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Abbreviations and Acronyms

BOU	British Ornithologists' Union
BTO	British Trust for Ornithology
CEH	Centre for Ecology and Hydrology
DECC	Department of Energy and Climate Change
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESAS	European Seabirds at Sea
FTOWDG	Forth and Tay Offshore Wind Farm Developers Group
HAT	Highest Astronomical Tide
HRA	Habitats Regulation Appraisal
IECS	Institute of Estuarine Coastal Studies
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
LSE	Likely Significant Effect
MHWS	Mean High Water Spring Tide
MLWS	Mean Low Water Spring Tide
MPA	Marine Protected Area
MS	Marine Scotland
MSS	Marine Scotland Science
OfTW	Offshore Transmission Works
OnTW	Onshore Transmission Works
OSP	Offshore Substation Platform
PVA	Population Viability Analysis
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SD	Standard Deviation

SNH	Scottish Natural Heritage
SOSS	Strategic Ornithological Support Services
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TCE	The Crown Estate
VOR	Valued Ornithological Receptor
WeBS	Wetland Bird Survey
WTG	Wind Turbine Generator
WWT	Wildfowl and Wetlands Trust

Glossary

Clupeid	Any of various widely distributed soft-finned fishes of the family Clupeidae, which includes herring and sprat.
Foraging	Foraging is searching for and exploiting food resources.
Gadoid	A bony fish of an order (Gadiformes) that comprises the cods, hakes, and their relatives.
Kleptoparasite	A form of feeding in which one animal habitually takes prey or other food from another.
Loafing	Behaviour not connected with feeding or breeding. The term includes preening and resting.
Passerine	Birds that are of the order Passeriformes, which includes more than half of all bird species. Referred to as perching birds or songbirds.
Quarry Species	A legally defined game bird, e.g. one which can by shot at certain times of the year.
Ramsar	Status of a site indicating it as an important wetland area.
Regional Population	The regional population estimate for each species as per the SMP database and Mitchell *et al.* (2004). Region was defined for each species separately based on foraging range (Thaxter *et al.,* 2012, see below).
Roosting	Resting or sleeping.
Seabird	Species group which inhabit offshore areas (where they forage, rest or loaf and may roost). The term is customarily applied to petrels, gannets, cormorants, skuas, gulls and terns, and auks. Some species of ducks, divers and grebes may also inhabit offshore areas, and may sometimes be considered as seabirds, although they tend to use areas closer to shore than the seabird groups described above.
Soft start	Commencement of a noisy procedure (i.e. piling) with low energy levels and building gradually to operational levels.

15 Ornithology

15.1 Introduction

1 This chapter assesses the likely impacts of the Inch Cape Offshore Wind Farm and its associated Offshore Transmission Works (OfTW) on birds. The assessment also comprises a Habitats Regulations Appraisal (HRA).

2 This Chapter is supported by the following documents, which contain all relevant background data and figures:

- *Appendix 15A: Offshore Ornithology Technical Report;*
- *Appendix 15B: Population Viability Analysis;*
  - *Annex 15B.1: HRA Screening Report; and*
- *Appendix 15C: Ornithology Intertidal and Nearshore Baseline.*

3 This chapter should also be read in conjunction with the following chapters:

- *Chapter 10: Metocean and Coastal Processes*;
- *Chapter 11: Underwater Noise*;
- *Chapter 12: Benthic Ecology;*
- *Chapter 13: Natural Fish and Shellfish;*
- *Chapter 19: Shipping and Navigation;* and
- *Chapter 20: Military and Civil Aviation.*

4 Figures 15.1 and 15.3 are embedded in the EIA section of this chapter, with Figures 15.4 to 15.13 incorporated at the end of the Chapter in *Section 15.13*.

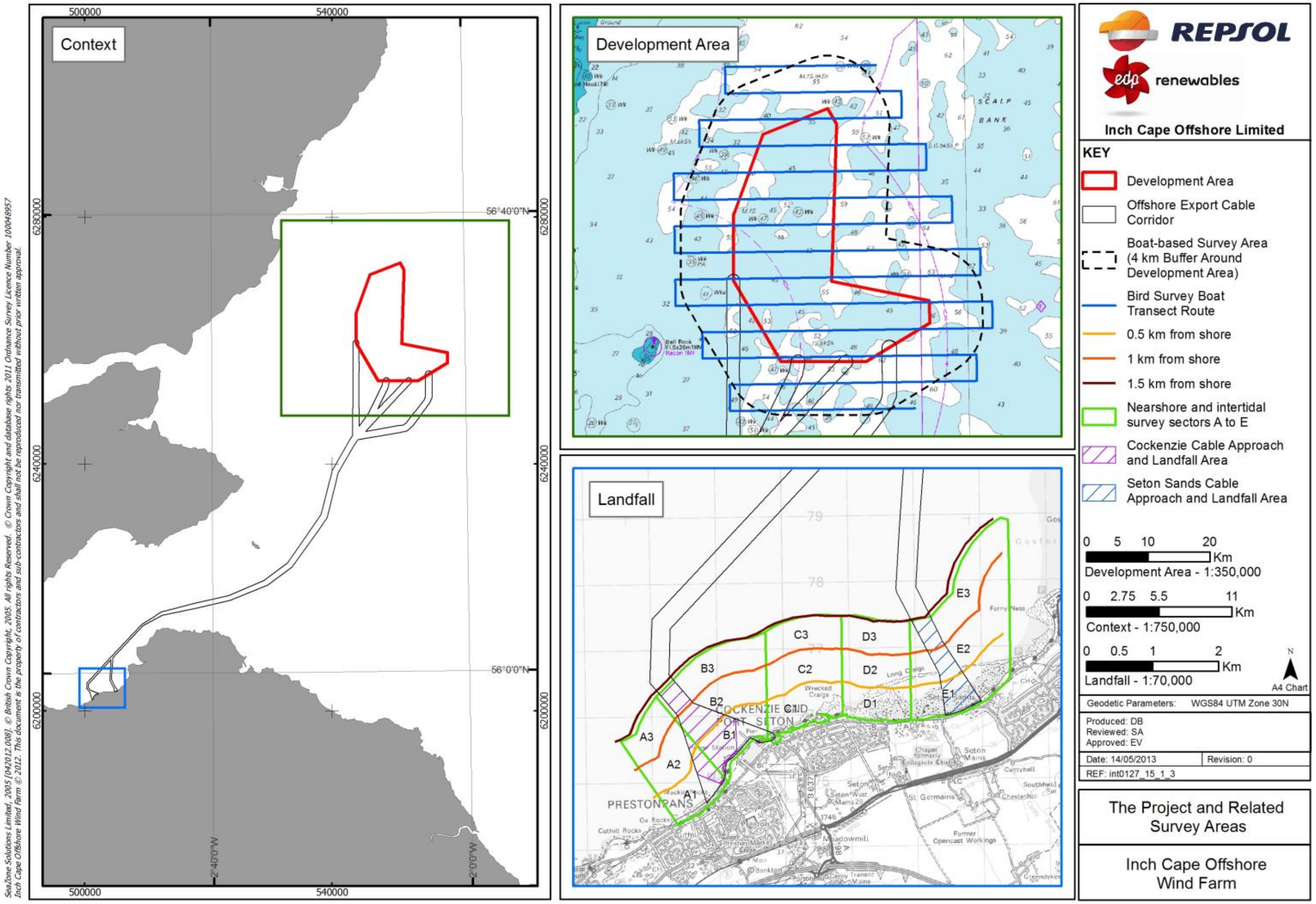
5 The terminology used in relation to the Project is explained in *Section 1.3.6* and in Table 1.1: Defined Terms. Terms relevant to this chapter are also given here:

- Boat-based Survey Area: the Development Area and a 4 km Buffer Zone for which the ornithological boat-based surveys were carried out;
- Buffer Zone: a 2 to 4 km wide buffer around the Development Area; and
- Near-shore Survey Area: the area from Mean High Water Springs (MHWS) out to 1.5 km that extends approximately six kilometres along the East Lothian coast: from Prestonpans Sea Front at Ox Rocks (NT 38288 74532) to the eastern end of Seton Sands (NT43301 76480). Ornithological surveys carried out in this survey area were undertaken by surveyors on land. The survey area was segregated into five discrete count sectors (Sectors A-E, see Figure 15.1).
- Cable Landfall Study Area: Three sectors were identified as relevant to the nearshore (including intertidal) assessment. These include:

- *Cockenzie Landfall: Sectors A and B*
- *Seton Sands Landfall: Sector E*

6 The location and extent of key features and survey areas from the above are shown in Figure 15.1.

Figure 15.1: The Project and Related Ornithological Survey Areas



7 Bird names quoted in this chapter follow the vernacular English names recommended by the British Ornithologists' Union (BOU, 2013). In the assessment, a distinction is made between seabirds and migratory species, as the former species group inhabit offshore areas (where they forage, rest or loaf and may roost) whereas migratory species may fly over offshore areas on migration, but do not generally spend extended periods foraging, loafing or roosting at sea. Seabirds is the term customarily applied to petrels, gannets, cormorants, skuas, gulls and terns, and auks. Some species of ducks, divers and grebes may also inhabit offshore areas, and may sometimes be considered as seabirds, although they tend to use areas closer to shore than the seabird groups described above.

15.2 Consultation

8 An Environmental Impact Assessment (EIA) Scoping Report for the Inch Cape Offshore Wind Farm was issued in August 2010 (SeaEnergy Renewables, 2010). Scoping advice from Scottish Natural Heritage (SNH) and the Joint Nature Conservation Committee (JNCC) was received in October 2010 (SNH, 2010a). In addition to the formal Scoping Opinion, further informal consultation has been undertaken in relation to the assessment of the impacts of the Wind Farm and OfTW with relevant stakeholders.

9 An HRA screening report for the Wind Farm was submitted to Marine Scotland and SNH on 29 August 2012 (included as *Annex 15B.1* to *Appendix 15B*). Comments from Marine Scotland were received on 28 September 2012 (pers. comm., 2012a). Comments from SNH on the HRA screening report were received on 2 November 2012 (pers. comm., 2012b).

10 SNH was further consulted on the approach to the HRA for the intertidal section of the Offshore Export Cable Corridor, and comments from SNH were received on 26 March 2013 (pers. Comm., 2013a).

11 Details of the consultation, such as relevant issues from Forth and Tay Offshore Wind Farm Developers Group (FTOWDG) meetings and correspondence with Marine Scotland, are discussed in Table 15.1 and referred to as appropriate throughout the chapter.

Table 15.1: Scoping Responses and Actions

Consultee	Scoping Response	Project Response
SNH[1]	Marine Scotland Act 2010 provides for Marine Protected Areas (MPAs). The applicant should liaise with Marine Scotland over this aspect and SNH will seek to keep the applicant informed as to their input to the progress of MPAs, where this is relevant.	The Firth of Forth Banks Complex (for offshore sand and gravel habitats) in the outer Forth and Tay Region is the closest MPA, 1.2 km from the Development Area (see Table 9.4).
SNH[1]	The location and extent of onshore infrastructure is not yet confirmed. There may be Sites of Special Scientific Interest (SSSIs) that require consideration in this regard but SNH cannot yet be definitive.	A location for the onshore grid connection has been identified at Cockenzie East Lothian. The onshore grid connection is considered where relevant in the ornithological assessment for the Wind Farm and Offshore Export Cable.

Consultee	Scoping Response	Project Response
SNH[1]	Cumulative impacts on Special Protection Area (SPA) bird species will need to be considered.	Cumulative impacts for all appropriate bird species are considered in the ornithological assessment (*Section 15.8 and 15.9*), and in-combination effects for SPA bird species are considered in the HRA *(Section 15.12*).
SNH[1]	SNH is only able to provide advice on HRA in respect of existing SPAs. The Firth of Forth supports nationally and internationally important bird species and is included as an area of search for marine SPAs. Extensions for seabirds have recently been announced for the Forth Islands SPA. There is ongoing work in respect of breeding terns. Marine SPAs will also be designated for inshore aggregations of non-breeding water birds and offshore aggregations of seabirds, with references to Dawson *et al*. (2008) and Kober *et al*. (2010).	The United Kingdom (UK) Statutory Nature Conservation Agencies are considering potential additions to the UK network of SPAs in offshore areas. Should additional sites be identified in the near future in the Forth/Tay area, or with potential connectivity with the Forth/Tay, these would also need to be considered for HRA in relation to the Wind Farm. A number of areas for consideration as possible offshore marine SPAs for seabirds have been identified, including sites in the Forth and Tay region (Kober *et al*., 2012) although it is understood that further work is required before any formal SPA proposals are announced. Dawson *et al*. (2008) considered that parts of the Firth of Forth may qualify as a marine SPA for inshore aggregations of non-breeding waterbirds, for red-throated diver and Slavonian grebe, but identified requirements for further survey work before any formal proposal could be made.
SNH[1]	Recommend that the regions to be considered should be based on the known foraging range of species that are likely to occur around the Development Area.	Seabird foraging ranges were used to define regional breeding populations on a species by species basis (see *Appendix 15A*, *Section 15A.2.3.2*).
SNH[1]	SNH urges caution in applying bird species sensitivity ratings in Garthe and Hüppop (2004) and COWRIE guidance (King *et al*., 2009). These are based on seabirds occurring in the south North Sea and may not be directly comparable to UK populations. Many of the species that occur in each area will be the same but consider differences in breeding and wintering behaviours. Breeding populations on the east coast of Scotland are likely to have differing sensitivity to offshore wind farm development compared with those in the southern North Sea. Reviewing and updating available information on seabird sensitivity in UK waters will require collaboration between JNCC, SNH and other conservation agencies and seabird experts.	Reference is made to an updated assessment of the vulnerability of Scottish seabirds to offshore Wind Turbine Generators (WTGs) (Furness and Wade, 2012) commissioned by Marine Scotland (*Section 15.4.2*)

Consultee	Scoping Response	Project Response
SNH[1]	SNH would welcome further details of how the applicant proposes to integrate the datasets from boat-based and aerial survey work.	Aerial survey data from The Crown Estate (TCE) for the outer Firth of Forth was considered. However, too few aerial transects ran through the Boat-based Survey Area to provide meaningful density and population estimates to compare with those from boat-based survey data. Therefore, high quality boat-based survey data was used to produce density and population estimates for key bird species.
SNH[1]	Recommend boat-based bird surveys follow standard methods set out in Camphuysen *et al*. (2004) and Maclean *et al*. (2009). Strongly recommend that bird surveyors are not used as marine mammal observers.	Boat-based survey methods (see *Appendix 15A*, *Section 15A.2.1*) for the Wind Farm are compliant with the SNH recommendations. Bird surveys began in September 2010 and from December 2010 a separate marine mammal observer was present on the vessel. Marine mammal data was collected independently from the bird data.
SNH[1]	Boat-based survey work does not address migratory species and/or bird movements at night.	The use of radar to collect data on migratory and nocturnal bird movements was considered. However, at 15 km to 22 km from the coast, the Development Area lies outside the effective range of most conventional short-range shore based radar systems (six nautical miles/11 km) (RPS, 2009). No suitable at-sea locations for radar were available. Therefore, the use of this technique was discounted. Migratory species passing through the Development Area have been assessed based on the approached recommended by the Strategic Ornithological Support Services (SOSS) for Offshore Renewables. The potential for nocturnal activity of seabirds is considered based on available information (e.g. in Furness and Wade, 2012).
SNH[1]	Advise a power analysis at the earliest opportunity on boat-based survey data to assess the magnitude of detectable effect (e.g. % change in bird numbers).	RPS undertook a power analysis for the study design of the Development Area (RPS, 2010), aiming to establish the optimal combination of buffer width and transect interval in order to allow for a reasonable level of confidence in the detection probability of population changes of a range of magnitudes. It was concluded that 2 km intervals between transects in- combination with a 4 km buffer zone would give a design which is considered to have sufficient power to permit reliable detection of displacement effects of 15% or more amongst more abundant species. The results also indicated that for less abundant species, reliable detection of displacement effects using standard data collection methods may only be possible when 30% or

Consultee	Scoping Response	Project Response
		more of the individuals are displaced. This analysis was based on simulated data with a random distribution.
SNH[1]	Camphuysen *et al*. (2004) and Maclean *et al*. (2009) recommend the collection of oceanographic and fish data during boat-based seabird surveys as this may allow habitat modelling to be undertaken. This could be used to achieve a better understanding of the reasons for bird numbers at the Development Area. SNH recommend that this issue is carefully considered and could benefit from a collaborative approach from FTOWDG.	Habitat modelling has been considered but there is no clear evidence to provide useful information on causal factors for the distribution of seabirds at the Development Area. For example, tracking data from the Isle of May revealed no strong associations between the foraging distributions of guillemot, razorbill and kittiwake and sea-surface temperature, chlorophyll a concentration (a measure of primary production), or benthic substrate; this is in accordance with the findings of other studies (Daunt *et al*. 2011a). There were associations between the foraging behaviour of individual species and bathymetry (water depth), with all species tending to forage within depths of 40 m - 70 m, and preferably at depths of 40 m - 50 m. Thus, at depths of 35.5 m -63.3 m, the Development Area falls within the preferred foraging depths of these species.
SNH[1]	Waders and waterfowl may move across the Development Area during severe weather as well as on migration. Recommend an analysis of hard weather movements of birds during average and extreme winter conditions, and consider climate change.	Collision risk for migratory species is addressed based on the recommendations made by SOSS. The migration corridors identified are considered likely to cover those used for hard weather movements.
SNH[1]	Recommend that the applicant makes a desk-based assessment of the impacts of construction and operational noise on the prey species of seabirds. The assessment, and any mitigation, should address breeding, moult and wintering periods.	An assessment of construction and operational noise on fish is included in *Chapter 13*. This has been used to assess potential indirect impacts on birds (*Sections 15.6* to *15.9*)
SNH[1]	Recommend an assessment of the potential for operation and maintenance activities (boat or helicopter) to cause disturbance and displacement to birds using the Development Area. Suggest remote condition monitoring systems to reduce the number of WTG visits as potential mitigation.	Operational and maintenance activities have been considered in the ornithological assessment (Section 15.6.2, 15.7.3, 15.8.2 and 15.9). The majority of control activities will be undertaken remotely from shore using a control centre, however offshore access and intervention will be required to maintain and potentially repair or refit plant and equipment.
SNH[1]	TCE SOSS will be reviewing existing knowledge on collision risk and avoidance rates for offshore wind farms and will also consider displacement impacts (100% avoidance). SNH	The SOSS recommended method for calculation of bird collision risk (Band, 2012) has been used in the ornithological assessment (Section 15.6.2)

Consultee	Scoping Response	Project Response
	recommend that this work is referred to once published.	
SNH[1]	Recommend an assessment of the potential impacts of WTG lighting on birds.	Considered in ornithology assessment as a potential additional risk factor for collision with WTGs (*Section 15.6.2*)
SNH[1]	Consider potential impacts of foundation designs on birds and possible mitigation (e.g. lattice type construction above the water may attract birds by providing a perch area).	Considered in ornithology assessment as a potential additional risk factor for collision with WTGs (*Section 15.6.2*).
SNH[1]	Recommend a preliminary analysis of potential collision risk to passerines using data from the North Sea Bird Club, East Coast Bird Observatories and locally available data. Suggest considering this via FTOWDG.	Passerines (perching birds) were not identified as target species for the ornithology assessment. Small numbers were recorded during boat surveys (see *Appendix 15A*, *Section 15A.2.1*) reflecting the fact that several species would be expected to pass through the Development Area on migration. Passerine birds typically migrate over broad fronts (Wright *et al*., 2012) and nationally important numbers of any species are not predicted to pass through the Development Area. Therefore, although passerines may be vulnerable to collisions with WTGs and other offshore structures, especially in conditions of poor visibility (Wright *et al*., 2012), the number of birds of a given species at risk is likely to be low compared to the national and international populations.
SNH[1]	Recommend that consideration is given to the potential impact of scour protection on sandeels, a primary prey species of seabirds.	Habitat loss associated with scour protection has been considered in *Chapter 13* and not been identified as a potentially significant impact on any fish species (see *Section 13.6 to 13.9*).
SNH[1]	Recommend that the applicant, and FTOWDG, consider potential collision risk to bean geese at the Slamannan Plateau SPA and the Svalbard population of barnacle geese overwintering at the Upper Solway Flats and Marshes SPA is included in any impact assessment and HRA.	The ornithology assessment and HRA consider potential impacts on Taiga bean goose and Svalbard Barnacle goose as well as other migratory species (Section 15.6, 15.9 and 15.12)
SNH[1]	The location of all elements of onshore infrastructure will need to be considered in respect of potential impacts to bird species, including qualifying species of SPAs.	The potential impacts on bird species from the onshore infrastructure has been considered in the impact assessment (project alone: *Section 15.7; cumulative: Section 15.8*). A separate ornithological assessment will also be undertaken for the onshore infrastructure and submitted in due course.

Consultee	Scoping Response	Project Response
SNH[1]	An HRA for SPAs will be carried out by the competent authority (most likely Marine Scotland) based on advice from SNH and using information and data collated by the developer. Potential impacts of the proposal will need to be considered alone and in-combination with other plans and projects – other offshore wind farm proposals in the Outer Forth and Tay and the Round 3 zone; also other types of industry and activity that may potentially be relevant. SNH recommend 20 SPAs for HRA in respect of cumulative impacts; it is also noted that HRA will be required for any new marine SPAs which may be classified for inshore or offshore aggregations of seabirds. SPA bird interests are wide-ranging, seabirds may make long foraging trips and there are migratory species to consider. Offshore wind farms may be 'connected to' SPAs at much greater distances than those experienced for onshore development. As proposals are located further away from the [SPA] site direct impacts are less likely on qualifying species while they are within the SPA (see Appendix D, 22-23).	An HRA screening report (see *Appendix 15B, Annex 15B.1*) was submitted to Marine Scotland in August 2012 (comments on the report are summarised below). An assessment to inform an HRA for the list of SPAs agreed with SNH is included in *Section 15.12*). This includes an in-combination assessment. Where SPAs on the list provided by SNH are designated due to their seabird populations in the breeding season, potential connectivity to the Development Area has been identified (i.e. whether the seabirds which are qualifying species at these sites may visit the Development Area and be subject to impacts from the Wind Farm and OfTW). Where qualifying species of SPAs on the list are not seabirds, species which might fly through the Development Area on migration have been identified, following guidance on migratory species provided by SOSS (Wright *et al.*, 2012).
The Royal Society for the Protection of Birds (RSPB)	Welcome the recognition that transboundary effects may occur some distance away from the impact source and will be included in the EIA. Consider that potential impacts on nature conservation should be included. Some projects may affect designated sites a considerable distance away and will require to be subject to Habitats Regulation Appraisal. There may be issues related to SPA-qualifying migratory waterfowl, moving up and down the east coast of Britain or across the North Sea.	An HRA has been undertaken and impacts on migratory species are considered in the assessment (see *Section 15.12*).
RSPB	Any offshore wind farms in the vicinity, either consented or proposed, should be included in the cumulative assessment. We also recommend that any major projects involving changes in land use should be considered as these could affect the feeding grounds of migratory birds, thus possibly resulting in	The cumulative and in-combination assessment has considered a number of other offshore wind farms, including developments that are operational, consented, submitted for determination and at scoping (see *Section 15.9 and 15.12*). A number of other major coastal developments are also considered.

Consultee	Scoping Response	Project Response
	significant impacts on survival, in addition to direct and indirect impacts attributable to wind energy development.	
RSPB	The area of assessment is outlined [in the scoping report] as the coastline between Montrose and St Abb's Head. It is also stated that birds using the Wee Bankie and Marr Bank are from colonies including the Farne Islands so this area should be included in the assessment.	The area of assessment has been re-defined for individual seabird species based on available information on their foraging ranges.
RSPB	The area of assessment may be less meaningful for migratory waterfowl such as waders and geese. The area lacks a landward boundary and some land birds may migrate through Scottish Territorial Waters (STW) east coast sites so impacts are theoretically possible beyond the east coast of Scotland.	Migratory birds have been considered in the assessment according to the methods recommended by SOSS (Wright *et al*., 2012).
RSPB	The EIA process will need to take account of any MPAs designated under the *Marine (Scotland) Act 2010*.	See project response in relation to MPAs in the first row of this table.
RSPB	The proposed survey programme states that further aerial surveys may be used to support future bird and mammal studies within the STW. RSPB consider that further aerial surveys should be considered, particularly as the use of boat-based surveys to provide baseline data for a site of this size may prove problematic.	The ornithological assessment is largely based on a two year programme of surveys within the Boat-based Survey Area. This was considered the most robust means of obtaining monthly population estimates of birds and data on flying birds for collision risk assessment, as explained above. Future aerial surveys may be considered for pre- or post-construction monitoring but at present there is no reliable means of comparing population estimates from aerial surveys with those from boat surveys.
RSPB	The use of radar should also be considered. Radar studies should be targeted to allow assessment of impacts on passage seabirds and migratory waterfowl. Boat and aerial surveys do not sufficiently assess such movements and radar can gather data in periods of darkness and poor weather.	The use of radar has not been considered feasible for the Development Area because it is beyond shore-based radar range (RPS, 2009). Migratory birds have been considered in the assessment according to the methods recommended by SOSS (Wright *et al*., 2012).
HRA Screening Responses		
Marine Scotland	Marine Scotland will commission a project to estimate collision numbers for a wide range of passage species, following the SOSS principles. Outputs can be made available to Inch Cape Offshore Limited (ICOL).	Noted. The report of this research was not available at the time of writing.

Consultee	Scoping Response	Project Response
Marine Scotland	The most recent source for species counts at SPAs is the recent project for Marine Scotland undertaken by Natural Power (Lewis *et al*., 2012).	SPA data from Lewis *et al.* (2012) have been referred to as appropriate. Since the comments from Marine Scotland were received, SNH provided further advice on recent SPA population counts for breeding seabird interests of SPAs in relation to determining 'Likely Significant Effect' (LSE) for the breeding season (pers. comm., 2013b). SNH indicated that they and JNCC would double-check the data provided to confirm these as the appropriate reference populations for use in HRA. No further communication has been received from SNH on this issue at the time of writing. Seabird data for 2012 has become available through the Seabird Monitoring Programme (SMP) database and species counts at SPAs referred to in this chapter have been updated where possible using this information.
Marine Scotland	In relation to displacement, Marine Scotland has recently published a commissioned 'proof of concept' paper on an energetics approach to the consequences of displacement of guillemots by a FTOWDG wind farm. Marine Scotland is about to commission an extension of this project to cover other species, and all FTOWDG wind farms.	Noted. The report of this research was not available at the time of writing.
SNH	SNH and JNCC are still considering possible approaches to impact assessment for seabird species during the non-breeding seasons (post-breeding, passage and migratory) and will be able to provide advice in this respect once this has been agreed between the UK Country Agencies.	Noted. At the time of writing this advice had not been received. Outside the breeding season, seabirds range over large areas; populations from breeding locations in the UK and Europe mix in the North Sea and some seabirds breeding in the UK migrate to the Atlantic Ocean or further. Clear connectivity with birds using the Development Area and SPA populations outside of the breeding season cannot be established. The approach taken is detailed in *Section 15.6* and *15.7*.
SNH	For non-seabird passage species (waders and wildfowl), Marine Scotland is letting a research contract to take a strategic overview of potential impacts from proposed offshore wind farms in Scotland. For these species, the advice of SNH and JNCC will be informed by the results of the Marine Scotland report.	Noted. The report of this research was not available at the time of writing.

Consultee	Scoping Response	Project Response
SNH	SNH requested that Svalbard Barnacle Goose was screened in for LSE, although noting that they had undertaken work to consider whether any potential collision mortality for this species would result in population level effects and that this work would inform their advice to the competent authority for appropriate assessment.	This species has been considered with in the HRA presented in *Section 15.12*.
SNH	The shortlist of SPAs and seabird species for consideration in HRA (for the breeding season) was confirmed by SNH based on the recommendations in the HRA screening report, with two amendments (Sandwich tern was screened out for the Forth Islands SPA and herring gull was screened in for Buchan Ness to Collieston Coast SPA). SNH also confirmed that effects on seabird assemblages will be considered via assessment of impacts on each individual species component.	This advice has been followed in the HRA presented in *Section 15.12.*
SNH	The applicant was advised to remain aware of the proposals for future designation of marine SPAs, based on the most recent update from the JNCC website.	Noted. At the time of writing no further formal proposals for marine SPAs have come forward.
SNH	In relation to cumulative impacts of the Export Cable landfall, there were no onshore renewables schemes to take into account near the proposed export cable landfall at Cockenzie. Consideration should be given to the conversion of the existing coal-fired Cockenzie Power Station with a Combined Cycle Gas Turbine power station, advice should be sought from East Lothian Council on any other proposals in the vicinity, including the Main Issues Report for the Local Development Plan (due in Summer 2013).	Advice noted. A search for projects for the cumulative assessment of the Offshore Export Cable has been made as requested and further consultation has been undertaken with SNH (Table 15.21).
SNH	Effects of the Export Cable landfall construction works should be taken into account along with the offshore construction works.	Assessment undertaken (see *Section 15.7*).
1. SNH (2010a).		

12 Meetings with SNH and JNCC, and SNH and Marine Scotland, were held respectively on 17 February 2011 and 22 February 2012. At each meeting a summary of the results of boat-based surveys to date and the key species identified for assessment was presented and discussed. A report on the first year of boat-based surveys was submitted to SNH, JNCC and Marine Scotland in February 2012. Prior to submission of the Environmental Statement (ES), a summary of the EIA and HRA, including the population modelling for kittiwake, razorbill, guillemot, and puffin, was presented at a meeting with Marine Scotland, SNH and The Royal Society for the Protection of Birds (RSPB) on 19 February 2013.

13 Inch Cape Offshore Limited (ICOL) has also participated in FTOWDG, a group facilitated by The Crown Estate (TCE) and involving representatives from Seagreen Wind Energy Limited (Firth of Forth Round 3 Zone) and Mainstream Renewable Power (Neart na Gaoithe) (see *Section 5.5.2*). FTOWDG was formed to promote collaborative discussion about the development of offshore wind in the outer Forth and Tay region of Scottish Waters. The FTOWDG birds sub-group has jointly commissioned a number of studies in relation to seabirds to inform ornithological assessments for offshore wind farms. More detail on this is provided in the desk study (*Section 15.4.2*) below. Relevant issues from FTOWDG meetings and correspondence with Marine Scotland are referred to as appropriate throughout this chapter.

The information received through this consultation, along with the formal Scoping Opinion and recognised best practice, has informed the methodology and scope for the assessment of the impacts on ornithology presented in this chapter. HRA specific advice from Marine Scotland and SNH has been noted, and consideration of these points has been incorporated in the assessment to inform the HRA, in *Section 15.12* of this chapter.

15.3 Design Envelope and Embedded Mitigation

14 The design envelope, i.e. the full range of potential development scenarios, is detailed in *Chapter 7*. The assessment of impacts on ornithological communities is based upon the worst case scenario as identified from this design envelope, and is specific to each predicted impact or effect. The worst case scenario for each predicted impact relating to the works within the Development Area and the Offshore Export Cable Corridor are detailed below in Tables 15.2 and 15.3 respectively, and as these scenarios have been carried through into the assessment, it is considered to be conservative such that any design taken forward is considered within the assessment.

Table 15.2: Worst Case Scenario Definition – Development Area

Predicted Impact	Design Envelope Scenario Assessed
Construction	
Direct disturbance, direct habitat loss, indirect impacts on birds via prey species.	Total seabed area disturbed is 5.54 km^2, equating to 3.69% of the Development Area (see Table 12.2 and 13.2). Noise model based on parameters in Table 11.2 and 11.3. Programme and vessels: vessel traffic: approximately 3,500 vessel movements (movement equals return trip from port – Development Area); Construction programme: maximum extent from 2016 to 2020. A worst case scenario considered that up to 15 vessels could be present in the Development Area at any one time (including tugs, and construction, heavy lift, cable laying and crew vessels).
Operation	
Direct habitat loss.	Gravity bases fitted to 213 WTGs as well as OSPs (5), met masts (3) and inter-array cables, with maximum protection of 10% of the cables length, covering 1.87 km^2, equivalent to 1.25% of the Development Area.
Disturbance, indirect impacts on birds via prey species, displacement.	Ports and harbours, and operation and maintenance considered for disturbance and indirect impacts: average number of vessel trips to Development Area per day during operational phase: four to six. For impacts on birds via prey species see Table 13.2. Maximum extent of Development Area (150 km^2) plus a 2 km buffer considered for displacement.
Collision risk, barrier effect.	Number of WTGs – 213 (largest dimensions): • Minimum hub height – 114 m above LAT; • Rotor diameter – 172 m; • Minimum air draft – 22 m above Highest Astronomical Tide (HAT); • Markings, foghorns and lighting – as per guidance and on agreement with navigation and aviation stakeholders. Array dimensions: closest average down-wind and cross-wind spacing – 820 m; Indicative additional parameters used are provided in Appendix 15A, *Section 15A.2.5.2*.

Table 15.3: Worst Case Scenario Definition – Offshore Export Cable Corridor

Type of Effect	Design Envelope Scenario Assessed
Construction	
Direct habitat loss, direct disturbance, indirect impacts on birds via prey species.	Specification of construction details (assumed worst case): • Maximum number of six cables; • Cable route length –approximately 83 km from the edge of the Development Area to the MHWS; • Maximum cable corridor width – 1,400 m (the maximum distance between the outer most trenches); • Maximum estimated cable laying rate – 500 m per hour; • Maximum duration of installation between Development Area and near-shore habitat – nine months; • Maximum duration of installation in intertidal habitat – will take up to four weeks per cable, with a maximum installation of three cables per year (i.e. 12 weeks per year). It is also a possibility that this process could be phased over three years (i.e. eight weeks per year); • Approximate number of vessel movements – 30 per cable. Sub-tidal area of seabed disturbed across Offshore Export Cable Corridor is 3.02 km^2 (3.0% of Offshore Export Cable Corridor) resulting from the Export Cable installation (see Table 12.3). Intertidal area disturbed at the Cockenzie landfall option is 2,216 m^2 which equates to 2.0% of total beach area (measured from the Cockenzie Power station to East Cuthill Rocks) (see Table 12.3). Intertidal Area disturbed at Seton Sands landfall option is 14,636 m^2 which equates to 1.1% of total beach area measure from Wrecked Craigs to Fenny Ness (see Table 12.3).
Operational Phase	
Direct disturbance.	Noise, visual disturbance through maintenance. A small number of vessel movements associated with inspections and monitoring to identify if the Offshore Export Cable becomes exposed over time and take appropriate remedial action.

15.3.1 Embedded Mitigation

15 The following committed Embedded Mitigation measures have already been incorporated into the Design Envelope and have been taken into account in the impact assessment:

- Piling operations will incorporate a soft start procedure that will reduce the potential for noise related fatality on prey species of seabirds.
- Cables will be suitably buried or will be protected by other means when burial is not practicable. This will reduce the potential for impacts relating to the electromagnetic field (EMF) on some prey species of seabird.

- A suitably qualified Ecological Clerk of Works will be appointed to the Project during construction. This will ensure compliance with mitigation and best practice is followed relating to disturbance of priority bird species (notably qualifying species from the Firth of Forth Special Protection Area (SPA).

15.4 Assessment Methodology

16 This section describes the assessment methods and the underpinning legislation and guidance.

15.4.1 Legislation and Guidance

17 In addition to the '*The Marine Works (Environmental Impact Assessment) Regulations 2007'* (the EIA Regulations), key legislation in relation to birds includes:

- The Council Directive on the Conservation of Wild Birds 2009/147/EC (EU *Birds Directive*).
- The Council Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora 1992/43/EEC (EU *Habitats Directive*).
- The *Nature Conservation (Scotland) Act 2004* (as amended).
- The *Wildlife and Countryside Act 1981* (as amended).
- *Conservation (Natural Habitats, etc.) Regulations 1994* (as amended).
- *The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000* as amended in 2008.
- *Conservation of Habitats and Species Regulations 2010*.
- The *Offshore Marine Conservation (Natural Habitats, etc.) Regulations 2007* (as amended).

EU Birds Directive

18 The European Union (EU) meets its obligations for birds through Directive 2009/147/EC (EC *Birds Directive*) on the conservation of wild birds (codified version of the European Council Directive 79/409/EEC as amended). This legislation was adopted in 1979 in response to increasing concern about declines in Europe's wild bird populations. The Directive emphasises the protection of habitat for endangered and vulnerable bird species listed on Annex I and migratory birds through a network of SPAs.

EU Habitats Directive

19 European Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (EC *Habitats Directive*) was adopted in response to the Bern Convention. This Directive is transposed into UK law by the *Conservation of Habitats and Species Regulations 2010* (together with the *Conservation (Natural Habitats, &c.) Regulations 1994*). The Directive requires Member States to maintain habitats and species at a favourable conservation status across their full range, as well as through a network of protected sites

(Natura 2000, comprising Special Areas of Conservation (SACs) and SPAs). Species protected under this legislation are known as European Protected Species (EPS).

Nature Conservation Act 2004

20 The *Nature Conservation (Scotland) Act 2004* places a duty on public bodies to further the conservation of biodiversity. It requires Scottish Ministers to designate one or more strategies for the conservation of biodiversity as the Scottish Biodiversity Strategy, and to publish lists of species and habitats of importance. Chapter 1 of Part 2, and Schedules 1 and 5, of the Act, repeal the Sites of Special Scientific Interest (SSSI) provisions of the *Wildlife and Countryside Act 1981* (as amended), enhancing the protection of SSSIs. Part 3 and Schedule 6 of the Act amend the *Wildlife and Countryside Act 1981*, strengthening the legal protection for wild bird species.

Wildlife and Countryside Act 1981

21 The *Wildlife and Countryside Act 1981* consolidates existing national legislation to implement the Bern Convention and *Birds Directive* in the UK. It protects native species, controls the release of non-native species, enhances the protection of SSSIs and builds upon rights of way rules. Special penalties are available for offences related to rare and endangered bird species listed on Schedule 1.

Conservation (Natural Habitats, &c.) Regulations 1994 (as amended), Conservation of Habitats and Species Regulations 2010

22 In Scotland, the *Conservation of Habitats and Species Regulations 1994*, as amended, most notably in 2004 and 2007, transpose the EC *Habitats Directive* into domestic law. The Regulations protect sites, species and habitats identified by the *Habitats Directive*. The *Conservation of Habitats and Species Regulations 2010* apply in Scotland in relation to certain specific activities, including consents granted under Sections 36 and 37 of the *Electricity Act 1989*. The 2010 Regulations are very similar to the 1994 Regulations (as amended in Scotland) in the protection they give to Natura sites, so in practice proposals are assessed in exactly the same way.

The Offshore Marine Conservation (Natural Habitats, etc.) Regulations 2007 (as amended)

23 These regulations transpose Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (*Habitats Directive*) and Council Directive 79/409/EEC on the conservation of wild birds (*Wild Birds Directive*) into national law. They came into force on 21 August 2007. These regulations apply to the UK's offshore marine area which covers waters beyond 12 nautical miles, within British Fishery Limits and the seabed within the UK Continental Shelf Designated Area.

Guidance

24 Guidance on ecological and ornithological assessments for offshore wind farms was derived from:

- IEEM (2010) Ecological Impact Assessment Guidelines for Marine and Coastal Projects.
- Maclean *et al*. (2009) A review of assessment methodologies for offshore wind farms.
- King *et al*. (2009) Developing guidance on ornithological cumulative impact assessment for offshore wind farm developers.
- Advice received from Marine Scotland, SNH and JNCC in writing and during discussions at meetings, including specific advice relating to the Wind Farm and OfTW (in response to the Scoping Report, HRA screening report, and discussions at project-specific meetings; see *Section 15.2*), advice received at FTOWDG meetings with Regulators and in response to FTOWDG reports, and written comments from SNH, JNCC and RSPB in relation to ES's for other offshore wind farms.

15.4.2 Desk Study

25 Background information on seabird distributions within the bio-geographic region and the North Sea in particular was taken from BirdLife International (2004), Stone *et al*. (1995), Skov *et al*. (1995), Forrester *et al*. (2007), Mitchell *et al*. (2004), Kober *et al*. (2010) and other sources as appropriate. Colony counts were derived from the JNCC Seabird Monitoring Programme Database. These sources were used to determine regional breeding, passage and non-breeding or wintering numbers and distributions for each species. Much of the information on bird behaviour and ecology has been taken from Birds of the Western Palaearctic (Snow and Perrins, 1998), which provides a comprehensive text on each species.

26 For a few offshore wind farms, mainly outside the UK, there are publicly available studies which provide information on the responses of birds to the construction and/or operation of a wind farm (e.g. Horns Rev and Nysted, Denmark, Petersen *et al*., 2006; Southern Kalmar Sound, Sweden, Pettersson, 2005; Egmond aan Zee, The Netherlands, Krijgsveld *et al*., 2011, Lindeboom *et al*., 2011). For these wind farms a range of studies have been conducted, looking at changes in bird distributions and migration routes. Where appropriate these studies are referred to in the assessment.

27 Through FTOWDG a number of studies were commissioned, including reviews of seabird tracking studies in the Forth/Tay region (Daunt *et al*., 2011b) and the distribution and behaviour of gannets (Hamer *et al*., 2011), and tracking studies of seabirds at the Isle of May, St Abb's Head and Fowlsheugh (Daunt *et al*., 2011a, Daunt *et al*., 2011c).

28 Reference has also been made to Marine Scotland commissioned reports on the vulnerability of Scottish Seabirds to offshore WTGs (Furness and Wade, 2012) and preliminary modelling of the effects of displacement from offshore wind farms on seabirds (McDonald *et al*., 2012). Marine Scotland has commissioned further work on population viability analyses of seabirds in the Forth and Tay area, a strategic assessment of cumulative collision risk of offshore wind farms to migratory seabirds, and further modelling of the

potential implications of displacement. The reports from these latter three projects are not available at the time of writing.

29 The SOSS for the UK offshore wind industry have produced a number of reports and products which are referred to in the assessment, including a model to predict bird collisions with offshore wind farms (Band, 2012), recommendations for the assessment of risk to migratory bird species (Wright *et al*., 2012) and a review of bird flight heights and avoidance rates (Cook *et al*., 2012).

30 Reference is also made to the assessment methods applied in the ES's for other offshore wind farms in the UK.

31 For intertidal and near-shore birds, the National Biodiversity Network (NBN) database was consulted to provide an overview of the bird species recorded within the survey area plus a five kilometre buffer. A search for seabird breeding colony records within the survey area plus a five kilometre buffer was also made sought from Seabird 2000 records (Mitchell *et al*., 2004). The desk study for the near-shore and intertidal areas also included reference to existing ES documents.

32 Wetland Bird Survey (WeBS) count data were obtained from the BTO, consisting of the most recent high and low tide datasets gathered from WeBS survey sectors which most closely corresponded to the potential landfall options (see *Appendix 15C* for further details).

33 WeBS core (high tide) counts are conducted around high water on all estuaries and key wetland sites in the UK, generally on a set day each month. As the counts are undertaken around high water, when estuarine birds are likely to congregate at roosts because intertidal feeding areas are submerged, they are able to ensure a relative accuracy of counting, as waterfowl are relatively close to the estuary banks. Core counts therefore tend to quantify birds present at high tide roosts.

34 The WeBS low tide count scheme generally records the number of waders and wildfowl that are foraging within a count sector. It aims to monitor the importance of intertidal feeding areas of UK estuaries and complement the information gathered by WeBS core counts. Low tide counts provide information to gauge the potential effects on waterbirds of a variety of human activities which affect the extent or value of intertidal habitats.

35 WeBS high tide core counts are conducted every year while low tide counts are usually undertaken every six years. In this case, the high tide data obtained covered the five year period 2006/07 to 2010/11 whilst the most recent low tide data were collected in 2009/10.

36 For SPAs considered in the HRA, information on qualifying species, site populations at classification and the condition of SPA features was gathered from the SNH sitelink website and the SPA site accounts on the JNCC website.

15.4.3 Offshore Boat-based Surveys (Development Area)

37 The Boat-based Survey Area was defined on the basis of a power analysis (RPS, 2010), to provide robust bird population estimates for the Development Area, and to facilitate detection of displacement of birds by monitoring during construction and post-construction. It was concluded that boat transects at 2 km intervals in-combination with a 4 km buffer zone would give a design with sufficient power to permit reliable detection of displacement effects of 15 per cent or more amongst more abundant species (RPS, 2010). The results also indicated that for less abundant species, reliable detection of displacement effects using standard data collection methods may only be possible when 30 per cent or more of the individuals are displaced. This analysis was based on simulated data with a random distribution.

38 Monthly boat-based surveys of the Boat-based Survey Area for the Project were carried out between September 2010 and September 2012. Key components of the survey methodology are summarised in Table 15.4, below. The Boat-based Survey Area included the Development Area and a 4 km buffer, a total area of 430 km^2 (Figure 15.1). The data, collected by European Seabirds at Sea (ESAS)-certified surveyors, were used to produce monthly population estimates of seabirds within the Boat-based Survey Area. Further details of these surveys, which follow the recommended standard methodology for offshore boat-based bird surveys, and the methods used to calculate population estimates for the Boat-based Survey Area, are provided in *Appendix 15A*, *Section 15A.2.1*.

Table 15.4: Key Components of Boat-based Survey Methodology

Study Design	
Survey effort	Monthly, over two years
Study Area	Development Area plus 4 km buffer (430 km^2)
Transect interval	2 km separation
Transect orientation	East-west; parallel transects
Transect tails	Not surveyed
Total transect length	219 km
Weather constraints	No surveys in sea state 5 or more; visibility less than 300 m
Navigation	
Recording of location	60 second intervals
Sampling	
Detection	Predominantly through naked eye, binoculars used for identification, although the latter are used more regularly for bird feeding concentrations and in rougher sea states

Study Design	
Scan arc	90 degrees; single side of the vessel during all surveys
Number of surveyors	One primary observer, one scribe, one extra surveyor allowing for rotation of roles
Strip width	300 m (distance bands A-E; 0 m -50 m, 50 m - 100 m, 100 m - 200 m, 200 m - 300 m, 300 m+)
Basic recording interval	One minute
Snapshot interval	One minute
Snapshot box	Parallel to vessel, 300 m x 300 m
Height classes	Bands: on the sea surface, 5 m, 10 m, 15 m, 20 m, 25 m, 30 m, 35 m, 40 m, 45 m, 50 m, 60 m …100 m, 150 m, 200 m)
Data	
Primary bird data collected	Species, number, distance, flight height, behaviour, flight direction, in/out of snapshot for birds in flight
Secondary bird data collected	Age, sex, moult status, plumage, associations
Other data collected	Weather conditions, visibility, glare, activity of other vessels

39 The data obtained from boat-based surveys forms the core of the ornithological assessment. However, other ornithological data sources for the Forth and Tay Region, including the Development Area, collected during recent years, were also used as appropriate. These included tracking studies of auks and kittiwake from breeding colonies on the Isle of May, Fowlsheugh and St Abb's Head, carried out by the Centre for Ecology and Hydrology (CEH) in 2010 and 2011 (Daunt *et al.*, 2011a, 2011c).

