- OREC, Levenmouth Demonstration Turbine (was Fife Energy Park Offshore Demonstration Wind Turbine); and
- ForthWind Demonstration Array.

143 The kittiwake collision estimate associated with the OREC, Levenmouth Demonstration Turbine, was for 1.3 birds per annum (with all kittiwakes at this site being recorded during the breeding period), whilst for the ForthWind Demonstration Array it was 0.4 (Arcus, 2017, ForthWind, 2015). These estimates are not apportioned to SPAs but even if it is assumed that they are attributable to adult birds from the Forth Islands SPA population it will have virtually no effect on the estimated in-combination impacts and would not affect the conclusions of the assessment.

144 Similarly, any impacts from displacement and barrier effects from these two wind farms will be minor (given that they comprise single WTGs only) and will not affect the conclusions of the assessment.

Population Viability Analysis of the kittiwake population

145 PVA was used to determine the effects of the predicted collision and displacement impacts from the Development-alone, and in-combination, on the Forth Islands SPA kittiwake population. Following the advice of the Scoping Opinion, PVAs were produced both for collisions only, and for collisions plus displacement. For the purposes of assessing the population-level impacts on the basis of the PVA, all collision estimates were derived from option 2 of the CRM, whilst the in-combination impacts used the 2014 designs of the other three Forth and Tay wind farms (as these represented the worst-case for each of these wind farms – Table 4.8). Estimates of displacement impacts were as derived by the SNCB matrix (Table 4.10).

146 The Forth Islands SPA kittiwake population model produced for the current assessment was a stochastic, density independent, model based on a Bayesian state-space modelling framework. It was adapted from earlier Forth Islands SPA kittiwake population models (Freeman *et al.,* 2014, Jitlal *et al.,* 2017), updated according to recently available population and demographic data. Further details of the model are provided in *Appendix 11E*.

147 The predicted population trends under baseline conditions (i.e. without wind farm impacts) were projected over both 28 and 53-year timescales. Additional mortality within the PVA was not incorporated until after year three of the projection (giving 25 and 50-year impact periods) to provide a more realistic representation of the likely population status at the time when the potential impacts will begin to arise. The additional mortality was incorporated on the basis of the percentage point change to the annual mortality of adult and sub-adult birds.

148 Outputs from the PVA were summarised according to the median predicted population sizes at the end of the projection period, and the three metrics which the Scoping Opinion advised should be used for the interpretation and which are defined above in the section on the Forth Islands SPA gannet population.

149 The PVA projected continuing population decline for the Forth Islands SPA kittiwake population with and without impacts for the Development-alone and in-combination. The median end population size for each modelled impact (Table 4.12) was lower than the current SPA population size (9,326 individuals), and the projected population size after 50 years was always smaller than that at 25 years.

150 The PVA metrics (Table 4.13) show that for the Development-alone the counterfactual of population size indicated small reductions in end population size after both 25 years and 50 years of impact (with the values being 0.966 and 0.950 for collisions only and collisions and displacement combined, respectively, after 50 years of impact – Table 4.13). The decrease in annual population growth rate was minimal (with counterfactual values of 0.999 for both collisions only and collisions and displacement combined), whilst the centile values for both collisions only and collisions and displacement were 49 even after 50 years of impact (indicating very considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period). It should also be borne in mind that these metrics derive from PVAs based upon option 2 collision estimates, which are an order of magnitude higher than those generated by the option 1 CRM. As outlined in *Appendix 11C,* there are good reasons for considering the site-specific flight heights (and hence the option 1 collision estimates) to be representative of the kittiwakes within the Development Area and two kilometre buffer.

151 In terms of the in-combination, as expected, the population-level impacts were greatest for the scenario incorporating the other three Forth and Tay wind farms plus the passage period collision estimates from the other UK North Sea wind farms (Table 4.13). These gave modest scale reductions of up to 22 per cent in end population size after 50 years of impact (values of 0.828 and 0.776 for collisions only and collisions and displacement combined, respectively) but considerably smaller reductions of less than 15 per cent after 25 years of impact (values of 0.909 and 0.878 for collisions only and collisions and displacement combined, respectively). The reductions in annual population growth rate remained relatively small (with counterfactual values of 0.996 and 0.995 for collisions only and collisions and displacement combined), whilst the centile values were in the mid 40s (Table 4.13), indicating considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a reasonable likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period.

152 The population projections in all cases showed that the end population size was much less than the population size at citation (16,800 pairs). However, for the Development-alone the estimated difference in population size after 25 years and 50 years was only 50 pairs and the population size was still sufficiently large to allow recovery at 1,550 pairs and 700 pairs respectively. This is also the case for the in-combination scenario which gives greatest population-level impacts, for which the population sizes after 25 and 50 years of impact were estimated to be 1,400 and 550 pairs, respectively (Table 4.12).

153 The primary reasons for population decline in kittiwakes in the North Sea and the Forth and Tay region (including the Forth Islands SPA) have been suggested as fisheries management

and climate change (Frederiksen *et al.,* 2004). With fisheries now more appropriately managed in the Forth and Tay region (a sandeel fishery ban has been in place since 2000), it may be that the recent increases in population size in the Forth Islands SPA may be sustained. However, changes caused by climate change, that are also hypothesised to be affecting the Forth Islands SPA kittiwake population, may still be affecting the population in 25 and 50 years. The primary management option to prevent climate change affecting the Forth Islands SPA kittiwake population will be through global initiatives to mitigate greenhouse gas emissions (e.g. 21st Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC) (COP21)). Therefore, while the conservation status of the Forth Islands SPA population is projected to be in unfavourable condition the effects of the Development-alone, and in-combination, will not result in any important change to this, nor prevent recovery in the event of the factors causing population decline being reversed.

Table 4.12 Projected end population sizes of the Forth Islands SPA kittiwake population after 25 and 50 years for baseline, Development-alone and two in-combination scenarios in relation to collision impacts and collision plus displacement impacts.

Impacts	Scenario	Percentage point change in mortality		Median number of breeding females (5th – 95th centiles)	
		Adults	Sub-adults	25 years	50 years
No impacts	Baseline	0	0	1,600 (400 – 8,100)	750 (50 – 10,650)
Collisions only	Development-alone	0.077	0.009	1,550 (350 – 8,050)	700 (50 – 10,300)
	In-combination – Development with other Forth and Tay wind farms	0.333	0.042	1,450 (350 – 7,600)	650 (50 – 9,250)
	In-combination – Development with other Forth and Tay wind farms plus passage collisions from other UK North Sea wind farms	0.401	0.080	1,450 (350 – 7,450)	600 (50 – 8,900)
Collisions and displacement combined	Development-alone	0.121	0.014	1,550 (350 – 7,950)	700 (50 – 10,100)
	In-combination – Development with other Forth and Tay wind farms	0.480	0.057	1,400 (350 – 7,350)	600 (50 – 8,700)

Impacts	Scenario	Percentage point change in mortality		Median number of breeding females (5th – 95th centiles)	
		Adults	Sub-adults	25 years	50 years
	In-combination – Development with other Forth and Tay wind farms plus passage collisions from other UK North Sea wind farms	0.548	0.095	1,400 (350 – 7,200)	550 (50 – 8,350)

Table 4.13 PVA metrics for the Forth Islands SPA kittiwake population after 25 and 50 years for the Development-alone and two in-combination scenarios in relation to collision impacts and collision plus displacement impacts.

Impacts	Scenario	Counterfactual of end population size		Counterfactual of population growth rate[1]	Centile of baseline population matching the median of the impacted population	
		25 years	50 years	25 and 50 years	25 years	50 years
No impact	Baseline	1.000	1.000	1.000	50	50
Collisions only	Development-alone	0.982	0.966	0.999	49	49
	In-combination – Development with other Forth and Tay wind farms	0.926	0.861	0.997	47	46
	In-combination - Development with other Forth and Tay wind farms plus passage collisions from other UK North Sea wind farms	0.909	0.828	0.996	46	45
	Development-alone	0.973	0.950	0.999	49	49

Impacts	Scenario	Counterfactual of end population size		Counterfactual of population growth rate[1]	Centile of baseline population matching the median of the impacted population	
		25 years	50 years	25 and 50 years	25 years	50 years
Collisions and displacement combined	In-combination – Development with other Forth and Tay wind farms	0.896	0.807	0.996	45	44
	In-combination - Development with other Forth and Tay wind farms plus passage collisions from other UK North Sea wind farms	0.878	0.776	0.995	44	43

[1]The value of this metric does not vary according to the length of the projection period.

Conclusion

154 The predicted impacts from the Development-alone and in-combination were small, and the outputs from the PVA indicate relatively small predicted population-level effects. Based upon the PVA projections, the Conservation Objective of the SPA, to maintain the "population of the species as a viable component of the site", will not be met even without the impacts from the Development-alone and in-combination. However, the predicted impacts of the Development-alone and in-combination are sufficiently small that it is considered they will effectively not contribute to accelerating the rate of the ongoing population decline, nor will they prevent population increase should environmental conditions become more favourable for kittiwakes. Accounting for the impacts from the other wind farms within foraging range of the Forth Islands SPA which were considered qualitatively does not affect this conclusion. It should therefore be possible for the CA to conclude, beyond reasonable scientific doubt, that the Development-alone, and in-combination, will have no adverse effect on site integrity due to the effects on the kittiwake population.

4.1.3 Herring Gull Population

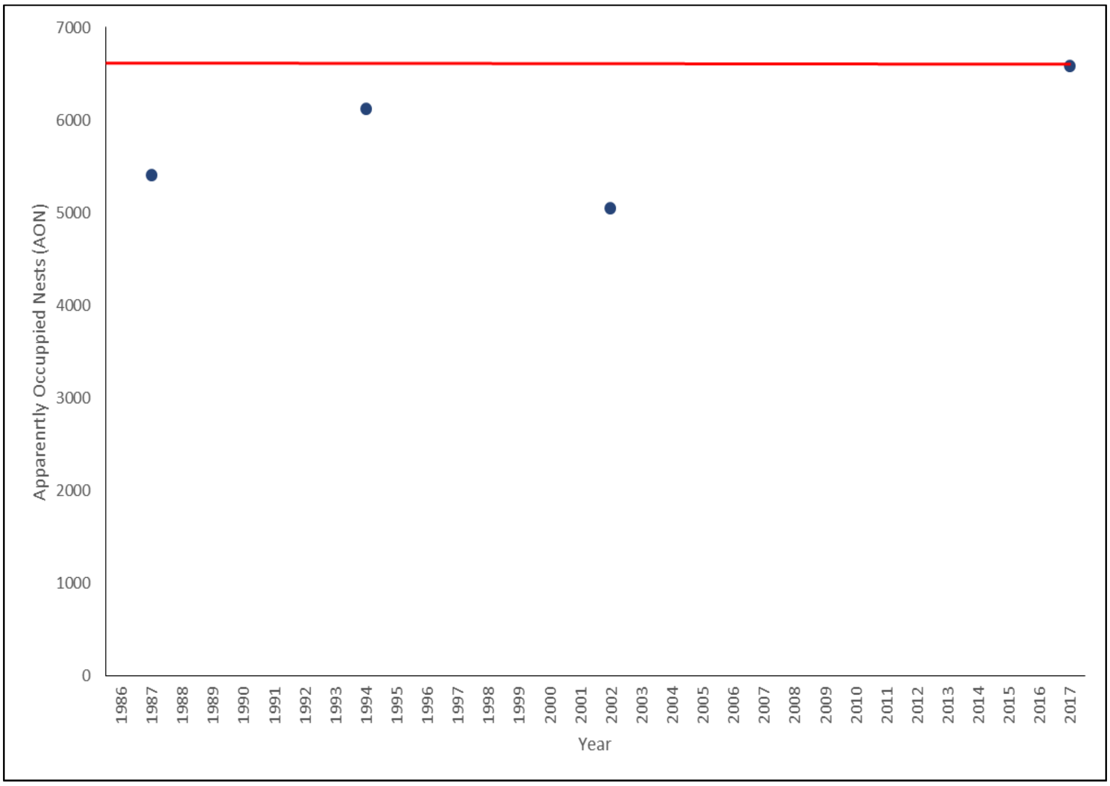
155 In their Scoping Opinion, MS-LOT stated that SNH recommend providing updated CRM results for herring gull in the breeding and non-breeding seasons. In-combination assessment was recommended at the Forth and Tay regional scale only.

156 Herring gulls are widespread in the northern hemisphere, and breed across a variety of habitats, from urban buildings to coastal seabird colonies. Herring gulls also forage across a

wide range of habitats, from human environments to coastal habitats. In particular, they often feed on discards from fishing boats, especially in winter.

157 The Forth Islands SPA herring gull population occurs on several islands in the Firth of Forth. The largest colony currently occurs on the Isle of May, with smaller colonies on Craigleith, Bass Rock, Fidra, Inchmickery and The Lamb. The Isle of May colony is about 47 per cent of the SPA total. Counts of the herring gull population across the whole SPA are only available for three years since 1985, with the 2017 estimate provided in the SNH scoping advice being from an amalgam of years (but with 97 per cent of the estimate deriving from counts in 2016 and 2017)[11]. While the data that are available for the total SPA count suggest that the colony population size has not exceeded the citation size (6,600 pairs) since the SPA was designated (Figure 4.3), the colony on Craigleith alone numbered 6,000 pairs in 1989 (when count data were available for a sample of the SPA colonies only). Count data from the largest colony in the SPA (Isle of May) has increased since the SPA was designated, and is currently 4,200 pairs (in 2014). The SPA population estimate for 2017, at 6,580 pairs, is close to the citation population size. Count data are from the JNCC SMP database[10], with the 2017 count as provided in the SNH scoping advice.

Figure 4.3 Changes in herring gull population size at the Forth Islands SPA between 1986 and 2017. The red line shows the population size at designation (6,600 pairs).



Potential impacts on the herring gull population

158 The Development Area, OfTW and associated buffers[6] do not overlap with the Forth Islands SPA. Consequently, the potential impacts on its herring gull population will only occur as a

result of individuals from the colony occurring in the Development Area. The impacts of concern identified in the Scoping Opinion from MS-LOT were from collisions of herring gulls with operational WTG blades which could impact on the population from the Forth Islands SPA. Data on herring gull from the boat-based surveys of the Development Area and two kilometre buffer indicate that there is a potential for collisions to occur. From published information on herring gull foraging ranges (Thaxter *et al.,* 2012) it is likely that breeding herring gull from the Forth Islands SPA will occur within the Development Area and two kilometre buffer, as well as within the proposed development areas of other wind farm proposals in the Forth and Tay. The breeding period of herring gull is defined as April to August, following the advice of the Scoping Opinion.

159 In the non-breeding season adult herring gulls in Great Britain are largely sedentary, with relatively short local movements only (Wernham *et al.,* 2002). However, there is an influx of breeding birds of Scandinavian breeding sub-species, *L. argentatus* (Coulson *et al.,* 1984). The apportioning of impacts to the Forth Islands SPA herring gull population in the breeding and non-breeding periods is detailed in *Appendix 11B*.

Predicted collision impacts alone and in-combination

Estimation of impacts

160 CRMs were undertaken using the Band (2012) model to predict the number of birds at risk from collisions both for the Development-alone and in-combination. Following the Scoping Opinion from MS-LOT, the assessment for herring gull was based on option 3 of the CRM, but with outputs from options 1 and 2 of the CRM also presented for the Development-alone. Option 3 of the CRM uses the modelled flight height distributions based on the generic flight height data from Johnston *et al.,* (2014a,b), whilst options 1 and 2 assume uniform flight height distributions based on site-specific and generic flight height data, respectively (*Appendix 11C*). An avoidance rate of 99.0 per cent was used with the option 3 CRMs and of 99.5 per cent with the options 1 and 2 in accordance with the Scoping Opinion and following the available SNCB advice (SNCBs, 2014).

161 In terms of the designs for the Wind Farm, the worst-case scenario for herring gull collision risk was represented by the 72 WTG design, so differing in this respect from gannet and kittiwake (*Appendix 11C*). Therefore, it is the collision estimates from this design that are presented in this report and used to inform the AA. For the in-combination assessment, both the 2014 and 2017 designs of the other three Forth and Tay wind farms were considered in relation to collision risk. The 2014 design represented the worst-case for each proposed development and is used for the in-combination assessment, although the in-combination collision estimates as calculated using the 2017 designs for these proposed developments are also presented. The 2017 designs for the other three Forth and Tay wind farms were based on the information provided by the respective developers. Full details of the CRM methods, inputs and resulting estimates are provided in *Appendix 11C*.

162 The Development-alone and in-combination CRM predictions calculated for the breeding period were apportioned between the different SPA and non-SPA colonies, as outlined above

and detailed in *Appendix 11B*. The apportioning calculations were undertaken separately for the Development Area and two kilometre buffer, and for Neart na Gaoithe (plus buffer) and Seagreen Alpha and Bravo combined (plus buffer). The two Seagreen sites were combined for the purposes of the apportioning calculations because they are contiguous along their longest boundary. On the basis of these calculations, the percentage of the breeding period impacts to herring gulls from the Development and each of the other three Forth and Tay wind farms attributed to the Forth Islands SPA population were as follows:

- The Development – 45.6 per cent
- Neart na Gaoithe – 81.7 per cent
- Seagreen Alpha and Bravo – 31.8 per cent

163 The above apportioning estimates for the breeding period were also applied to the non-breeding period, which will be precautionary because it does not account for the influx of birds to the UK (and particularly the east coast) from northern European breeding populations (Furness, 2015, *Appendix 11B*).

164 Collision estimates were apportioned to age classes on the basis of the plumage characteristics of herring gulls recorded during the 'at-sea' baseline surveys for the Survey Area[9] (*Appendix 11A*) and for each of the other Forth and Tay wind farms (*Appendix 11C*). Thus, apportioning to age classes was based upon data specific to each wind farm. The number of adult collisions was also amended according to an assumed 35 per cent sabbatical rate amongst the breeding adult birds, as advised in the Scoping Opinion (*Appendix 11C*).

165 Development-alone and in-combination collision estimates were produced by summing the respective breeding and non-breeding period estimates. In-combination collision estimates were undertaken for the following scenarios:

- The Development with the worst-case of the 2014 and 2017 designs for each of the other three Forth and Tay wind farms
- The Development with the 2017 designs for each of the other three Forth and Tay wind farms

166 In addition, qualitative consideration was given to the breeding period collisions arising from other wind farms within mean maximum foraging range of the Forth Islands SPA.

<u>*Estimated collision impacts*</u>

Development-alone

167 The predicted impacts on the Forth Islands SPA herring gulls from the Development-alone were small, with fewer than one bird from the breeding adult age class (0.5) estimated to collide per annum, as estimated by option 3 of the CRM (Table 4.14). The collision estimates for the sub-adult age class were similarly small. The predicted number of collisions per annum from the Development-alone on breeding adult birds was small compared with the current

(13,160 individuals) and citation (13,200 individuals) population sizes (0.005 per cent in both cases).

168 Collision estimates by options 1 and 2 of the CRM were similar to those produced by option 3 (Table 4.14), with the option 2 estimates slightly higher in the non-breeding period and the option 1 estimates slightly lower in both seasonal periods (which was associated with a smaller percentage of birds estimated to be at PCH by the site-specific flight height data – *Appendix 11C*).

Table 4.14 Estimated collision impacts from the Development-alone on the herring gull population at Forth Islands SPA. Estimates based on avoidance rates of 99.0% for option 3 and 99.5% for options 1 and 2.

Model option	Seasonal period	Estimated number of collisions[1]	
		Breeding adults[2]	Sub-adult birds[3]
3	Breeding	0.2	0.1
	Non-breeding	0.3	0.4
2	Breeding	0.2	0.1
	Non-breeding	0.5	0.6
1	Breeding	0.0	0.0
	Non-breeding	0.2	0.2

[1]Collision estimates are presented to 1 decimal place because of the small numbers of total collisions estimated to occur.
[2]The number of adult collisions is reduced by 35 % to account for an assumed 35 % sabbatical rate amongst the adults (as advised in the Scoping Opinion).
[3]Juveniles are not distinguished within the sub-adult age class because they were only recorded in the data from the baseline surveys for the Development.

In-combination

169 The estimated in-combination collisions for the Development with the other Forth and Tay wind farms were six to 10 times higher than for the Development-alone, depending on whether the 2014 or 2017 designs of the other wind farms were considered (Table 4.15). The 2014 designs were the worst-case for each of the other Forth and Tay wind farms (where differences between the designs were apparent), and these all gave similar or higher collision estimates than those associated with the Development. The estimated collisions were slightly higher in the non-breeding than breeding period, although (as stated above) the apportioning of herring gull collisions to SPA populations in the non-breeding period was precautionary.

170 Overall, the total predicted in-combination collision mortality to adult herring gulls from the Forth Islands SPA was five birds per annum (Table 4.15). This is a small proportion of the

current and citation Forth Islands SPA population size (representing 0.04 per cent in both cases). Based on an annual survival rate of 83.4 per cent for adult herring gulls (Horswill and Robinson, 2015), the mortality of adult herring gulls from the Forth Islands SPA population will equate to 2,185 individuals each year in the absence of any wind farm impacts. Therefore, the in-combination collision estimates would represent an increase in the baseline annual adult mortality of 0.24 per cent (which is precautionary, given the approach taken to apportioning collisions to SPA populations in the non-breeding period).

Table 4.15 In-combination collision estimates for the Forth Islands SPA herring gull population for the Development and the other three Forth and Tay wind farms, for both the 2014 and 2017 designs of the other Forth and Tay wind farms.

Wind farm	Seasonal period	Estimated number of collisions (based on option 3 with a 99.0 % avoidance rate)[1]			
		2014 designs for other developments and 2017 for the Development		2017 designs for other developments and the Development	
		Breeding adults[2]	Sub-adults[3]	Breeding adults[2]	Sub-adults[3]
Inch Cape[4]	Breeding	0.2	0.1	0.2	0.1
Neart na Gaoithe		1.2	0.6	0.4	0.2
Seagreen Alpha		0.4	0.3	0.4	0.3
Seagreen Bravo		0.3	0.1	0.3	0.1
Total breeding		**2.2**	**1.1**	**1.4**	**0.8**
Inch Cape	Non-breeding	0.3	0.4	0.3	0.4
Neart na Gaoithe		1.8	1.3	0.7	0.5
Seagreen Alpha		0.5	0.8	0.5	0.8
Seagreen Bravo		0.4	0.6	0.4	0.6
Total non-breeding		**3.1**	**3.1**	**2.0**	**2.4**
TOTAL	**All seasons**	**5.2**	**4.3**	**3.3**	**3.1**

[1]Collision estimates are presented to 1 decimal place because of the small numbers of total collisions estimated to occur and totals may differ by a small amount from the summed numbers in the above cells due to rounding errors.
[2]The number of adult collisions is reduced by 35 % to account for an assumed 35 % sabbatical rate amongst the adults (as advised in the Scoping Opinion).
[3]Juveniles are not distinguished within the sub-adult age class because they were only recorded in the data from the baseline surveys for the Development.
[4]Only the 2017 design is considered for the Development, with collision estimates as in Table 4.14.

Collisions from other wind farms within foraging range

171 As detailed above for the Forth Islands SPA gannet population, several offshore wind farms other than Neart na Gaoithe and Seagreen Alpha and Bravo occur within mean maximum foraging range of breeding herring gulls from the Forth Islands SPA (as defined by Thaxter *et al.,* 2012). The advice from the Scoping Opinion was to consider the breeding season effects from these wind farms qualitatively.

172 These wind farms are the OREC, Levenmouth Demonstration Turbine and the ForthWind Demonstration Array. Although herring gulls are known to occur within the OREC site (and have been recorded flying through the rotor swept area of the WTG – Arcus, 2017), and the collision estimate (for all age classes) for herring gulls at the ForthWind site was six per breeding period (ForthWind, 2015). It is unlikely that many of the birds using these sites derive from the Forth Islands SPA population. This is because of the presence of non-SPA birds, particularly from the increasing numbers of urban nesting birds (Calladine *et al.,* 2006), which may be more likely to occur in the vicinity of these relatively inshore sites.

173 As such, the impacts to the Forth Islands SPA herring gull population from these sites will have little effect on the estimated impacts and would not affect the conclusions of the assessment.

Conclusion

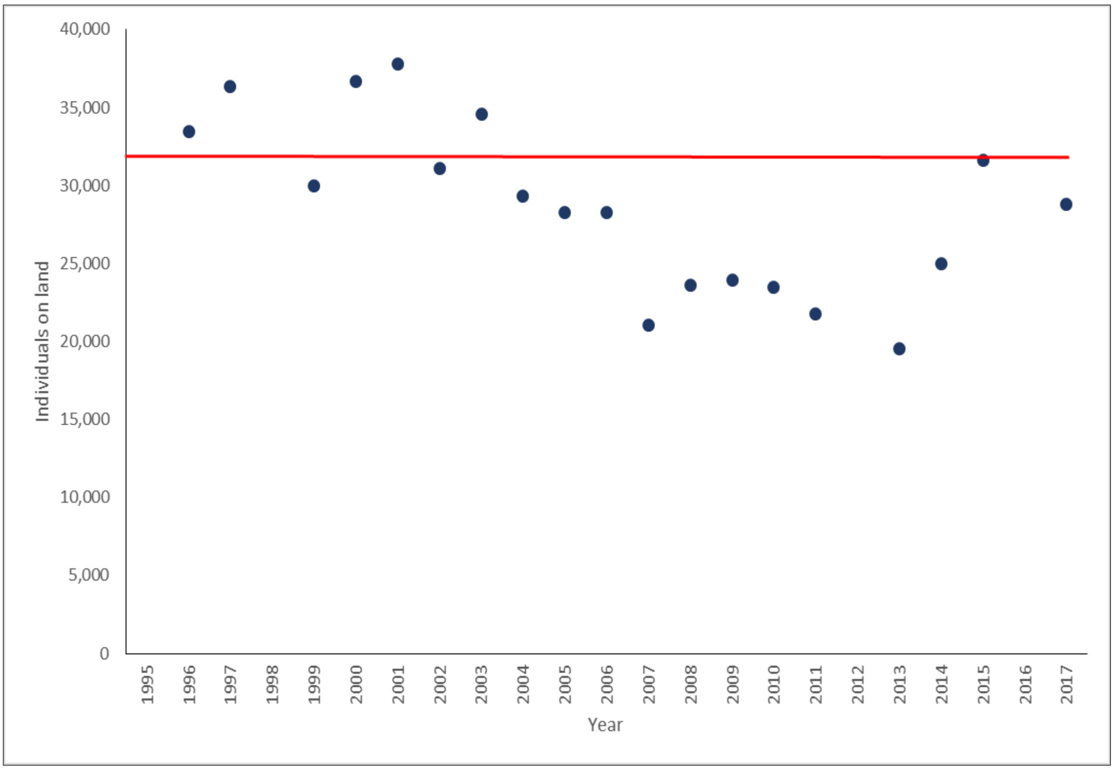
174 The predicted impacts from the Development-alone and in-combination were very small and are considered likely to result in minimal population-level impacts, and consequently PVA was not required to investigate impacts further. The Conservation Objective of the SPA, to maintain the "population of the species as a viable component of the site" would likely be met with or without the impacts from the Development-alone and in-combination. Accounting for the collisions from the other wind farms within foraging range of the Forth Islands SPA which were considered qualitatively does not affect this conclusion. It should therefore be possible for the CA to conclude, beyond reasonable scientific doubt, that the Development-alone, and in-combination, will have no adverse effect on site integrity due to the effects on the herring gull population.

4.1.4 Guillemot Population

175 Guillemots are a colonial nesting seabird that breed in relatively high north latitudes, often with other species of seabird. Guillemot colonies in Europe occur along the Atlantic coast from northern Portugal to the north coast of Scandinavia and Iceland, along the Irish Sea, North Sea and the Baltic Sea coasts. They forage entirely at sea diving for small shoaling fish, particularly *Ammodytidae*, *Clupeidae* and *Gadidae* (Mitchell *et al.,* 2004). In winter, guillemots are widespread across north-west European seas (Stone *et al.,* 1995), although many adults remain in the vicinity of their nest-sites throughout much of the year (Harris *et al.,* 2006) and the Scoping Opinion advises that the assessment for the non-breeding period should be based on the same apportioning as for the breeding period. Such an approach is likely to be precautionary on the basis that during the non-breeding period birds from the SPA breeding populations are likely to be augmented by birds from more northern breeding colonies (Furness, 2015).

176 The Forth Islands SPA guillemot population occurs on several islands in the Firth of Forth. The largest colony occurs on the Isle of May, with smaller colonies on Craigleith, Bass Rock, Fidra and The Lamb. The Isle of May colony is about 68 per cent of the SPA total. The guillemot population size in the SPA declined during the 2000's, but has shown signs of recovery in more recent years (Figure 4.4). The count data shown in Figure 4.4 derive largely from the JNCC SMP database[10], with the 2017 count as provided in the SNH scoping advice[11]. It should be noted that the data shown in Figure 4.4 are the count of individuals on land. This needs to be multiplied by 1.34 to give the estimated number of breeding adults[11] (except in the case of the citation population size which is taken as 32,000 individuals or 16,000 breeding pairs - SNH (2009a)).

Figure 4.4 Guillemot population trend at the Forth Islands SPA between 1996 and 2017. The red line shows the population size at designation (32,000 individuals).



Potential impacts on the guillemot population

177 The Development Area, OfTW and associated buffers[6] do not overlap with the Forth Islands SPA. Consequently, the potential impacts on its guillemot population will only occur as a result of individuals from the colony occurring in the Development Area. In relation to guillemot, the impacts of concern identified in the Scoping Opinion from MS-LOT were from displacement from the Development Area and two kilometre buffer and barrier effects (with the two latter impacts subsequently considered together). From published information on guillemot foraging ranges generally (Thaxter *et al.,* 2012) and tracking from the Isle of May (part of the Forth Islands SPA,) specifically (CEH, 2011), it is very likely that breeding guillemots from the

Forth Islands SPA occur within the Development Area and two kilometre buffer, as well as within the proposed development areas of other wind farms in the Forth and Tay.

178 The breeding period for guillemot is defined as April to mid-August, following the advice of the Scoping Opinion.

<u>Predicted displacement impacts on the guillemot population alone and in-combination</u>

179 The SNCB matrix approach (SNCBs, 2017) was used to estimate the impacts from displacement (and barrier effects) as advised in the Scoping Opinion[13], and was used to estimate the additional mortality attributable to the Forth Islands SPA guillemot population as a result of displacement during both the breeding and non-breeding periods. Following the advice of the Scoping Opinion, the mortality from displacement was calculated using the peak population size, averaged over the two years of survey, for the Development Area and two kilometre buffer (combining birds on the water and in flight), with this undertaken separately for the breeding and non-breeding periods. A displacement rate of 60 per cent was applied to this mean peak estimate, with one per cent of the displaced birds assumed to die, for both the breeding and non-breeding periods.

180 The Development-alone and in-combination mortality estimated from displacement was apportioned between SPA and non-SPA colonies as outlined above and detailed in *Appendix 11B*. The apportioning calculations were undertaken separately for the Development Area and two kilometre buffer, and for Neart na Gaoithe (plus buffer) and Seagreen Alpha and Bravo combined (plus buffer). The two Seagreen sites were combined for the purposes of the apportioning calculations because they are contiguous along their longest boundary. On the basis of these calculations, the percentage of the breeding and non-breeding period impacts to guillemots from the Development and each of the other three Forth and Tay wind farms attributed to the Forth Islands SPA population were as follows:

- The Development – 35.0 per cent
- Neart na Gaoithe – 65.7 per cent
- Seagreen Alpha and Bravo – 16.5 per cent

181 The estimated displacement mortality was also apportioned to age classes, which in this case was based upon the stable age distribution from the Forth Islands SPA guillemot population model produced for the current assessment (and as detailed in *Appendix 11E*). This approach followed the advice of the Scoping Opinion for species for which age distributions could not be distinguished during the 'at-sea' surveys. The estimated number of adult birds displaced during the breeding period was also amended according to an assumed seven per cent sabbatical rate amongst the breeding adult birds, as advised in the Scoping Opinion (*Appendix 11D)*

182 For the Development-alone in the breeding period, the mean peak population estimate was 8,184 birds, of which 43.7 per cent were adults (3,576 birds) and 35.0 per cent were from the Forth Islands SPA (1,252 birds) and seven per cent were birds on sabbatical (giving 1,164 adult birds from the Forth Islands SPA population). Applying the advised 60 per cent displacement

rate and one per cent mortality rate gives an estimated mortality of seven adult birds per breeding period (Table 4.16). This predicted displacement mortality from the Development-alone on breeding adults is very small compared with the current (38,573 individuals) and citation (32,000 individuals) population sizes (0.02 per cent in both cases).

183 For the Development-alone in the non-breeding season, the mean peak population estimate was 3,912 birds, giving an estimated non-breeding season mortality of three adult birds (based on the same rates as used in the breeding period for apportioning to colonies and age classes, assigning sabbaticals and for estimating displacement and mortality amongst displaced birds). Thus, the estimated annual mortality of adult guillemots from the Forth Islands SPA population was nine, representing 0.03 per cent of the current and citation SPA population sizes.

Table 4.16 Displacement matrix for adult guillemots from the Forth Islands SPA in the breeding season. Based on mean peak abundance apportioned to adult birds from the Forth Islands SPA. Recommended displacement rate and mortality rate is shown in green, and the resulting displacement mortality in dark green.

		DISPLACEMENT										
		0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
MORTALITY	0%	0	0	0	0	0	0	0	0	0	0	0
	1%	0	1	2	3	5	6	**7**	8	9	10	11
	2%	0	2	5	7	9	12	14	16	19	21	23
	3%	0	3	7	10	14	17	21	24	28	31	35
	4%	0	5	9	14	19	23	28	33	37	42	47
	5%	0	6	12	17	23	29	35	41	47	52	58
	10%	0	12	23	35	47	58	70	81	93	105	116
	15%	0	17	35	52	70	87	105	122	140	157	175
	20%	0	23	47	70	93	116	140	163	186	210	233
	30%	0	35	70	105	140	175	210	244	279	314	349
	40%	0	47	93	140	186	233	279	326	372	419	466
	50%	0	58	116	175	233	291	349	407	466	524	582
	60%	0	70	140	210	279	349	419	489	559	629	698
	70%	0	81	163	244	326	407	489	570	652	733	815
	80%	0	93	186	279	372	466	559	652	745	838	931

		DISPLACEMENT										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	90%	0	105	210	314	419	524	629	733	838	943	1048
	100%	0	116	233	349	466	582	698	815	931	1048	1164

Table 4.17 Displacement matrix for adult guillemots from the Forth Islands SPA in the non-breeding season. Based on mean peak abundance apportioned to adult birds from the Forth Islands SPA. Recommended displacement rate and mortality rate is shown in green, and the resulting displacement mortality in dark green.

		DISPLACEMENT										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
MORTALITY	0%	0	0	0	0	0	0	0	0	0	0	0
	1%	0	1	1	2	2	3	3	4	4	5	6
	2%	0	1	2	3	4	6	7	8	9	10	11
	3%	0	2	3	5	7	8	10	12	13	15	17
	4%	0	2	4	7	9	11	13	16	18	20	22
	5%	0	3	6	8	11	14	17	19	22	25	28
	10%	0	6	11	17	22	28	33	39	44	50	56
	15%	0	8	17	25	33	42	50	58	67	75	83
	20%	0	11	22	33	44	56	67	78	89	100	111
	30%	0	17	33	50	67	83	100	117	133	150	167
	40%	0	22	44	67	89	111	133	156	178	200	222
	50%	0	28	56	83	111	139	167	195	222	250	278
	60%	0	33	67	100	133	167	200	234	267	300	334
	70%	0	39	78	117	156	195	234	272	311	350	389
	80%	0	44	89	133	178	222	267	311	356	400	445
	90%	0	50	100	150	200	250	300	350	400	450	500
	100%	0	56	111	167	222	278	334	389	445	500	556

184 The displacement matrix predictions for the Development in-combination with the other three Forth and Tay wind farms were apportioned between SPA colonies and between age classes (Table 4.18). The predicted in-combination mortality from displacement for the Forth Islands SPA guillemots during the breeding period is approximately three times greater than for the Development-alone, with a total estimated mortality of 22 breeding adults and 30 sub-adult birds (Table 4.18). This level of mortality remains small compared with the current (38,573 individuals) and citation (32,000 individuals) population sizes (with the adult mortality representing 0.06 per cent and 0.07 per cent, respectively).

185 Levels of predicted mortality from displacement in the non-breeding period for the Development in-combination with the other three Forth and Tay wind farms were similar to those for the breeding period (Table 4.18). However, the contribution of the Development to the total in-combination mortality was smaller in the non-breeding period. Combining the two seasonal estimates gave an estimated annual mortality from the in-combination impacts of 42 breeding adults and 58 sub-adult birds (Table 4.18). The estimated annual mortality of breeding adults from displacement represented only 0.11 per cent and 0.13 per cent of the current and citation SPA population sizes.

Table 4.18 Estimated mortality of Forth Islands SPA guillemots as a result of displacement from the Development in-combination with the other three Forth and Tay wind farms.

Seasonal period	Project	Mean peak estimate (individuals)	Adult propor-tion[1]	SPA propor-tion	Sabbatical proportion	Additional mortality	
						Breeding adults	Sub-adults
Breeding	Inch Cape	8,184	0.437	0.350	0.07	7.0	9.6
	Neart na Gaoithe	3,263		0.657		5.2	7.2
	Seagreen Alpha	12,190		0.165		4.9	6.8
	Seagreen Bravo	10,778		0.165		4.3	6.0
	Total	34,415	-	-	-	21.5	29.6
Non-breeding	Inch Cape	3,912	0.437	0.350	0.07	3.3	4.6
	Neart na Gaoithe	7,618		0.657		12.2	16.8
	Seagreen Alpha	6,131		0.165		2.5	3.4
	Seagreen Bravo	6,780		0.165		2.7	3.8
	Total	24,441	-	-	-	20.7	28.6
Annual	Total[2]	-	-	-	-	42.2	58.1

[1]Based on the stable age distribution from the Forth Islands SPA guillemot population model (*Appendix 11E*).
[2]Totals may differ by a small amount from the summed numbers in the above table cells due to rounding errors.

186 As described for the Forth Islands SPA kittiwake population (*Section 4.1.2* above), impacts from displacement and barrier effects were also estimated using the SeabORD and Searle *et al.,* (2014) individual-based modelling approaches. These estimates and the comparisons with the SNCB matrix estimates are presented in *Appendix 11D*.

Impacts from other wind farms within foraging range

187 As detailed above for the Forth Islands SPA gannet population, several offshore wind farms other than Neart na Gaoithe and Seagreen Alpha and Bravo occur within mean maximum foraging range of breeding guillemots from the Forth Islands SPA (as defined by Thaxter *et al.,* 2012). The advice from the Scoping Opinion was to consider the breeding season effects from these wind farms qualitatively.

188 These wind farms are the OREC, Levenmouth Demonstration Turbine and the ForthWind Demonstration Array. Both comprise single WTGs only and any impacts from displacement and barrier effects will be minor and will not affect the conclusions of the assessment.

Population Viability Analysis of the guillemot population

189 PVA was used to determine the effects of the predicted displacement impacts from the Development-alone, and in-combination, on the Forth Islands SPA guillemot population. The Forth Islands SPA guillemot population model produced for the current assessment was a stochastic, density independent, model based on a Bayesian state-space modelling framework. It was adapted from earlier Forth Islands SPA guillemot population models (Freeman *et al.,* 2014, Jitlal *et al.,* 2017), updated according to recently available population and demographic data. Further details of the model are provided in *Appendix 11E*.

190 The predicted population trends under baseline conditions (i.e. without wind farm impacts) were projected over both 28 and 53 year timescales. Additional mortality within the PVA was not incorporated until after year three of the projection (giving 25 and 50-year impact periods) to provide a more realistic representation of the likely population status at the time when the potential impacts will begin to arise.

191 The additional mortality was incorporated on the basis of the percentage point change to the annual mortality of adult and sub-adult birds, as represented by the SNCB matrix estimates (Table 4.18). Outputs from the PVA were summarised according to the median predicted population sizes at the end of the projection period, and the three metrics which the Scoping Opinion advised should be used for the interpretation and which are defined above in the section on the Forth Islands SPA gannet population.

192 The PVA projected population growth for the Forth Islands SPA guillemot population with and without impacts for the Development-alone and in-combination. The median end population size (Table 4.19) was higher than the current SPA population size (38,573 individuals) and increased over the projection period, irrespective of whether impacts were incorporated or not, with the projected population size at 50 years always larger than at 25 years.

193 The PVA metrics (Table 4.20) show that for the Development-alone the counterfactual of population size indicated small reductions in end population size after both 25 years and 50 years of impact (with the values being 0.992 and 0.984, respectively). A decrease in annual population growth rate was not detectable (at least when the counterfactual value was taken to three decimal places – i.e. it remained at a value of 1.000), whilst the centile value was 48 even after 50 years of impact (indicating very considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period).

194 In terms of the in-combination, the PVA metrics continued to indicate small population-level impacts (albeit that they were greater than for the Development-alone, as would be expected – Table 4.20). The predicted reduction in end population size was only 5.7 per cent even after 50 years of impact (the counterfactual of population size being 0.943), whilst the reduction in annual population growth rate was minimal (with a counterfactual value of 0.999). The centile value was 44 and 43 for the 25 and 50 year impact periods, respectively, indicating considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a reasonable likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period.

195 The population projections in all cases showed that the end population size was greater than the population size at citation (16,000 pairs), and that the population continued to increase over the projection period. Therefore, the effects of the Development-alone, and in-combination, would not result in the conservation status of the Forth Islands SPA population being in unfavourable condition.

Table 4.19 Projected end population sizes of the Forth Islands SPA guillemot population after 25 and 50 years for baseline, Development-alone and in-combination scenarios.

	Percentage point change in mortality		**Median number of breeding females (5th – 95th centiles)**	
	Adults	**Sub-adults**	**25 years**	**50 years**
Baseline			31,900 (21,050 – 46,500)	43,100 (22,650 – 81,250)
Development-alone	0.027	0.029	31,650 (20,900 – 46,350)	42,400 (22,350 – 79,400)
In-combination	0.109	0.118	30,900 (20,350 – 45,000)	40,400 (21,100 – 75,250)

Table 4.20 PVA metrics for the Forth Islands SPA guillemot population after 25 and 50 years for the Development-alone and in-combination scenarios.

	Counterfactual of end population size		Counterfactual of population growth rate[1]	Centile of baseline population matching the median of the impacted population	
	25 years	50 years	25 and 50 years	25 years	50 years
Baseline	1.000	1.000	1.000	50	50
Development-alone	0.992	0.984	1.000	49	48
In-combination	0.968	0.936	0.999	44	43

[1]The value of this metric does not vary according to the length of the projection period.

<u>Conclusion</u>

196 The predicted impacts from the Development-alone and in-combination were small, and outputs from the PVA indicate small predicted population-level effects. Based upon the PVA projections, the Conservation Objective of the SPA, to maintain the "population of the species as a viable component of the site", will not be compromised for the guillemot population. It should therefore be possible for the CA to conclude, beyond reasonable scientific doubt, that the Development-alone, and in-combination, will have no adverse effect on site integrity due to the effects on the guillemot population.

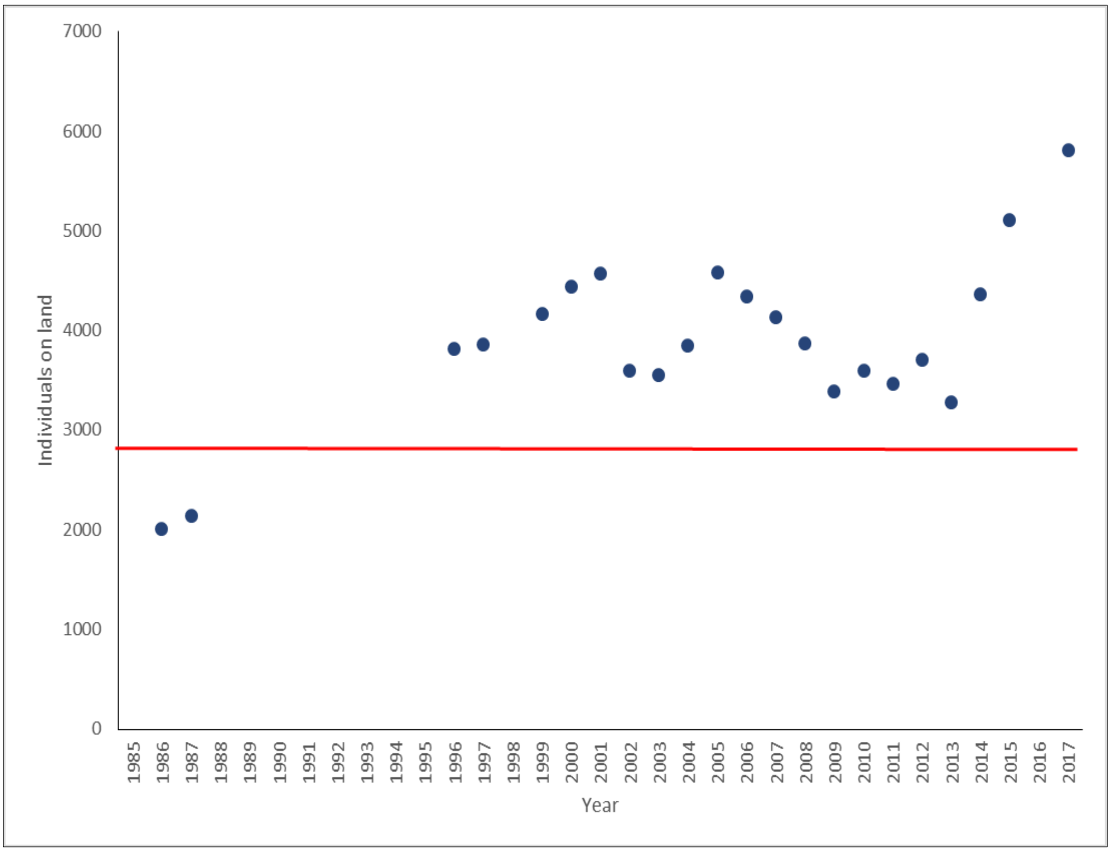
4.1.5 Razorbill Population

197 Razorbills are also a colonial nesting seabird that breed in relatively high northern latitudes, often with other species of seabird. Razorbill colonies only occur in the North Atlantic, with most of the global population in Iceland. In Europe colonies occur along the Atlantic coast from northern France to the north coast of Scandinavia and Iceland. They forage entirely at sea diving for small shoaling fish, and like guillemot this is particularly *Ammodytidae*, *Clupeidae* and *Gadidae* (Mitchell *et al.,* 2004). In winter, razorbills are widespread across north-west European seas (Stone *et al.,* 1995), with more northerly colonies wintering south of their breeding sites (Furness, 2015). The Scoping Opinion advises, as for guillemot, the assessment for the non-breeding period should be based on the same apportioning as for the breeding period, on the basis that a proportion of the breeding razorbill population may remain in the vicinity of the nesting colonies for much of this period. Such an approach is likely to be precautionary because of the likely influx of birds from more northern breeding colonies to the Forth and Tay region (Furness, 2015).

198 The Forth Islands SPA razorbill population occurs on several islands in the Firth of Forth. The largest colony occurs on the Isle of May, with smaller colonies on Craigleith, Bass Rock, Fidra and The Lamb. The Isle of May colony is about 90 per cent of the SPA total. The razorbill population size in the SPA has grown since 1985, and despite a period of decline in the mid

2000's there has been sustained increases since 2013 (Figure 4.5). The count data shown in Figure 4.5 derive largely from the JNCC SMP database[10], with the 2017 count as provided in the SNH scoping advice[11]. It should be noted that the data shown in Figure 4.5 are the count of individuals on land. This needs to be multiplied by 1.34 to give the estimated number of breeding adults[11] (except in the case of the citation population size which is taken as 2,800 individuals or 1,400 breeding pairs - SNH (2009a)).

Figure 4.5 Razorbill population trend at the Forth Islands SPA between 1986 and 2017. The red line shows the population size at designation (2,800 individuals).



<u>Potential impacts on the razorbill population</u>

199 The Development Area, OfTW and associated buffers[6] do not overlap with the Forth Islands SPA. Consequently, the potential impacts on its razorbill population will only occur as a result of individuals from the colony occurring in the Development Area. In relation to razorbill, the impacts of concern identified in the Scoping Opinion from MS-LOT were from displacement from the Development Area, and two kilometre buffer and barrier effects (with the two latter impacts subsequently considered together). From published information on razorbill foraging ranges generally (Thaxter *et al.,* 2012) and tracking from the Isle of May (part of the Forth Islands SPA,) specifically (CEH, 2011), it is very likely that breeding razorbills from the Forth Islands SPA occur within the Development Area and two kilometre buffer, as well as within the proposed development areas of other wind farms in the Forth and Tay.

200 The breeding period for razorbill is defined as April to mid-August, following the advice of the Scoping Opinion.

<u>Predicted displacement impacts on the razorbill population alone and in-combination</u>

201 The SNCB matrix approach (SNCBs, 2017) was used to estimate the impacts from displacement (and barrier effects) as advised in the Scoping Opinion[13], and was used to estimate the additional mortality attributable to the Forth Islands SPA razorbill population as a result of

displacement during both the breeding and non-breeding periods. Following the advice of the Scoping Opinion, the mortality from displacement was calculated using the peak population size, averaged over the two years of survey, for the Development Area and two kilometre buffer (combining birds on the water and in flight), with this undertaken separately for the breeding and non-breeding periods. A displacement rate of 60 per cent was applied to this mean peak estimate, with one per cent of the displaced birds assumed to die, for both the breeding and non-breeding periods.

202 The Development-alone and in-combination mortality estimated from displacement was apportioned between SPA and non-SPA colonies as outlined above and detailed in *Appendix 11B*. The apportioning calculations were undertaken separately for the Development Area and two kilometre buffer, and for Neart na Gaoithe (plus buffer). The Seagreen Alpha and Bravo sites were beyond the mean maximum foraging range of razorbills from the Forth Islands SPA (*Appendix 11B*, Thaxter *et al.,* 2012), and were deemed not to have connectivity. On the basis of these calculations, the percentage of the breeding and non-breeding period impacts to razorbills from the Development and the Neart na Gaoithe wind farm attributed to the Forth Islands SPA population were as follows:

- The Development – 31.9 per cent
- Neart na Gaoithe – 85.6 per cent

203 The estimated displacement mortality was also apportioned to age classes, which in this case was based upon the stable age distribution from the Forth Islands SPA razorbill population model produced for the current assessment (and as detailed in *Appendix 11E*). This approach followed the advice of the Scoping Opinion for species for which age distributions could not be distinguished during the ‘at-sea’ surveys. The estimated number of adult birds displaced during the breeding period was also amended according to an assumed seven per cent sabbatical rate amongst the breeding adult birds, as advised in the Scoping Opinion (*Appendix 11D).*

204 For the Development-alone in the breeding period, the mean peak population estimate was 4,671 birds, of which 48.4 per cent were adults (2,261 birds) and 31.9 per cent were from the Forth Islands SPA (721 birds) and seven per cent were birds on sabbatical (giving 671 adult birds from the Forth Islands SPA population). Applying the advised 60 per cent displacement rate and one per cent mortality rate gives an estimated mortality of four adult birds per breeding period (Table 4.21). This predicted displacement mortality from the Development-alone on breeding adults is small compared with the current (7,792 individuals) and citation (2,800 individuals) population sizes (0.05 per cent and 0.14 per cent, respectively).

205 For the Development-alone in the non-breeding season, the mean peak population estimate was 4,905 birds, giving an estimated non-breeding season mortality of four birds (based on the same rates as used in the breeding period for apportioning to colonies and age classes, assigning sabbaticals and for estimating displacement and mortality amongst displaced birds). Thus, the estimated annual mortality of adult razorbills from the Forth Islands SPA population was eight, representing 0.10 per cent and 0.29 per cent of the current and citation SPA population sizes, respectively.

Table 4.21 Displacement matrix for adult razorbills from the Forth Islands SPA in the breeding season. Based on mean peak abundance apportioned to adult birds from the Forth Islands SPA. Recommended displacement rate and mortality rate is shown in green, and the resulting displacement mortality in dark green.

		DISPLACEMENT										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
MORTALITY	0%	0	0	0	0	0	0	0	0	0	0	0
	1%	0	1	1	2	3	3	4	5	5	6	7
	2%	0	1	3	4	5	7	8	9	11	12	13
	3%	0	2	4	6	8	10	12	14	16	18	20
	4%	0	3	5	8	11	13	16	19	21	24	27
	5%	0	3	7	10	13	17	20	23	27	30	34
	10%	0	7	13	20	27	34	40	47	54	60	67
	15%	0	10	20	30	40	50	60	70	81	91	101
	20%	0	13	27	40	54	67	81	94	107	121	134
	30%	0	20	40	60	81	101	121	141	161	181	201
	40%	0	27	54	81	107	134	161	188	215	242	268
	50%	0	34	67	101	134	168	201	235	268	302	336
	60%	0	40	81	121	161	201	242	282	322	362	403
	70%	0	47	94	141	188	235	282	329	376	423	470
	80%	0	54	107	161	215	268	322	376	429	483	537
	90%	0	60	121	181	242	302	362	423	483	544	604
	100%	0	67	134	201	268	336	403	470	537	604	671

Table 4.22 Displacement matrix for adult razorbills from the Forth Islands SPA in the non-breeding season. Based on mean peak abundance apportioned to adult birds from the Forth Islands SPA. Recommended displacement rate and mortality rate is shown in green, and the resulting displacement mortality in dark green.

		DISPLACEMENT										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
MORTALITY	0%	0	0	0	0	0	0	0	0	0	0	0
	1%	0	1	1	2	3	4	4	5	6	6	7
	2%	0	1	3	4	6	7	8	10	11	13	14
	3%	0	2	4	6	8	11	13	15	17	19	21
	4%	0	3	6	8	11	14	17	20	23	25	28
	5%	0	4	7	11	14	18	21	25	28	32	35
	10%	0	7	14	21	28	35	42	49	56	63	70
	15%	0	11	21	32	42	53	63	74	84	95	106
	20%	0	14	28	42	56	70	84	99	113	127	141
	30%	0	21	42	63	84	106	127	148	169	190	211
	40%	0	28	56	84	113	141	169	197	225	253	282
	50%	0	35	70	106	141	176	211	246	282	317	352
	60%	0	42	84	127	169	211	253	296	338	380	422
	70%	0	49	99	148	197	246	296	345	394	444	493
	80%	0	56	113	169	225	282	338	394	451	507	563
	90%	0	63	127	190	253	317	380	444	507	570	634
	100%	0	70	141	211	282	352	422	493	563	634	704

206 The displacement matrix predictions for the Development in-combination with the Neart na Gaoithe wind farm were apportioned between SPA colonies and between age classes (Table 4.23). The predicted in-combination mortality from displacement for the Forth Islands SPA razorbills during the breeding period is approximately one and half times greater than for the Development-alone, with a total estimated mortality of seven breeding adults and eight sub-adult birds (Table 4.23). This level of mortality remains relatively small compared with the current (7,792 individuals) and citation (2,800 individuals) population sizes (with the adult mortality representing 0.09 per cent and 0.25 per cent, respectively).

207 Levels of predicted mortality from displacement in the non-breeding period for the Development in-combination with the Neart na Gaoithe wind farm were higher than those for the breeding period (Table 4.23), and the contribution of the Development to the total in-

combination mortality was smaller in the non-breeding period. Combining the two seasonal estimates gave an estimated annual mortality from the in-combination impacts of 18 breeding adults and 21 sub-adult birds (Table 4.23). The estimated annual mortality of breeding adults from displacement represented 0.23 per cent and 0.64 per cent of the current and citation SPA population sizes, respectively.

Table 4.23 Estimated mortality of Forth Islands SPA razorbills as a result of displacement from the Development in-combination with the Neart na Gaoithe wind farm.

Seasonal period	Project	Mean peak estimate (individuals)	Adult proportion[1]	SPA proportion	Sabbatical proportion	Additional mortality	
						Breeding adults	Sub-adults
Breeding	Inch Cape	4,671	0.484	0.319	0.07	4.0	4.6
	Neart na Gaoithe	1,248		0.856		2.9	3.3
	Total		-	-	-	6.9	8.0
Non-breeding	Inch Cape	4,905	0.484	0.319	0.07	4.2	4.9
	Neart na Gaoithe	3,101		0.856		7.2	8.3
	Total		-	-	-	11.4	13.2
Annual	Total[2]	-	-	-	-	18.3	21.1

[1]Based on the stable age distribution from the Forth Islands SPA razorbill population model (*Appendix 11E*).
[2]Totals may differ by a small amount from the summed numbers in the above table cells due to rounding errors.

208 As described for the Forth Islands SPA kittiwake population (*Section 4.1.2* above), impacts from displacement and barrier effects were also estimated using the SeabORD and Searle *et al.,* (2014) individual-based modelling approaches. These estimates and the comparisons with the SNCB matrix estimates are presented in *Appendix 11D*.

<u>Impacts from other wind farms within foraging range</u>

209 As detailed above for the Forth Islands SPA gannet population, several offshore wind farms other than Neart na Gaoithe and Seagreen Alpha and Bravo occur within mean maximum foraging range of breeding razorbills from the Forth Islands SPA (as defined by Thaxter *et al.,* 2012). The advice from the Scoping Opinion was to consider the breeding season effects from these wind farms qualitatively.

210 These wind farms are the OREC, Levenmouth Demonstration Turbine and the ForthWind Demonstration Array. Both comprise single WTGs only and any impacts from displacement and barrier effects will be minor and will not affect the conclusions of the assessment.

Population Viability Analysis of the razorbill population

211 PVA was used to determine the effects of the predicted displacement impacts from the Development-alone, and in-combination, on the Forth Islands SPA razorbill population. The Forth Islands SPA razorbill population model produced for the current assessment was a stochastic, density independent, model based on a Bayesian state-space modelling framework. It was adapted from earlier Forth Islands SPA razorbill population models (Freeman *et al.,* 2014, Jitlal *et al.,* 2017), updated according to recently available population and demographic data. Further details of the model are provided in *Appendix 11E*.

212 The predicted population trends under baseline conditions (i.e. without wind farm impacts) were projected over both 28 and 53 year timescales. Additional mortality within the PVA was not incorporated until after year three of the projection (giving 25 and 50-year impact periods) to provide a more realistic representation of the likely population status at the time when the potential impacts will begin to arise.

213 The additional mortality was incorporated on the basis of the percentage point change to the annual mortality of adult and sub-adult birds, as represented by the SNCB matrix estimates (Table 4.23). Outputs from the PVA were summarised according to the median predicted population sizes at the end of the projection period, and the three metrics which the Scoping Opinion advised should be used for the interpretation and which are defined above in the section on the Forth Islands SPA gannet population.

214 The PVA projected population growth for the Forth Islands SPA razorbill population with and without impacts for the Development-alone and in-combination. The median population size increased over the projection period whether impacts were incorporated or not, and the projected population size at 50 years was always larger than that at 25 years (Table 4.24).

215 The PVA metrics (Table 4.25) show that for the Development-alone the counterfactual of population size indicated small reductions in the end population size after both 25 and 50 years of impact (with the values being 0.969 and 0.938, respectively). The decline in the annual population growth rate was minimal (with the counterfactual value being 0.999), whilst the centile value was 46 even after 50 years of impacts, indicating considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a reasonable likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period.

216 For the in-combination, the PVA metrics continued to indicate relatively small population-level impacts (albeit that they were greater than for the Development-alone, as would be expected – Table 4.25). The predicted reductions in end population size were seven per cent and 13 per cent after 25 and 50 years of impact, respectively (the counterfactual values being 0.933 and 0.868), whilst the reduction in annual population growth rate was small (with a

counterfactual value of 0.997). The centile values were 43 and 42 for the 25 and 50 year impact periods, respectively, indicating considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a reasonable likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period.

217 The population projections in all cases showed that the end population size was considerably greater than the population size at citation (1,400 pairs), and that it continued to increase over the projection period. Therefore, the effects of the Development- alone, and in-combination, would not result in the conservation status of the Forth Islands SPA population being in unfavourable condition.

Table 4.24 Projected end population size of the Forth Islands SPA razorbill population after 25 and 50 years for baseline, Development-alone and in-combination scenarios.

	Percentage point change in mortality		Median number of breeding females (5th – 95th centiles)	
	Adults	Sub-adults	25 years	50 years
Baseline	-	-	8,400 (4,400 – 15,350)	15,800 (5,600 – 43,150)
Development-alone	0.106	0.113	8,150 (4,200 – 14,850)	14,900 (5,150 – 40,400)
In-combination	0.235	0.251	7,850 (4,100 – 14,250)	13,850 (4,700 – 37,950)

Table 4.25 PVA metrics for the Forth Islands SPA razorbill population after 25 and 50 years for the Development-alone and in-combination scenarios.

	Counterfactual of end population size		Counterfactual of population growth rate[1]	Centile of baseline population matching the median of the impacted population	
	25 years	50 years	25 and 50 years	25 years	50 years
Baseline	1.000	1.000	1.000	50	50
Development-alone	0.969	0.938	0.999	47	46
In-combination	0.933	0.868	0.997	43	42

[1]The value of this metric does not vary according to the length of the projection period.

Conclusion

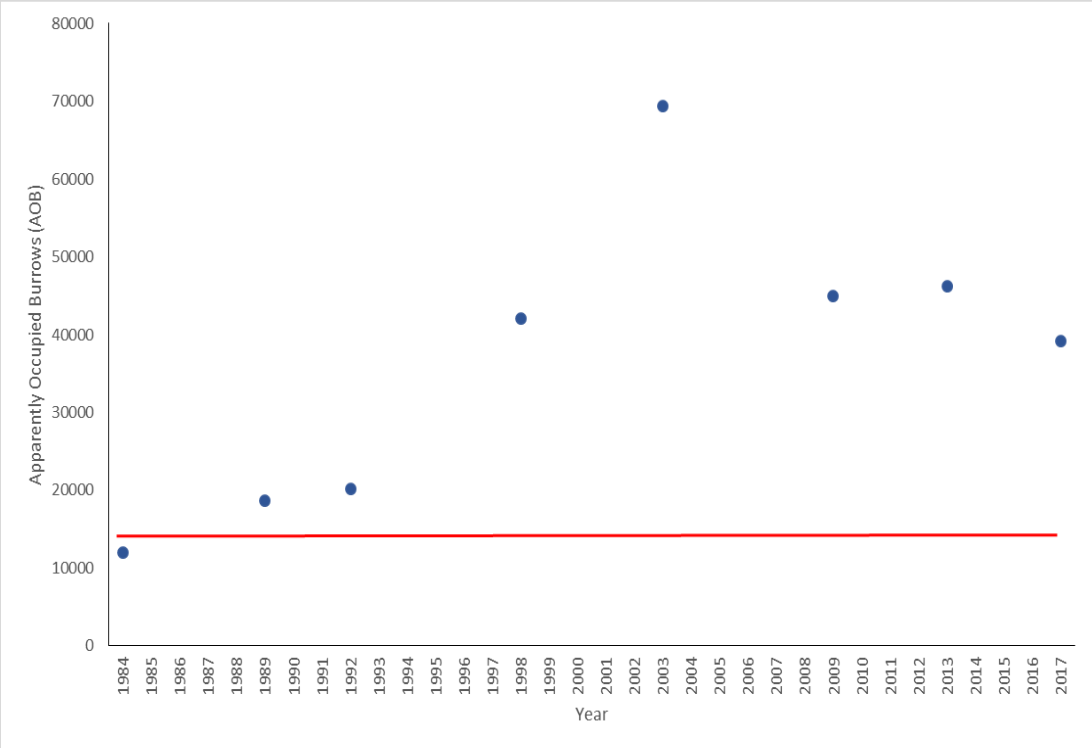
218 The predicted impacts from the Development-alone and in-combination were small, and outputs from the PVA indicate small predicted population-level effects. Based upon the PVA projections, the Conservation Objective of the SPA, to maintain the "population of the species as a viable component of the site", will not be compromised for the razorbill population. It should therefore be possible for the CA to conclude, beyond reasonable scientific doubt, that the Development-alone, and in-combination, will have no adverse effect on site integrity due to the effects on the razorbill population.

4.1.6 Puffin Population

219 Puffins are a burrow nesting colonial seabird that occurs around the coasts of the North Atlantic region, mostly on islands. In Europe colonies occur along the Atlantic coasts of Brittany, offshore islands in the British Isles, Faroes, Iceland, Norway and Russia. They forage entirely at sea, diving for small shoaling fish, particularly *Ammodytidae*, *Clupeidae* and *Gadidae* (Mitchell *et al.,* 2004). In winter, puffins are very widespread across north-west European seas (Stone *et al.,* 1995) and the Atlantic (Jessopp *et al.,* 2013).

220 The Forth Islands SPA puffin population occurs on several islands in the Firth of Forth. The largest colony occurs on the Isle of May, with smaller colonies on Craigleith, Fidra, Inchmickery, and The Lamb. The Isle of May colony is about 89 per cent of the SPA total. The puffin population in the SPA is only counted sporadically and there are very few counts across all the colonies in the SPA in any one year. Therefore, count data are shown only for the Isle of May, where the population is counted approximately every five years (Figure 4.6). This has shown an overall increase since the first count in the SMP database in 1984[10]. The number of apparently occupied burrows peaked in 2003 (69,300) with lower counts in 2009 (44,971), 2013 (46,200) and 2017 (39,200). The 2017 count for the Isle of May is as provided by CEH to SNH, and as used to contribute to the Forth Islands SPA population estimate provided in the SNH scoping advice (i.e. 45,005 pairs)[11]. The current population of the SPA is well above the citation population size (14,000 pairs).

Figure 4.6 Puffin population trend on the Isle of May between 1984 and 2017. The red line shows the population size for the whole Forth Islands SPA at designation (14,000 pairs).



__Potential impacts on the puffin population__

221 The Development Area, OfTW and associated buffers[6] do not overlap with the Forth Islands SPA. Consequently, the potential impacts on its puffin population will only occur as a result of individuals from the colony occurring in the Development Area. In relation to puffin, the impacts of concern identified in the Scoping Opinion from MS-LOT were from displacement from the Development Area and two kilometre buffer and barrier effects (with the two latter impacts subsequently considered together). From published information on puffin foraging ranges generally (Thaxter *et al.,* 2012) it is very likely that breeding puffins from the Forth Islands SPA occur within the Development Area and two kilometre buffer, as well as within the proposed development areas of other wind farms in the Forth and Tay.

222 The breeding period for puffin is defined as April to mid-August, following the advice of the Scoping Opinion. As also advised in the Scoping Opinion[3], no assessment of impacts during the non-breeding period is undertaken for puffin. This is on the basis that the species migrate rapidly from their UK breeding areas, leaving the seas immediately adjacent to their colonies by late August (Wernham *et al.,* 2002, Harris and Wanless, 2011).

__Predicted displacement impacts on the puffin population alone and in-combination__

223 The SNCB matrix approach (SNCBs, 2017) was used to estimate the impacts from displacement (and barrier effects) as advised in the Scoping Opinion[13], and was used to estimate the additional mortality attributable to the Forth Islands SPA puffin population as a result of

displacement during the breeding period. Following the advice of the Scoping Opinion, the mortality from displacement was calculated using the peak breeding period population size, averaged over the two years of survey, for the Development Area and two kilometre buffer (combining birds on the water and in flight). A displacement rate of 60 per cent was applied to this mean peak estimate, with two per cent of the displaced birds assumed to die.

224 The Development-alone and in-combination mortality estimated from displacement was apportioned between SPA and non-SPA colonies as outlined above and detailed in *Appendix 11B*. The apportioning calculations were undertaken separately for the Development Area and two kilometre buffer, and for Neart na Gaoithe (plus buffer) and Seagreen Alpha and Bravo combined (plus buffer). The two Seagreen sites were combined for the purposes of the apportioning calculations because they are contiguous along their longest boundary. On the basis of these calculations, the percentage of the breeding period impacts to puffins from the Development and each of the other three Forth and Tay wind farms attributed to the Forth Islands SPA population were as follows:

- The Development – 90.0 per cent;
- Neart na Gaoithe – 95.3 per cent; and
- Seagreen Alpha and Bravo – 79.0 per cent.

225 The estimated displacement mortality was also apportioned to age classes, which in this case was based upon the stable age distribution from the Forth Islands SPA puffin population model produced for the current assessment (and as detailed in *Appendix 11E*). This approach followed the advice of the Scoping Opinion for species for which age distributions could not be distinguished during the 'at-sea' surveys. The estimated number of adult birds displaced during the breeding period was also amended according to an assumed seven per cent sabbatical rate amongst the breeding adult birds, as advised in the Scoping Opinion (*Appendix 11D).*

226 For the Development-alone in the breeding period, the mean peak population estimate was 5,678 birds, of which 38.1 per cent were adults (2,163 birds) and 90.0 per cent were from the Forth Islands SPA (1,947 birds) and seven per cent were birds on sabbatical (giving 1,811 adult birds from the Forth Islands SPA population). Applying the advised 60 per cent displacement rate and two per cent mortality rate gives an estimated mortality of 22 adult birds per annum (Table 4.26). This predicted displacement mortality from the Development-alone on breeding adults is very small compared with the current (90,010 individuals) and citation (28,000 individuals) population sizes (0.02 per cent and 0.08 per cent, respectively).

Table 4.26 Displacement matrix for adult puffins from the Forth Islands SPA in the breeding season. Based on peak mean abundance apportioned to adult birds from the Forth Islands SPA. Recommended displacement rate and mortality rate is shown in green, and the resulting displacement mortality in dark green.

		DISPLACEMENT										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
MORTALITY	0%	0	0	0	0	0	0	0	0	0	0	0
	1%	0	2	4	5	7	9	11	13	14	16	18
	2%	0	4	7	11	14	18	22	25	29	33	36
	3%	0	5	11	16	22	27	33	38	43	49	54
	4%	0	7	14	22	29	36	43	51	58	65	72
	5%	0	9	18	27	36	45	54	63	72	81	91
	10%	0	18	36	54	72	91	109	127	145	163	181
	15%	0	27	54	81	109	136	163	190	217	244	272
	20%	0	36	72	109	145	181	217	254	290	326	362
	30%	0	54	109	163	217	272	326	380	435	489	543
	40%	0	72	145	217	290	362	435	507	580	652	724
	50%	0	91	181	272	362	453	543	634	724	815	906
	60%	0	109	217	326	435	543	652	761	869	978	1087
	70%	0	127	254	380	507	634	761	887	1014	1141	1268
	80%	0	145	290	435	580	724	869	1014	1159	1304	1449
	90%	0	163	326	489	652	815	978	1141	1304	1467	1630
	100%	0	181	362	543	724	906	1087	1268	1449	1630	1811

227 The displacement matrix predictions for the Development in-combination with the other three Forth and Tay wind farms were apportioned between SPA colonies and between age classes (Table 4.27). The predicted in-combination mortality from displacement for the Forth Islands SPA puffins during the breeding period is more than three times greater than for the Development-alone, with a total estimated mortality of 77 breeding adults and 135 sub-adult birds per annum (Table 4.27). This level of mortality remains small compared with the current (90,010 individuals) and citation (28,000 individuals) population sizes (with the adult mortality representing 0.08 per cent and 0.28 per cent, respectively).

Table 4.27 Estimated mortality of Forth islands SPA puffins as a result of displacement from the Development in-combination with the other three Forth and Tay wind farms.

Project	Mean peak estimate (individuals)	Adult proportion[1]	SPA proportion	Sabbatical proportion	Additional mortality	
					Breeding adults	Sub-adults
Inch Cape	5,678	0.381	0.900	0.07	21.7	38.0
Neart na Gaoithe	6,173		0.903		25.0	43.8
Seagreen Alpha	3,704		0.790		12.4	21.8
Seagreen Alpha	5,340		0.790		17.9	31.4
Total[2]	20,896	-	-	-	77.1	135.0

[1]Based on the stable age distribution from the Forth Islands SPA puffin population model (*Appendix 11E*).
[2]Total may differ by a small amount from the summed numbers in the above table cells due to rounding errors.

228 As described for the Forth Islands SPA kittiwake population (*Section 4.1.2* above), impacts from displacement and barrier effects were also estimated using the SeabORD and Searle *et al.,* (2014) individual-based modelling approaches. These estimates and the comparisons with the SNCB matrix estimates are presented in *Appendix 11D*.

Impacts from other wind farms within foraging range

229 As detailed above for the Forth Islands SPA gannet population, several offshore wind farms other than Neart na Gaoithe and Seagreen Alpha and Bravo occur within mean maximum foraging range of breeding puffins from the Forth Islands SPA (as defined by Thaxter *et al.,* 2012). The advice from the Scoping Opinion was to consider the breeding season effects from these wind farms qualitatively.

230 These wind farms are the OREC, Levenmouth Demonstration Turbine and the ForthWind Demonstration Array. Both comprise single WTGs only and any impacts from displacement and barrier effects will be minor and will not affect the conclusions of the assessment.