15.4.4 Near-Shore Bird Surveys

40 A programme of monthly intertidal and near-shore bird surveys in and around the Cable Landfall Study Area was conducted over a period of thirteen months between January 2012 and January 2013 inclusive. These surveys were designed to assess the use of the intertidal and near-shore habitats associated within the Cable Landfall Study Area by qualifying species of the Forth Islands and Firth of Forth SPAs and Wetland of International Importance (Ramsar, see *Section 3.3.4* for information on Ramsar Convention) and other bird species of conservation concern and used to inform the ornithological assessment for the EIA as well as the HRA.

41 The intertidal and near-shore bird survey area extended for approximately six kilometres along the East Lothian coast from Prestonpans Sea Front at Ox Rocks (NT 38288 74532) to

the eastern end of Seton Sands (NT43301 76480) in order to cover the full area under investigation for potential cable landfall sites. Given the extent of this survey area it was segregated into five discrete count sectors (Sectors A-E, see Figure 15.1 and *Appendix 15C* for further details). Potential Offshore Export Cable Landfall options were subsequently identified by ICOL at Cockenzie and Seton Sands, which formed the focus of the report in *Appendix 15C*.

42 Although the largest numbers of birds were expected to be present during the non-breeding season (approximately September to March, covering the spring and autumn migration periods as well as the winter months), data were collected for the full year in order to cover the post-breeding period for Sandwich tern (one of the Firth of Forth SPA qualifying interests) and to provide confirmation of the periods when fewer birds were present.

43 Survey methods were based on the high tide (core count) methodology of the WeBS scheme (Musgrove *et al*., 2003 and Holt *et al*., 2012). Each sector extended out to 1.5 km from the MHWS mark. To identify the distribution of birds, the count sectors were segregated into three distance bands; 0 m - 500 m, 500 m - 1 km and 1 km - 1.5 km, and covered a range of tidal conditions. Full details of methodology are presented in *Appendix 15C*.

15.4.5 Information Gaps and Limitations

44 A full two year baseline boat-based bird survey programme was undertaken within the Boat-based Survey Area between September 2010 and September 2012. Temporal coverage was excellent, with only a single winter month missed during the programme – with complete coverage of the Development Area realised in 23 out of 24 surveys. Data were collected exclusively in good to moderate sea state conditions, COWRIE survey guidelines were adhered to in all aspects of the survey protocol and experienced ESAS surveyors were used on all surveys. Data analysis was undertaken to industry standard, using the latest guidance from statutory bodies (see *Appendix 15A*, *Section 15A.2*). It is therefore considered that the data collected for the offshore assessment fulfil the industry requirements and that there are no significant data limitations to the assessment.

45 Surveys of the intertidal and near-shore area in the vicinity of the Export Cable Landfall options were carried out to provide data in relation to potential impacts on estuarine birds in this area. A programme of 'through the tide' surveys was designed to capture the numbers and distribution of birds in the intertidal and near-shore area throughout the year and over the full tidal cycle. Surveys were carried out in suitable weather conditions (avoiding times of low visibility and heavy precipitation) and there were no data gaps due to prolonged adverse weather. As for the boat-based offshore surveys, the intertidal surveys are considered to fulfil the industry standard requirements with no limitations or data gaps in this respect.

46 Because of the limited scale of works required for the Offshore Export Cable Corridor (i.e. a small number of vessel movements), no specific surveys of this area were commissioned for the Offshore Export Cable Corridor between the Boat-based Survey Area (i.e. 4 km from the Development Area) and Near-shore Survey Area (i.e. 1.5 km from MHWS, covered by shore-

based surveys). The assessment for this section of the Offshore Export Cable Corridor makes use of data on the presence of birds from the desk study.

15.4.6 Impact Assessment

47 The approach to the assessment of ornithological impacts has drawn on published guidance on Environmental Impact Assessment in Scotland (SNH, 2009; Scottish Government, 1999), and also advice provided by SNH in discussions over the approach to impact assessment for offshore wind farms in the Forth and Tay area (see *Section 15.2*). During consultation, SNH advised against the use of matrices for impact assessment when they are used to replace, rather than guide, thinking (pers. comm., 2011) expressing a preference for a more descriptive approach to impact assessment as recommended by IEEM (2010).

48 The assessment considers the potential impacts of the Wind Farm and OfTW on Valued Ornithological Receptors (VORs) with the aim of identifying whether impacts are significant. The process consisted of the following steps:

- Identify VORs (bird species and nature conservation sites designated for birds) which are potentially sensitive to the impacts of the Project;
- Assess the sensitivity of VORs based on ornithological importance of the Development Area and the Offshore Export Cable Corridor for these receptors, their conservation status or status as a qualifying interest for a designated site (see Table 15.5);
- Based upon the worst case scenario as identified in the Design Envelope (see Tables 15.2 and 15.3), establish the magnitude of potential impacts on VORs quantitatively, or qualitatively where sufficient numeric data are not available (see Table 15.6);
- In determining impact significance for each VOR, consideration was given to the impact magnitude, VOR sensitivity and also to the ecological characteristics of each VOR, Embedded Mitigation, the spatial extent and likely duration of each impact as well as its timing, frequency and reversibility (as recommended by IEEM guidelines). Where possible, reference was made to available scientific information - from peer reviewed scientific papers, commissioned research reports relevant to seabird ecology and interactions with offshore wind farms, and other sources as appropriate. Where empirical evidence as to a magnitude of effect has not been available, the ecology of the species has been considered and appropriate conservative assumptions made. All such assumptions have been detailed within the assessments concerned, and all reference sources are cited and listed at the end of the chapter;
- Evaluate the significance of impacts based on the approach above taking account of Embedded Mitigation measures;
- Identify any Additional Mitigation measures which would avoid or reduce significant impacts; and,
- Assess residual impacts (post-mitigation).

49 The approach to the impact assessment is described in detail below.

Identifying Valuable Ornithological Receptors

50 As the Wind Farm and OfTW extend across a range of marine, estuarine and intertidal habitats, with the potential to affect different bird communities across different seasons, it is considered appropriate to identify VORs for specific Project elements, as opposed to for the Project as a whole, in order to account for differences in bird assemblages present within near-shore/intertidal areas and areas further offshore. Specifically, some bird species which were recorded in both the near-shore and boat-based surveys were allocated different sensitivity ratings because of potential differences in their sensitivities in the different environments (as a result of alternative habitat availability, seasonality, prey distribution etc.).

51 An overview of how VORs were identified for the different elements is provided below.

Development Area

52 For the EIA all seabird species recorded in the Boat-based Survey Area were considered as potential VORs either for the breeding or non-breeding season, or both where the species occurs year-round. Assessments for most species are provided separately for the breeding and non-breeding seasons. Where appropriate, for some species a post-breeding season is considered as well (see *Appendix 15A*, *Section 15A.2.2.1* for more information about the definition of seasonality).

53 Migratory species may pass through the Development Area in potentially large numbers over a short period of days or weeks, and may be missed if monthly boat surveys do not coincide with the migration window and/or if migratory movements tend to take place at night (or high altitude). Several sources of information were used to identify migratory bird species which may pass through the Development Area in significant numbers, in particular a report on migratory pathways for birds commissioned by the SOSS for the UK Offshore Wind Industry (Wright *et al*., 2012).

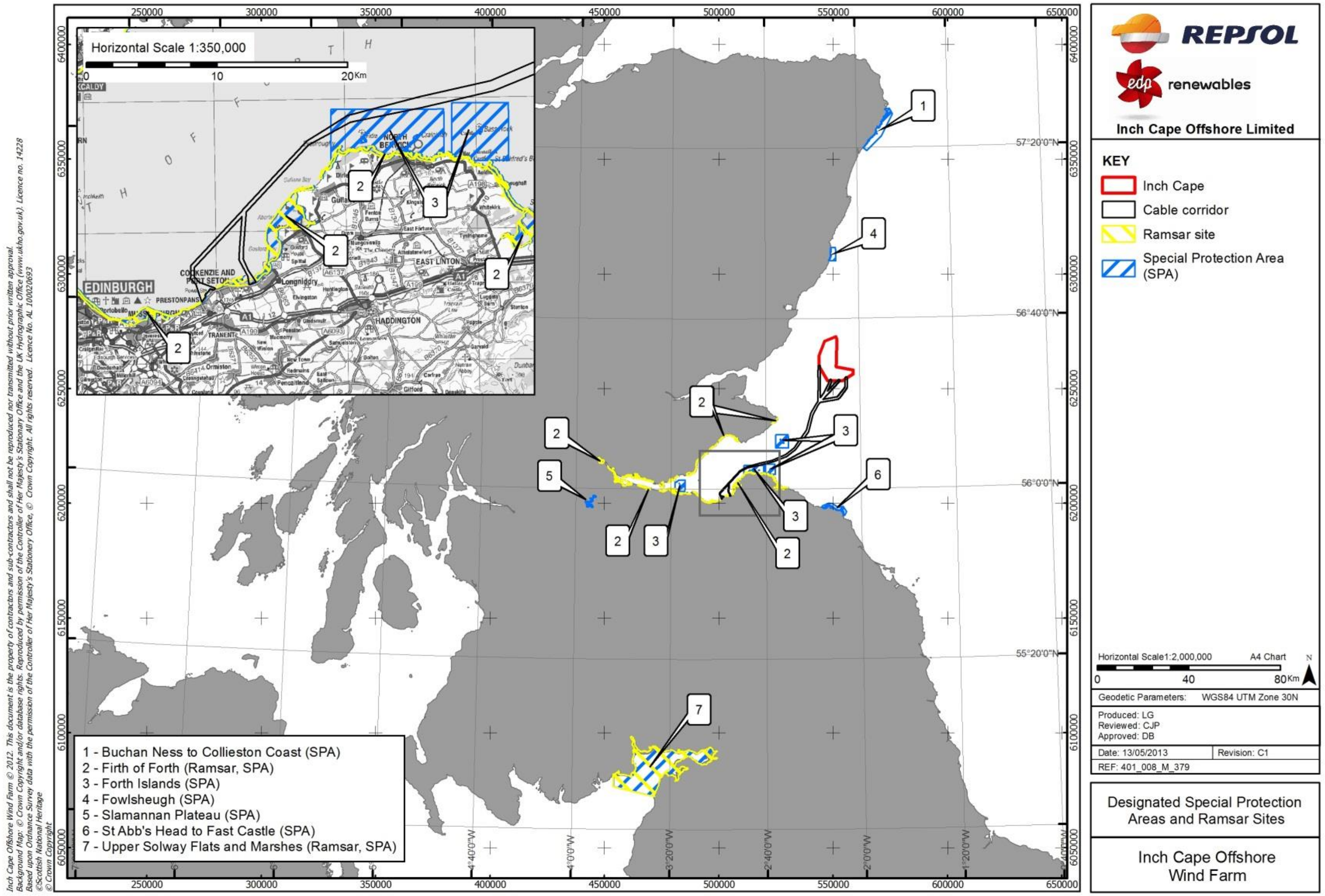
54 The Development Area does not physically overlap with any nature conservation sites designated for birds. There is potential connectivity with sites designated as SPAs for breeding seabirds, as birds nesting in these areas may forage within the Development Area and therefore there is potential for direct and indirect impacts on some SPA populations. Potential impacts on SPAs are considered in *Section 15.12* (HRA).

Offshore Export Cable Corridor – from the Development Area to Near-shore

55 For the EIA, all seabird species recorded in the Boat-based Survey Area (which partially overlaps with the Offshore Export Cable Corridor in the deeper waters of the Outer Forth) were considered VORs for the Offshore Export Cable Corridor. For the non-surveyed section of the corridor in the Inner Forth (see *Section 15.4.5*) various published sources were used to define the likely VORs present. In addition, because the Offshore Export Cable Corridor overlaps with foraging ranges of seabirds nesting within nearby SPAs, and for a small part of its length crosses part of the Forth Islands SPA (see Figure 15.2), these SPA species were considered VORs as well even where they had not been recorded during the boat-based

surveys. The potential impacts on SPAs from this part of the Offshore Export Cable Corridor specifically are considered in *Section 15.12*.

Figure 15.2: Designated Special Protection Areas and Ramsar Sites



Offshore Export Cable Corridor from Near-shore to Mean High Water Springs (Including Intertidal)

56 For the EIA, all bird species recorded during the near-shore surveys were considered as potential VORs.

57 Identified intertidal Offshore Export Cable Corridor landfall options at Cockenzie and Seton Sands both overlap with the Firth of Forth SPA, Ramsar site and SSSI, and so direct connectivity is likely for SPA qualifying interests that have been recorded there during baseline surveys. The potential impacts on this SPA from this part of the Offshore Export Cable Corridor are considered in *Section 15.12* (Information to inform the HRA for ornithology).

Defining the Sensitivity of VORs

58 The sensitivity of each potential VOR was defined according to a range of criteria. These included measures of the importance of the bird populations within the Boat-based Survey Area and the Offshore Export Cable Corridor, the conservation status of the species, whether a species is protected under environmental legislation, or is cited as an interest feature of a designated site of national or international importance. The sensitivities range from high to low, as presented in Table 15.5, below.

Table 15.5: Defining the Sensitivity of Valued Ornithological Receptors

Sensitivity	Definition
High	Bird species present in internationally important numbers, more than 1% of the relevant international/biogeographic population. Species which are cited as qualifying interests of SPAs (i.e. referred to in the SPA citations) with direct connectivity to the Development Area and the Offshore Export Cable Corridor during the breeding or non-breeding season[1], either as qualifying interests under Article 4.1, or as cited components of an assemblage under Article 4.2. Direct connectivity indicates that there is a degree of certainty that birds from the SPA in question use or pass through the Development Area and Offshore Export Cable Corridor. Bird species present in nationally important populations (more than 1% of the British population) of a species listed on Annex 1 of the EU *Birds Directive*. A site designated as an SPA or Ramsar site on the basis of supporting internationally important numbers of birds.
Moderate	Bird species not listed on Annex 1 of the EU *Birds Directive* that are present in nationally important numbers (more than 1% of the British population). Species populations of regional importance based on numbers estimated to be utilising the Development Area and Offshore Export Cable Corridor (more than 1% of the regional population) or distributional context (e.g. occurring at the edge of a species'

Sensitivity	Definition
	international or British range). Species which are cited as qualifying interests of UK SPAs (i.e. referred to in the SPA citations) with potential connectivity to the Development Area and Offshore Export Cable Corridor during the non-breeding season[1], either as qualifying interests under Article 4.1, or as cited components of an assemblage under Article 4.2. This category has been used for situations where a species which is a qualifying interest at a number of UK SPAs may pass through the Development Area and Offshore Export Cable Corridor on migration only, but there is only hypothetical connectivity between particular SPA(s) and birds recorded at the Development Area and Offshore Export Cable Corridor. Species cited as interest features of SSSIs with connectivity to the Development Area and Offshore Export Cable Corridor. Species listed on Annex 1 of the EU *Birds Directive* and/or Schedule 1 of the *Wildlife and Countryside Act 1981* (if not covered above). Red and Amber-listed Birds of Conservation Concern in the UK (Eaton *et al*., 2009), if not covered above. Priority Species of the UK or Local Biodiversity Action Plan (if not covered above).
Low	All other bird species.
1. SPA qualifying features have been identified as of high or moderate sensitivity respectively depending on whether there is evidence for direct connectivity to the Development Area or the Offshore Export Cable Corridor during the breeding or non-breeding season. It is recognised that the level of legal protection afforded to SPA species does not differ between the breeding or non-breeding season and it is understood that species which use an SPA for part of a year are subject to protection throughout the year, even when they are not using an SPA.	

59 Sources of international and national population estimates used for the bird species referred to in this chapter are given in *Appendix 15A*, *Section 15A.2.2*. SPA population estimates are described in *Section 15.12*.

60 Regional population estimates for seabird species during the breeding season were defined according to species-specific information on foraging ranges, such that species with larger potential foraging ranges have bigger regions and vice versa (see *Appendix 15A*, *Section 15A.2.3.2*). Similarly, connectivity between SPAs for breeding seabirds and the Development Area and Offshore Export Cable Corridor was identified based on foraging ranges - i.e. potential impacts on an SPA qualifying seabird species were considered if birds breeding at that SPA might forage within the Boat-based Survey Area, based on available information on their foraging ranges (Thaxter *et al*., 2012). Information on likely connectivity of VORs with SPAs is provided in the HRA Screening Report (see *Appendix 15B*, *Annex 15B.1*).

61 There are no published wintering population estimates for many seabird species for UK, British or International waters. Wintering population estimates for the North Sea and

regional populations were based on Skov *et al*. (1995), Stone *et al.* (1995), Forrester *et al.* (2007) and Wright *et al.* (2012) or other sources where relevant.

Assessing the Magnitude of Impacts

62 The magnitude of each potential impact on a VOR was assessed by adopting a population-based approach according to the criteria in Table 15.6 below.

Table 15.6: Assessing the Magnitude of a Potential Impact on Valued Ornithological Receptors

Magnitude	Definition
High	Total loss or major alteration to key elements/features of the baseline conditions. Where a quantitative assessment can be made, a prediction that >1% of the population is affected; or >1% change in demographic rate.
Moderate	Partial loss or alteration to one or more key elements/features of the baseline conditions. Where a quantitative assessment can be made, a prediction that 0.5% – 1% of the population affected; or 0.5% – 1% change in demographic rate.
Low	Minor shift away from the baseline conditions. Prediction that 0.1% – 0.49% of the population affected; or 0.1% – 0.49% change in demographic rate.
Negligible	Very slight change from baseline conditions. Prediction that <0.1% of the population affected; or <0.1% change in demographic rate.

63 Where quantitative assessments were possible (in terms of the number of individuals of a species affected, or predicted changes to mortality rate or breeding success), the relevant population comparison level was assessed on a species by species and species by impact basis. In some cases this was achieved by considering the number of individuals likely to be affected as a percentage of the national or regional population or the population of a designated site (taking a hierarchical approach whereby the highest level of sensitivity appropriate to the Development Area and Offshore Export Cable Corridor was used). Where an impact was considered likely to affect the survival of individuals (e.g. collision risk), or the productivity of breeding attempts (e.g. displacement), the predicted change in mortality or productivity was assessed against available information on the background mortality or productivity rate of a species.

64 A precautionary approach has been taken to setting thresholds, reflecting the fact that many of the seabird and estuarine species present at the Development Area and Offshore Export Cable Corridor are qualifying species of SPAs and therefore are considered as internationally important receptors. Thus a one per cent threshold has been used to identify potential

impacts of high magnitude. Although there is no fundamental biological reason for this, one per cent is used as a 'rule of thumb' in relation to the identification of important concentrations of birds, for example in identifying areas for site protection (e.g. JNCC, 2012a; BTO, 2012).

65 In relation to demographic parameters such as mortality, it is recognised that changes of one per cent or less may actually not be detectable as one percent will fall within the likely errors of estimates for the values concerned or within fluctuations caused by natural variation. Nevertheless, it is possible that the actual consequence of varying a demographic parameter such as mortality by one per cent might affect the population growth rate of a species, so on a precautionary basis this level has been set to flag up potentially significant impacts where further detailed assessment is required.

Determining the Significance of Impacts

66 In determining the significance of the impacts, the following was taken into account: VOR sensitivity (Table 15.5), impact magnitude (Table 15.6) and IEEM (2010) recommendations that each impact is evaluated according to the parameters below:

- Whether it is negative or positive;
- The spatial extent or area over which it is likely to occur;
- The likely duration;
- Whether it is reversible or not;
- The timing and frequency; and
- The degree of confidence in predictions.

67 Based on a detailed review using the criteria above, four categories (or combinations of categories such as moderate/major where insufficient information was available to confidently define a single impact significance category) were applied to evaluate impacts, based on the definitions shown in Table 15.7 below.

Table 15.7: Criteria for Defining Impacts Based on Further Evaluation

Impact Evaluation	Rationale
Negligible	An impact that is considered likely to produce no effects, or effects well within the limits of natural variation for a VOR.
Minor	An impact that may result in changes, but these will be small in scale, temporary and within 'acceptable' limits, for example where an adverse change in population growth rate is small, temporary or not considered likely.
Moderate	An impact that will be measureable in the medium term and over a broad scale but will be reversible. It is likely to have a measurable effect on wider ecosystem functioning but still remain within 'acceptable' limits.

Impact Evaluation	Rationale
Major	An impact that will be measureable in the medium to long term and where changes may be outside acceptable limits – for example leading to a permanent population decline at a regional or larger scale.

68 Where possible consideration was given to the likely ability of individual species populations to absorb impacts, which depends on factors such as demographics (whether a species has high or low adult survival and productivity levels) and population trend. Seabirds, for example, are typically long-lived species with low annual productivity, and population trends are more sensitive to changes in adult survival than breeding success or juvenile survival. Thus, a predicted increase of more than one per cent in the mortality rate of breeding adults may be more likely to have an adverse impact on a population than a one per cent increase in breeding failure rate. For a few seabird species (kittiwake, razorbill, puffin and guillemot) where predicted impacts were considered to have the potential to adversely affect population growth rates through increases in mortality and/or breeding failure, population models were developed (see *Appendix 15B*). These models explored the impacts of mortality and productivity in terms of the probability of change in population growth rate and the likelihood of population decline, and the outputs have been used in the assessments of significance. For gannet, reference is made to recent population modelling commissioned by SOSS (WWT Consulting, 2012). For the purposes of this assessment, those residual positive and negative effects indicated as Major and Moderate/Major are considered significant.

<u>**Dealing with Uncertainty in Impact Assessment**</u>

69 In order to address the issue of uncertainty, this assessment incorporates a series of conservative assumptions about the Design Envelope (see Tables 15.2 and 15.3) as well as the potential magnitude of impacts of the Project on ornithological receptors. Where possible, impact magnitude is assigned based on scientific research and available information on the population status. Where this empirical evidence has not been available, the ecology of the species has been considered and appropriate conservative assumptions made. The list below provides details of these conservative assumptions and why they are considered to be appropriately conservative. It is considered that as a consequence of these conservative assumptions, confidence that 'likely impacts' (the definition for the likelihood of a defined outcome having occurred or occurring in the future, as defined by the Intergovernmental Panel on Climate Change (IPCC)) are within the ranges predicted by the models used is 'high' or 'very high' (quantitatively calibrated levels of confidence used in this assessment as defined by the IPCC) for the assessment undertaken to inform the EIA and HRA.

- Disturbance during all project phases (see *Sections 15.6 to 15.9*): disturbance effects on seabirds up to around 0.5 km around vessels, disturbance of species in near-shore and intertidal habitats up to 2 km. This assessment is based on the species most sensitive to disturbance and considers worst case effects for those species from published sources.

E.g. a distance of 0.5 km has been assessed for auks although they are considered to flush from vessels at worst up to several hundred metres (Furness and Wade, 2012);

- Indirect effects on bird species via prey species (see Tables 15.12 and 15.13 and associated text): reduced abundance of prey species during construction as a result of piling activities across the entire spatial extent of the modelled fish prey avoidance areas. These avoidance areas are based on the worst case scenario of two piling events within the Development Area (or per site in the Forth and Tay area, in case of the cumulative assessment) taking place simultaneously, with the proportional overlap of these areas with a species' foraging range considered to constitute total (temporary) loss of prey species. In reality this is particularly conservative as many wide ranging seabird species are adapted to exploiting patchily distributed and temporary aggregations of prey, and any redistribution of fish prey species is unlikely to represent total loss of a foraging range;
- Displacement during operation (see Tables 15.14 and associated text): conservative assumptions included disturbance up to 2 km from the Development Area; the choice of the proportion of birds displaced and the resulting reduction in breeding success (each displaced bird represents breeding failure of a breeding pair). For example for razorbill, available evidence indicated that total displacement is very unlikely and that the lowest recorded displacement estimate is 30 per cent. The latter value was based on a single year of post-construction monitoring and does not therefore reflect inter-annual variation. Given the species' importance as a receptor (qualifying feature of the Forth Islands, Fowlsheugh and St Abb's Head to Fast Castle SPAs) a more conservative displacement scenario of 50 per cent was used in the assessment instead to ensure that effects were not underestimated; and

  Collision risk (see Table 15.15 and associated text): use of precautionary avoidance rates for seabirds and migratory species (98 and 99 per cent); use of conservative assumptions of the proportion of migratory birds flying at risk height. For example, for migratory geese species it has been assumed that 75 per cent of all birds passing through the Wind Farm fly at collision risk height. In reality this is likely to be an over-estimate, with geese on average tending to fly above collision risk height.

15.5 Baseline Environment

15.5.1 Development Area

70 Information from the desk study and boat survey data indicate that the Boat-based Survey Area - which includes the Development Area and a 4 km buffer - is used as a foraging and resting/roosting area for seabirds throughout the year, but particularly during the breeding season (which falls within the period April to September for most seabird species, (see *Appendix 15A*, Table 15A.3)). During this time of year, the Boat-based Survey Area lies within the foraging range of a number of breeding colonies of seabirds on the east coast of Scotland, including several internationally important sites classified as SPAs for breeding colonies of seabirds. Adult seabirds with active nests are likely to be constrained in the distances that they can travel to forage, as they need to acquire sufficient energy to meet

their own needs as well as the requirements of incubating eggs and feeding nestlings. Immediately after the breeding season, aggregations of post-breeding birds were recorded, including guillemot, razorbill and kittiwake. Outside the breeding season the Boat-based Survey Area is also used for foraging and resting/roosting by seabirds, although at this time of year birds can potentially range and forage over large offshore areas, and individuals of many species present during the breeding season will migrate to wintering areas elsewhere in the North Sea, Atlantic Ocean or Mediterranean Sea.

71 Boat-based surveys covering the Development Area and a 4 km buffer (Figure 15.1 and *Appendix 15A*, Figure 15.A.1.1,) were conducted between September 2010 and September 2012. These data and analysis methods are described in detail in *Appendix 15A*.

<u>Identification of Bird Species to be Included in the Assessment (VORs)</u>

72 A list of bird species in the Boat-based Survey Area is included in Table 15.8 below. This includes all seabird species which were recorded in boat surveys, and migratory waterfowl species (geese, ducks and wading birds) which were recorded infrequently, or not at all, but were considered likely to be under-recorded in boat surveys. Other bird species recorded infrequently in boat surveys – mainly passerines - are included in Table 15.8 as a species group. Species which are scoped into the ornithological assessment are identified in Table 15.8.

73 Species scoped in for consideration were those recorded in the Boat-based Survey Area with the potential to be affected directly or indirectly by the Project. A range of factors were taken into account for this scoping, including the species' sensitivity (Table 15.5), frequency of occurrence, and the importance of the number of birds present.

74 Note the species which have been scoped out include Sandwich tern which was recorded on only one occasion during the boat surveys. Particular note is made of this as Sandwich tern is a qualifying species of the Forth Islands SPA. However, breeding numbers have declined from 440 pairs (*c.* 1987) cited at classification to few or no pairs each year since 2006 (Lewis *et al*., 2012). These declines coincided with low numbers elsewhere in the southeast of Scotland and increased numbers in northeast Scotland, suggesting there may have been a shift in the population's distribution (SNH, 2004). SNH indicated, in their advice on the HRA screening report (pers. comm., 2012b) (see *Section 15.2*), that although this species was screened out in relation to Likely Significant Effect (LSE) for the Firth of Forth SPA, the EIA should consider impacts on this species because it could return to breed at the Forth Islands in the future.

75 The Development Area lies within the mean maximum foraging range of Sandwich tern (40 km, Thaxter *et al*., 2012) from the Isle of May, a former breeding site for the species. So it is possible that if the species returned to nest on the Isle of May, some breeding birds might travel as far as the Development Area. However, like other terns, Sandwich terns forage mainly in coastal waters, usually within a few kilometres of shore (BirdLife International, 2012). Thus the Development Area is not considered likely to provide an important foraging area for the species during the breeding season, should Sandwich terns return to nest in the

Forth Islands. There is a regular post-breeding aggregation of Sandwich terns in the Firth of Forth and the species is a qualifying feature of the Firth of Forth SPA during the passage period. However, even with the occurrence of these birds in the wider Firth of Forth, no Sandwich terns were recorded during the two years' boat surveys at the Boat-based Survey Area during the post-breeding passage period (a single bird was recorded in May 2012, Table 15.8). This evidence indicates the Development Area is not important for the species during this time of year and consequently on the basis of the above, the species has been scoped out of the EIA.

Table 15.8: Bird Species Recorded during Boat-based Surveys and Identification of Valued Ornithological Receptors for the Boat-based Survey Area

Bird species	Summary of Recorded Presence (See *Appendix 15A, Annex 15A.2* for details)	Sensitivity[1]	Scoped in or out of Assessment	Rationale
Taiga bean goose*	Not recorded in any surveys but included in assessment on the basis that migrating birds from the single UK SPA for this species may fly through the Development Area.	High	In	Connectivity with SPAs. Any birds passing through the Boat-based Survey Area are assumed to derive from the Slamannan Plateau SPA.
Pink-footed goose*	Migrating birds recorded on three boat surveys (84 individuals; winter).	Moderate	In	Potential connectivity with SPA.
Svalbard Barnacle Goose*	Migrating flocks recorded in two boat surveys (74 individuals within Boat-based Survey Area; autumn and spring passage).	High	In	Connectivity with SPAs. Any birds passing through the Boat-based Survey Area are assumed to derive from the Upper Solway Flats and Marshes SPA.
Shelduck*	Recorded on a single boat survey (one individual; winter).	Moderate	In	Potential connectivity with SPAs.
Tufted duck*	Recorded on a single boat survey outwith Boat-based Survey Area (two individuals; May).	Moderate	In	Potential connectivity with SPA.
Eider	Recorded twice on boat surveys (five individuals; April, November).	High	Out	Very small numbers recorded in relation to the UK population, potential connectivity to SPAs likely to be very low.
Long-tailed duck*	Recorded on two boat surveys (three individuals; winter).	Moderate	In	Potential connectivity with SPAs.
Common Scoter*	Recorded twice on boat surveys (three individuals; winter, summer).	Moderate	In	Potential connectivity with SPAs.

Bird species	Summary of Recorded Presence (See *Appendix 15A*, *Annex 15A.2* for details)	Sensitivity[1]	Scoped in or out of Assessment	Rationale
Goldeneye*	Recorded on a single boat survey outwith Boat-based Survey Area (two individuals; April).	Moderate	In	Potential connectivity with SPAs.
Red-throated diver	Recorded on three out of 24 surveys (six individuals in flight, autumn, winter).	High	Out	Very small numbers recorded in relation to the UK population. Connectivity to SPAs unlikely as species prefers inshore coastal habitats.
Great northern diver	Recorded on two out of 24 surveys (two individuals, winter).	Moderate	Out	Small numbers recorded in relation to the UK population. Not a qualifying feature of any UK SPAs.
Fulmar	Recorded on 23 out of 24 boat surveys. Amongst the ten most numerous species.	High	In	Cited as an SPA qualifying interest for SPAs within foraging range. SPAs: Forth Islands, Fowlsheugh, and Buchan Ness to Collieston Coast.
Sooty shearwater	Recorded on seven out of 24 boat surveys between August and October (97 individuals).	Moderate	Out	Occurs in the UK on passage only. No UK SPAs. Low numbers (not exceeding nationally or regionally important number) present in the Boat-based Study Area.
Manx shearwater	Recorded on 14 out of 24 boat surveys (150 individuals; mainly between June and October.	Moderate	Out	Small numbers recorded in relation to the UK population. Connectivity to SPAs unlikely.
Storm petrel	Recorded on four out of 24 surveys (nine individuals; June-July and September-October).	Moderate	Out	Small numbers recorded in relation to the UK population. Connectivity to SPAs unlikely.

Bird species	Summary of Recorded Presence (See *Appendix 15A, Annex 15A.2* for details)	Sensitivity[1]	Scoped in or out of Assessment	Rationale
Gannet	Recorded in all 24 boat surveys. Amongst the ten most numerous species.	High	In	Cited as an SPA qualifying interest of SPAs within foraging range. SPAs: Forth Islands (Bass Rock).
Shag	Recorded on seven boat surveys (25 individuals in 4 km buffer zone, in winter and spring/summer).	Moderate	In	Amber listed. Potential connectivity with UK SPAs.
Grey heron	Recorded on a single boat survey (one individual; September).	Low	Out	Very small numbers recorded, not a species of conservation concern. No UK SPAs.
Peregrine	Recorded on a single boat survey (one individual; September).	Moderate	Out	Very small numbers recorded, likely to occur on passage only.
Oystercatcher*	Recorded on a single boat survey (20 individuals, August).	Moderate	In	Potential connectivity with SPAs.
Golden plover*	Recorded on a single boat survey (two individuals; November).	Moderate	In	Potential connectivity with SPAs.
Ringed plover*	Recorded on two boat surveys (two individuals; winter).	Moderate	In	Potential connectivity with SPAs.
Curlew*	Recorded on a single boat survey (three individuals; June)	Moderate	In	Potential connectivity with SPAs.
Knot*	Recorded on a single boat survey (three individuals; July).	Moderate	In	Potential connectivity with SPAs.
Dunlin*	Recorded on a single boat survey (five individuals; August).	Moderate	In	Potential connectivity with SPAs.

Bird species	Summary of Recorded Presence (See *Appendix 15A*, *Annex 15A.2* for details)	Sensitivity[1]	Scoped in or out of Assessment	Rationale
Purple sandpiper*	Recorded on a single boat survey (one individual; November).	Moderate	In	Potential connectivity with SPAs.
Grey phalarope*	Recorded on four boat surveys between September to November (18 individuals).	Moderate	In	Recorded in nationally important numbers.
Pomarine Skua	Recorded during four boat surveys (24 individuals; October to December).	Low	Out	UK Green listed species (not of conservation concern); small numbers recorded, Occurs in the UK on passage only. No UK SPAs.
Arctic skua	Recorded on eight boat surveys (23 individuals; July to November).	Moderate	In	UK Red listed, UK BAP priority. Potential connectivity with SPAs.
Great Skua	Recorded during 11 boat surveys (39 individuals; June to December).	Moderate	In	UK Amber listed. Potential connectivity with SPAs.
Puffin	Recorded on 23 out of 24 boat surveys. Amongst the ten most numerous species.	High	In	Cited as an SPA qualifying interest of SPAs within foraging range. SPA: Forth Islands.
Black guillemot	Recorded on a single survey (one individual, January).	Moderate	Out	Very small numbers recorded in relation to the UK population. Not an Annex 1 or migratory species. Not a qualifying feature of any SPAs.
Razorbill	Recorded in all 24 boat surveys. Amongst the ten most numerous species.	High	In	Cited as an SPA qualifying interest of SPAs within foraging range. SPAs: Forth Islands, Fowlsheugh, St Abb's Head to Fast Castle.

Bird species	Summary of Recorded Presence (See *Appendix 15A*, *Annex 15A.2* for details)	Sensitivity[1]	Scoped in or out of Assessment	Rationale
Little auk	Recorded on seven out of 24 boat surveys (809 individuals between November and February).	Low	Out	Green listed species. Occurs irregularly in British waters during the winter only. No SPAs. Amongst the ten most numerous species but only present in the Boat-based Study Area between November and February. Although large numbers were recorded in the winter of 2011/2012 the population estimate represents less than 0.01% of the estimated North Sea winter population.
Guillemot	Recorded in all 24 boat surveys. Amongst the ten most numerous species.	High	In	Cited as an SPA qualifying interest of SPAs within foraging range. SPAs: Forth Islands, Fowlsheugh, St Abb's Head to Fast Castle and Buchan Ness to Collieston.
Sandwich tern	Recorded on a single boat survey (one individual, May).	High	Out	Cited as an SPA qualifying interest for the Forth Islands but has not been recorded breeding within the SPA in recent years.
Common tern	Recorded during three boat surveys (13 individuals; September, June-July).	High	In	Cited as an SPA qualifying interest of SPAs within foraging range. SPA: Forth Islands.
Arctic tern	Recorded during six boat surveys between May and September. Amongst the ten most numerous species.	High	In	Cited as an SPA qualifying interest of SPAs within foraging range. SPA: Forth Islands.

Bird species	Summary of Recorded Presence (See *Appendix 15A, Annex 15A.2* for details)	Sensitivity[1]	Scoped in or out of Assessment	Rationale
Kittiwake	Recorded on all 24 boat surveys, highest numbers in June and July. Amongst the ten most numerous species.	High	In	Cited as an SPA qualifying interest of SPAs within foraging range. SPAs: Forth islands, Fowlsheugh, St Abb's Head to Fast Castle and Buchan Ness to Collieston Coast.
Little gull	Recorded on ten boat surveys, (175 individuals; mainly between July and September).	High	In	Annex 1 species present in potentially national important numbers.
Common gull	Recorded on 16 boat surveys (85 individuals; mainly in winter).	Moderate	In	Potential connectivity with SPAs.
Lesser black-backed gull	Recorded on 11 out of 24 boat surveys (51 individuals; April to September).	High	In	Cited as an SPA qualifying interest of SPAs within foraging range. SPA: Forth Islands.
Herring gull	Recorded on 18 out of 24 boat surveys (302 individuals; highest numbers in the winter.	High	In	Cited as an SPA qualifying interest of SPAs within foraging range. SPAs: Forth Islands, Fowlsheugh, St Abb's Head to Fast Castle, Buchan Ness to Collieston Coast.
Great black-backed gull	Recorded on 20 out of 24 boat surveys (260 individuals; predominantly in winter).	Moderate	In	Potential connectivity with SPAs.
Passerines	Recorded on nine out of 24 surveys from April to November.	Low	Out	Common species occurring along broad front during migration. No SPAs in the UK for any species involved.

Bird species	Summary of Recorded Presence (See *Appendix 15A*, *Annex 15A.2* for details)	Sensitivity[1]	Scoped in or out of Assessment	Rationale

1. As defined in Table 15.5. Where a species is identified as high sensitivity based on its status as an SPA qualifying species, SPA(s) where a likely significant effect has been identified during the breeding season as a result of the HRA screening process (ICOL, 2012) are listed. For herring gull one additional site, Buchan Ness to Collieston Coast SPA, has been added based on SNH advice on the HRA Scoping report (SNH, 2012). These SPAs have been provided for information only at this time, with more detailed assessments provided in *Section 15.12*.

*Species which may migrate through the Boat-based Survey Area (Development Area and 4.0 km buffer) scoped in for potential collision risk and barrier effect only.

15.5.2 Offshore Export Cable Corridor

76 The Offshore Export Cable Corridor runs through deep waters (>50 m) between the Development Area and the mouth of the Firth of Forth and the Rath Grounds between the Isle of May and North Berwick (50 m - 20 m depth (see Figure 7.1)). Desk study data indicate that these areas support concentrations of seabirds, particularly in the breeding season, with the numbers and densities of species present likely to vary with factors such as water depth and proximity to nesting colonies. The Offshore Export Cable Corridor then enters the shallower waters (20 m - 5 m) of the south Channel of the Firth of Forth. Here again, seabirds are likely to be present in large numbers, particularly in the breeding season and close to nesting colonies. In addition, these shallower inshore waters support a range of seaduck, divers and grebes, especially in the non-breeding season. Many of these species are classified features of the Firth of Forth SPA. The final section of the Offshore Export Cable Corridor passes through the intertidal area of the Firth of Forth with landfall options at Cockenzie and Seton Sands, passing through the Firth of Forth SPA, Ramsar site and SSSI. This shoreline contains a variety of coastal and estuarine habitats which attract large numbers, and a wide variety, of over-winter and passage wetland birds (waders and waterfowl) to the area.

77 Because of the limited scale of works required for the Offshore Export Cable (i.e. a small number of vessel movements), no specific surveys of this area were commissioned for the Offshore Export Cable Corridor between the Boat-based Survey Area (i.e. beyond 4 km from the Development Area) and the near-shore (i.e. 1.5 km from MHWS). The assessment for this part of the Offshore Export Cable Corridor makes use of published data sources on the presence of birds as collated by the desk study.

78 Comprehensive surveys of the intertidal and near-shore area were carried out between January 2012 and January 2013 inclusive. The results from these surveys are presented in detail in *Appendix 15C*.

<u>Identification of Bird Species to be Included in the Assessment (VORs)</u>

79 The list of VORs identified above for the Boat-based Survey Area individually (Table 15.8), is considered to apply to the section of the Offshore Export Cable Corridor between the survey area and near-shore as well, due to the similarities of both areas in terms of habitat and bird communities present.

80 A different assemblage of bird species emerges between the near-shore and MHWS. Table 15.9 lists the species recorded during intertidal and near-shore bird surveys as well as species recorded from WeBS counts, and identifies the species which have been scoped in for assessment.

81 Species scoped in for consideration were those recorded in the Near-shore Survey Area with the potential to be affected directly or indirectly by the Project. A range of factors were taken into account for this scoping, including the species' sensitivity (Table 15.5), frequency of occurrence, and the importance of the number of birds present.

82 Note that some bird species which were recorded in both the near-shore/intertidal and boat-based surveys have been allocated different sensitivity ratings for the Development Area and the Offshore Export Cable Corridor. As highlighted above, this is because of differences in ornithological importance of these areas, species' habitat preferences or seasonal occurrence of species.

Table 15.9: Bird Species Recorded During Near-shore Surveys (including Intertidal) and Identification of Valued Ornithological Receptors

Bird species	Recorded Presence	Sensitivity	Scoped in or out of Assessment	Rationale
Mute swan	Occasionally recorded pairs/single birds. Absent from the Nearshore Survey Area- Sector A.	Low	Out	Small numbers recorded in relation to the UK population, no UK SPAs.
Shelduck	Absent during the nearshore surveys and a peak of only four birds in the Port Seton to Craigielaw WeBS Sector (Nearshore Survey Area- Sector E) in April (0.1% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Wigeon	Present only in sector E during the nearshore surveys with a peak of 66 birds in February (2.9% of SPA pop.). Peak of 107 birds recorded in the Port Seton to Craigielaw WeBS Sector (Nearshore Survey Area- Sector E) in October (4.8% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Mallard	Absent from all nearshore surveys and only present in the Port Seton to Craigielaw WeBS Sector (Nearshore Survey Area-Sector E), with a peak count of 26 birds in December (2.2% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Eider	Found throughout year in all nearshore survey count sectors with largest counts in August in Sector E (425 birds, 7.2% of SPA pop.). Similar peak count of 452 in the wider Port Seton to Craigielaw WeBS Sector (Nearshore Survey Area-Sector E) in July (7.6% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Long-tailed duck	Peak counts generally recorded in March-April, with 17 birds recorded in Sector E (7.7% of SPA pop.). Corresponding Port Seton to Craigielaw WeBS Sector (Nearshore Survey Area-Sector E) held a peak of 29 birds (13.2% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Common scoter	Mainly found in winter, but peak count of 70 birds in survey Sector E in May (2.5% of SPA pop.). WeBS peak of 196 birds in April in the Port Seton to Craigielaw WeBS Sector (Nearshore Survey Area-Sector E) (7.0% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.

Bird species	Recorded Presence	Sensitivity	Scoped in or out of Assessment	Rationale
Velvet scoter	Present in all nearshore survey sectors with peaks in March and May. Up to 121 birds, which equals 13.0% of SPA pop. A peak of 161 birds recorded in the Port Seton to Craigielaw WeBS Sector (Nearshore Survey Area-Sector E) in September (17.3% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Goldeneye	Peak counts in January in Sector A (20 birds, 1.5% of SPA pop.). Up to 34 birds in the wider Preston Grange to Port Seton Count Sector (Nearshore Survey Area-Sectors A and B) (2.5% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Red-breasted merganser	Found throughout winter and migratory periods with peak count of 28 birds in survey Sector E in December (8.1% of SPA pop.). Peak of 101 birds recorded in the corresponding Port Seton to Craigielaw WeBS Sector (Nearshore Survey Area--Sector E) in September (29.1% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Red-throated diver	Recorded in peak numbers during autumn, with highest counts of 13 birds in the Preston Grange to Port Seton WeBS Sector (Nearshore Survey Area-Sectors A and B) in November (12.7% of SPA pop.). Peak of six birds in survey sector E in Sep (5.9% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Black-throated diver	Single record in September in Nearshore Survey Area-Sector E.	Moderate	Out	Small number recorded in relation to the UK population, no likely connectivity to SPA populations.
Fulmar	Single records in Nearshore Survey Area- Sectors B and E.	Moderate	Out	Small numbers recorded in relation to the UK population, no significant connectivity to SPA populations.
Gannet	Present during breeding season, with peak of 49 birds in Nearshore Survey Area- Sector E.	High	In	Cited as an SPA qualifying interest in the breeding season for SPAs within foraging range. SPAs: Forth Islands (Bass Rock).

Bird species	Recorded Presence	Sensitivity	Scoped in or out of Assessment	Rationale
Cormorant	Recorded throughout the year, with a peak of 18 birds within Nearshore Survey Area-Sector B in July (2.8% of SPA pop.). WeBS count peak of 72 in the Preston Grange to Port Seton Count Sector (Sectors A and B) in September (11.0% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Shag	Recorded throughout the year with a peak of 30 birds in October, in Nearshore Survey Area-Sector B.	Moderate	In	Potential connectivity with UK SPA populations.
Little grebe	Single birds recorded in Nearshore Survey Area- Sectors A and B.	Moderate	Out	Small numbers recorded in relation to the UK population, no significant connectivity to SPA populations.
Great crested grebe	Low numbers recorded during the nearshore surveys (peak of two birds recorded in Nearshore Survey Area- Sector B in September (1.4% of SPA pop.)). Up to 24 birds recorded in the wider Preston Grange to Port Seton Count Sector (Nearshore Survey Area-Sectors A and B) in September (17.3% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Red-necked grebe	Recorded in Nearshore Survey Area-Sector E mainly during autumn passage, with a peak of 12 birds in August.	High	In	Potentially significant peak numbers in relation to small UK wintering population (57 birds, Musgrove *et al*., 2013).
Slavonian grebe	Recorded during autumn and winter months in the Port Seton to Craigielaw WeBS Sector only (Nearshore Survey Area-Sector E), with a peak count of 12 in February (41.0% of SPA pop.). Found in small numbers during autumn/winter with a peak of two birds in all survey sectors (6.9% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Oystercatcher	Recorded in all Nearshore Survey Area-Sectors with peak of 42 birds in Sector E in March (0.5% of SPA pop.). Much higher peak of 388 birds in the wider Port Seton to Craigielaw WeBS Sector (Nearshore Survey Area-Sector E) in December (4.7% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.

Bird species	Recorded Presence	Sensitivity	Scoped in or out of Assessment	Rationale
Golden plover	Recorded mainly during passage and winter, particularly in the Port Seton to Craigielaw WeBS Sector (Nearshore Survey Area-Sector E), with a peak count of 192 in August (5.4% of SPA pop.). Max. count of four birds in Sector E in January (0.1% of SPA pop.) but absent in others.	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Grey plover	Peak of three birds in Sector E in November (0.6% of SPA pop.) and absent in other sectors. Peak WeBS count of 70 birds in the Port Seton to Craigielaw WeBS Sector (Nearshore Survey Area-Sector E) in April (14.9% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Lapwing	Absent from the nearshore surveys and only recorded in the Port Seton to Craigielaw WeBS Sector (Nearshore Survey Area-Sector E), with peak of 171 birds in September (3.1% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Ringed plover	Absent from all nearshore surveys but with a peak of 26 birds in the Port Seton to Craigielaw WeBS Sector (Nearshore Survey Area-Sector E) in January (2.4% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Curlew	Recorded in low numbers in Nearshore Survey Area Sectors (peak of seven birds in Sector E in March, 0.2% of SPA pop.). Higher numbers in the Port Seton to Craigielaw WeBS Sector (Sector E) in July (124 birds, 2.7% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Bar-tailed godwit	Recorded during winter, particularly in the Port Seton to Craigielaw WeBS Sector (Nearshore Survey Area-Sector E), with a peak count of 211 in February (14.0% of SPA pop.). Max. count of 18 birds in Sector E in February (1.2% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.