Population Viability Analysis of the puffin population

231 PVA was used to determine the effects of the predicted displacement impacts from the Development-alone, and in-combination, on the Forth Islands SPA puffin population. The Forth Islands SPA puffin population model produced for the current assessment was a stochastic, density independent, model based on a Bayesian state-space modelling framework. It was adapted from earlier Forth Islands SPA puffin population model developed by Freeman *et al.,* (2014) but with the underpinning data augmented by further count and

productivity estimates collected since 2013. Further details of the model are provided in *Appendix 11E*.

232 The predicted population trends under baseline conditions (i.e. without wind farm impacts) were projected over both 28 and 53 year timescales. Additional mortality within the PVA was not incorporated until after year three of the projection (giving 25 and 50-year impact periods) to provide a more realistic representation of the likely population status at the time when the potential impacts will begin to arise.

233 The additional mortality was incorporated on the basis of the percentage point change to the annual mortality of adult and sub-adult birds, as represented by the SNCB matrix estimates (Table 4.27). Outputs from the PVA were summarised according to the median predicted population sizes at the end of the projection period, and the three metrics which the Scoping Opinion advised should be used for the interpretation and which are defined above in the section on the Forth Islands SPA gannet population.

234 The PVA projected a steeply increasing population for the Forth Islands SPA puffins with and without impacts for the Development-alone and in-combination. The median end population size for each modelled impact (Table 4.28) was considerably larger than the current SPA population size (90,010 individuals), and the projected population size at 50 years was always larger than the projected population size at 25 years. Irrespective of the impact scenario considered, the Forth Islands SPA puffin population was predicted to number over a quarter of a million breeding pairs after 25 years of impacts and close to one million pairs after 50 years of impact (Table 4.28). An increase of this magnitude is unrealistic and other factors would likely act to limit the growth of the population before it reached such levels (e.g. sufficient suitable areas for nesting burrows).

235 The PVA metrics (Table 4.29) show that for the Development-alone the counterfactual of population size indicated small reductions in the end population size after both 25 years and 50 years of impact (with the values being 0.993 and 0.986, respectively). A decrease in annual population growth rate was not detectable (at least when the counterfactual value was taken to three decimal places – i.e. it remained at a value of 1.000), whilst the centile value was 49 even after 50 years of impact (indicating very considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period).

236 In terms of the in-combination, the PVA metrics continued to indicate small population-level impacts (albeit that they were greater than for the Development-alone, as would be expected – Table 4.29). The predicted reduction in end population size was less than five per cent even after 50 years of impact (the counterfactual of population size being 0.952), whilst the reduction in annual population growth rate was minimal (with a counterfactual value of 0.999). The centile value was 48 for both the 25 and 50 year impact periods, indicating considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a reasonable likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period.

237 Accepting the limited reliability of the overall projections from the PVA, in terms of predicting such a steeply increasing population over the full 53 year projection period, it is clear that the PVA indicates an end population size that is considerably greater than both the current (45,005 pairs) and citation (14,000 pairs) populations, irrespective of the Development-alone and in-combination impacts. Therefore, these impacts are not predicted to result in the conservation status of the Forth Islands SPA puffin population being in unfavourable condition.

Table 4.28 Projected end population sizes of the Forth Islands SPA puffin population after 25 and 50 years for baseline, Development-alone and in-combination scenarios.

	Percentage point change in mortality		Median number of breeding females (5th – 95th centiles)	
	Adults	**Sub-adults**	**25 years**	**50 years**
Baseline	-	-	286,950 (106,850 – 614,550)	1,002,250 (225,050 – 3,043,050)
Development-alone	0.024	0.026	285,100 (106,150 – 610,550)	989,450 (221,700 – 2,999,650)
In-combination	0.086	0.092	279,850 (104,300 – 599,450)	955,100 (213,350 – 2,894,500)

Table 4.29 PVA metrics for the Forth Islands SPA puffin population after 25 and 50 years for the Development-alone and in-combination scenarios.

	Counterfactual of end population size		Counterfactual of population growth rate[1]	Centile of baseline population matching the median of the impacted population	
	25 years	**50 years**	**25 and 50 years**	**25 years**	**50 years**
Baseline	1.000	1.000	1.000	50	50
Development-alone	0.993	0.986	1.000	50	49
In-combination	0.975	0.952	0.999	48	48

[1]The value of this metric does not vary according to the length of the projection period.

Conclusion

238 The predicted impacts from the Development-alone and in-combination were small, and outputs from the PVA indicate small predicted population-level effects. Based upon the PVA projections, the Conservation Objective of the SPA, to maintain the "population of the species as a viable component of the site", will not be compromised for the puffin population. It should therefore be possible for the CA to conclude, beyond reasonable scientific doubt, that the Development-alone, and in-combination, will have no adverse effect on site integrity due to the effects on the puffin population.

4.1.7 Breeding Seabird Assemblage

239 The breeding seabird assemblage for the Forth Islands SPA is a qualifying feature on the basis of the SPA supporting 90,000 individual seabirds, including razorbill, guillemot, kittiwake, herring gull, cormorant, fulmar, puffin, lesser black-backed gull, shag, gannet, Arctic tern, common tern, Roseate tern and Sandwich tern.

240 Potential impacts of the Development on the breeding seabird assemblage for the Forth Islands SPA could arise via effects on the individual named species within the assemblage feature. However, no adverse effects are predicted from the Development alone or in-combination on those species assessed above, whilst for the other species within the assemblage there is either no connectivity or route to impact (or both) with the Development.

241 Therefore, no adverse effects of the Development alone or in-combination are predicted on the Forth Islands SPA breeding seabird assemblage.

4.2 Fowlsheugh SPA

242 Fowlsheugh SPA is a mainland seabird colony on the coast of Aberdeenshire, north-east Scotland. The SPA is north-west of the Development Area, and was classified in August 1992, with an additional two kilometre marine extension to the site classified in September 2009. The SPA is underpinned by the Fowlsheugh SSSI.

243 There are no Annex I qualifying features and the whole SPA is designated as an assemblage of more than 20,000 seabirds. The seabird assemblage regularly supports more than 145,000 breeding seabirds with the following named features: razorbill, guillemot, kittiwake, herring gull, and fulmar. Further information on the qualifying features is available in Table 3.4.

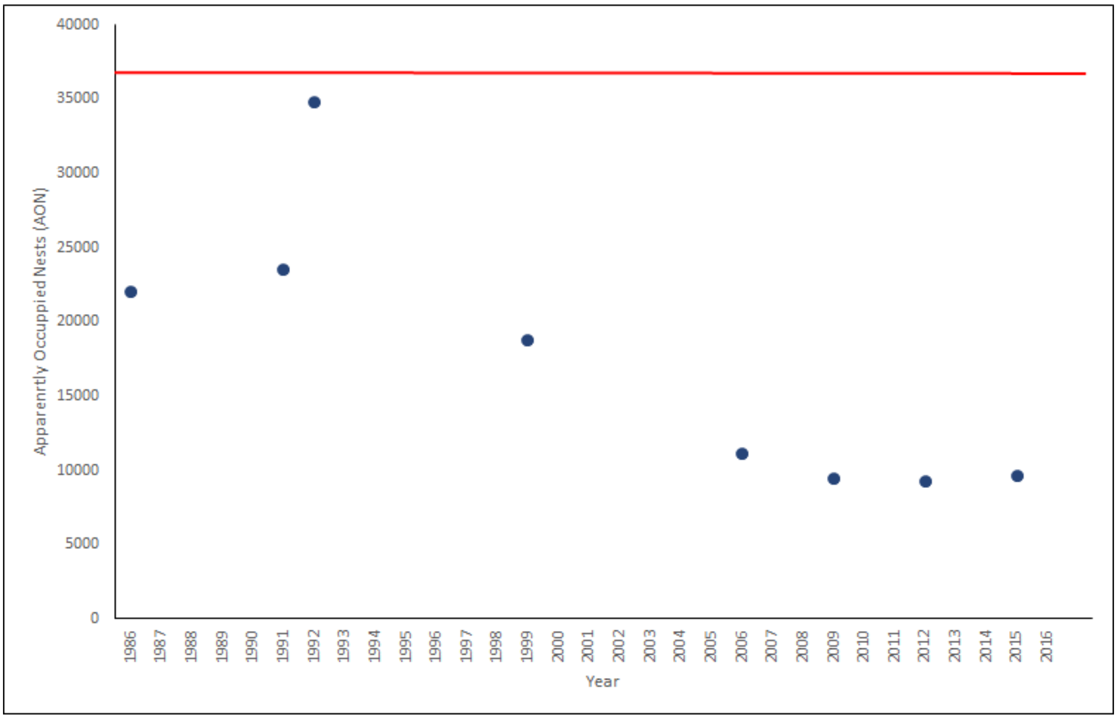
244 The Conservation Objectives of the site are shown in *Section 3*, and are the same as the Conservation Objectives of all SPAs in Scotland at the time of writing.

245 The HRA screening and consultation with MS-LOT and their statutory advisors, SNH, identified that the species resulting in a conclusion of no LSE being rejected were kittiwake, guillemot, and razorbill. The information below provides information on each of these species for the CA to carry out their AA on the Fowlsheugh SPA.

4.2.1 Kittiwake Population

246 The Fowlsheugh SPA kittiwake population has declined since the SPA was designated. The population size has been below the cited population size in all years for which count data available since the mid-1980s. The count data shown in Figure 4.7 are from the JNCC SMP database[10], with the 2015 estimate as provided in the SNH scoping advice[11].

Figure 4.7 Kittiwake population trend at the Fowlsheugh SPA between 1986 and 2015. The red line shows the population size at designation (36,650 pairs).



<u>**Potential impacts on the kittiwake population**</u>

247 The Development, OfTW and associated buffers[6] do not overlap with the Fowlsheugh SPA. Consequently, the potential impacts on its kittiwake population will only occur as a result of individuals from the colony occurring in the Development Area. In relation to kittiwakes, the impacts of concern identified in the Scoping Opinion from MS-LOT were from collisions with operational WTG blades, displacement from the Development Area and a two kilometre buffer, and barrier effects (with the latter two effects subsequently considered together). Data collected on kittiwakes indicate that there is a potential for collisions and displacement to occur (CEH, 2011, and data collected from boat-based surveys from the Development Area and buffer – *Appendix 11A*). From published information on kittiwake foraging ranges generally (Thaxter *et al.,* 2012) and tracking from the SPA specifically (CEH, 2011), it is very likely that during the breeding period kittiwakes from the Fowlsheugh SPA occur within the Development Area and two kilometre buffer, as well as within the proposed development areas of other wind farms in the Forth and Tay. The breeding period for kittiwake is defined as mid-April to August, following the advice of the Scoping Opinion.

248 In the non-breeding season kittiwakes are largely pelagic, with birds from some colonies wintering as far west as the coast of eastern Canada (Frederiksen *et al.,* 2011), though most

kittiwakes breeding on the North Sea coast likely winter in the North Sea and Celtic Sea. Therefore, it is likely that there is the potential for birds from the Forth Islands SPA population to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to December and January to mid-April, respectively, following the advice of the Scoping Opinion). In their Scoping Opinion, MS-LOT recommended using the BDMPS to apportion the estimated collisions from UK North Sea wind farms to the Fowlsheugh SPA population during the autumn and spring passage periods (Furness, 2015). Following correspondence between ICOL, SNH and MS-LOT[7], the approach adopted followed that used to apportion passage period collisions to the Flamborough Head and Filey Coast pSPA kittiwake population in the assessment for the East Anglia THREE wind farm (MacArthur Green, 2015b, Royal HaskoningDHV *et al.,* 2015), which was in turn based upon the BDMPS approach.

249 In addition, it was advised in the Scoping Opinion[7] that collision estimates for the wind farms in the UK North Sea should be amended from those presented in the East Anglia THREE assessment (Royal HaskoningDHV *et al.,* 2015) according to the report on Estimates of Ornithological Headroom in Offshore Wind Farm Collision Mortality (MacArthur Green, 2017). However, for the Development and the each of the other three Forth and Tay wind farms, the passage period collision estimates were as calculated in the CRMs for the current assessment (see below). The full details of the methods and approach used to apportion the estimated collisions from wind farms in the UK North Sea to the Fowlsheugh SPA kittiwake population are detailed in *Appendix 11B*.

250 In relation to displacement during the non-breeding period, MS-LOT advised in their Scoping Opinion that effects should be considered qualitatively.

Predicted collision impacts alone and in-combination

Estimation of impacts

251 CRMs were undertaken using the Band (2012) model to predict the number of birds at risk from collisions both for the Development-alone and in-combination scenarios. Following the Scoping Opinion from MS-LOT, the assessment for kittiwake was based on option 2 of the CRM, but with outputs from option 1 of the CRM also presented for the Development-alone. As detailed above for the Forth Islands SPA gannet population, option 2 of the CRM uses the generic flight height data from Johnston *et al.,* (2014a,b), whilst option 1 uses the site-specific flight height data, as collected during baseline surveys of the Survey Area[9] (*Appendix 11C*). An avoidance rate of 98.9 per cent was used with both CRM options. Thus, the approach in relation to CRM options and avoidance rate was in accordance with the Scoping Opinion and followed the available SNCB advice (SNCBs, 2014).

252 In terms of designs for the Wind Farm, the worst-case scenario for kittiwake collision risk was represented by the 40 WTG design, which is detailed in *Appendix 11C.* Therefore, it is the collision estimates from this design that are presented in this report and used to inform the AA. For the in-combination assessment, both the 2014 and 2017 designs of the other Forth and Tay wind farms were considered in relation to collision risk. The 2014 design represented

the worst-case for each proposed development and is used for the in-combination assessment, although the in-combination collision estimates as calculated using the 2017 designs for these proposed developments are also presented. The 2017 designs for the other Forth and Tay wind farms were based on the information provided by the respective developers. Full details of the CRM methods, inputs and resulting estimates are provided in *Appendix 11C*.

253 The Development-alone and in-combination CRM predictions calculated for the breeding period were apportioned between the different SPA and non-SPA colonies, as outlined above and detailed in *Appendix 11B*. The apportioning calculations were undertaken separately for the Development Area and two kilometre buffer, and for Seagreen Alpha and Bravo combined (plus buffer), with the two Seagreen sites combined for the purposes of the apportioning calculations because they are contiguous along their longest boundary. The Neart na Gaoithe site was beyond the mean maximum foraging range of kittiwakes from the Fowlsheugh SPA (*Appendix 11B*, Thaxter *et al.,* 2012), and was deemed not to have connectivity to the SPA population during the breeding period. On the basis of these calculations, the percentage of the breeding period impacts to kittiwakes from the Development and the Seagreen Alpha and Bravo wind farms attributed to the Fowlsheugh SPA population were as follows:

- The Development – 28.7 per cent; and
- Seagreen Alpha and Bravo – 41.2 per cent.

254 Collision estimates were apportioned to age classes on the basis of the plumage characteristics of kittiwakes recorded during the 'at-sea' baseline surveys for the Survey Area[9] (*Appendix 11A*) and for the other three Forth and Tay wind farms (noting that the Neart na Gaoithe wind farm still had potential to cause collisions to Fowlsheugh SPA kittiwakes during the passage periods). Thus, apportioning to age classes was based upon data specific to each wind farm (*Appendix 11C*). The number of adult collisions during the breeding period was also amended according to an assumed 10 per cent sabbatical rate amongst the breeding adult birds, as advised in the Scoping Opinion (*Appendix 11C).*

255 Development-alone collision estimates were produced by summing the breeding period estimate with the estimates derived for the autumn and spring passage periods (as calculated using the amended BDMPS approach – see above).

256 In-combination collision estimates were also produced by summing the breeding period estimate with the estimates derived for the autumn and spring passage periods, and were undertaken for the following scenarios:

- The Development with the worst-case of the 2014 and 2017 designs for each of the other three Forth and Tay wind farms;
- The Development with the 2017 designs for each of the other three Forth and Tay wind farms; and

- The Development with the worst-case of the 2014 and 2017 designs for each of the other three Forth and Tay wind farms, and the passage period estimates from the other wind farms in the UK North Sea.

257 In addition, qualitative consideration was given to the breeding period collisions arising from other wind farms within mean maximum foraging range of the Fowlsheugh SPA.

<u>*Estimated collision impacts*</u>

Development-alone

258 The predicted impacts on the Fowlsheugh SPA kittiwakes from the Development-alone were small, and mostly on the breeding adult population, with a predicted 10 birds per annum estimated to collide by option 2 of the CRM (Table 4.30). The estimated collision mortality was essentially limited to the breeding period (with only fractions of a bird estimated to collide during passage periods. The predicted number of collisions from the Development-alone on breeding adult birds is small compared with the current (19,310 individuals) and citation (73,300 individuals) population sizes (representing 0.05 per cent and 0.01 per cent of these population sizes, respectively).

259 The breeding period collision estimates for kittiwake from option 1 of the CRM were very low (*Appendix 11C*). Following apportioning and rounding to the nearest integer they equated to zero collisions for the Fowlsheugh SPA population (Table 4.30). As detailed in *Appendix 11C*, this difference results from the lower percentage of kittiwakes estimated to be at PCH by the site-specific data than by the generic data (with this difference most pronounced during the breeding period). The site-specific flight height estimates are based upon a large sample-size and there is relatively strong statistical support for the observed differences in the site-specific and generic flight height estimates (*Appendix 11C*). Furthermore, the difference between the site-specific and generic estimates is such as to make systematic bias in the recording of the kittiwake flight heights during the baseline surveys a highly unlikely explanation for this difference (*Appendix 11C*), whilst it has been established that between-site variability in kittiwake flight heights is high (Johnston *et al* 2014a,b).

260 Consequently, it is considered likely that the use of the option 2 CRM will overestimate the Development-alone collisions, and will result in a highly precautionary assessment.

Table 4.30 Estimated collision impacts from the Development-alone on the kittiwake population at Fowlsheugh SPA. Estimates based on a 98.9% avoidance rate.

Model option	Seasonal period	Estimated number of collisions	
		Breeding adults[1]	Sub-adult birds[2]
2	Breeding	10	1
	Autumn passage[3]	0.4	0.2
	Spring passage[3]	0.1	<0.1
1	Breeding	0	0
	Autumn passage[3]	0.3	0.2
	Spring passage[3]	0.2	<0.1

[1]The number of adult collisions during the breeding period is reduced by 10 % to account for an assumed 10 % sabbatical rate amongst the adults (as advised in the Scoping Opinion).
[2]Juveniles are not distinguished within the sub-adult age class because they were only recorded in the data from the baseline surveys for the Development and are also not distinguished in the collision estimates from the other UK North Sea wind farms (*Appendix 11B*, Royal HaskoningDHV *et al.,* 2015).
[3]Passage period collision estimates presented to 1 decimal place because of the nature of the apportioning calculation (*Appendix 11*).

In-combination

261 The estimated in-combination impacts from the Development with the other Forth and Tay wind farms were more than seven times higher than for the Development-alone, with only a small difference in the estimated impacts as calculated by the 2014 and 2017 designs of the other Forth and Tay wind farms (Table 4.31). The substantial increase between the Development-alone and in-combination collision estimates was due primarily to the higher breeding period collisions estimated at the two Seagreen sites (the breeding period collisions attributed to the adults in the breeding period accounting for the vast majority of the collisions, as for the Development-alone). The estimated in-combination collisions of breeding adults from the Forth and Tay wind farms remains relatively small compared to the current and citation SPA population size, at 0.38 and 0.35 per cent of the current population size (for the 2014 and 2017 design scenarios, respectively) and 0.10 and 0.09 per cent of the citation population size (for the 2014 and 2017 design scenarios, respectively).

Table 4.31 In-combination collisions estimates for the Fowlsheugh SPA kittiwake population for the Development and the other three Forth and Tay wind farms, for both the 2014 and 2017 designs of the other Forth and Tay wind farms.

Wind farm	Seasonal period	Estimated number of collisions (based on option 2 with a 98.9 % avoidance rate)			
		2014 designs for other developments and 2017 for the Development		2017 designs for other developments and the Development	
		Breeding adults[1]	Sub-adults[2]	Breeding adults[1]	Sub-adults[2]
Inch Cape[3]	Breeding	10	1	10	1
Neart na Gaoithe		0	0	0	0
Seagreen Alpha		27	2	26	2
Seagreen Bravo		30	2	28	2
Inch Cape[3]	Autumn passage[4]	0.4	0.2	0.4	0.2
Neart na Gaoithe		0.5	0.3	0.2	0.1
Seagreen Alpha		1.3	0.7	1.2	0.7
Seagreen Bravo		0.7	0.4	0.7	0.4
Inch Cape[3]	Spring passage[4]	0.1	<0.1	0.1	<0.1
Neart na Gaoithe		0.1	<0.1	<0.1	<0.1
Seagreen Alpha		0.7	0.3	0.7	0.3
Seagreen Bravo		0.9	0.4	0.8	0.4
TOTAL[5]	**All seasons combined**	**71**	**7**	**67**	**7**

[1]The number of adult collisions during the breeding period is reduced by 10 % to account for an assumed 10 % sabbatical rate amongst the adults (as advised in the Scoping Opinion).
[2]Juveniles are not distinguished within the sub-adult age class because they were only recorded in the data from the baseline surveys for the Development and are also not distinguished in the collision estimates from the other UK North Sea wind farms (*Appendix 11B*, Royal HaskoningDHV *et al.,* 2015).
[3]Only the 2017 design is considered for the Development, with collision estimates as in Table 4.30.
[4]Passage period collision estimates presented to 1 decimal place because of the nature of the apportioning calculation (*Appendix 11B*).
[5]Totals may differ by a small amount from the summed numbers in the above table cells due to rounding errors.

262 The final in-combination scenario that was considered involved the collision estimates for the Development with the 2014 designs for each of the other three Forth and Tay wind farms (the 2014 design being the worst-case for each of these wind farms), plus the passage period

collision estimates from other wind farms in the UK North Sea. The inclusion of the collision estimates from the other UK North Sea wind farms substantially increased the impacts during both passage periods, although the combined passage period collisions of adult birds still represented only 23 per cent of the total adult collisions (Table 4.32).

263 Overall, the total predicted in-combination collision mortality to adult kittiwakes from the Fowlsheugh SPA was 88 birds per annum, when the worst-case design for the other Forth and Tay wind farms was assumed and when passage period collision estimates from other UK North Sea wind farms were included (Table 4.32). This remains a relatively small proportion of the Fowlsheugh SPA population size currently (0.46 per cent) and at citation (0.12 per cent)

Table 4.32 Estimated in-combination collisions for the Fowlsheugh SPA kittiwake population for the Development and the 2014 designs of the other three Forth and Tay wind farms (as derived from Table 4.31)[1] combined with the passage period collisions from other UK North Sea wind farms.

Wind farms	Seasonal period	Estimated number of collisions	
		Breeding adults[2]	Sub-adult birds[3]
Forth and Tay	Breeding	66	5
Forth and Tay	Autumn passage[4]	2.7	1.6
Other UK North Sea		6.7	4.0
Total autumn passage		**9.4**	**5.6**
Forth and Tay	Spring passage[4]	1.7	0.8
Other UK North Sea		10.3	4.5
Total spring passage		**12.0**	**5.3**
TOTAL[5]	**All seasons**	**88**	**16**

[1]The 2014 design represents the worst-case of the 2014 and 2017 designs for each of the other three Forth and Tay wind farms.
[2]The number of adult collisions during the breeding period is reduced by 10 % to account for an assumed 10 % sabbatical rate amongst the adults (as advised in the Scoping Opinion).
[3]Juveniles are not distinguished within the sub-adult age class because they were only recorded in the data from the baseline surveys for the Development and are also not distinguished in the collision estimates from the other UK North Sea wind farms (*Appendix 11B*, Royal HaskoningDHV *et al.,* 2015).
[4]Passage period collision estimates presented to 1 decimal place because of the nature of the apportioning calculation (*Appendix 11B*).
[5]Totals may differ by a small amount from the summed numbers in the above table cells due to rounding errors.

Predicted displacement impacts alone and in-combination

264 The SNCB matrix approach provided the main basis for estimating impacts from displacement (as advised in the Scoping Opinion[13]), and was used to estimate the additional mortality

attributable to the Fowlsheugh SPA kittiwake population as a result of displacement (and barrier effects) during the breeding period. Following the advice of the Scoping Opinion, the mortality from displacement was calculated using the peak breeding period population size, averaged over the two years of survey, for the Development Area and two kilometre buffer (combining birds on the water and in flight). A displacement rate of 30 per cent was applied to this mean peak estimate, with two per cent of the displaced birds assumed to die. The estimated mortality from displacement, as calculated by the matrix approach, was apportioned to the Fowlsheugh SPA population and across the population age classes in the same way as for the breeding period collision estimates (see above).

265 For the Development-alone the apportioning was based on a mean peak of 3,866 birds, of which 93 per cent were adults (3,595 birds) and 28.7 per cent were from the Fowlsheugh SPA (1,032 birds) and 10 per cent were birds on sabbatical (giving 929 adult birds from the Fowlsheugh SPA population). Applying the advised 30 per cent displacement rate and two per cent mortality rate, gives an estimated mortality of six adult birds per annum (Table 4.33). This predicted displacement mortality from the Development-alone on breeding adult birds is very small compared with the current (19,310 individuals) and citation (73,300 individuals) population sizes (0.03 per cent and 0.01 per cent, respectively).

Table 4.33 Displacement matrix for adult kittiwakes from the Fowlsheugh SPA in the breeding season. Based on mean peak abundance apportioned to adult birds from the Fowlsheugh SPA. Recommended displacement rate and mortality rate is shown in green, and the resulting displacement mortality in dark green.

		DISPLACEMENT										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
MORTALITY	0%	0	0	0	0	0	0	0	0	0	0	0
	1%	0	1	2	3	4	5	6	7	7	8	9
	2%	0	2	4	6	7	9	11	13	15	17	19
	3%	0	3	6	8	11	14	17	20	22	25	28
	4%	0	4	7	11	15	19	22	26	30	33	37
	5%	0	5	9	14	19	23	28	33	37	42	46
	10%	0	9	19	28	37	46	56	65	74	84	93
	15%	0	14	28	42	56	70	84	98	111	125	139
	20%	0	19	37	56	74	93	111	130	149	167	186
	30%	0	28	56	84	111	139	167	195	223	251	279
	40%	0	37	74	111	149	186	223	260	297	334	372

	DISPLACEMENT										
	0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
50%	0	46	93	139	186	232	279	325	372	418	465
60%	0	56	111	167	223	279	334	390	446	502	557
70%	0	65	130	195	260	325	390	455	520	585	650
80%	0	74	149	223	297	372	446	520	595	669	743
90%	0	84	167	251	334	418	502	585	669	752	836
100%	0	93	186	279	372	465	557	650	743	836	929

266 The displacement matrix predictions for the Development in-combination with the Seagreen Alpha and Bravo wind farms (there being no connectivity with the Neart na Gaoithe wind farm during the breeding period) were apportioned between SPA colonies and between age classes (Table 4.34). The predicted in-combination mortality from displacement of Fowlsheugh SPA kittiwakes during the breeding period is approximately three times greater than for the Development-alone, with a total estimated mortality of 16 breeding adults and one sub-adult bird per annum (Table 4.34). This level of additional mortality remains small compared with the current (19,310 individuals) and citation (73,300 individuals) population sizes (with the adult mortality representing 0.08 per cent and 0.02 per cent, respectively).

Table 4.34 Estimated mortality of Fowlsheugh SPA kittiwakes in the breeding period as a result of displacement from the Development in-combination with the Seagreen Alpha and Bravo wind farms.

Project	Mean peak estimate (individuals)	Adult proportion[1]	SPA proportion	Sabbatical proportion	Additional mortality	
					Breeding adults	Sub-adults
Inch Cape	3,866	0.93	0.287	0.10	5.6	0.5
Seagreen Alpha	2,220	0.93	0.412		4.6	0.4
Seagreen Bravo	2,707	0.95	0.412		5.7	0.3
TOTAL	8,793	-	-	-	16	1.2

[1]Based on data from site surveys (*Appendix 11A* and *11C*).

267 The Scoping Opinion from MS-LOT requested that a qualitative assessment of displacement of kittiwakes in the non-breeding period was provided. As discussed above, evidence from geo-locator tracking of kittiwakes from colonies around the North Atlantic have shown that

kittiwakes occur across a large sea area from the Barents Sea to Canada (Frederiksen *et al.,* 2011). Details from Frederiksen *et al.,* (2011) predicted that almost half of the winter population of kittiwakes in the North Sea were from colonies around the North Sea. So, it seems likely that half of the adult kittiwakes from the Fowlsheugh SPA colonies also spend the non-breeding seasons in the North Sea. However, the remaining (approximately) half of the birds likely winter in areas from the Celtic-Biscay shelf to eastern Canada. Therefore, from these data, it is reasonable to conclude that kittiwakes from the Fowlsheugh SPA are not dependent on any particular area and use large areas of sea, and therefore the likely effects of displacement from offshore wind farms in the North Sea, or elsewhere, during the non-breeding period are likely to have little or no effect on the Fowlsheugh SPA population.

268 As described for the Forth Islands SPA kittiwake population (*Section 4.1.2* above), impacts from displacement and barrier effects were also estimated using the SeabORD and Searle *et al.,* (2014) individual-based modelling approaches. These estimates and the comparisons with the SNCB matrix estimates are presented in *Appendix 11D*.

<u>Predicted combined collision risk and displacement impacts alone and in-combination</u>

269 The combined predicted impacts from collisions and displacement were assumed to be additive. Thus, the combined impact from the Development-alone was an additional mortality of 15 adult birds per annum (and approximately one sub-adult bird per annum) from the Fowlsheugh SPA (Table 4.35). Combining collision and displacement impacts for the in-combination scenario comprising the Development with the other three Forth and Tay wind farms gave an additional mortality of 86 adult and eight sub-adult birds per annum, whilst the worst-case in-combination scenario (which also incorporated the passage period collisions from the other UK North Sea wind farms) gave an overall additional mortality of 103 adult and 17 sub-adult birds per annum.

270 These mortality estimates for the different in-combination scenarios with impacts from collisions and displacement combined represent relatively small proportions of the current (19,310 individuals) and citation (73,300 individuals) population sizes (at 0.45 – 0.53 per cent and 0.12 – 0.14 per cent, respectively, for the adult mortality).

Table 4.35 Combined predicted collision plus displacement mortality to the Fowlsheugh SPA kittiwake population for the Development-alone and two in-combination scenarios. Both in-combination scenarios use the 2014 designs for each the other three Forth and Tay wind farms

Scenario	Season	Breeding adults[1]	Sub-adults[1]
Development-alone	Breeding	15	1
	Autumn passage[2]	0.4	0.2
	Spring passage[2]	0.1	<0.1
	Breeding	82	6

Scenario	Season	Breeding adults[1]	Sub-adults[1]
In-combination – Development with other Forth and Tay wind farms	Autumn passage[2]	2.7	1.6
	Spring passage[2]	1.7	0.8
In-combination – Development with other Forth and Tay wind farms plus passage collisions from other UK North Sea wind farms	Breeding	82	6
	Autumn passage[2]	9.5	5.6
	Spring passage[2]	12.0	5.3

[1]The estimated additional mortality values are derived from those provided in Tables 4.32 and 4.34 but may differ slightly to the summed totals from these earlier tables due to rounding errors.
[2]Passage period collision estimates presented to 1 decimal place because of the nature of the apportioning calculation (*Appendix 11B*).

Impacts from other wind farms within foraging range

271 As detailed above for the Forth Islands SPA gannet population, several offshore wind farms other than Neart na Gaoithe and Seagreen Alpha and Bravo occur within mean maximum foraging range of breeding kittiwakes from the Fowlsheugh SPA (as defined by Thaxter *et al.,* 2012). The advice from the Scoping Opinion was to consider the breeding season effects from these wind farms qualitatively.

272 These wind farms are:

- Aberdeen Offshore Wind Farm;
- Kincardine Floating Offshore Wind Farm,

273 The breeding period collision mortality of kittiwakes at the Aberdeen Offshore Wind Farm is estimated to be nine (based upon the data extracted from the East Anglia THREE assessment (Royal HaskoningDHV *et al.,* 2015), and updated in accordance with the report on Estimates of Ornithological Headroom in Offshore Wind Farm collision mortality (MacArthur Green, 2017), as described in *Appendix 11B*). Applying the age distribution from the 'at sea' surveys for the Development (93 per cent adults) to this estimate gives eight collisions per breeding period. The Aberdeen Offshore Wind Farm is located between the Fowlsheugh and Buchan Ness to Collieston Coast SPAs, but is more than twice as far from the former than from the latter (with the Buchan Ness to Collieston Coast SPA kittiwake population also being larger than the Fowlsheugh SPA population[11]). There are also numerous non-SPA kittiwake colonies located between these two SPAs (e.g. at Stonehaven to Wine Cove, Findon Ness to Hare Ness and Gridle Ness to Hare Ness – *Appendix 11B, Annex 11B.1*). Given this, a relatively small proportion (probably less than 10 per cent) of these collisions is likely to be attributable to the Fowlsheugh SPA population.

274 The total collision estimate per breeding period for the Kincardine Floating Offshore Wind Farm was 28 birds, with the apportioning calculations undertaken in the developer's assessment suggesting that eight of these were attributable to the Fowlsheugh SPA (KOWL, 2016). The AA for this wind farm states that SNH considered that this apportioning calculation was erroneous and that 16 of the collisions were attributable to the Fowlsheugh SPA (MS, 2017). However, the SNH estimate also appears to be incorrect.

275 Examination of the SMP database[10] shows that there are numerous non-SPA colonies within the mean maximum foraging range of the Kincardine Floating Offshore Wind Farm, with many of these being closer than the Fowlsheugh SPA to the wind farm. Although there are recent count data (mainly 2017) available for many of these non-SPA colonies, this is not the case for the Stonehaven to Wine Cove sites (for which the most recently available count data are from 1999[10], and for which kittiwake numbers at that time were high – *Appendix 11B, Annex11B.1*). Given this, a precautionary apportioning calculation was undertaken using the two-step approach advised in the Scoping Opinion (*Appendix 11B*). This included only the Buchan Ness to Collieston Coast SPA, the Fowlsheugh SPA and the non-SPA colonies on the Kincardine and Deeside coast (with the distances of the two SPAs to the wind farm being taken as 27 and 16 kilometres, respectively (KOWL, 2016), and all the non-SPA colonies being assumed to be the same distance from the wind farm as the Fowlsheugh SPA, although the vast majority are closer). This calculation suggested that at most 12 of the 28 kittiwake breeding period collisions should be apportioned to the Fowlsheugh SPA, which equates to 11 adult birds when the age distribution from the 'at sea' surveys for the Development are applied.

276 Based upon the above, the Aberdeen Offshore Wind Farm and the Kincardine Floating Offshore Wind Farm together could contribute a further 12 collisions to the total estimated for the Fowlsheugh SPA kittiwake population (assuming 10 per cent of the eight collisions from the former and 11 collisions from the latter). This represents a small proportion of the current SPA population size (0.06 per cent) and is approximately 12 per cent of the worst-case in-combination impact calculated above (Table 4.35). This would have a relatively small effect on the estimated in-combination impacts and would not affect the conclusions of the assessment.

277 Both of these wind farms are relatively small developments, comprising 11 and six to eight WTGs each. As such, any impacts from displacement and barrier effects will be minor and will not affect the conclusions of the assessment.

Population Viability Analysis of the kittiwake population

278 PVA was used to determine the effects of the predicted collision and displacement impacts from the Development-alone, and in-combination, on the Fowlsheugh SPA kittiwake population. Following the advice of the Scoping Opinion, PVAs were produced both for collisions only, and for collisions plus displacement. For the purposes of assessing the population-level impacts on the basis of the PVA, all collision estimates were derived from option 2 of the CRM, whilst the in-combination impacts used the 2014 designs of the other three Forth and Tay wind farms (as these represented the worst-case for each of these wind

farms – Table 4.31). Estimates of displacement impacts were as derived by the SNCB matrix (Table 4.34).

279 The Fowlsheugh SPA kittiwake population model produced for the current assessment was a stochastic, density independent, model based on a Bayesian state-space modelling framework. It was adapted from the earlier Fowlsheugh SPA kittiwake population model developed by Freeman *et al.,* (2014), updated according to recently available population and demographic data. Further details of the models are provided in *Appendix 11E*.

280 The predicted population trends under baseline conditions (i.e. without wind farm impacts) were projected over both 28 and 53 year timescales. Additional mortality within the PVA was not incorporated until after year three of the projection (giving 25 and 50-year impact periods) to provide a more realistic representation of the likely population status at the time when the potential impacts will begin to arise. The additional mortality was incorporated on the basis of the percentage point change to the annual mortality of adult and sub-adult birds.

281 Outputs from the PVA were summarised according to the median predicted population sizes at the end of the projection period, and the three metrics which the Scoping Opinion advised should be used for the interpretation and which are defined above in the section on the Forth Islands SPA gannet population.