Bird species	Recorded Presence	Sensitivity	Scoped in or out of Assessment	Rationale
Turnstone	Found throughout winter with peak counts in autumn/winter. Peak of 22 birds in Sector E in December (2.4% of SPA pop.), and peak of 87 birds in the Port Seton to Craigielaw WeBS Sector (Nearshore Survey Area-Sector E) in January (9.3% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Knot	Present throughout winter but peak count in the Port Seton to Craigielaw WeBS Sector (Nearshore Survey Area-Sector E) of 135 birds in April (3.3% of SPA pop.). Absent from nearshore surveys.	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Dunlin	Absent from nearshore surveys and relatively low numbers during WeBS counts. Peak of 16 birds (0.2% of SPA pop.) in August and October in the Port Seton to Craigielaw WeBS Sector (Nearshore Survey Area-Sector E).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Purple sandpiper	Three birds recorded on two occasions in Nearshore Survey Area-Sector A.	Moderate	Out	Small numbers recorded in relation to the UK population, no significant connectivity to SPA populations.
Redshank	Found in all survey sectors with a peak of 13 birds in December (0.3% of SPA pop.). WeBS count peak of 121 birds in the Port Seton to Craigielaw Count Sector (Nearshore Survey Area-Sector E) in September (2.4% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Puffin	Occasionally recorded with peak of eight birds in May, in Nearshore Survey Area-Sector B.	Moderate	Out	Small numbers recorded in relation to the UK population, no significant connectivity to SPA populations.
Razorbill	Highest numbers recorded during post-breeding period with peak of 416 birds in August within Nearshore Survey Area-Sector B.	High	In	Cited as an SPA qualifying interest in the breeding season for SPAs within foraging range and post-breeding dispersal. SPAs: Forth Islands may be particularly sensitive during post-breeding moult/young rearing.

Bird species	Recorded Presence	Sensitivity	Scoped in or out of Assessment	Rationale
Guillemot	Highest numbers recorded during post-breeding period with peak of 414 birds in August within Nearshore Survey Area-Sector B.	High	In	Cited as an SPA qualifying interest in the breeding season for SPAs within foraging range and post-breeding dispersal. SPAs: Forth Islands.
Sandwich tern	Present in summer/autumn with peak of 41 birds in the Port Seton to Craigielaw WeBS Sector (Nearshore Survey Area-Sector E) in May (4.0% of SPA pop.). Peak count of 38 birds in Sector E in same month (3.7% of SPA pop.).	High	In	Cited as a qualifying interest of Firth of Forth SPA.
Common tern	Sporadically recorded in low numbers with peak of 10 birds in Nearshore Survey Area-Sector E in August.	High	In	Cited as an SPA qualifying interest in the breeding season for SPAs within foraging range/post-breeding dispersal. SPAs: Imperial Dock Lock, Leith; Forth Islands.
Kittiwake	Occasionally recorded with peak of 18 birds in August in Nearshore Survey Area-Sector B. Absent from Sector E.	Moderate	Out	Small numbers recorded in relation to the UK population, no significant connectivity to SPA populations.
Black-headed gull	Present in most months during winter. Peak of 127 birds in Nearshore Survey Area-Sector E in February.	Moderate	Out	Small numbers recorded in relation to the UK population, no likely connectivity to SPA populations.
Common gull	Recorded in all Nearshore Survey Area-Sectors, with a peak of 118 birds in August in Sector B.	Moderate	Out	Small numbers recorded in relation to the UK population, no likely connectivity to SPA populations.
Lesser black-backed gull	Occasionally recorded, with peak of 12 birds in August in Nearshore Survey Area-Sector B.	Moderate	Out	Small numbers recorded in relation to the UK population, no significant connectivity to SPA populations.
Herring gull	Recorded throughout the year with peak of 430 birds in August in Nearshore Survey Area-Sector B.	High	In	Cited as an SPA qualifying interest in the breeding season for SPAs within foraging range. SPA: Forth Islands.

Bird species	Recorded Presence	Sensitivity	Scoped in or out of Assessment	Rationale
Great black-backed gull	Small numbers throughout year with peak of 12 birds in Sector B in August.	Moderate	Out	Small numbers recorded in relation to the UK population, no significant connectivity to SPA populations.
All Firth of Forth SPA qualifying interests that have been recorded during baseline surveys have been identified as high sensitivity due to likely direct connectivity. Species sensitivity, as identified in Table 15.8 (Boat-based Survey Area)) may have a different sensitivity rating here due to differences in e.g. ornithological importance in near-shore/intertidal habitats.				

15.5.3 Baseline without the Project

Development Area

83 In the absence of the Wind Farm, the numbers of seabirds using and passing through the Boat-based Survey Area over the next 25 to 50 years (the period when it is assumed the Wind Farm could be operational), would reflect changes in populations which are driven by a number of factors. Key drivers of population change in seabirds in the recent past, and likely future causes of change, are described below.

84 Historically, many species of seabirds have undergone large increases in numbers and distribution in Scotland (and elsewhere in the UK and Ireland) during the late 19th and mid to late 20th Centuries. Causes of change included the increased availability of offal in the form of discards from fisheries, and reduced anthropogenic mortality from hunting for food (eggs, nestlings and adults) or killing for other purposes (predominantly to reduce predation where a species was perceived as a competitor for human food resources) (Mitchell *et al*., 2004). In the late 20th and early 21st Centuries, many species have gone into decline, including in Scotland (SNH, 2012), with changes influenced by a number factors including reduced availability of natural food (e.g. breeding failure of various seabird species at colonies in the east of Scotland has been linked to reduced availability of small shoaling fish such as sandeels which are important food items for nestlings), predation of nests and adults at breeding colonies (including gulls and skuas, introduced non-native predators such as mink, or native predators such as rats, introduced to island breeding colonies) and exploitation by humans in the wintering areas. Indirect drivers of population declines include fishing effort and increasing sea temperatures, which affect the distribution and abundance of prey species. In addition, proposed changes in fisheries policy to reduce or eliminate discards of unsuitable catches are likely to affect seabird populations.

85 In the event of the Project not being developed, no change in the baseline conditions in the Development Area would be expected beyond those resulting from the drivers referred to above: climatic factors (such as temperature change and subsequent impacts of species' ranges), or anthropogenic activities such as changes in fishing activities indirectly affecting seabird communities.

86 To support the underlying impact assessment and specifically to determine likely future population trajectories, population viability analysis was undertaken for four seabird species. The existing baseline conditions are considered to be representative of those which could be expected in the short to medium term for ornithological receptors.

Offshore Export Cable Corridor

87 In the absence of the OfTW, the numbers of wetland birds using and passing through the near-shore study area over the next 25 to 50 years would reflect changes in populations which are driven by a number of factors. Along the Firth of Forth the main pressures identified in the SSSI Site Management Statement include land reclamation, development, recreation, wildfowling and bait digging (SNH sitelink website). Climate change is possibly

affecting some species, such as cormorant or sea duck species, due to changes in the marine ecosystem affecting prey species populations.

88 In the event of the Project not being developed, no change in the baseline conditions in the Offshore Export Cable Corridor would be expected beyond those resulting from the drivers referred to above: climatic factors or anthropogenic activities indirectly affecting intertidal and near-shore bird communities.

89 For most species an assessment of the potential scale of an effect over a long period is difficult to predict because trends in climate and anthropogenic activities are not possible to accurately predict. The baseline conditions reported in this chapter are considered to be representative of those which could be expected in the short to medium term for ornithological receptors of intertidal and near-shore habitats associated with the Offshore Export Cable Corridor.

15.6 Impact Assessment – Development Area

Identifying Potential Impacts of the Wind Farm and OfTW

90 The impacts identified for assessment are listed in Table 15.10 below along with the relevant stages of the Project. Further background on the potential impacts is provided in the assessment.

91 The assessment is based on the Design Envelope for the Wind Farm and OfTW and the worst case scenarios and Embedded Mitigation as defined in *Section 15.3.1*.

Table 15.10: Potential Impacts of the Wind Farm and Offshore Transmission Works on Valued Ornithological Receptors

Impact	Project Stage	Definition and Notes
Direct disturbance, indirect impacts on birds via prey species	Construction Operation Decommissioning	For the purposes of this assessment, disturbance is a deviation in an animal's behaviour from patterns occurring without direct human influences, caused by human presence, a human-related object or emission such as sound or light (after Frid and Dill, 2002). The assessment includes disturbance from noise and vibration, the presence of construction/maintenance vessels and equipment, and lighting; and also potential indirect impacts on birds through disturbance of prey.
Displacement	Operation Decommissioning	Displacement occurs if individuals of a species avoid an area of previously used habitat and are effectively excluded from this area.
Barrier effect	Operation	The Wind Farm and OSPs may pose a barrier to movements so that birds which previously flew through the Development Area might divert their flight paths to avoid it.

Impact	Project Stage	Definition and Notes
Direct habitat loss	Construction Operation Decommissioning	The foundations of WTGs and associated offshore structures and the Offshore Export Cable will result in loss of seabed habitats. There may be indirect impacts on birds via impacts on the habitat of prey species. It is also possible that WTG foundations will result in the creation of benthic habitats. Habitat loss will also occur within the intertidal area due to Export Cable landfall, which may affect feeding or roosting habitat.
Collision risk	Operation	Birds may collide with WTGs, especially when the WTGs are rotating, which is almost certain to result in mortality.

15.6.1 Effects of Construction

Direct Disturbance

92 The construction activities are expected to start in 2016 and work will occur over approximately four years.

93 The main potential sources of disturbance are vessel traffic and the construction of WTGs and associated infrastructure. Foundation options currently under consideration include GBSs, and driven, suction and drilled piles. Of these, piling operations will be expected to generate the greatest source of direct disturbance to birds, through vessel activity and above sea surface noise. Disturbance from vessel activity and noise/vibration will be temporary and confined to relatively small areas of the Development Area at any one time.

94 As a worst case scenario, construction activity could result in the complete avoidance of the surrounding area out to a given range by all the individuals, of one or more bird species, for the duration of construction activity. It is expected that a worst case would involve up two piling vessels to be operating simultaneously in the Development Area, with additional vessels present at any one time. Vessel traffic will be subject to defined navigation routes as part of Embedded Mitigation measures (see *Section 15.3.1*). Thus at any given time construction disturbance is likely to extend over comparatively small areas of the Development Area, making it likely that birds may re-distribute throughout the Development Area, making use of non-impacted areas.

95 Susceptibility to disturbance and its consequences may depend on:

- the foraging strategy of the birds involved, i.e. aerial, swimming or surface diving foragers;
- whether the birds present in the Development Area are actively feeding or simply loafing or rafting, with the relative proportions of these activities likely to vary depending on the season;

- the period and duration of occupancy of the Development Area and the reasons behind it, e.g. whether birds are engaged in another activity other than feeding, such as resting or undergoing moult;
- the origin of the birds involved (i.e. whether they are breeding or non-breeding birds, or migrants); and
- the timing of construction operations.

96 A few published studies are available to inform the assessment of impacts. Leopold and Camphuysen (2007) noted that the only birds seen to be present around the Egmond aan Zee wind farm in the Netherlands at the times of (observed) pile driving were gulls (mainly lesser black-backed and herring gulls) and terns (mainly Sandwich and common terns). These birds were predominantly seen in flight (i.e. in the air where they were not subjected to underwater noise). They concluded that there was little, if any effect of pile driving on the presence of gulls in the area.

97 Little is known about how diving birds may respond directly to underwater noise. As species which have hearing adapted primarily for use in air, however, it is expected that hearing sensitivity underwater will generally be low in comparison to that for marine mammals or fish. In addition, the 'soft start' piling procedures that form part of the Embedded Mitigation are intended specifically to minimise any major direct noise impacts by allowing animals to move away from a source of noise disturbance.

98 The predicted direct impacts of disturbance during the construction phase are assessed in Table 15.11, below. A distinction between seabirds and migratory birds has been made on the basis of differences in Development Area utilisation and likely exposure to potential disturbance impacts: species in the former group are more likely to encounter disturbance during construction of the Wind Farm and OfTW within the Development Area, through regular foraging, roosting etc. activities than the latter group, which only passes through the Development Area on a few occasions each year. With a few exceptions, seabirds are considered to have low sensitivity (hereafter referred to as susceptibility to avoid confusion with sensitivity of receptors) to disturbance from noise and movement (Furness and Wade, 2012) and therefore grouping them (yet focussing on the exceptions) for this part of the assessment is considered appropriate.

Table 15.11 Assessment of Direct Impacts of Construction Disturbance for all VORs

Bird species	Assessment of Construction Disturbance	Conclusion
Seabirds	With some exceptions, most seabirds are considered to have low susceptibility to disturbance from noise and movement (Garthe and Hüppop, 2004; Furness and Wade, 2012). Species which fall in this category and are present in important numbers in the Boat-based Survey Area during the breeding season are: fulmar, gannet, kittiwake, lesser black-backed gull, herring gull, Arctic tern, common tern and puffin. In the non-breeding season (including spring and autumn passage) this species category is largely composed of the same species as present during the breeding period, with the addition of Arctic skua, great skua and little gull. Species present during the breeding, post-breeding and non-breeding seasons which are considered moderately susceptible to disturbance are guillemot and razorbill. Both auk species can show flight behaviour from approaching vessels up to several 100 m away (Furness and Wade, 2012). No species considered highly susceptible to disturbance (i.e. both scoter species and all diver species, as per Furness and Wade, 2012) are present in the Boat-based Survey Area in important numbers during any time of year. During the construction phase direct impacts will be temporary and extend over comparatively small areas. Impacts would include those due to the presence and movement of vessels at the Development Area, and as a result of particular construction activities. Therefore it is possible that birds may re-distribute around a construction zone, making use of non-impacted areas during periods of construction activity. **Breeding season** As outlined above, the most disturbance-susceptible species present in the Boat-based Survey Area during the breeding season are guillemot and razorbill. Using the most sensitive species as a focal point for the underlying assessment means that predicted impacts on species of lower sensitivity are automatically lower (or similar). Given known flight behaviour of both auk species (at several 100 m in relation to approaching vessels), it is considered particularly precautionary to assume that during the breeding season these species could be disturbed in a 500 m radius around a construction zone. Boat-based bird surveys at the Boat-based Survey Area in 2010 to 12 clearly show that only a small proportion of auks were recorded in flight (see *Appendix 15A*, Tables 15A.23, 15A.24 and 15A.25), with very few birds actively taking off due to the approaching survey vessel. Assuming a 500 m disturbance zone, and a worst case of up to 15 vessels present at any given moment in time, approximately 11.8 km^2 of sea surface is likely to be affected by the presence of construction vessels at any one time. Construction vessel traffic will be subject to making use of designated shipping lanes. Guillemot and razorbill are considered moderately flexible in their habitat use (Furness and Wade, 2012).	**Breeding, post-breeding and non-breeding seasons** Negligible impact

Bird species	Assessment of Construction Disturbance	Conclusion
	The assessment considered two VORs of high sensitivity and direct construction disturbance of negligible magnitude. Based on the highly localised extent over which direct disturbance is predicted to occur (at worst within several 100 m of any vessel), as well as its short-term nature (piling and other activities estimated to take place during two breeding seasons, construction vessel activity to continue up to two more seasons thereafter), the reversibility of any effect and both species' moderate habitat flexibility, effects of construction disturbance on guillemot and razorbill during the breeding season are evaluated as a negligible impact. It follows that impact evaluation of VORs of lower sensitivity is similarly negligible. **Post-breeding season** During guillemot and razorbill's post-breeding season (July-August), large numbers of parent birds accompany their fledged chicks offshore. Important post-fledging aggregations are expected to occur throughout the Development Area during this time of year. During this period individuals of either species are flightless – adults undergo moult, chicks are not capable of flight yet. As a result birds' reaction to nearby disturbance involves escape diving and actively swimming away. Regular disturbance of fledglings in particular could in theory lead to a decrease in survival rate. Observations during baseline boat-based seabird surveys indicated that disturbance distances – leading to escape dives - were small, and did not appear to extend beyond 100 m from the vessel. Camphuysen (2002) showed that guillemot parent-fledged chick combinations travelled large distances of up to 50 km a day after leaving the colony, moving into the central North Sea. This shows that even while they are flightless, guillemots are capable of dispersing over large distances quickly, and that movements in response to disturbance over relatively small areas around construction sites are unlikely to represent a significant energetic cost. Given the ecological similarities between both species, it is considered likely that razorbill behaves in a similar way. The assessment considered two VORs of high sensitivity, and direct construction disturbance of negligible magnitude. It is predicted that direct disturbance impacts during construction will be highly localised (at worst within several 100 m of any vessel), of a short-term nature (piling and other activities estimated to take place during two post-breeding seasons, construction vessel activity to continue up to two more seasons thereafter), reversible and unlikely to affect available habitat (as birds are effectively passing through the Development Area). Therefore, construction disturbance of guillemot and razorbill during the post-breeding season is evaluated as a negligible impact. It follows that impact evaluation of VORs of lower sensitivity is similarly negligible.	

Bird species	Assessment of Construction Disturbance	Conclusion
	Non-breeding season The assessment considered two VORs of high sensitivity and direct construction disturbance of negligible magnitude. It is predicted that direct disturbance impacts during construction will be highly localised (at worst within several 100 m of any vessel), of a short-term nature (piling and other activities estimated to take place during two non-breeding seasons, construction vessel activity to continue up to two more seasons thereafter), reversible and unlikely to affect available habitat as birds are not constrained by the need to attend a nest site. Therefore, construction disturbance of guillemot and razorbill during the non-breeding season is evaluated as a negligible impact. It follows that impact evaluation of VORs of lower sensitivity is similarly negligible.	
Migratory birds	Migratory birds (geese, waders etc.) only have a direct link to the Development Area through collision risk, as they only use an area of airspace within their flyway within which very little time is actually spent as birds are flying to destinations elsewhere. In addition, depending on weather conditions, migratory birds such as geese and waders tend to fly at high altitude, and can show substantial levels of nocturnal flight activity, further limiting visual and auditory cues from disturbance. The magnitude of any direct construction disturbance impact is therefore predicted to be of negligible for all VORs. The assessment considered two VORs of the highest sensitivity (Taiga bean goose and Svalbard barnacle goose) and construction disturbance of negligible magnitude. It is predicted that such disturbance impacts will be highly localised, of a short-term nature (particularly in light of the small spring and autumn passage windows of both species), and reversible. Therefore, construction disturbance of both goose species during passage migration is evaluated as a negligible impact. It follows that impact evaluation of VORs of lower sensitivity is similarly negligible.	**Passage migration** Negligible impact

Indirect Impacts on Birds via Prey Species

99 For some bird species, indirect disturbance impacts of construction activity may potentially arise through impacts upon the distribution of prey species. Direct habitat loss during construction from WTGS, OSPs, met mast foundations and inter-array installation is considered secondary to indirect impacts of disturbance and has nominally been included in this assessment.

100 As identified in the assessment for Natural Fish and Shellfish (*Chapter 13*) the activity likely to impact on fish populations over the largest range is piling, because of the nature of the sound levels generated. High intensity sounds within the water column are known to have an effect on certain fish species, ranging from lethal effects for individuals close to a sound source to behavioural reactions at greater distances from the noise source (see Table 13.22 and associated text). It is possible, therefore, that piling could influence the abundance and distribution of some prey species during construction. This effect could potentially extend beyond the period of construction if spawning grounds and fish larvae are affected. Pile driving for the installation of foundations is therefore considered as the worst case scenario for underwater noise effects (see *Chapter 11* and *Appendix 11A* for more information). Complete installation for all piles will occur within a two year period during the construction phase, although piling will not be constant throughout, but will occur during an estimated 11 to 23 per cent of this period (see *Section 7.6.4*).

101 Key conclusions from the assessment of construction on natural fish populations (see *Chapter 13*) are as follows:

- In relation to key prey species for seabirds, habitat mapping of the Development Area indicates that there are large areas are which are considered suitable for sandeel, but there are few areas of prime habitat;. Site specific surveys, and Marine Scotland Science surveys, recorded few sandeels actually being present at the Development Area. Low numbers of adult herring were recorded in the site-specific surveys for the Development Area and a review of ICES landings data indicated a lack of landings of this species in the relevant ICES rectangle over the period 2007 to 2011. Sprat are abundant and widespread, and nursery and spawning grounds are ubiquitous around the North Sea. The area around the Development Area does not have any particular importance to the North Sea sprat population that would attract high densities..
- The effects of underwater piling noise on fish range from death and auditory injury, to avoidance and behavioural changes. The extent of the avoidance and behavioural effects from the piling locations are species specific. Fish species that are hearing specialists (with a swim bladder connected to the inner ear) are more affected than those that are hearing generalists (without or with a poorly developed swim bladder, or a bladder not connected to the inner ear). Considering key prey species for seabirds, sandeels are predicted to be of low sensitivity to piling noise because they lack a swim bladder, and minimal avoidance reactions to piling are predicted; herring and sprat however are considered as high sensitivity because they are hearing specialists. Based upon the models of predicted piling noise, based on the worst case scenario of piling occurring

simultaneously at two piling locations within the Development Area, the area within which noise levels are predicted to cause injury to herring is only 0.2 km^2 or 0.13 per cent of the Development Area (Table 13.22 and associated text), whereas the predicted strong avoidance response (based on 90 dBht (herring)) would result in an avoidance area for herring of about 2,473 km^2 during piling activities. The distances for injury and avoidance reactions of sprat to piling were considered to be similar to those of herring. For sandeels, because of their low sensitivity to noise, the spatial extent of noise levels that would cause mortality and/or auditory injury was too small to model. The impact ranges for behavioural responses in sandeels are also limited compared to hearing specialists, with an area of 0.17 km^2 affected by the strong avoidance (90 dBht, sand lance) contour (Table 13.22). The assessment of construction noise (see *Section 13.6.1*) considers noise impacts on all life stages of fish – including adults, larvae and eggs (behavioural and avoidance (but not lethal or physical injury) effects may extend into spawning areas of some species close to the Development Area). Although there may be some movements of fish in relation to construction noise, affecting the spatial distribution of some fish populations in and around the Development Area, no significant impacts of construction noise were predicted on any fish species.

- Increases in suspended sediment levels from construction activities under the worst case scenario of all GBS foundations were considered likely to impact small areas over short durations in a region where fish species were already acclimatised to short-term increases in suspended sediments due to storm events. Impacts were considered to be not significant on all fish species (Table 13.20 and associated text).
- Temporary habitat loss from WTGS, OSPs, met mast foundations and inter-array installation, under the worst case scenario (GBS foundations) covers 5.54 km^2, equating to 3.69 per cent of the Development Area. The potential impacts were considered to be non-significant on all fish species (Table 13.19), including sandeels which were considered most at risk as a low-mobility species.

102 Many of the seabirds present at the Development Area are considered as sandeel specialists, feeding their chicks predominantly on this fish species during the breeding season (e.g. Daunt *et al.,* 2008). The predicted impacts of construction disturbance on the abundance and distribution of sandeels are considered to be minor (see *Section 13.6.1*). Sandeel abundance in the southern North Sea is variable and in some years other fish species are of increased importance to seabirds in the breeding season (e.g. Wanless et al., 2005; CEH, 2012). If sandeel abundance is low, the temporary displacement of some of these fish species from the Development Area may still be of little consequence to breeding birds if they are able to exploit alternative prey that are not displaced and/or locate suitable foraging habitat nearby, or if fish prey re-populate the affected area once piling has ceased, or in between piling events. Outside the breeding season, little is known of the diet of seabirds although it is possible that sandeels feature less and alternative prey species become more important (e.g. Blake *et al.*, 1985). If fish species which are vulnerable to injury are able to avoid injury by moving away from piling activity (in response to soft-start procedures), then the total food resource is not likely to be reduced but re-distributed within the marine environment. Many wide ranging seabird species are already adapted to exploiting patchily distributed and temporary aggregations of prey – especially outside the

breeding season when they are not constrained in their foraging range by the need to return to a nest site.

103 An assessment of indirect construction disturbance for seabirds scoped in for the EIA is presented below. As piling activities at the Development Area are scheduled over two years (see *Chapter 7*), indirect construction impacts via fish prey will be temporary. Assessments consider available information on the diet of each seabird species and whether a species feeds mainly or exclusively offshore (some species - notably gulls - also forage onshore and in coastal areas and are less dependent on offshore areas than other seabird species). For species which feed exclusively or mainly offshore, the breeding season assessment considers overlap between the regional (offshore) foraging area (defined on the basis of foraging range, see *Appendix 15A*, *Section 15A.2.3.2*) and avoidance areas for sandeel and herring/sprat - to assess whether fish species which are important in the diet might be absent from a proportion of the foraging range. As described above, these avoidance areas are based on the worst case scenario of piling occurring simultaneously at two piling locations within the Development Area, see Table 13.22. These two species represent the two extremes in terms of predicted avoidance reactions of fish to piling, from species which are minimally sensitive to noise (sandeel) to hearing specialists (herring/sprat). All other fish species – including other species which may be taken by seabirds – will lie between these two extremes in terms of likely avoidance. Table 15.12, below, presents the areas and per cent overlap between seabird foraging ranges during the breeding season and fish avoidance areas. Table 15.13 includes a species by species assessment of indirect construction impacts via fish prey.

Table 15.12: Overlap Between Seabird Breeding Season Foraging Areas and Avoidance Areas for Sandeel and Herring/Sprat in Relation to Piling Impacts at the Development Area

Species	Breeding Season Regional Foraging Area (km^2)[1]	Area of Overlap with Avoidance Area for Sandeel	% of Regional Foraging Area	Area of Overlap with Avoidance Area for Herring and Sprat (km^2)	% of Regional Foraging Area
Fulmar	532,960	0.17	<0.0001	2483	0.5
Gannet	200,000	0.17	<0.0001	2483	1.2
Shag	572	0.02	<0.01	491	85.8
Puffin	83,446	0.17	<0.001	2483	3.0
Razorbill	34,534	0.17	<0.001	2483	7.2
Guillemot	68,407	0.17	<0.001	2483	3.6
Common tern	3244	0.09	<0.01	1481	45.7

Species	Breeding Season Regional Foraging Area (km^2)[1]	Area of Overlap with Avoidance Area for Sandeel	% of Regional Foraging Area	Area of Overlap with Avoidance Area for Herring and Sprat (km^2)	% of Regional Foraging Area
Arctic tern	3,957	0.17	<0.01	1809	45.7
Kittiwake	34,660	0.17	<0.001	2483	7.2
Lesser black-backed gull	82,667	0.17	<0.001	2483	3.0
Herring gull	50,322	0.17	<0.001	2483	4.9
Great black-backed gull	6747	0.17	<0.01	2358	35.0

1. Based on areas of sea within breeding season foraging ranges from Thaxter *et al*., 2012, see *Appendix 15A*, Table 15A.5; except for gannet for which the foraging range is taken from Hamer *et al*., 2011.

Table 15.13: Assessment of Indirect Impacts of Construction Disturbance on Birds via Impacts on Prey Species

Bird species	Assessment of Indirect Construction Disturbance via Impacts on Prey Species	Conclusion
Fulmar	**Breeding season** Low densities of fulmars were observed in the Boat-based Survey Area during the breeding season. There were few observations of active feeding behaviour (up to 8% of birds had a clear association with the sea surface, which may indicate foraging). Fulmars prey on a wide variety of fish (including sandeels, sprat and gadoids), zooplankton and squid and also scavenge offal from fishery waste (Birdlife International Seabird Database, 2012). Prey is mainly snatched from on or just below the sea surface. The predicted avoidance areas for sandeels and herring/sprat during piling at the Development Area represent a very small percentage of the regional foraging range for fulmar in relation to the Development Area (<0.0001% for sandeel avoidance and 0.5 % for herring/sprat). The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. Based on the species' flexible foraging strategy, enabling it to opportunistically exploit a range of food resources, its extensive potential foraging range (mean maximum of 400 km, Thaxter *et al,.* 2012, *Appendix 15A*, Table 15A.5), the limited spatial extent over which indirect disturbance is predicted to occur, as well as its temporary nature (piling activities estimated to take place intermittently during two breeding seasons) the impact is evaluated as negligible. **Non-breeding season** Higher densities of fulmars were recorded during the non-breeding season, but the numbers were very small in relation to the estimated North Sea population at 1,872,000 million individuals (see *Appendix 15A*, *Section 15A.3.2.1*). The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. The species' potential foraging range at this time of year is much more extensive than during the breeding season as birds are no longer constrained by the need to attend a nest site. Any impacts of indirect construction disturbance on fish prey in relation to piling within the Development Area are reversible, temporary and could affect two consecutive non-breeding seasons. The impact is therefore considered to represent no more than a slight change from baseline conditions, with any effects to lie within the limits of natural variation, and evaluated as negligible.	**Breeding and non-breeding** Negligible impact
Gannet	**Breeding season** Gannets are flexible in their habitat use (Furness and Wade, 2012) with a foraging strategy which includes pursuit diving for live fish and exploitation of discards from fishing vessels (Hamer *et al.*, 2011), so they are unlikely to encounter food	**Breeding and non-breeding** Negligible impact

Bird species	Assessment of Indirect Construction Disturbance via Impacts on Prey Species	Conclusion
	shortages (JNCC, 2012b). In contrast with populations of many other seabird species bordering the North Sea, which have experienced large variation in reproductive success in recent years, the breeding success of gannets has remained remarkably stable (Hamer *et al*., 2007). During the breeding season, an average of 14% of gannets recorded during boat surveys were considered to be actively foraging (see *Appendix 15A*, *Section 15A.3.2.4*). All, or the majority, of the birds observed during the breeding season are likely to originate from Bass Rock (Hamer *et al*., 2011). At this colony, sandeels comprise up to 50% of the diet (by biomass) with other important prey species including mackerel, herring, sprat and gadoids (Hamer *et al*., 2007). Gannets breeding at Bass Rock forage over a very wide area of the North Sea (> 200,000 km^2) although the core foraging area is much smaller and a tidal mixing front about 50 km off the east Scottish coast is of key importance. Individual birds tend to make successive trips on similar bearings, suggesting that the foraging areas of individuals are much smaller than that of the population (Hamer *et al*., 2011); however individuals also exhibit great flexibility in the species and sizes of prey consumed and in foraging trip durations, ranges and total distances travelled (Hamer *et al*., 2007). The predicted avoidance areas for sandeels and herring/sprat during piling at the Development Area represent a very small percentage of the regional foraging range for gannet in relation to the Development Area (<0.0001% for sandeel avoidance and 1.2% for herring/sprat). Gannets have a flexible diet and have the ability to extend foraging distances in response to changes in food availability. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. Based on the species' flexible foraging strategy, its extensive potential foraging range, the limited spatial extent over which indirect disturbance is predicted to occur as well as its temporary and reversible nature (piling activities estimated to take place intermittently during two breeding seasons) the impact is evaluated as negligible. **Non-breeding season** Outside the breeding season, much lower numbers of gannets were recorded in the Boat-based Survey Area. The origin of the birds recorded at this time of year is diverse, probably including some birds from Bass Rock, (an estimated 80% of birds from this breeding colony migrate south, Hamer *et al*., 2011) but also from colonies further north in Britain and Europe (Fort *et al*., 2012). Outside the breeding season gannets are much less constrained in their foraging areas by the need to attend a nest and therefore potentially even more flexible in their ability to change foraging strategies in response to changes in prey availability. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. Any impacts of indirect construction disturbance via fish prey in relation to piling within the Development Area are small in relation to the species' large foraging range, and are reversible and temporary (estimated to affect two consecutive non-breeding seasons). The impact is therefore considered to represent no more than a slight change from baseline conditions, with any effects to lie within the limits of natural variation, and evaluated as negligible.	

Bird species	Assessment of Indirect Construction Disturbance via Impacts on Prey Species	Conclusion
Shag	**Breeding season** Sandeels form a major component of the diet of breeding shags in the Forth and Tay area (e.g. 96%, Daunt *et al.*, 2008). The remainder of the diet comprises mainly gadoids but also a range of other small fish (BirdLife International, 2012). The Development Area is beyond the maximum foraging range of all but two small colonies in the Forth and Tay area, and very few shags were recorded during boat surveys in the breeding season (see *Appendix 15A*, *Section 15A.3.2.5*). Consequently it is considered to be of very low importance as a foraging area for this species during the breeding season. The predicted avoidance areas for sandeels during piling at the Development Area represents a very small percentage (<0.01%) of the species' regional foraging range. There is a high degree of overlap between the regional shag foraging range and avoidance areas for herring/sprat (85.8% of the regional foraging range overlaps with the avoidance areas), but these fish species have not been identified as an important diet component. The assessment considered a VOR of moderate sensitivity and indirect construction disturbance via impacts on fish prey (in particular sandeels) of negligible magnitude. Based on the highly localised impact of piling activities on sandeel populations, the very low shag densities present in the Development Area during the breeding season and the minimal overlap of the species' foraging range with the predicted spatial extent of indirect disturbance for sandeels, the impact is considered temporary and reversible (piling activities estimated to take place intermittently during two breeding seasons) and evaluated as negligible. **Non-breeding season** As shags forage primarily in inshore waters (they need to return to land daily to dry their feathers; Birdlife International Seabird Database, 2012), the Development Area – at 14.9 km from the coast line - is not considered to provide an important foraging area for this species outside the breeding season. This is corroborated by the boat-based survey results, which recorded very few shags in the non-breeding season (see *Appendix 15A*, *Section 15A.3.2.5*). The assessment considered a VOR of moderate sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. Any impacts of indirect construction disturbance via fish prey in relation to piling within the Development Area are reversible, temporary and could affect two consecutive non-breeding seasons. The impact is therefore considered to represent no more than a slight change from baseline conditions, with any effects to lie within the limits of natural variation, and evaluated as negligible.	**Breeding and non-breeding** Negligible impact

Bird species	Assessment of Indirect Construction Disturbance via Impacts on Prey Species	Conclusion
Arctic skua	**Breeding season** Arctic skuas were recorded within the Boat-based Survey Area on autumn passage only (see *Appendix 15A*, *Section 15A.3.2.13*) and there are no breeding colonies within foraging range. Thus no indirect construction disturbance via impacts on fish prey is predicted. **Post-breeding/passage** Outside the breeding season, Arctic skuas depend mainly on kleptoparasitising other seabirds, principally terns and gulls (BirdLife International Seabird Database, 2012). Within the Boat-based Survey Area, Arctic skuas were recorded kleptoparasitising gulls. Small numbers were recorded (peak count six) although boat surveys are likely to underestimate the numbers of passage birds. Similar to great skua, Arctic skuas move along the Scottish east coast in autumn to their winter quarters in the southern hemisphere. It is therefore considered likely that (on average) most individual birds only spend a very small amount of time in the Development Area. The assessment considered a VOR of moderate sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. In light of the species' tendency to kleptoparasitise other species, the considerable length of the species' migratory pathway and the likely high turnover in birds moving through the Development Area it is considered that spatial and temporal overlap of any impact is likely to be minimal. This effectively represents no more than a very slight change away from baseline conditions and evaluation therefore concludes the impact to be negligible.	**Breeding** N/A **Post-breeding/passage** Negligible impact
Great skua	**Breeding season** Great skuas were recorded within the Boat-based Survey Area on autumn passage only (see *Appendix 15A*, *Section 15A.3.2.12*) and there are no breeding colonies within foraging range. Thus no indirect construction disturbance via impacts on fish prey is predicted. **Post-breeding/passage** Outside the breeding season, great skuas are found in offshore and oceanic waters. They prey directly on fish caught on or just under the surface, kleptoparasitise and also predate other seabirds, and take discards from fishing vessels. They are capable of switching between prey groups depending on availability (BirdLife International Seabird Database, 2012). Within the Boat-based Survey Area, great skuas were recorded kleptoparasitising on a number of occasions, preying on kittiwake, great black-backed gull and pomarine skua. As the species is moving along the Scottish east coast in autumn to its winter quarters in the southern hemisphere, it is likely that (on average) most individual birds only spend a very small amount of time in the Development Area.	**Breeding** N/A **Post-breeding season/passage** Negligible impact

Bird species	Assessment of Indirect Construction Disturbance via Impacts on Prey Species	Conclusion
	The assessment considered a VOR of moderate sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. In light of the species' dietary flexibility, the considerable length of the species' migratory pathway and the likely high turnover in birds moving through the Development Area it is considered that spatial and temporal overlap of any impact is likely to be minimal. This effectively represents no more than a very slight change away from baseline conditions and evaluation therefore concludes the impact to be negligible.	
Puffin	**Breeding season** Assuming that birds on the sea surface are using the area for foraging, 76% of puffins in the Development Area and 71% of those in the Buffer Zone were recorded foraging in the breeding season (see *Appendix 15A*, *Section 15A.3.2.19*). The main prey species of puffins in the Forth and Tay offshore region is the lesser sandeel (Daunt *et al*., 2008), with published estimates indicating that this species comprises 80% - 81% of the diet (Furness and Tasker, 2000; Daunt *et al*., 2008) and 63% - 91% of the diet in recent years (CEH, 2012 for the period 2007 to 2012). Despite their predominance in the diet, the breeding success of puffins was not found to be related to the abundance of sandeels, which may be explained by their capacity to dive and gain access to a greater proportion of the sandeel population, even in years of lower abundance (Daunt *et al*,. 2008). Respective avoidance areas for sandeels and herring/sprat in relation to piling at the Development Area represent < 0.001% and 3.0% of the regional foraging range of puffin. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey (in particular sandeels) of negligible magnitude. Based on the highly localised impact of piling activities on sandeel populations, the minimal spatial extent over which herring/sprat distribution would change and puffin's large foraging range, indirect construction disturbance is considered temporary and reversible (piling activities estimated to take place intermittently during two breeding seasons) and evaluated as a negligible impact. **Post-breeding** Densities of puffins recorded during the post-breeding season were similar to or higher than those during the breeding season (see *Appendix 15A*, *Section 15A.3.2.19*) suggesting that birds from local breeding colonies may congregate in this area before dispersing. Unlike guillemots and razorbills, puffin chicks generally leave colonies by flying; after fledging chicks have no further contact with their parents and are independent (Harris and Wanless, 2011). Energy demands on adults at this time are likely to be less than during the nestling period, as they no longer need to attend a nest or provide food for chicks. As is the case for razorbill and guillemot, adult puffins moult their primary feathers during the non-breeding season and are flightless for a period. The timing of primary moult in puffins is not precisely known, it may take place in late winter but there appears to be considerable variation and flightless birds have been found in all months between September and April (Harris and Wanless, 2011). No information has been found on the diet once puffins have left nest sites, and whether there may be a change in diet as suggested for guillemot (see below). Puffins will be able to	**Breeding** Negligible impact **Post-breeding and non-breeding** Negligible impact

Bird species	Assessment of Indirect Construction Disturbance via Impacts on Prey Species	Conclusion
	move (by flying or swimming during flightless periods) in response to any movements of alternative prey which might result from construction disturbance and they are capable of covering large distances quickly (e.g. flight speeds are estimated at 70–80 km/h; Harris and Wanless, 2011). Furthermore, as with the other auk species, the puffin's diving ability, which can buffer birds against changes in sandeel abundance, means that alternative prey can be sought throughout the entire water column. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey in the post-breeding season of negligible magnitude. Based on the highly localised impact of piling activities on sandeel populations, and the likelihood that any changes in the distribution of other prey species would be buffered by the species' capacity to respond to prey re-distribution during post-breeding (when no longer constrained by nest-attendance), indirect construction disturbance is considered temporary and reversible (piling activities estimated to take place during two post-breeding seasons) and evaluated as a negligible impact. **Non-breeding** Movements of puffins outside the breeding season are poorly understood, although they are thought to be dispersive rather than following migratory routes (Wright *et al*., 2012). Recent deployment of geolocators from adults on the Isle of May has shown that some birds move around the north coast of Scotland into the Atlantic, whereas others remain in the North Sea throughout the winter (Harris and Wanless, 2011). Puffin density estimates for the Boat-based Survey Area were low during the non-breeding season, with no birds present in midwinter, reflecting the tendency of this species to disperse far offshore. As is the case for the post-breeding season, during the non-breeding season birds are not constrained in their foraging range by the need to attend a nest; and birds can follow any movements of alternative prey which might result from construction disturbance. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. Based on the localised impact of piling activities on sandeel populations, and the likelihood that any changes in the distribution of other prey species would be buffered by the species' capacity to respond to prey redistribution during non-breeding (when no longer constrained by nest-attendance), indirect construction disturbance is considered temporary and reversible (piling activities estimated to take place intermittently during two non-breeding seasons) and evaluated as a negligible impact.	
Razorbill	**Breeding season** Assuming that birds on the sea surface are using the area for foraging, 81% of razorbills in the Development Area and 63% of those in the Buffer Zone were apparently foraging in the breeding season (see *Appendix 15A*, *Section 15A.3.2.18*). The main prey species of razorbills in the Forth and Tay region is the lesser sandeel (Daunt *et al*., 2008), with published	**Breeding** Minor impact

Bird species	Assessment of Indirect Construction Disturbance via Impacts on Prey Species	Conclusion
	estimates indicating that this species comprises 77% - 80% of the diet (Furness and Tasker, 2000; Daunt *et al*., 2008). Recent data from the Isle of May indicate that sandeels continued to be the most numerous prey item between 2007 to 2012, except for 2010 when 67% of the diet was sprat (CEH, 2012). Despite their predominance in the diet, the breeding success of razorbills was not found to be related to the abundance of sandeels, which may be explained by the ability of razorbills to dive and gain access to a greater proportion of the sandeel population, even in years of lower abundance (Daunt *et al*., 2008). Respective avoidance areas for sandeels and herring/sprat in relation to piling at the Development Area represent < 0.001% and 7.2% of the regional foraging range of razorbill. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey (in particular sandeels) of negligible magnitude. Based on the highly localised impact of piling activities on sandeel populations, and the minimal spatial extent over which herring/sprat distribution would change, indirect construction disturbance is considered temporary and reversible (piling activities estimated to take place during two breeding seasons). However, despite the aforementioned, given the species' foraging range (considerably smaller than both other auk species) and the uncertainty around the population trend of the regional (and national) population (see *Appendix 15B*), it is considered appropriate to evaluate indirect construction disturbance as a minor impact. **Post-breeding season** High post-breeding densities of razorbills were recorded (see *Appendix 15A*, *Section 15A.3.2.18*). Fledglings are flightless for a period after leaving the nest, while their flight feathers develop. At this time they are accompanied by the male parent who continues to feed them for several weeks (Forrester *et al*., 2007). Adult birds moult flight feathers between August and October (Ginn and Melville, 1983) and are flightless during primary moult. No information has been found on the diet once razorbills have left nest sites, and whether there may be a change in diet as suggested for guillemot (see below). Razorbills will be able to move (by flying or swimming during flightless periods) in response to any movements of prey which might result from construction disturbance. Little information has been found about the travel distances and speed of razorbills departing breeding colonies. A single radio-tracked male assumed to be accompanying a chick that had just left the breeding ledge travelled at about 1.5 km/h away from the Isle of May in six hours before moving out of signal range (Wanless *et al*., 1988). It seems likely that, as for guillemot (see below), razorbills and fledglings may disperse offshore beyond feeding areas used by adults during the fledging period to avoid potential predation of young by other seabirds. Furthermore, the diving ability of the species, which can buffer birds against changes in sandeel abundance, means that alternative prey can be sought throughout the entire water column. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey in the post-breeding season of negligible magnitude. Based on the highly localised impact of piling activities on sandeel populations, and the likelihood that any changes in the distribution of other prey species would be buffered by the species' capacity to respond to prey redistribution during post-breeding (with even adults accompanying fledged chicks	**Post-breeding and non-breeding** Negligible impact

Bird species	Assessment of Indirect Construction Disturbance via Impacts on Prey Species	Conclusion
	able to move rapidly move through the Development Area), indirect construction disturbance will be temporary and reversible (piling activities estimated to take place intermittently during two post-breeding seasons) and evaluated as a negligible impact. **Non-breeding season** Razorbills breeding in the UK tend to migrate southwards after the breeding season, although some may make more local movements and remain close to breeding colonies throughout the year (Wright *et al*., 2012; Forrester *et al*., 2007; Stone *et al*., 1995). As is the case for the post-breeding season, during the non-breeding season birds are not constrained in their foraging range by the need to attend a nest or to feed chicks which have recently left the nest; and birds can follow any movements of alternative prey which might result from construction disturbance. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. Based on the localised impact of piling activities on sandeel populations, and the likelihood that any changes in the distribution of other prey species would be buffered by the species' capacity to respond to prey redistribution during non-breeding (when no longer constrained by nest-attendance), indirect construction disturbance is considered temporary and reversible (piling activities estimated to take place intermittently during two non-breeding seasons) and evaluated as a negligible impact.	
Guillemot	**Breeding season** Assuming that birds on the sea surface are using the area for foraging, 81% of guillemots in the Development Area and 75% of those in the Buffer Zone were foraging in the breeding season (see *Appendix 15A*, *Section 15A.3.2.17*). The main prey species of guillemots in the Forth and Tay region is the lesser sandeel (Daunt *et al*., 2008), with published estimates indicating that this species comprises 80% - 84% of the diet (Furness and Tasker, 2000; Daunt *et al*., 2008). Despite their importance in the diet, the breeding success of guillemots was not found to be related to the abundance of sandeels, which may be explained by their capacity to dive and gain access to a greater proportion of the sandeel population, even in years of lower abundance (Daunt *et al.,* 2008). Guillemots also feed on sprat, however, and this species appears to have become more numerous in the diet of birds at the Isle of May in recent years, 67% - 92% of the diet between 2007 – 2012 (CEH, 2012). Respective avoidance areas for sandeels and herring/sprat in relation to piling at the Development Area represent < 0.001% and 3.6% of the regional foraging range of guillemot. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey (in particular sandeels) of negligible magnitude. Based on the highly localised impact of piling activities on sandeel populations, the minimal spatial extent over which herring/sprat distribution would change and guillemot's known capacity within its time and energy budget to increase foraging effort in response to adverse environmental conditions	**Breeding, post-breeding and non-breeding** Negligible impact