282 The PVA population models projected continuing population decline for the Fowlsheugh SPA kittiwake population with and without impacts for the Development-alone and in-combination. The median end population size for each modelled impact (Table 4.36) was lower than the current SPA population size (9,655 pairs), and the projected population size at 50 years was always smaller than that at 25 years.

283 The PVA metrics (Table 4.37) show that for the Development-alone the counterfactual of population size indicated small reductions in end population size after both 25 years and 50 years of impact (with the values being 0.977 and 0.964 for collisions only and collisions and displacement combined, respectively, after 50 years of impact – Table 4.37). The decrease in annual population growth rate was not detectable for collisions only (at least when the counterfactual was taken to three decimal places – i.e. it remained at the value of 1.000), and was minimal for collisions and displacement combined (with the value being 0.999). The centile values for both collisions only and collisions and displacement were 49 even after 50 years of impacts, indicating very considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period. It should also be borne in mind that these metrics derive from PVAs based upon option 2 collision estimates, which are an order of magnitude higher than those generated by the option 1 CRM. As outlined in *Appendix 11C,* there are good reasons for considering the site-specific flight heights (and hence the option 1 collision estimates) to be representative of the kittiwakes within the Development Area and two kilometre buffer.

284 In terms of the in-combination, as expected, the population-level impacts were greatest for the scenario incorporating the other three Forth and Tay wind farms plus the passage period

collision estimates from the other UK North Sea wind farms (Table 4.37). These gave modest scale reductions of up to 22 per cent in end population size after 50 years of impact (values of 0.808 and 0.779 for collisions only and collisions and displacement combined, respectively) but considerably smaller reductions of 12 per cent or less after 25 years of impact (values of 0.896 and 0.879 for collisions only and collisions and displacement combined, respectively). The reductions in annual population growth rate remained relatively small (with counterfactual values of 0.996 and 0.995 for collisions only and collisions and displacement combined), whilst the centile values ranged from 41 to 44 for the 25 and 50 year impact periods (Table 4.37), indicating considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a reasonable likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period.

285 The population projections in all cases showed that the end population size was much less than the population size at citation (36,650 pairs). However, for the Development-alone impacts the difference in the end population sizes after 25 years and 50 years was only 50 pairs and the median predicted population size was still sufficiently large to allow recovery at 3,950 pairs and 1,750 pairs respectively. This is also the case for the in-combination scenario which gives greatest population-level impacts, for which the population sizes after 25 and 50 years of impact were estimated to be 3,550 and 1,400 pairs, respectively (Table 4.36).

286 The reasons for population decline in kittiwakes in the North Sea and the Forth and Tay region (including the Fowlsheugh SPA) have been suggested as fisheries management and climate change (Frederiksen *et al.,* 2004). With fisheries now more appropriately managed in the Forth and Tay region, it may be that the recent small scale changes in the size of the Fowlsheugh SPA population may indicate an end to the decline, as could be the case with the Forth Islands SPA kittiwake population (see above). However, changes caused by climate change that are also hypothesised to be affecting the Fowlsheugh SPA kittiwake population, may still be affecting the population in 25 and 50 years. The primary management option to prevent climate change affecting the Fowlsheugh SPA kittiwake population will be through global initiatives to mitigate greenhouse gas emissions (e.g. 21st Conference of the Parties of the UNFCCC (COP21)). Therefore, while the conservation status of the Fowlsheugh SPA population is projected to be in unfavourable condition the effects of the Development-alone, and in-combination, will not result in any important change to this, nor prevent recovery in the event of the factors causing population decline being reversed.

Table 4.36 Projected end population size of the Fowlsheugh SPA kittiwake population after 25 and 50 years for baseline, Development-alone and two in-combination scenarios in relation to collision impacts and collision plus displacement impacts.

Impacts	Scenario	Percentage point change in mortality		Median number of breeding females (5th – 95th centiles)	
		Adults	Sub-adults	25 years	50 years
No impacts	Baseline	0	0	4,000 (1,350 – 12,200)	1,800 (300 – 10,900)
Collisions only	Development-alone	0.052	0.006	4,000 (1,350 – 12,150)	1,750 (300 – 10,700)
	In-combination – Development with other Forth and Tay wind farms	0.364	0.042	3,700 (1,200 – 11,250)	1,500 (250 – 9,300)
	In-combination – Development with other Forth and Tay wind farms plus passage collisions from other UK North Sea wind farms	0.452	0.091	3,600 (1,200 – 11,000)	1,450 (250 – 8,850)
Collisions and displacement combined	Development-alone	0.081	0.009	3,950 (1,300 – 12,050)	1,750 (300 – 10,450)
	In-combination – Development with other Forth and Tay wind farms	0.446	0.048	3,650 (1,200 – 11,050)	1,450 (250 – 9,000)
	In-combination – Development with other Forth and Tay wind farms plus passage collisions from other UK North Sea wind farms	0.534	0.098	3,550 (1,150 – 10,800)	1,400 (250 – 8,600)

Table 4.37 PVA metrics for the Fowlsheugh SPA kittiwake population after 25 and 50 years for the Development-alone and two in-combination scenarios in relation to collision impacts and collision plus displacement impacts.

Impacts	Scenario	Counterfactual of end population size		Counterfactual of population growth rate[1]	Centile of baseline population matching the median of the impacted population	
		25 years	50 years	25 and 50 years	25 years	50 years
No impact	Baseline	1.000	1.000	1.000	50	50
Collisions only	Development-alone	0.988	0.977	1.000	49	49
	In-combination – Development with other Forth and Tay wind farms	0.919	0.847	0.997	45	44
	In-combination - Development with other Forth and Tay wind farms plus passage collisions from other UK North Sea wind farms	0.896	0.808	0.996	44	42
Collisions and displacement combined	Development-alone	0.981	0.964	0.999	49	49
	In-combination – Development with other Forth and Tay wind farms	0.902	0.819	0.996	44	43
	In-combination - Development with other Forth and Tay wind farms plus passage collisions from other UK North Sea wind farms	0.879	0.779	0.995	42	41

[1]The value of this metric does not vary according to the length of the projection period.

Conclusion

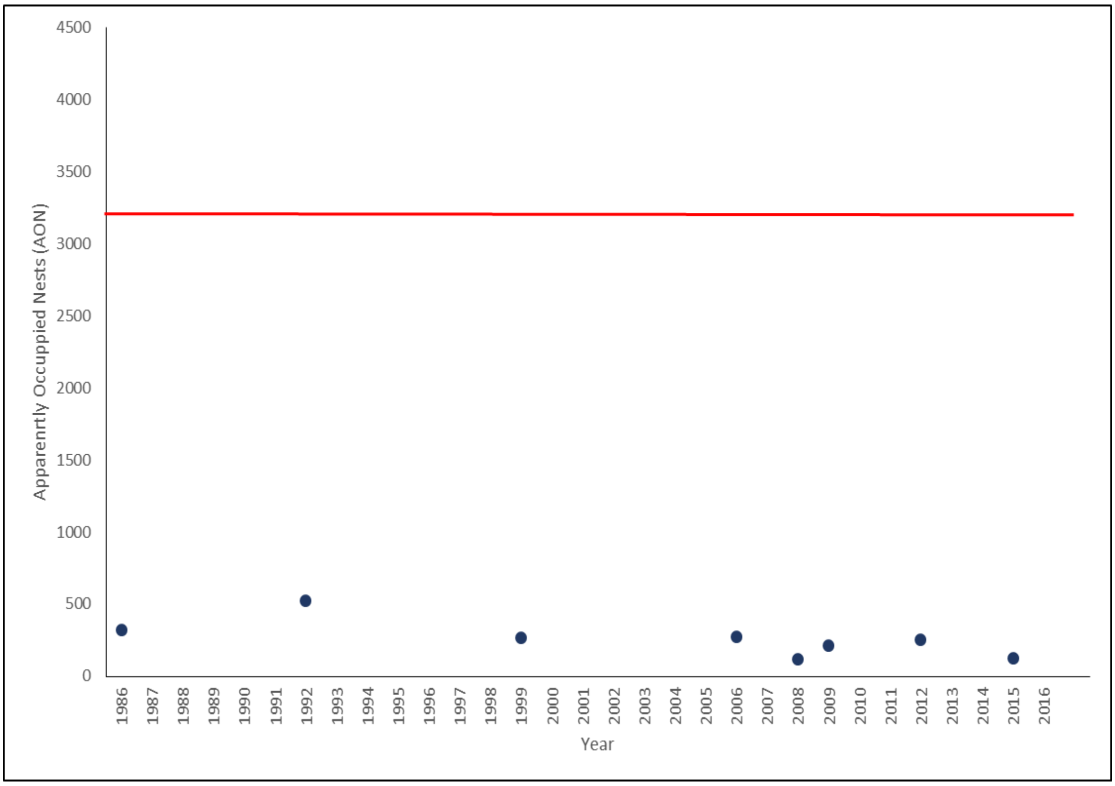
287 The predicted impacts from the Development-alone and in-combination were at most of a modest scale, and the outputs from the PVA indicate limited population-level effects. Based upon the PVA projections, the Conservation Objective of the SPA, to maintain the "population of the species as a viable component of the site", will not to be met even without the impacts from the Development-alone and in-combination. However, the predicted impacts of the Development-alone and in-combination are sufficiently small that it is considered they will effectively not contribute to accelerating the rate of the ongoing population decline, nor will they prevent population increase should environmental conditions become more favourable for kittiwakes. Accounting for the impacts from the other wind farms within foraging range of the Fowlsheugh SPA which were considered qualitatively does not affect this conclusion. It should therefore be possible for the CA to conclude, beyond reasonable scientific doubt, that the Development-alone, and in-combination, will have no adverse effect on site integrity due to the effects on the kittiwake population.

4.2.2 Herring Gull Population

288 In their scoping opinion, MS-LOT stated that SNH recommend providing updated CRM results for herring gull in the breeding and non-breeding seasons. In-combination assessment was recommended at the Forth and Tay regional scale only.

289 The Fowlsheugh SPA herring gull population has only been counted across the whole SPA regularly since 1986 (Figure 4.8). The SPA count data suggest that the colony has not been above the citation size (3,190 pairs) since the SPA was designated. Over the period of the available count data the population size has declined. The current population size is 125 pairs. The count data in Figure 4.8 were from the JNCC SMP database[10], with the 2015 count as provided in the SNH scoping advice[11].

Figure 4.8 Herring gull population trend at the Fowlsheugh SPA between 1986 and 2015. The red line shows the population size at designation (3,190 pairs).



<u>**Potential impacts on the herring gull population**</u>

290 The Development, OnTW and associated buffers do not overlap with the Fowlsheugh SPA. Consequently, the potential impacts on its herring gull population will only occur as a result of individuals from the colony occurring in the Development Area. The impacts of concern identified in the Scoping Opinion from MS-LOT were from collisions of herring gulls with operational WTG blades which could impact on the population from the Fowlsheugh SPA. Data on herring gull from boat-based surveys from the Development Area and two kilometre buffer indicate that there is a potential for collisions to occur. From published information on herring gull foraging ranges (Thaxter *et al.,* 2012) it is likely that breeding herring gull from the Fowlsheugh SPA will occur within the Development Area and two kilometre buffer, as well as within the proposed development areas of other wind farms in the Forth and Tay. The breeding period of herring gull is defined as April to August, following the advice of the Scoping Opinion.

291 In the non-breeding season adult herring gulls in Great Britain are largely sedentary, with relatively short local movements only (Wernham *et al.,* 2002). However, there is an influx of breeding birds of Scandinavian breeding sub-species, *L. argentatus argentatus* (Coulson *et al.,* 1984). The apportioning of impacts to the Fowlsheugh SPA herring gull population in the breeding and non-breeding periods is detailed in *Appendix 11B*.

Predicted collision impacts alone and in-combination

Estimation of impacts

292 CRMs were undertaken using the Band (2012) model to predict the number of birds at risk from collisions both for the Development-alone and in-combination. Following the Scoping Opinion from MS-LOT, the assessment for herring gull was based on option 3 of the CRM, but with outputs from options 1 and 2 of the CRM also presented for the Development-alone. Option 3 of the CRM uses the modelled flight height distributions based on the generic flight height data from Johnston *et al.,* (2014a,b), whilst options 1 and 2 assume uniform flight height distributions based on site-specific and generic flight height data, respectively (*Appendix 11C*). An avoidance rate of 99.0 per cent was used with the option 3 CRMs and of 99.5 per cent with the options 1 and 2 in accordance with the Scoping Opinion and following the available SNCB advice (SNCBs, 2014).

293 In terms of the designs for the Wind Farm, the worst-case scenario for herring gull collision risk was represented by the 72 WTG design, so differing in this respect from gannet and kittiwake (*Appendix 11C*). Therefore, it is the collision estimates from this design that are presented in this report and used to inform the AA. For the in-combination assessment, both the 2014 and 2017 designs of the Seagreen Alpha and Bravo wind farms were considered in relation to collision risk. The Neart na Gaoithe site was beyond the mean maximum foraging range of herring gulls from the Fowlsheugh SPA (Thaxter *et al.,* 2012), and was deemed not to have connectivity to the SPA population during either the breeding or non-breeding periods (*Appendix 11B*). The 2014 design represented the worst-case for each of the Seagreen sites and is used for the in-combination assessment, although the in-combination collision estimates as calculated using the 2017 designs for these proposed developments are also presented. The 2017 designs for the Seagreen Alpha and Bravo were based on the information provided by the respective developer. Full details of the CRM methods, inputs and resulting estimates are provided in *Appendix 11C.*

294 The Development-alone and in-combination CRM predictions calculated for the breeding period were apportioned between the different SPA and non-SPA colonies, as outlined above and detailed in *Appendix 11B*. The apportioning calculations were undertaken separately for the Development Area and two kilometre buffer, and for Seagreen Alpha and Bravo combined (plus buffer). The two Seagreen sites were combined for the purposes of the apportioning calculations because they are contiguous along their longest boundary. On the basis of these calculations, the percentage of the breeding period impacts to herring gulls from the Development and the two Seagreen wind farms attributed to the Fowlsheugh SPA population were as follows:

- The Development – 0.6 per cent
- Seagreen Alpha and Bravo – 1.3 per cent

295 The above apportioning estimates for the breeding period were also applied to the non-breeding period, which will be precautionary because it does not account for the influx of birds

to the UK (and particularly the east coast) from northern European breeding populations (Furness, 2015, *Appendix 11B*).

296 Collision estimates were apportioned to age classes on the basis of the plumage characteristics of herring gulls recorded during the 'at-sea' baseline surveys for the Survey Area[9] (*Appendix 11A*) and for each of the Seagreen Alpha and Bravo wind farms (*Appendix 11C*). Thus, apportioning to age classes was based upon data specific to each wind farm. The number of adult collisions was also amended according to an assumed 35 per cent sabbatical rate amongst the breeding adult birds, as advised in the Scoping Opinion (*Appendix 11C*).

297 Development-alone and in-combination collision estimates were produced by summing the respective breeding and non-breeding period estimates. In-combination collision estimates were undertaken for the following scenarios:

- The Development with the worst-case of the 2014 and 2017 designs for each of the Seagreen Alpha and Bravo wind farms
- The Development with the 2017 designs for each of the Seagreen Alpha and Bravo wind farms

298 In addition, qualitative consideration was given to the breeding period collisions arising from other wind farms within mean maximum foraging range of the Fowlsheugh SPA.

Estimated collision impacts

Development-alone

299 The predicted impacts on the Fowlsheugh SPA herring gulls from the Development-alone were extremely small with fewer than 0.01 birds from the breeding age class estimated to collide per annum, as estimated by option 3 of the CRM (Table 4.38). The collision estimates for the sub-adult age class were similarly small. The predicted number of collisions per annum from the Development-alone on breeding adult birds was small compared with the current (250 individuals) and citation (6,380 individuals) population sizes (0.003 per cent and 0.0001 per cent, respectively).

300 Collision estimates by options 1 and 2 of the CRM were similar to those produced by option 3 (Table 4.38), with the option 1 estimates giving no collisions during the breeding period – *Appendix 11C*).

Table 4.38 Estimated collision impacts from the Development-alone on the herring gull population at Fowlsheugh SPA. Estimates based on avoidance rates of 99.0% for option 3 and 99.5% for options 1 and 2.

Model option	Seasonal period	Estimated number of collisions[1]	
		Breeding adults[2]	Sub-adult birds[3]
3	Breeding	<0.1	<0.1
	Non-breeding	<0.1	<0.1
2	Breeding	<0.1	0.0
	Non-breeding	<0.1	<0.1
1	Breeding	0.0	0.0
	Non-breeding	<0.1	<0.1

[1]Collision estimates are presented to 1 decimal place because of the small numbers of total collisions estimated to occur.
[2]The number of adult collisions is reduced by 35 % to account for an assumed 35 % sabbatical rate amongst the adults (as advised in the Scoping Opinion).
[3]Juveniles are not distinguished within the sub-adult age class because they were only recorded in the data from the baseline surveys for the Development.

In-combination

301 The estimated in-combination collisions for the Development with the Seagreen Alpha and Bravo wind farms remained low and for both the breeding and non-breeding periods combined did not exceed 0.1 adult birds per annum (Table 4.39). Due to the very low collision estimates, there was no discernible difference between the scenarios incorporating the different designs for the Seagreen Alpha and Bravo wind farms (i.e. the 2014 and 2017 designs).

302 Overall, the total predicted in-combination collision mortality to adult herring gulls from the Fowlsheugh SPA represented only 0.03 per cent of the current population size and 0.001 per cent of the citation population size. Based on an annual survival rate of 83.4 per cent for adult herring gulls (Horswill and Robinson, 2015), the mortality of adult herring gulls from the Fowlsheugh SPA population will equate to 41 individuals each year in the absence of any wind farm impacts. Therefore, the in-combination collision estimates would represent an increase in the baseline annual adult mortality of 0.19 per cent (which is precautionary, given the approach taken to apportioning collisions to SPA populations in the non-breeding period).

Table 4.39 In-combination collision estimates for the Fowlsheugh SPA herring gull population for the Development and the Seagreen Alpha and Bravo wind farms, for both the 2014 and 2017 designs of the Seagreen Alpha and Bravo wind farms.

Other offshore wind farm	Seasonal period	Estimated number of collisions (based on option 3 with a 99.0 % avoidance rate)[1]			
		2014 designs for other developments and 2017 for the Development		2017 designs for other developments and the Development	
		Breeding adults[2]	Sub-adults[3]	Breeding adults[2]	Sub-adults[3]
Inch Cape[4]	Breeding	<0.1	<0.1	<0.1	<0.1
Seagreen Alpha		<0.1	<0.1	<0.1	<0.1
Seagreen Bravo		<0.1	<0.1	<0.1	<0.1
Total breeding		**<0.1**	**<0.1**	**<0.1**	**<0.1**
Inch Cape[4]	Non-breeding	<0.1	<0.1	<0.1	<0.1
Seagreen Alpha		<0.1	<0.1	<0.1	<0.1
Seagreen Bravo		<0.1	<0.1	<0.1	<0.1
Total non-breeding		**<0.1**	**0.1**	**<0.1**	**0.1**
TOTAL	**All seasons**	**0.1**	**0.1**	**0.1**	**0.1**

[1]Collision estimates are presented to 1 decimal place because of the small numbers of total collisions estimated to occur.
[2]The number of adult collisions is reduced by 35 % to account for an assumed 35 % sabbatical rate amongst the adults (as advised in the Scoping Opinion).
[3]Juveniles are not distinguished within the sub-adult age class because they were only recorded in the data from the baseline surveys for the Development.
[4]Only the 2017 design is considered for the Development, with collision estimates as in Table 4.39.

__Collisions from other wind farms within foraging range__

303 As detailed above for the Forth Islands SPA gannet population, several offshore wind farms other than Neart na Gaoithe and Seagreen Alpha and Bravo occur within mean maximum foraging range of breeding herring gulls from the Fowlsheugh SPA (as defined by Thaxter *et*

al., 2012). The advice from the Scoping Opinion was to consider the breeding season effects from these wind farms qualitatively.

304 These other wind farms are the Aberdeen Offshore Wind Farm and the Kincardine Floating Offshore Wind Farm. The estimated collision mortality to adult herring gulls during the breeding period was of one bird or less from each of these wind farms. As such, the impacts from these wind farms would not affect the conclusions of this assessment.

Conclusion

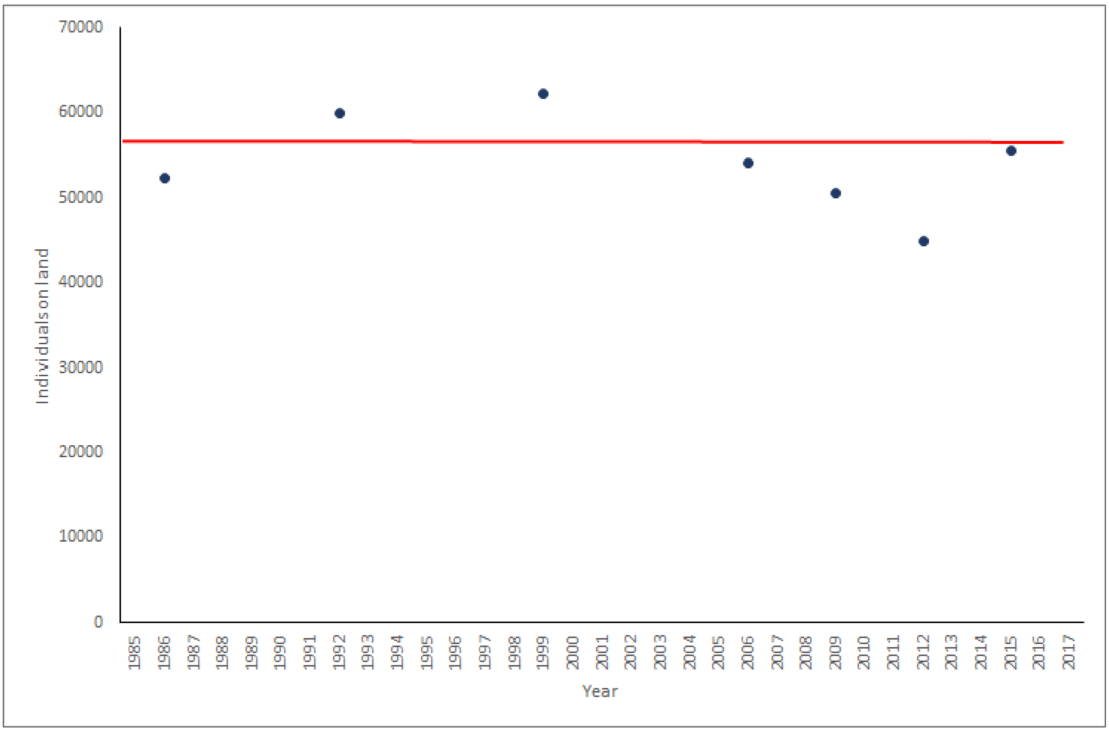
305 The predicted impacts from the Development-alone and in-combination were very small and are considered likely to result in minimal population-level impacts, and consequently PVA was not required to investigate impacts further. The Conservation Objective of the SPA, to maintain the "population of the species as a viable component of the site" is currently not being met but, given the small level of impact predicted, this will not be affected or exacerbated by the predicted impacts from the Development-alone or in-combination. Accounting for the collisions from the other wind farms within foraging range of the Fowlsheugh SPA which were considered qualitatively does not affect this conclusion. It should therefore be possible for the CA to conclude, beyond reasonable scientific doubt, that the Development-alone, and in-combination, will have no adverse effect on site integrity due to the effects on the herring gull population.

4.2.3 Guillemot Population

306 The Fowlsheugh SPA guillemot population has fluctuated around the citation population size (56,450 individuals) over the last 30 years (Figure 4.9).

307 The data shown in Figure 4.9 are from the JNCC SMP database[10], with the 2015 count as provided in the SNH scoping advice[11]. Between 1999 to 2012 there was evidence of decline in the Fowlsheugh SPA guillemot population, but the recent (2015) data show numbers to have increased to a level above the earliest count (1985) and close to the citation population size. It should be noted that the data shown in Figure 4.9 are the count of individuals on land. This needs to be multiplied by 1.34 to give the estimated number of breeding adults[11] (except in the case of the citation population size which is taken as 56,450 individuals -SNH (2009b)).

Figure 4.9 Guillemot population trend at the Fowlsheugh SPA between 1986 and 2015. The red line shows the population size at designation (56,450 individuals).



__Potential impacts on the guillemot population__

308 The Development, OnTW and associated buffers do not overlap with the Fowlsheugh SPA. Consequently, the potential impacts on its guillemot population will only occur as a result of individuals from the colony occurring in the Development Area. In relation to guillemot, the impacts of concern identified in the Scoping Opinion from MS-LOT were from displacement from the Development Area and two kilometre buffer and barrier effects (with the two latter impacts subsequently considered together). From published information on guillemot foraging ranges generally (Thaxter *et al.,* 2012) and tracking from the Fowlsheugh SPA specifically (CEH 2011), it is likely that breeding guillemots from the Fowlsheugh SPA occur within the Development Area and two kilometre buffer, as well as within the proposed development areas of other wind farms in the Forth and Tay.

309 As detailed above for the Forth Islands SPA guillemot population, the Scoping Opinion advises that the assessment for the non-breeding period should be based on the same apportioning as for the breeding period. The breeding period for guillemot is defined as April to mid-August, following the advice of the Scoping Opinion.

__Predicted displacement impacts on the guillemot population alone and in-combination__

310 The SNCB matrix approach (SNCBs, 2017) was used to estimate impacts from displacement (and barrier effects) as advised in the Scoping Opinion[13], and was used to estimate the additional mortality attributable to the Fowlsheugh SPA guillemot population as a result of displacement during both the breeding and non-breeding periods. Following the advice of the

Scoping Opinion, the mortality from displacement was calculated using the peak population size, averaged over the two years of survey, for the Development Area and two kilometre buffer (combining birds on the water and in flight), with this undertaken separately for the breeding and non-breeding periods. A displacement rate of 60 per cent was applied to this mean peak estimate, with one per cent of the displaced birds assumed to die, for both the breeding and non-breeding periods.

311 The Development-alone and in-combination mortality estimated from displacement was apportioned between SPA and non-SPA colonies as outlined above and detailed in *Appendix 11B*. The apportioning calculations were undertaken separately for the Development Area and two kilometre buffer, and for Neart na Gaoithe (plus buffer) and Seagreen Alpha and Bravo combined (plus buffer). The two Seagreen sites were combined for the purposes of the apportioning calculations because they are contiguous along their longest boundary. On the basis of these calculations, the percentage of the breeding and non-breeding period impacts to guillemots from the Development and each of the other three Forth and Tay wind farms attributed to the Fowlsheugh SPA population were as follows:

- The Development – 37.7 per cent;
- Neart na Gaoithe – 8.5 per cent;
- Seagreen Alpha and Bravo – 55.2 per cent.

312 The estimated displacement mortality was also apportioned to age classes, which in this case was based upon the stable age distribution from the Fowlsheugh SPA guillemot population model produced for the current assessment (and as detailed in *Appendix 11E*). This approach followed the advice of the Scoping Opinion for species for which age distributions could not be distinguished during the 'at-sea' surveys. The estimated number of adult birds displaced during the breeding period was also amended according to an assumed seven per cent sabbatical rate amongst the breeding adult birds, as advised in the Scoping Opinion (*Appendix 11D*).

313 For the Development-alone in the breeding period, the mean peak population estimate was 8,184 birds, of which 45.2 per cent were adults (3,699 birds) and 37.7 per cent were from the Fowlsheugh SPA (1,395 birds) and seven per cent were birds on sabbatical (giving 1,297 adult birds from the Fowlsheugh SPA population). Applying the advised 60 per cent displacement rate and one per cent mortality rate gives an estimated mortality of eight adult birds per breeding period (Table 4.40). This predicted displacement mortality from the Development-alone on breeding adults is very small compared with the current (74,379 individuals) and citation (56,450 individuals) population sizes (representing 0.01 per cent in both cases).

314 For the Development-alone in the non-breeding season, the mean peak population estimate was 3,912 birds, giving an estimated non-breeding season mortality of four birds (based on the same rates as used in the breeding period for apportioning to colonies and age classes, assigning sabbaticals and for estimating displacement and mortality amongst displaced birds). Thus, the estimated annual mortality of adult guillemots from the Fowlsheugh SPA population was 14 (allowing for rounding errors in the breeding and non-breeding period estimates),

which represented 0.005 and 0.007 per cent of the current and citation SPA population sizes, respectively.

Table 4.40 Displacement matrix for adult guillemots from the Fowlsheugh SPA in the breeding season. Based on mean peak abundance apportioned to adult birds from the Fowlsheugh SPA. Recommended displacement rate and mortality rate is shown in green, and the resulting displacement mortality in dark green.

		DISPLACEMENT										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
MORTALITY	0%	0	0	0	0	0	0	0	0	0	0	0
	1%	0	1	3	4	5	6	8	9	10	12	13
	2%	0	3	5	8	10	13	16	18	21	23	26
	3%	0	4	8	12	16	19	23	27	31	35	39
	4%	0	5	10	16	21	26	31	36	42	47	52
	5%	0	6	13	19	26	32	39	45	52	58	65
	10%	0	13	26	39	52	65	78	91	104	117	130
	15%	0	19	39	58	78	97	117	136	156	175	195
	20%	0	26	52	78	104	130	156	182	208	233	259
	30%	0	39	78	117	156	195	233	272	311	350	389
	40%	0	52	104	156	208	259	311	363	415	467	519
	50%	0	65	130	195	259	324	389	454	519	584	649
	60%	0	78	156	233	311	389	467	545	623	700	778
	70%	0	91	182	272	363	454	545	636	726	817	908
	80%	0	104	208	311	415	519	623	726	830	934	1038
	90%	0	117	233	350	467	584	700	817	934	1051	1167
	100%	0	130	259	389	519	649	778	908	1038	1167	1297

Table 4.41 Displacement matrix for adult guillemots from the Fowlsheugh SPA in the non-breeding season. Based on mean peak abundance apportioned to adult birds from the Fowlsheugh SPA. Recommended displacement rate and mortality rate is shown in green, and the resulting displacement mortality in dark green.

		DISPLACEMENT										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
MORTALITY	0%	0	0	0	0	0	0	0	0	0	0	0
	1%	0	1	1	2	2	3	4	4	5	6	6
	2%	0	1	2	4	5	6	7	9	10	11	12
	3%	0	2	4	6	7	9	11	13	15	17	19
	4%	0	2	5	7	10	12	15	17	20	22	25
	5%	0	3	6	9	12	16	19	22	25	28	31
	10%	0	6	12	19	25	31	37	43	50	56	62
	15%	0	9	19	28	37	47	56	65	74	84	93
	20%	0	12	25	37	50	62	74	87	99	112	124
	30%	0	19	37	56	74	93	112	130	149	167	186
	40%	0	25	50	74	99	124	149	174	198	223	248
	50%	0	31	62	93	124	155	186	217	248	279	310
	60%	0	37	74	112	149	186	223	260	298	335	372
	70%	0	43	87	130	174	217	260	304	347	391	434
	80%	0	50	99	149	198	248	298	347	397	446	496
	90%	0	56	112	167	223	279	335	391	446	502	558
	100%	0	62	124	186	248	310	372	434	496	558	620

315 The displacement matrix predictions for the Development in-combination with the other three Forth and Tay wind farms were apportioned between SPA colonies and between age classes (Table 4.42). The predicted in-combination mortality from displacement for the Fowlsheugh SPA guillemots during the breeding period is five times greater than for the Development-alone, with a total estimated mortality of 40 breeding adults and 53 sub-adult birds (Table 4.42). This level of mortality remains small compared with the current (74,379 individuals) and citation (56,450 individuals) population sizes (with the adult mortality representing 0.05 per cent and 0.07 per cent, respectively).

316 Levels of predicted mortality from displacement in the non-breeding period for the Development in-combination with the other three Forth and Tay wind farms were substantially lower than for the breeding period (Table 4.42), but with the contribution of the Development to the total in-combination mortality being a similar proportion. Combining the two seasonal estimates gave an estimated annual mortality from the in-combination impacts of 64 breeding adults and 83 sub-adult birds (Table 4.42). The estimated annual mortality of breeding adults from displacement represented only 0.09 per cent and 0.11 per cent of the current and citation SPA population sizes.

Table 4.42 Estimated mortality of Fowlsheugh SPA guillemots as a result of displacement from the Development in-combination with the other three Forth and Tay wind farms.

Seasonal period	Project	Mean peak estimate (individuals)	Adult pro-portion[1]	SPA pro-portion	Sabbatical proportion	Additional mortality	
						Breeding adults	Sub-adults
Breeding	Inch Cape	8,184	0.452	0.377	0.07	7.8	10.2
	Neart na Gaoithe	3,263		0.085		0.7	0.9
	Seagreen Alpha	12,190		0.552		16.9	22.2
	Seagreen Bravo	10,778		0.552		15.0	19.6
	Total	34,415	-		-	40.4	52.9
Non-breeding	Inch Cape	3,912	0.452	0.377	0.07	3.7	4.9
	Neart na Gaoithe	7,618		0.085		1.6	2.1
	Seagreen Alpha	6,131		0.552		8.5	11.1
	Seagreen Bravo	6,780		0.552		9.4	12.3
	Total	24,441	-	-	-	23.3	30.5
Annual	Total[2]	-	-	-	-	63.7	83.3

[1]Based on the stable age distribution from the Fowlsheugh SPA guillemot population model (*Appendix 11E*).
[2]Totals may differ by a small amount from the summed numbers in the above table cells due to rounding errors.

317 As described for the Forth Islands SPA kittiwake population (*Section 4.1.2* above), impacts from displacement and barrier effects were also estimated using the SeabORD and Searle *et*

al., (2014) individual-based modelling approaches. These estimates and the comparisons with the SNCB matrix estimates are presented in *Appendix 11D*.

Impacts from other wind farms within foraging range

318 As detailed above for the Forth Islands SPA gannet population, several offshore wind farms other than Neart na Gaoithe and Seagreen Alpha and Bravo occur within mean maximum foraging range of breeding guillemots from the Fowlsheugh SPA (as defined by Thaxter *et al.,* 2012). The advice from the Scoping Opinion was to consider the breeding season effects from these wind farms qualitatively.

319 These wind farms are the Aberdeen Offshore Wind Farm, Hywind Scotland Pilot Park and the Kincardine Floating Offshore Wind Farm. These are all relatively small developments, comprising 11, five and six to eight WTGs, respectively. As such, any impacts from displacement and barrier effects will be minor and will not affect the conclusions of the assessment.

Population Viability Analysis of the guillemot population

320 PVA was used to determine the effects of the predicted displacement impacts from the Development-alone, and in-combination, on the Fowlsheugh SPA guillemot population. The Fowlsheugh SPA guillemot population model produced for the current assessment was a stochastic, density independent, model based on a Bayesian state-space modelling framework. It was adapted from earlier Fowlsheugh SPA guillemot population model developed by Freeman *et al.,* (2014), updated according to recently available population and demographic data. Further details of the model are provided in *Appendix 11E*.

321 The predicted population trends under baseline conditions (i.e. without wind farm impacts) were projected over both 28 and 53 year timescales. Additional mortality within the PVA was not incorporated until after year three of the projection (giving 25 and 50-year impact periods) to provide a more realistic representation of the likely population status at the time when the potential impacts will begin to arise.

322 The additional mortality was incorporated on the basis of the percentage point change to the annual mortality of adult and sub-adult birds, as represented by the SNCB matrix estimates (Table 4.42). Outputs from the PVA were summarised according to the median predicted population sizes at the end of the projection period, and the three metrics which the Scoping Opinion advised should be used for the interpretation and which are defined above in the section on the Forth Islands SPA gannet population.

323 The PVA projected a decline for the Fowlsheugh SPA guillemot population with and without impacts for the Development-alone and in-combination. Despite the predicted decline in this population, the median end population size remained above the citation population size (56,450 individuals) for all impact scenarios and for both the 25 and 50 year projection periods (Table 4.43).

324 The PVA metrics (Table 4.44) show that for the Development-alone the counterfactual of end population size indicated small reductions in end population size after both 25 years and 50 years of impact (with the values being 0.995 and 0.991, respectively). A decrease in annual population growth rate was not detectable (at least when the counterfactual value was taken to three decimal places – i.e. it remained at a value of 1.000), whilst the centile value was 49 even after 50 years of impact (indicating very considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period).

325 In terms of the in-combination, the PVA metrics continued to indicate small population-level impacts (albeit that they were greater than for the Development-alone, as would be expected – Table 4.44). The predicted reduction in end population size was only five per cent even after 50 years of impact (the counterfactual of population size being 0.948), whilst the reduction in annual population growth rate was minimal (with a counterfactual value of 0.999). The centile value was 45 for both the 25 and 50 year impact periods (indicating considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a reasonable likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period).