Bird species	Assessment of Indirect Construction Disturbance via Impacts on Prey Species	Conclusion
	(Daunt *et al*., 2008; 2011a and 2011b), indirect construction disturbance is considered temporary and reversible (piling activities estimated to take place intermittently during two breeding seasons) and evaluated as a negligible impact. **Post-breeding season** High post-breeding densities of guillemots were recorded (see *Appendix 15A*, *Section 15A.3.2.17*). Chicks are flightless for a period after leaving the nest, while their flight feathers develop. At this time they are accompanied by the male parent who continues to feed them for six to eight weeks while they learn to feed themselves (Forrester *et al*., 2007). Adult birds moult primary flight feathers from late July and are flightless for 45 to 50 days (Ginn and Melville, 1983). Little information is available on the diet once guillemots have left nest sites. Examination of stomach contents of shot guillemots and corpses (from oil spills and other incidents) in the northern North Sea suggested that sandeels continue to dominate in the diet through August, but from September clupeid and gadoid remains became increasingly frequent in stomach contents (Blake *et al.,* 1985). If the diet of guillemots using the Development Area switches from sandeels to other species during the post-breeding period then some of the alternative prey species may redistribute in relation to construction disturbance. However, post-breeding birds are able to move (by flying or swimming during flightless periods) in response to any movements of prey. Camphuysen (2002) indicates that guillemot parent- fledged chick combinations travelled large distances of up to 50 km a day after leaving a colony and travelled into the open sea, much further offshore than the feeding areas used by adults during the chick rearing stage, probably to avoid concentrations of seabirds which might prey on fledged chicks. Furthermore, the diving ability of the species which can buffer birds against changes in sandeel abundance means that alternative prey can be sought throughout the entire water column. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey in the post-breeding season of negligible magnitude. Based on the highly localised impact of piling activities on sandeel populations, and the likelihood that any changes in the distribution of other prey species would be buffered by the species' capacity to respond to prey redistribution during post-breeding (with even adults accompanying fledged chicks able to move rapidly through the Development Area), indirect construction disturbance is considered temporary and reversible (piling activities estimated to take place during two post-breeding seasons) and evaluated as a negligible impact. **Non-breeding season** Guillemots breeding in the UK disperse into surrounding seas after the breeding season (Wright *et al*., 2012; Stone *et al*., 1995). At this time the availability of food may be a key factor in determining bird distribution although there is little information on diet composition during this period. Analysis of stomach contents from shot birds and corpses recovered from oil spills and other incidents suggested that from September the proportion of sandeels in the diet of guillemots may decrease and clupeids and gadoids become more important; this situation may persist until February and March	

Bird species	Assessment of Indirect Construction Disturbance via Impacts on Prey Species	Conclusion
	when the proportion of sandeels increases again (Blake *et al.*, 1985). During the non-breeding season birds are not constrained in their foraging range by the need to attend a nest or to feed chicks which have recently left the nest; birds can range over extensive offshore area and follow any movements of prey which might result from construction disturbance. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. Based on the localised impact of piling activities on sandeel populations, and the likelihood that any changes in the distribution of other prey species would be buffered by the species' capacity to respond to prey redistribution during non-breeding (when no longer constrained by nest-attendance), indirect construction disturbance is considered temporary and reversible (piling activities estimated to take place intermittently during two non-breeding seasons) and evaluated as a negligible impact.	
Arctic tern	**Breeding season** Arctic terns were recorded infrequently in the Boat-based Survey Area during the breeding season and no foraging behaviour was observed (see *Appendix 15A*, *Section 15A.3.2.15*). Arctic terns snatch prey at, or just below, the surface of the water, taking small fish, invertebrates, zooplankton and discards. Sandeels form a substantial component of the diet of breeding Arctic terns in the UK (BirdLife International Seabird Database, 2012); they were estimated as 34% of the diet for tern species in south-east Scotland (Daunt *et al.,* 2008), which indicates that the species is not solely dependent on sandeels, but that other prey items feature substantially in the diet as well. There is evidence from at least some east coast UK colonies that sandeels predominate in the diet in April and May, with clupeids becoming relatively more important in late July (BirdLife International Seabird Database, 2012). Based on the mean maximum foraging range plus 1 SD (30.5 km, see *Appendix 15A*, *Table 15A.5*), birds from regional colonies might forage within the Development Area. However, nesting terns tend to feed primarily within 10 km of breeding colonies (BirdLife International Seabird Database, 2012; Thaxter *et al.,* 2012). In light of the small numbers of Arctic terns recorded during boat-based surveys, the Development Area is not considered to provide an important foraging area for nesting birds. However, long-distance prey avoidance of areas around piling activities might result in the absence of prey species from part of the regional foraging range. Respective avoidance areas for sandeels and herring/sprat in relation to piling at the Development Area represent < 0.01% and 45.7% respectively of the regional foraging range. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey of moderate magnitude. Predicted avoidance areas of herring/sprat could potentially result in a partial loss of the (prey availability) baseline conditions. However, impacts on sandeel populations through piling activities are predicted to be highly localised, potentially buffering the partial loss of herring/sprat prey elsewhere. Arctic tern is in decline both regionally and nationally and although indirect impacts on prey distribution through piling are considered temporary and	**Breeding** Minor/Moderate impact **Post-breeding season/passage** Negligible impact **Non-breeding** N/A

Bird species	Assessment of Indirect Construction Disturbance via Impacts on Prey Species	Conclusion
	reversible (estimated to affect two breeding seasons), in the context of a decreasing population of a high sensitivity receptor it is considered appropriately precautionary to evaluate a partial loss of baseline conditions as a minor/moderate impact. **Post-breeding season** Peak numbers of Arctic terns were recorded in the Boat-based Survey Area in August, with a maximum estimate of 509 birds (22% fledged juveniles) in the Development Area in August 2011, exceeding 1% of the passage population estimate (see *Appendix 15A*, *Section 15A.3.2.15*). No information has been found on the diet of post-breeding birds although this could potentially include sandeels, clupeids and other small fish within the Development Area. The impacts of indirect construction disturbance via impacts on fish prey could potentially affect the distribution of some prey species for Arctic terns, although post-breeding birds are no longer visiting nest sites and so are not constrained in foraging distances and are considered to be able to move in response to prey availability. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey in the post-breeding season of negligible magnitude. Based on the highly localised impact of piling activities on sandeel populations, and the likelihood that any changes in the distribution of other prey species would be buffered by the species' capacity to respond to prey redistribution during post-breeding, the impact is considered temporary and reversible (piling activities estimated to take place during two post-breeding seasons) and evaluated as negligible. **Non-breeding season** Arctic terns migrate south along the eastern seaboard of the Atlantic; many juveniles winter in western and southern Africa (Forrester *et al.,* 2007). The species was not recorded in the Boat-based Survey Area during the non-breeding season and indirect construction disturbance via impacts on fish prey is not predicted.	
Common tern	**Breeding season** Common terns were rarely recorded in the Boat-based Survey Area during the breeding season and no foraging behaviour was observed (see *Appendix 15A*, *Section 15A.3.2.16*). As for Arctic tern, there is evidence from some colonies on the east coast of Britain that sandeels predominate in the diet during April and May, with clupeids becoming relatively more important in late July during chick-rearing. The diet of breeding common terns at Leith Docks (Firth of Forth, about 25 km from the Isle of May) was found to comprise 55% clupeids and 32% sandeels in 2009 and 79% and 14% respectively in 2010 (Jennings, 2012). Although the mean maximum foraging range plus 1 SD (26.4 km, see *Appendix 15A*, *Table 15A.5*) suggests that birds from regional colonies might forage within the Development Area, on average nesting common terns feed mostly within 8 km - 10 km of breeding colonies (BirdLife International Seabird Database, 2012; Thaxter *et al.,* 2012). Therefore, the Development Area is not considered to provide an important foraging area for	**Breeding** Minor/Moderate impact **Post-breeding** Negligible

Bird species	Assessment of Indirect Construction Disturbance via Impacts on Prey Species	Conclusion
	nesting birds. However long-distance prey avoidance of areas around piling activities might result in the absence of some fish prey species from part of the regional foraging range of common tern. Avoidance areas for sandeels and herring/sprat in relation to piling at the Development Area represent < 0.01% and 45.7% respectively of the regional foraging range. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey of moderate magnitude. Predicted avoidance areas of herring/sprat in particular could potentially result in a partial loss of the (prey availability) baseline conditions. However, impacts on sandeel populations through piling activities are predicted to be highly localised, potentially buffering the partial loss of herring/sprat prey elsewhere. Common tern is in decline nationally and although indirect impacts on prey distribution through piling are considered temporary and reversible (estimated to affect two breeding seasons), in the context of a decreasing population of a high sensitivity receptor it is considered appropriately precautionary to evaluate a partial loss of baseline conditions as a minor/moderate impact. **Post-breeding season** Post-breeding aggregations can occur in the coastal waters of the Firth of Forth (Forrester *et al.,* 2007) but there was no evidence from boat surveys that the Development Area provides an important foraging area during the post-breeding period. No information has been found on the diet of post-breeding birds although this could potentially include sandeels, clupeids and other small fish within the Development Area. The impacts of indirect construction disturbance via re-distribution of fish prey could potentially affect the distribution of some prey species for post-breeding common terns elsewhere in the outer Firth of Forth. Post-breeding birds are, however, no longer visiting nest sites and so are not constrained in foraging distances but able to move in response to the availability of prey. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey in the post-breeding season of negligible magnitude. Based on the highly localised impact of piling activities on sandeel populations, and the likelihood that any changes in the distribution of other prey species would be buffered by the species' capacity to respond to prey redistribution during post-breeding, the impact is considered temporary and reversible (piling activities estimated to take place during two post-breeding seasons) and evaluated as negligible. **Non-breeding** Common terns breeding in Britain, winter along the west coast of tropical Africa (Forrester *et al.,* 2007). The species was not recorded in the Boat-based Survey Area during the non-breeding season and no indirect construction disturbance via impacts on fish prey is predicted.	**Non-breeding** N/A

Bird species	Assessment of Indirect Construction Disturbance via Impacts on Prey Species	Conclusion
Kittiwake	**Breeding season** At least 61% of kittiwakes observed during boat-based surveys were recorded as foraging in the breeding season (see Appendix 15A, Section 15A.3.2.6). As surface feeders, kittiwakes have limited ability to dive to exploit the water column if prey is not abundant at the water surface, but range relatively widely and forage over inshore and offshore waters. The lesser sandeel is the main prey in the outer Forth and Tay region, published information reports that sandeels comprise: 80% (Furness and Tasker, 2000), 87% (Daunt et al., 2008), and 44% & - 89% (2007 – 2012; CEH, 2012) of the diet of kittiwakes breeding in the east of Scotland. A range of other prey species are taken including herring which comprised 12% -55% of the diet of kittiwakes on the Isle of May between 2007 - 2012 (CEH, 2012). A number of studies have demonstrated that kittiwake breeding success increases with the abundance of sandeels (Daunt et al., 2008). Frederiksen et al. (2004) found that poor breeding success of kittiwakes on the Isle of May was associated with periods when the Wee Bankie sandeel fishery (to the east of the Development Area) was active. The Wee Bankie sandeel fishery has been closed to commercial fishing since 2000 because of concerns about the potential negative impact on seabird populations (Daunt et al., 2008), Frederiksen et al. (2004) also found that kittiwake breeding success was negatively related to mean sea surface temperature in February and March, with rising temperatures reducing sandeel recruitment (Arnott and Ruxton, 2002). The construction activities themselves are not predicted to cause more than a moderate/minor impact on sandeels from direct temporary habitat disturbance, indirect impacts of increases in SSC and sediment deposition and noise effects (*Chapter 13*). Respective avoidance areas for sandeels and herring/sprat in relation to piling at the Development Area represent < 0.001% and 7.2% respectively of the regional foraging range of kittiwake. If piling activities associated with construction coincide with years when sandeel abundance is low, then the re-distribution of other prey species in response to piling activities may affect the availability of alternative prey over a small part of the foraging range. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey (in particular sandeels) of negligible magnitude. Based on the highly localised impact of piling activities on sandeel populations, and the predicted likelihood that any changes in the distribution of other prey species would take place over a small part of the species' foraging range, the impact is considered temporary and reversible (piling activities estimated to take place intermittently during two breeding seasons) and evaluated as negligible. **Post-breeding season** High post-breeding densities of kittiwakes were recorded (see Appendix 15A, Section 15A.3.2.6). If sandeels continue to form an important component of the diet during the post-breeding season, then negligible impacts of construction disturbance are predicted on this prey species. However, it is possible that other prey species become more important in the diet at this time, and that some of these species (e.g. herring and sprat) might be displaced by construction	**Breeding, post-breeding and non-breeding** Negligible impact

Bird species	Assessment of Indirect Construction Disturbance via Impacts on Prey Species	Conclusion
	disturbance. Kittiwakes are restricted to foraging at, or near, the water surface and are unable to dive deep to exploit prey throughout the water column, but at the same time the species is naturally well adapted to exploit food resources which are patchily distributed in the marine environment. It is considered that the species' flexibility in response to prey movements is even more pronounced during the post-breeding season when birds are no longer constrained by the need to attend a nest site. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey (in particular sandeels) in the post-breeding season of negligible magnitude. Based on the highly localised impact of piling activities on sandeel populations, and the likelihood that any changes in the distribution of other prey species would be buffered by the species' capacity to respond to prey redistribution, the impact is considered temporary and reversible (piling activities estimated to take place intermittently during two post-breeding seasons) and evaluated as negligible. **Non-breeding** Lower densities of kittiwakes were recorded outside the breeding season. At this time birds are pelagic and populations from different breeding localities are thought to mix in the North Sea and Atlantic Ocean (Frederiksen et al., 2011). Sandeels may form a less important component of the winter diet (Birdlife International Seabird Database, 2012), but at this time kittiwakes are no longer constrained in their foraging ranges by the requirement to attend a nest. They are predicted to be able to respond to any movements of alternative prey species which might result from construction disturbance. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey (in particular sandeels) of negligible magnitude. Based on the highly localised impact of piling activities on sandeel populations, and the likelihood that any changes in the distribution of other prey species would be buffered by the species' capacity to respond to prey redistribution, the impact is considered temporary and reversible (piling activities estimated to take place intermittently during two non-breeding seasons) and evaluated as negligible.	
Common gull	Common gulls forage both inland and offshore, primarily taking terrestrial invertebrates, fish and discards (Mitchell *et al.,* 2004; Forrester *et al.,* 2007). Overall, 15% of birds recorded in boat surveys were reported to be engaged in foraging behaviour. **Breeding season** A very small population (estimated at 19 pairs, see *Appendix 15A*, *Section 15A.3.2.8*) of common gulls nests within potential foraging range of the Development Area. Very few birds were recorded during boat surveys in the breeding season, as common gulls largely feed in inland and coastal areas during this time of year. Therefore, the site is not	**Breeding and non-breeding** Negligible impact

Bird species	Assessment of Indirect Construction Disturbance via Impacts on Prey Species	Conclusion
	considered to provide an important foraging area for this species in the breeding season. The assessment considered a VOR of moderate sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. Based on the very low common gull densities present in the Development Area during the breeding season and the minimal overlap of the species' foraging range (largely comprising of onshore habitat and coastal waters) with the predicted spatial extent of indirect disturbance, the impact is considered temporary (piling activities estimated to take place intermittently during two breeding seasons), reversible and unlikely to occur and is therefore evaluated as negligible. **Non-breeding season** The largest numbers of common gulls recorded in boat surveys were between October 2010 and February 2011, with a peak raw count of 35 birds (for this species there were too few records for reliable estimation of population size) in the Boat-based Survey Area in December 2010 (compared with an estimated regional winter population of 3,000 birds and a North Sea population of 175,530 birds (see *Appendix 15A*, *Section 15A.3.2.8*)). Outside the breeding season, birds are not constrained in their foraging range by the requirement to attend a nest and can move in response to the distribution of prey. The assessment considered a VOR of moderate sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. The species predominantly forages in onshore habitat as well as coastal waters. Baseline data indicate that the Development Area is evidently not an important foraging area for common gull. Any impacts of indirect construction disturbance via fish prey in relation to piling within the Development Area are therefore predicted to be reversible and temporary (estimated to affect two consecutive non-breeding seasons). The impact is therefore considered to represent no more than a slight change from baseline conditions, with any effects to lie within the limits of natural variation, and evaluated as negligible.	
Little gull	**Breeding season** The species does not breed in the UK and there are no breeding populations within foraging range. **Non-breeding season** Little gulls predominantly occur in the outer Forth and Tay on autumn passage, and numbers may vary from year to year (see *Appendix 15A*, *Section 15A.3.2.7*). Little gulls usually forage over water in a similar manner to a tern or small petrel, dipping down to the surface periodically (sometimes after a brief hover) to catch prey at or just below the surface; at sea they feed on small fish, aquatic invertebrates including zooplankton, and discards (Birdlife International Seabird Database, 2012). Numbers close to or exceeding national importance thresholds (50 birds) were recorded in the Boat-	**Breeding** N/A **Non-breeding** Negligible impact

Bird species	Assessment of Indirect Construction Disturbance via Impacts on Prey Species	Conclusion
	based Survey Area on two occasions (see *Appendix 15A*, *Section 15A3.2.7*). The ecology and movements of passage/wintering little gulls in the North Sea are not well understood. Large flocks have been reported at a number of locations off the east coast of Scotland and England (Forrester *et al.,* 2007; Hartley, 2004), and the numbers in specific locations appear to vary from year to year. Given the large potential foraging range of non-breeding birds and the relatively short window of time during which peak numbers occur in autumn, it is considered unlikely that redistribution of prey in relation to piling activities at the Development Area would have adverse effects on little gulls. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. Any impacts of indirect construction disturbance via fish prey in relation to piling within the Development Area are small in relation to the species' large potential foraging range, and are reversible and temporary (estimated to affect two consecutive non-breeding seasons). The impact is therefore considered to represent no more than a slight change from baseline conditions, with any effects to lie within the limits of natural variation, and evaluated as negligible.	
Lesser black-backed gull	**Breeding season** Low numbers of lesser black-backed gulls were recorded in the Boat-based Survey Area during the breeding season, representing less than 1% of the regional breeding population (see *Appendix 15A*, *Section 15A.3.2.9*). The species makes use of inland (including urban), coastal and intertidal habitats as well as offshore areas for foraging, although it spends more time feeding at sea than other large gulls (Kim and Monaghan, 2006; Bustnes *et al.,* 2010). Respective avoidance areas for sandeels and herring/sprat in relation to piling at the Development Area represent < 0.001% and 3.0 % of the regional (offshore) foraging range, and any re-distribution of fish caused by construction disturbance is not considered likely to cause adverse impacts on lesser black-backed gull via its food supply. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. Spatial overlap of the species' foraging range and predicted fish avoidance areas is limited, the species' does not depend on these prey species and is capable of foraging on a wide range of food resources. Taking into account the aforementioned, as well as the temporary and reversible nature of piling activities, evaluation concluded the impact to be negligible. **Non-breeding season** The majority of lesser black-backed gulls breeding in the UK migrate south to winter in coastal areas of Iberia and north-west Africa (Wright *et al.,* 2012), and none were recorded during boat-based surveys outside the breeding season,	**Breeding season** Negligible impact **Non-breeding** N/A

Bird species	Assessment of Indirect Construction Disturbance via Impacts on Prey Species	Conclusion
	therefore birds are not predicted to be subject to indirect construction disturbance via impacts on fish prey at this time.	
Herring gull	**Breeding season** Low numbers of herring gulls were recorded in the Boat-based Survey Area during the breeding season, representing less than 1% of the regional breeding population (see *Appendix 15A*, *Section 15A.3.2.10*) and therefore the Development Area is not considered to provide an important foraging area for this species. Herring gulls are omnivorous (including feeding on fisheries discards and human waste) and may feed onshore and offshore, although chicks may be selectively fed fish and the meat of birds and mammals (Nogales *et al.,* 1995). On the Isle of May, for example, gulls frequently predate young puffins and kleptoparasitise (steal prey from) adults as they return to the colony with fish; and gulls have been controlled on the island to reduce their impacts on other seabirds (Finney *et al.,* 2003). Respective avoidance areas for sandeels and herring/sprat in relation to piling at the Development Area represent <0.001% and 4.9% of the regional (offshore) foraging range, and any re-distribution of fish caused by construction disturbance is not considered likely to cause adverse impacts on herring gulls via impacts on their food supply. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. Based on the limited overlap between the species' foraging range and predicted fish avoidance areas and the species' capacity to opportunistically exploit a wide range of food resources, the impact is considered temporary and reversible (piling activities estimated to take place intermittently during two breeding seasons) and evaluated as negligible. **Non-breeding season** Higher densities of herring gulls were observed outside the breeding season, but numbers were less than 1% of the estimated regional and North Sea populations. As described above, herring gulls may forage in a range of habitats (offshore, in coastal areas, and inland). Outside the breeding season herring gulls are not constrained by the requirement to attend a nest site, and there is no requirement to selectively forage for fish for small chicks. Any re-distribution of fish prey in relation to construction activities at the Development Area is not predicted to adversely affect the species. The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. Based on the limited overlap between the species' wide potential foraging range during this time of year and predicted fish avoidance areas as well as the species' broad diet, the impact is considered temporary and reversible (piling activities estimated to take place during two non-breeding seasons) and evaluated as negligible.	**Breeding and non-breeding** Negligible impact

Bird species	Assessment of Indirect Construction Disturbance via Impacts on Prey Species	Conclusion
Great black-backed gull	**Breeding season** Great black-backed gulls were only recorded in the Boat-based Survey Area in low numbers in the early part of the breeding season (see *Appendix 15A*, *Section 15A.3.2.11*) so the Development Area is not considered to provide an important foraging area for breeding birds. The little information available on foraging range suggests that breeding great-black backed gulls feeding offshore tend to stay within 10 km – 40 km of nests (Ratcliffe *et al.,* 2000). Diet during the breeding season includes eggs, nestlings and adults of other seabirds as well as intertidal and marine invertebrates, fish and discards from fishing vessels (e.g. Buckley, 2009); chicks may be selectively fed smaller, easily digestible prey of high energy content, such as marine invertebrates and small fish (Steenweg *et al.,* 2011). Respective avoidance areas for sandeels and herring/sprat in relation to piling at the Development Area represent <0.01% and 35.0% of the regional (offshore) foraging range of great black-backed gull. Although redistribution of herring and sprat in relation to piling activities may affect about a third of the offshore foraging area, adverse impacts are not predicted because fish represent only one element of the broad diet of great black-backed gulls. The assessment considered a VOR of moderate sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. Although the overlap between the species' foraging range and predicted herring/sprat avoidance areas is considerable, the species' does not depend on these prey species and is capable of foraging on a wide range of food resources. Taking into account aforementioned, as well as the temporary and reversible nature of piling activities evaluation concluded the impact to be negligible. **Non-breeding season** Higher densities of great black-backed gulls were observed outside the breeding season (when birds from northern Europe move into the North Sea), but numbers were less than 1% of the estimated regional and North Sea populations. Foraging behaviour was recorded on a number of occasions in autumn and winter, all involving associations with working fishing vessels. In the non-breeding season, great black-backed gulls are not constrained by the requirement to attend a nest site, and there is no requirement to selectively forage for fish for small chicks. Any re-distribution of fish prey in relation to construction activities at the Development Area is not predicted to adversely affect the species. The assessment considered a VOR of moderate sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. The species does not depend on these prey species and is capable of foraging on a wide range of food resources over large areas. Evaluation considered the nature of indirect disturbance through piling activities to be temporary and reversible and concluded any impact to be negligible.	**Breeding and non-breeding** Negligible impact

15.6.2 Effects of Operation and Maintenance

Direct Disturbance

104 Activities associated with the operation and maintenance of the Wind Farm and OfTW (within the Development Area) have the potential to cause disturbance to VORs. These are likely to be mainly associated with the movements of maintenance vessels and associated maintenance activities at WTGs, OSPs and met masts. These impacts are unlikely to affect migratory birds as these species have minimal interaction with the Development Area, only moving through the area on a few occasions each year.

105 As outlined in *Section 15.6.1* (Effects of Construction), the two seabird species present during the breeding, post-breeding and non-breeding seasons which are considered the most susceptible to disturbance are **guillemot** and **razorbill**. Both auk species can show flight behaviour from approaching vessels up to several 100 m away (Furness and Wade, 2012).

106 The levels of disturbance due to operational and maintenance activities will be considerably lower than during construction. Disturbance will be temporary and localised and is likely to affect birds for distances of no more than 500 m from vessels or activities. Thus very small parts of the Development Area will be affected and birds are likely to re-distribute in response to disturbance. As only negligible impacts from disturbance are predicted during construction (Table 15.11), it is considered that at worst any impact during the operational phase is of a similar level.

107 The assessment considered two VORs of high sensitivity and direct operational disturbance of negligible magnitude across all seasons. Based on the highly localised extent over which direct disturbance is predicted to occur (at worst within 500 meters of any vessel), as well as the short-term nature of most maintenance activities, the reversibility of any effect and both species' moderate habitat flexibility, effects of construction disturbance on **guillemot** and **razorbill** during all seasons are evaluated as a negligible impact. It follows that impact evaluation of VORs of lower sensitivity is similarly negligible.

108 Potential disturbance in relation to lighting of WTGs is discussed below as a potential contributing factor for collision risk, in particular for migratory birds.

Direct Habitat Loss

109 The introduction of WTGs, OSPs, met mast foundations and protection on inter-array cables will cause a net loss of the original seabed habitat. The most likely mechanism for impacts on birds is indirect, through changes in the distribution of prey and foraging habitat.

110 At the Development Area, the total loss of seabed habitat resulting from the worst case scenario for WTG foundations (gravity bases fitted to 213 WTGs as well as up to five OSPs and three met masts) and inter-array cables covers 1.87 km^2, equivalent to 1.25 per cent of the total seabed area of the Development Area. Birds are not likely to be directly affected by this extent of habitat loss. Seabirds diving to forage within the Development Area will not necessarily make use of the sea bottom – some species such as kittiwake and terns feed only

on or just below the surface, and species which do dive deeper may feed at different levels in the water column depending on the availability of prey. Visibility underwater is likely to be poor so that diving birds are unlikely to be aware of the presence of WTG bases or other structures unless they pass very close to them. In addition, there are numerous anecdotal observations of auks foraging around offshore oil and gas platforms (North Sea Bird Club 21st Anniversary Report, 2001), including from cameras near the seabed, so it seems plausible that the presence of underwater structures is not a deterrent to birds utilising nearby underwater habitat. In light of this, the predicted extent of seabed loss is considered unlikely to impact directly on any bird species (Exo *et al.,* 2003).

111 The assessment considered all VORs and direct operational habitat loss of negligible magnitude across all seasons. Based on the localised extent over which direct habitat loss is predicted to occur and the minimal proportion this represent of species' foraging ranges, effects of operational habitat loss on **all VORs** during all seasons are evaluated as a negligible impact.

112 Note that displacement of birds due to the physical presence of the Wind Farm and OfTW structures in the Development Area, deterring species from entering the Development Area, also can lead to effective, absolute habitat loss. This form of displacement is considered below.

<u>**Indirect Impacts on Birds via Prey Species**</u>

113 Indirect impacts on seabirds via impacts on fish prey may occur during the operation of the Wind Farm. The following operational impacts on natural fish populations were considered (see *Section 13.6.2*): long term loss of original habitat and displacement, behavioural response to EMF associated with cabling, disturbance or injury from operational noise, changes in fishing effort (reduced pressure within the Wind Farm), creation of new habitat due to presence of Project infrastructure. No significant adverse impacts are predicted on fish populations.

114 Some possible small benefits for some benefits were considered possible due to increased habitat complexity, food resources and refuge areas. A potential indirect effect of the operational Wind Farm may therefore be to increase prey availability for birds by raising the carrying capacity of the area for certain populations of invertebrates and fish. Leonhard and Pedersen (2006), for example, reported that fish biomass increased considerably in the vicinity of WTG bases at Horns Rev (Denmark) due to the shelter afforded by scour protection. Assessment of the short-term effects of Egmond aan Zee offshore wind farm in the Netherlands, however, found evidence for a high degree of variability in fish species composition before and after construction, but no indication that these changes were influenced by the wind farm (Lindeboom *et al.*, 2011). These results were based on a short timespan, however, and changes resulting from the construction of a wind farm may take about five years to become observable (*Chapter 13*).

115 While evidence is therefore limited, it appears that there may be some potential for a positive, indirect impact on birds as a result of increasing prey abundance and availability.

Any potential impacts on birds, however, might be offset by displacement due to the presence of the Wind Farm and OfTW within the Development Area.

116 The assessment considered all VORs and indirect impacts on birds via prey distribution of negligible magnitude across all seasons. Given that no significant adverse impacts on fish populations were predicted during the operational phase (*Chapter 13*) it follows that significant indirect impacts on bird communities are similarly unlikely to occur. It is considered that impacts could be slightly positive instead, but uncertainty regarding the extent of positive long-term effects of offshore wind farms on seabird prey communities means that no definitive conclusion can be made. Based on currently available studies it is concluded that indirect impacts on bird communities through prey are likely to represent a very slight change to baseline conditions with no or limited positive effects. The impact for **all VORs** during all seasons is therefore evaluated as a negligible (neutral or slightly positive) impact.

Displacement

117 Displacement resulting from operating WTGs can exclude birds from suitable breeding, roosting, and feeding habitats around a larger area than otherwise would occur through direct habitat loss (Exo *et al.*, 2003). Displacement may result from birds avoiding WTGs and other wind farm structures, and/or because of changes in the habitat which impact on its attractiveness to birds, for example the abundance or availability of prey. The implications of such displacement at the population scale, in terms of the effects on population viability, depends on the importance of the area from which birds are displaced and the capacity of alternative areas to support displaced birds. Breeding seabirds must return to the nest to incubate eggs and feed chicks and are potentially constrained to obtain food within a certain distance of their breeding colony. Displacement-induced loss of foraging habitat may lead to a reduction in food supply within the foraging range, which in turn may affect adult body condition and could conceivably lead to reduced breeding success and/or individual survival or abandonment of the breeding territory. Outside the breeding season the area may be used for foraging and/or moulting.

118 As is the case for onshore wind farms, to date there is no consistent statistically significant evidence on the exact extent to which birds are displaced from offshore wind farms. Some early work reported effects out to four kilometres for scoters and auks (Petersen *et al.*, 2006), whilst some species such as divers and auks appear to avoid flying or foraging to within several hundred metres of WTGs (Kerlinger and Curry, 2002). Not all species avoid wind farms, and some such as gulls and cormorants may be attracted (Petersen *et al.*, 2006).

119 In their more recent review, Wright and Burton (2011) assessed the availability of bird data for the pre-, during and post-construction periods for nine operational offshore wind farms in the UK and Europe and concluded that at many sites the numbers of birds of most species recorded were too small to be able to assess displacement rates, although for some sites information on post-construction monitoring was not available at the time of their review.

120 Data from boat surveys conducted around the Kentish Flats Offshore Wind Farm (comprising 30 WTGs situated 8.5 to 13 km north of Herne Bay and Whitstable in south east England), were analysed by Rexstad and Buckland (2012). The study focused on the five most commonly recorded species: red-throated diver, lesser black-backed gull, herring gull, common gull and cormorant. There was insufficient data to conclude whether there was evidence of displacement or not. For the purposes of measuring displacement, the survey area was noted to be a limiting factor in that birds displaced away from the wind farm could only be detected if they relocated within a few kilometres. This sheds light on the potential problems of measuring and detecting displacement effects using survey data. Ideally a survey area should be sufficiently large to cover areas where displaced birds might relocate to, but it is evident this may be difficult to achieve given the potentially large areas over which seabirds forage. Data which demonstrate a reduction in density of birds within a wind farm pre- and post-construction may indicate displacement, but changes in seabird density in a given area may also occur for other reasons, and therefore a suitably large area must also be monitored before robust conclusions can be drawn.

121 Other comparative studies of offshore wind farms pre- and post-construction have been undertaken (e.g. Horns Rev and Nysted in Denmark, Petersen *et al.*, 2006; the Kalmar Sound in Sweden, Pettersson, 2005; Egmond aan Zee, the Netherlands, Lindeboom *et al.*, 2011), although the wind farms studied have all been located in shallower depths and nearer to shore than the Inch Cape Development Area. Consequently, a somewhat different suite of species, notably comprising wintering populations of seaduck, have been the primary targets for research on displacement effects to date. At present there is limited evidence to enable prediction of displacement of seabirds from WTG arrays close to breeding colonies. Due to the differences in the marine environment and key bird species prevalent in the Development Area, previous research can guide displacement predictions, but cannot be assumed to be directly comparable to the assessment of potential effects on foraging seabirds during the breeding season. At Thorntonbank and Blighbank wind farms off the coast of Belgium, pre-construction surveys and monitoring surveys covered the wind farm area, a three kilometre buffer and a separate control area with similar environmental conditions and comparable seabird numbers (Vanermen *et al.*, 2012). Seabird densities in the control and impact areas pre- and post- construction were compared. Overall the results for the two wind farms indicated attraction effects for some species (common gull, little gull, great-black-backed gull, kittiwake, common tern and sandwich tern) no detectable change for others (fulmar, great skua, lesser black-backed gull, herring gull, and razorbill) and significant decreases in density for only two species (guillemot and northern gannet).

122 As well as the above post-construction monitoring work, attempts have been made to model displacement impacts at potential offshore sites. Notably, a preliminary model for breeding guillemots has been developed at CEH, which assumes birds which formerly travelled to forage within a wind farm site were displaced and that birds travelling to foraging areas beyond the wind farm flew around the site. The model considered the energetic consequences of displacement for guillemots breeding at the Isle of May in relation to the Neart na Gaoithe offshore wind farm in the outer Firth of Forth (situated approximately 26 km south of the Development Area). Increased energetic costs were assumed for a subset of

the breeding guillemot population displaced from the wind farm site; a reduction in average prey densities in the remaining habitat was also assumed due to increased intra-specific competition, affecting not just displaced birds but the population as a whole. The model predicted increases in the time required for flight and foraging associated with the presence of the wind farm, for example of about 20–30 per cent under a scenario of randomly distributed prey. It was considered that displacement is not likely to result in death but in changes to daily time and energy budgets of seabirds (McDonald *et al.*, 2012).

123 Outside the breeding season, long range migratory seabird species are unlikely to be significantly affected by displacement as their presence in a given area is generally highly transient, with distribution probably largely steered by weather conditions and opportunistic feeding opportunities.

Assessment of Displacement

124 A review of displacement (Wright and Burton, 2011) described that it is common practice for EIAs of offshore wind farms to assume that the majority of birds using a site prior to construction will be displaced by the operational wind farm and from a surrounding buffer zone. It may also be assumed that all displaced birds die. However, field observations of birds at a number of operational sites suggest few or no species are displaced completely, many continue to use a site following construction and some species (as highlighted above) may even be attracted to a site if habitat change provides new feeding opportunities, or other resources (e.g. roosting sites).

125 Recent approaches to displacement for the purposes of EIA for offshore wind farms have varied:

- For the Moray Firth Round 3 Zone 1 (Eastern Development Area (EDA)) (MORL, 2012; Appendix 4.5A), two scenarios were considered: a worst case scenario of 100 per cent displacement for gannet, fulmar and auks and 50 per cent for kittiwake and gulls; and a realistic scenario of 50 per cent for gannet, fulmar and auks and 10 per cent for kittiwake and gulls. The realistic scenario was based on monitoring from the Robin Rigg offshore wind farm (MORL, 2012; Appendix 4.5A) and monitoring results from offshore wind farms elsewhere in Europe. The displacement analysis considered only birds recorded on the sea or, in the case of aerial foragers, using the sea, and excluded birds in flight, defining displacement as a reduction in the numbers of birds using the sea (for foraging, resting etc.). It was assumed under the worst case scenario that all displaced birds would fail to breed; the same assumption was made under the realistic scenario for all species except for fulmar and gannet where 50 per cent breeding failure was predicted because of the greater foraging ranges of these species. The significance of the potential impacts under different scenarios was assessed with reference to population viability analysis, considering the change in likelihood of population decline associated with the different displacement scenarios.
- For Beatrice Offshore Wind Farm (Beatrice Offshore Wind Farm Ltd., 2012) displacement impacts on breeding seabirds were explored through population modelling, assuming 100

per cent displacement and that each displaced breeding adult was part of a pair that failed to reproduce.

- For the Firth of Forth Phase 1 (Seagreen, 2012: Chapter 10 Ornithology), the extent of displacement has also been discussed under different scenarios: a worst case scenario of 100 per cent displacement resulting in 100 per cent mortality and a 'practical' scenario based on predicted disturbance distances for different species. In the latter scenario, avoidance distances from WTGs were used to estimate the proportion of the wind farm from which a species would be displaced, assuming that birds would use all areas outside a given radius from each WTG. Avoidance distances were estimated at 300 m for kittiwakes, and 400 m for razorbill, puffin and guillemot giving displacement predictions of 9.9 per cent for kittiwake and 16.9 per cent for auks. Displacement effects on gannet and fulmar were not assessed. It was further assumed that one per cent of displaced individuals would die. The displacement assessment also considered the location of the wind farm sites within the Round 3 zone in relation to information on the core foraging ranges of seabirds from breeding colonies classified as SPAs.
- For Neart na Gaoithe, it was assumed that seabirds were displaced from the offshore site and a one kilometre buffer (Mainstream, 2012: Chapter 12 Ornithology). Displacement was assumed to be 100 per cent for gannet and fulmar, 50 per cent for auks, and 25 per cent for terns and gulls. The assessment considered the proportion of a given species population present at the site, based on estimates from boat surveys, as a measure of the importance of the area to that species. During the breeding season, published estimates of colony attendance rates were used to estimate the total number of birds from a colony that would be away at sea at a given time (e.g. for a colony of 10,000 birds with a 60 per cent attendance rate at any one time a total of 4,000 birds would be expected to be away at sea). The population estimate of a given species within the offshore site and buffer was expressed as a proportion of the estimated number of birds at sea. This was used to provide an indication of the proportion of the foraging habitat likely to be lost for that species as a result of displacement (Mainstream, 2012). No assumptions were made about potential impacts of displacement on mortality or reproductive rates of seabird populations.

126 A request from Marine Scotland for a preliminary analysis of breeding season impacts at the offshore wind farms within the Forth and Tay area was received in August 2011 (NIRAS, 2012; Appendix 1). Developers were asked to consider a range of displacement rates for seabirds within the "wind farm footprint and a 2 km buffer": 50 – 100 per cent displacement for gannet, guillemot, razorbill and puffin, and 0 – 50 per cent for kittiwake and herring gull. The full range of the displacement spectrum for each species (10 - 100 per cent) is provided in *Appendix 15A, Annex 15A.5*.

127 Available studies - see Wright and Burton (2011) and above discussion - of offshore wind farms post-construction indicate that it is excessively precautionary to predict that all seabird species will be completely displaced from the Development Area during operation of the Wind Farm and OfTW (see above discussion of recorded displacement levels). The following assessment therefore considers the available evidence for displacement on a

species by species basis, together with potential reduction in post-construction density based on this.

128 For the purposes of predicting potential displacement impacts, assuming that displaced birds die is also considered excessively precautionary. Instead it is considered that all, or a proportion of, displaced birds fail to breed, depending on species. Consideration is given to whether this is likely to result in population level effects by assessing the predicted change in productivity against available information on breeding success. This reasoning that displaced birds fail to breed rather than die is based on life-history theory as applied to long-lived species such as seabirds, which predicts that they buffer themselves against the impacts of food supply on adult survival, for example by refraining from breeding in years when food is scarce, or through brood reduction (Furness and Tasker, 2000). Some seabird studies support this hypothesis, although some exceptions have been noted, e.g. in relation to kittiwakes breeding on the northern isles off Scotland (Oro and Furness, 2002). However, in this case, other factors such as increased great skua predation on adult kittiwakes affected adult survival in years of low food abundance.

129 Overall, for this assessment it is assumed that birds which are displaced from foraging areas within the Development Area cannot be accommodated in alternative areas of equivalent quality outside the Development Area and are forced to use sub-optimal areas and/or travel increased distances to feed and therefore do not reproduce successfully.

130 The estimated numbers of birds displaced are based on the peak mean bird densities recorded during boat surveys in the appropriate seasons (bird surveys were undertaken over a period of two years and the highest annual mean for a season was used) in the Development Area and a 2 km buffer. The inclusion of the 2 km buffer reflects the available evidence from post construction monitoring that displacement effects are likely to extend beyond the WTG array of a wind farm (e.g. as demonstrated for auk species at the Horns Rev Wind Farm in Denmark – Petersen and Fox, 2007). However, although there is evidence that displacement effects can extend beyond a wind farm area itself and into the immediately surrounding areas, there appear to be no data available on the relative extent of displacement in these different zones. Biologically, it seems most likely that the magnitude of such effects will decline with distance from a wind farm and, therefore, the assumption made here that the effects within the 2 km buffer are equal to those within the actual wind farm area is likely to be precautionary. Displacement is considered separately for the breeding and non-breeding seasons, and for some species also post-breeding. It is possible, although unproven, that breeding birds might be less susceptible to displacement or more likely to habituate to offshore wind farms than non-breeding birds; given that breeding birds are more constrained in their foraging opportunities by the need to attend a nest site.

131 During the breeding season it is assumed that 50 per cent of the estimated site population of adult birds comprises breeding adults, based on advice from Marine Scotland and SNH (NIRAS, 2012; Appendix 1). For four species (kittiwake, guillemot, razorbill and puffin) where the impacts of displacement were considered to have the potential for population level effects, population viability analysis was carried out, (see *Appendix 15B*). For these species, stable age distributions estimated by population models were used to estimate the

proportion of birds which were breeding adults. For gannet, a PVA commissioned by SOSS (WWT Consulting, 2012) found no evidence of non-breeding adults at monitored colonies and it has been assumed that 100 per cent adult plumage birds present during the breeding season are breeding.

132 The Population Viability Analysis carried out here assesses whether the predicted impacts could affect the annual population processes such that the long term viability of the population is compromised. While the models produced predicted effects up to 25 years into the future, the ability to predict further into the future was only limited by the uncertainties in the model processes. As is typical with population modelling, the ability of this model to make usable predictions beyond 25 years is low. However, since the predicted impacts from the Project were concluded not to impact population viability through the annual processes, it is likely, within the assumptions of the model, that assessments and conclusions for the modelled period would be maintained in the longer term.

133 Table 15.14 provides an overview of the assessment of operational displacement for each VOR based on the displacement (and PVA) modelling that has been undertaken.

Table 15.14: Potential Impacts of Displacement from the Development Area and 2 km buffer on Valued Ornithological Receptors

Species	Assessment of Displacement	Conclusion
Fulmar	Very little evidence is available in relation to likely displacement or reduction in density of fulmars by offshore wind farms. Langston (2010) classified fulmar as of at low risk of displacement based on the species' ecology. Monitoring at two Belgian Wind Farms after partial construction showed no detectable relationship between changes in fulmar density in relation to two wind farms: Thorntonbank (six of 54 WTGs in place, 27 km offshore), and Blighbank wind farm (55 of 100 WTGs constructed, 40 km offshore); in both cases the densities of fulmars in the wind farm and a nearby control area were lower after partial construction compared with pre-construction (Vanermen *et al.*, 2012). Fulmars were rarely seen during studies at the Egmond Aan Zee offshore wind farm, off the Netherlands, as would be expected for a pelagic species that is not often observed in coastal waters (Krijgsveld *et al.*, 2011). A scenario of 100% displacement has been assumed. **Breeding** The peak mean population estimate for the Development Area and a 2 km buffer during the breeding season is 72 adults of which 36 (50%) are assumed to be breeding (*Appendix 15.A*, Table 15A.39). It is predicted that all birds would be displaced. Because of the large potential foraging range of fulmar as well as its broad diet, it is considered very unlikely that all displaced birds will suffer breeding failure; a precautionary assumption has been made that 50% of displaced birds will suffer breeding failure and all birds are from different breeding pairs. Thus 18 pairs are predicted to fail because of displacement. This can be compared to available information on the breeding success of fulmars. Breeding success of fulmars at the Isle of May (part of the regional breeding population for the Project, which is estimated to extend between Caithness in the north and Flamborough Head in the south; *Appendix 15A*, *Section 15A.3.2.1*) between 2007 and 2010 was 0.28 chicks per pair (varying between 0.13–0.44; CEH, 2012). Applying this rate to the regional population of 41,112 pairs (*Appendix 15A*, *15A.3.2.1*) predicts that 11,511 chicks will fledge annually (note that breeding success on the Isle of May between 2007 – 2010 included two of the worst years on record (CEH, 2012) so applying the breeding success for the Isle of May to the regional population will almost certainly under-estimate breeding success). The failure of 18 pairs due to displacement from the Development Area represents a loss of five chicks (assuming that the breeding success would otherwise have been 0.28 chicks per pair) and a 0.04% increase in breeding failure. The assessment considered a VOR of high sensitivity and operational displacement impacts of negligible magnitude. If the species does not fully habituate to the presence of the WTG array, there is a potential for displacement to affect at least a proportion of the population throughout the operational phase. However, it is considered that such an effect will be offset by the species' very large foraging range, its flexibility in exploiting a multitude of food resources, and the limited spatial extent over which displacement is likely to occur. It is concluded that the predicted impact on the regional fulmar breeding	**Breeding and non-breeding** Negligible impact

Species	Assessment of Displacement	Conclusion
	population through displacement is negligible as it represents a slight change from baseline conditions, with any effects likely to fall within fluctuations of natural variation. **Non-breeding season** Outside the breeding season, a peak mean population of 101 individuals was estimated within the Development Area and a 2 km buffer (*Appendix 15A*, Table 15A.39). A worst case scenario of 100% displacement would affect <0.1% of the regional population and the North Sea population (*Appendix 15A*; Table 15A.39). Given the wide potential foraging range of this species and the fact that non-breeding fulmars are much less constrained in their foraging areas than during the breeding season, displaced birds would be predicted to be capable of exploiting alternative areas without consequences to individual survival. The assessment considered a VOR of high sensitivity and operational displacement impacts of moderate (regional population) and low (North Sea population) magnitude. Based on the wide potential foraging range of fulmars during this time of year, the fact that non-breeding birds are much less constrained in their foraging areas than during the breeding season, and the likelihood that displaced birds are capable of exploiting alternative areas without consequences to individual survival, displacement during the non-breeding season is concluded to have a negligible impact on both the regional and the North Sea population.	
Gannet	Langston (2010) and Furness and Wade (2012) classified gannet as at low risk of displacement based on the species' long-ranging capacity and foraging flexibility. Preliminary results from post-construction monitoring of the Robin Rigg offshore wind farm (Walls *et al.*, 2013) suggest an overall annual displacement rate of 50% displacement for gannets. Robin Rigg is likely to lie within the foraging range of gannets at Scar Rocks and Ailsa Craig in southwest Scotland. At the Dutch offshore wind farm Egmond aan Zee, gannets were found to avoid entering the WTG array, with only 3% of observations inside the wind farm, 14% at the edge and 83% outside; gannets were reported to fly in a wide range around the wind farm (Krijgsveld *et al.*, 2011). Monitoring at two Belgian Wind Farms after partial construction showed no detectable change in gannet density at the Thorntonbank wind farm (six out of 54 WTGs in place, 27 km offshore), but a significant decrease in gannet numbers within the Blighbank wind farm (55 out of 100 WTGs constructed, 40 km offshore) although no estimate of reduced density is given (Vanermen *et al.*, 2012). The Dutch and Belgian wind farms, in the southern North Sea, are probably outwith the foraging range of any gannet breeding colonies. A precautionary 75% displacement scenario has been identified given that the few known studies indicate that total displacement is unrealistic, and the lowest available estimate of reduced numbers post-construction is 50%.	**Breeding and non-breeding** Negligible impact

Species	Assessment of Displacement	Conclusion
	Breeding season At 75% displacement it is predicted that 973 adult breeding birds would be displaced from the Development Area and a 2 km buffer during the breeding season (*Appendix 15.A*, Table 15A.42). Because of the large potential foraging range and flexible foraging strategy of gannet it is considered very unlikely that all displaced birds will suffer breeding failure; a precautionary assumption has been made that 50% of displaced birds will suffer breeding failure and all birds are from different breeding pairs. Thus 487 pairs are predicted to fail because of displacement. This can be compared to available information on the breeding success of gannets. It is most likely that gannets recorded during the boat-based bird surveys during the breeding season are from the Forth Islands SPA (Bass Rock). The mean breeding success of gannets on the Bass Rock is 0.77 chicks per pair (standard deviation 0.05, n=12 years, WWT Consulting, 2012). Assuming all gannets within the regional population have a similar breeding success, a regional population of 58,629 breeding pairs (*Appendix 15A*, *Section 15A.3.2.4*), would be expected to fledge 45,144 chicks annually. If 487 pairs fail to breed due to displacement from the Development Area and 2 km buffer then this represents a loss of 375 chicks (assuming the breeding success of these pairs would otherwise have been 0.77) and a 0.8 % increase in annual breeding failure. However a population model for gannets in the British Isles indicated that population growth rate was sensitive to changes in adult survival rates, but that changes in reproductive rates (over a range of ± 4%) had little impact (WWT Consulting, 2012). To provide context for the assessment of displacement during the breeding season, the potential displacement area can be compared with the foraging range for gannets in the regional population, likely to derive mainly from Bass Rock. Hamer *et al.* (2011) estimate the potential foraging range of this colony to be in excess of 200,000 km^2; if 75% of birds are displaced from the Development Area plus a 2 km buffer, a total of 278 km^2, this is equivalent to a loss of about 0.1% of potential foraging habitat for the regional population, if all areas within foraging range provide suitable foraging habitat. However, in reality, not all areas within the foraging range will be used equally, and preferred foraging areas may vary between years. The assessment considered a VOR of high sensitivity and operational displacement impacts of moderate magnitude (at a 0.8% reduction in breeding success). If the species does not fully habituate to the presence of the WTG array, there is a potential for displacement to affect at least a proportion of the population throughout the operational phase. However, it is considered that such an effect will be offset by the species' very large foraging range, its flexibility in exploiting a multitude of food resources, the population's relative insensitivity to small changes in reproduction rates, and the limited spatial extent over which displacement is likely to occur (the Development Area and its immediate vicinity). It is concluded that the predicted impact on the regional gannet breeding population through displacement is negligible as it represents a slight change from baseline conditions, with any effects likely to fall within fluctuations of natural variation.	

Species	Assessment of Displacement	Conclusion
	Non-breeding season Outside the breeding season, much lower numbers of gannets were recorded in the Boat-based Survey Area, with a peak mean of 196 individuals within the Development Area and a 2 km buffer (*Appendix 15A*, Table 15A.42). A worst case scenario of 75% displacement would affect 0.5% of the regional population and 0.1% of the North Sea population (*Appendix 15A*; Table 15A.42). The origin of the birds recorded at the Development Area at this time of year is diverse and it is likely to include some birds from Bass Rock, but also many birds from colonies further north in Britain and Europe (Fort *et al.*, 2012). The assessment considered a VOR of high sensitivity and operational displacement impacts of moderate (regional population) and low (North Sea population) magnitude. Based on the wide potential foraging range of gannets during this time of year, the fact that non-breeding birds are much less constrained in their foraging areas than during the breeding season, and the likelihood that displaced birds are capable of exploiting alternative areas without consequences to individual survival, displacement during the non-breeding season is concluded to have a negligible impact on both the regional and the North Sea population.	
Shag	**Breeding season** The Development Area is beyond the maximum foraging range of all but two small breeding colonies in the Forth and Tay area, and very few birds were recorded during boat surveys in the breeding season (a peak mean of one bird in the 2 km buffer, *Appendix 15A*, Table 15A.44). Consequently the Development Area is considered to be of very low importance as a foraging area for shags during the breeding season. The assessment considered a VOR of moderate sensitivity and operational displacement impacts of negligible magnitude. Given that the species was absent in the Development Area during the breeding season and occurred in very low numbers in the 2-0 km buffer zone, as well as the distance to the nearest colonies (at the edge of the species maximum foraging range of 17 km, Thaxter *et al.*, 2012), displacement is evaluated as a negligible impact as it is predicted to represent a very slight change from baseline conditions, with any effects likely to fall well within fluctuations of natural variation. **Non-breeding season** In the non-breeding season few shags were recorded during boat-based surveys and none were recorded within the Development Area (*Appendix 15A*, *Section 15A.3.2.5*). Shags forage almost exclusively in inshore waters throughout the year and therefore the Development Area is not predicted to provide an important foraging area for this species in the non-breeding season. The assessment considered a VOR of moderate sensitivity and operational displacement impacts of negligible magnitude. Given that the species was absent in the Development Area during the non-breeding season and occurred in very low	**Breeding and non-breeding** Negligible impact

Species	Assessment of Displacement	Conclusion
	numbers in the 2 km buffer zone, displacement is evaluated as a negligible impact as it is predicted to represent a very slight change from baseline conditions, with any effects likely to fall well within fluctuations of natural variation.	
Arctic skua	There is very little empirical evidence on which to estimate potential displacement impacts for skuas. Small numbers of skuas (including great and Arctic skuas) were recorded during visual observations at Egmond aan Zee Wind Farm in the Netherlands. Three skuas were recorded flying towards the wind farm and all birds flew through (Krijgsveld *et al.,* 2011). Great skuas were recorded during monitoring at Blighbank wind farm in Belgium, although no displacement or attraction effects were detected for this species (Vanermen *et al.*, 2012). In this assessment a 100% displacement rate has been assumed. **Breeding season** Arctic skuas were recorded within the Boat-based Survey Area on autumn passage only (*Appendix 15A*, *Section 15A.3.2.13*) and there are no breeding colonies within foraging range. Thus no impacts of displacement are predicted. **Post-breeding/passage** At 100% displacement an estimated six birds are predicted to be displaced from the Development Area and a 2 km buffer (*Appendix 15A*, Table 15A.53), representing 0.6% of the estimated regional passage population and <0.1% of the North Sea passage population. The assessment considered a VOR of moderate sensitivity and operational displacement of moderate to negligible magnitude. In light of the species' tendency to kleptoparasitise other species, the considerable length of the its migratory pathway and the likely high turnover in birds moving through the Development Area it is considered that spatial and temporary overlap of any impact is likely to be minimal on an annual basis (even though impacts could occur for the lifespan of the Wind Farm if no habituation were to occur). This effectively represents no more than a very slight change away from baseline conditions and evaluation therefore concludes the impact to be negligible.	**Breeding** N/A **Post-breeding/ passage** Negligible impact
Great skua	There is very little empirical evidence on which to estimate potential displacement impacts for skuas (see entry for Arctic skua above). **Breeding season** Great skuas were recorded within the Boat-based Survey Area during the autumn passage/non-breeding season only (*Appendix 15A*, *Section 15A.3.2.12*) and there are no breeding colonies within foraging range. Thus no displacement impacts are predicted.	**Breeding season** N/A **Post-breeding/ passage** Negligible

Species	Assessment of Displacement	Conclusion
	Post-breeding/passage Outside the breeding season, great skuas are found in offshore and oceanic waters. An estimated 12 birds were predicted to be displaced from the Development Area and a 2 km buffer (*Appendix 15A*, Table 15A.52), representing 0.1% and <0.1% of the regional and North Sea passage populations if 100% of these birds were to be displaced. The assessment considered a VOR of moderate sensitivity and operational displacement impacts of low to negligible magnitude. In light of the species' dietary flexibility, the considerable length of the its migratory pathway and the likely high turnover in birds moving through the Development Area it is considered that spatial and temporary overlap of any impact is likely to be minimal on an annual basis (even though impacts could occur for the lifespan of the Wind Farm if no habituation were to occur). This effectively represents no more than a very slight change away from baseline conditions and evaluation therefore concludes the impact to be negligible.	impact
Puffin	Post-construction data from Robin Rigg offshore wind farm in the Solway Firth reported a 30% reduction in auk numbers during the first year of operation (Walls *et al.*, 2013); although very small numbers of puffins were recorded and no specific assessment of displacement was carried out for this species. Robin Rigg appears to lie within the foraging range of puffin breeding colonies on the south-west coast of Scotland (based on maps in Mitchell *et al.*, 2004) so the reduction in numbers could apply to breeding birds. No observations of puffins are reported for studies of offshore wind farms from the Netherlands, Belgium and Denmark (studies by Krijgsveld *et al.*, 2011; Vanermen *et al.*, 2012; and Petersen *et al.*, 2006 reported below for razorbill and guillemot), reflecting the scarcity of this species in the southern North Sea. A scenario of 50% displacement has been identified based on the approach taken for the other auk species. **Breeding** At 50% displacement it is predicted that up to 1,478 individuals will be displaced from the Development Area and a 2 km buffer (*Appendix 15A*, Table 15A.61). Given the relatively limited foraging range of puffins (although the species tends to cover larger areas than razorbill and guillemot, *Appendix 15A*, Table 15A.5), it is assumed that 100% of displaced birds fail to breed successfully and that all are from separate breeding pairs. Breeding success of puffins at the Isle of May (part of the regional breeding population) between 2007 and 2012 was 0.60 chicks per pair (CEH, 2012; see also *Appendix 15B*, Table 15B.4 – note that this table gives breeding success as fledglings per adult bird, so it has been doubled for pairs). Assuming that productivity is similar for all puffins in the regional breeding population (114,642 pairs, *Appendix 15A*, *Section 15A.3.2.19* – note that the latter table gives breeding success per adult rather than per pair), then in a given year 68,785 chicks will fledge. If 1,478 pairs fail because of displacement from the Development Area and 2 km buffer, this would reduce overall breeding success by 887 chicks (assuming that the breeding success would otherwise have been 0.60 chicks per pair),	**Breeding** Minor impact **Post-breeding and non-breeding** Negligible impact

Species	Assessment of Displacement	Conclusion
	representing a 1.3% increase in breeding failure. Population viability analysis has been carried out to further investigate the impacts of displacement for puffin. A population model has been developed based on empirical estimates of demographic parameters (rates of survival and reproduction) from regional populations with potential connectivity to the Development Area. Full details are included in *Appendix 15B, Section 15B.3.5*. The population model, based on demographic data from the Isle of May, predicts an increase of about 20% over 25 years, although with considerable variability about the mean values for population size, which indicates a high degree of uncertainty in the predictions (*Appendix 15B*, *Section 15B.3.5.1*). Displacement at 50% has minimal or no detectable effects on limiting population growth at most levels of increase. Impacts on the likelihood of population growth increase under higher displacement levels but remain relatively small, even at assumed displacement of 100%. Lewis *et al.* (2012) indicate that the recent trend of puffins in the Forth Islands SPA is unclear. Harris and Wanless (2011) report that on the Isle of May, numbers increased steadily from the mid-1950s until 2003 but had declined by about 30% by 2008, which seemed to be associated with two consecutive winters (2006/07 and 2007/08) of aberrant low adult survival; similar changes appear to have taken place at other colonies within the Forth Islands SPA. Adult survival rates appear to have increased to more typical levels in the past two years (Harris and Wanless, 2011), so it is unclear whether the recent population declines will be of a short- or long-term nature. Recent UK and Scottish trends for puffins are not available due to the logistical difficulties of regular monitoring of these burrow-nesting birds. Numbers were estimated in national seabird censuses in 1969 – 70, 1985 – 88 and 1998 – 2002, indicating an increase in the UK population over this period (JNCC, 2012a). Based on the above, although there is considerable variation around the model predictions, displacement impacts (via reductions in breeding success) are not considered likely to cause population declines, but to limit population growth, with the predicted effects being minimal (as described above and in *Appendix15B*, *Section 15B.3.5.2*). The assessment considered a VOR of high sensitivity and operational displacement impacts of high magnitude (based on a 1.3% reduction in breeding success). Puffin population modelling predicts that displacement effects of this magnitude are unlikely to lead to a population decline, but rather have the potential to limit the population growth. Displacement effects on the regional puffin breeding population are evaluated as a minor impact as the predicted effect on the long-term population growth rate is small and considered to be within acceptable limits. To provide context for the assessment of displacement, the total foraging area available to puffins which use the Development Area and a 2 km buffer during the breeding season can be estimated. Based on a foraging range of 151.4 km (Thaxter *et al.*, 2012, see *Appendix 15A,* Table 15A.5), puffins within the regional population for the Project (all breeding	

Species	Assessment of Displacement	Conclusion
	colonies within foraging range) can potentially forage over 83,446 km^2 of sea. The Development Area and a 2 km buffer occupies an area of 278 km^2 so if 50% of this area is lost (if half of the birds are displaced) this is equivalent to a loss of about 0.2% of potential foraging habitat for the regional population, if all areas within foraging range provide suitable habitat. However, in reality, not all areas within the foraging range will be used equally, and preferred foraging areas may vary between years. **Post breeding** At a 50% displacement scenario it is predicted that 1,344 puffins are predicted to be displaced from the Development Area and a 2 km buffer (*Appendix 15A*, Table 15A.61). As birds are not constrained by the need to attend a nest site, they are able to forage over large areas. At this time of year, any displacement from the Development Area and a 2 km buffer is not predicted to affect the survival of individuals or the breeding success of pairs, as it is considered that sufficient alternative habitat exists to accommodate displaced birds. Thus no changes in survival rates are predicted. The assessment considered a VOR of high sensitivity and operational displacement impacts in the post-breeding season of negligible magnitude. Based on the localised impact of displacement relative to the large potentially available foraging area during this time of year, displacement is considered spatially limited and short term on an annual basis as puffins move rapidly further offshore (yet long term in relation to the lifespan of the Project if no habituation occurs). Displacement is therefore evaluated as a negligible impact. **Non breeding** At 50% displacement, it is predicted that 190 birds are displaced from the Development Area and a 2 km buffer (*Appendix 15A*, Table 15A.61). As is the case for the post-breeding season, birds are not constrained at this time of year by the requirement to attend a nest so they are able to forage over extensive areas. Recent deployment of geolocators on puffins from the Isle of May has shown that the most intensively used area is the northern North Sea, but that more than three-quarters of marked birds moved around the north coast of Scotland into the Atlantic (Harris *et al.*, 2010; Harris and Wanless, 2011). At this time of year, birds range over large areas of open sea and any displacement from the Development Area and a 2 km buffer is not predicted to affect survival. The assessment considered a VOR of high sensitivity and operational displacement impacts of negligible magnitude. Based on the localised impact of displacement relative to available foraging areas during non-breeding (when the species is no longer constrained by nest-attendance), it is evaluated as a negligible impact as any impact is likely to lie within the limits of natural variation.	

Species	Assessment of Displacement	Conclusion
Razorbill	Monitoring data from Robin Rigg offshore wind farm in the Solway Firth found a displacement rate of 30% for auks in the first year of operation. Specifically, for razorbill, the predicted densities of birds recorded on the sea within the WTG area were approximately 15% lower during the first year post-construction than during the pre-construction monitoring period (with the raw counts approximately 30% lower), although these differences were based upon relatively small sample sizes (particularly during the breeding season) and were not statistically significant. The conclusions state that based on analysis for the first year of operation there was no evidence of razorbills avoiding the wind farm site (Walls *et al.*, 2013). Robin Rigg is within the foraging range of razorbill breeding colonies on the south-west coast of Scotland (based on maps in Mitchell *et al.*, 2004) so the reduction in numbers could apply to breeding birds. No other empirical estimates of displacement or reduced densities of razorbills at offshore wind farms have been found. Post-construction monitoring at Horns Rev offshore wind farm, Denmark, indicated that guillemot/razorbill (aerial survey data was used so the two auk species could not be distinguished) avoided the wind farm area and areas up to four kilometres away, although the results were not statistically significant because of large variation in the dataset (Petersen *et al.*, 2006). In this study the highest densities of auks were present in the winter months. Results from boat surveys suggest that wintering guillemots and razorbill avoided the Egmond aan Zee offshore wind farm, Holland (Krijgsveld *et al.,* 2011) but it was not possible to show statistically significant effects because of the low densities present (Leopold *et al.*, 2010 quoted in Poot *et al.*, 2011); however it is also reported that razorbills may enter the wind farm by swimming and that they regularly forage within the wind farm boundaries (Leopold *et al.*, 2010 quoted in Poot *et al.*, 2011). Monitoring at the Blighbank wind farm, off Belgium, did not suggest any reduction in razorbill densities after WTGs were built, rather an apparent increase in densities in the wind farm and a control area (Vanermen *et al.*, 2012). A 50% displacement scenario has been used, given that available studies indicate that total displacement would be unrealistically precautionary. This percentage is still considerably above the rates identified from other post-construction estimates (e.g. 30% for auks). **Breeding season** Assuming 50% displacement, up to 718 individuals are predicted to be displaced from the Development Area and a 2 km buffer (*Appendix 15A*, Table 15A.59). Given the relatively limited foraging range of razorbills, it is assumed that all displaced birds fail to breed successfully and that all are from separate breeding pairs. The regional breeding population is estimated at 13,521 pairs (derived from 20,181 counted individuals on land with a correction factor of 0.67, *Appendix 15A*, *Section 15A.3.2.18*). Breeding success of razorbills at the Isle of May (part of the regional breeding population) between 2007 and 2012 was 0.60 chicks per pair (CEH, 2012; see also *Appendix 15B*, Table 15B.4 – note that the latter table gives breeding success per individual rather than per pair); assuming that productivity is similar for all razorbills in the regional breeding population, in a given year 8,113 chicks will be produced. Failure of 718 pairs because of displacement from the Development Area and a 2 km buffer would reduce the overall breeding success by 431 chicks (assuming that the breeding	**Breeding** Minor impact **Post-breeding and non-breeding** Negligible impact

Species	Assessment of Displacement	Conclusion
	success would otherwise have been 0.60 chicks per pair). This represents a 5.3% increase in breeding failure. Population viability analysis has been carried out to further investigate the impacts of displacement for razorbill. A population model has been developed based on empirical estimates of demographic parameters (rates of survival and reproduction) from regional populations with potential connectivity to the Development Area. Given the magnitude of the increase in breeding failure resulting from a 50% displacement level, where all displaced birds are assumed to fail (i.e. 5.3% - see above), and that this is based on precautionary assumptions, the PVA also investigated the effects of 25% displacement. For both 50% and 25% displacement, scenarios of 100%, 75% and 50% breeding failure were investigated, with each displaced bird being assumed to be from a separate breeding pair. The 25% displacement level may be a more realistic representation of the likely displacement effects, given that the (albeit limited) available evidence suggests a maximum 30% displacement for auks (see above). Full details are included in *Appendix 15B*, *Section 15B.3.4*. A model based on survival and breeding success for razorbill on the Isle of May population predicts an increasing population over the next 25 years, with a probability of about 0.5 of a 50% increase (*Appendix 15B*, *Section 15B.3.4.1*). Incorporating the potential impacts of displacement (in terms of reduced breeding success) indicates that the effect is to limit the predicted population increase. Assuming 50% displacement and 100% failure for displaced birds indicates a near 10% decrease in the likelihood of the population increasing by at least 50% (*Appendix 15B*, Figure 15B.11). Thus, based upon the PVA used here, the predicted rates of displacement from the Development Area and 2 km buffer are highly unlikely to cause population decline, but may limit growth. The extent to which displacement may limit growth is predicted to be greatest for situations of relatively high population growth (i.e. for population increases of 25% – 75%, displacement decreases the likelihood of achieving such increases by circa.6% – 10%). However, for more moderate levels of population increase, the risk of displacement impacts is reduced (*Appendix 15B*, Figure 15B.11). As it would be expected, these predicted impacts are considerably less when 25% displacement is assumed, so that the likelihood of achieving relatively high population growth of 25% - 75% is reduced by only 3% - 4% (see *Appendix 15B*, Table 15B.12). Similarly, reducing the assumed level of breeding failure amongst displaced birds reduces the predicted impact. With 50% displacement, a reduction from 100% to 75% in the assumed breeding failure amongst displaced birds produces marginal differences only, but with 50% breeding failure the predicted reduction in the likelihood of the population achieving relatively high growth is at most 5% (see *Appendix 15B*, Table 15B.12). Demographic data derived from the Scottish east coast were generally scarcer for razorbill than for other species for which PVA was undertaken (see *Appendix 15B*, *Section 15B.2.2.1*) and so confidence in the applicability of model outputs will be less than for (at least some of) these other species. The available data on razorbill population trends within the region were of limited value in assessing the likely reliability of the model outputs in terms of the projected trends, with no clear overall trend apparent from the monitoring data (Lewis *et al.*, 2012). The best information on trends derives from the Isle of May, where the razorbill population is identified as stable with high confidence (based on data from 1985 to 2011), whilst at	

Species	Assessment of Displacement	Conclusion
	Fowlsheugh the trend is unclear and at St Abb's Head to Fast Castle, the trend is assessed as decreasing, but with low confidence. A visual inspection of the data presented in Lewis *et al*. (2012) for these three SPAs suggests a general pattern of increase in razorbill numbers at each site between 1986 and 2003 - 2005, followed by a more recent decrease. Thus, although the available monitoring data do not provide strong support for the modelled trends, neither do they provide sufficient evidence to conclude that the modelled trends are a poor representation of the real situation. Seabird Monitoring Programme data show the UK population was stable between 1986 and 1991, increased fairly steadily until 2005, and declined until 2010; there was an apparent increase in 2011 but with wide confidence intervals so this trend should be treated with caution (JNCC, 2012a). The Scottish population shows a similar trend. Low productivity in recent years may lead to future declines (JNCC, 2012a). In assessing the impact of displacement on razorbill, the following factors have been considered: (i) The population model predicts an increasing trend, with the predicted impact of displacement (at 50% displacement, with all displaced birds failing to breed) being to reduce the likelihood of achieving particular thresholds of population growth, as opposed to causing the trajectory to change to one of stability or decline. (ii) The assumed displacement impacts are based upon precautionary assumptions, both in terms of the numbers of razorbill assumed to be displaced and the resulting effects on breeding success. The (albeit limited) available evidence suggests that fewer than 50% of birds are likely to be displaced from within the Development Area, whilst this is likely to be substantially lower within the surrounding 2 km buffer (accepting that the available evidence suggests that some displacement is likely to occur within this buffer). In terms of the effects on breeding success, it is also highly unlikely that all displaced birds will fail to breed and that each of these will derive from separate breeding pairs. Given the above, it seems likely that the modelled scenarios based upon the lower levels of displacement (i.e. 25%) and/or reductions in breeding success (i.e. 75% and 50% of displaced birds failing to breed) will provide the most realistic assessment of likely population impacts. However, even under the most precautionary assumptions the impact of breeding season displacement is not predicted to lead to a decline in the razorbill population, but rather to limit population growth (decreasing the likelihood of this by at most 6% - 10%, which is still equivalent to an 'very unlikely' event under the IPCC guidance – IPCC, 2010). The assessment considered a VOR of high sensitivity and operational displacement impacts of high magnitude (based on a 5.3% increase in breeding failure). Razorbill population modelling predicts that displacement effects of this magnitude are unlikely to lead to a population decline, but rather have the potential to limit the population growth. Displacement effects on the regional razorbill breeding population are evaluated as a minor impact as the predicted effect on the long-term population growth rate is small and considered to be within acceptable limits. In addition, it is noted that two post-construction monitoring reports for offshore wind farms – for Robin Rigg, Scotland	

Species	Assessment of Displacement	Conclusion
	(Walls *et al.*, 2013) and Blighbank, Belgium (Vanermen *et al.*, 2012), have suggested that any reduction in razorbill densities after WTGs are in place may in fact be relatively small (although both are preliminary studies). To provide further context for the assessment of displacement, the predicted displacement area can be compared to the total foraging area available to razorbills which use the Development Area during the breeding season. Based on a foraging range of 83.5 km (Thaxter *et al.*, 2012, see *Appendix 15A*, Table 15A.5), razorbills within the regional population for the Project the Development Area (all breeding colonies within foraging range) can potentially forage over 34,534 km^2 of sea. The Development Area and a 2 km buffer occupies an area of 278 km^2 so if 50% of this area is lost (equivalent to displacing half of the birds) this equates to a loss of about 0.4% of potential foraging habitat for the regional population. This broad-scale approach assumes that all areas within foraging range provide equally suitable habitat. Although in reality, not all areas within the foraging range will be used equally, and preferred foraging areas may vary between years. Also, given that the foraging range identified for razorbill is based on mean maximum of 48.5 km with a SD of 35.0 km (*Appendix 15A*, Table 15A.5), there is a large degree of variation in the estimated foraging range area. In relation to this variation, a loss of 0.4% of the total foraging range is a trivial reduction. Finally, the loss of 0.4% is based on the highly precautionary assumption that there will be 50% displacement from the 2 km buffer area as well as the Development Area. **Post breeding** A peak mean population of 2,870 individual razorbills was estimated for the Development Area and a 2 km buffer (*Appendix 15A*, Tables 15A.5.15C and D). At 50% displacement up to 1,435 birds are predicted to be displaced from this area. As birds are not constrained by the need to attend a nest site, they are able to forage over large areas. Little information has been found about the travel distances and speed of razorbills departing breeding colonies. A single radio-tracked male assumed to be accompanying a chick that had just left the breeding ledge travelled at about 1.5 km/h away from the Isle of May in six hours before moving out of signal range (Wanless *et al.*, 1988). It is likely that, as for guillemot (see below), razorbills and fledged chicks disperse offshore beyond feeding areas used during the nestling period to avoid potential predation of fledged chicks by other seabirds. At this time of year, any displacement from the Development Area is not predicted to affect the survival of individuals or the breeding success of pairs as it is considered that habitat is not limiting as birds disperse into the North Sea. Thus no changes in survival rates are predicted. The assessment considered a VOR of high sensitivity and operational displacement impacts in the post-breeding season of negligible magnitude. Based on the localised impact of displacement relative to the large, potentially available foraging area during this time of year, the likely high turnover of parent birds with fledged chicks moving through the Development Area and 2 km buffer (meaning that any impacts are likely to be diluted across a much larger population than the displacement estimate above, yet with effects on individual birds predicted to be minimal due to the short period of time they spend in the region during post-breeding), displacement is considered spatially limited and short term on an annual basis (yet long term in relation to the lifespan of the Project if no habituation occurs). Displacement is therefore evaluated as a negligible	

Species	Assessment of Displacement	Conclusion
	impact. **Non breeding** A peak mean of 651 razorbills was estimated for the Development Area and a 2 km buffer (*Appendix 15A*, Tables 15A.5.15E and F). At 50% displacement up to 326 birds are predicted to be displaced from this area (*Appendix 15A*, Table 15A.59). Birds are not constrained at this time of year by the requirement to attend a nest, nor to attend young which have recently left nesting colonies, so they are able to forage over extensive areas. At this time of year, any displacement from the Development Area and 2 km buffer is not predicted to affect survival. The assessment considered a VOR of high sensitivity and operational displacement impacts of negligible magnitude. Based on the localised impact of displacement relative to available foraging areas during non-breeding (when the species is no longer constrained by nest-attendance), it is evaluated as a negligible impact as any impact is likely to lie within the limits of natural variation.	
Guillemot	Preliminary monitoring data from Robin Rigg offshore wind farm in the Solway Firth indicated a displacement rate of 30% for auks in the first year of operation. Specifically for guillemot it was concluded there was some evidence that guillemots were avoiding the constructed wind farm but further data were required to confirm (Walls *et al.*, 2013). Robin Rigg appears to lie within the foraging range of guillemot breeding colonies on the south-west coast of Scotland (based on maps in Mitchell *et al.,* 2004) so the reduction in numbers could apply to breeding birds. No other empirical estimates of displacement or reduced densities of guillemot at offshore wind farms have been found. Based upon aerial survey data (which does not enable distinction of guillemots and razorbills), post-construction monitoring at Horns Rev offshore wind farm, Denmark, indicated that guillemot/razorbill avoided the wind farm area and areas up to four kilometres away, although the results were not statistically significant because of the large variation in the dataset (Petersen *et al.*, 2006). In this study the highest densities of auks were present in the winter months. Results from boat surveys suggest that wintering guillemots avoided the Egmond aan Zee offshore wind farm, Holland (Krijgsveld *et al.,* 2011) but it was not possible to show statistically significant effects because of the low densities present (Leopold *et al.*, 2010 quoted in Poot *et al.*, 2011). However, it is also reported that guillemots may have entered the wind farm by swimming and that they regularly foraged within the wind farm boundaries (Leopold *et al.*, 2010 quoted in Poot *et al.*, 2011). Monitoring at the Blighbank wind farm, off Belgium, found a significant reduction in guillemot densities after WTGs were built but no detectable change in razorbill densities (Vanermen *et al.*, 2012). A 50% displacement scenario has been identified given that available studies indicate that total displacement is unrealistic and the lowest available estimate of reduced numbers is 30% for auks.	**Breeding** Minor impact **Post-breeding and non-breeding** Negligible impact

Species	Assessment of Displacement	Conclusion
	Breeding season A peak mean population of 4,371 guillemots (all age classes) was estimated to use the Development Area and a 2 km buffer during the breeding season (*Appendix 15.A, Annex 15A*, Table 15A.5.14A and 15A.5.14B). A stable age distribution estimated from population viability analysis predicted that 3,654 birds were breeding adults *(Appendix 15B*, Tables 15B.6 and 15B.10 – excluding juveniles from consideration, as young of the year will still be in the nest, predicts 83.6% of all birds will be breeding adults). Thus 1,827 birds are predicted to be displaced. Given the relatively limited foraging range of guillemots, it is assumed that 100% of displaced birds fail to breed successfully and that all are from separate breeding pairs. The regional breeding population is estimated at 126,101 pairs (derived from 188,210 individuals with correction factor of 0.67, *Appendix 15A*, *Section 15A.3.2.17*). Breeding success of guillemots at the Isle of May (part of the regional breeding population) between 2007 and 2012 was 0.66 chicks per pair (varying from 0.28 to 0.8, CEH, 2012; see also *Appendix 15B*, Table 15B.4, note that the latter table gives chicks per individual rather than per pair). Assuming that breeding success is similar for all guillemots in the regional breeding population, in a given year 83,227 chicks will fledge. If all pairs displaced from the Development Area and 2 km buffer fail to breed, this would potentially reduce the overall breeding success of the population by 1,206 chicks (assuming that the breeding success would otherwise have been 0.66 chicks per pair), representing a 1.4% increase in breeding failure. To provide context for the assessment of displacement, the total foraging area available to guillemots from the regional population during the breeding season can be estimated. Based on a mean maximum foraging range plus 1 SD of 134.3 km (Thaxter *et al.*, 2012, see *Appendix 15A*, Table 15A.5), guillemots within the regional population (all breeding colonies within foraging range) can potentially forage over 68,407 km^2 of sea. The Development Area and a 2 km buffer occupies an area of 278 km^2 so if 50% of this area is lost (if half of the birds are displaced) this is equivalent to a loss of about 0.2% of potential foraging habitat for the regional population if all areas within foraging range provide suitable habitat. However, in reality, not all areas within the foraging range will be used equally, and preferred foraging areas may vary between years. Population viability analysis has been carried out to further investigate the impacts of displacement for guillemot. A population model has been developed based on empirical estimates of demographic parameters (rates of survival and reproduction) from regional populations with potential connectivity to the Development Area. Full details are included in *Appendix 15B*. A model based on survival and breeding success for the Isle of May population predicts a decline of about 25% over 25 years (*Appendix 15B*, *Section 15B.3.3.1*). Although it is affecting a declining population, the model predicts that displacement (50% of birds displaced and 100% breeding failure) has a negligible effect on increasing the chance of population decline up to 25%, whilst the increased likelihood of larger declines (50% and 75%) resulting from displacement is only 2% - 3% (*Appendix 15B*, *Section 15B3.3.2*). The predicted trends from the guillemot population model fit with reported declines at all four breeding colonies within the regional population: Forth Islands, Buchan Ness to Collieston, Fowlsheugh and St Abb's Head to Fast Castle (Lewis *et al.*,	

Species	Assessment of Displacement	Conclusion
	2012; although confidence in the trend is low at all except the Forth Islands SPA). The population trend of guillemots in Scotland increased slightly between the early 1990s and 2001 but numbers have since declined. Recent low breeding productivity across Scotland and possible reductions in adult survival rates may lead to future declines (JNCC, 2012a). Nevertheless the population model developed indicates that displacement from the Development Area is not likely to cause a significant change in the population growth rate of guillemots. The assessment considered a VOR of high sensitivity and operational displacement impacts of moderate magnitude (based on a 1.4% increase in breeding failure). Guillemot population modelling predicts that displacement effects of this magnitude are only likely to lead to a very small, statistically non-significant change in population growth, even if displacement were to occur throughout the entire lifespan of the Project (i.e. assuming no habituation will occur). It is concluded that displacement effects on the regional guillemot breeding population constitute a minor impact as the predicted effect on the long-term population growth rate is small and unlikely to significantly contribute to the current population decline. **Post breeding** A peak mean population of 3,177 individual guillemots was estimated for the Development Area and a 2 km buffer (*Appendix 15A*, Tables 15A.5.14C and 15A.5.14D), so 1,588 birds are predicted to be displaced (*Appendix 15A*, Table 15A.57). During the post breeding period both chicks and parent birds will be flightless for a period, chicks for a while after they leave the nest (accompanied by the male parent) and adults during primary moult. However, as birds are not constrained by the need to attend a nest site, they are able to forage over large areas. Camphuysen (2002) indicates that guillemot parent-chick combinations travelled large distances of up to 50 km a day after leaving a colony and travelled into the open sea, further offshore than the feeding areas used by adults during the chick rearing stage, probably to avoid concentrations of seabirds which might prey on chicks. At this time of year, any displacement from the Development Area is not predicted to affect the survival of individuals or the breeding success of pairs as post-breeding birds are capable of dispersing rapidly into the North Sea and may indeed deliberately avoid foraging areas used during the nestling period, preferring offshore areas several hundred kilometres away from breeding colonies (Camphuysen, 2002). Thus no changes in survival or mortality rates are predicted. The assessment considered a VOR of high sensitivity and operational displacement impacts in the post-breeding season of negligible magnitude. Based on the localised impact of displacement relative to the large potentially available foraging area during this time of year, the likely high turnover of parent birds with fledged chicks moving through the Development Area and 2 km buffer (meaning that any impacts are likely to be diluted across a much larger population than the displacement estimate above, yet with effects on individual birds predicted to be minimal due to the short period of time they spend in the region during post-breeding), displacement is considered spatially limited and short term on an annual basis (yet long term in relation to the lifespan of the Wind Farm if no habituation occurs). Displacement is therefore evaluated as a	

Species	Assessment of Displacement	Conclusion
	negligible impact. **Non-breeding** A peak mean population of 1,760 guillemots was estimated for the Development Area and a 2 km buffer *(Appendix 15A*, Tables 15A.5.14E and 15A.5.14F), so 880 birds are predicted to be displaced (*Appendix 15A*, Table 15A.57). Birds are not constrained at this time of year by the requirement to attend a nest, nor to attend young which have recently left nesting colonies, so they are able to forage over extensive areas. At this time of year, any displacement from the Development Area is not predicted to affect survival as it is considered that sufficient alternative habitat exists to accommodate displaced birds. The assessment considered a VOR of high sensitivity and operational displacement impacts of negligible magnitude. Based on the localised impact of displacement relative to available foraging areas during non-breeding (when the species is no longer constrained by nest-attendance) and the very large North Sea background population, displacement is evaluated as a negligible impact as any impact is likely to lie within the limits of natural variation.	
Common tern	Tern species, including common terns, were recorded flying in the vicinity of the Egmond aan Zee offshore wind farm study area (the Netherlands) in the spring and summer; they were considered to avoid the wind farm (Krijgsveld *et al.,* 2011). It was reported from visual observations that 24% of 34 terns (species not specified) observed flying in the vicinity of the wind farm did not fly through, and 38% of 24 terns deflected their flight path away from the wind farm on approach. The difference between the two sample sizes apparently reflects the fact that deflection was not always recorded (Krijgsveld *et al.,* 2011). Monitoring at a Belgian Offshore Wind Farm after partial construction showed attraction effects for common and Sandwich tern (present March to August) in relation to a development at Thorntonbank (six of 54 WTGs in place, 27 km offshore) (Vanermen *et al.,* 2012). Terns are generally considered at low risk of displacement (Langston, 2010). A 30% displacement scenario has been assumed based on the findings at Egmond aan Zee which suggests that total displacement is unrealistic, and 62% - 76% of terns approaching the wind farm were observed to fly through. **Breeding season** Assuming a 30% reduction in common tern densities post-construction predicts the displacement of less than one breeding adult from the Development Area and a 2 km buffer (*Appendix 15A*, Table 15A.56). Although the mean maximum foraging range plus 1 SD (26.4 km) of regional colonies overlaps with the Boat-based Survey Area, on average nesting common terns tend to feed primarily within 8 - 10 km of breeding colonies (BirdLife International Seabird Database, 2012; Thaxter *et al.*, 2012). Therefore the Development Area is evidently not an important foraging area for this species during the breeding season. The assessment considered a VOR of high sensitivity and operational displacement impacts of negligible magnitude. Given	**Breeding and post-breeding** Negligible impact **Non-breeding** N/A

Species	Assessment of Displacement	Conclusion
	the lack of importance of the Development Area during the breeding season, as well as the minimal overlap between common tern's core foraging range and the spatial extent of any impact (limited to the Development Area and a 2 km buffer), displacement is evaluated as a negligible impact as it is predicted to represent a very slight change from baseline conditions, with any effects likely to fall well within fluctuations of natural variation. **Post-breeding** Many common tern breeding sites in Scotland are empty by mid-August, although laying may sometimes extend into August with young fledging as late as mid-September. In late summer and autumn, flocks of several hundred birds may occur on passage along the east and west coast of Scotland, and aggregations of common terns may linger in coastal waters in food rich areas including the Firth of Forth (Forrester *et al.,* 2007). The origin of birds at the Development Area at this time of year is uncertain. Assuming 30% displacement, eight common terns are predicted to be displaced from the Development Area during the post-breeding season (*Appendix 15A*, Table 15A.56). As birds are not constrained by the need to attend a nest site, they are able to forage over large areas. At this time of year, any displacement from the Development Area is not predicted to affect the survival of individuals or the breeding success of pairs. The assessment considered a VOR of high sensitivity and operational displacement impacts of negligible magnitude. Birds are not constrained by the need to attend a nest site and are able to forage over large areas and spend only a short period of time in the region before migrating. At this time of year, any displacement is therefore not predicted to affect the survival of individuals or the breeding success of pairs and thus no changes in survival or mortality rates are predicted. Displacement is evaluated as a negligible impact as it is predicted to represent a very slight change from baseline conditions, with any effects likely to fall well within fluctuations of natural variation. **Non-breeding** Common terns breeding in the UK migrate to wintering grounds on the west coast of Africa (Wright *et al.*, 2012). No birds were recorded in the non-breeding season; therefore birds are not predicted to be subject to displacement at this time.	
Arctic tern	Terns, (mainly Sandwich terns) including small numbers of Arctic tern, were recorded flying in the vicinity of the Egmond aan Zee offshore wind farm (the Netherlands) in the spring and summer; they were considered to avoid the wind farm. It was reported from visual observations that 24% of 34 terns (species not specified) observed flying in the vicinity of the wind farm did not fly through, and 38% of 24 terns deflected their flight path away from the wind farm on approach. The difference between the two sample sizes apparently reflects the fact that deflection was not always recorded (Krijgsveld *et al.,* 2011). Terns are generally considered at low risk of displacement (Langston, 2010).	**Breeding and post-breeding** Negligible impact

Species	Assessment of Displacement	Conclusion
	A scenario of 30% displacement has been assumed based on the findings at Egmond aan Zee which suggests that total displacement is unrealistic, and 62% - 76% of terns approaching the wind farm were observed to fly through. **Breeding season** Assuming a 30% reduction in Arctic tern densities, post-construction predicts the displacement of three breeding adults from the Development Area and a 2 km buffer (*Appendix 15A*, Table 15A.55). However the species was recorded infrequently and in relatively low numbers during boat-based surveys in the breeding season (*Appendix 15A*, *Section 15A.3.2.15*). Although the mean maximum foraging range plus 1 SD (30.5 km) of regional colonies overlaps with the Boat-based Survey Area, on average nesting terns tend to feed primarily within 10 km of breeding colonies (BirdLife International Seabird Database, 2012; Thaxter *et al.*, 2012). Therefore the Development Area is not considered to provide an important foraging area for breeding birds. The assessment considered a VOR of high sensitivity and operational displacement impacts of negligible magnitude. Given the lack of importance of the Development Area during the breeding season, as well as the minimal overlap between Arctic tern's core foraging range and the spatial extent of any impact (limited to the Development Area and a 2 km buffer), displacement is evaluated as a negligible impact as it is predicted to represent a very slight change from baseline conditions, with any effects likely to fall well within fluctuations of natural variation. **Post-breeding** Arctic terns breeding in Scotland usually leave nesting sites by mid-August and may migrate southwards through the North Sea or off the west coast. Aggregations of several hundred terns may remain in Scottish coastal areas for one to two weeks where suitable feeding habitat exists, including the Firth of Forth (Forrester *et al.*, 2007). Assuming 30% displacement, 90 Arctic terns are predicted to be displaced from the Development Area and a 2 km buffer during the post-breeding season (*Appendix 15A*, Table 15A.55). The assessment considered a VOR of high sensitivity and operational displacement impacts of negligible magnitude. Birds are not constrained by the need to attend a nest site and are able to forage over large areas and spend only a short period of time in the region before migrating. At this time of year, any displacement is therefore not predicted to affect the survival of individuals or the breeding success of pairs and thus no changes in survival or mortality rates are predicted. Displacement is evaluated as a negligible impact as it is predicted to represent a very slight change from baseline conditions, with any effects likely to fall well within fluctuations of natural variation.	**Non-breeding** N/A

Species	Assessment of Displacement	Conclusion
	Non-breeding Arctic terns migrate south along the eastern seaboard of the Atlantic; many juveniles winter in western and southern Africa (Forrester *et al.*, 2007) and were not recorded during boat-based bird surveys between September and April, therefore birds are not predicted to be subject to displacement over this period.	
Kittiwake	Preliminary results from post-construction monitoring of the Robin Rigg offshore wind farm (Walls *et al.*, 2013) suggest a possible increase in kittiwake numbers during the first year of operation (and a possible decrease during construction), although more data are required to confirm this. Robin Rigg is likely to lie within the foraging range of kittiwake breeding colonies on the south-west coast of Scotland (based on maps in Mitchell *et al.*, 2004) so the change in numbers could apply to breeding birds. Monitoring of wind farms in Belgian waters (Vanermen *et al.*, 2012) found attraction effects for wintering kittiwake in relation to a small wind farm at Thornton Bank, with numbers in the partially constructed wind farm increasing relative to a control area; a similar effect was apparent for the larger Blighbank Wind Farm but it was not statistically significant. Krijgsveld *et al.* (2011) reported that gulls, including kittiwakes during the winter, were regularly seen foraging or resting in the Egmond aan Zee wind farm, although no estimate of changes in numbers post-construction is provided. It was reported from visual observations that 25% of 146 gulls (species not specified) observed flying in the vicinity of the wind farm did not fly through, and 40% of 78 gulls deflected their flight path away from the wind farm on approach. The difference between the two sample sizes apparently reflects the fact that deflection was not always recorded (Krijgsveld *et al.,* 2011). A scenario of 30% displacement has been assumed based on observations that 60% - 75% of gulls approaching the Egmond Aan Zee wind farm (Krijgsveld *et al*., 2011, see paragraph above) were observed to fly through (i.e. 25% - 40% did not enter). However other post-construction monitoring studies (described above) suggest that there may be attraction effects, although estimates of potential increases in numbers are not available. **Breeding season** From an estimated 1,673 breeding adult kittiwakes within the Boat-based Survey Area, at 30% displacement an estimated 502 adults are predicted to be displaced from the Development Area and a 2 km buffer during the breeding season (*Appendix 15A*, Table 15A.47). Because of the relatively limited foraging range of kittiwakes, it is assumed that all displaced birds fail to breed successfully and that all are from separate breeding pairs. Breeding success of kittiwakes within the regional population with potential connectivity to the Development Area is highly variable. For example, on the Isle of May (part of the regional population) it varied from 0.02 to 1.24 fledged chicks per pair between 1986 and 2002 (Frederiksen *et al.*, 2004); poor breeding success was associated with periods when the Wee Bankie sandeel fishery (off the Firth of Forth) was active and breeding success was also negatively related to mean sea surface	**Breeding** Minor impact **Post-breeding and non-breeding** Negligible impact

Species	Assessment of Displacement	Conclusion
	temperature in February and March. Since 2000, the Wee Bankie sandeel fishery has been closed (Daunt *et al.*, 2008). Based on recent data from the Isle of May and other colonies within the regional population, mean breeding success of kittiwakes was 0.68 chicks per pair (*Appendix 15B*, Table 15B.4 – note that this table gives breeding success as fledglings per adult bird, so it has been doubled for pairs). A regional population of 55,040 breeding pairs (*Appendix 15A*, *Section 15A.3.2.6*) with an average productivity of 0.68 would be expected to fledge 37,427 chicks. If all 502 pairs predicted to be displaced from the Development Area and 2 km buffer were to fail, this would potentially reduce the overall breeding success of the population by 341 chicks (assuming that the breeding success would otherwise have been 0.68 chicks per pair), representing 0.9% of the total number of chicks produced. To provide context for the assessment of displacement, the total foraging area available to kittiwakes that use the Development Area and a 2 km buffer during the breeding season can be estimated. Based on a foraging range of 83.3 km (mean maximum plus 1 SD, Thaxter *et al.*, 2012; see *Appendix 15A*, Table 15A.5), kittiwakes within the regional population (all breeding colonies within foraging range) can potentially forage over 34,660 km^2 of sea. The Development Area and a 2 km buffer encompass an area of 278 km^2. If all kittiwakes were displaced, 0.8% of the regional foraging area would be lost, however it is considered likely that only 30% of birds will be displaced, effectively a loss of 30% of this area which is equivalent to a loss of about 0.2% of potential foraging habitat. This area comparison assumes that all areas within foraging range provide suitable foraging habitat. However, in reality, not all areas within the foraging range will be used equally, and preferred foraging areas may vary between years. Population viability analysis has been carried out to further investigate the impacts of displacement for kittiwake. A population model has been developed based on empirical estimates of demographic parameters (rates of survival and reproduction) from regional populations with potential connectivity to the Development Area (full details are included in Appendix *15B*, *Section 15B.3.2*). Information on survival was derived from kittiwakes on the Isle of May, and breeding success was estimated as a mean of data from breeding colonies within the regional population. In the absence of displacement, the model predicts a population decline of about 50% over 25 years (*Appendix 15B*, *Section 15B.3.2.1*). Predicted declines from the population model are consistent with trends for three sites within the regional population: Forth Islands, St Abb's Head to Fast Castle and Fowlsheugh (declines identified with respectively high, moderate and low confidence; Lewis *et al.,* 2012); whereas the population at another site, Buchan Ness to Collieston, is considered to be stable (with moderate confidence; Lewis *et al.*, 2012). Kittiwakes at Scottish colonies have declined steadily since the late 1980s and in 2011 reached the lowest point yet recorded. It seems likely, given the declining trend in productivity recorded since 1986, and a falling survival rate, that the decline will continue (JNCC, 2012a). Declines have been driven by declines in the abundance of sandeels – the main prey species in the breeding season, the latter in turn affected by fishing effort and increases in sea surface temperatures (Frederiksen *et al.*, 2004). Thus the population model developed for kittiwakes	

Species	Assessment of Displacement	Conclusion
	appears to fit the trends observed for regional populations with potential connectivity to the Development Area, and also the Scottish population. Incorporating the predicted effects of displacement (30% of birds displaced and failing to breed) into the model has a very small effect on the population growth rate (changing it from 0.9718 to 0.9716) and reduces the predicted population size after 25 years by about 400 birds (equivalent to <0.5% of the 25-year population size predicted in the absence of any displacement). Compared to a model with no displacement impacts, 30% displacement causes very marginal, and statistically non-significant increases in the probability of the population declining by varying extents (*Appendix 15B*, *Section 15B.3.2.3*). The assessment considered a VOR of high sensitivity and operational displacement impacts of moderate magnitude (based on a decrease in breeding success of 0.9%). Kittiwake population modelling, however, predicts that displacement of this magnitude is only likely to lead to a very small, statistically non-significant change in population growth, even if displacement were to occur throughout the entire lifespan of the Wind Farm (i.e. assuming no habituation will occur). It is concluded that displacement effects on the regional kittiwake breeding population constitute a minor impact as the predicted effect on the long-term population growth rate is exceedingly small and unlikely to significantly contribute to the current population decline. **Post breeding** A peak mean population of 1,355 individual kittiwakes was estimated for the Development Area and a 2 km buffer. If 30% of birds are displaced this amounts to 407 birds, representing 0.4% to 0.1% of the regional and North Sea populations respectively (*Appendix 15A*, Table 15A.47). At this time of year, any displacement from the Development Area is not predicted to affect the survival of individuals or the breeding success of pairs as birds are not constrained by the need to attend a nest site and are able to forage over large areas. Tracking data and ringing recovery data indicate that kittiwakes from regional breeding colonies range widely across the North Sea and North Atlantic outside the breeding season (Bogdanova *et al.*, 2011). Thus birds can forage over extensive areas and no changes in survival or mortality rates are considered likely. The assessment considered a VOR of high sensitivity and operational displacement in the post-breeding season of low magnitude. Based on the localised impact of displacement on kittiwake (limited to the Development Area and 2 km buffer in relation to the species' wide ranging behaviour during this time of year, any impact is likely to fall within the limits of natural variation and is therefore evaluated as negligible.	