326 The population projections in all cases showed that the end population size was greater than the population size at citation (56,450 individuals), and that the impacts had a very minor effect only on the projected population decline even after 50 years. Therefore, the effects of the Development-alone, and in-combination, will not result in the conservation status of the Forth Islands SPA population being in unfavourable condition.

Table 4.43 Projected end population size of the Fowlsheugh SPA guillemot population after 25 and 50 years for baseline, Development-alone and in-combination scenarios.

	Percentage point change in mortality		**Median number of breeding females (5th – 95th centiles)**	
	Adults	**Sub-adults**	**25 years**	**50 years**
Baseline			34,650 (22,500 – 51,200)	31,000 (16,200 – 57,800)
Development-alone	0.015	0.017	34,500 (22,400 – 50,700)	30,600 (16,000 – 57,200)
In-combination	0.086	0.092	33,750 (21,800 – 49,600)	29,300 (15,300 – 54,800)

Table 4.44 PVA metrics for the Fowlsheugh SPA guillemot population after 25 and 50 years for the Development-alone and in-combination scenarios.

	Counterfactual of end population size		Counterfactual of population growth rate[1]	Centile of baseline population matching the median of the impacted population	
	25 years	**50 years**	**25 and 50 years**	**25 years**	**50 years**
Baseline	1.000	1.000	1.000	50	50
Development-alone	0.995	0.991	1.000	49	49
In-combination	0.974	0.948	0.999	45	45

[1]The value of this metric does not vary according to the length of the projection period.

<u>Conclusion</u>

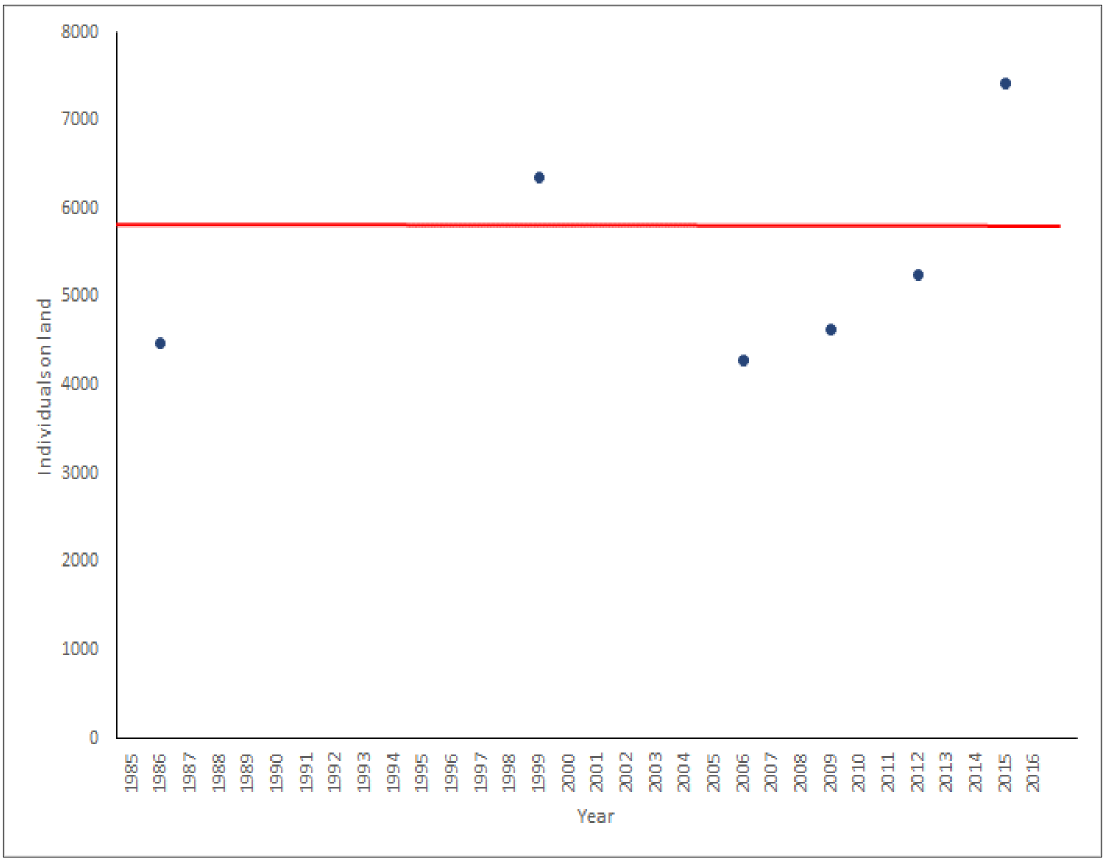
327 The predicted impacts from the Development-alone and in-combination were small, and outputs from the PVA indicate small predicted population-level effects. Based upon the PVA projections, the Conservation Objective of the SPA, to maintain the "population of the species as a viable component of the site", would not be compromised for the guillemot population. It should therefore be possible for the CA to conclude, beyond reasonable scientific doubt, that the Development-alone, and in-combination, will have no adverse effect on site integrity due to the effects on the guillemot population.

4.2.4 Razorbill population

328 The Fowlsheugh SPA razorbill population has fluctuated around the citation population size (5,800 individuals) over the last 30 years. These data are shown in

329 Figure 4.10, which are from the JNCC SMP database[10], with the 2015 estimate as provided in the SNH scoping advice[11]. Between the 1999 and 2006 there was a relatively large decline in the Fowlsheugh SPA razorbill population, but recent (2015) data shows numbers to have increased to a level above the previous counts and the citation population size. It should be noted that the data shown in Figure 4.10 are the count of individuals on land. This needs to be multiplied by 1.34 to give the estimated number of breeding adults[11] (except in the case of the citation population size which is taken as 5,800 individuals - SNH (2009b)).

Figure 4.10 Razorbill population trend at the Fowlsheugh SPA between 1986 and 2015. The red line shows the population size at designation (5,800 individuals).



<u>Potential impacts on the razorbill population</u>

330 The Development, OnTW and associated buffers do not overlap with the Fowlsheugh SPA. Consequently, the potential impacts on its razorbill population will only occur as a result of individuals from the colony occurring in the Development Area. In relation to razorbill, the impacts of concern identified in the Scoping Opinion from MS-LOT were from displacement from the Development Area and two kilometre buffer and barrier effects (with the latter two impacts subsequently considered together). From published information on razorbill foraging ranges generally (Thaxter *et al.,* 2012) and tracking from Fowlsheugh SPA specifically (CEH, 2011), it is likely that breeding razorbills from the SPA occur within the Development Area and two kilometre buffer, as well as within the proposed development areas of other wind farms in the Forth and Tay.

331 As detailed above for the Forth Islands SPA razorbill population, the Scoping Opinion advises that the assessment for the non-breeding period should be based on the same apportioning as for the breeding period. The breeding period for razorbill is defined as April to mid-August, following the advice of the Scoping Opinion.

Predicted displacement impacts on the razorbill population alone and in-combination

332 The SNCB matrix approach (SNCBs, 2017) was used to estimate the impacts from displacement (and barrier effects) as advised in the Scoping Opinion[13], and was used to estimate the additional mortality attributable to the Fowlsheugh SPA razorbill population as a result of displacement during both the breeding and non-breeding periods. Following the advice of the Scoping Opinion, the mortality from displacement was calculated using the peak population size, averaged over the two years of survey, for the Development Area and two kilometre buffer (combining birds on the water and in flight), with this undertaken separately for the breeding and non-breeding periods. A displacement rate of 60 per cent was applied to this mean peak estimate, with one per cent of the displaced birds assumed to die, for both the breeding and non-breeding periods.

333 The Development-alone and in-combination mortality estimated from displacement was apportioned between SPA and non-SPA colonies as outlined above and detailed in *Appendix 11B*. The apportioning calculations were undertaken separately for the Development Area and two kilometre buffer, and for Seagreen Alpha and Bravo (plus buffer). The Neart na Gaoithe wind farm was beyond the mean maximum foraging range of razorbills from the Fowlsheugh SPA (*Appendix 11B*, Thaxter *et al.,* 2012), and was deemed not to have connectivity. On the basis of these calculations, the percentage of the breeding and non-breeding period impacts to razorbills from the Development and each of the Seagreen wind farms attributed to the Fowlsheugh SPA population were as follows:

- The Development – 31.4 per cent
- Seagreen Alpha and Bravo – 60.3 per cent

334 The estimated displacement mortality was also apportioned to age classes, which in this case was based upon the stable age distribution from the Fowlsheugh SPA razorbill population model produced for the current assessment (and as detailed in *Appendix 11E*). This approach followed the advice of the Scoping Opinion for species for which age distributions could not be distinguished during the 'at-sea' surveys. The estimated number of adult birds displaced during the breeding period was also amended according to an assumed seven per cent sabbatical rate amongst the breeding adult birds, as advised in the Scoping Opinion (*Appendix 11D).*

335 For the Development-alone in the breeding period, the mean peak population estimate was 4,671 birds, of which 49.2 per cent were adults (2,298 birds) and 31.4 per cent were from the Fowlsheugh SPA (722 birds) and seven per cent were birds on sabbatical (giving 671 adult birds from the Fowlsheugh SPA population). Applying the advised 60 per cent displacement rate and one per cent mortality rate gives an estimated mortality of four adult birds per breeding period (Table 4.45). This predicted displacement mortality from the Development-alone on breeding adults is small compared with the current (9,950 individuals) and citation (5,800 individuals) population sizes (0.04 per cent and 0.07 per cent, respectively).

336 For the Development-alone in the non-breeding season, the mean peak population estimate was 4,905 birds, giving an estimated non-breeding season mortality of four birds (based on

the same rates as used in the breeding period for apportioning to colonies and age classes, assigning sabbaticals and for estimating displacement and mortality amongst displaced birds). Thus, the estimated annual mortality of adult razorbills from the Fowlsheugh SPA population was eight, representing 0.08 per cent and 0.14 per cent of the current and citation SPA population sizes, respectively.

Table 4.45 Displacement matrix for adult razorbills from the Fowlsheugh SPA in the breeding season. Based on mean peak abundance apportioned to adult birds from the Fowlsheugh SPA. Recommended displacement rate and mortality rate is shown in green, and the resulting displacement mortality in dark green.

		DISPLACEMENT										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
MORTALITY	0%	0	0	0	0	0	0	0	0	0	0	0
	1%	0	1	1	2	3	3	4	5	5	6	7
	2%	0	1	3	4	5	7	8	9	11	12	13
	3%	0	2	4	6	8	10	12	14	16	18	20
	4%	0	3	5	8	11	13	16	19	21	24	27
	5%	0	3	7	10	13	17	20	23	27	30	34
	10%	0	7	13	20	27	34	40	47	54	60	67
	15%	0	10	20	30	40	50	60	70	81	91	101
	20%	0	13	27	40	54	67	81	94	107	121	134
	30%	0	20	40	60	81	101	121	141	161	181	201
	40%	0	27	54	81	107	134	161	188	215	242	268
	50%	0	34	67	101	134	168	201	235	268	302	336
	60%	0	40	81	121	161	201	242	282	322	362	403
	70%	0	47	94	141	188	235	282	329	376	423	470
	80%	0	54	107	161	215	268	322	376	429	483	537
	90%	0	60	121	181	242	302	362	423	483	544	604
	100%	0	67	134	201	268	336	403	470	537	604	671

Table 4.46 Displacement matrix for adult razorbills from the Fowlsheugh SPA in the non-breeding season. Based on mean peak abundance apportioned to adult birds from the

Fowlsheugh SPA. Recommended displacement rate and mortality rate is shown in green, and the resulting displacement mortality in dark green.

		DISPLACEMENT										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
MORTALITY	0%	0	0	0	0	0	0	0	0	0	0	0
	1%	0	1	1	2	3	4	4	5	6	6	7
	2%	0	1	3	4	6	7	8	10	11	13	14
	3%	0	2	4	6	8	11	13	15	17	19	21
	4%	0	3	6	8	11	14	17	20	23	25	28
	5%	0	4	7	11	14	18	21	25	28	32	35
	10%	0	7	14	21	28	35	42	49	56	63	71
	15%	0	11	21	32	42	53	63	74	85	95	106
	20%	0	14	28	42	56	71	85	99	113	127	141
	30%	0	21	42	63	85	106	127	148	169	190	212
	40%	0	28	56	85	113	141	169	197	226	254	282
	50%	0	35	71	106	141	176	212	247	282	317	353
	60%	0	42	85	127	169	212	254	296	338	381	423
	70%	0	49	99	148	197	247	296	345	395	444	494
	80%	0	56	113	169	226	282	338	395	451	508	564
	90%	0	63	127	190	254	317	381	444	508	571	635
	100%	0	71	141	212	282	353	423	494	564	635	705

337 The displacement matrix predictions for the Development in-combination with the Seagreen Alpha and Bravo wind farms were apportioned between SPA colonies and between age classes (Table 4.47). The predicted in-combination mortality from displacement for the Fowlsheugh SPA razorbills during the breeding period is approximately two and a half times greater than for the Development-alone, with a total estimated mortality of 10 breeding adults and 11 sub-adult birds (Table 4.47). This level of mortality remains relatively small compared with the current (9,950 individuals) and citation (5,800 individuals) population sizes (with the adult mortality representing 0.10 per cent and 0.17 per cent, respectively).

338 Levels of predicted mortality from displacement in the non-breeding period for the Development in-combination with the Seagreen Alpha and Bravo wind farms were similar to those for the breeding period (Table 4.47). However, the contribution of the Development to the total in-combination mortality was slightly greater in the non-breeding period (representing approximately 45 per cent of this). Combining the two seasonal estimates gave an estimated annual mortality from the in-combination impacts of 19 breeding adults and 22 sub-adult birds (Table 4.47). The estimated annual mortality of breeding adults from displacement represented 0.19 per cent and 0.33 per cent of the current and citation SPA population sizes, respectively.

Table 4.47 Estimated mortality of Fowlsheugh SPA razorbills as a result of displacement from the Development in-combination with the Seagreen Alpha and Bravo wind farms.

Seasonal period	Project	Mean peak estimate (individuals)	Adult pro-portion[1]	SPA pro-portion	Sabbatical proportion	Additional mortality	
						Breeding adults	Sub-adults
Breeding	Inch Cape	4,671	0.492	0.314	0.07	4.0	4.5
	Seagreen Alpha	2,768		0.603		4.6	5.1
	Seagreen Bravo	993		0.603		1.6	1.8
	Total	8,432	-	-	-	10.2	11.4
Non-breeding	Inch Cape	4,905	0.492	0.314	0.07	4.2	4.7
	Seagreen Alpha	1,253		0.603		2.1	2.3
	Seagreen Bravo	1,723		0.603		2.9	3.2
	Total	7,881	-	-	-	9.2	10.2
Annual	Total	-	-	-	-	19.4	21.6

[1]Based on the stable age distribution from the Fowlsheugh SPA razorbill population model (*Appendix 11E*).

339 As described for the Forth Islands SPA kittiwake population (*Section 4.1.2* above), impacts from displacement and barrier effects were also estimated using the SeabORD and Searle *et al.,* (2014) individual-based modelling approaches. These estimates and the comparisons with the SNCB matrix estimates are presented in *Appendix 11D*.

Impacts from other wind farms within foraging range

340 As detailed above for the Forth Islands SPA gannet population, several offshore wind farms other than Neart na Gaoithe and Seagreen Alpha and Bravo occur within mean maximum

foraging range of breeding razorbills from the Fowlsheugh SPA (as defined by Thaxter *et al.,* 2012). The advice from the Scoping Opinion was to consider the breeding season effects from these wind farms qualitatively.

341 These wind farms are the Aberdeen Offshore Wind Farm and the Kincardine Floating Offshore Wind Farm. Both are relatively small developments, comprising 11 and six to eight WTGs, respectively. As such, any impacts from displacement and barrier effects will be minor and will not affect the conclusions of the assessment.

Population Viability Analysis of the razorbill population

342 PVA was used to determine the effects of the predicted displacement impacts from the Development-alone, and in-combination, on the Fowlsheugh SPA razorbill population. The Fowlsheugh SPA razorbill population model produced for the current assessment was a stochastic, density independent, model based on a Bayesian state-space modelling framework. It was adapted from earlier Fowlsheugh SPA razorbill population model developed by Freeman *et al.,* (2014), updated according to recently available population and demographic data. Further details of the model are provided in *Appendix 11E*.

343 The predicted population trends under baseline conditions (i.e. without wind farm impacts) were projected over both 28 and 53 year timescales. Additional mortality within the PVA was not incorporated until after year three of the projection (giving 25 and 50-year impact periods) to provide a more realistic representation of the likely population status at the time when the potential impacts will begin to arise.

344 The additional mortality was incorporated on the basis of the percentage point change to the annual mortality of adult and sub-adult birds, as represented by the SNCB matrix estimates (Table 4.47). Outputs from the PVA were summarised according to the median predicted population sizes at the end of the projection period, and the three metrics which the Scoping Opinion advised should be used for the interpretation and which are defined above in the section on the Forth Islands SPA gannet population.

345 The PVA projected gradual population growth for the Fowlsheugh SPA razorbill population with and without impacts for the Development-alone and in-combination. The median population size increased over the projection period whether impacts were incorporated or not, and the projected population size at 50 years was always larger than that at 25 years (Table 4.48).

346 The PVA metrics (Table 4.49) show that for the Development-alone the counterfactual of population size indicated small reductions in the end population size after both 25 and 50 years of impact (with the values being 0.977 and 0.952, respectively). The decline in the annual population growth rate was minimal (with the counterfactual value being 0.999), whilst the centile values were 47 for both the 25 and 50 year impact periods, indicating considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period.

347 For the in-combination, the PVA metrics continued to indicate relatively small population-level impacts (albeit that they were greater than for the Development-alone, as would be expected – Table 4.49). The predicted reductions in end population size were six per cent and 11 per cent after 25 and 50 years of impact, respectively (the counterfactual values being 0.944 and 0.890), whilst the reduction in annual population growth rate was small (with a counterfactual value of 0.998). The centile values were 44 and 42 for the 25 and 50 year impact periods, respectively, indicating considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a reasonable likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period.

348 The population projections in all cases showed that the end population size was considerably greater than the population size at citation (5,800 individuals), and that it continued to increase over the projection period. Therefore, the effects of the Development-alone, and in-combination, will not result in the conservation status of the Fowlsheugh SPA population being in unfavourable condition.

Table 4.48 Projected end population size of the Fowlsheugh SPA razorbill population after 25 and 50 years for baseline, Development-alone and in-combination scenarios.

	Percentage point change in mortality		Median number of breeding females (5th – 95th centiles)	
	Adults	Sub-adults	25 years	50 years
Baseline	-	-	6,850 (3,600 – 12,450)	10,500 (3,750 – 29,200)
Development-alone	0.083	0.089	6,700 (3,500 – 12,250)	10,100 (3,600 – 27,900)
In-combination	0.195	0.209	6,450 (3,400 – 12,000)	9,350 (3,400 – 26,200)

Table 4.49 PVA metrics for the Fowlsheugh SPA razorbill population after 25 and 50 years for the Development-alone and in-combination scenarios.

	Counterfactual of end population size		Counterfactual of population growth rate[1]	Centile of baseline population matching the median of the impacted population	
	25 years	50 years	25 and 50 years	25 years	50 years
Baseline	1.000	1.000	1.000	50	50

	Counterfactual of end population size		Counterfactual of population growth rate[1]	Centile of baseline population matching the median of the impacted population	
	25 years	50 years	25 and 50 years	25 years	50 years
Development-alone	0.977	0.952	0.999	47	47
In-combination	0.944	0.890	0.998	44	42

[1]The value of this metric does not vary according to the length of the projection period.

Conclusion

349 The predicted impacts from the Development-alone and in-combination were small, and outputs from the PVA indicate small predicted population-level effects. Based upon the PVA projections, the Conservation Objective of the SPA, to maintain the "population of the species as a viable component of the site", will not be compromised for the razorbill population. It should therefore be possible for the CA to conclude, beyond reasonable scientific doubt, that the Development-alone, and in-combination, will have no adverse effect on site integrity due to the effects on the razorbill population.

4.2.5 Breeding Seabird Assemblage

350 The breeding seabird assemblage for the Fowlsheugh SPA is a qualifying feature on the basis of the SPA supporting 145,000 individual seabirds, including guillemot, razorbill, fulmar, kittiwake and herring gull.

351 Potential impacts of the Development on the breeding seabird assemblage for the Fowlsheugh SPA could arise via effects on the individual named species within the assemblage feature. However, no adverse effects are predicted from the Development alone or in-combination on those species assessed above (which includes four of the five named species in the assemblage), whilst for the remaining species within the assemblage (fulmar) there is no route to impact with the Development.

352 Therefore, no adverse effects of the Development alone or in-combination are predicted on the Fowlsheugh SPA breeding seabird assemblage.

4.3 St Abb's Head to Fast Castle SPA

353 St Abb's Head to Fast Castle SPA is mainland seabird SPA of multiple colonies along the coast of Berwickshire, in south-east Scotland. The SPA is south-west of the Development Area, and

was classified in August 1997, with a further two kilometre marine extension to the site classified in September 2009. The SPA is underpinned by the St Abb's Head to Fast Castle SSSI.

354 There are no Annex I qualifying features and the whole SPA is designated as an assemblage of more than 20,000 seabirds. The seabird assemblage regularly supports more than 79,560 breeding seabirds with the following named features: razorbill, guillemot, kittiwake, herring gull, and shag. Further information on the qualifying features is available in Table 3.5

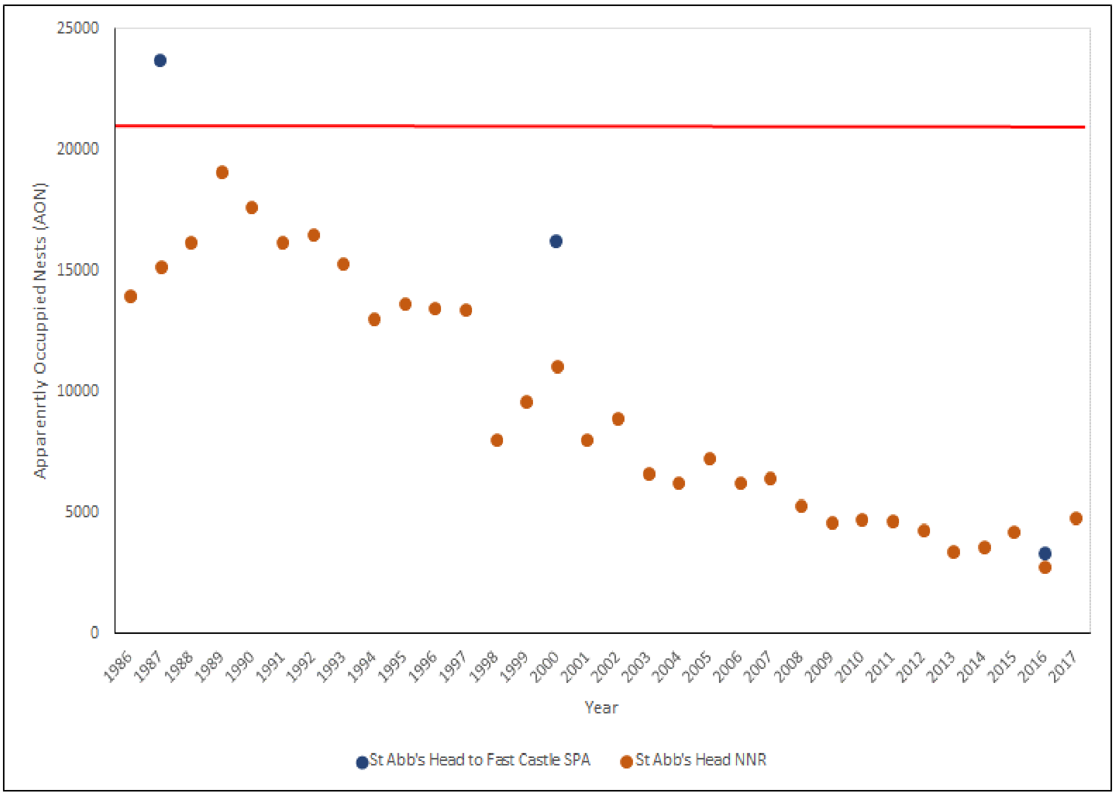
355 The Conservation Objectives of the site are shown in *Section 3*, and are the same as the Conservation Objectives of all SPAs in Scotland at the time of writing.

356 The HRA screening and consultation with MS-LOT and their statutory advisors, SNH, identified that the species that resulted in a conclusion of no LSE being rejected were kittiwake, herring gull and guillemot. The information below provides information on each of these species for the CA to carry out their AA on the St Abb's Head to Fast Castle SPA.

4.3.1 Kittiwake Population

357 The St Abb's Head to Fast Castle SPA kittiwake population has declined since the SPA was designated. The whole SPA has only been counted in three years since 1985, most recently in 2016, but the main colony in the SPA (the St Abb's Head NNR, which comprised 83 per cent of the SPA population in 2016) is counted annually. The population size has been below the cited population size in all years for which count data are available since 1987 (Figure 4.11). The count data shown in Figure 4.11 are from the JNCC SMP database[10], with the 2016 estimate as provided in the SNH scoping advice[11].

Figure 4.11 Kittiwake population trend at the St Abb's Head NNR between 1985 and 2017, with the three counts for the entire St Abb's Head to Fast Castle SPA also shown. The red line shows the population size for the whole SPA at designation (21,170 pairs).



Potential impacts on the kittiwake population

358 The Development Area, OfTW and associated buffers[6] do not overlap with the St Abb's Head to Fast Castle SPA. Consequently, the potential impacts on its kittiwake population will only occur as a result of individuals from the colony occurring in the Development Area. In relation to kittiwakes, the impacts of concern identified in the Scoping Opinion from MS-LOT were from collisions with operational WTG blades, displacement from the Development Area and a two kilometre buffer, and barrier effects (with the latter two effects subsequently considered together). Data collected on kittiwakes indicate that there is a potential for collisions and displacement to occur (CEH, 2011, and data collected from boat-based surveys from the Development Area and buffer – *Appendix 11A*). From published information on kittiwake foraging ranges generally (Thaxter *et al.,* 2012) and tracking from the SPA specifically (CEH, 2011) it is very likely that during the breeding period kittiwakes from the St Abb's Head to Fast Castle SPA occur within the Development Area and two kilometre buffer, as well as within the proposed development areas of other wind farms in the Forth and Tay. The breeding period for kittiwake is defined as mid-April to August, following the advice of the Scoping Opinion.

359 In the non-breeding season kittiwakes are largely pelagic, with birds from some colonies wintering as far west as the coast of eastern Canada (Frederiksen *et al.,* 2011), though most kittiwakes breeding on the North Sea coast likely winter in the North Sea and Celtic Sea. Therefore, it is likely that there is the potential for birds from the St Abb's Head to Fast Castle SPA population to pass through offshore wind farms in the North Sea during the autumn and spring passage periods (defined as September to December and January to mid-April, respectively, following the advice of the Scoping Opinion). In their Scoping Opinion, MS-LOT

recommended using the BDMPS to apportion the estimated collisions from UK North Sea wind farms to the St Abb's Head to Fast Castle SPA population during the autumn and spring passage periods (Furness, 2015). Following correspondence between ICOL, SNH and MS-LOT[7], the approach adopted followed that used to apportion passage period collisions to the Flamborough Head and Filey Coast pSPA kittiwake population in the assessment for the East Anglia THREE wind farm (MacArthur Green, 2015b, Royal HaskoningDHV *et al.,* 2015), which was in turn based upon the BDMPS approach.

360 In addition, it was advised in the Scoping Opinion[8] that collision estimates for the wind farms in the UK North Sea should be amended from those presented in the East Anglia THREE assessment (Royal HaskoningDHV *et al.,* 2015) according to the report on Estimates of Ornithological Headroom in Offshore Wind Farm Collision Mortality (MacArthur Green, 2017). However, for the Development and the each of the other three Forth and Tay wind farms, the passage period collision estimates were as calculated in the CRMs for the current assessment (see below). The full details of the methods and approach used to apportion the estimated collisions from wind farms in the UK North Sea to the St Abb's Head to Fast Castle SPA kittiwake population are detailed in *Appendix 11B*.

361 In relation to displacement during the non-breeding period, MS-LOT advised in their Scoping Opinion that effects should be considered qualitatively.

Predicted collision impacts alone and in-combination

Estimation of impacts

362 CRMs were undertaken using the Band (2012) model to predict the number of birds at risk from collisions both for the Development-alone and in-combination scenarios. Following the Scoping Opinion from MS-LOT, the assessment for kittiwake was based on option 2 of the CRM, but with outputs from option 1 of the CRM also presented for the Development-alone. As detailed above for the Forth Islands SPA gannet population, option 2 of the CRM uses the generic flight height data from Johnston *et al.,* (2014a,b), whilst option 1 uses the site-specific flight height data, as collected during baseline surveys of the Survey Area[9] (*Appendix 11C*). An avoidance rate of 98.9 per cent was used with both CRM options. Thus, the approach in relation to CRM options and avoidance rate was in accordance with the Scoping Opinion and followed the available SNCB advice (SNCBs, 2014).

363 In terms of designs for the Wind Farm, the worst-case scenario for kittiwake collision risk was represented by the 40 WTG design, which is detailed in *Appendix 11C.* Therefore, it is the collision estimates from this design that are presented in this report and used to inform the AA. For the in-combination assessment, both the 2014 and 2017 designs of the other Forth and Tay wind farms were considered in relation to collision risk. The 2014 design represented the worst-case for each proposed development and is used for the in-combination assessment, although the in-combination collision estimates as calculated using the 2017 designs for these proposed developments are also presented. The 2017 designs for the other Forth and Tay wind farms were based on the information provided by the respective

developers. Full details of the CRM methods, inputs and resulting estimates are provided in *Appendix 11C*.

364 The Development-alone and in-combination CRM predictions calculated for the breeding period were apportioned between the different SPA and non-SPA colonies, as outlined above and detailed in *Appendix 11B*. The apportioning calculations were undertaken separately for the Development Area and two kilometre buffer, and for the Neart na Gaoithe wind farm (plus buffer). The Seagreen Alpha and Bravo sites were beyond the mean maximum foraging range of kittiwakes from the St Abb's Head to Fast Castle SPA (*Appendix 11B*, Thaxter *et al.,* 2012), and were deemed not to have connectivity to the SPA population during the breeding period. On the basis of these calculations, the percentage of the breeding period impacts to kittiwakes from the Development and the Neart na Gaoithe wind farm attributed to the St Abb's Head to Fast Castle SPA population were as follows:

- The Development –5.6 per cent; and
- Neart na Gaoithe –13.3 per cent.

365 Collision estimates were apportioned to age classes on the basis of the plumage characteristics of kittiwakes recorded during the 'at-sea' baseline surveys for the Survey Area[9] (*Appendix 11A*) and for the other three Forth and Tay wind farms (noting that the Seagreen Alpha and Bravo wind farms still have potential to cause collisions to St Abb's Head to Fast Castle SPA kittiwakes during the passage periods). Thus, apportioning to age classes was based upon data specific to each wind farm (*Appendix 11C*). The number of adult collisions during the breeding period was also amended according to an assumed 10 per cent sabbatical rate amongst the breeding adult birds, as advised in the Scoping Opinion (*Appendix 11C).*

366 Development-alone collision estimates were produced by summing the breeding period estimate with the estimates derived for the autumn and spring passage periods (as calculated using the amended BDMPS approach – see above).

367 In-combination collision estimates were also produced by summing the breeding period estimate with the estimates derived for the autumn and spring passage periods, and were undertaken for the following scenarios:

- The Development with the worst-case of the 2014 and 2017 designs for each of the other three Forth and Tay wind farms;
- The Development with the 2017 designs for each of the other three Forth and Tay wind farms;
- The Development with the worst-case of the 2014 and 2017 designs for each of the other three Forth and Tay wind farms, and the passage period estimates from the other wind farms in the UK North Sea.

368 In addition, qualitative consideration was given to the breeding period collisions arising from other wind farms within mean maximum foraging range of the Fowlsheugh SPA.

<u>*Estimated collision impacts*</u>

Development-alone

369 The predicted impacts on the St Abb's Head to Fast Castle SPA kittiwakes from the Development -alone were small, and mostly on the breeding adult population, with a predicted two birds per annum estimated to collide by option 2 of the CRM (Table 4.50). The estimated collision mortality was essentially limited to the breeding period (with only fractions of a bird estimated to collide during passage periods. The predicted number of collisions from the Development-alone on breeding adult birds is very small compared with the current (6,668 individuals) and citation (42,340 individuals) population sizes (representing 0.03 per cent and 0.005 per cent of these population sizes, respectively).

370 The breeding period collision estimates for kittiwake from option 1 of the CRM were very low (*Appendix 11C*). Following apportioning and rounding to the nearest integer they equated to zero collisions for the St Abb's Head to Fast Castle SPA population (Table 4.50). As detailed in *Appendix 11C*, this difference results from the lower percentage of kittiwakes estimated to be at PCH by the site-specific data than by the generic data (with this difference most pronounced during the breeding period). The site-specific flight height estimates are based upon a large sample-size and there is relatively strong statistical support for the observed differences in the site-specific and generic flight height estimates (*Appendix 11C*). Furthermore, the difference between the site-specific and generic estimates is such as to make systematic bias in the recording of the kittiwake flight heights during the baseline surveys a highly unlikely explanation for this difference (*Appendix 11C*), whilst it has been established that between-site variability in kittiwake flight heights is high (Johnston *et al.,* 2014a,b).

371 Consequently, it is considered likely that the use of the option 2 CRM will overestimate the Development-alone collisions, and will result in a highly precautionary assessment.

Table 4.50 Estimated collision impacts from the Development-alone on the kittiwake population at St Abb's Head to Fast Castle SPA. Estimates based on a 98.9% avoidance rate.

Model option	Seasonal period	Estimated number of collisions	
		Breeding adults[1]	Sub-adult birds[2]
2	Breeding	2	0
	Autumn passage[3]	0.1	0.1
	Spring passage[3]	<0.1	<0.1
1	Breeding	0	0
	Autumn passage[3]	0.1	0.1
	Spring passage[3]	<0.1	<0.1

[1]The number of adult collisions during the breeding period is reduced by 10 % to account for an assumed 10 % sabbatical rate amongst the adults (as advised in the Scoping Opinion).

[2]Juveniles are not distinguished within the sub-adult age class because they were only recorded in the data from the baseline surveys for the Development and are also not distinguished in the collision estimates from the other UK North Sea wind farms (*Appendix 11B*, Royal HaskoningDHV *et al.,* 2015).
[3]Passage period collision estimates presented to 1 decimal place because of the nature of the apportioning calculation (*Appendix 11B*).

In-combination

372 The estimated in-combination impacts from the Development with the other Forth and Tay wind farms were approximately three times higher than for the Development-alone when considering the 2014 designs of the other Forth and Tay wind farms, but only twice as high when considering the 2017 designs for the other Forth and Tay wind farms (Table 4.51). This was due largely to the reduction in estimated collisions associated with the 2017 design of the Neart na Gaoithe wind farm. The estimated in-combination collisions of breeding adults from the Forth and Tay wind farms remains small compared to the current and citation SPA population size, at 0.09 and 0.06 per cent of the current population size (for the 2014 and 2017 design scenarios, respectively) and 0.01 per cent of the citation population size (for both the 2014 and 2017 design scenarios).

Table 4.51 In-combination collision estimates for the St Abb's Head to Fast Castle SPA kittiwake population for the Development and the other three Forth and Tay wind farms, for both the 2014 and 2017 designs of the other Forth and Tay wind farms.

Wind farm	Seasonal period	Estimated number of collisions (based on option 2 with a 98.9 % avoidance rate)			
		2014 designs for other developments and 2017 for the Development		2017 designs for other developments and the Development	
		Breeding adults[1]	Sub-adults[2]	Breeding adults[1]	Sub-adults[2]
Inch Cape[3]	Breeding	2	0	2	0
Neart na Gaoithe		2	0	1	0
Seagreen Alpha		0	0	0	0
Seagreen Bravo		0	0	0	0
Inch Cape[3]	Autumn passage[4]	0.13	0.1	0.13	0.1
Neart na Gaoithe		0.2	0.1	0.1	<0.1
Seagreen Alpha		0.5	0.3	0.4	0.3
Seagreen Bravo		0.3	0.2	0.2	0.1
Inch Cape[3]	Spring passage[4]	<0.1	<0.1	<0.1	<0.1
Neart na Gaoithe		<0.1	<0.1	<0.1	0.0
Seagreen Alpha		0.2	0.1	0.2	0.1
Seagreen Bravo		0.3	0.1	0.3	0.1
TOTAL	**All seasons combined**	**6**	**1**	**4**	**1**

[1]The number of adult collisions during the breeding period is reduced by 10 % to account for an assumed 10 % sabbatical rate amongst the adults (as advised in the Scoping Opinion).
[2]Juveniles are not distinguished within the sub-adult age class because they were only recorded in the data from the baseline surveys for the Development and are also not distinguished in the collision estimates from the other UK North Sea wind farms (*Appendix 11B*, Royal HaskoningDHV *et al.,* 2015).
[3]Only the 2017 design is considered for the Development, with collision estimates as in Table 4.50.
[4]Passage period collision estimates presented to 1 decimal place because of the nature of the apportioning calculation (*Appendix 11B*).