Species	Assessment of Displacement	Conclusion
	Non-breeding A peak mean population of 918 kittiwakes was estimated for the Development Area and a 2 km buffer. If 30% of birds are displaced this amounts to 275 birds, representing 0.3% and <0.1% of the regional and North Sea populations respectively (*Appendix 15A*, Table 15A.47). As is the case for the post-breeding season, birds are not constrained at this time of year by the requirement to attend a nest, and tracking data indicate that kittiwakes from UK breeding colonies range widely across the North Sea and North Atlantic outside the breeding season (Bogdanova *et al.*, 2011), so they are able to forage over extensive areas. Any displacement from the Development Area and 2 km buffer is considered unlikely to affect survival. The assessment considered a VOR of high sensitivity and operational displacement in the non-breeding season of low magnitude. Based on the localised impact of displacement on kittiwake (limited to the Development Area and its immediate vicinity) in relation to the species' wide ranging behaviour during this time of year, any impact is likely to fall within the limits of natural variation and is therefore evaluated as negligible.	
Little gull	**Non-breeding season** Little gulls predominantly occur in the outer Forth and Tay on autumn passage, and numbers may vary from year to year (*Appendix 15A*, *Section 15A.3.2.7*). The species does not breed in the UK and there are no breeding populations within foraging range. In line with other gull species, Langston (2010) rates the species as of low risk to displacement. As the potential foraging range during the non-breeding season is extensive, and birds are not constrained by the requirement to attend nest sites, any displacement from the Development Area and a 2 km buffer is considered unlikely to cause adverse effects. The assessment considered a VOR of high sensitivity and operational displacement of negligible magnitude. The species has a large potential foraging range during this time of year and is therefore likely to be able to adapt to displacement effects. The impact is therefore considered to represent no more than a slight change from baseline conditions, with any effects to lie within the limits of natural variation, and evaluated as negligible.	**Breeding** N/A **Non-breeding** Negligible impact
Common gull	**Breeding season** A very small population (estimated at 19 pairs, *Appendix 15A*, *Section 15A.3.2.8*) of common gulls nests within potential foraging range of the Development Area. Very few birds were recorded in boat surveys during the breeding season. In addition, the Development Area is not considered to provide an important foraging area for common gulls at this time of year as it lies towards the maximum limit of the potential foraging range (50 km, Thaxter *et al.*, 2012). The assessment considered a VOR of moderate sensitivity and operational displacement impacts of negligible magnitude.	**Breeding and non-breeding** Negligible impact

Species	Assessment of Displacement	Conclusion
	Based on the very low common gull densities present in the Development Area during the breeding season and the minimal overlap of the species' foraging range (largely comprising of onshore habitat and coastal waters) with the predicted spatial extent of displacement, the impact is evaluated as negligible. **Non-breeding season** A scenario of 30% displacement has been assumed based on the rationale described for gulls in the assessment for kittiwake above. Under that scenario an estimated 16 common gulls are predicted to be displaced from the Development Area and a 2 km buffer (*Appendix 15A*, Table 15A.45). This represents 0.5% of the regional and <0.1% of the North Sea wintering populations (population estimates in *Appendix 15A*, Table 15A.45). The assessment considered a VOR of moderate sensitivity and operational displacement impacts of moderate to negligible magnitude. Baseline data indicate that the Development Area is evidently not an important foraging area for common gull. As birds are not constrained by nest attendance requirements at this time of year they are able to forage over extensive areas of sea. Operational displacement from the Development Area and a 2 km buffer is therefore predicted to represent no more than a slight change from baseline conditions, with any effects to lie within the limits of natural variation, and is therefore evaluated as a negligible impact.	
Lesser black-backed gull	As for kittiwake and other gulls, 30% displacement has been assumed. **Breeding season** A peak mean population of 16 breeding adult birds was estimated for the Development Area and a 2 km buffer during the breeding season (*Appendix 15A*, Tables 15A.5.11A and 15A.5.11B). Assuming a 30% reduction in lesser black-backed gull densities post-construction predicts the displacement of five breeding adults from the Development Area and a 2 km buffer (*Appendix 15A*, Table 15A.51). Given the relatively limited foraging range, it is assumed that all displaced birds fail to breed successfully and that all are from separate breeding pairs. Mean breeding success of lesser black-backed gulls on the Isle of May (part of the regional population) between 1986 and 2005 was 0.88 fledged chicks per pair (standard error 0.07; Mavor *et al.*, 2008). Assuming the recent breeding success of the regional population is similar to birds on the Isle of May, a regional population of 8,917 breeding pairs (*Appendix 15A*, *Section 15A.3.2.9*) with an average productivity of 0.88 would be expected to fledge 7,847 chicks. If an additional five pairs were to fail due to displacement from the Development Area and 2 km buffer, this would potentially reduce the overall breeding success of the population by four chicks (assuming that the breeding success would otherwise have been 0.88 chicks per pair), representing 0.05% of the total number of chicks produced. The regional population is considered an appropriate level for assessment as it includes the Forth Islands SPA for breeding lesser black-backed gull.	**Breeding** Negligible impact **Non-breeding** N/A

Species	Assessment of Displacement	Conclusion
	To provide context for the assessment of displacement, the total foraging area available to the regional population of lesser black-backed gulls during the breeding season can be estimated. Based on a mean maximum foraging range of 141 km (Thaxter *et al.*, 2012, see *Appendix 15A*, Table 15A.5), lesser black-backed gulls within the regional population (all breeding colonies within foraging range) can potentially forage over 82,667 km^2 of sea. The Development Area and a 2 km buffer occupies an area of 278 km^2 so if 30% of this area is lost (if 30% of the birds are displaced) this is equivalent to a loss of about 0.1% of potential foraging habitat for the regional population if all areas within foraging range provide suitable foraging habitat. However, in reality, not all areas within the range will be used equally, and preferred foraging areas may vary between years. The assessment considered a VOR of high sensitivity and operational displacement impacts of negligible magnitude (based on a reduction in breeding success of 0.05%). Based on the species limited susceptibility to displacement and its capacity to opportunistically exploit a wide range of food resources over large areas, the impact is evaluated as negligible. **Non-breeding** The majority of lesser black-backed gulls breeding in the UK migrate south to winter in coastal areas of Iberia and north-west Africa (Wright *et al.*, 2012), and none were recorded during boat-based bird surveys outside the breeding season, therefore birds are not predicted to be subject to displacement at this time.	
Herring gull	A scenario of 30% displacement has been assumed based on the rationale described for gulls in the assessment for kittiwake above. **Breeding season** Assuming a 30% reduction in herring gull densities post-construction predicts the displacement of two breeding adults from the Development Area and a 2 km buffer (*Appendix 15A*, Table 15A.49). Given the relatively limited foraging range, it is assumed that all displaced birds fail to breed successfully and that all are from separate breeding pairs, and that these failures are additional to other causes of breeding failure. Mean breeding success of herring gulls on the Isle of May (part of the regional population) between 1986 and 2005 was 0.98 fledged chicks per pair (Mavor *et al.*, 2008). Assuming the recent breeding success of the regional population is similar to birds on the Isle of May, a regional population of 19,741 breeding pairs (*Appendix 15A*, *Section 15A.3.2.10*) would be expected to fledge 19,346 chicks. If an additional two pairs were to fail due to displacement from the Development Area and 2 km buffer, this would potentially reduce the overall breeding success of the population by two chicks (assuming the breeding success would otherwise have been 0.98 chicks per pair), representing 0.01% of the total number of chicks produced.	**Breeding and non-breeding** Negligible impact

Species	Assessment of Displacement	Conclusion
	The assessment considered a VOR of high sensitivity and operational displacement impacts of negligible magnitude. Based on the species limited susceptibility to displacement and its capacity to opportunistically exploit a wide range of food resources over large areas, the impact is evaluated as negligible. **Non-breeding** Assuming a 30% reduction in herring gull densities post-construction predicts the displacement of 16 birds from the Development Area and a 2 km buffer during the non-breeding season (*Appendix 15A*, Table 15A.49). This represents <0.1% of the regional and North Sea wintering populations (*Appendix 15A*, Table 15A.49). Birds are not constrained at this time of year by the requirement to attend a nest so they are able to forage over extensive areas and utilise a range of habitats including offshore, coastal and onshore. Given the low numbers of birds potentially displaced and the flexible foraging strategy of herring gulls, any displacement from the Development Area and 2 km buffer is not predicted to affect survival. The assessment considered a VOR of high sensitivity and operational displacement impacts of negligible magnitude. Based on the species limited susceptibility to displacement and its capacity to opportunistically exploit a wide range of food resources over large areas, the impact is evaluated as negligible.	
Great black-backed gull	As for kittiwake and other gulls, a scenario of 30% displacement has been assumed. **Breeding season** Great black-backed gulls were only recorded in the Boat-based Survey Area in exceedingly low numbers (a peak mean of one bird, *Appendix 15A*, Tables 15A.5.10A and B) in the breeding season. The assessment considered a VOR of moderate sensitivity and operational displacement impacts of negligible magnitude. Based on great black-backed gull's limited foraging range, largely constrained to inshore coastal waters close to the nest site (and therefore very small overlap with displacement effects in the Development Area and a 2 km buffer), the very small numbers recorded during the breeding season and the species' capacity to opportunistically exploit a wide range of food resources, the impact is evaluated as negligible. **Non-breeding season** A peak mean population of 48 birds was estimated for the Development Area and a 2 km buffer during the non-breeding season (*Appendix 15A*, Tables 15A.5.10C and 15A.5.10D). Assuming a 30% reduction in densities post-construction predicts the displacement of 14 birds from the Development Area and a 2 km buffer. This represents 0.1% and <0.1% of the regional and North Sea wintering populations (*Appendix 15A*, Table 15A.50). Given the low numbers of birds potentially displaced, no changes in survival rates are predicted.	**Breeding and non-breeding** Negligible impact

Species	Assessment of Displacement	Conclusion
	The assessment considered a VOR of moderate sensitivity and operational displacement impacts of negligible to low magnitude. The impact is evaluated as negligible based on the species limited susceptibility to displacement and its capacity to opportunistically exploit a wide range of food resources over large areas during this time of year.	

Barrier Effect

134 Large wind farms may represent barriers to movement for some bird species including migrating wildfowl, which tend to move in large flocks along linear flight lines. Flight deviation as a result of any potential barrier effect caused by the presence of a wind farm may increase journey distance, and therefore represent an energetic cost to migratory birds (Masden *et al.,* 2010). Avoidance in this way does however reduce collision risk. A review of a number of wind farm sites indicated that wildfowl begin to take avoiding action from wind farms at between 100 m – 3,000 m, with avoidance distances increasing on the darkest nights (Drewitt and Langston, 2006).

135 Species that move through the site on a single occasion during migration are unlikely to bear a measurable cost in most cases, particularly as deviation may begin from a large distance away. Pettersson (2005) showed that increased distance experienced by migratory waterfowl represented only 0.2 – 0.4 per cent of the total migration distance from the breeding grounds to wintering areas and vice versa. Whilst this represented a likely increase in energy expenditure, it was considered to be trivial. Masden *et al.* (2009) considered the impacts of the Nysted offshore wind farm (Denmark) on migrating eider duck. Radar surveillance suggested that birds adjusted their flight paths in the presence of the wind farm and the additional distance travelled (500 m) was trivial compared with a total migration distance of 1,400 km. A model of the impacts of energy expenditure of migrating birds deviating around a single wind farm suggested that for most species this would result in depletion of less than two per cent of their fat reserves, and was likely to be trivial (Speakman *et al.,* 2009).

136 The assessment considered (**migratory birds**) VORs of all sensitivities and barrier effects during the operational phase of negligible magnitude across all seasons. If species do not habituate to the presence of the WTG array it is possible that at least a proportion of background populations could be affected throughout the entire operational phase. However, based on the very small spatial extent over which any barrier effect is predicted to occur (the immediate vicinity of the Development Area) and the likely minimal effects on birds' energy expenditure, operational barrier effects on **all VORs** during passage migration are evaluated as a negligible impact.

137 Barrier effect has also been identified as a potential impact on **breeding seabirds**. In practice, however, barrier effects for breeding seabirds are considered to be a component of displacement. Breeding seabirds will make repeated journeys from nest sites to foraging areas. Displacement – the reduction of numbers of seabirds of a given species within a wind farm post-construction – may result from a combination of scenarios whereby (i) all or a proportion of individuals of a given species that would have used the Development Area prior to the Wind Farm construction move elsewhere to forage, and (ii) all or a proportion of birds travelling to foraging areas beyond the Wind Farm fly around it rather than through. Thus the costs to seabirds of repeatedly flying around rather than through a wind farm are considered to be contributory to the prediction of reduced breeding success which has been used to assess displacement. This approach is consistent with the modelling approach to displacement that has been developed by CEH on behalf of Marine Scotland for guillemot

(MacDonald *et al.,* 2012). Thus the conclusions of the assessment for breeding seabirds in relation to displacement take into consideration the potential for the Wind Farm to act as a barrier to seabirds during trips between nest sites and foraging areas. Therefore no separate conclusions are presented for barrier effects.

Collision Risk

138 Birds may collide with WTGs and associated structures and this is almost certain to result in the mortality of the individual. The actual risk of collision depends on a number of factors including the location of a wind farm, the bird species (behaviour and morphology) and total numbers of birds using or passing through the area, weather conditions (e.g. wind speed, visibility) and the size and design of the wind farm including the number and size of WTGs and use of lighting.

139 Most studies which have attempted to measure actual collision rates have found evidence of low levels of avian mortality associated with operational wind farms, as birds are able to take avoiding action (Drewitt and Langston, 2006), but exceptions do occur (e.g. Everaert and Kuijken, 2007; Thelander and Smallwood, 2007; Nygård *et al.,* 2010). As there are relatively few studies of actual collision rates, assessments of potential collision risk are based on collision risk modelling. The standard model used in the United Kingdom, sometimes known as the ‘Band’ model, was developed for onshore wind farms (SNH, 2000; SNH, 2010b) and has recently been modified for use with offshore wind farms (Band, 2012).

140 The effect of losing an individual from a population is influenced by several characteristics of the affected population, notably its size, density, recruitment rate (additions to the population through reproduction and immigration) and background mortality rate (the natural rate of losses due to death and emigration). In general, the effect of losing an individual of breeding age from the population will be greater for species that are relatively long-lived and reproduce at a low rate. Most seabird species fall into this category. Conversely, the effect will often be much less for relatively short-lived species with higher reproductive rates, including some smaller gulls.

141 It should be noted that disturbance/displacement and collision risk effects during the operational phase are mutually exclusive in a spatial sense, i.e. a bird that avoids a wind farm area cannot also be at risk of collision with the WTG rotors. However, they are not mutually exclusive in a temporary sense; a bird may initially avoid a wind farm, but habituate to it, and would then be at risk of collision. Note that the avoidance rate used to adjust the predicted number of collisions from the model takes into account all changes that result in a difference between the predicted and actual collision rate. Thus displacement effects and even attraction effects on collision risk should be taken into account by the avoidance rate.

142 In general, effects of increased mortality on populations due to collisions with WTGs are considered to be long-term (i.e. to persist throughout the operational wind farm’s lifespan). Collision risk modelling predicts collisions on the basis that flight activity of birds at the time of pre-construction surveys is maintained in the presence of the wind farm and throughout

the life of the wind farm. In reality, effects may change over time due to the factors such as changes in prey abundance or distribution.

143 Estimates of predicted collision mortality for wind farms using the Band model are very sensitive to assumptions about avoidance rates (Chamberlain *et al.,* 2006). The model estimates mortality by multiplying the collision probability of a single bird of a given species by the number of birds passing through the area at risk height, derived from survey data. It assumes that birds take no avoiding action in relation to WTGs so an adjustment to the results is made to account for avoidance behaviour. The avoidance rate takes account of the fact that most birds avoid collisions with WTGs, by avoiding the wind farm entirely (flying around or above it – macro-avoidance), or flying through the wind farm but avoiding individual WTGs (changing direction to fly below or above rotor blade height or moving horizontally out of the way of WTG blades – micro-avoidance). Avoidance rates are expressed as percentages so a rate of 99 per cent indicates that 99 per cent of birds that the model predicts will fly through the wind farm at collision risk height are expected to take some form of avoiding action (SNH, 2010b). Small differences in avoidance rates can make a considerable difference to collision risk estimates, for example if the model predicts 1,000 birds will collide with a wind farm in the absence of avoidance, the adjusted prediction at 98 per cent avoidance is 20 birds whereas at 99 per cent the collision risk estimate reduces by half to 10 birds.

144 A differentiation is often made between avoidance rates (birds taking evasive action) and collision rates (birds colliding with WTGs) as it is possible that some birds take no avoiding action but still do not collide with a WTG by chance.

145 There are no published estimates of collision rates for offshore wind farms and few data with which to empirically estimate avoidance for seabird species. Current SNH guidance in relation to onshore wind farms (SNH, 2010b) recommends a precautionary avoidance rate of 98 per cent unless further information permits another rate to be used for a given bird species. Maclean *et al.* (2009) provided expert opinion for seabirds and recommended avoidance rates of 99.9 per cent for fulmar and shearwaters, 99.5 per cent for auks, gulls and gannet, and 99 per cent for terns, divers, cormorant, ducks, geese, grebes and puffin. A recent SOSS report (Cook *et al.*, 2012) suggests that avoidance rates are likely to exceed 99 per cent for some seabird species (divers, gannet, sea ducks and auks); it advices that 98 per cent, as recommended by SNH (SNH, 2010b), should be used as a precautionary avoidance rate but that estimates are also presented at rates of 95, 99 and 99.5 per cent. It is understood that Marine Scotland has commissioned a review of avoidance rates for seabirds with a view to advising whether 99 per cent avoidance could be considered appropriate based on available studies and expert opinion.

146 Avoidance may be subdivided into macro-avoidance of the whole wind farm and micro-avoidance of individual WTGs, and total avoidance behaviour can be considered as a combination of macro and micro avoidance (Cook *et al.,* 2012; MORL, 2012):

- Total avoidance = 1 – [(1 – macro-avoidance) x (1 – micro-avoidance)].

147 However, care is needed in applying this equation due to inconsistencies in the way that macro and micro avoidance rates are calculated in different studies (Cook *et al.,* 2012). Macro-avoidance rates may depend on the technique used for measurement. Radar studies have the potential to monitor a far wider area than visual observations (and thus may pick up birds which take avoiding action at long distances), and can detect birds at night and during conditions of poor visibility, but birds cannot usually be identified to species. For Egmond aan Zee offshore wind farm, estimates of macro-avoidance from visual observations were 72 per cent for gannets, 45 per cent for auks and 30 per cent for gulls and terns (combined estimates from observations of birds not entering a wind farm and those deflecting around a wind farm); whereas macro-avoidance estimates for gannets and auks validated with radar data were 64 and 68 per cent respectively and for gulls based on radar alone were 18 per cent (data from Krijgsveld *et al.,* 2011 presented in Poot *et al.,* 2012).

148 Based on visual and radar observations at Egmond aan Zee, an average micro avoidance rate of 97.6 per cent was estimated for all bird species (Krijgsveld *et al.,* 2011). Most of the data used to estimate micro-avoidance were from radar, so it was not possible to distinguish individual species. It was suggested that this was a conservative estimate which might increase with better resolution of radar data. The possibility that birds may make subtle changes in their flight paths to avoid a WTG – which might not be detected as micro-avoidance, was noted. There were also indications that birds flew closer to non-operational rather than operational WTGs, and that micro avoidance was greater at night. Visual observations of micro-avoidance were carried out on eight separate occasions during daylight hours and good weather. The bird species recorded were: seabirds (fulmar, gannet, cormorant, guillemot, pomarine skua, two species of terns and eight species of gulls), geese and ducks, waders and passerines (the latter comprising the majority of records). A total of 1,610 birds was recorded, and of these only eight individuals/flocks flew within 50 m of a WTG at rotor height – the species comprising lesser and greater black-backed gulls, starlings and skylarks. Of birds entering the wind farm, 98 per cent avoided the proximity of the WTGs.

149 Applying the above equation for total avoidance to the data from Egmond aan zee, using the average micro-avoidance rate and estimates of macro-avoidance from visual and radar data produces estimates of total avoidance for gannet of 99.1 – 99.3 per cent; for auks of 98.7–99.2 per cent and for gulls of 98 – 98.3 per cent.

150 Collision rates may also be measured directly by recording collisions (using remote monitoring equipment and/or visual observations) with WTGs. There are almost no records of bird collisions with offshore wind farms, due to the difficulty of observing and/or recording collisions or collecting corpses (Collier *et al.,* 2011 and 2012), and therefore no empirical estimates of collision rate. Empirical collision rates for some seabirds are available from studies of coastal and onshore wind farms, based on corpse searches. Inverse collision rates (1-collision rate) of 99.5 per cent and above are reported for gulls and terns from sites in Belgium and the Netherlands (Everaert and Kuijken, 2007; Krijgsveld *et al.,* 2010; Cook *et al.,* 2012). The inverse collision or 'non-collision' rate is not considered to be equivalent to

avoidance, however, as some birds may take no avoiding action but still not collide with WTGs (Cook *et al.,* 2012).

151 Recommendations with respect to the most applicable avoidance rates for different species vary in recent submitted environmental statements. For the Firth of Forth Phase 1, 98 per cent was applied for all species (Seagreen, 2012). For Neart na Gaoithe, 99.8 per cent was used for gannet, and for other species results are considered for 98 and 99.5 per cent avoidance. MORL (2012) applied avoidance rates of 99.5 per cent for gannet, 98.5 per cent for large gulls and 99 per cent for small gulls (kittiwake).

152 Collision risk estimates for bird species in relation to the Inch Cape Offshore Wind Farm are presented at rates of 95, 98, 99 and 99.5 per cent in *Appendix 15A*, Table 15A.29. For the purposes of the assessment below, the most appropriate precautionary rate for gannet is considered to be 99 per cent and for all other species 98 per cent. This is based mainly on the data from Egmond aan Zee discussed above. It is anticipated that actual avoidance rates are likely to be considerably higher. In light of the ongoing consideration of avoidance rates by Marine Scotland, collision risk estimates for kittiwake are also presented at 99 per cent in the assessment below to provide context.

153 Collision risk for some species may potentially be affected by factors such as WTG lighting and the structure of WTG bases if they include areas where birds may perch (as noted in Table 15.1).

154 WTGs and associated structures will be lit according to best practice guidance and in agreement with navigation and aviation stakeholders. Lighting was identified as a factor affecting the risk that birds will collide with a structure (Drewitt and Langston, 2008) although this was based on evidence from collisions with structures such as communication towers and lighthouses, rather than direct evidence from wind farms. There are many observations of birds being attracted to and disorientated by lights at night, particularly during conditions of poor visibility (e.g. fog). Lights may create a trapping effect whereby birds entering a lighted area may be hesitant to fly into the darkness beyond. Birds attracted to lights are not only at risk of collision with a structure, but also of exhaustion, starvation and predation. The colour of light may affect the responses of birds. Published evidence of lighting impacts often relates to migratory birds. A number of instances of seabirds being attracted to lights are cited in Reed *et al.* (1985), although none of the examples cited in the research are species recorded during Boat-based surveys.

155 Avian collision fatality data from studies conducted at 30 onshore wind farms across North America were examined to estimate how many night migrants collide with WTGs and towers, and whether collision fatalities are associated with aviation lighting (Kerlinger *et al.,* 2010). Fatality rates of night migrants, adjusted for scavenging and searcher efficiency, at WTGs 54 m to 125 m in height ranged from <one bird/WTG/year to seven birds/WTG/year. Songbirds have been recorded colliding with communication towers, lighthouses, skyscrapers, and other structures during nocturnal migration with fatalities sometimes numbering hundreds or even thousands of birds in a single night. Multi-bird fatality events (defined as >three birds killed in one night at one WTG) at the wind farms studied were rare,

recorded in only four of 25,000 WTG searches. Lighting and weather conditions may have been causative factors in the four documented multi-bird fatality events, but flashing red aviation lights, most commonly used at wind farms, were not involved. No significant differences were found between fatality rates at WTGs with aviation lights and those without lighting at the same wind farm. It was concluded that either red or white flashing lights are safer for night migrants than steady-burning lights (which may disorient birds on foggy nights). Communication towers with guy wires and a combination of steady-burning and flashing lights, have night migrant fatality rates ten to 100 times greater than WTGs.

156 Based on the available evidence, lighting of WTGs may not be a significant risk factor in terms of bird collisions and is not considered to merit separate consideration in the assessment of potential collision risk. Use of pre-cautionary avoidance rates of 98 or 99 per cent (depending on the species) in collision risk modelling assumes that some collisions will take place. Offshore met masts have no moving parts, have no guy wires and will be equipped with aviation lights similar to those on WTGs.

157 Depending on the design, WTG foundations may provide perching areas for birds, for example safety rails around platforms, the platforms themselves, or lattice foundations. This might potentially affect collision risk if birds approaching or taking off from perches are more susceptible to collisions. At the Altamont Pass onshore wind farm in California, WTGs situated on lattice towers were suspected of causing many of the observed bird fatalities, because they provided suitable perches, for example for hunting raptors. However, no evidence was found to support this and in fact research indicated that tubular towers killed more raptors than other tower types (Thelander and Smallwood, 2007). At Egmond Aan Zee offshore wind farm (Netherlands), cormorants were reported to use the met mast and WTG platforms for resting (Krijgsveld *et al*., 2011). Other bird species reported also to use the met mast and/or WTG platforms included peregrine, collared dove and starling. No mention is made of gulls making use of the met mast or WTG platforms for perching.

158 As for lighting, on the limited available evidence, it is not considered appropriate to consider WTG foundations and perches separately in relation to collision risk. Use of pre-cautionary avoidance rates is considered to ensure that potential correlates of collision (such as WTG substructure), are covered as far as is possible based on available knowledge.

159 Predicted collision mortality for seabird species at the Wind Farm has been calculated by applying the Band offshore collision risk model (Band, 2012) to density estimates derived from boat surveys, for species with sufficient numbers of birds recorded as flying at potential collision risk height. For the breeding season assessments, with the exception of kittiwake, guillemot, razorbill, puffin and gannet (for which PVA models were used to calculate breeding adult proportions), it has been assumed that 50 per cent of adult birds observed in boat surveys are breeding adults, based on advice from Marine Scotland and SNH to FTOWDG (NIRAS, 2012: Appendix 1). For migratory species the procedure outlined in Wright *et al.* (2012) has been followed to estimate migration corridors and collision risk. Full details of the methods are given in *Appendix 15A*, *Section 15A.4.1*.

160 The worst case WTG layout scenario for bird collisions at the Development Area is considered to be 213WTGs of the larger dimensions, as this gave the greatest extent of rotor swept airspace (*Appendix 15A*). Large WTGs fit the worst case scenario in terms of the risk of bird collisions in all aspects except rotation speed, as the risk of bird collisions is likely to increase with rotation speed. Of the three specified WTG options, small WTGs have the highest minimum speed and medium WTGs the highest maximum speed (respectively five (small) and 14.8 (medium) rpm compared with 4.8 and 12.8 for the large WTGs). However sensitivity tests of the Band collision risk model indicated that variation in rotation speed had a relatively small impact on collision estimates (Chamberlain *et al.,* 2006). The large WTG scenario generated the most conservative mortality estimates and alternative WTGs scenarios (medium and small) both generate lower mortality estimates, see *Appendix 15A*, *Section 15A.4.3* and *Section 15A.4.4*). For all species the collision estimates for the small WTG scenario are provided in *Appendix 15A* (*Section 15A.4.3* and *Section 15A.4.4*), effectively providing a minimum – maximum range of collision estimates for the Development Area.

161 Collision risk for bird species is assessed in Table 15.15 below. The following seabird species were excluded from the assessment of collision risk because they were either never or rarely recorded flying at collision risk height during boat-based surveys: fulmar, shag, common gull, little gull, common tern, Arctic tern, guillemot, razorbill and puffin (*Appendix 15A*, Table 15A.26). Herring gull, great black-backed gull and lesser black-backed gull in the breeding season were excluded from assessment as well due to scarcity of data.

Table 15.15: Assessment of Collision Risk Impacts on Valued Ornithological Receptors

Bird species	Assessment of Collision Risk	Conclusion
Taiga bean goose	Taiga bean geese were not recorded during the boat-based survey programme. However, the species is of interest as the Slamannan Plateau SPA holds internationally important numbers, with the Development Area situated within the population's flyway. As Forrester *et al.* (2007) indicate that the majority of spring arrival records are from the Scottish east coast and the northern isles, the flyway has been defined as Shetland to the Firth of Forth. In lieu of on-site data, the migration collision model in Band (2012) was used, with 75% of birds assumed to fly at collision risk height as per recommendations from Wright *et al.* (2012). SNH guidance for onshore wind farms (SNH, 2010c) recommends an avoidance rate of 99% for geese. **Passage migration** The estimated annual (spring and autumn migration) collision mortality is 0.01 bird at 99% avoidance (see *Appendix 15A*, Table 15A.38), assuming 75% of all birds fly at potential collision risk height (upper range as recommended by Wright *et al.,* 2012). All birds theoretically flying through the Development Area are likely to winter on the Slamannan Plateau SPA as the nearest (and only other) UK SPA for this species lies in southern England. Nilsson *et al.* (1999) estimated survival in adult Taiga bean geese from northern Finland to be at least 75% - 80% for birds marked during the period 1980 - 1993. Assuming the predicted collision risk mortality is additional to other causes of death, and only adult birds are killed, the predicted increase in adult mortality – using the mid-point of the available range - for the SPA population (260 individuals in 2009/10, 14.8% juveniles, Holt *et al.,* 2012) is <0.1 %. The assessment considered a VOR of high sensitivity and operational collision risk impacts of negligible magnitude. Based on the very small predicted increase in adult mortality during passage migration, collision risk is evaluated as a negligible impact as any impact is likely to lie within the limits of natural variation.	**Passage migration** Negligible impact
Pink-footed goose	Pink-footed geese were recorded on three occasions during the boat-based survey programme, in flocks totalling 84 birds. Scotland holds internationally important over-wintering numbers of this species, with the Development Area situated within the population's flyway. In autumn up to 200,000 birds arrive in north-east Scotland, which subsequently move into southern Scotland and northern England (Forrester *et al.,* 2007; Mitchell, 2011). The flyway width has been defined as the Great Glen to Peterhead, assuming flocks can reach the 12 nautical mile boundary off the east coast (the species was recorded on a few occasions during surveys for the Firth of Forth Phase 1 (Seagreen, 2012). In lieu of sufficient on-site data, the migration collision model in Band (2012) was used, with recommendations from Wright *et al.* (2012) incorporated. SNH guidance for onshore wind farms (SNH, 2010c) recommends an avoidance rate of 99% for geese, which was therefore the figure used.	**Passage migration** Negligible impact

Bird species	Assessment of Collision Risk	Conclusion
	Passage migration A total of 23 pink-footed geese are predicted to collide annually with WTGs at the Wind Farm. At an adult survival rate of 0.84 (Trinder *et al.,* 2005) and a proportion of juveniles of 19.3% (mean, all-Scotland, 2000 - 2009; Mitchell, 2011), collision mortality equates to a 0.08% increase of the background mortality of the Scottish winter population estimated at 200,000 birds. Pink-footed geese wintering in Scotland (and Britain) are from the Greenland and Icelandic breeding populations. The long-term trend for this population is a steady growth from about 50,000 birds in 1960 to over 360,000 in 2009 – the highest number ever recorded (Mitchell, 2010), despite this being a quarry species with an estimated mortality of at least 38,000 birds each year from shooting in Britain and Iceland (Trinder *et al*., 2005; Mitchell, 2010). The assessment considered a VOR of moderate sensitivity and operational collision risk impacts of negligible magnitude. A population model for this species (WWT Consulting, 2008) suggested that the loss of up to 1,000 additional birds each year would result in little or no detectable effect on the probability of population decline. Collision risk impacts on pink-footed goose are therefore evaluated as negligible.	
Svalbard barnacle goose	Flocks of migrating birds were recorded during boat surveys at the Development Area in October 2010. The species is of concern as the vast majority of the Svalbard population winter in the Solway Firth (Holt *et al.,* 2012) and fly through a very narrow migration corridor between the Firth of Forth and the Farne Islands (Griffin *et al.,* 2011) in spring and autumn. SNH guidance for onshore wind farms (SNH, 2010b) recommends an avoidance rate of 99% for geese. **Passage migration** The estimated annual collision mortality for the Wind Farm is seven birds at 99% avoidance (see *Appendix 15A*, Table 15A.38). All birds flying through the Development Area are likely to winter on the Upper Solway Flats and Marshes SPA. The adult survival rate of this species is estimated as 0.95 (Trinder *et al.,* 2005). Assuming the predicted collision risk mortality is additional to other causes of death, and only adult birds are killed, the predicted increase in adult mortality for the SPA population (35,640 birds in 2009 - 2010, 10.8% juveniles; Holt *et al.,* 2012) is 0.4%. The assessment considered a VOR of high sensitivity and operational collision risk impacts of low magnitude. Population modelling of Svalbard barnacle goose by Trinder *et al.* (2005) considered the loss of 350 to 1,000 adults annually of a (then) 27,000 strong Scottish population to lead to a stable to slightly decreasing population. Since 2005 the population has continued to grow substantially (Holt *et al.,* 2012), making it particularly unlikely that additional mortality of seven annual collisions equates to a significant impact. Based on the very small predicted increase in adult mortality during passage migration and in light of the PVA modelling considerations, collision risk is evaluated as a negligible impact as any impact is likely to lie within the limits of natural variation.	**Passage migration** Negligible impact

Bird species	Assessment of Collision Risk	Conclusion
Shelduck	**Passage migration** The predicted annual mortality for shelduck is one bird at 98% avoidance, assuming the non-breeding Great Britain population of 61,000 birds moves twice a year through a corridor extending from Orkney to Kent (Wright *et al.,* 2012). Predicted annual collisions represent <0.01% of the background population. The assessment considered a VOR of moderate sensitivity and operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, collision risk is evaluated as a negligible impact.	**Passage migration** Negligible impact
Tufted duck	**Passage migration** The predicted annual mortality for tufted duck is one bird at 98% avoidance, assuming the wintering Great Britain population of 110,000 birds moves twice a year through a corridor extending from Orkney to Kent (Wright *et al.,* 2012). The species is of amber concern (Eaton *et al.,* 2009) due to its decline at a European level. The assessment considered a VOR of moderate sensitivity and operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, collision risk is evaluated as a negligible impact.	**Passage migration** Negligible impact
Long-tailed duck	**Passage migration** The predicted annual mortality for long-tailed duck is less than one bird at 98% avoidance, assuming the wintering Great Britain population of 11,000 birds moves twice a year through a corridor extending from Shetland to the Farne Islands (Wright *et al.,* 2012). The species is of global concern (status Vulnerable; International Union for Conservation of Nature (IUCN), 2012) due to its decline at a European level. Predicted annual collisions represent <0.01% of the background population. The assessment considered a VOR of moderate sensitivity and operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, collision risk is evaluated as a negligible magnitude.	**Passage migration** Negligible impact
Common scoter	**Passage migration** The predicted annual mortality for common scoter is one bird at 98% avoidance, assuming the wintering Scottish population of 30,000 birds (upper range of estimate, Forrester *et al.,* 2007) moves twice a year through a corridor extending from Orkney to the Farne Islands (Wright *et al.,* 2012). Predicted annual collisions represent less than 0.01%	**Passage migration** Negligible impact

Bird species	Assessment of Collision Risk	Conclusion
	of the background population. The assessment considered a VOR of moderate sensitivity and operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, collision risk is evaluated as a negligible impact.	
Goldeneye	**Passage migration** The predicted annual mortality for goldeneye is less than one bird at 98% avoidance, assuming the wintering Great Britain population of 20,000 birds moves twice a year through a corridor extending from Orkney to Norfolk (Wright *et al.,* 2012). Predicted annual collisions represent less than 0.01% of the background population. The assessment considered a VOR of moderate sensitivity and operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, collision risk is evaluated as a negligible impact.	**Passage migration** Negligible impact
Gannet	**Breeding season** The predicted breeding season collision mortality for breeding adult gannets at 99% avoidance is 315 (see *Appendix 15A*, Table 15A.29), assuming 100% of birds in adult plumage are breeding). This was compared to the baseline adult mortality rate of the population, estimated at 8.1% (Wanless *et al.,* 2005). Assuming collision mortality is additional to other causes of death, this equates to respective mortality increases of 3.34% for the regional and 0.89% for National (UK) breeding populations (see *Appendix 15A*, Table 15A.30). The majority of gannets recorded in the Development Area during the breeding season are likely to originate from the Bass Rock colony in the Firth of Forth (Hamer *et al.,* 2011). Assigning the predicted mortality of 315 adult breeding birds to this colony of 55,482 pairs results in an increased adult mortality of 3.51%. A population model for gannets in the British Isles (WWT Consulting, 2012) has assessed the potential numbers that could be removed from the population without a high risk of population decline (before the average population growth rate will fall to 1, equivalent to stability). This has estimated a harvest of 2,000 birds per year for the Bass Rock colony and 10,000 for the British and Irish population. The estimated mortality for the Wind Farm for the breeding season (315 gannets, at 99 % avoidance, see *Appendix 15A*, Tables 15A.29) falls well within this limit. The assessment considered a VOR of high sensitivity and operational collision risk impacts of high (regional) to moderate (national) magnitude. However, population modelling indicates that the annual collision rate for the project individually would have to be six times higher than currently estimated in order for the regional population's growth rate to be reduced to a stable (i.e. no longer growing) level. It is concluded that the annual collision estimate for the	**Breeding** Minor impact **Non-breeding** Negligible impact

Bird species	Assessment of Collision Risk	Conclusion
	breeding season represents a small scale change, at worst slightly suppressing the positive growth rate of the gannet population (regionally as well as nationally) and therefore within acceptable limits. Collision risk is therefore evaluated as a minor impact. **Non-breeding season** Outside the breeding season, the predicted annual collision mortality of gannets is 13 individuals (all age classes) at 99% avoidance (see *Appendix 15A*, Table 15A.33). This represents less than 0.1% of the regional and North Sea populations (see *Appendix 15A*, Table 15A.33). The assessment considered a VOR of high sensitivity and operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, collision risk is evaluated as a negligible impact.	
Oystercatcher	**Passage migration** The predicted annual mortality for oystercatcher amounts to three birds at 98% avoidance, assuming a population of 200,000 birds moving twice a year through a corridor extending from Orkney to Kent. These birds are made up of British breeding birds remaining in the UK during winter as well as mainland Europe and Scandinavian (largely Norwegian) birds wintering in the British Isles (Delany *et al.,* 2009). The nominate species appears to be in decline across much of its range since the 1990s, as evidenced by decreasing numbers across a range of key wintering sites in The Netherlands and the UK (Delany *et al.,* 2007). Predicted annual collisions represent less than 0.01% of the background population. The assessment considered a VOR of moderate sensitivity and operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, collision risk is evaluated as a negligible impact.	**Passage migration** Negligible impact
Golden plover	**Passage migration** The predicted annual mortality for golden plover amounts to 36 birds at 98% avoidance, assuming the entire Icelandic population of 930,000 birds migrates through a corridor between Shetland and southwest Ireland twice a year. This population appears to be stable (Delany *et al.,* 2009). In reality the background population of golden plovers potentially migrating through the Development Area is substantially higher as both populations from northwest Europe (including the British Isles) and northern Europe move to and from staging and wintering areas across the North Sea (Delany *et al.,* 2009). Annual collision estimates represent less than 0.01% of the Icelandic population alone. The assessment considered a VOR of moderate sensitivity and operational collision risk impacts of negligible	**Passage migration** Negligible impact

Bird species	Assessment of Collision Risk	Conclusion
	magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, collision risk is evaluated as a negligible impact.	
Ringed plover	**Passage migration** The predicted annual mortality for ringed plover amounts to one bird at 98% avoidance, assuming a population of 73,000 birds (total nominate *hiaticula* population) moving twice a year through a corridor extending from Orkney to Kent (adapted from Wright *et al.,* 2012). In reality the background population is much larger (and much more complex), with substantial numbers of ringed plovers from northeast Canada, Greenland and northern Scandinavia moving through the British Isles on spring and autumn migration (Wright *et al.,* 2012). Predicted annual collisions represent less than 0.01% of the background population. The assessment considered a VOR of moderate sensitivity and operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, collision risk is evaluated as a negligible impact.	**Passage migration** Negligible impact
Curlew	**Passage migration** The predicted annual mortality for curlew is two birds at 98% avoidance, assuming the entire Scottish wintering population of 85,700 birds (Forrester *et al.,* 2007) migrates through a corridor stretching from Shetland to the Farne Islands twice a year. These birds originate from the European breeding population of the nominate species, which is decreasing (Delany *et al*., 2009). Annual collision estimates represent less than 0.01% of the wintering population. The assessment considered a VOR of moderate sensitivity and operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, collision risk is evaluated as a negligible impact.	**Passage migration** Negligible impact
Knot	**Passage migration** The predicted annual mortality for knot amounts to five birds at 98% avoidance, assuming half the Icelandic population (450,000 birds, Stroud *et al.,* 2004) migrates through the North Sea twice a year through a corridor stretching from Fife Ness to southern Norway. The Icelandic population is decreasing (Delany *et al.,* 2009). Annual collision estimates represent less than 0.01% of the background population. The assessment considered a VOR of moderate sensitivity and operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, collision risk is evaluated as a negligible impact.	**Passage migration** Negligible impact

Bird species	Assessment of Collision Risk	Conclusion
Dunlin	**Passage migration** The predicted annual mortality for dunlin amounts to eight birds at 98% avoidance, assuming roughly a third of the population (350,000 birds) from Iceland and Greenland (940,000 - 960,000 birds, 21,000 - 45,000 birds respectively; Delany *et al.,* 2009) migrates through the North Sea twice a year, through a corridor stretching from Lewis (Western Isles) to the Firth of Forth. Both populations appear to be stable (Delany *et al.,* 2009), though the non-breeding population in the UK is Red-listed due to long term declines. Annual collision estimates represent less than 0.01% of the Icelandic population alone. The assessment considered a VOR of moderate sensitivity and operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, collision risk is evaluated as a negligible impact.	**Passage migration** Negligible impact
Purple sandpiper	**Passage migration** The predicted annual mortality for purple sandpiper is less than one bird at 98% avoidance, assuming the entire Great Britain wintering population of 13,000 birds (Holt *et al.,* 2012) migrates through a corridor stretching from Lewis (Western Isles) to the Firth of Forth twice a year. This population consists of birds from Arctic Canada and northeast Greenland (population possibly decreasing, Delany *et al.,* 2009) and northern Europe and western Siberia (population probably stable, Delany *et al.,* 2009). Annual collision estimates represent less than 0.01% of the wintering population. The assessment considered a VOR of moderate sensitivity and operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, collision risk is evaluated as a negligible impact.	**Passage migration** Negligible impact
Grey phalarope	**Passage migration** The predicted annual mortality for grey phalarope is less than one bird at 98% avoidance, assuming a population of 50 birds (upper range of estimate, Forrester *et al.,* 2007) migrates through a corridor stretching from Lewis (Western Isles) to the Firth of Forth on autumn passage. Birds recorded in the Development Area during that time of year are likely part of a very large migration movement of approximately one million birds from the Canadian, Greenland and Icelandic populations, which largely takes place across the Atlantic, west of the British Isles. Peak numbers recorded off the Scottish west and north coast tend to coincide with westerly gales, making it likely that birds recorded in the Development Area are part of this migratory movement in this time of year (the population breeding in Europe is very small and unlikely to contribute significantly to the autumn passage population). Delany *et al.* (2009) indicate the Nearctic population to be decreasing. Annual collision estimates represent less than 0.01% of the autumn passage	**Passage migration** Negligible impact

Bird species	Assessment of Collision Risk	Conclusion
	population. The assessment considered a VOR of moderate sensitivity and operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, collision risk is evaluated as a negligible impact.	
Arctic skua	There are no breeding colonies within foraging range of the Development Area. Arctic skuas were recorded in the Boat-based Survey Area between the months of July to October only (see *Appendix 15A*, Figure 15A.20) and all are likely to be autumn passage migrants. Collision risk has been assessed only during the autumn passage period. Insufficient data was recorded during boat-based surveys for use in collision-risk modelling, so instead the migration model (Wright *et al.,* 2012) was used. Arctic Skuas breeding further north in Scotland and elsewhere in northern Europe are thought to migrate through the North Sea to wintering areas off the coasts of Europe, Africa and possibly South America (Wright *et al.,* 2012). Spring passage migration is mainly along the west coast of Scotland rather than the North Sea (Forrester *et al.,* 2007). **Passage migration** The estimated annual collision mortality at 98% avoidance is one bird (see *Appendix 15A*, Table 15A.32). The Scottish Autumn passage is estimated at 1,000 – 10,000 birds (Forrester *et al.,* 2007). The North Sea autumn passage population may include breeding birds from the UK, Norway, Sweden and the Faeroe Islands, an estimated 25,900 birds (based on BirdLife International, 2004). The predicted collision mortality during the autumn passage period represents a proportion of 0.02% of the Scottish passage population (based on the mid-point of the estimate at 5,500 birds) and 0.01% of the North Sea population. The assessment considered a VOR of moderate sensitivity and operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background populations predicted to be affected through annual collisions, which are considered to fall within the limits of natural variation, collision risk is evaluated as a negligible impact.	**Passage migration** Negligible impact
Great skua	There are no breeding colonies within foraging range of the Development Area. Great skuas were recorded at the Boat-based Survey Area between the months of June to December (see *Appendix 15A*, *Section 15A.3.2.12*) and all are likely to be autumn passage migrants. Collision risk has been assessed only during the autumn passage period. Insufficient data was recorded during boat-based surveys for use in collision-risk modelling, so instead the migration model (Wright *et al.,* 2012) was used. Passage birds from Scottish and more northerly breeding colonies are seen most commonly in autumn along the east coast. The main wintering areas are from the Celtic Sea to the Atlantic Ocean off the west coast of Africa and the Western Mediterranean (Forrester *et al.,* 2007). Spring passage migration is mainly	**Passage migration** Negligible impact

Bird species	Assessment of Collision Risk	Conclusion
	along the west coast of Scotland rather than the North Sea (Forrester *et al.,* 2007). **Passage migration** The estimated annual collision mortality at 98% avoidance is two birds (see *Appendix 15A*, Table 15A.32). The predicted collision mortality during the autumn passage period represents a proportion of 0.02% of the regional passage population (10,750 birds, see *Appendix 15A*, *Section 15A.3.2.12*) and 0.02% for the North Sea passage population (12,200, see *Appendix 15A*, *Section 15A.3.2.12*). The assessment considered a VOR of moderate sensitivity and operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background populations predicted to be affected through annual collisions, which are considered to fall within the limits of natural variation, collision risk is evaluated as a negligible impact.	
Kittiwake	**Breeding season** The predicted breeding season collision mortality for kittiwakes (all age classes) at 98% avoidance is 24 birds (see *Appendix 15A*, Table 15A.29). Based on a stable age structure from a population model for the regional population with potential connectivity to the Development Area (see *Appendix 15B*, Table 15B.6), 74.4% of birds observed during the breeding season are estimated to be breeding adults (given that the juvenile age class is confined to the nest at that time), giving 18 collisions of breeding adults. This was compared to the baseline adult mortality rate of the population, estimated at 12% (Harris *et al*., 2000; see *Appendix 15B*, Table 15B.4 for justification to use this source for adult survival rate). Assuming collision mortality is additional to other causes of death, this equates to respective mortality increases of 0.14% and 0.02% for the regional and National breeding populations (*Appendix 15.A*, Table 15A.31). Just considering predicted collision mortality during the breeding season, however, is likely to under-estimate the impact on the regional breeding population of kittiwakes, as birds from this population might also be at risk of collision during the post-and non-breeding season. Thus a PVA was carried out considering the potential impact of collisions throughout the year on the regional breeding population. The population model was based on empirical estimates of demographic parameters (rates of survival and reproduction) from regional populations with potential connectivity to the Development Area. Full details are included in *Appendix 15B* (*Section 15B.3.2*). The baseline population model predicted a declining population (*Appendix 15B*, Figure 15B.2) which was considered to be consistent with observed trends of kittiwakes at sites within the regional population, and also with current information on the status of kittiwakes in Scotland. The population baseline modelling in fact suggested that there is more than a 70% chance of the kittiwake population declining by 50% (*Appendix 15B*, Figure 15B.2), so that a decline of this magnitude may be considered as a 'likely' event (IPCC, 2010). Declines have been driven by declines in the abundance of sandeels, the main prey species of kittiwakes during the breeding season, the latter affected by fishing effort and increases in sea	**Breeding** Minor impact **Post-breeding and non-breeding** Negligible impact

Bird species	Assessment of Collision Risk	Conclusion
	surface temperatures (Frederiksen *et al.,* 2004). The estimated number of kittiwake collisions per year at the Inch Cape Offshore Wind Farm is 548 birds of all age classes (*Appendix 15B*, Table 15B.8). Outside the breeding season, kittiwakes using the Development Area are likely to include birds from other breeding populations as well as local breeding birds, so not all these collisions will affect the regional breeding population. GPS tracking of kittiwakes from the Isle of May has revealed that many of the birds that breed in this region winter in the Atlantic Ocean (including the far west), with a substantial proportion (>50% of those tracked) having moved out of the North Sea region by early September (Bogdanova *et al.,* 2011; Frederiksen *et al.,* 2012). Many of the kittiwakes recorded within the Development Area during the post-breeding and winter periods are likely to derive from Arctic and sub-Arctic breeding colonies (Frederiksen *et al.,* 2012). Therefore, collision mortality was incorporated into the PVA under assumptions that (i) 100% of birds recorded during the breeding, post-breeding and non-breeding periods, belonged to the regional breeding population; and an alternative scenario (ii) where 100% of birds in the breeding season, 50% of birds in the post-breeding season, and 25% of birds in the non-breeding season were from the regional breeding population. At 98% avoidance, the predicted annual mortality of kittiwakes from the regional population under scenario (ii) is 246 birds (*Appendix 15B*, Table 15B.8). These two scenarios were also considered using the collision estimate derived with an avoidance rate of 99%. Introduction of a 99% scenario increases the range of annual mortality estimates for inclusion in the PVA, and reflects the fact that, at the time of writing, Marine Scotland and SNH are reviewing the evidence for seabird avoidance rates. The projected trends of the regional kittiwake population under these four scenarios of collision mortality, compared with the baseline model with no collision mortality, are shown in *Appendix 15B*, Figure 15B.3. The effects of a range of additional mortalities (equivalent to 123 – 1,000 birds per year, representing the mortality level from the least precautionary of the four collision estimate scenarios, to one which was almost double that from the most precautionary of these scenarios) on the probability of the population declining to a range of thresholds, are shown in *Appendix 15B*, Figures 15B.2 and 15B.3. For all scenarios, there is relatively little effect of additional mortality on the probability of decline by up to 25% (see *Appendix 15B*, Figure 15B.3). This is largely because of the high probability of decline to such thresholds even in the absence of additional mortality. However, for thresholds of 50% and 75% decline, additional mortality has a more marked effect on the probability of attaining a decline of such magnitude, although this is strongly influenced by the level of additional mortality. Thus, additional mortalities equivalent to removing 123 - 400 birds from the starting population increase the likelihood of such declines by c.2% - 4% (equivalent to being 'very unlikely' under the IPCC guidance – IPCC, 2010), with no apparent increase in this risk over this range of additional mortality (see *Appendix 15B*, Figure 15B.3). This range encompasses three of the four scenarios considered for the additional mortality resulting from the estimated collisions (i.e. all but the most precautionary scenario of 98% avoidance and all birds killed throughout the year originating from the regional population). Higher levels of additional mortality produce a greater increase in the likelihood of the population	

Bird species	Assessment of Collision Risk	Conclusion
	experiencing declines of 50% to 75%, with the most precautionary collision mortality scenario (i.e. 98% avoidance and all estimated collisions during all seasons affecting birds from the regional breeding population) producing an increase of c.7% - 8% in the likelihood of such declines (*Appendix 15B*, Figure 15B.3). The assessment considered a VOR of high sensitivity and operational collision risk impacts of low (regional) to negligible (national) magnitude. Evaluation of predicted mortality from collisions represents a **negligible** impact on the national kittiwake breeding population based on the very small proportion of the background populations predicted to be affected. Evaluation of collision impacts predicted by the PVA, considered that predicted mortality from collisions at the Wind Farm represents a **minor** impact on the regional kittiwake breeding population. This conclusion takes into account: (i) the context of a declining population, with baseline population modelling (no additional mortality from collisions) suggesting there is more than a 70% chance of a 50% decline; (ii) the effect of collisions during the breeding, post-breeding and non-breeding season on the regional breeding population. Given the evidence that kittiwakes from the regional population disperse into the Atlantic Ocean outside the breeding season (Bogdanova *et al.,* 2011; Frederiksen *et al.,* 2012), it is highly unlikely that all predicted annual collisions (total of 548 birds) will affect the regional breeding population. GPS tracking indicates that more than 50% of breeding birds leave the North Sea by early September, so a scenario where 50% of collisions during the post-breeding and 25% of those during the non-breeding season is more realistic. This predicts and annual mortality of 246 birds from the regional breeding population; (iii) examination of the impact of additional mortality on the probability of population decline, suggests that across the range of 100 to 400 birds (from the starting population), there is a 2% - 4% increase in the likelihood of population declining by 50% or 75%. Furthermore, over this range of additional mortality there is no discernible increase in the level of population impact as the additional mortality increases, so that impacts remain relatively small across this range. Therefore over this range of additional mortality, the additional impact on an already declining population will be minimal. **Post-breeding season** At 98% avoidance the estimated collision mortality for kittiwakes is 365 individuals (see *Appendix 15A*, Table 15A.32). Based on a stable age structure from a population model the regional breeding population is considered to consist of 181,832 birds (see *Appendix 15B*, Table 15B.7), of which the collision estimate represents a proportion of 0.2%. Studies by Bogdanova *et al.* (2011) and Frederiksen *et al.* (2012) indicate that the kittiwake post-breeding season in the North Sea is characterised by a high level of flux, with a substantial proportion of British breeding birds moving into the	

Bird species	Assessment of Collision Risk	Conclusion
	Atlantic and birds from northern European populations moving into the North Sea. Similarly, estimates by Skov *et al.* (1995) show that the North Sea population nearly doubles in size between the breeding and non-breeding season, indicating a substantial flux between seasons. Therefore, any predicted impact from collision on the kittiwake regional post-breeding population is likely to be distributed across many different populations and unlikely to impact any of those significantly. The assessment considered a VOR of high sensitivity and operational collision risk impacts of low magnitude. Based on the very small proportion of the background populations predicted to be affected through annual collisions, which are considered to fall within the limits of natural variation, collision risk is evaluated as a negligible impact. **Non-breeding season** At 98% avoidance the estimated collision mortality for kittiwakes in the non-breeding season is 158 individuals (see *Appendix 15A*, Table 15A.32). This represents a proportion of 0.19% of the regional population at 84,000 and 0.02% for the North Sea population at 1,032,690 birds (see *Appendix 15A*, Table 15A.35). It is considered that the regional non-breeding population is probably much larger than the previously identified 84,000 kittiwakes and probably extends into the northern and central North Sea. Areas to the north of the Development Area (Moray Firth, Orkney, Fladen Ground) support up to 187,500 birds, with areas to the south (Dogger Bank, Barmade Bank to Silver Pit) supporting up to 202,000 birds (Skov *et al.,* 1995). Considering the very large numbers of kittiwakes present in the North Sea originating from a range of different populations (Bogdanova *et al.,* 2011; Frederiksen *et al.,* 2012) and the species capacity to cover large distances throughout the non-breeding season, it is likely this results in a high turnover of birds in the Development Area. Therefore any impact from collisions on the non-breeding regional population is predicted to be distributed across a much larger population of at least several hundred thousand birds present in the northern North Sea. The assessment considered a VOR of high sensitivity and operational collision risk impacts of low (regional) to negligible (North Sea) magnitude. Based on the very small proportion of the background populations predicted to be affected through annual collisions, which are considered to fall within the limits of natural variation, collision risk is evaluated as a negligible impact.	
Lesser black-backed gull	**Breeding season** Lesser black-backed gulls were recorded in exceedingly low numbers in the Boat-based Survey Area during the breeding season (see *Appendix 15A*, *Section 15A.3.2.9*). There were only four records of this species in flight in the Development Area during the breeding season on which to base flight densities (see *Appendix 15A*, Table 15A.26). Using such a small sample to calculate flight density within the Boat-based Survey Area is not considered to be robust	**Breeding** N/A **Non-breeding**

Bird species	Assessment of Collision Risk	Conclusion
	(density is not likely to be significantly different to zero) and the output of the collision risk model for such a small sample is likely to be unreliable and over-estimate collision mortality. Given the extremely low level of flight activity it is considered that the species is highly unlikely to be at risk of collision during the breeding season. **Non-breeding season** The majority of lesser black-backed gulls breeding in the UK migrate south to winter in coastal areas of Iberia and northwest Africa (Wright *et al.,* 2012). No birds were recorded at the Development Area during bird surveys outside the breeding season and therefore the species is not at collision risk at this time.	N/A
Herring gull	**Breeding season** Herring gull observations in the Development Area during the breeding season were exceedingly low (see *Appendix 15A*, Table 15A.26). Using such a small sample to calculate flight density within the Boat-based Survey Area is not considered to be robust (density is not likely to be significantly different to zero) and the output of the collision risk model for such a small sample is likely to be unreliable and over-estimate collision mortality. Herring gulls were particularly uncommon in the Boat-based Survey Area during the breeding season (see *Appendix 15A*, *Section 15A.3.2.10*). Given the extremely low level of flight activity it is considered that the species is unlikely to be at risk of collision during the breeding season. **Non-breeding season** The predicted collision mortality for herring gulls at 98% avoidance is 54 birds (see *Appendix 15A*, Table 15A.32). Assuming all birds are adults and collision mortality is additional to other causes of death, this equates to a proportion of 0.03% for the regional and 0.01% for the North Sea winter populations (see *Appendix 15A*, Table 15A.36). The assessment considered a VOR of high sensitivity and operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background populations predicted to be affected through annual collisions, which are considered to fall within the limits of natural variation, collision risk is evaluated as a negligible impact.	**Breeding** N/A **Non-breeding** Negligible impact
Great black-backed gull	**Breeding season** There were only two observations of great black-backed gull in flight in the Development Area during the breeding season on which to base flight densities (see *Appendix 15A*, Table 15A.26). Using such a small sample to calculate flight density within the Boat-based Survey Area is not considered to be robust (density is not likely to be significantly different to zero) and the output of the collision risk model for such a small sample is likely to be unreliable and over-estimate collision mortality. Given the extremely low level of flight activity it is considered that the species is unlikely to	**Breeding** N/A **Non-breeding** Negligible impact

Bird species	Assessment of Collision Risk	Conclusion
	be at risk of collision during the breeding season. **Non-breeding season** The predicted collision mortality for great-black-backed gulls at 98% avoidance is 147 individuals (see *Appendix 15A*, Table 15A.32). Assuming all these are adult birds, the predicted collision estimate represents a proportion of 0.68% of the regional and 0.05% of the North Sea populations (see *Appendix 15A*, Table 15A.37). However, it has been known that many of the great black-backed gulls wintering on the east coast of Britain originate from Norway and Russia, with birds arriving from late July onwards (Coulson *et al.,* 1984). Ringing recoveries indicate that the majority of the British breeding population remains close to breeding areas during the winter (Wernham *et al.,* 2002), so birds using the Development Area during the non-breeding season are likely to comprise a mixture of local breeding birds and Norwegian/Russian birds. The proportion of local birds versus visitors is unknown, but given the small east coast breeding population, immigrants are likely to outnumber local birds. The assessment considered a VOR of moderate sensitivity and operational collision risk impacts of moderate (regional) to negligible (North Sea) magnitude. Based on the small proportion of the background populations predicted to be affected through annual collisions (considered to fall within the limits of natural variation), collision risk is evaluated as a negligible impact.	

15.6.3 Effects of Decommissioning

162 The potential effects of decommissioning are considered to be equivalent to and potentially lower than the worst case effects assessed for the construction phase. The approach to decommissioning is described in *Section 7.12*. A decommissioning plan will be prepared in accordance with the requirements of the *Energy Act 2004* (see *Section 3.2.5*) and will be subject to approval from the Department of Energy and Climate Change prior to implementation.

15.7 Impact Assessment - Offshore Export Cable Corridor

163 This section presents the ornithological impact assessment for the Offshore Export Cable Corridor. The Offshore Export Cable Corridor runs from the south of the Development Area to MHWS at the landfall options at Cockenzie/Seton Sands in East Lothian (Figure 15.1).

15.7.1 Ornithological Characteristics of the Offshore Export Cable Corridor

164 The Offshore Export Cable Corridor crosses four broadly differing marine environments, defined by their geographical location, bathymetry and associated bird assemblages. These are described below:

- Through the initial part of the Offshore Export Cable Corridor, in the deeper waters (approximately >50 m) between the Development Area and the mouth of the Firth of Forth, important numbers of seabirds occur over large areas during the breeding season, originating from colonies on the Forth Islands, the Fife, Angus and southeast Scotland coastline (*Appendix 15A*; Mainstream Renewable Power, 2012: (Chapter 12 and appendices); Seagreen, 2012: (Chapter 10 and appendices)). Nationally and regionally important seabird numbers occur in this area in the non-breeding season (Skov *et al.,* 1995; Kober *et al.,* 2010).
- Where the corridor is situated within the Firth, on the Rath Grounds between the Isle of May and North Berwick (approximately 50 m - 20 m depth) important concentrations of seabirds associated with the Forth Islands SPA are present, particularly in close proximity to the colonies for which marine SPA extensions have been designated. Important seabird numbers occur in this area during the non-breeding season (Skov *et al.,* 1995, Kober *et al.,* 2010), as well as eider and red-throated diver (Dean *et al.,* 2003 and 2004; Wilson *et al.,* 2006).
- In the shallower waters, roughly a triangle between Gullane, the South Channel and Cockenzie, the habitat is distinctly different with water depth largely between approximately 20 m and 5 m. Important bird numbers present here are species likely originating from the southern section of the Forth Islands SPA colonies (Fidra, The Lamb, Craigleith). During the non-breeding season this area is important for a range of species, particularly seaducks, scoters, red-throated diver and grebes (Dean *et al.,* 2003 and 2004; Wilson *et al.,* 2006, Holt *et al.,* 2012).
- Finally, within the last section of the Offshore Export Cable Corridor, corresponding with the near-shore area (including the intertidal) roughly between water depth of five metres

and MHWS, a mixture of seaducks, divers and grebes are found in the shallower waters, with waders, ducks and other wildfowl present between low and high tide marks (depending on the state of the tide). Many species present, particularly during winter months, are qualifying interests of the Firth of Forth SPA, although some seabird species such as auks and gulls may also utilise near-shore and intertidal habitats, and may be part of more distant SPAs.

165 To take into account these broad habitat differences, the assessment has been divided in two main parts of the Offshore Export Cable Corridor (i) the Offshore Export Cable Corridor between the Development Area and the near-shore and (ii) the Offshore Export Cable Corridor between the near-shore and MHWS (and therefore including intertidal).

166 Details of the sensitivity of VORs used for the assessment of Offshore Export Cable Corridor are provided in Tables 15.8 (between the Development Area and the near-shore area) and 15.9 (near-shore area (including intertidal)) above, and as described in *Section 15.5.2*.

15.7.2 Effects of Construction

167 Several construction scenarios for the Offshore Export Cable are under consideration (see *Chapter 7*), of which only the worst case scenario relevant for ornithological receptors is considered in this assessment. Worst case is defined here as the scenario with the largest spatial (the widest part of the corridor, 1,400) and temporal extent (phased construction of cable potentially phased over three years, totalling nine months (Development Area to near-shore) and six months (near-shore and intertidal), and requiring the maximum number of cables (six), details of which are included in Table 15.3. Full details of the potential installation procedures and required equipment for cable laying across the intertidal area are provided in *Chapter 7* (see *Section 7.9.3*). Potential effects associated with the construction of the Offshore Export Cable are:

- Direct habitat loss (including intertidal areas) due to construction of the Offshore Export Cable;
- Disturbance due to increased vessel/vehicle traffic and construction activities; and
- Indirect impacts of cable installation on bird communities due to impacts on benthic and natural fish species..

168 Each of the resulting potential effects on ornithological receptors is considered separately, first for the section of the Offshore Export Cable Corridor from the Development Area to near-shore (1.5 km from MHWS), and then from near-shore to MHWS. Where appropriate, the potential effects on VORs are considered for a particular time of year, depending whether they are present over winter, during the breeding season, post-breeding or year-round; i.e. for the breeding and post-breeding season only seabirds are considered, whereas for the non-breeding season, species of near-shore and intertidal habitats are included as well.

Direct Habitat Loss - Development Area to Near-shore

169 For the subtidal Offshore Export Cable, direct temporary disturbance of habitats will be restricted to a narrow strip along the Offshore Export Cable Corridor which equates to three per cent of the total Offshore Export Cable Corridor. Where cable burial equipment is used, this area of disturbance will be associated with the compression of sediments beneath the plant over the trench affected width of six metres. Within this trench affected area, a trench of one metre width will be excavated. Direct temporary habitat loss will therefore be of very limited extent and highly localised.

170 The assessment considered VORs of all sensitivities in all seasons, and direct habitat loss impacts of Offshore Export Cable laying during construction to be of negligible magnitude due to the very localised and short-term effects of such habitat loss, effectively representing a very slight change to baseline conditions. Therefore, direct habitat loss during construction on **all VORs** during all seasons is evaluated as a negligible impact, with any effects predicted to lie within the limits of natural variation of a dynamic seabed ecosystem.

Indirect Impacts on Bird via Prey Species - Development Area to Near-shore

171 During the installation of the Offshore Export Cable, indirect effects on bird communities through impacts on prey availability may occur. The impacts on prey species are assessed in *Chapter 12* and *Chapter 13,* (see *Section 13.7.1*) and may result from temporary habitat disturbance, increase in SSC and deposition, and noise related disturbance for natural fish. Cable laying and burying affect comparably very discrete and limited areas, sediment plumes are low and localised (see *Chapter 12* and *Chapter 13*). It is considered highly unlikely that seabird communities would be affected as impacts would not significantly extend beyond the Offshore Export Cable Corridor or be of sufficient scale to impact prey abundance or distribution.

172 The assessment considered **all VORs** of all sensitivities in all seasons and indirect construction disturbance via impacts on fish prey of negligible magnitude, as any impacts in relation to the Offshore Export Cable are very small in relation to the VOR's foraging ranges, and are short-term (with disturbed sediments resettling within hours at worst) and reversible. The impact is therefore considered to represent no more than a slight change from baseline conditions, with any effects to lie within the limits of natural variation, and evaluated as negligible.

Direct Disturbance - Development Area to Near-shore

173 Approximately 30 vessel movements per cable are predicted to be required during construction. Characteristic rates for laying are approximately 500 m per hour. Cable laying and activities related to this will be 24 hour operations. Overall, this level of vessel activity would represent a fractional increase over and above existing traffic levels (see *Chapter 19,* and Figures 19.10 and 19.11), and would only cause localised and temporary disturbance effects over a period of nine months (see Table 15.3).

174 As a worst case scenario, direct disturbance through construction activity could result in the complete avoidance of the cable laying vessel(s) out to a given range by all the individuals of one or more species for the duration of the activity.

Breeding and Post-breeding Seasons

175 The species (VORs) most susceptible to disturbance (based on ratings as per Furness and Wade, 2012) present between the Development Area and the near-shore during the breeding season are **shag, eider, razorbill and guillemot**. Of these, eider and shag are largely absent from the deep water offshore section between the Development Area and the Isle of May (Mainstream, 2012: Appendix 12.1). Observations during the boat-based surveys during 2010-12 clearly show the proportion of auks in flight to be minimal (less than one per cent April - June (see *Appendix 15A*, Tables 15A.3.4, 15A.3.5 and 15A.3.6), with very few birds actively taking off due to the approaching survey vessel. Given observations on flight behaviour of auks, it is therefore considered particularly precautionary to assume that during the breeding season these species could be disturbed in a 500 m radius around the cable laying vessel (which travels at a much lower speed).

176 Assuming a 500 m disturbance zone, at any given moment in time approximately 0.8 km^2 of sea surface is likely to be affected by the presence of a construction vessel, during cable laying.

177 Disturbance in the breeding season could potentially be buffered by a large foraging range, i.e. activities which disturb species with a restricted foraging range are likely to have a larger impact than the same activities would have on a wide-ranging bird species. Of the species under consideration here, **shag** is particularly restricted in its range during the breeding season, with a mean foraging range of 5.9 km ± 4.7 km (Thaxter *et al.,* 2012), equating to an available sea surface area of 353 km^2. Within its range however, the species is considered to moderately flexible in its habitat use (Furness and Wade, 2012). Based on a vessel disturbance zone of 0.8 km^2, at any given moment in time during the breeding season a cable laying vessel could potentially affect 0.2 - 0.4 per cent of a shag's theoretically available foraging range for island colonies (e.g. Isle of May) and coastal colonies respectively (as a result of directional restrictions due to the presence of landmass).

178 Assuming a similar scenario for **eider** – a species for which limited information on foraging range is available – an equally small level of proportional overlap between vessel disturbance zone and foraging range is expected.

179 **Razorbill** and **guillemot** tend to forage much further offshore, with inshore feeding comparatively scarce, although large aggregations occur at sea in the vicinity of breeding colonies in the Firth of Forth. Both species are considered less sensitive to direct disturbance due to much larger foraging ranges, enabling exploitation of alternative resources in the wider, non-impacted area. Both species are considered moderately flexible in their habitat use (Furness and Wade, 2012). Due to both species' large foraging range it follows that any potential impact from direct disturbance during this time of year is likely to be substantially less than for shag and eider.

180 During the post-breeding season (July - August) for **razorbill and guillemot**, large numbers of parent birds accompany their fledged chicks offshore. Important post-fledging aggregations are expected to occur throughout the Offshore Export Cable Corridor during this time of year. During this period individuals of both species are largely flightless – adults undergo moult, chicks are not capable of flight yet. As a result birds' reaction to nearby disturbance involves escape diving and actively swimming away. Observations during boat-based seabird surveys indicated that disturbance distances – leading to escape dives - were small, and did not appear to extend beyond 100 m from the vessel. Regular disturbance of small chicks in particular could, in theory, lead to a decrease in survival rate. Camphuysen (2002) however, indicates that guillemot parent-chick combinations travelled large distances of up to 50 km a day after leaving the colony, moving into the central North Sea. It follows that turnover in these birds within the Offshore Export Cable Corridor is very high, and any disturbance impact on **guillemot** and **razorbill** in the post-breeding season due to cable laying activities is likely to be distributed across a very large transitory population, rather than a fixed population dependent on a particular area of sea.

181 The assessment considered two VORs of high sensitivity in the breeding season (**shag, eider**) which are considered most susceptible to disturbance as well as most restricted in their foraging range, and direct construction disturbance of low magnitude, as any impacts are relatively small in relation to both VORs foraging ranges, and are short-term (at worst occurring intermittently in up to three breeding seasons) and reversible. The impact is therefore considered to represent no more than a slight change from baseline conditions, with any effects to lie within the limits of natural variation, and evaluated as negligible. It follows that for **all other VORs** which are similarly (razorbill, guillemot) or less susceptible (other VORs) to disturbance the evaluated impact is negligible.

182 Furthermore, the assessment considered two VORs of high sensitivity in the post-breeding season (**razorbill, guillemot**) which are considered most susceptible to disturbance as well as largely flightless during that time of year, and direct construction disturbance of negligible magnitude, as any impacts are relatively small in relation to available foraging areas for both VORs, and are short-term (at worst occurring intermittently in up to three post-breeding seasons) and reversible. The impact is therefore considered to represent no more than a slight change from baseline conditions, with any effects to lie within the limits of natural variation, and evaluated as negligible.

Non-breeding Season

183 In the non-breeding season, seabirds tend to be less sensitive to disturbance as there is no requirement to attend a nest site, and species are likely to be able to forage over large areas.

184 The assessment considered **all VORs** of all sensitivities in the non-breeding season and direct construction disturbance of negligible magnitude, as the spatial extent of any impact (up to 500 m disturbance from a vessel) is very small in relation to available foraging areas during this time of year, and are short-term (at worst occurring intermittently in up to three non-breeding seasons) and reversible. The impact is therefore considered to represent no more

than a slight change from baseline conditions, with any effects to lie within the limits of natural variation, and evaluated as negligible.

185 For non-seabirds a range of species highly and moderately susceptible to disturbance occur within the Offshore Export Cable Corridor. Only the former category is considered here, under the assumption that any impact on moderately susceptible species will be similar or less than those for the most susceptible species.

186 The VORs most susceptible to disturbance present within this part of the Offshore Export Cable Corridor during the non-breeding season are **red-throated diver , common scoter, velvet scoter and goldeneye**.

187 Of these five species, red-throated diver, velvet scoter and common scoter are particularly easily disturbed, with the latter known to be flushed at one to two kilometres from approaching vessels (Dirksen *et al.,* 2005; Kaiser *et al.,* 2006). Goldeneye can take flight due to vessel presence at 0.5 – 1.0 km distance (Platteeuw and Beekman, 1994). Divers are especially sensitive to approaching boats and may dive or fly off when vessels are more than one kilometre away (Schwemmer *et al.,* 2011). Given known flight behaviour of these species it is considered appropriate to assume that scoters could be disturbed in a two kilometre radius around the cable laying vessel and the other species up to one kilometre.

188 Aerial surveys of the Firth of Forth, indicate that the distribution of all five species is largely restricted to shallow, inshore habitats, with important bird numbers occurring in relatively small areas (Dean et al., 2003 and 2004; Wilson et al., 2006; Dawson et al., 2008). The Offshore Export Cable Corridor overlaps with areas where such concentrations occur, particularly near Aberlady Bay, Gullane and Gosford Bay. Thus, in theory the presence of a cable laying vessel could disturb birds for the duration of construction activities where these take place within foraging habitats.

189 The assessment focussed on the nature of the cable laying process. It is considered cable laying involves localised impact levels, and low levels of visual and auditory intrusion: the construction vessel will represent a short-term presence in any one area in the Offshore Export Cable Corridor, a maximum speed of 500 m an hour is to be maintained, and from a bird perspective the vessel 'behaviour' will therefore be predictable, lacking any sudden movements at high speed (e.g. sea ducks were found to habituate to offshore traffic in areas with designated shipping lanes, Schwemmer et al., 2011). Furthermore, the likely noise levels involved are expected to be low as the cable laying and jetting takes place on the seabed.

190 The assessment considered the **VORs** of high sensitivity (**red-throated diver, common scoter, velvet scoter, goldeneye**) in the non-breeding season and direct construction disturbance of negligible magnitude, as the spatial extent of any impact (up to two kilometre disturbance from a vessel for both **scoters**, up to one kilometre for the other species) is small in relation to the available foraging areas during this time of year, are short-term (at worst occurring intermittently up to three non-breeding seasons) and reversible. The impact

is therefore considered to represent no more than a slight change from baseline conditions, with any effects to lie within the limits of natural variation, and evaluated as negligible.

Near-shore to MHWS (including Intertidal) - Direct Habitat Loss

191 The Offshore Export Cable landfall location will be within the intertidal area either near Cockenzie or Seton Sands, on the southern shore of the outer Firth of Forth (Figure 15.1). Full details of the cable laying options across the intertidal landfall areas are provided in *Chapter 7* and the worst case scenario is presented in Table 15.3. In summary, within the chosen Offshore Export Cable Corridor up to six Export Cables will be installed in separate trenches. Each one metre trench will result in habitat disturbance from installation equipment of up to six metres, i.e. up to 36 m in total. In addition, two jointing pits are required, estimated at 100 m^2 each.

192 The worst case scenario considers the affected intertidal area at the Cockenzie beach landfall option to be 2,216 m^2, which equates to two per cent of the total beach area measured from the Cockenzie Power station to East Cuthill Rocks. This is based on the tidal range at widest point of the beach, and therefore the Export Cable length across the intertidal area measures 56 m.

193 Intertidal surveys showed that the habitat at the Cockenzie cable landfall survey area is divided into two main areas - classified as hard substratum and by mixed substrata respectively (see *Chapter 12*, *Section 12.5.3*). The mixed substrate ranged from sandy gravel on the upper to mid shore, to sandy gravel and cobbles on the mid to lower shore. The hard substrata in the northern half of the Cockenzie cable landfall survey area showed typical zonation for a rocky shore.

194 The worst case scenario considers the intertidal area disturbed at Seton Sands beach landfall option is 14,636 m^2 which equates to 1.1 per cent of total beach area measured from Wrecked Craigs to Fenny Ness (based on the Export Cable length across the intertidal area of 401 m). The Seton Sands cable landfall area consists predominantly of fine sand habitats. Polychaete worms were present in large numbers down into the low shore and the bivalve mollusc, *Angulus tenuis* was present in numbers on the extreme low shore (see *Section 12.5.3*).

195 Recovery of sandy intertidal biotopes characterised by polychaetes is predicted to take between one to two years after installation impacts have ceased (Budd, 2008). Although it is likely from a technical feasibility perspective that installation in the chosen intertidal area will avoid areas of hard substrates, impacts to rocky/boulder habitats may occur and will be variable depending on installation methods used (e.g. directional drilling, mechanical cutting, etc.), with mechanical cutting considered the worst case in this aspect. Recovery is typically longer for rocky intertidal species (e.g. Fucoid seaweed species four to five years, limpets up to 20 years, but usually < 10 years, Hill *et al*., 1998), although prey items taken by wader species (e.g. littorinid gastropod molluscs and amphipod crustaceans) are more mobile and likely to recolonise rapidly.

196 The direct temporary habitat disturbance associated with Export Cable installation at Seton Sands and Cockenzie is therefore likely to be short to medium-term and predicted to be restored in the medium to long term.

197 In terms of the impact of this temporary habitat loss on VORs, the intertidal area may be used for feeding or loafing by seaducks, grebes, divers and terns when submerged through the high tide. For these species, prey items are mobile fish and invertebrates and so intertidal habitat loss would be negligible. For species such as eider that take sedentary invertebrate prey species (mainly mussels), impacts will be of a very small magnitude since no important feeding habitat will be lost in the intertidal area.

198 Impacts of habitat loss down to low tide, when habitats are exposed, have the potential to affect wader populations. The magnitude of this impact is likely to be affected by the relative availability and proximity of other suitable foraging habitats, although the effects of habitat loss will be dependent on the species and their site-fidelity, and whether affected individuals are familiar with these alternative sites.

199 Stillman *et al.* (2005), for example, assessed the quality of the Humber estuary for nine shorebirds (namely dunlin, ringed plover, knot, redshank, grey plover, black-tailed godwit, bar-tailed godwit, oystercatcher and curlew). Their model predicted overwinter survival, based on shorebird distribution and the diets of each species. A two to eight per cent reduction in intertidal area decreased predicted survival rates in redshank, grey plover, black-tailed godwit, bar-tailed godwit and curlew. Stillman *et al.* (2005) stated that "*Predicted survival rates were highest in dunlin and ringed plovers, the smallest species, and in oystercatchers, which consumed larger prey than the other species*."

200 While certain wader species fly long distances during migration, studies have shown that once on their wintering grounds, many tend to move only short distances between roosts within an estuary (Rehfisch *et al*., 1996). In the Firth of Forth, studies have shown that movements within and through the estuarine complex of seven species of waders formed two groups: grey plover, turnstone, oystercatcher and redshank tended to stay within the same part of the estuary throughout the winter, whereas bar-tailed godwit, dunlin and knot ranged more widely (Symonds *et al.,* 1984).

201 Site-faithful species such as grey plover and turnstone may therefore be at relatively more risk from habitat loss, unless alternative local sites were below their carrying capacity for the species and were therefore able to support displaced birds. If, however, alternative sites are of lower quality or limited extent or already at, or near, carrying capacity, increased densities have the potential to increase competition for available resources and may potentially increase mortality in the population (Burton *et al*., 2002).

202 Based on species' habitat preferences and the likely abundance of suitable alternative intertidal foraging habitat within the wider Firth of Forth none of the species recorded are expected to have habitat requirements that are specific to the area of the landfall locations. Even the most sensitive of species (grey plover, turnstone) , if affected , are expected to be able to find alternative habitat in the adjoining areas. Any effects on individuals are

therefore at worst likely to be restricted to temporary reductions in fitness levels due to reduced foraging efficiency, rather than on mortality or productivity effects at a population scale.

203 The assessment considered **all VORs** of high sensitivity in the breeding and non-breeding season and direct habitat loss during construction of negligible magnitude, as the spatial extent of any impact represents a very slight change from baseline conditions, is small in relation to the available foraging areas and is considered short-term (at worst occurring intermittently and incrementally in up to three non-breeding seasons). The impact is therefore considered to represent no more than a slight change from baseline conditions, with any effects to lie within the limits of natural variation, and evaluated as negligible.

Direct Disturbance – Near-shore to MHWS (Including Intertidal)

204 It is assumed that works in the near-shore and intertidal areas will take up to four weeks per cable, with a maximum installation of three cables per year (i.e. 12 weeks per year). It is also a possibility that this process could be phased over three years (i.e. eight weeks per year). Given the duration, any direct disturbance is considered an impact of a temporary nature.

205 A variety of research has been carried out on the cause, extent and significance of disturbance to waterbirds in near-shore and intertidal environments.

206 Cutts *et al*. (2009) found from a review of shorebird responses to disturbance, that sensitivity is likely to be greatest in the spring and autumn passage periods, as well as in periods of hard weather conditions when food supply and habitat is limited. Most studies did not however, distinguish between noise and movement components of disturbance, measuring impacts of human activity as a whole. However, the recorded disturbance effects on waders compiled in a review by Goss-Custard (2007) appeared to result more from movements of pedestrians etcetera, rather than noise.

207 Goss-Custard (2007) demonstrated that flight distance varied almost tenfold (27 m to 250 m) between studies of roosting birds and even more (seven metres to 350 m) in foraging birds, depending on factors such as climate conditions, species differences, habitat differences and flock size. Exposed human activity along the skyline is commonly recorded as resulting in a larger-scale disturbance effect than if the visibility of human activity is screened in any way.

208 Burton *et al.* (2002) demonstrated that numbers of six out of nine shorebird species they observed on mudflats at low tide (shelduck, knot, dunlin, black-tailed godwit, curlew and redshank), were significantly lower where a footpath was close to a count section. The distances to which footpaths affected species varied, ranging from 25 m (dunlin) to 200 m (curlew). Grey plovers showed disturbance responses up to 200 m from a railway line, and black-tailed godwit showed reaction up to 75 m. The traffic along railway lines can be unpredictable, and usually noisy, and birds are less likely to become used to it than other sources such as busy roads. Smaller species however tended to show lower reaction distances – for example ringed plover showed no disturbance beyond 25 m, and was found more frequently than predicted near to a town.

209 Smit and Visser (1993) recorded disturbance distances of up to 300 m for curlew, with shelduck up to 197 m, ringed plover to 162 m, and dunlin to 86 m.

210 Burger (1988) found that efforts to mitigate the adverse effects on birds by restricting demolition and beach clean-up activity to a 100 m stretch of beach at any one time succeeded in significantly reducing adverse effects and in allowing birds some space to rest and feed. It was suggested that birds can habituate to some noise and disturbance, particularly when it is contained in a restricted area.

211 Cutts and Allen (1999) found that there was a minimal effect of disturbance at distances of more than 300 m from feeding or roosting waterfowl on the Humber Estuary, with curlew being the most sensitive, and most common wader species showing responses out to 150 m.

212 It has been observed that for foraging and roosting waterbirds in estuarine habitats, disturbances usually only interrupt birds' activity patterns temporarily or displace them short distances (e.g. Hockin *et al.,* 1992). Only a small proportion of disturbance events may actually cause birds to leave a site (Burton *et al.,* 1996; Marsden, 2000), and a number of studies have shown that birds may rapidly move back into areas when a source of disturbance has been removed (e.g. Owen, 1993; Hirons and Thomas, 1993; IECS, 2007). IECS (2007) studied responses of shorebirds to flood defence works in the Humber Estuary. The study showed that birds continued to feed within 200 m of piling operations. During repair work along a pipeline birds remained within 100 m when workers were active and flocks returned to the nearby vicinity within 15 minutes of construction activity ceasing. Construction activity using a mechanical digger resulted in birds staying 100 m from the locality, but they returned within 30 minutes of cessation.

213 However, longer-term impacts of disturbance on the numbers of birds using adjacent areas have been suggested in a number of studies (e.g. Pfister *et al.,* 1992; Tubbs *et al.,* 1992; Townsend and O'Connor, 1993; Burton *et al.,* 1996; Gill *et al.,* 1996).

214 Gill (2007) has argued that many previous studies have recorded disturbance behaviour and assumed, without clear justification, that these changes will have fitness consequences for the individuals (e.g. Klein *et al.,* 1995). Gill argues that behavioural responses to disturbance are also context dependent and will depend on trade-offs experienced by individuals. A bird's decision to remain in or leave an area may depend on:

- the quality of the area for feeding, roosting etc.;
- the availability and relative quality of alternative areas; or
- relative predation risk on current and alternative sites.

215 Birds may therefore remain in disturbed areas if the cost of moving (that is the energy required to move) to a new location is too great. In contrast, those individuals that move readily in response to disturbance may do so if alternative locations have better food resources, or lower predation risk, or if the costs of moving are small (e.g. Beale and Monaghan, 2004). Impacts may also vary according to the stage of tide or the time of day.

For example, although wader densities may be reduced in the daytime close to footpaths, the same areas may hold much higher densities at night (Burton *et al.,* 2002).

216 Klein *et al*. (1995) and Madsen (1995) have also found that birds may become habituated to some forms of disturbance, particularly when repeatedly subjected to the same stimulus, and conversely may therefore be more sensitive to disturbance when they are subjected to a sequence of different, sudden or surprising stimuli (e.g. Goss-Custard, 2007).

217 Taking these studies into account, it is considered that direct disturbance impacts from construction activities across the intertidal area will be temporary in nature and localised - with disturbance for the most susceptible species occurring up to 300 m - 350 m when roosting and up to 200 m - 250 m when foraging.

218 The assessment considered **all VORs** of high sensitivity in the breeding and non-breeding season and direct disturbance during construction of negligible magnitude. Taking into account the above studies, it is predicted that such impacts will be temporary in nature (at worst occurring intermittently in up to three non-breeding seasons) and will be localised. Given the available foraging areas in the wider Firth of Forth during this time of year, the spatial extent of any impact represents a very slight change from baseline conditions. Disturbance is therefore predicted to represent effects which will lie within the limits of natural variation and evaluated as a negligible impact.

<u>Indirect Impacts on Birds via Prey Species – Near-shore to MHWS (Including Intertidal)</u>

219 Wader and waterfowl species feed on a variety of invertebrates and plant material within the substrate, as well as fish in the intertidal and near-shore environments. Disruption to these food sources due to construction activities, e.g. through increased sediment suspension and deposition, nutrient addition, waste and sewage release through the water supply or disturbed silt, or through displacement of fish and invertebrates due to disturbance could have an impact on prey availability for bird communities. If such an effect is of sufficient duration and extent birds could be subjected to reduced fitness levels, potentially affecting winter survival and breeding success.

220 The VORs are likely to vary in their susceptibility to changes in habitat quality, with some species such as ringed plover being broader in their habitat preference and diet choice than others and therefore being more flexible to cope with changes in environmental conditions.

221 Lourenço *et al*. (2004) found that areas around drainage channels are particularly important feeding sites for waders, with prey abundance corresponding closely to that of bird distribution. Water or mud discharge from construction areas into channels, which is likely to be of a greater extent than diffuse discharge over mud substrate, may therefore affect those species that have been observed to make particular use of these areas. Due to the nature of the construction activities considered in this assessment, sediment discharges are considered the potential key impact source.

222 In the breeding and post-breeding/migratory periods, species such as Sandwich terns and common terns require clear water to feed and so any sediment discharge into the near-

shore environment may affect the ability of birds to locate and obtain fish. Most of the sediment plumes will settle out within tens or a few hundred metres of the Export Cables, over a period of seconds or minutes. The finest sediment fractions will persist for longer in the water column and be carried further, but will generally not be transported beyond three kilometres from the Export Cable, and will settle out within one hour of disturbance (see *Chapter 10*, *Section 10.6.1*). It is therefore predicted that the extent of any such discharge would be localised and temporary. Any displaced birds would be able to feed elsewhere in nearby coastal waters and return quickly to the area once sediment plumes have settled. Note that there will be no impact for works generally done at high water. With an increase in SSC only likely at high tide.

223 The assessment considered **all VORs** of high sensitivity in the breeding, post-breeding and non-breeding seasons and indirect disturbance of bird communities through prey availability during construction of negligible magnitude, as sediment discharges are only likely to result in a very slight change from baseline conditions over relatively small areas. Indirect disturbance is therefore predicted to represent effects well within the limits of natural variation and evaluated as a negligible impact.

15.7.3 Effects of Operation and Maintenance

Direct Disturbance – Development Area to Near-Shore and Intertidal

224 Disturbance of birds resulting from maintenance activity required for the Offshore Export Cable is likely to be similar in scope to that discussed in relation to vessel/vehicle traffic during the construction phase of the Export Cable. However, as vessel/vehicle traffic during maintenance events will be substantially lower in frequency than during construction, the associated impacts are expected to be reduced.

225 Given the likelihood that any maintenance operations required will be localised events, involving few vessels/vehicles which will be present for a short duration of time, any impacts on ornithological receptors are expected to be similarly localised. As such, significant direct or indirect effects on birds are considered unlikely for the operation and maintenance of the Offshore Export Cable.

226 The assessment considered VORs of all sensitivities and direct operational disturbance of negligible magnitude across all seasons. Taking into account the highly localised extent over which direct disturbance is predicted to occur (at worst within 500 meters of any vessel or vehicle), as well as the short-term nature of most operational maintenance activities and the reversibility of any disturbance impact, effects of operational disturbance on **all VORs** during all seasons are evaluated as a negligible impact.

15.7.4 Effects of Decommissioning

227 The potential effects of decommissioning are considered to be equivalent to and potentially lower than the worst case effects assessed for the construction phase. The approach to decommissioning is described in *Section 7.12*. A decommissioning plan will be prepared in accordance with the requirements of the *Energy Act 2004* (see *Section 3.2.5*) and will be

subject to approval from Department of Energy and Climate Change prior to implementation.