373 The final in combination scenario that was considered involved the collision estimates for the Development with the 2014 designs for each of the other three Forth and Tay wind farms (the 2014 design being the worst-case for each of these wind farms), plus the passage period collision estimates from other wind farms in the UK North Sea. The inclusion of the collision

estimates from the other UK North Sea wind farms substantially increased the impacts during both passage periods, and doubled the estimated impact overall (Table 4.52).

374 Overall, the total predicted in-combination collision mortality to adult kittiwakes from the St Abb's Head to Fast Castle SPA was 12 birds per annum, when the worst-case design for the other Forth and Tay wind farms was assumed and when passage period collision estimates from other UK North Sea wind farms were included (Table 4.52). This remains a relatively small proportion of the St Abb's Head to Fast Castle SPA population size currently (0.18 per cent) and at citation (0.03 per cent)

Table 4.52 Estimated in-combination collisions for the St Abb's Head to Fast Castle SPA kittiwake population for the Development and the 2014 designs of the other three Forth and Tay wind farms (as derived from Table 4.51)[1] combined with the passage period collisions from other UK North Sea wind farms.

Wind farms	Seasonal period	Estimated number of collisions	
		Breeding adults[2]	Sub-adult birds[3]
Forth and Tay	Breeding	4	0
Forth and Tay	Autumn passage[4]	1	0.6
Other UK North Sea		2.5	1.4
Total autumn passage		**3.5**	**2.0**
Forth and Tay	Spring passage[4]	0.6	0.3
Other UK North Sea		3.8	1.7
Total spring passage		**4.4**	**1.9**
TOTAL	**All seasons**	**12**	**4**

[1]The 2014 design represents the worst-case of the 2014 and 2017 designs for each of the other three Forth and Tay wind farms.
[2]The number of adult collisions during the breeding period is reduced by 10 % to account for an assumed 10 % sabbatical rate amongst the adults (as advised in the Scoping Opinion).
[3]Juveniles are not distinguished within the sub-adult age class because they were only recorded in the data from the baseline surveys for the Development and are also not distinguished in the collision estimates from the other UK North Sea wind farms (*Appendix 11B*, Royal HaskoningDHV *et al.,* 2015).
[4]Passage period collision estimates presented to 1 decimal place because of the nature of the apportioning calculation (*Appendix 11B*).

<u>**Predicted displacement impacts alone and in-combination**</u>

375 The SNCB matrix approach provided the main basis for estimating impacts from displacement (as advised in the Scoping Opinion[13]), and was used to estimate the additional mortality attributable to the St Abb's Head to Fast Castle SPA kittiwake population as a result of displacement (and barrier effects) during the breeding period. Following the advice of the

Scoping Opinion, the mortality from displacement was calculated using the peak breeding period population size, averaged over the two years of survey, for the Development Area and two kilometre buffer (combining birds on the water and in flight). A displacement rate of 30 per cent was applied to this mean peak estimate, with two per cent of the displaced birds assumed to die. The estimated mortality from displacement, as calculated by the matrix approach, was apportioned to the St Abb's Head to Fast Castle SPA population and across the population age classes in the same way as for the breeding period collision estimates (see above).

376 For the Development-alone the apportioning was based on a mean peak of 3,866 birds, of which 93 per cent were adults (3,595 birds) and 5.6 per cent were from the St Abb's Head to Fast Castle SPA (201 birds) and 10 per cent were birds on sabbatical (giving 181 birds adult birds from the St Abb's Head to Fast Castle SPA population). Applying the advised 30 per cent displacement rate and two per cent mortality rate, gives an estimated mortality of one adult bird per annum (Table 4.53). This predicted displacement mortality from the Development-alone on breeding adult birds is very small compared with the current (6,668 individuals) and citation (42,340 individuals) population sizes (0.01 per cent and 0.002 per cent, respectively).

Table 4.53 Displacement matrix for adult kittiwakes from the St Abb's Head to Fast Castle SPA in the breeding season. Based on mean peak abundance apportioned to adult birds from the St Abb's Head to Fast Castle SPA. Recommended displacement rate and mortality rate is shown in green, and the resulting displacement mortality in dark green.

		DISPLACEMENT										
		0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
MORTALITY	0%	0	0	0	0	0	0	0	0	0	0	0
	1%	0	0	0	1	1	1	1	1	1	2	2
	2%	0	0	1	1	1	2	2	3	3	3	4
	3%	0	1	1	2	2	3	3	4	4	5	5
	4%	0	1	1	2	3	4	4	5	6	7	7
	5%	0	1	2	3	4	5	5	6	7	8	9
	10%	0	2	4	5	7	9	11	13	14	16	18
	15%	0	3	5	8	11	14	16	19	22	24	27
	20%	0	4	7	11	14	18	22	25	29	33	36
	30%	0	5	11	16	22	27	33	38	43	49	54
	40%	0	7	14	22	29	36	43	51	58	65	72
	50%	0	9	18	27	36	45	54	63	72	81	91

		DISPLACEMENT										
		0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
	60%	0	11	22	33	43	54	65	76	87	98	109
	70%	0	13	25	38	51	63	76	89	101	114	127
	80%	0	14	29	43	58	72	87	101	116	130	145
	90%	0	16	33	49	65	81	98	114	130	147	163
	100%	0	18	36	54	72	91	109	127	145	163	181

377 The displacement matrix predictions for the Development in-combination with the Neart na Gaoithe wind farm (there being no connectivity with the Seagreen Alpha and Bravo wind farms during the breeding period) were apportioned between SPA colonies and between age classes (Table 4.54). The predicted in-combination mortality from displacement of the St Abb's Head to Fast Castle SPA kittiwakes during the breeding period is more than twice that for the Development-alone, with a total estimated mortality of three breeding adults and fewer than one sub-adult bird per annum (Table 4.54). This level of additional mortality remains small compared with the current (6,668 individuals) and citation (42,340 individuals) population sizes (with the adult mortality representing 0.04 per cent and 0.007 per cent, respectively).

Table 4.54 Estimated mortality of St Abb's Head to Fast Castle SPA kittiwakes in the breeding period as a result of displacement from the Development in-combination with the Neart na Gaoithe wind farm.

Project	Mean peak estimate (individuals)	Adult proportion[1]	SPA proportion	Sabbatical proportion	Additional mortality	
					Breeding adults	Sub-adults
Inch Cape	3,866	0.93	0.056	0.10	1.1	0.1
Neart na Gaoithe	2,164	0.93	0.133		1.4	0.1
TOTAL	6,030	-	-	-	2.5	0.2

[1]Based on data from site surveys (*Appendix 11A* and *11C*).

378 The Scoping Opinion from MS-LOT requested that a qualitative assessment of displacement of kittiwakes in the non-breeding period was provided. As discussed above, evidence from geo-locator tracking of kittiwakes from colonies around the North Atlantic have shown that kittiwakes occur across a large sea area from the Barents Sea to Canada (Frederiksen *et al.,* 2011). Details from Frederiksen *et al.,* (2011) predicted that almost half of the winter population of kittiwakes in the North Sea were from colonies around the North Sea. So, it

seems likely that half of the adult kittiwakes from the St Abb's Head to Fast Castle SPA colonies also spend the non-breeding seasons in the North Sea. However, the remaining (approximately) half of the population likely winters in areas from the Celtic-Biscay shelf to eastern Canada. Therefore, from these data, it is reasonable to conclude that kittiwakes from the St Abb's Head to Fast Castle SPA are not dependent on any particular area and use large areas of sea, and therefore the likely effects of displacement from offshore wind farms in the North Sea, or elsewhere, during the non-breeding period are likely to have little or no effect on the St Abb's Head to Fast Castle SPA population.

379 As described for the Forth Islands SPA kittiwake population (*Section 4.1.2* above), impacts from displacement and barrier effects were also estimated using the SeabORD and Searle *et al.,* (2014) individual-based modelling approaches. These estimates and the comparisons with the SNCB matrix estimates are presented in *Appendix 11D*.

<u>Predicted combined collision risk and displacement impacts alone and in-combination</u>

380 The combined predicted impacts from collisions and displacement were assumed to be additive. Thus, the combined impact from the Development-alone was an additional mortality of three adult birds per annum (and no sub-adult birds) from the St Abb's Head to Fast Castle Islands SPA (Table 4.55). Combining collision and displacement impacts for the in-combination scenario comprising the Development with the other three Forth and Tay wind farms gave an additional mortality of eight adult and two sub-adult birds per annum, whilst the worst-case in-combination scenario (which also incorporated the passage period collisions from the other UK North Sea wind farms) gave an overall additional mortality of 14 adult and five sub-adult birds per annum (Table 4.55).

381 These mortality estimates for the different in-combination scenarios with impacts from collisions and displacement combined represent relatively small proportions of the current (6,668 individuals) and citation (42,340 individuals) population sizes (at 0.12 – 0.21 per cent and 0.02 – 0.03 per cent, respectively, for the adult mortality).

Table 4.55 Combined predicted collision plus displacement mortality to the St Abb's Head to Fast Castle SPA kittiwake population for the Development-alone and two in-combination scenarios. Both in-combination scenarios use the 2014 designs for each the other three Forth and Tay wind farms.

Scenario	Season	Breeding adults[1]	Sub-adults[1]
Development-alone	Breeding	3	<1
	Autumn passage[2]	0.1	0.1
	Spring passage[2]	<0.1	<0.1
In-combination – Development with other Forth and Tay wind farms	Breeding	6	1
	Autumn passage[2]	1.0	0.6

Scenario	Season	Breeding adults[1]	Sub-adults[1]
	Spring passage[2]	0.6	0.3
In-combination – Development with other Forth and Tay wind farms plus passage collisions from other UK North Sea wind farms	Breeding	6	1
	Autumn passage[2]	3.5	2.0
	Spring passage[2]	4.4	1.9

[1]The estimated additional mortality values are derived from those provided in Tables 4.52 and 4.54 but may differ slightly to the summed totals from these earlier tables due to rounding errors.
[2]Passage period collision estimates presented to 1 decimal place because of the nature of the apportioning calculation (*Appendix 11B*).

Impacts from other wind farms within foraging range

382 As detailed above for the Forth Islands SPA gannet population, several offshore wind farms other than Neart na Gaoithe and Seagreen Alpha and Bravo occur within mean maximum foraging range of breeding kittiwakes from the St Abb's Head to Fast Castle SPA (as defined by Thaxter *et al.,* 2012). The advice from the Scoping Opinion was to consider the breeding season effects from these wind farms qualitatively.

383 These wind farms are the OREC, Levenmouth Demonstration Turbine and the ForthWind Demonstration Array. The estimated collision mortality to kittiwakes during the breeding period was of one bird or less from each of these wind farms (without apportioning to the SPA). Also, both wind farms are at the edge of (or just beyond) the mean maximum foraging range and, as such, there is unlikely to be connectivity with the St Abb's Head to Fast Castle SPA kittiwake population.

384 Similarly, any impacts from displacement and barrier effects from these two wind farms will be minor (given that they comprise single WTGs only) and will not affect the conclusions of the assessment.

Population Viability Analysis of the kittiwake population

385 PVA was used to determine the effects of the predicted collision and displacement impacts from the Development-alone, and in-combination, on the St Abb's Head to Fast Castle SPA kittiwake population. Following the advice of the Scoping Opinion, PVAs were produced both for collisions only, and for collisions plus displacement. For the purposes of assessing the population-level impacts on the basis of the PVA, all collision estimates were derived from option 2 of the CRM, whilst the in-combination impacts used the 2014 designs of the other three Forth and Tay wind farms (as these represented the worst-case for each of these wind farms – Table 4.51). Estimates of displacement impacts were as derived by the SNCB matrix (Table 4.54).

386 The St Abb's Head to Fast Castle SPA kittiwake population model produced for the current assessment was a stochastic, density independent, model based on a Bayesian state-space

modelling framework. It was adapted from earlier St Abb's Head to Fast Castle SPA kittiwake population model developed by Freeman *et al.,* (2014), updated according to recently available population and demographic data. Further details of the model are provided in *Appendix 11E*.

387 The predicted population trends under baseline conditions (i.e. without wind farm impacts) were projected over both 28 and 53 year timescales. Additional mortality within the PVA was not incorporated until after year three of the projection (giving 25 and 50-year impact periods) to provide a more realistic representation of the likely population status at the time when the potential impacts will begin to arise. The additional mortality was incorporated on the basis of the percentage point change to the annual mortality of adult and sub-adult birds.

388 Outputs from the PVA were summarised according to the median predicted population sizes at the end of the projection period, and the three metrics which the Scoping Opinion advised should be used for the interpretation and which are defined above in the section on the Forth Islands SPA gannet population.

389 The PVA projected continuing rapid population decline for the St Abb's Head to Fast Castle SPA kittiwake population with and without impacts for the Development-alone and in-combination. The median end population size for each modelled impact was lower than the current SPA population size (3,334 pairs), and the projected population size at 50 years was always smaller than the projected population size at 25 years (Table 4.56).

390 The PVA metrics (Table 4.57) show that for the Development-alone the counterfactual of population size indicated small reductions in end population size after both 25 years and 50 years of impact (with the values being 0.985 and 0.974 for collisions only and collisions and displacement combined, respectively, after 50 years of impact – Table 4.57). The decrease in annual population growth rate was not detectable for collisions only (at least when the counterfactual value was taken to three decimal places – i.e. it remained at a value of 1.000), and was minimal for collisions and displacement combined (with a counterfactual value of 0.999). The centile value for collisions only remained at 50, and for collisions and displacement combined was 49 even after 50 years of impact (indicating very considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period). It should also be borne in mind that these metrics derive from PVAs based upon option 2 collision estimates, which are an order of magnitude higher than those generated by the option 1 CRM. As outlined in *Appendix 11C,* there are good reasons for considering the site-specific flight heights (and hence the option 1 collision estimates) to be representative of the kittiwakes within the Development Area and two kilometre buffer.

391 In terms of the in-combination, as expected, the population-level impacts were greatest for the scenario incorporating the other three Forth and Tay wind farms plus the passage period collision estimates from the other UK North Sea wind farms (Table 4.57). These still gave relatively small-scale reductions of up to 11 per cent in the end population size after 50 years of impact (with counterfactual values of 0.904 and 0.888 for collisions only and collisions and

displacement combined, respectively) and considerably smaller reductions of less than six per cent after 25 years of impact (with counterfactual values of 0.953 and 0.944 for collisions only and collisions and displacement combined, respectively). The reductions in annual population growth rate remained small (with counterfactual values of 0.998 for both collisions only and collisions and displacement combined), whilst the centile values were 47 (Table 4.57), indicating considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period.

392 The population projections in all cases showed that the end population size was much less than the population size at citation (21,170 pairs). However, the projected end population sizes were the same irrespective of the scenario (Table 4.56). After 25 years of impact the median predicted population size, at 550 pairs, is still likely to be sufficiently large to allow recovery, although after 50 years of impact it is predicted to be 100 pairs only, with the lower fifth quantile encompassing zero (suggesting a reasonable likelihood of extinction). However, this was the case for all scenarios and irrespective of whether the SPA population was subjected to the predicted wind farm impacts (Table 4.56).

393 The reasons for population decline in kittiwakes in the North Sea and the forth and Tay region (including the St Abb's Head to Fast Castle SPA) have been suggested as fisheries management and climate change (Frederiksen *et al.,* 2004). With fisheries now more appropriately managed in the Forth and Tay region, it may be that the recent small scale changes in the size of the St Abb's Head to Fast Castle SPA population may indicate an end to the decline, as could be the case with the Forth Islands SPA kittiwake population (see above). However, changes caused by climate change that are also hypothesised to be affecting the St Abb's Head to Fast Castle SPA kittiwake population may still be affecting the population in 25 and 50 years. The primary management option to prevent climate change affecting the St Abb's Head to Fast Castle SPA kittiwake population will be through global initiatives to mitigate greenhouse gas emissions (e.g. 21st Conference of the Parties of the UNFCCC (COP21)). Therefore, while the conservation status of the St Abb's Head to Fast Castle SPA population is projected to be in unfavourable condition the effects of the Development-alone, and in-combination, will not result in any important change to this, nor prevent recovery in the event of the factors causing population decline being reversed.

Table 4.56 Projected end population size of the St Abb's Head to Fast Castle SPA kittiwake population after 25 and 50 years for baseline, Development-alone and two in-combination scenarios in relation to collision impacts and collision plus displacement impacts.

Impacts	Scenario	Percentage point change in mortality		Median number of breeding females (5th – 95th centiles)	
		Adults	Sub-adults	25 years	50 years
No impacts	Baseline	0	0	550 (150 – 2,050)	100 (0 - 950)
Collisions only	Development-alone	0.031	0.005	550 (150 – 2,000)	100 (0 - 950)
	In-combination – Development with other Forth and Tay wind farms	0.082	0.024	550 (150 – 2,000)	100 (0 - 900)
	In-combination – Development with other Forth and Tay wind farms plus passage collisions from other UK North Sea wind farms	0.176	0.085	550 (150 – 1,950)	100 (0 - 850)
Collisions and displacement combined	Development-alone	0.047	0.007	550 (150 – 2,000)	100 (0 - 900)
	In-combination – Development with other Forth and Tay wind farms	0.120	0.028	550 (150 – 2,000)	100 (0 - 900)
	In-combination – Development with other Forth and Tay wind farms plus passage collisions from other UK North Sea wind farms	0.214	0.089	550 (150 – 1,950)	100 (0 - 850)

Table 4.57 PVA metrics for the St Abb's Head to Fast Castle SPA kittiwake population after 25 and 50 years for the Development-alone and two in-combination scenarios in relation to collision impacts and collision plus displacement impacts.

Impacts	Scenario	Counterfactual of end population size		Counterfactual of population growth rate[1]	Centile of baseline population matching the median of the impacted population	
		25 years	50 years	25 and 50 years	25 years	50 years
No impact	Baseline	1.000	1.000	1.000	50	50
Collisions only	Development-alone	0.992	0.985	1.000	50	50
	In-combination – Development with other Forth and Tay wind farms	0.978	0.951	0.999	49	49
	In-combination - Development with other Forth and Tay wind farms plus passage collisions from other UK North Sea wind farms	0.953	0.904	0.998	47	47
Collisions and displacement combined	Development-alone	0.988	0.974	0.999	49	49
	In-combination – Development with other Forth and Tay wind farms	0.969	0.938	0.999	48	48
	In-combination - Development with other Forth and Tay wind farms plus passage collisions from other UK North Sea wind farms	0.944	0.888	0.998	47	47

[1]The value of this metric does not vary according to the length of the projection period.

__Conclusion__

394 The predicted impacts from the Development-alone and in-combination were small, and the outputs from the PVA indicate small predicted population-level effects. Based upon the PVA

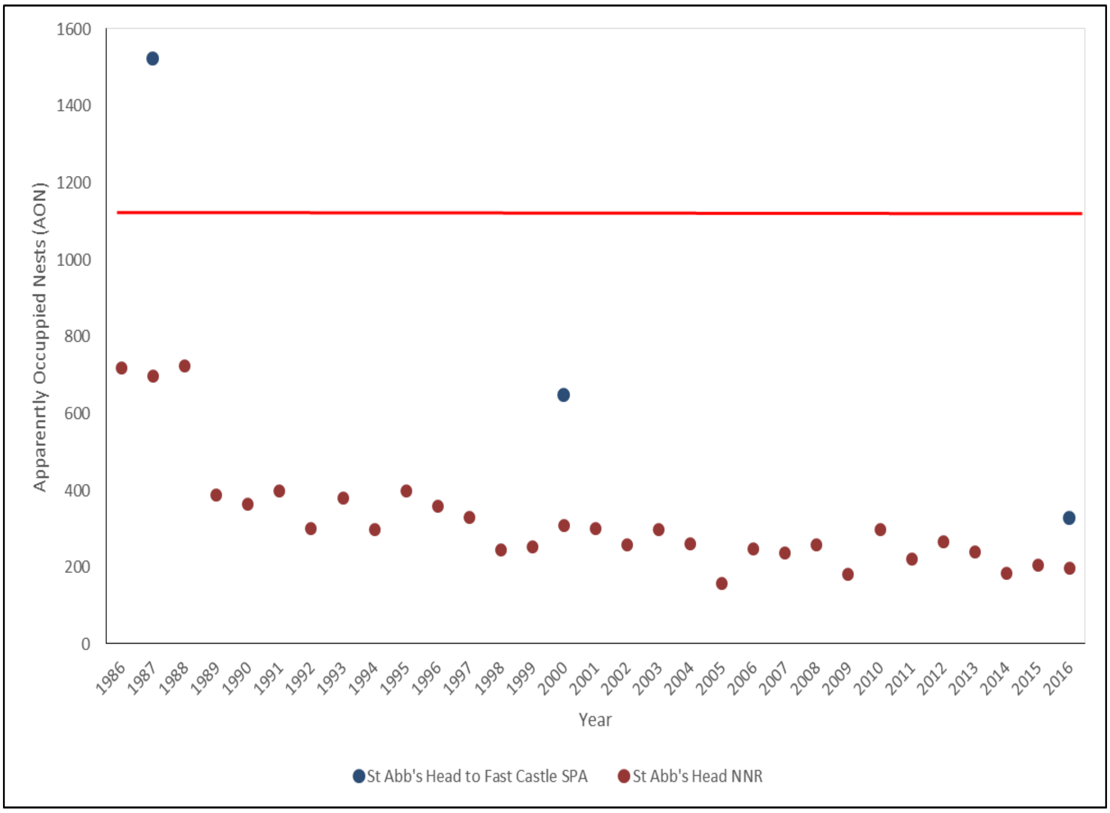
projections, the Conservation Objective of the SPA, to maintain the "population of the species as a viable component of the site", will not to be met even without the impacts from the Development- alone and in-combination. However, the predicted impacts of the Development-alone and in-combination are sufficiently small that it is considered they will effectively not contribute to accelerating the rate of the ongoing population decline, nor will they prevent population increase should environmental conditions become more favourable for kittiwakes. Accounting for the impacts from the other wind farms within foraging range of the St Abb's Head to Fast Castle SPA which were considered qualitatively does not affect this conclusion. It should therefore be possible for the CA to conclude, beyond reasonable scientific doubt, that the Development-alone, and in-combination, will have no adverse effect on site integrity due to the effects on the kittiwake population.

4.3.2 Herring Gull Population

395 In their scoping opinion, MS-LOT stated that SNH recommend providing updated CRM results for herring gull in the breeding and non-breeding seasons. In-combination assessment was recommended at the Forth and Tay regional scale only.

396 The St Abb's Head to Fast Castle SPA herring gull population is currently estimated to number 325 breeding pairs, which is considerably lower than the citation population size of 1,160 pairs (Figure 4.12). The whole SPA has only been counted in three years since 1986 but the annual count data from the St Abb's Head NNR demonstrate a long-term decline between 1986 and 2016. The count data shown in Figure 4.12 are from the JNCC SMP database[10], with the 2016 estimate as provided in the SNH scoping advice[11].

Figure 4.12 Herring gull population trend at the St Abb's Head NNR between 1986 and 2016, with the three counts for the entire St Abb's Head to Fast Castle SPA also shown. The red line shows the population size for the whole SPA at designation (1,160 pairs).



<u>Potential impacts on the herring gull population</u>

397 The proposed Development Area and two kilometre buffer and Offshore Export Cable Corridor do not overlap with the St Abb's Head to Fast Castle SPA. Consequently, the potential impacts on its herring gull population will only occur as a result of individuals from the colony occurring in the Development Area. The impacts of concern identified in the Scoping Opinion from MS-LOT were from collisions of herring gulls with operational WTG blades which could impact on the population from the St Abb's Head to Fast Castle SPA. Data on herring gull from boat-based surveys from the Development Area and two kilometre buffer indicate that there is a potential for collisions to occur. From published information on herring gull foraging ranges (Thaxter *et al.,* 2012) it is possible that breeding herring gull from the St Abb's Head to Fast Castle SPA occur within the Development Area and two kilometre buffer, as well as within the proposed development areas of other wind farms in the Forth and Tay. The breeding period of herring gull is defined as April to August, following the advice of the Scoping Opinion.

398 In the non-breeding season adult herring gulls in Great Britain are largely sedentary, with relatively short local movements only (Wernham *et al.,* 2002). However, there is an influx of breeding birds of Scandinavian breeding sub-species, *L. argentatus argentatus* (Coulson *et al.,* 1984). The apportioning of impacts to the St Abb's Head to Fast Castle SPA herring gull population in the breeding and non-breeding periods is detailed in *Appendix 11B*.

Predicted collision impacts alone and in-combination

Estimation of impacts

399 CRMs were undertaken using the Band (2012) model to predict the number of birds at risk from collisions both for the Development-alone and in-combination. Following the Scoping Opinion from MS-LOT, the assessment for herring gull was based on option 3 of the CRM, but with outputs from options 1 and 2 of the CRM also presented for the Development-alone. Option 3 of the CRM uses the modelled flight height distributions based on the generic flight height data from Johnston *et al.,* (2014a,b), whilst options 1 and 2 assume uniform flight height distributions based on site-specific and generic flight height data, respectively (*Appendix 11C*). An avoidance rate of 99.0 per cent was used with the option 3 CRMs and of 99.5 per cent with the options 1 and 2 in accordance with the Scoping Opinion and following the available SNCB advice (SNCBs, 2014).

400 In terms of the designs for the Wind Farm, the worst-case scenario for herring gull collision risk was represented by the 72 WTG design, so differing in this respect from gannet and kittiwake (*Appendix 11C*). Therefore, it is the collision estimates from this design that are presented in this report and used to inform the AA. For the in-combination assessment, both the 2014 and 2017 designs of the Neart na Gaoithe wind farm were considered in relation to collision risk. The Seagreen Alpha and Bravo sites were beyond the mean maximum foraging range of herring gulls from the St Abb's Head to Fast Castle SPA (Thaxter *et al.,* 2012), and were deemed not to have connectivity to the SPA population during either the breeding or non-breeding periods (*Appendix 11B*). The 2014 design represented the worst-case for the Neart na Gaoithe wind farm and is used for the in-combination assessment, although the in-combination collision estimates as calculated using the 2017 design for this proposed development is also presented. The 2014 design for the Neart na Gaoithe wind farm was based on the information provided by the respective developer. Full details of the CRM methods, inputs and resulting estimates are provided in *Appendix 11C.*

401 The Development-alone and in-combination CRM predictions calculated for the breeding period were apportioned between the different SPA and non-SPA colonies, as outlined above and detailed in *Appendix 11B*. The apportioning calculations were undertaken separately for the Development Area and two kilometre buffer, and for Neart na Gaoithe (plus buffer). On the basis of these calculations, the percentage of the breeding period impacts to herring gulls from the Development and the Neart na Gaoithe wind farm attributed to the St Abb's Head to Fast Castle SPA population were as follows:

- The Development – 0.8 per cent; and
- Neart na Gaoithe – 1.1 per cent.

402 The above apportioning estimates for the breeding period were also applied to the non-breeding period, which will be precautionary because it does not account for the influx of birds to the UK (and particularly the east coast) from northern European breeding populations (Furness, 2015, *Appendix 11B*).

403 Collision estimates were apportioned to age classes on the basis of the plumage characteristics of herring gulls recorded during the 'at-sea' baseline surveys for the Survey Area[9] (*Appendix 11A*) and for the Neart na Gaoithe wind farm (*Appendix 11C*). Thus, apportioning to age classes was based upon data specific to each wind farm. The number of adult collisions was also amended according to an assumed 35 per cent sabbatical rate amongst the breeding adult birds, as advised in the Scoping Opinion (*Appendix 11C*).

404 Development-alone and in-combination collision estimates were produced by summing the respective breeding and non-breeding period estimates. In-combination collision estimates were undertaken for the following scenarios:

- The Development with the worst-case of the 2014 and 2017 designs for the Neart na Gaoithe wind farm; and
- The Development with the 2017 designs for the Neart na Gaoithe wind farm.

405 In addition, qualitative consideration was given to the breeding period collisions arising from other wind farms within mean maximum foraging range of the St Abb's Head to Fast Castle SPA.

<u>*Estimated collision impacts*</u>

Development-alone

406 The predicted impacts on the St Abb's Head to Fast Castle SPA herring gulls from the Development-alone were extremely small with fewer than 0.1 birds from the breeding age class estimated to collide per annum, as estimated by option 3 of the CRM (Table 4.58). The collision estimates for the sub-adult age class were similarly small. The predicted number of collisions per annum from the Development-alone on breeding adult birds was small compared with the current (650 individuals) and citation (2,320 individuals) population sizes (0.002 per cent and 0.0004 per cent, respectively).

407 Collision estimates by options 1 and 2 of the CRM were similar to those produced by option 3 (Table 4.58), with the option 1 estimates giving no collisions during the breeding period – *Appendix 11C*).

Table 4.58 Estimated collision impacts from the Development-alone on the herring gull population at St Abb's Head to Fast Castle SPA. Estimates based on avoidance rates of 99.0% for option 3 and 99.5% for options 1 and 2.

Model option	Seasonal period	Estimated number of collisions[1]	
		Breeding adults[2]	Sub-adult birds[3]
3	Breeding	<0.1	0.0
	Non-breeding	<0.1	<0.1
2	Breeding	<0.1	0.0
	Non-breeding	<0.1	<0.1
1	Breeding	0.0	0.0
	Non-breeding	<0.1	<0.1

[1]Collision estimates are presented to 1 decimal place because of the small numbers of total collisions estimated to occur.
[2]The number of adult collisions is reduced by 35 % to account for an assumed 35 % sabbatical rate amongst the adults (as advised in the Scoping Opinion).
[3]Juveniles are not distinguished within the sub-adult age class because they were only recorded in the data from the baseline surveys for the Development

In-combination

408 The estimated in-combination collisions for the Development with the Neart na Gaoithe wind farm remained low and for both the breeding and non-breeding periods combined was less than 0.1 adult birds per annum (Table 4.59). Due to the very low collision estimates, there was no discernible difference between the scenarios incorporating the different designs for the Neart na Gaoithe wind farm (i.e. the 2014 and 2017 designs).

409 Overall, the total predicted in-combination collision mortality to adult herring gulls from the St Abb's Head to Fast Castle SPA represented only 0.008 per cent of the current population size and 0.002 per cent of the citation population size. Based on an annual survival rate of 83.4 per cent for adult herring gulls (Horswill and Robinson, 2015), the mortality of adult herring gulls from the St Abb's Head to Fast Castle SPA population will equate to 108 individuals each year in the absence of any wind farm impacts. Therefore, the in-combination collision estimates would represent an increase in the baseline annual adult mortality of 0.05 per cent (which is precautionary, given the approach taken to apportioning collisions to SPA populations in the non-breeding period).

Table 4.59 In-combination collision estimates for the St Abb's Head to Fast Castle SPA herring gull population for the Development and the Neart na Gaoithe wind farm, for both the 2014 and 2017 designs of the Neart na Gaoithe wind farm.

		Estimated number of collisions (based on option 3 with a 99.0 % avoidance rate)[1]			
		2014 designs for other developments and 2017 for the Development		2017 designs for other developments and the Development	
Wind farm	**Seasonal period**	**Breeding adults[2]**	**Sub-adults[3]**	**Breeding adults[2]**	**Sub-adults[3]**
Inch Cape[4]	Breeding	<0.1	0.0	<0.1	0.0
Neart na Gaoithe		<0.1	<0.1	<0.1	<0.1
Total breeding		<0.1	<0.1	<0.1	<0.1
Inch Cape[4]	Non-breeding	<0.1	<0.1	<0.1	<0.1
Neart na Gaoithe		<0.1	<0.1	<0.1	<0.1
Total non-breeding		<0.1	<0.1	<0.1	<0.1
TOTAL	**All seasons**	**0.1**	**0.1**	**<0.1**	**<0.1**

[1]Collision estimates are presented to 1 decimal place because of the small numbers of total collisions estimated to occur.
[2]The number of adult collisions is reduced by 35 % to account for an assumed 35 % sabbatical rate amongst the adults (as advised in the Scoping Opinion).
[3]Juveniles are not distinguished within the sub-adult age class because they were only recorded in the data from the baseline surveys for the Development.
[4]Only the 2017 design is considered for the Development, with collision estimates as in Table 4.58.

<u>**Collisions from other wind farms within foraging range**</u>

410 As detailed above for the Forth Islands SPA gannet population, several offshore wind farms other than Neart na Gaoithe and Seagreen Alpha and Bravo occur within mean maximum foraging range of breeding herring gulls from the St Abb's Head to Fast Castle SPA (as defined by Thaxter *et al.,* 2012). The advice from the Scoping Opinion was to consider the breeding season effects from these wind farms qualitatively.

411 These wind farms are the OREC, Levenmouth Demonstration Turbine) and the ForthWind Demonstration Array. As for the St Abb's Head to Fast Castle SPA kittiwakes, there will be little connectivity of the St Abb's Head to Fast Castle SPA herring gulls with these wind farms, as they are at the edge of the foraging range for the species. As such, any collisions at these

small-scale wind farms are highly unlikely to be attributable to the St Abb's Head to Fast Castle SPA population.

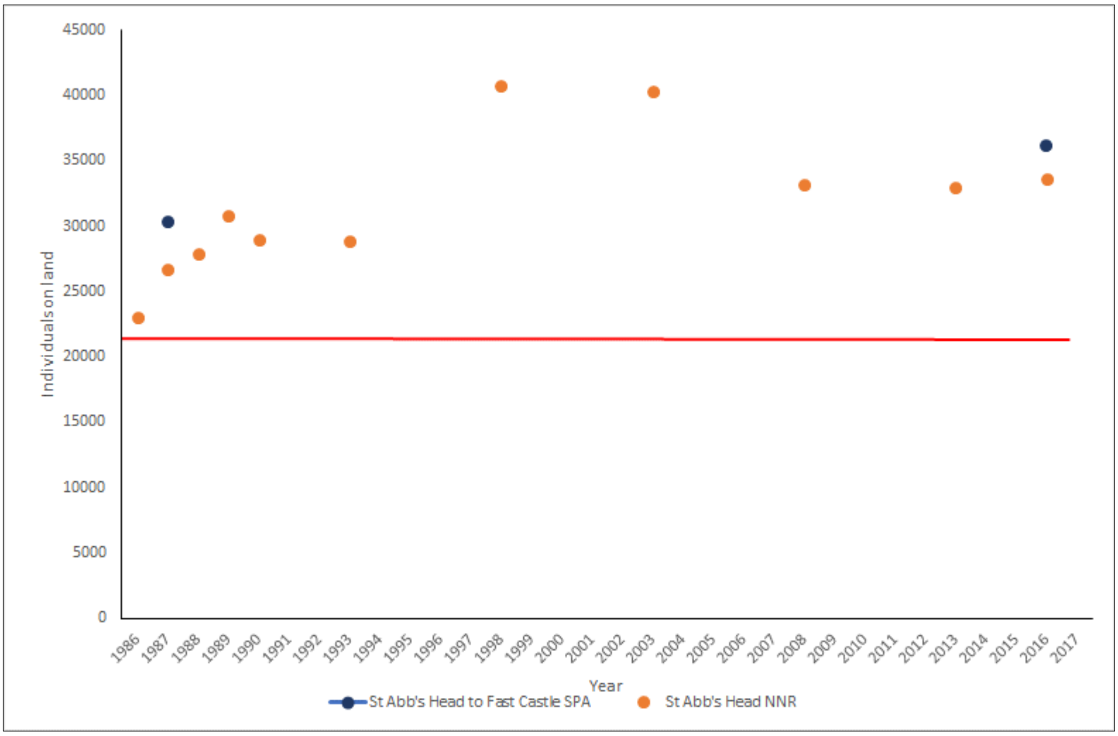
Conclusion

412 The predicted impacts from the Development-alone and in-combination were very small, and are considered likely to result in minimal population-level impacts, and consequently PVA was not required to investigate impacts further. The Conservation Objective of the SPA, to maintain the "population of the species as a viable component of the site" is currently not being met but, given the small level of impact predicted, this will not be affected or exacerbated by the predicted impacts from the Development-alone or in-combination. Accounting for the collisions from the other wind farms within foraging range of the St Abb's Head to Fast Castle SPA which were considered qualitatively does not affect this conclusion. It should therefore be possible for the CA to conclude, beyond reasonable scientific doubt, that the Development-alone, and in-combination, will have no adverse effect on site integrity due to the effects on the herring gull population.

4.3.3 Guillemot Population

413 The St Abb's Head to Fast Castle SPA guillemot population has shown an overall increase during the last 30 years, and relative stability for the past 10 years, based on count data from the St Abb's Head NNR (which holds the vast majority of the SPA population – Figure 4.13). It has remained above the citation population size (31,750 individuals) since designation. The data shown in Figure 4.12 are from the JNCC SMP database[10] , with the 2016 count for the whole SPA as provided in the SNH scoping advice[11]. It should be noted that the data shown in Figure 4.13 are the count of individuals on land. This needs to be multiplied by 1.34 to give the estimated number of breeding adults[11] (except in the case of the citation population size which is taken as 31,750 individuals - SNH (2009c)).

Figure 4.12 Guillemot population trend at the St Abb's Head NNR between 1986 and 2016, with the two counts for the entire St Abb's Head to Fast Castle SPA also shown. The red line shows the population size for the whole SPA at designation (31,750 individuals).



Potential impacts on the guillemot population

414 The proposed Development Area and two kilometre buffer and Offshore Export Cable Corridor do not overlap with the St Abb's Head to Fast Castle SPA. Consequently, the potential impacts on its guillemot population will only occur as a result of individuals from the colony occurring in the Development Area. In relation to guillemot, the impacts of concern identified in the Scoping Opinion from MS-LOT were from displacement from the Development Area and two kilometre buffer and barrier effects (with the two latter impacts subsequently considered together). From published information on guillemot foraging ranges generally (Thaxter *et al.,* 2012) and tracking from the St Abb's Head to Fast Castle SPA specifically (CEH, 2011), it is very likely that breeding guillemots from the St Abb's Head to Fast Castle SPA occur within the Development Area and two kilometre buffer, as well as within the proposed development areas of other wind farm s in the Forth and Tay.

415 As detailed above for the Forth Islands SPA guillemot population, the Scoping Opinion advises that the assessment for the non-breeding period should be based on the same apportioning as for the breeding period. The breeding period for guillemot is defined as April to mid-August, following the advice of the Scoping Opinion.

Predicted displacement impacts on guillemot population alone and in-combination

416 The SNCB matrix approach (SNCBs, 2017) was used to estimate the impacts from displacement (and barrier effects) as advised in the Scoping Opinion[13], and was used to estimate the

additional mortality attributable to the St Abb's Head to Fast Castle SPA guillemot population as a result of displacement during both the breeding and non-breeding periods. Following the advice of the Scoping Opinion, the mortality from displacement was calculated using the peak breeding period population size, averaged over the two years of survey, for the Development Area and two kilometre buffer (combining birds on the water and in flight), with this undertaken separately for the breeding and non-breeding periods. A displacement rate of 60 per cent was applied to this mean peak estimate, with one per cent of the displaced birds assumed to die, for both the breeding and non-breeding periods.

417 The Development-alone and in-combination mortality estimated from displacement was apportioned between SPA and non-SPA colonies as outlined above and detailed in *Appendix 11B*. The apportioning calculations were undertaken separately for the Development Area and two kilometre buffer, and for Neart na Gaoithe (plus buffer) and Seagreen Alpha and Bravo combined (plus buffer). The two Seagreen sites were combined for the purposes of the apportioning calculations because they are contiguous along their longest boundary. On the basis of these calculations, the percentage of the breeding and non-breeding period impacts to guillemots from the Development and each of the other three Forth and Tay wind farms attributed to the St Abb's Head to Fast Castle SPA population were as follows:

- The Development – 15.3 per cent;
- Neart na Gaoithe – 21.0 per cent; and
- Seagreen Alpha and Bravo – 12.7 per cent.

418 The estimated displacement mortality was also apportioned to age classes, which in this case was based upon the stable age distribution from the St Abb's Head to Fast Castle SPA guillemot population model produced for the current assessment (and as detailed in *Appendix 11E*). This approach followed the advice of the Scoping Opinion for species for which age distributions could not be distinguished during the 'at-sea' surveys. The estimated number of adult birds displaced during the breeding period was also amended according to an assumed seven per cent sabbatical rate amongst the breeding adult birds, as advised in the Scoping Opinion (*Appendix 11D*).

419 For the Development-alone in the breeding period, the mean peak population estimate was 8,184 birds, of which 43.9 per cent were adults (3,593 birds) and 15.3 per cent were from the St Abb's Head to Fast Castle SPA (550 birds) and seven per cent were birds on sabbatical (giving 511 adult birds from the St Abb's Head to Fast Castle SPA population). Applying the advised 60 per cent displacement rate and one per cent mortality rate gives an estimated mortality of three adult birds per breeding period (Table 4.60). This predicted displacement mortality from the Development-alone on breeding adults is very small compared with the current (48,516 individuals) and citation (31,750 individuals) population sizes (0.006 and 0.009 per cent, respectively).

420 For the Development-alone in the non-breeding season, the mean peak population estimate was 3,912 birds, giving an estimated non-breeding season mortality of two birds (based on the same rates as used in the breeding period for apportioning to colonies and age classes,

assigning sabbaticals and for estimating displacement and mortality amongst displaced birds). Thus, the estimated annual mortality of adult guillemots from the St Abb's Head to Fast Castle SPA population was five birds, which represented 0.01 and 0.02 per cent of the current and citation SPA population sizes, respectively.

Table 4.60 Displacement matrix for adult guillemots from the St Abb's Head to Fast Castle SPA in the breeding season. Based on mean peak abundance apportioned to adult birds from the St Abb's Head to Fast Castle SPA. Recommended displacement rate and mortality rate is shown in green, and the resulting displacement mortality in dark green.

		DISPLACEMENT										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
MORTALITY	0%	0	0	0	0	0	0	0	0	0	0	0
	1%	0	1	1	2	2	3	3	4	4	5	5
	2%	0	1	2	3	4	5	6	7	8	9	10
	3%	0	2	3	5	6	8	9	11	12	14	15
	4%	0	2	4	6	8	10	12	14	16	18	20
	5%	0	3	5	8	10	13	15	18	20	23	26
	10%	0	5	10	15	20	26	31	36	41	46	51
	15%	0	8	15	23	31	38	46	54	61	69	77
	20%	0	10	20	31	41	51	61	72	82	92	102
	30%	0	15	31	46	61	77	92	107	123	138	153
	40%	0	20	41	61	82	102	123	143	164	184	204
	50%	0	26	51	77	102	128	153	179	204	230	256
	60%	0	31	61	92	123	153	184	215	245	276	307
	70%	0	36	72	107	143	179	215	250	286	322	358
	80%	0	41	82	123	164	204	245	286	327	368	409
	90%	0	46	92	138	184	230	276	322	368	414	460
	100%	0	51	102	153	204	256	307	358	409	460	511

Table 4.61 Displacement matrix for adult guillemots from the St Abb's Head to Fast Castle SPA in the non-breeding season. Based on mean peak abundance apportioned to adult birds from the St Abb's Head to Fast Castle SPA. Recommended displacement rate and mortality rate is shown in green, and the resulting displacement mortality in dark green.

		DISPLACEMENT										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
MORTALITY	0%	0	0	0	0	0	0	0	0	0	0	0
	1%	0	0	1	1	1	1	**2**	2	2	2	3
	2%	0	1	1	2	2	3	3	4	4	5	5
	3%	0	1	2	2	3	4	5	6	6	7	8
	4%	0	1	2	3	4	5	6	7	8	9	10
	5%	0	1	3	4	5	7	8	9	10	12	13
	10%	0	3	5	8	10	13	16	18	21	24	26
	15%	0	4	8	12	16	20	24	28	31	35	39
	20%	0	5	10	16	21	26	31	37	42	47	52
	30%	0	8	16	24	31	39	47	55	63	71	79
	40%	0	10	21	31	42	52	63	73	84	94	105
	50%	0	13	26	39	52	66	79	92	105	118	131
	60%	0	16	31	47	63	79	94	110	126	142	157
	70%	0	18	37	55	73	92	110	128	147	165	183
	80%	0	21	42	63	84	105	126	147	168	189	210
	90%	0	24	47	71	94	118	142	165	189	212	236
	100%	0	26	52	79	105	131	157	183	210	236	262

421 The displacement matrix predictions for the Development in-combination with the other three Forth and Tay wind farms were apportioned between SPA colonies and between age classes (Table 4.62). The predicted in-combination mortality from displacement for the St Abb's Head to Fast Castle SPA guillemots during the breeding period is approximately four times greater than for the Development-alone, with a total estimated mortality of 12 breeding adults and 16 sub-adult birds (Table 4.62). This level of mortality remains small compared with the current (48,516 individuals) and citation (31,750 individuals) population sizes (with the adult mortality representing 0.02 per cent and 0.04 per cent, respectively).

422 Levels of predicted mortality from displacement in the non-breeding period for the Development in-combination with the other three Forth and Tay wind farms were similar to those for the breeding period (Table 4.62), with the contribution of the Development to the total in-combination mortality being a slightly smaller proportion. Combining the two seasonal estimates gave an estimated annual mortality from the in-combination impacts of 21 breeding adults and 29 sub-adult birds (Table 4.62). The estimated annual mortality of breeding adults from displacement represented only 0.04 per cent and 0.07 per cent of the current and citation SPA population sizes.

Table 4.62 Estimated mortality of St Abb's Head to Fast Castle SPA guillemots as a result of displacement from the Development in-combination with the other three Forth and Tay wind farms.

Seasonal period	Project	Mean peak estimate (individuals)	Adult pro-portion[1]	SPA pro-portion	Sabbatical proportion	Additional mortality	
						Breeding adults	Sub-adults
Breeding	Inch Cape	8,184	0.439	0.153	0.07	3.1	4.2
	Neart na Gaoithe	3,263		0.210		1.7	2.3
	Seagreen Alpha	12,190		0.127		3.8	5.2
	Seagreen Bravo	10,778		0.127		3.4	4.6
	Total	34,415	-	-	-	12.0	16.3
Non-breeding	Inch Cape	3,912	0.439	0.153	0.07	1.5	2.0
	Neart na Gaoithe	7,618		0.210		3.9	5.4
	Seagreen Alpha	6,131		0.127		1.9	2.6
	Seagreen Bravo	6,780		0.127		2.1	2.9
	Total	24,441	-	-	-	9.4	12.9
Annual	Total	-	-	-	-	21.4	29.2

[1]Based on the stable age distribution from the St Abb's Head to Fast Castle SPA guillemot population model (*Appendix 11E*).

423 As described for the Forth Islands SPA kittiwake population (*Section 4.1.2* above), impacts from displacement and barrier effects were also estimated using the SeabORD and Searle *et*

al., (2014) individual-based modelling approaches. These estimates and the comparisons with the SNCB matrix estimates are presented in *Appendix 11D*.

Impacts from other wind farms within foraging range

424 As detailed above for the Forth Islands SPA gannet population, several offshore wind farms other than Neart na Gaoithe and Seagreen Alpha and Bravo occur within mean maximum foraging range of breeding guillemots from St Abb's Head to Fast Castle SPA (as defined by Thaxter *et al.,* 2012). The advice from the Scoping Opinion was to consider the breeding season effects from these wind farms qualitatively.

425 These wind farms are the OREC, Levenmouth Demonstration Turbine and the ForthWind Demonstration Array. Both comprise single WTGs only and any impacts from displacement and barrier effects will be minor and will not affect the conclusions of the assessment.

Population Viability Analysis of the guillemot population

426 PVA was used to determine the effects of the predicted displacement impacts from the Development-alone, and in-combination, on the St Abb's Head to Fast Castle SPA guillemot population. The St Abb's Head to Fast Castle SPA guillemot population model produced for the current assessment was a stochastic, density independent, model based on a Bayesian state-space modelling framework. It was adapted from earlier St Abb's Head to Fast Castle SPA guillemot population model developed by Freeman *et al.,* (2014), updated according to recently available population and demographic data. Further details of the model are provided in *Appendix 11E*.

427 The predicted population trends under baseline conditions (i.e. without wind farm impacts) were projected over both 28 and 53 year timescales. Additional mortality within the PVA was not incorporated until after year three of the projection (giving 25 and 50-year impact periods) to provide a more realistic representation of the likely population status at the time when the potential impacts will begin to arise.

428 The additional mortality was incorporated on the basis of the percentage point change to the annual mortality of adult and sub-adult birds, as represented by the SNCB matrix estimates (Table 4.62). Outputs from the PVA were summarised according to the median predicted population sizes at the end of the projection period, and the three metrics which the Scoping Opinion advised should be used for the interpretation and which are defined above in the section on the Forth Islands SPA gannet population.

429 The PVA population models projected population growth for the St Abb's Head to Fast Castle SPA guillemot population with and without impacts for the Development-alone and in-combination. The median end population size for each modelled impact) was higher than the current SPA population size (48,516 individuals), and the projected population size at 50 years was always larger than the projected population size at 25 years (Table 4.63).

430 The PVA metrics (Table 4.64) show that for the Development-alone the counterfactual of end population size indicated small reductions in end population size after both 25 years and 50

years of impact (with the values being 0.997 and 0.995, respectively). A decrease in annual population growth rate was not detectable (at least when the counterfactual value was taken to three decimal places – i.e. it remained at a value of 1.000), whilst the centile value was 49 even after 50 years of impact (indicating very considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period).

431 In terms of the in-combination, the PVA metrics continued to indicate small population-level impacts (albeit that they were greater than for the Development-alone, as would be expected – Table 4.64). The predicted reduction in end population size was only three per cent even after 50 years of impact (the counterfactual of population size being 0.974), whilst the reduction in annual population growth rate was minimal (with a counterfactual value of 0.999). The centile values were 47 even after 50 years of impacts, indicating considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period.

432 The population projections in all cases showed that the end population size was greater than the population size at citation (31,750 individuals), and that the population continued to increase over the projection period. Therefore, the effects of the Development-alone, and in-combination, would not result in the conservation status of the St Abb's Head to Fast Castle SPA population being in unfavourable condition.

Table 4.63 Projected end population size of the St Abb's Head to Fast Castle SPA guillemot population after 25 and 50 years for baseline, Development-alone and in-combination scenarios.

	Percentage point change in mortality		**Median number of breeding females (5th – 95th centiles)**	
	Adults	**Sub-adults**	**25 years**	**50 years**
Baseline	-	-	45,700 (29,550 – 70,150)	66,400 (33,750 – 137,250)
Development-alone	0.009	0.010	45,550 (29,550 – 70,150)	66,000 (33,750 – 136,300)
In-combination	0.044	0.047	44,950 (29,150 – 69,300)	64,700 (33,000 – 133,200)

Table 4.64 PVA metrics for the St Abb's Head to Fast Castle SPA guillemot population after 25 and 50 years for the Development-alone and in-combination scenarios.

	Counterfactual of end population size		Counterfactual of population growth rate[1]	Centile of baseline population matching the median of the impacted population	
	25 years	50 years	25 and 50 years	25 years	50 years
Baseline	1.000	1.000	1.000	50	50
Development-alone	0.997	0.995	1.000	49	49
In-combination	0.986	0.974	0.999	47	47

[1]The value of this metric does not vary according to the length of the projection period.

Conclusion

433 The predicted impacts from the Development-alone and in-combination were small, and outputs from the PVA indicate small predicted population-level effects. Based upon the PVA projections, the Conservation Objective of the SPA, to maintain the "population of the species as a viable component of the site", will not be compromised for the guillemot population. It should therefore be possible for the CA to conclude, beyond reasonable scientific doubt, that the Development-alone, and in-combination, will have no adverse effect on site integrity due to the effects on the guillemot population.

4.3.4 Breeding Seabird Assemblage

434 The breeding seabird assemblage for the St Abb's Head to Fast Castle SPA is a qualifying feature on the basis of the SPA supporting 79,560 individual seabirds, including guillemot, razorbill, shag, kittiwake and herring gull.

435 Potential impacts of the Development on the breeding seabird assemblage for the St Abb's Head to Fast Castle SPA could arise via effects on the individual named species within the assemblage feature. However, no adverse effects are predicted from the Development alone or in-combination on those species assessed above (which includes three of the five named species in the assemblage), whilst for the remaining species within the assemblage (razorbill and shag) there is no connectivity with the Development.

436 Therefore, no adverse effects of the Development alone or in-combination are predicted on the St Abb's Head to Fast Castle SPA breeding seabird assemblage.

4.4 Buchan Ness to Collieston Coast SPA

437 Buchan Ness to Collieston Coast SPA consists of multiple mainland colonies along the coast of Aberdeenshire, in north-east Scotland. The SPA is north-west of the Development Area, and was classified in March 1998, with a further two kilometre marine extension to the site classified in September 2009. The SPA is underpinned by the Bullers of Buchan Coast SSSI and Collieston to Whinnyfold Coast SSSI.

438 There are no Annex I qualifying features and the whole SPA is designated as an assemblage of more than 20,000 seabirds. The seabird assemblage regularly supports more than 95,000 breeding seabirds with the following named features: fulmar, guillemot, kittiwake, herring gull, and shag. Further information on the qualifying features is available in Table 3.6.

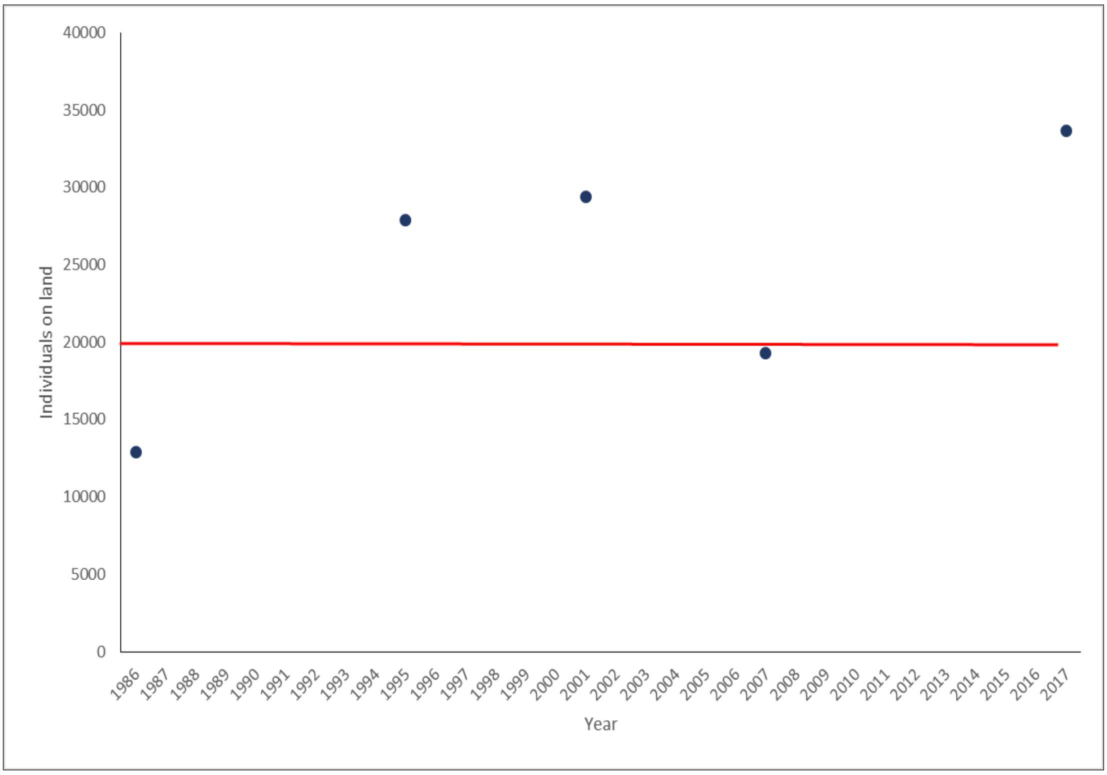
439 The Conservation Objectives of the site are shown in *Section 3*, and are the same as the Conservation Objectives of all SPAs in Scotland at the time of writing.

440 The HRA screening and consultation with MS-LOT and their statutory advisors, SNH, identified that the species that resulted in a conclusion of no LSE being rejected was guillemot. The information below provides information on this species for the CA to carry out their AA on the Buchan Ness to Collieston Coast SPA.

4.4.1 Guillemot Population

441 The Buchan Ness to Collieston Coast SPA guillemot population has been counted on only five occasions in the last 30 years. Over this period the population has fluctuated about the citation population size (17,280 individuals), with the most recent estimate considerably higher than this (Figure 4.13). The data shown in Figure 4.13 are from the JNCC SMP database[10], with the most recent count (from 2016/17) as provided in the SNH scoping advice[11]. It should be noted that the data shown in Figure 4.14 are the count of individuals on land. This needs to be multiplied by 1.34 to give the estimated number of breeding adults[11] (except in the case of the citation population size which is taken as 17,280 individuals or 8,640 pairs - SNH (2008)).

Figure 4.13 Changes in the guillemot population size at the Buchan Ness to Collieston Coast SPA between 1986 and 2017. The red line shows the population size at designation (17,280 individuals).



<u>Potential impacts on the Buchan Ness to Collieston Coast SPA guillemot population</u>

442 The Development, OnTW and associated buffers do not overlap with the Buchan Ness to Collieston Coast SPA. Consequently, the potential impacts on its guillemot population will only occur as a result of individuals from the colony occurring in the Development Area. In relation to guillemot, the impacts of concern identified in the Scoping Opinion from MS-LOT were from displacement of guillemots from the Development Area and two kilometre buffer and barrier effects (with the two latter impacts subsequently considered together). From published information on guillemot foraging ranges generally (Thaxter *et al.,* 2012) it is possible that breeding guillemots from the Buchan Ness to Collieston Coast SPA occur within the Development Area and two kilometre buffer, as well as within the proposed development areas of other wind farms in the Forth and Tay.

443 The breeding period for guillemot is defined as April to mid-August, following the advice of the Scoping Opinion.

<u>Predicted displacement impacts on the Buchan Ness to Collieston Coast SPA guillemot population alone and in-combination</u>

444 The SNCB matrix approach (SNCBs, 2017) was used to estimate the impacts from displacement (and barrier effects) as advised in the Scoping Opinion[13], and was used to estimate the additional mortality attributable to the Buchan Ness to Collieston Coast SPA guillemot

population as a result of displacement during both the breeding and non-breeding periods. Following the advice of the Scoping Opinion, the mortality from displacement was calculated using the peak population size, averaged over the two years of survey, for the Development Area and two kilometre buffer (combining birds on the water and in flight), with this undertaken separately for the breeding and non-breeding periods. A displacement rate of 60 per cent was applied to this mean peak estimate, with one per cent of the displaced birds assumed to die, for both the breeding and non-breeding periods.

445 The Development-alone and in-combination mortality estimated from displacement (as calculated by the matrix approach) was apportioned between SPA and non-SPA colonies as outlined above and detailed in *Appendix 11B*. The apportioning calculations were undertaken separately for the Development Area and two kilometre buffer, and for the Seagreen Alpha and Bravo wind farms (plus buffer). The Neart na Gaoithe wind farm was beyond the mean maximum foraging range of guillemots from the Buchan Ness to Collieston Coast SPA (*Appendix 11B*, Thaxter *et al.,* 2012), and was deemed not to have connectivity. The two Seagreen sites were combined for the purposes of the apportioning calculations because they are contiguous along their longest boundary. On the basis of these calculations, the percentage of the breeding and non-breeding period impacts to guillemots from the Development and each of the Seagreen Alpha and Bravo wind farms attributed to the Buchan Ness to Collieston Coast SPA population were as follows:

- The Development – 3.2 per cent
- Seagreen Alpha and Bravo – 5.7 per cent

446 The estimated displacement mortality was also apportioned to age classes, which in this case was based upon the stable age distribution from the Buchan Ness to Collieston Coast SPA guillemot population model produced for the current assessment (and as detailed in *Appendix 11E*). This approach followed the advice of the Scoping Opinion for species for which age distributions could not be distinguished during the 'at-sea' surveys. The estimated number of adult birds displaced during the breeding period was also amended according to an assumed seven per cent sabbatical rate amongst the breeding adult birds, as advised in the Scoping Opinion (*Appendix 11D)*

447 For the Development-alone in the breeding period, the mean peak population estimate was 8,184 birds, of which 43.1 per cent were adults (3,527 birds) and 3.2 per cent were from Buchan Ness to Collieston Coast SPA (275 birds) and seven per cent were birds on sabbatical (giving 105 adult birds from the Buchan Ness to Collieston Coast SPA). Applying the advised 60 per cent displacement rate and one per cent mortality rate gives an estimated mortality of one adult birds per breeding period (Table 4.65). This predicted displacement mortality from the Development-alone on breeding adults is very small compared with the current (45,067 individuals) and citation (17,280 individuals) population sizes (0.002 per cent and 0.006 per cent, respectively).

448 For the Development-alone in the non-breeding season, the mean peak population estimate was 3,912 birds, giving an estimated non-breeding season mortality of zero birds (based on the same rates as used in the breeding period for apportioning to colonies and age classes,

assigning sabbaticals and for estimating displacement and mortality amongst displaced birds). The estimated annual mortality of adult guillemots from the Buchan Ness to Collieston Coast SPA population was one bird. As detailed above for the breeding period, this represents 0.004 per cent and 0.006 per cent of the current and citation SPA population sizes, respectively.

Table 4.65 Displacement matrix for adult guillemots from Buchan Ness to Collieston Coast SPA in the breeding season. Based on mean peak abundance apportioned to adult birds from the Buchan Ness to Collieston Coast SPA. Recommended displacement rate and mortality rate is shown in green, and the resulting displacement mortality in dark green.

		DISPLACEMENT										
		0%	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
MORTALITY	0%	0	0	0	0	0	0	0	0	0	0	0
	1%	0	0	0	0	0	1	1	1	1	1	1
	2%	0	0	0	1	1	1	1	1	2	2	2
	3%	0	0	1	1	1	2	2	2	3	3	3
	4%	0	0	1	1	2	2	3	3	3	4	4
	5%	0	1	1	2	2	3	3	4	4	5	5
	10%	0	1	2	3	4	5	6	7	8	9	11
	15%	0	2	3	5	6	8	9	11	13	14	16
	20%	0	2	4	6	8	11	13	15	17	19	21
	30%	0	3	6	9	13	16	19	22	25	28	32
	40%	0	4	8	13	17	21	25	29	34	38	42
	50%	0	5	11	16	21	26	32	37	42	47	53
	60%	0	6	13	19	25	32	38	44	50	57	63
	70%	0	7	15	22	29	37	44	51	59	66	74
	80%	0	8	17	25	34	42	50	59	67	76	84
	90%	0	9	19	28	38	47	57	66	76	85	95
	100%	0	11	21	32	42	53	63	74	84	95	105

Table 4.66 Displacement matrix for adult guillemots from the Buchan Ness to Collieston Coast SPA in the non-breeding season. Based on mean peak abundance apportioned to adult birds from the Buchan Ness to Collieston Coast SPA. Recommended displacement rate and mortality rate is shown in green, and the resulting displacement mortality in dark green.

		DISPLACEMENT										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
MORTALITY	0%	0	0	0	0	0	0	0	0	0	0	0
	1%	0	0	0	0	0	0	0	0	0	0	1
	2%	0	0	0	0	0	1	1	1	1	1	1
	3%	0	0	0	0	1	1	1	1	1	1	2
	4%	0	0	0	1	1	1	1	1	2	2	2
	5%	0	0	1	1	1	1	2	2	2	2	3
	10%	0	1	1	2	2	3	3	4	4	5	5
	15%	0	1	2	2	3	4	5	5	6	7	8
	20%	0	1	2	3	4	5	6	7	8	9	10
	30%	0	2	3	5	6	8	9	11	12	14	15
	40%	0	2	4	6	8	10	12	14	16	18	20
	50%	0	3	5	8	10	13	15	18	20	23	25
	60%	0	3	6	9	12	15	18	21	24	27	30
	70%	0	4	7	11	14	18	21	25	28	32	35
	80%	0	4	8	12	16	20	24	28	32	36	40
	90%	0	5	9	14	18	23	27	32	36	41	45
	100%	0	5	10	15	20	25	30	35	40	45	50

449 The displacement matrix predictions for the Development in-combination with the Seagreen Alpha and Bravo wind farms were apportioned between SPA colonies and between age classes (Table 4.67). The predicted in-combination mortality from displacement for the Buchan Ness to Collieston Coast SPA guillemots during the breeding period is approximately six times greater than for the Development-alone, with a total estimated mortality of four breeding adults and five sub-adult birds (Table 4.67). This level of mortality remains small compared with the current (45,067 individuals) and citation (17,280 individuals) population sizes (with the adult mortality representing 0.01 per cent and 0.02 per cent, respectively).

450 Levels of predicted mortality from displacement in the non-breeding period for the Development in-combination with the Seagreen Alpha and Bravo wind farms were slightly more than half of those for the breeding period (Table 4.67), with the contribution of the Development to the total in-combination mortality for the non-breeding period being similar to that for the breeding period. Combining the two seasonal estimates gave an estimated annual mortality from the in-combination impacts of six breeding adults and eight sub-adult birds (Table 4.67). The estimated annual mortality of breeding adults from displacement represented only 0.01 per cent and 0.03 per cent of the current and citation SPA population sizes, respectively.

Table 4.67 Estimated mortality of Buchan Ness to Collieston Coast SPA guillemots as a result of displacement from the Development in-combination with the Seagreen Alpha and Bravo wind farms.

Seasonal period	Project	Mean peak estimate (individuals)	Adult pro-portion[1]	SPA pro-portion	Sabbatical proportion	Additional mortality	
						Breeding adults	Sub-adults
Breeding	Inch Cape	8,184	0.431	0.032	0.07	0.6	0.9
	Seagreen Alpha	12,190		0.057		1.7	2.4
	Seagreen Bravo	10,778		0.057		1.5	2.1
	Total	34,415	-	-	-	3.8	5.4
Non-breeding	Inch Cape	3,912	0.431	0.032	0.07	0.3	0.4
	Seagreen Alpha	6,131		0.057		0.8	1.2
	Seagreen Bravo	6,780		0.057		0.9	1.3
	Total	24,441	-	-	-	2.0	2.9
Annual	Total	-	-	-	-	5.8	8.3

[1]Based on the stable age distribution from the Forth Islands SPA guillemot population model (*Appendix 11E*).

451 As described for the Forth Islands SPA kittiwake population (*Section 4.1.2* above), impacts from displacement and barrier effects were also estimated using the SeabORD and Searle *et al.,* (2014) individual-based modelling approaches. These estimates and the comparisons with the SNCB matrix estimates are presented in *Appendix 11D*.

Impacts from other wind farms within foraging range

452 As detailed above for the Forth Islands SPA gannet population, several offshore wind farms other than Neart na Gaoithe and Seagreen Alpha and Bravo occur within mean maximum foraging range of breeding guillemots from the Buchan Ness to Collieston Coast SPA (as defined by Thaxter *et al.,* 2012). The advice from the Scoping Opinion was to consider the breeding season effects from these wind farms qualitatively.

453 These wind farms are the Aberdeen Offshore Wind Farm, Hywind Scotland Pilot Park and the Kincardine Floating Offshore Wind Farm. These are all relatively small developments, comprising 11, five and six to eight WTGs, respectively. As such, any impacts from displacement and barrier effects will be minor and will not affect the conclusions of the assessment.

Population Viability Analysis of the Buchan Ness to Collieston Coast SPA guillemot population

454 PVA was used to determine the effects of the predicted displacement impacts from the Development-alone, and in-combination, on the Buchan Ness to Collieston Coast SPA guillemot population. The Buchan Ness to Collieston Coast SPA guillemot population model produced for the current assessment was a stochastic, density independent, model based on a Bayesian state-space modelling framework. It was adapted from earlier Buchan Ness to Collieston Coast SPA guillemot population model developed by Freeman *et al.,* (2014), updated according to recently available population and demographic data. Further details of the model are provided in *Appendix 11E*.

455 The predicted population trends under baseline conditions (i.e. without wind farm impacts) were projected over both 28 and 53 year timescales. Additional mortality within the PVA was not incorporated until after year three of the projection (giving 25 and 50-year impact periods) to provide a more realistic representation of the likely population status at the time when the potential impacts will begin to arise.

456 The additional mortality was incorporated on the basis of the percentage point change to the annual mortality of adult and sub-adult birds, as represented by the SNCB matrix estimates (Table 4.67). Outputs from the PVA were summarised according to the median predicted population sizes at the end of the projection period, and the three metrics which the Scoping Opinion advised should be used for the interpretation and which are defined above in the section on the Forth Islands SPA gannet population.

457 The PVA projected population growth for the Buchan Ness to Collieston Coast SPA guillemot population with and without impacts for the Development-alone and in-combination. The median end population size increased over the projection period, irrespective of whether impacts were incorporated or not, and the projected population size at 50 years was always larger than the projected population size at 25 years (Table 4.68).

458 The PVA metrics (Table 4.69) show that for the Development-alone the counterfactual of end population size indicated very small reductions in end population size after both 25 years and 50 years of impact (with the values being 0.999 for both periods). A decrease in annual population growth rate was not detectable (at least when the counterfactual value was taken to three decimal places – i.e. it remained at a value of 1.000), whilst the centile value was 50 even after 50 years of impact (indicating complete overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period).

459 In terms of the in-combination, the PVA metrics continued to indicate small population-level impacts (albeit that they were greater than for the Development-alone, as would be expected – Table 4.69). The predicted reduction in end population size was less than one per cent even after 50 years of impact (the counterfactual of population size being 0.992), whilst the reduction in annual population growth rate remained undetectable (at least when the counterfactual value was taken to three decimal places – i.e. it remained at a value of 1.000). The centile value was 49 even after 50 years of impacts, indicating considerable overlap in the distributions of the predicted impacted and un-impacted population sizes and, hence, a high likelihood of the impacted population being a similar size to the un-impacted population at the end of the projection period.

460 The population projections in all cases showed that the end population size was greater than the population size at citation (17,280 individuals), and that the population continued to increase over the projection period. Therefore, the effects of the Development-alone, and in-combination, would not result in the conservation status of the Buchan Ness to Collieston Coast SPA population being in unfavourable condition.

Table 4.68 Projected end population size of the Buchan Ness to Collieston Coast SPA guillemot population after 25 and 50 years.

	Percentage point change in mortality		Median number of breeding females (5th – 95th centiles)	
	Adults	Sub-adults	25 years	50 years
Baseline	-	-	47,750 (26,450 – 78,500)	88,500 (36,800 – 193,750)
Development-alone	0.002	0.002	47,600 (26,400 – 78,500)	89,050 (36,950 – 193,700)
In-combination	0.013	0.014	47,650 (26,250 – 78,150)	87,900 (36,600 – 192,150)

Table 4.69 PVA metrics for the Buchan Ness to Collieston Coast SPA guillemot population after 25 and 50 years.

	Counterfactual of end population size		Counterfactual of population growth rate[1]	Centile of baseline population matching the median of the impacted population	
	25 years	50 years	25 and 50 years	25 years	50 years
Baseline	1.000	1.000	1.000	50	50
Development-alone	0.999	0.999	1.000	50	50
In-combination	0.997	0.992	1.000	50	49

[1]The value of this metric does not vary according to the length of the projection period.

<u>Conclusion</u>

461 The predicted impacts from the Development-alone and in-combination were small, and outputs from the PVA indicate small predicted population-level effects. Based upon the PVA projections, the Conservation Objective of the SPA, to maintain the "population of the species as a viable component of the site", will not be compromised for the guillemot population. It should therefore be possible for the CA to conclude, beyond reasonable scientific doubt, that the Development-alone, and in-combination, will have no adverse effect on site integrity due to the effects on the guillemot population.

4.4.2 Breeding Seabird Assemblage

462 The breeding seabird assemblage for the Buchan Ness to Collieston Coast SPA is a qualifying feature on the basis of the SPA supporting 95,000 individual seabirds, including guillemot, fulmar, kittiwake, herring gull and shag.

463 Potential impacts of the Development on the breeding seabird assemblage for the Buchan Ness to Collieston Coast SPA could arise via effects on the individual named species within the assemblage feature. However, no adverse effects are predicted from the Development alone or in-combination on the SPA breeding guillemot population (which is assessed above), whilst for the remaining species within the assemblage there is either no connectivity (kittiwake, herring gull and shag) or no route to impact (fulmar) with the Development.

464 Therefore, no adverse effects of the Development alone or in-combination are predicted on the Buchan Ness to Collieston Coast SPA breeding seabird assemblage.

4.5 Outer Firth of Forth and St Andrews Bay Complex pSPA

4.5.1 The pSPA and Potential Impacts

465 The Outer Firth of Forth and St Andrews Bay Complex pSPA is a large estuarine/marine site encompassing the outer Firths of Forth and Tay and adjacent marine areas (SNH and JNCC 2016b; Figure 3.1). The total area of the site is 2,720.68 kilometres squared. The coastal boundary of the pSPA extends to mean low water springs and in some areas it abuts the Firth of Forth SPA and the Firth of Tay and Eden Estuary SPA. It also abuts the shorelines of islands designated as components of the Forth Islands SPA (except Long Craig Island) and overlaps with marine areas of the Forth Islands SPA.

466 The pSPA encompasses areas used for foraging, moulting and roosting/loafing by seaduck, divers, grebes and seabirds during the breeding and non-breeding seasons, with the estuarine and offshore waters providing relatively sheltered conditions in places and supporting a wide variety of fish, crustaceans and marine worms which provide prey for marine birds. The species included as qualifying features and the seasonal periods relevant to the different qualifying features are presented in Table 3.8. Further details on those qualifying features and the basis for their inclusion are given in the Departmental Brief (SNH and JNCC 2016b). The Conservation Objectives for the site are given in *Section 3* above.

467 The OfTW (but not the Wind Farm) overlaps with the pSPA, with the Offshore Export Cable passing through the pSPA for approximately 85 per cent of its 83 kilometre length (Figure 3.1). As a consequence of this spatial overlap between the Development and the pSPA, a conclusion of no LSE was not possible in relation to all qualifying features of the pSPA, with the potential impacts being direct disturbance/displacement, indirect disturbance of seabed habitats and/or prey species of seabirds and loss of seabed habitats (see *Section 3.2* above). Potential impacts from displacement and barrier effects as a result of the presence of the Wind Farm and of collisions with the rotor blades of the WTGs on gannet, kittiwake, herring gull, guillemot, razorbill and puffin were considered via the assessments undertaken for the breeding colony SPAs, as advised in the Scoping Opinion (see *Section 3.6.2*).

468 As stated earlier (*Section 1.1*), the HRA for the OnTW identified no adverse effects on the integrity of the Outer Firth of Forth and St Andrews Bay Complex pSPA as a result of the construction, operation and maintenance and decommissioning of the OnTW (ICOL, 2018a).

4.5.2 Offshore Export Cable – Description and the Associated Activities

Construction (and decommissioning)

469 The route of the Offshore Export Cable will consist of up to two cables, with the Offshore Export Cable Corridor running from the OSPs to the landfall at the site of the former Cockenzie Power Station, East Lothian (Figure 3.1).

470 Under the worst-case scenario (two, AC cables), each of the Export Cables will be laid in separate trenches through the sub-tidal areas. Due to technical and practical constraints around access to cables, and local conditions, cable separation is generally four times the water depth with a minimum separation of 50 metres (the separation will reduce as the cables come closer to the landfall).

471 The total route length of the Offshore Export Cable Corridor is approximately 83 kilometres. The width affected by the Export Cable is about 250 metres, based on a separation of about 200 metres between cables (four times water depth of about 50 metres) and a distance of about 25 metres from each cable centreline to the outer extremity of the corridor. This gives a worst-case affected area of approximately 20.75 kilometres squared. Accounting for the fact that approximately 85 per cent of the length of the Offshore Export Cable Corridor overlaps with the pSPA, this equates to about 0.7 per cent of the area of the pSPA being affected.

472 Each of the two cables will be installed in a separate trench. The sub-tidal area of seabed disturbed during the installation of the export cable will be less than the area of the cable corridor, and is estimated at 2.5 kilometres squared. This is equivalent to less than 0.1 per cent of the pSPA area.

473 The duration of the export cable installation in subtidal areas will be nine months, with start and finish dates to be confirmed.

474 There are various techniques in which the cable can be installed:

- Lay then burial: The cable is laid on the seabed or in a pre-cut trench and then buried in separate installation activities, sometimes using different vessels; or
- Simultaneous lay and burial: The cable is laid and buried simultaneously.

475 Cables may be ploughed or jetted into the seabed or laid into a pre-cut trench which is then backfilled. The following are typical tools:

- Boulder clearance plough: clears boulders from the cable route to enable other excavation and burial tools to be used;
- Trenching plough: cuts a V-shaped trench to allow subsequent cable lay;
- Cable burial ploughs: buries the cable by lifting a wedge of soil, placing the cable at the base of the trench and allowing the soil to naturally backfill behind the plough. Subsequent passes will be required with a backfill plough which pushes trenched material on top of the cable for full protection. Trenching and backfill ploughs are towed by a powerful surface vessel; and
- Jetting Trenchers: buries the laid cable by directing water jets towards the seabed and cutting and/or liquidising the soil beneath the cable. Displaced material is suspended in the water and then resettles over the cable which settles into the soil slurry created by the water jets through self-weight. This process is controlled to ensure that sediment is not displaced too far from the cable. Jetting trenchers are commonly self-propelled or mounted as skids onto Remotely Operated Vehicles (ROV).
- Mechanical Rock Wheel Cutters: can be fitted to tracked cable burial vehicles and would only be used in areas of hard or rocky seabed to cut narrow trenches. The rock wheel cutter consists of a rotating disc fitted with a number of replaceable teeth.

476 Export cables will be installed using floating Cable Installation Vessels (CIVs). These are usually self-propelled but may be towed or assisted. These vessels store and transport the cables on

either a number of cable reels or one or more carousels. They feed the cable to the lay system which lowers the cable catenary onto the seabed in a controlled manner. There would be an estimated 30 vessel movements per cable during the installation period.

477 Cable protection would be required in some areas, using materials as follows:

- Mattresses: small concrete blocks connected together with polypropylene rope. The mattresses are lowered over the laid cable by a vessel crane. The rope between the blocks allows the mattresses to drape over the cable. The weight of the mattress keeps the cable stable on the seabed and the concrete blocks protect the cable from damage;
- Sand/grout Bag Placement: a smaller scale version of mattresses. The bags can either be pre-filled or empty bags are taken to the seabed and then a diver coordinates the filling of the bags from a pumping spread located on the vessel; or
- Rock placement.

478 The total area of original habitat loss from cable protection is estimated in the worst-case as 0.2 kilometres squared resulting from protection of areas 6 m wide over 20 per cent of each 83 kilometre cable. This is equivalent to less than 0.01 per cent of the pSPA area.

Operation

479 During operation there would be a small number of vessel movements associated with inspections and monitoring to identify whether the Offshore Export Cable becomes exposed over time and to take appropriate remedial action.

480 Reduced electrical performance indicating a fault would be established through the cable's built-in condition monitoring system (no geophysical monitoring will be required). It would then be necessary to locate, uncover and investigate the defect. This would be done with excavation equipment deployed from a construction vessel. If a significant defect was identified, the cable repair vessel would be required. Repairs will either be a subsea joint, carried out from a vessel (usually two joints and an inserted spare length of cable; or full replacement of the cable if short enough to match a strategic spare and likely of shorter duration than a repair. When a cable repair is made on the deck of a vessel, the inserted extra length results in a loop on the seabed. This will also be protected or buried.

481 Temporary habitat disturbance from operation and maintenance of the export cables is estimated to affect a maximum of 0.0025 kilometres squared of seabed per year. This is based on a maximum predicted reburial of 10 per cent of the 83 kilometre Export Cable length for each cable during the operational phase. The annual area predicted to be disturbed is less than 0.0001 per cent of the pSPA area.

4.5.3 Assessment of Effects

482 Because of the limited scale of works required in relation to the Offshore Export Cable, no specific bird surveys were commissioned for the OfTW, between the Survey Area and the near-shore. The assessment for this part of the Offshore Export Cable Corridor makes use of published data sources on the presence of birds, in particular the Departmental Brief for the

Outer Firth of Forth and St Andrews Bay Complex pSPA (SNH and JNCC 2016b), which includes maps of relative density for qualifying species within the site boundary.

483 The Offshore Export Cable Corridor runs through deep waters (greater than 50 metres) between the Development Area and the mouth of the Firth of Forth and the Rath Grounds between the Isle of May and the East Lothian Coast at North Berwick (where water depth is between 20 and 50 metres). It then enters the shallower waters (with depths of five to 20 metres of the south Channel of the Firth of Forth, running more or less parallel to the East Lothian Coast until turning into the shore at Cockenzie (Figure 3.1).

484 The final section of the Offshore Export Cable Corridor passes through the intertidal area of the Firth of Forth at Cockenzie, transiting the Firth of Forth SPA. As noted above, the information to inform AA for this section of the works is included in the HRA for the OnTW (ICOL, 2018a).

Direct disturbance/displacement

485 The assessment for the construction (and decommissioning) and operational phases considers this effect in relation to the Conservation Objective to "avoid significant mortality, injury and disturbance of the qualifying features, so that the distribution of the species and ability to use the site are maintained in the long-term".

Construction (and decommissioning)

Development-alone

486 The predicted levels of vessel and other activity during cable laying are described in *Section 4.5.2* above. The predicted construction period of nine months means that disturbance will be short-term, although works will overlap with both the breeding and non-breeding seasons for birds. Disturbance would not take place simultaneously over the Offshore Export Cable Corridor, but would be limited to the vicinity of works activities around cable laying vessels. These would move slowly as cable installation takes place and remain static for long periods. Their presence would represent only a fractional increase in existing shipping traffic levels (*Chapter 15: Shipping and Navigation*). Cable laying activities emit low levels of noise, both above and below water. Visual disturbance above the sea surface would be limited to vessels and activities on board, and below water to areas in close proximity to the cable-laying tools and the cable itself.

487 An index has been developed of the likely sensitivity of marine birds to disturbance/displacement from man-made structures (e.g. offshore wind infrastructure), ships and helicopters. This is based on a combination of information from the scientific literature and expert opinion (Furness *et al.,* 2013, Furness and Wade, 2012, Garthe and Hüppop, 2004). Species were scored on a scale of one (low sensitivity: limited escape behaviour and a very short flight distance when approached) to five (high sensitivity: strong escape behaviour and responses at a large distance on approach). An index of habitat flexibility was also developed for marine species, with scores from one (high flexibility, tends to forage over large marine areas with little known association with particular marine areas)

to five (low flexibility, tends to feed on specific habitat features such as shallow banks with bivalve mollusc communities). Species with higher habitat flexibility are also considered less sensitive to effects of disturbance as they are more likely to be able to find alternative areas of suitable habitat in response to displacement.

488 Disturbance and habitat flexibility scores for SPA qualifying species are shown in Table 4.70 below. The combined score has been used to allocate an overall rating for species in terms of sensitivity to disturbance and displacement for the purposes of this assessment. Any species with a disturbance index score of two or less was considered of low (overall score of four or five) or very low (overall score of three or less) susceptibility to disturbance.

489 Given the very small-scale and temporary nature of cable-laying activities, pSPA qualifying species which are considered to have a low or very low sensitivity to disturbance (Table 4.70) are not predicted to be subject to significant adverse effects during the construction and decommissioning phases for the Offshore Export Cable.

490 For species considered to be of medium or high sensitivity to disturbance and displacement, further consideration is given to the potential effects of disturbance/displacement with reference to available information on their distribution within the pSPA (SNH and JNCC 2016b).

Table 4.70 Disturbance and habitat flexibility indices for qualifying species of the Outer Firth of Forth and St Andrews Bay Complex pSPA.

Qualifying feature	Disturbance index[1]	Habitat flexibility index[2]	Total	Overall sensitivity to disturbance/ displacement
Common scoter*	5	4	9	High
Red-throated diver	5	4	9	High
Velvet scoter*	5	3	8	High
Goldeneye*	4	4	8	High
Slavonian grebe	3	4	7	High
Eider	3	4	7	High
Long-tailed duck*	3	4	7	High
Guillemot*	3	3	6	Medium
Razorbill*	3	3	6	Medium
Shag	3	3	6	Medium
Common tern	2	3	5	Low
Arctic tern	2	3	5	Low

Qualifying feature	Disturbance index[1]	Habitat flexibility index[2]	Total	Overall sensitivity to disturbance/ displacement
Puffin*	2	3	5	Low
Black-headed gull*	2	2	4	Low
Common gull*	2	2	4	Low
Kittiwake*	2	2	4	Low
Little gull	1	3	4	Low
Gannet	2	1	3	Very low
Herring gull*	2	1	3	Very low
Manx shearwater*	1	1	2	Very Low
Red-breasted merganser*				Medium[3]

1. A scale of 1 (low sensitivity: limited escape behaviour and a very short flight distance when approached) to 5 (high sensitivity: strong escape behaviour and responses at a large distance on approach), based on Furness *et al.,* (2013), Furness and Wade (2012) or Garthe and Huppop (2004).
2. Scale of 1 (high flexibility, tends to forage over large marine areas with little known association with particular marine areas) to 5 (low flexibility, tends to feed on specific habitat features such as shallow banks with bivalve mollusc communities). References as above.
3. Species not considered in Furness *et al.,* (2013), Furness and Wade (2012), or Garthe and Huppop (2004), classified as medium overall sensitivity on a pre-cautionary basis.

* Assemblage named feature only

491 Within the pSPA, over-wintering densities of common scoter, velvet scoter, common eider, long-tailed duck, red-breasted merganser and red-throated divers are highest in the outer Firth of Tay; densities are generally lower in the Firth of Forth, with birds using inshore areas along the north (Fife) and south (Edinburgh and East Lothian) coasts (SNH and JNCC 2016b).

492 These species may be flushed at distances of about 200 metres to more than one kilometre from approaching vessels, with red-throated diver and common scoter tending to react at greater distances (Furness and Wade 2012). Faster moving ships with less predictable behaviour are likely to cause greatest disturbance (Schwemmer *et al.,* 2010) and it is possible that birds will suffer less displacement and may even habituate to an extent to slower-moving vessels.

493 Disturbance and displacement of these species is predicted only when works take place in the section of the Offshore Export Cable Corridor which runs parallel and close to the East Lothian

coast between North Berwick and Cockenzie. These activities may potentially result in a temporary and small-scale re-distribution of birds in the immediate vicinity of the CIV. The short-term presence of a slow-moving vessel with low levels of associated visual and noise disturbance is therefore considered likely to cause temporary and localised disturbance and displacement only, with no adverse effects on pSPA qualifying species.

494 Within the pSPA, wintering Slavonian grebe and common goldeneye are more abundant in the outer Firth of Forth than the outer Firth of Tay, with both species occurring along the north (Fife) and south (Edinburgh and East Lothian) coasts (SNH and JNCC 2016b). Disturbance and displacement of these species is predicted only when works take place in the section of the Offshore Export Cable Corridor which runs parallel to the East Lothian coast between North Berwick and Cockenzie. These activities may potentially result in a temporary and small-scale re-distribution of birds in the immediate vicinity of the CIV. The short-term presence of a slow-moving vessel with low levels of associated visual and noise disturbance is therefore considered likely to cause temporary and localised disturbance and displacement only, with no adverse effects on pSPA qualifying species.

495 Shags are present within the pSPA throughout the year. The key foraging areas during the breeding season are around the Isle of May, the north coast of the outer Firth of Forth, and the outer Firth of Tay (SNH and JNCC 2016b). These areas may overlap to a small extent with the Offshore Export Cable Corridor where it passes to the east and south of the Isle of May, and activities associated with the laying of the export cable are therefore likely to cause minimal disturbance to shags during the breeding season. Information on the winter distribution of shags in the pSPA is not presented in SNH and JNCC (2016b). Studies of colour-ringed shags breeding at the Isle of May indicate that the population is partly migratory, with some birds remaining nearby and some travelling up to about 500 kilometres along the coast (Grist *et al.,* 2014). Even if winter foraging ranges overlap to a greater extent with the Offshore Export Cable Corridor, the short-term presence of a slow-moving vessel with low levels of associated visual and noise disturbance is considered likely to cause temporary and localised disturbance and displacement only. No significant adverse effect is predicted.

496 Guillemots are abundant in the pSPA throughout the year. During the non-breeding season, their distribution is centred around the Isle of May in the outer Firth of Forth, with a second concentration to the west, between the Forth Bridges and Edinburgh (south coast)/Burntisland (north coast). Large numbers of birds are also present during the breeding season, associated with the breeding colonies within the Forth Islands SPA (and potentially including birds from other breeding colonies including Fowlsheugh, St Abb's Head to Fast Castle and Buchan Ness to Collieston SPAs), and numbers increase in the post-breeding period (August-September) (SNH and JNCC 2016b).

497 Razorbill is also present in the pSPA throughout the year. During the breeding season, birds are present at breeding colonies in the Forth Islands SPA, and the 'at sea' distribution extends throughout the outer Firths of Forth and Tay and into offshore marine areas. During the non-breeding season, no significant hotspots have been identified (SNH and JNCC 2016b).

498 Razorbills and guillemots may be disturbed by boats at distances of several hundred metres (Furness and Wade 2012), although they appear to be less sensitive to boat disturbance than divers and seaduck. There is considerable overlap between the Offshore Export Cable Corridor and areas used by guillemot and razorbill throughout the year. As for other species, the short-term presence of a slow-moving vessel with low levels of associated visual and noise disturbance is considered likely to cause temporary and localised disturbance and displacement only, with no adverse effects on the pSPA populations predicted.

In-combination

499 As described above, for the Development-alone there will be temporary and localised levels of disturbance from vessel activity associated with the laying of export cables between the Wind Farm and the cable landfall at Cockenzie. At any one time, disturbance will be focused on the area where the CIV is working, with the potential for birds to be displaced within the immediate vicinity of the vessel only. Levels of noise and visual disturbance will be very small.

500 In the context of wider shipping activities (see *Chapter 15* for further information) in the outer Firth of Forth, the effects of disturbance to birds from the construction (and decommissioning) activities associated with the OfTW are considered to be so small as to be likely to be undetectable. Consequently, there is little potential for in-combination effects of disturbance and displacement with other ongoing activities. This includes consideration of in-combination effects with the OnTW.

501 Therefore, the Conservation Objective of the pSPA, to "avoid significant mortality, injury and disturbance of the qualifying features, so that the distribution of the species and ability to use the site are maintained in the long-term" would not be compromised for the qualifying features of the pSPA as a result of the predicted impacts from the Development-alone and in-combination from disturbance and displacement associated with the construction (and decommissioning) of the Offshore Export Cable.

Operation

Development-alone and in-combination

502 Based on predictions of the very small-scale repair requirements for offshore cables (about 10 per cent of the export cable length for each cable over the operational life of the Wind Farm, see *Section 4.5.2* above), vessel and other activities associated with cable repairs and/or reburial would represent infrequent, temporary and localised sources of disturbance. These would be smaller in scale and less frequent than those associated with the construction (and decommissioning) of the Offshore Export Cable.

503 In the context of wider shipping activities in the outer Firth of Forth the potential disturbance/displacement to pSPA qualifying species from operation and maintenance of the OfTW is considered to be trivial. The effect for the Development-alone is considered to be negligible, with no potential for in-combination effects with other ongoing activities. This includes consideration of in-combination effects with the OnTW.

504 Therefore, the Conservation Objective of the pSPA, to "avoid significant mortality, injury and disturbance of the qualifying features, so that the distribution of the species and ability to use the site are maintained in the long-term" would not be compromised for the qualifying features of the pSPA as a result of the predicted impacts from the Development-alone and in-combination from disturbance and displacement associated with the operation and maintenance of the Offshore Export Cable.

Habitat disturbance

505 The assessment for the construction (and decommissioning) and operational phases considers this effect in relation to the Conservation Objective" to maintain the habitats and food resources of the qualifying features in favourable condition".

Construction (and decommissioning)

Development-alone

506 During the laying of the Offshore Export Cable there would be disturbance to subtidal habitats along the cable corridor, associated with the digging and backfill of trenches on the sea floor for the cables, and use of rock placement, concrete mattresses and/or sand/grout bags for cable protection (see *Section 4.5.2* above).

507 This could disturb foraging habitat and affect the availability and abundance of prey for pSPA qualifying species.

508 As described above (*Section 4.5.2*), the sub-tidal area of seabed that will be disturbed during the installation of the Offshore Export Cable is estimated at 2.5 kilometres squared. This is equivalent to less than 0.1 per cent of the pSPA area. Disturbance would not affect the whole area at once, rather at any given time during the nine month construction period, it would be limited to the area where cable laying works were ongoing, and recovery of habitats would be expected to begin as soon as cable laying was completed.

509 From the Development Area, the Offshore Export Cable Corridor passes through the outer Firth of Forth where there are extensive areas of sandy and gravelly muds and fine sediments; it then runs roughly parallel and close to the south shoreline between North Berwick, where there are sandy gravels and shell material (SNH and JNCC 2016b). Subtidal areas often support a wide range of fish, crustaceans, molluscs and marine worms that provide prey for birds.

510 Cable laying operations would likely result in disturbance, displacement and/or mortality of benthic species living on and in sediments in the areas where the cable is laid. Such species would include bivalve molluscs (shellfish), annelid worms, and other marine invertebrates, which are prey species for a number of pSPA qualifying species. However, as described above the areas affected would be very small in relation to the available seabed habitat, and any losses of benthic prey species are likely to be so small as to be virtually undetectable in relation to the sizes of local populations. Construction works are not predicted to displace birds from any offshore foraging areas within the pSPA. Recovery of disturbed seabed areas would be expected in the short to medium term (based on a range of studies of dredged areas this might

be expected to begin within one to two months and take one to three years in an estuarine environment - UK Marine SACs Project 2018).

511 Fish would be expected able to swim away from areas of seabed disturbed during cable-laying operations, and the small scale disturbance of habitat would not be expected to cause any detectable changes in the abundance and distribution of fish in the vicinity of the export cable corridor and thus no change in prey availability for birds.

512 Given the very small scale and temporary nature of works, and the expected recovery of habitats in the short term, no adverse effect on any SPA qualifying species is predicted due to loss of habitat for prey species or depletion of prey resource as a result of the construction (and decommissioning) of the OfTWs for the Development.

In-combination

513 Based on the information above, it is likely that the effects of the construction (and decommissioning) of the OfTW for the Development-alone on the habitat for prey species and the available prey resource will be temporary and their effects so small as to be virtually undetectable. It is considered, therefore, that there would be no potential for in combination effects with other ongoing activities, or plans and projects in the outer Firth of Forth, including with the OnTW.

514 Therefore, the Conservation Objective of the pSPA, to "maintain the habitats and food resources of the qualifying features in favourable condition" would not be compromised for the qualifying features of the pSPA as a result of the predicted impacts from the Development-alone and in-combination from disturbance to habitats and prey species associated with the construction (and decommissioning) of the Offshore Export Cable.

Operation

Development-alone and in-combination

515 As described above (*Section 4.5.2*), temporary habitat disturbance from operation and maintenance of the export cables is estimated to affect a maximum of 0.0025 kilometres squared of seabed per year, equivalent to less than 0.0001 per cent of the pSPA area. No detectable effects of loss of habitat for prey species or depletion of prey resource would be predicted for the Development, and thus no potential for an in-combination effect in relation to the Conservation Objective to "maintain habitats and food resources of the qualifying features in favourable condition".

Habitat loss

516 This effect is considered in relation to the operational phase only, as habitat loss during construction is considered above as part of the disturbance to habitats during cable laying activities. The extent of construction (and decommissioning) related habitat loss (both temporary and permanent) would be greater than during operation, as it would include temporary losses due to disturbance of habitats which subsequently recover, as well as losses

of habitat which do not recover and are therefore considered permanent. This effect is considered in relation to the Conservation Objective to "maintain the habitats and food resources of the qualifying features in favourable condition".

Operation

Development-alone and in-combination

517 The total area of original seabed habitat that will be lost due to the presence of the Offshore Export Cable is estimated to be 0.2 kilometres squared in the worst-case. This results from protection of areas 6 metres wide over 20 per cent of each 83 kilometre cable (*Section 4.5.2* above), and is equivalent to less than 0.01 per cent of the pSPA area.

518 This scale of seabed habitat loss is so small as to be virtually undetectable in terms of the extent of habitat available for prey species and the prey resource for pSPA qualifying species. It is considered, therefore, that there would be adverse effect from the Development-alone, and given the very small area affected, no potential for in -combination effects with other ongoing activities, or plans and projects in the outer Firth of Forth, including with the OnTW.

Conclusion

519 The predicted impacts from the Development-alone are considered small and virtually undetectable, with negligible potential to contribute to in-combination effects with other activities, plans and projects in the Outer Forth and Tay area. The Conservation Objectives, to "avoid significant mortality, injury and disturbance of the qualifying features, so that the distribution of the species and ability to use the site are maintained in the long-term", and to "maintain the habitats and food resources of the qualifying features in favourable condition", will not be compromised for any pSPA qualifying species. It should therefore be possible for the CA to conclude, beyond reasonable scientific doubt, that the OfTW for the Development-alone, and in-combination, will have no adverse effect on site integrity.

5 Summary and Conclusions

520 The predicted impacts on the qualifying features of each SPA and the conclusions on the effects of these impacts on the SPA population in relation to a 50 year operational period for the Development are summarised below.

Table 5.1 Summary of predicted effects and impacts on the Forth Islands SPA from the Development-alone and in-combination.

Qualifying feature	Conclusion
Gannet	Development-alone The predicted collisions on the breeding adult gannet population from the Development-alone were 94 in the breeding season, 2 in the autumn passage period and 2 in the spring passage period. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (above 0.9).
	In-combination The worst-case in-combination collisions prediction on the breeding adult gannet population was 659 in the breeding season, 70 in the autumn passage period and 46 in the spring passage period. Therefore, the total additional mortality on breeding adult gannets was 775 birds per annum. PVA results showed that this would have little effect on population growth. Ratios of end population size and population growth were all high (above 0.8).
Kittiwake	Development-alone The predicted collisions on the breeding adult kittiwake population from the Development-alone was seven in the breeding season, and zero in the autumn and spring passage periods. Predicted displacement effects on the breeding adult kittiwake population from the Development-alone were four in the breeding season. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (above 0.9).
	In-combination The predicted worst-case in-combination impacts from collisions and displacement combined on the breeding adult kittiwake population was 43 in the breeding season, and four in each of the autumn and spring passage periods. PVA results showed that this would have little effect on population growth. Ratios of end population size and population growth were all high (above 0.77).
Herring gull	Development-alone The predicted collisions on the breeding adult herring gull population from the Development-alone was 0.2 in the breeding season, and 0.3 in the non-breeding season. These impacts were trivial in comparison to the current SPA population size.
	In-combination The in-combination collisions prediction on the breeding adult herring population was 2.2 in the breeding season, and 3.1 in the non-breeding season. These impacts were small in comparison to the current SPA population size, representing an increase of 0.24 per cent in annual mortality rate of adult birds. Furthermore, the calculation of the non-breeding season collisions was highly precautionary because of the approach taken to the apportioning of impacts.

Qualifying feature	Conclusion
Guillemot	Development-alone The predicted displacement mortality on the breeding adult guillemot population from the Development-alone was seven in the breeding season, and three in the non-breeding season. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (above 0.9).
	In-combination The predicted in-combination impacts from displacement on the breeding adult guillemot population was 22 in the breeding season, and 42 over the full annual period. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (above 0.9).
Razorbill	Development-alone The predicted displacement mortality on the breeding adult razorbill population from the Development-alone was four in the breeding season, and four in the non-breeding season. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (above 0.9).
	In-combination The predicted in-combination impacts from displacement on the breeding adult razorbill population was seven in the breeding season, and 11 in the non-breeding season. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (above 0.8).
Puffin	Development-alone The predicted displacement mortality on the breeding adult puffin population from the Development-alone was 22. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (above 0.9).
	In-combination The predicted in-combination impacts from displacement on the breeding adult puffin population was 77. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (above 0.9).

521 The predicted impacts on the qualifying features of the Forth Islands SPA (Table 5.1) from the Development-alone, and in-combination with other reasonably foreseeable plans and projects, can be concluded, beyond reasonable scientific doubt, to the have no adverse effect on site integrity.

Table 5.2 Summary of predicted effects and impacts on the Fowlsheugh SPA from the Development-alone and in-combination.

Qualifying feature	Conclusions
Kittiwake	Development-alone The predicted collisions on the breeding adult kittiwake population from the Development-alone was 10 in the breeding season, and zero in the autumn and spring passage periods. Predicted displacement mortality on the breeding adult kittiwake population from the Development-alone was six in the breeding season. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (above 0.9).
	In-combination The predicted worst-case in-combination impacts from collisions and displacement combined on the breeding adult kittiwake population was 82 in the breeding season, nine in the autumn passage period, and 12 in the spring passage period. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (above 0.77).
Herring gull	Development-alone The predicted collisions on the breeding adult herring gull population from the Development-alone was less than 0.01 per annum. These impacts were trivial in comparison to the current SPA population size.
	In-combination The in-combination collisions prediction on the breeding adult herring population was 0.03 in the breeding season, and 0.04 in the non-breeding season. These impacts were trivial in comparison to the current SPA population size.
Guillemot	Development-alone The predicted displacement effects on the breeding adult guillemot population from the Development- alone was eight in the breeding season, and four in the non-breeding season. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (above 0.9).
	In-combination The predicted in-combination impacts from displacement on the breeding adult guillemot population was 40 in the breeding season, and 64 for the full annual period. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (above 0.9).
Razorbill	Development-alone The predicted displacement effects on the breeding adult razorbill population from the Development-alone was four in the breeding season, and four in the non-breeding season. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (above 0.9).
	In-combination The predicted in-combination mortality from displacement on the breeding adult razorbill population was 10 in the breeding season, and nine in the non-breeding season. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (0.89 or above).

522 The predicted impacts on the qualifying features of the Fowlsheugh SPA (Table 5.2) from the Development-alone, and in-combination with other reasonably foreseeable plans and projects, can be concluded, beyond reasonable scientific doubt, to the have no adverse effect on site integrity.

Table 5.3 Summary of predicted effects and impacts on the St Abb's Head to Fast Castle SPA from the Development-alone and in-combination.

Qualifying feature	Conclusions
Kittiwake	Development-alone The predicted collisions on the breeding adult kittiwake population from the Development-alone was two in the breeding season, and zero in the autumn and spring passage periods. Predicted displacement mortality on the breeding adult kittiwake population from the Development- alone was one in the breeding season. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (above 0.9).
	In-combination The predicted worst-case in-combination impacts from collisions and displacement combined on the breeding adult kittiwake population was six in the breeding season, four in the autumn passage period, and four in the spring passage period. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (0.89 or above).
Herring gull	Development-alone The predicted collisions on the breeding adult herring gull population from the Development-alone was less than 0.1 per annum. These impacts were trivial in comparison to the current SPA population size.
	In-combination The in-combination collision prediction on the breeding adult herring population for the breeding and non-breeding periods combined was also than 0.1. This impact is trivial in comparison to the current SPA population size.
Guillemot	Development-alone The predicted displacement mortality on the breeding adult guillemot population from the Development-alone was three in the breeding season, and two in the non-breeding season. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (above 0.9).
	In-combination The predicted in-combination impacts from displacement on the breeding adult guillemot population was 12 in the breeding season, and nine in the non-breeding season. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (above 0.9).

523 The predicted impacts on the qualifying features of the St Abb's Head to Fast Castle SPA (Table 5.3) from the Development-alone, and in-combination with other reasonably foreseeable

plans and projects, can be concluded, beyond reasonable scientific doubt, to the have no adverse effect on site integrity.

Table 5.4 Summary of predicted effects and impacts on the Buchan Ness to Collieston Coast SPA from the Development-alone and in-combination.

Qualifying feature	Conclusions
Guillemot	Development-alone The predicted displacement mortality on the breeding adult guillemot population from the Development-alone was one in the breeding season, and zero in the non-breeding season. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (above 0.9).
	In-combination The predicted in-combination impacts from collisions and displacement combined on the breeding adult guillemot population was four in the breeding season, and two in the non-breeding season. PVA results showed that this would have little effect on population status. Ratios of end population size and population growth were all high (above 0.9).

524 The predicted impacts on the qualifying features of the Buchan Ness to Collieston Coast SPA (Table 5.3) from the Development-alone, and in-combination with other reasonably foreseeable plans and projects, can be concluded, beyond reasonable scientific doubt, to the have no adverse effect on site integrity.

Table 5.5 Summary of predicted effects and impacts on the Outer Firth of Forth and St Andrews Bay Complex pSPA from the Development-alone and in-combination.

Qualifying feature	Effect	Conclusions
All (see Table 3.8)	Displacement/disturbance of birds during cable laying (construction and decommissioning)	Development-alone The predicted OfTW construction period of nine months means that disturbance will be short-term. Disturbance would not take place simultaneously over the entire Offshore Export Cable Corridor, but would be limited to the vicinity of activities around CIVs. These would move slowly as cable installation takes place and remain static for long periods. Their presence would represent an increase in existing shipping traffic levels that would be so small as to be virtually undetectable. Cable laying activities emit low levels of noise, both above and below water. Visual disturbance above the sea surface would be limited to vessels and

Qualifying feature	Effect	Conclusions
		activities on board, and below water to areas in close proximity to the cable-laying tools and the cable itself. The AA considered each pSPA species based on indices of the likely sensitivity to disturbance/displacement from man-made structures (e.g. offshore wind infrastructure), ships and helicopters. This is based on information in the scientific literature and expert opinion ((Furness *et al.,* 2013, Furness & Wade 2012, Garthe and Huppop 2004). The short-term presence of a slow-moving vessel with low levels of associated visual and noise disturbance is considered likely to cause temporary and localised disturbance and displacement only, with no adverse effects on pSPA qualifying species.
		In-combination In the context of wider shipping activities in the outer Firth of Forth, the disturbance to birds from OfTW is considered to be so small as to be undetectable. The potential for in-combination effects of disturbance and displacement with other ongoing activities to be significant in terms of the pSPA Conservation Objectives is therefore considered to be negligible. No adverse effects from in-combination disturbance and displacement are predicted in relation to the Conservation Objective to "avoid significant mortality, injury and disturbance of the qualifying features, so that the distribution of the species and ability to use the site are maintained in the long-term".
	Displacement/disturbance of birds during cable maintenance / repair (operation)	Development-alone and in combination Very small-scale repair requirements are predicted for offshore cables (about 10 per cent of the export cable length for a maximum of two cables over the operational life of the Wind Farm). In the context of wider shipping activities in the outer Firth of Forth the

Qualifying feature	Effect	Conclusions
		potential disturbance / displacement to pSPA qualifying species from operation and maintenance of the OfTW is considered to be trivial. No adverse effect is predicted for the Development-alone or in-combination in relation to the Conservation Objective to "avoid significant mortality, injury and disturbance of the qualifying features, so that the distribution of the species and ability to use the site are maintained in the long-term".
	Disturbance to seabed habitats, loss of foraging habitat and depletion of prey resource (construction and decommissioning)	Development-alone In total a predicted 2.5 kilometres squared of seabed habitat will be disturbed during the installation of the export cable (equivalent to less than 0.1 per cent of the pSPA area). Within this area, during the nine month construction period, disturbance at any given time will be limited to the area where cable laying works are ongoing. Recovery of disturbed areas would be expected to begin within one to two months and take one to three years. Given the very small scale and temporary nature of the works, and the expected recovery of habitats in the short term, no adverse effect on any pSPA qualifying species is predicted in relation to the Conservation Objective to "maintain habitats and food resources of the qualifying features in favourable condition".
		It is likely that the effects of the OfTW for the construction (and decommissioning) of the Development-alone on the habitat for prey species and the available prey resource will be so small as to be undetectable. It is considered, therefore, that there would be no potential for in-combination effects with other ongoing activities, or plans and projects in the outer Firth of Forth in relation to the Conservation Objective to "maintain habitats and food resources of the qualifying features in favourable condition".

Qualifying feature	Effect	Conclusions
	Disturbance to seabed habitats, loss of foraging habitat and depletion of prey resource (operation)	Development-alone and in combination Temporary habitat disturbance from operation and maintenance of the export cables is estimated to affect a maximum of 0.0025 kilometres squared of seabed per year, equivalent to less than 0.0001 per cent of the pSPA area. No detectable effects of loss of habitat for prey species or depletion of prey resource would be predicted for the Development-alone, and no potential for an in combination effect in relation to the conservation objective of maintaining habitats and food resources of the qualifying features in favourable condition.
	Habitat loss (operation)	The total area of seabed habitat lost as a result of the Offshore Export Cable is estimated to represent less than 0.01 per cent of the pSPA area. This scale of loss is so small as to be virtually undetectable in terms of the available habitat, and no adverse effects on the pSPA qualifying features are predicted from the Development-alone or in-combination with other plans or projects.

525 The predicted impacts on the qualifying features of the Outer Firth of Forth and St Andrews Bay Complex pSPA (Table 5.5) from the Development-alone, and in-combination with other reasonably foreseeable plans and projects, can be concluded, beyond reasonable scientific doubt, to the have no adverse effect on site integrity.

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