15.8 Cumulative Impacts of the Project

228 This section assesses the scope for potential cumulative impacts from the Project's different components (i.e. the combined impacts of the Wind Farm, OfTW, and Onshore Transmission Works (OnTW)) on VORs. In practice, this means the assessment considers cumulative impacts during:

- joint construction, joint operation or joint decommissioning (because the situation would not arise, for example, of having an operational wind farm whilst the Export Cable was still under construction);
- circumstances where these activities were in sufficiently close proximity to cause overlapping impacts; and
- where the impacts effect the same habitat or VOR (for example, no cumulative impacts can arise on intertidal habitats from the Development Area, or as a further example, there will be no cumulative impacts on a specie from both the Development Area and the OnTW Area if that particular specie does not use marine on intertidal habitats at the potential landfall locations).

229 Therefore, the combinations of Project elements that could potentially have cumulative impacts and have therefore been assessed are:

- Where the Offshore Export Cable Corridor is adjacent to the Development Area, during construction, operation or decommissioning. Here, the potential for cumulative impacts arises from direct habitat loss, disturbance, displacement and/or indirect effects from displacement of prey; and
- If works undertaken for the Offshore Export Cable and the OnTW overlap during construction, operation or decommissioning, cumulative impacts might arise from disturbance on VORs in the near-shore and/or intertidal area.

230 The consideration of these potential cumulative impacts is given below.

15.8.1 Cumulative Effects of Construction

Direct Habitat Loss

231 As concluded above, and drawing from *Chapter 12*, no significant habitat loss is predicted from construction works within the Offshore Export Cable Corridor or the Development Area. It is therefore considered that the cumulative impact predicted from habitat loss will have a negligible effect on all VORs.

Direct Disturbance

232 Cumulative direct disturbance impacts from works within the Development Area and adjacent Offshore Export Cable Corridor are predicted to be negligible. This is because:-

- The presence of an additional single cable-laying vessel, travelling at a low speed and involving relatively few vessel movements during construction, is not predicted to add any additional significant direct disturbance;
- The spatial overlap between construction activities in the Development Area and the Offshore Export Cable Corridor is relatively small. It would extend two kilometres along the Offshore Export Cable Corridor, at most (see Figure 7.1), as this is the maximum disturbance distance recorded in the literature for the most susceptible VORs, particularly common scoter (Dirksen *et al.,* 2005; Kaiser *et al.,* 2006). Once the cable laying vessel sails beyond two kilometres from the Development Area therefore, there is only limited scope for any bird which has been displaced from the Development Area to also be disturbed by a cable laying vessel; and
- Given the nature of construction activities, any direct disturbance impacts for other species are generally unlikely to extend beyond 500 m from vessels/construction locations.

233 Cumulative disturbance impacts from construction works in the Offshore Export Cable Corridor and Onshore Area are not considered likely. Whilst the exact location of the OnTW is yet to be finalised, the main works will be set back from the shoreline. As a result, there is only a low risk that disturbance either from noise or visual disturbance (which would require a line of sight) would extend into either of the two cable landfall options. As the Seton Sands location is heavily screened by mature trees and Cockenzie by local topography, no line of site is likely. Furthermore, the combination of existing settlements, associated human activity, recreation access to the Seton Sands beach, road traffic along the B1348 (the main coast road), and historically the operation of Cockenzie Power Station all mean there is a relatively constant baseline of noise and human activity at both landfall options. A degree of habituation must already therefore exist by the birds recorded in the intertidal area. Taking all these factors into account it is not predicted that the Project will result in any significant cumulative disturbance impacts to birds in the cable landfall areas.

Indirect Impacts on Birds via Prey Species

234 Cumulative indirect construction impacts of the Project elements on seabirds via fish prey are not considered likely. Whilst the noise contours for impacts on fish species do partially overlap the Offshore Export Cable Corridor (Figure 13.14), the potential impact of cable-laying activities on fish prey is highly localised, temporary and negligible. In addition, the same scenario applies if piling noise in the Development Area has already led to prey being displaced, then the vessel traffic could not cause cumulative displacement over that same period. If fish prey had returned, as there was no piling, then the presence of the vessels would not cause displacement of prey on its own. As a result, there are no cumulative impacts from the Project via displacement of prey species.

15.8.2 Cumulative Effects of Operation and Maintenance

Direct Habitat Loss, Direct Disturbance and Indirect Impacts on Birds via Prey Species

235 During the operational phase of the Offshore Export Cable no habitat loss is incurred, and therefore no cumulative effect will arise in-combination with other Project components.

236 Cumulative direct disturbance impacts of operation and maintenance works of the Project elements are very unlikely. Operation and maintenance activities will predominantly take place within the Development Area, with the majority of disturbance effects from individual sources of activity likely to extend over no more than 500 m distance from each vessel or construction location, and being temporary in nature. Any operation and maintenance activities required in the Offshore Export Cable Corridor are likely to be substantially more infrequent, localised and with a minimal spatial overlap of activities taking place in the Development Area.

237 Similarly, any operation and maintenance activities required for the Offshore Export Cable and the Onshore Transmission Works are likely to be infrequent, localised and generally unlikely to overlap spatially.

238 There is no significant scope for cumulative collision or barrier effect impacts, as the Export Cable and OnTW do not cause any such effects for the VORs.

239 Overall therefore, during the operational phase of the Project, no cumulative impacts are predicted from habitat loss, disturbance or from indirect displacement of prey species, or any other cumulative source.

15.8.3 Cumulative Effects of Decommissioning

240 As highlighted in *Section 15.6.3* and *15.7.4*, the potential effects of decommissioning are considered to be equivalent to and potentially lower than the worst case effects assessed for the construction phase. The same is also considered to apply cumulatively for the Project and as a result there are no significant cumulative impacts predicted on any VORs.

15.9 Cumulative Impacts from the Project with Other Projects

241 This section considers the potential cumulative impacts of the Project and other projects. A list of other projects which have been considered in this cumulative assessment are included in Tables 15.16 and 15.21.

242 It is considered that there is only potential for cumulative impacts with near-shore, intertidal and onshore elements of the Project up to a distance of five kilometres from the cable landfall locations. A distance of five kilometres is considered highly conservative as any cumulative impacts are likely to be more localised (e.g. estuarine birds tend to be disturbed up to approximately 500 m from a disturbance source). However, this conservative approach is consistent with the approach adopted for other major infrastructure developments, such as the Forth Replacement Crossing.

243 Due to the limited scope for cumulative impacts with the near-shore, intertidal and onshore elements of the Project, an assessment of the cumulative effects of these elements of the Project with other projects is presented separately (*Section 15.9.2*) from the assessment of the cumulative effects of the Wind Farm and OfTW (to near-shore) elements of the Project with other projects (*Section 15.9.1*).

15.9.1 Cumulative Effects – Development Area and Offshore Export Cable Corridor to Near-shore

244 This section considers the potential cumulative impacts of the components of the Project (within the Development Area and the Offshore Export Cable Corridor to near-shore) with other relevant developments. A list of the offshore wind farms and other developments is included in Table 15.16 below and the locations of these developments are shown in Figure 4.1 and Figure 15.3.

245 In relation to offshore wind farms, the cumulative assessment considers projects which have been approved or where applications have been submitted. Table 15.16 provides the published maximum number of WTGs and this has been used to assess cumulative collision risk, with published site boundaries and a 2 km buffer used to assess cumulative displacement. The cumulative assessment of indirect impacts via prey species was undertaken on the basis of underwater piling noise contours assuming two piling vessels per offshore wind farm, Neart na Gaoithe and Firth of Forth Phase 1(*Chapter 13*). The existing Beatrice Demonstrator Wind Farm is considered to be part of the baseline. The Methil (Fife Energy Park) Offshore Demonstration Wind Turbine has been omitted from assessment due to the likely negligible cumulative effect of a single WTG in inshore waters.

Table 15.16: Developments Identified for Potential Cumulative Impacts - Development Area and Offshore Export Cable Corridor to Near-shore

Project	Distance in km from the Development Area (boundary to boundary)	No. WTGs	Status	Area/ Details	Area + 2 km Buffer
Firth of Forth Round 3 Phase I (Alpha & Bravo)	9	154–299	Application submitted October 2012	391 km^2	596 km^2
Neart na Gaoithe Offshore Wind Farm	10	75–125	Application submitted September 2012	105 km^2	199 km^2
European Offshore Wind Deployment Centre (Aberdeen)	68	11	Approved March 2013	4.3 km^2	40 km^2

Project	Distance in km from the Development Area (boundary to boundary)	No. WTGs	Status	Area/ Details	Area + 2 km Buffer
Moray Firth R3 Zone 1 (Eastern Development Area, EDA)	169	283-339	Application submitted August 2012	295 km^2	467 km^2
Beatrice Offshore Wind Farm	181	142–277	Application submitted April 2012	131 km^2	243 km^2
Blyth Offshore Demonstration Project	139	Up to 15	Application Submitted March 2012	13.6 km^2	128 km^2
Firth of Forth Round 3 Phase I, onshore transmission	22	n/a	Scoping	Onshore cable and substation	n/a
Neart na Gaoithe Onshore Transmission	52	n/a	Application submitted January 2013	Onshore cable and substation	n/a
Dundee Waterfront Development	38	n/a	Different plots at different stages of development	Mixed use – Commercial/ Exhibition/ Recreation	n/a
Edinburgh Waterfront Development	75	n/a	Different plots at different stages of development	Mixed use – commercial and residential	n/a
Forth Replacement Crossing	86	n/a	In construction phase	Cable-stayed Bridge over the inner Forth Estuary	n/a
Note: distances and surface areas have been rounded to whole numbers The cumulative assessment excludes Phases 2 and 3 of the Firth of Forth Round 3 Zone proposed offshore wind farms. Although a scoping report has been published for these sites, the Environmental Impact Assessment for Firth of Forth Phase 1 (Seagreen, 2012) excludes these developments from the cumulative assessment on the basis that the data for these sites has yet to be analysed in a form that can be used to determine cumulative impacts, stating that this has been agreed with Marine Scotland.					

Direct Disturbance - Construction

246 Of the offshore wind farms and onshore development projects identified for cumulative assessment, cumulative direct impacts of construction disturbance are likely only in relation to the Project Neart na Gaoithe, and Firth of Forth Round 3 Phase I, as these sites are in close proximity and, under the worst case scenario, may be under construction simultaneously. None of the other offshore and onshore developments are sufficiently close to the Development Area or the Offshore Export Cable Corridor (to near-shore) to result in a likely cumulative impact.

247 Construction vessels required for the three Forth and Tay offshore wind farm developments are not expected to present a significant cumulative impact since the three sites are relatively far apart (closest distance between the Development Area and both other sites is approximately nine to ten kilometres) and of sufficient size that any simultaneous activity is likely to occur at widely separated locations. Impacts would be temporary and extend over comparatively small areas. Therefore, the level of additional boat traffic and above-water construction noise expected to result from the above developments, over and above that already present in the outer Firths of Forth and Tay, is not considered likely to constitute a significant cumulative impact on seabirds present in the region (see *Chapter 19*).

248 Overlap of offshore export cables routes for the three developments is considered minimal: the proposed cable route for the Firth of Forth Phase I (projects Alpha and Bravo) skirts the northern-most tip of the Development Area (see *Appendix 6A*, Figure 6A.2). The cable route proposed for the Neart na Gaoithe Offshore Wind Farm does not overlap with any elements of the Project. The Offshore Export Cable Corridor for the Project overlaps slightly with the northwest boundary of the Neart na Gaoithe site.

249 For the Project a four year construction programme is due to start in 2016 (including a two year piling phase). The construction of Neart na Gaoithe is due to extend over two years from March 2015 (Mainstream, 2012) – although it is noted that this timing may slip. Construction of Firth of Forth Phase 1 is due to take place between Quarter 4 of 2015 and Quarter 4 of 2019 (Seagreen, 2012). Based on this, the overall construction period for all three wind farms is predicted to extend over nearly five years from March 2015, with one site only (Neart na Gaoithe) throughout the quarters two and three of 2015, two sites in the last quarter of 2015 (Neart na Gaoithe and Firth of Forth Phase 1), all three sites throughout 2016 and the first quarter of 2017, and then two sites (the Project and Firth of Forth Phase 1) from the second quarter of 2017 to 2019.

250 As highlighted above, direct disturbance impacts from the individual Forth and Tay offshore wind farm developments is predicted to be localised - within at most 500 m of construction activities on those VORs most susceptible to disturbance (as considered in detail in *Section 15.6.1*) - and thus particularly unlikely to extend beyond the respective areas or cable corridors in a manner which would cumulatively affect ornithological receptors in the wider area.

251 The assessment considered all VORs of all sensitivities and cumulative direct construction disturbance of negligible magnitude. Based on the highly localised extent over which direct disturbance is predicted to occur (at worst up to 500 meters of any vessel or construction location), as well as its short-term nature (cumulative construction activities estimated to take place during one breeding season for three offshore wind farms and two more additional breeding seasons for the Project together with Firth of Forth Phase 1), and the reversibility of any effect, construction disturbance on **all VORs** during all the seasons is evaluated as a **negligible** impact.

Indirect Impacts on Birds via Prey Species - Construction

252 Construction disturbance could potentially have cumulative indirect impacts on seabirds due to impacts on the abundance and distribution of prey species. As discussed previously (see *Section 15.6.1* which cross references to *Chapter 13*), pile driving for the installation of substructure bases has been identified as the worst case method of construction, as the resultant noise may adversely affect fish. The abundance and distribution of sandeels, a key prey species of seabirds during the breeding season, is not predicted to be adversely affected by piling as sandeels are not considered to have low sensitive to underwater noise. However, other fish species which are more sensitive to noise also feature in the breeding season diet of seabirds, and may provide alternative prey in years when sandeel abundance is low. Herring and sprat, which also feature in the breeding season diet of seabirds, are predicted to show the strongest avoidance reactions to piling noise.

253 Of the offshore wind farms identified for cumulative assessment, cumulative indirect construction disturbance via impacts on fish prey are likely only in relation to Inch Cape Offshore Wind Farm, Neart na Gaoithe and Firth of Forth Phase 1, as these sites are in close proximity and, under the worst case scenario, may be under construction simultaneously. All other offshore and onshore developments are considered to be too far from the Development Area to result in a likely cumulative impact.

254 For fish, an increase in significance from impacts of construction noise at the Development Area, Neart na Gaoithe and Firth of Forth Phase 1 offshore wind farms were not identified for any fish species, from low noise sensitivity species such as sandeel, to hearing specialists, such as herring and sprat (*Chapter 13*, *Section 13.9*). As described above, some re-distribution of fish is predicted through avoidance of areas around piling locations, and some possible re-distribution of herring within spawning areas, but no overall impacts at a population level.

255 Cumulative impacts will be temporary in nature and are only likely if piling is used for the foundations of WTGs, OSPs and met masts at all sites. The precise area of potential displacement for herring and sprat from piling will depend on the number of locations where piling is taking place simultaneously and also their relative positions. Potential overlap between avoidance areas for herring and sprat (based on avoidance distance as represented by 90 dBht contours (see Table 13.22) from the worst case scenario of two piling locations per site taking place simultaneously, as shown in Figure 11A.70). The combined overlap of avoidance areas from all three wind farms is estimated at 0.4 km^2 for sandeel and 4,758 km^2

for herring/sprat. These represent the two extremes in terms of predicted avoidance reactions of fish to piling, from species which are not sensitive to noise to hearing specialists. All other fish species – including other species which may be taken by seabirds – will lie between these two extremes in terms of likely avoidance. The combined avoidance areas for sandeels and herring/sprat are shown as a percentage of the breeding season foraging range for seabirds in Table 15.17, below.

Table 15.17: Overlap Between Seabird Breeding Season Foraging Areas and Avoidance Areas for Sandeel and Herring/Sprat in Relation to Cumulative Piling Impacts

Species	Breeding Season Regional Foraging Area (km^2)[1]	Area of Overlap with Combined Avoidance Area for Sandeel (km^2)	Per cent of Regional Foraging Area (sandeel)	Area of Overlap with Combined Avoidance Area for Herring/sprat (km^2)	Per cent of Regional Foraging Area (herring/sprat)
Fulmar	532,960	0.4	<0.0001	4,758	0.9
Gannet	200,000	0.4	<0.001	4,758	2.4
Puffin	83,446	0.4	<0.001	4,758	5.7
Lesser black-backed gull	82,667	0.4	<0.001	4,758	5.8
Guillemot	68,407	0.4	<0.001	4,758	7.0
Herring gull	50,322	0.4	<0.001	4,758	9.5
Kittiwake	34,660	0.4	<0.01	4,758	13.7
Razorbill	34,534	0.4	<0.01	4,758	13.8
Great black-backed gull	6,747	0.38	<0.01	3,726	55.2
Arctic tern	3,957	0.3	<0.01	2,693	68.1
Common tern	3,244	0.2	<0.01	2,241	69.1
Shag	572	0.02	<0.01	491	85.8

1. Based on areas of sea within breeding season foraging ranges based on Thaxter *et al.,* 2012, see *Appendix 15A*, Table 15A.5; except for gannet for which the foraging range is taken from Hamer *et al,.* 2010.

256 Cumulative impacts of piling on fish prey will be temporary and their extent will depend on the overlap in construction (and specifically piling) periods for the three Forth and Tay offshore wind farms.

257 Breeding seasons for seabirds recorded during the boat-based bird surveys extend over the period March to September (*Appendix 15A*, Table 15A.3). It is recognised that with the current construction timescales (see Table 7.12) for the Project and programme schedules for Neart na Gaoithe (Mainstream Renewable Power, 2012) and Firth of Forth Phase 1 (Seagreen Wind Energy, 2012) presented within their respective ES's, concurrent piling of all three projects is not likely. However, the assessments presented consider all three projects piling concurrently (2016) to allow for potential programme slippage and overlap of piling schedules, and as such are considered to be a conservative representation of worst case for each receptor.

258 Evaluation of indirect disturbance impacts on seabirds via impacts on their prey takes into account the predicted effects on different fish species in relation to available information on seabird diet, and the extent of overlap between regional foraging areas for seabird and fish avoidance areas.

259 Maximum effects on receptors arising from cumulative piling activities is assumed to occur if all three projects within the Firth of Forth and Tay area pile within the same time. Chapters 13, 14 and 15 assess this scenario as worst case in the cumulative assessments presented.

Breeding Season

260 Avoidance areas for fish represent less than one per cent of the breeding season foraging range of **fulmar** (Table 15.17).

261 The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. Based on the species' flexible foraging strategy, enabling it to opportunistically exploit a range of food resources, its extensive potential foraging range (mean maximum of 400 km per Thaxter *et al.,* 2012; *Appendix 15A*, Table 15A.5), the limited spatial extent over which indirect disturbance is predicted to occur as well as its temporary nature (cumulative piling activities at the three wind farms are likely to occur over only one breeding season) the impact is evaluated as **negligible**.

262 For **gannets** breeding on Bass Rock, the main breeding colony within the region, sandeels comprise up to 50 per cent of the diet (by biomass) with other important prey species including mackerel, herring, sprat and gadoids (Hamer *et al*., 2007). There is a small degree of overlap (0.4 per cent for sandeel, 2.4 per cent for herring/sprat) between the foraging range and avoidance areas for fish prey (Table 15.17).

263 The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey of negligible magnitude. Based on the species' flexible foraging strategy, its extensive potential foraging range, the limited spatial extent over which indirect disturbance on prey is predicted to occur as well as its temporary and reversible nature

(cumulative piling activities at the three wind farms are likely to occur over only one breeding season) the impact is evaluated as **negligible**.

264 Sandeels form a major component of the diet of breeding **shags** in the Forth and Tay area (96 per cent, Daunt *et al.,* 2008; 28 - 92 per cent on the Isle of May between 2007 – 2012, CEH, 2012). The remainder of the diet comprises mainly gadoids but also a range of other small fish (BirdLife International, 2012). Very limited cumulative effects of construction disturbance are predicted on sandeels during the breeding season, and the cumulative sandeel avoidance area represents less than 0.01 per cent of the regional foraging range of this species (Table 15.17). The cumulative exclusion area for herring/sprat overlaps with 85.8 per cent of the regional shag foraging range, although these species have not been identified as important in the breeding season diet of shag.

265 The assessment considered a VOR of moderate sensitivity and indirect construction disturbance via impacts on fish prey (in particular sandeels) of negligible magnitude. Based on the highly localised impact of piling activities on sandeel populations, and the relatively small overlap of the species' foraging range with the predicted spatial extent of indirect effects, the impact is considered temporary and reversible (cumulative piling activities at the three wind farms are likely to occur over only one breeding season) and evaluated as **negligible**.

266 **Herring gulls** and **greater black-backed gulls** both forage in terrestrial and coastal habitats, as well as offshore, during the breeding season, where they are able to exploit a range of prey, including kleptoparasitising and predating other seabirds (Nogales *et al.,* 1995; Finney *et al*., 2003; Buckley, 2009; Steenweg *et al.,* 2011).

267 The assessment considered two VORs of high and moderate sensitivity respectively, and cumulative indirect construction disturbance via impacts on fish prey of negligible magnitude. Based on the limited overlap between the species' foraging ranges and predicted fish avoidance areas, and the species' capacity to opportunistically exploit a wide range of food resources, the impact is considered temporary and reversible (cumulative piling activities at the three wind farms are likely to occur over only one breeding season) and evaluated as **negligible**.

268 **Common gulls** also forage both inland and offshore, mainly in coastal and estuarine waters; the diet is primarily terrestrial invertebrates, fish and discards (Mitchell *et al.,* 2004; Forrester *et al.,* 2007). The regional population is very small (19 pairs, *Appendix 15A*, *Section 15A.3.2.8*), with the Development Area situated on the edge of the species' maximum foraging range.

269 The assessment considered a VOR of moderate sensitivity and cumulative indirect construction disturbance via impacts on fish prey of negligible magnitude. Based on the minimal overlap of the species' foraging range (largely comprising of onshore, estuarine and coastal waters) with the predicted spatial extent of indirect disturbance, the impact is considered temporary (cumulative piling activities at the three wind farms are likely to occur over only one breeding season), reversible and is therefore evaluated as **negligible**.

270 **Kittiwakes** are surface feeders; they have limited ability to dive to exploit the water column if prey is not abundant at the water surface, but range relatively widely and forage over inshore and offshore waters. The lesser sandeel is the main prey in the outer Forth and Tay region; published information reports that sandeels comprise: 80 per cent (Furness and Tasker, 2000), 87 per cent (Daunt *et al.,* 2008) and 44 - 89 per cent (2007 – 2012, CEH, 2012) of the diet of kittiwakes breeding in the east of Scotland. A range of other prey are taken including herring which comprised 12 - 55 per cent of the diet of kittiwakes on the Isle of May between 2007 - 2012 (CEH, 2012). Studies have demonstrated that the breeding success of kittiwakes increases with the abundance of sandeels (Daunt *et al.,* 2008), which in turn has been adversely influenced by fishing effort and rising sea surface temperatures (Frederiksen *et al.,* 2004). The avoidance area for sandeels represents <0.01 per cent of the regional foraging range of kittiwake whereas overlap with that for herring and sprat is 13.7 per cent (Table 15.17).

271 The assessment considered a VOR of high sensitivity and cumulative indirect construction disturbance via impacts on fish prey of negligible (sandeel) to low (herring/sprat) magnitude. Based on the highly localised impact of piling activities on sandeel populations, and the predicted likelihood that any changes in the distribution of other prey species would represent small scale change over a part of the species' foraging range, the impact is considered temporary and reversible (cumulative piling activities at the three wind farms are likely to occur over only one breeding season) and evaluated as **minor**.

272 **Lesser black-backed gull** makes use of inland (including urban) and coastal/intertidal habitats as well as offshore areas for foraging, although it spends more time feeding at sea than other large gulls (Kim and Monaghan, 2006; Bustnes *et al.,* 2010). The avoidance area for sandeels represents <0.001 per cent of the regional foraging range whereas that for herring and sprat is 5.8 per cent (Table 15.17).

273 The assessment considered a VOR of high sensitivity and cumulative indirect construction disturbance via impacts on fish prey of negligible (sandeel) to low (herring/sprat) magnitude. Spatial overlap of the species' large foraging range and predicted fish avoidance areas is limited, the species' does not depend on herring and sprat as prey species and is capable of foraging on a wide range of food resources, including discards from fishing vessels (Camphuysen *et al.,* 1995). By taking into account aforementioned, as well as the temporary and reversible nature of the indirect impact of piling activities, evaluation concluded the impact to be **negligible**.

274 For **Arctic tern**, there is evidence from colonies on the east coast of Britain that sandeels predominate in the diet early in the breeding season, after which other species such as clupeids and sprat become more important (BirdLife International, 2012). Sandeels were found to comprise 34 per cent of the diet of terns (Arctic and common) in south-east Scotland between 1996 and 2003 (Daunt *et al.*, 2008; no information was provided on the remainder of the diet); in north-east England, clupeids/sprat may comprise 30 – 40 per cent of the breeding season diet of Arctic terns at Coquet Island and over 60 per cent at the Farne Islands (BirdLife International, 2012). The cumulative avoidance area for sandeels represents <0.01 per cent of the regional foraging range, whereas for herring and sprat it is 68.1 per

cent (Table 15.17). Thus piling activities during the breeding season might affect the availability of some fish species which form part of the breeding season diet. Current information on timetables suggests that construction activities at all three Forth and Tay sites are likely for only one year, so that the maximum predicted overlap between Arctic tern foraging areas and herring/sprat avoidance areas is likely only in one year and then only if piling activities are ongoing at all three sites during the seabird breeding season.

275 The assessment considered a VOR of high sensitivity and indirect construction disturbance via impacts on fish prey of negligible (sandeel) to moderate (herring/sprat) magnitude, based on the evidence that herring and sprat are important in the breeding season diet, which could lead to partial loss of the (prey availability) baseline conditions in part of the species' foraging range. Impacts on sandeel populations through piling activities are predicted to be highly localised, which could potentially buffer the partial loss of herring/sprat prey elsewhere. Arctic tern is in decline both regionally and nationally and although indirect impacts on prey distribution through piling are considered temporary and reversible (cumulative piling activities at the three wind farms are likely to occur over only one breeding season), in the context of a decreasing population of a high sensitivity receptor cumulative displacement is evaluated as a **moderate** impact.

276 As for Arctic tern, there is evidence from some **common tern** colonies on the east coast of Britain that sandeels predominate in the diet during April and May, with clupeids becoming relatively more important in late July. Although the species has a fairly broad diet (BirdLife International Seabird Foraging database, 2012) the diet of breeding common terns at Leith Docks (Firth of Forth, about 25 km from the Isle of May) was found to comprise between 55 and 79 per cent of clupeids in 2009 - 2010 (Jennings, 2012). The cumulative avoidance area for sandeels represents <0.01 per cent of the regional foraging range whereas for herring and sprat it is 69.1 per cent (Table 15.17). Thus cumulative piling activities during the breeding season might affect the availability of some fish species which form part of the breeding season diet. Current information on timetables suggests that construction activities at all three Forth and Tay sites are likely for only one year, so that the maximum predicted overlap between common tern foraging areas and herring/sprat avoidance areas is likely to occur over only one breeding season and then only if piling activities are ongoing at all three sites during the breeding season.

277 The assessment considered a VOR of high sensitivity and cumulative indirect construction disturbance via impacts on fish prey of negligible (sandeel) to moderate (herring/sprat) magnitude. Predicted avoidance areas of herring/sprat in particular could potentially result in a partial loss of the (prey availability) baseline conditions, however, impacts on sandeel populations through piling activities are predicted to be highly localised, potentially buffering the partial loss of herring/sprat prey elsewhere. Common tern is in decline nationally and although cumulative indirect impacts on prey distribution through piling are considered temporary and reversible (cumulative piling activities at the three wind farms are likely to occur over only one breeding season), in the context of a decreasing population of a high sensitivity receptor cumulative indirect disturbance is evaluated as a **moderate** impact.

278 The main prey species of **guillemots** in the Forth and Tay region is the lesser sandeel (Daunt *et al.,* 2008), with published estimates indicating that this species comprises 80 - 84 per cent of the diet (Furness and Tasker, 2000; Daunt *et al.,* 2008). Despite their importance in the diet, the breeding success of guillemots was not found to be related to the abundance of sandeels, which may be explained by their capacity to dive and gain access to a greater proportion of the sandeel population, even in years of lower abundance (Daunt *et al.,* 2008). Guillemots also feed on sprat, however, and this species appears to have become more important in the diet of birds at the Isle of May in recent years, comprising 67 - 92 per cent of the diet between 2007 and 2012 (CEH, 2012). The avoidance area for sandeels represents <0.001 per cent of the regional foraging range whereas that for herring and sprat is 7.0 per cent (Table 15.17).

279 The assessment considered a VOR of high sensitivity and cumulative indirect construction disturbance via impacts on fish prey of negligible (sandeels) to low (herring/sprat) magnitude. Based on the highly localised impact of piling activities on sandeel populations, the relatively small spatial extent over which herring/sprat distribution would change and guillemot's known capacity within its time and energy budget to increase foraging effort in response to adverse environmental conditions (Daunt *et al.,* 2008; 2011a and 2011b), cumulative indirect construction disturbance is considered to be temporary and reversible (cumulative piling activities at the three wind farms are likely to occur over only one breeding season) and is therefore evaluated as a **negligible** impact.

280 The main prey species of **razorbills** in the Forth and Tay region is the lesser sandeel (Daunt *et al.,* 2008), with published estimates indicating that this species comprises 77 - 80 per cent of the diet (Furness and Tasker, 2000; Daunt *et al.,* 2008); and recent data from the Isle of May indicating that sandeels continued to be the most numerous prey item between 2007 – 2012, except for 2010 when 67 per cent of the diet was sprat (CEH, 2012). The avoidance area for sandeels represents <0.001 per cent of the regional foraging range whereas that for herring and sprat is 13.8 per cent (Table 15.17).

281 The assessment considered a VOR of high sensitivity and cumulative indirect construction disturbance via impacts on fish prey of negligible (sandeel) to low (herring/sprat) magnitude. Based on the highly localised impact of piling activities on sandeel populations, and the relatively small spatial extent over which herring/sprat distribution would change, cumulative indirect construction disturbance is considered temporary and reversible (cumulative piling activities at the three wind farms are likely to occur over only one breeding season). However, despite the aforementioned, given the species' more restricted foraging range (considerably smaller than both other auk species) and the uncertainty around the population trend of the regional (and national) population (see *Appendix 15B*), it is considered appropriate to evaluate indirect construction disturbance as a **minor** impact.

282 The main prey species of **puffins** in the Forth and Tay offshore region is the lesser sandeel (Daunt *et al.,* 2008), with published estimates indicating that this species comprises 80 - 81 per cent of the diet (Furness and Tasker, 2000; Daunt *et al.,* 2008) and 63 - 91 per cent (CEH, 2012; for the period 2007 to 2012). Despite their predominance in the diet, the breeding success of puffins was not found to be related to the abundance of sandeels, which may be

explained by their capacity to dive and gain access to a greater proportion of the sandeel population, even in years of lower abundance (Daunt *et al.,* 2008). The avoidance area for sandeels represents <0.001 per cent of the regional foraging range of puffin whereas that for herring and sprat (not identified as important in the diet) is 5.7 per cent (Table 15.17).

283 The assessment considered a VOR of high sensitivity and cumulative indirect construction disturbance via impacts on fish prey of negligible (sandeel) and low (herring/sprat) magnitude. Based on the highly localised impact of piling activities on sandeel populations, the relatively small spatial extent over which herring/sprat distribution would change and puffin's large foraging range, cumulative indirect construction disturbance is considered temporary and reversible (cumulative piling activities at the three wind farms are likely to occur over only one breeding season) and consequently evaluated as a **negligible** impact.

284 **Great skua**, **Arctic skua** and **little gull** were recorded within the Inch Cape Boat-based Survey Area during autumn passage only and there are no breeding colonies within foraging range. No cumulative indirect construction impacts are predicted on these species during the breeding season.

Post and Non-breeding Season

285 Outside the breeding season, seabirds are not constrained in their foraging range by the requirement to attend nest sites and are able to range widely over offshore areas and move in response to the distribution and abundance of fish prey. For many species, the individuals that make up the regional breeding populations migrate away during the winter. Some species – including lesser black-backed gull, common and Arctic tern - are entirely absent from the Forth and Tay offshore area during the non-breeding season; whereas for others, such as gannet and kittiwake, the majority of the regional breeding population migrates to wintering areas elsewhere, and individuals from breeding colonies further north move into the area (Fort *et al.,* 2012; Frederiksen *et al.,* 2011). Other species which do not breed in the vicinity of the Development Area, pass through the area on autumn passage (great and Arctic skua) or are present during both autumn passage and the winter period (little gull).

286 Therefore, the assessment considered **all VORs** (regardless of sensitivity) and cumulative indirect construction disturbance via impacts on fish prey in the post- and non-breeding seasons of negligible magnitude. As cumulative construction disturbance is not predicted to cause significant effects on any fish species, beyond some re-distribution in relation to piling noise (*Chapter 13*, *Sections 13.8 and 13.9*), the prey resource for seabirds will not be significantly reduced. Because of the wide-ranging nature of seabirds during the post and non-breeding season, they can re-distribute in relation to prey abundance, and therefore negligible indirect disturbance impacts via fish prey are predicted. Based on the limited spatial extent over which indirect disturbance is predicted to occur (relative to the potentially available foraging areas in both seasons) as well as its temporary nature (cumulative piling activities at the three wind farms are likely to occur over only one breeding season) the impact is evaluated as **negligible**.

Direct Habitat Loss - Operation

287 Habitat loss from WTGs, met masts, OSPs foundations and cable protection in the Development Area, under the worst case scenario (all substructures with gravity bases) covers 1.87 km^2 of seabed, 1.25 per cent of the Development Area. This loss was considered to have negligible impacts on seabirds or their prey (see *Section 15.6.*). A similar worst case scenario was assumed for the other two Forth and Tay offshore wind farms identified for the cumulative assessment. All other offshore and onshore developments are considered too far from the Development Area and the Offshore Export Cable Corridor (to near-shore) to result in a likely cumulative impact.

288 Based on available information for the Firth of Forth Phase 1, the maximum extent of 150 WTGs, inter-array cabling and offshore substation platform foundations covers 2.18 km^2 of seabed, or 1.69 per cent of the Alpha and Bravo wind farm areas combined (at 391 km^2).

289 For the Neart na Gaoithe Offshore Wind Farm the direct habitat loss from WTG and substation foundations and inter-array cables is 0.185 km^2 (Mainstream Renewable Power, 2012), representing 0.36 per cent of the total site area (105 km^2).

290 Direct loss of seabed and water column habitat could have an impact on seabirds at a local level – i.e. in immediate proximity to a given substructure – reducing the amount of foraging habitat available for birds. Where several developments lie within the foraging range of a species there is a potential for a cumulative impact of direct habitat loss on the background population. However, it is considered such an impact is likely to be negligible in comparison to a) the extent of foraging ranges for species relevant to this assessment (see e.g. foraging ranges in Table 15.17 for comparison with the proportional habitat loss for the different developments) and b) the overriding impact of displacement of birds due to the presence of an operational wind farm which, due to its size, is likely to have a larger spatial impact, up to 2 km distance from the WTG array.

291 The assessment considered all VORs and cumulative direct operational habitat loss of negligible magnitude across all seasons. Based on the localised extent over which direct habitat loss is predicted to occur and the minimal proportion this represent of species' foraging ranges, effects of operational habitat loss on **all VORs** during all seasons are evaluated as a negligible impact.

Direct Disturbance - Operation

292 Maintenance vessels required for the three Forth and Tay offshore wind farm developments are not expected to present a significant cumulative impact since the three sites are relatively far apart (closest distance between the Development Area and both other areas is approximately nine to ten kilometres; while overlap of the Offshore Export Cable Corridor with other projects is minimal) and of sufficient size that any simultaneous activity will occur at widely separated locations. All other offshore and onshore developments are considered to lie so far from the Development Area and the Offshore Export Cable Corridor (to near-shore) that any cumulative impact is unlikely.

293 Direct disturbance impacts are predicted to be temporary and extend over comparatively small areas – up to 500 m of vessels and activities (see *Section 15.6.2*). It is anticipated that increases in vessel traffic will not be significantly greater than the levels of marine traffic currently experienced in the Firth of Forth and Tay (*Chapter 19*), with the Wind Farm and OfTW vessels using defined transit routes, thereby limiting potential impacts to particular areas. The use of defined transit routes will also maximise predictability of vessel movements by birds and serve to localise any displacement associated to vessel traffic.

294 The assessment considered all VORs and cumulative direct operational disturbance of negligible magnitude across all seasons. Based on the highly localised extent over which direct disturbance is predicted to occur, as well as the short-term and reversible nature of disturbance effects from maintenance activities, effects of cumulative construction disturbance on **all VORS** during all seasons are evaluated as **negligible**.

Indirect Impacts on Birds via Prey Species - Operation

295 *Section 15.6.2* (*Effects of Operation and Maintenance*) provided a detailed overview of indirect disturbance via impacts on fish prey. It was concluded that while evidence is limited, there may be some potential for a positive, indirect impact on birds as a result of increasing prey abundance and availability. Any potential impacts on birds however might be offset by displacement due to the presence of the wind farm. Only the other two Forth and Tay offshore developments are considered in this assessment, as all other onshore and offshore developments are too far away from the Development Area to result in a likely cumulative impact.

296 The assessment considered all VORs and cumulative indirect impacts on birds via prey distribution of negligible magnitude across all seasons as impacts are likely to be highly localised and without spatial overlap of the three Forth and Tay offshore developments. Given that no significant adverse cumulative impacts on fish populations were predicted during the operational phase for the Inch Cape Offshore Wind Farm (*Chapter 13, Section 13.9.3*) it follows that significant indirect impacts on bird communities are also unlikely to occur. Based on currently available studies it is concluded that indirect impacts on bird communities through prey are likely to represent a very slight change to baseline conditions with no or limited positive effects. The impact for **all VORs** during all seasons is therefore evaluated as a **negligible** (neutral or slightly positive) impact.

Displacement - Operation

297 The assessment considers potential cumulative displacement to exist only for offshore wind farms. Coastal developments at Dundee and Edinburgh as well as the Forth Replacement Crossing are not considered likely to displace VORs from key offshore foraging areas in the Development Area or the Offshore Export Cable Corridor (up to near-shore), as because of their coastal locations they are far removed from these areas. The developments do not lie between seabird breeding colonies and foraging areas, so are not predicted to pose a barrier to the movements of birds travelling between colonies and offshore foraging areas.

298 During the **breeding season**, seabirds will potentially be subject to cumulative displacement impacts through loss of potential foraging habitat from offshore wind farms within their foraging ranges from breeding colonies. Direct comparison of the predicted number of birds displaced from each wind farm is not possible without re-working the data presented because the Environmental Statements for individual developments take different approaches to assessing displacement. For example predictions of the percentage reduction in numbers for a given species within a wind farm vary between developments. The cumulative assessment below considers the potential loss of foraging habitat for individual seabird species based on the total area of wind farm developments (plus a 2 km buffer as birds may be displaced from areas close to the wind farm) within regional foraging ranges of colonies with potential connectivity to the Wind Farm. This is a relatively crude approach, as it assumes that all areas of sea within foraging range for a given species are of equal value as foraging habitat, which is not the case, but it does provide an indication of the overall scale of potential habitat loss from multiple developments. Robust methods of accurately predicting the foraging distribution of seabirds over extensive offshore areas are not available. In modelling the potential impacts of displacement on guillemots from the Isle of May, MacDonald *et al.* (2012) used prey distribution as an input layer to the model, however as no empirical data on fish shoal size and distribution were available, they used simulated distributions based on clustered and random prey.

299 The offshore wind farms considered in the cumulative assessment of displacement for each seabird species are shown in Table 15.18 below. The predicted cumulative loss of foraging area within this range due to displacement from offshore wind farms is presented in Table 15.19, and varies from 0.4 per cent for fulmar to 4.4 per cent for common tern. For each species, the percentage loss of foraging area in relation to displacement from the Inch Cape Development Area plus a 2 km buffer alone is also provided.

300 Cumulative assessment of operational displacement was not carried out for Arctic skua, great skua or little gull during the breeding season, as these species do not breed locally (i.e. no regional breeding population exists).

Table 15.18: Wind Farms within Foraging Areas and Included in the Cumulative Assessment of Displacement for Seabird Species

Species	Foraging Area[1] (km^2)	Wind Farms Considered in Cumulative Assessment of Displacement					
		Inch Cape	Firth of Forth Round 3 Phase I	Neart na Gaoithe Offshore Wind Farm	European Offshore Wind Development Centre	Moray Firth Round 3 Zone 1, EDA	Beatrice Offshore Wind Farm
Fulmar[2]	532,960	✓	✓	✓	✓	✓	✓
Gannet[3]	200,000	✓	✓	✓	✓		
Puffin	83,446	✓	✓	✓	✓	✓	✓
Lesser black-backed gull	82,667	✓	✓	✓	✓	✓	✓
Guillemot	68,407	✓	✓	✓	✓	✓	✓
Herring gull	50,322	✓	✓	✓	✓		
Kittiwake	34,660	✓	✓	✓	✓		
Razorbill	34,534	✓	✓	✓	✓		
Great black-backed gull	6,747	✓		✓	✓		
Arctic tern	3,957	✓		✓			
Common tern	3,244	✓		✓			
Shag[4]	572	(✓)					

Species	Foraging Area[1] (km^2)	Wind Farms Considered in Cumulative Assessment of Displacement					
		Inch Cape	Firth of Forth Round 3 Phase I	Neart na Gaoithe Offshore Wind Farm	European Offshore Wind Development Centre	Moray Firth Round 3 Zone 1, EDA	Beatrice Offshore Wind Farm

1. Foraging areas are based on the total areas of sea within foraging distances (mean maximum foraging range, Thaxter *et al*., 2012) of breeding colonies within the region for each species. Foraging ranges are presented in *Appendix 15A*, Table 15A.5, in the following Figures: fulmar: 15A.1.2; gannet: 15A.1.5; puffin 15A.1.28; lesser black-backed gull 15A.1.12; guillemot 15A.1.22; herring gull 15A.1.14; kittiwake: 15A.1.9; razorbill: 15A.1.25; great black-backed gull 15A.1.17; Arctic tern 15A.1.20; common tern 15A.1.21; shag: 15A.1.8.

2. For fulmar foraging range calculated as shown in Figure 15A.1.2 assuming birds breeding within foraging range, forage mainly within the North Sea.

3. Gannet foraging range area for Bass Rock colony taken from Hamer *et al.* (2011). Although offshore wind farms in the Moray Firth are potentially within range of gannets in the regional population (Figure 15A.1.5), the majority of birds recorded during the breeding season are assumed to be from Bass Rock and unlikely to forage in the Moray Firth (Hamer *et al.,* 2011).

4. Shag foraging range only partially overlaps with the Inch Cape Development Area (Figure 15A.1.8) and no cumulative displacement impacts with other wind farms are predicted.

Table 15.19: Potential Cumulative Displacement Impacts of Offshore Wind farms in terms of Loss of Regional Foraging Area

Species	Regional Foraging Area (km^2)	Assumed Displacement (Per cent reduction in numbers within wind farms)	Per Cent Loss of Foraging Area in relation to Inch Cape Alone (km^2)[1]	Total Area of Wind Farms within Foraging Range (km^2)[2]	Cumulative Per cent loss of Foraging Area
Fulmar	532,960	100	0.05	2,138	0.4
Gannet	200,000	75	0.1	1,113	0.4
Puffin	83,446	50	0.2	2,138	1.3
Lesser black-backed gull	82,667	30	0.1	2,138	0.8
Guillemot	68,407	50	0.2	2,138	1.6
Herring gull	50,322	30	0.2	1,113	0.7
Kittiwake	34,660	30	0.2	1,113	1.0
Razorbill	34,534	50	0.4	1,113	1.6
Great black-backed gull	6,747	30	1.2	518	2.3
Arctic tern	3,957	30	1.4	478	3.6
Common tern	3,244	30	1.2	478	4.4

1. The Development Area plus a 2 km buffer (278 km^2) as a percentage of the regional foraging range, adjusted for the predicted percentage of birds displaced.

2. The total area of wind farms (including 2 km buffers) overlapping with the regional foraging range (list of wind farms in Table 15.18).

301 There is little empirical data to use in the assessment of the impacts of loss of foraging areas on breeding seabirds. Foraging ranges of seabirds from individual colonies are known to vary from year to year. For the Isle of May significant inter-annual variation in foraging ranges of seabirds has been shown from tracking studies (Daunt *et al.,* 2011a). Thus the regional foraging range areas calculated for individual species from the Wind Farm may over-estimate the actual foraging areas used.

302 Examination of the standard deviations for the mean maximum foraging ranges that have been identified for seabirds (*Appendix 15A*, Table 15A.5) gives further indication of the

extent of variation. In most cases the SDs are large compared with the actual foraging range values, for example, for kittiwake, the mean maximum foraging range is estimated at 60 km with a SD of 23.3 km, thus the SD is 39 per cent of the mean, for herring gull the SD is 72 per cent of the mean, and for Arctic tern the SD is 26 per cent of the mean (*Appendix 15A*, Table 15A.5). As the regional foraging areas have been identified, and their size estimated, based on these mean maximum values (for most species mean maximum plus one SD, see *Appendix 15A*, *Section 15A.2.3.2*), there is inevitably a large degree of uncertainty about the total area in square kilometres that has been calculated. In the context of this large degree of variation in the foraging ranges that have been used to estimate regional foraging areas, predicted losses of between 0.4 per cent and 4.4 per cent of the regional foraging areas due to displacement from offshore wind farms (Table 15.19) are considered a minor shift from baseline conditions.

303 For **fulmar** and **gannet** the assessment considered two VORs of high sensitivity and operational displacement impacts of negligible magnitude. If the species does not fully habituate to the presence of the WTG array, there is a potential for displacement to affect at least a proportion of the population throughout the operational phase. However, it is considered that such an effect will be offset by the both species' very large foraging ranges, their flexibility in exploiting a multitude of food resources, and the limited spatial extent over which displacement is likely to occur (the Development Area and its immediate vicinity). It is concluded that the predicted impact on the regional fulmar and gannet breeding populations through displacement is negligible as it represents a slight change from baseline conditions, with any effects likely to fall within fluctuations of natural variation.

304 For **shag** the foraging range of the regional population does not overlap with any other offshore developments (Figure 15A.1.8) and no cumulative displacement impacts with other wind farms are predicted, resulting in the original assessment for the Project alone being retained (**negligible** impact).

305 The assessment considered two high sensitivity receptors - **common tern and Arctic tern** – and cumulative displacement impacts in the breeding season of a negligible magnitude. This is based on these terns' tendency to predominantly forage in coastal and inshore waters within eight to ten kilometres of colonies during the breeding season (Birdlife International Seabird Database, 2012; Thaxter *et al.,* 2012). Thus although there is some overlap between the foraging range areas estimated by mean maximum foraging distances (Table 15.19), in reality, areas within the two offshore wind farms, Inch Cape and Neart na Gaoithe, identified for potential cumulative impacts (Table 15.18) will rarely be used for foraging by terns during the breeding season because both wind farms are situated substantially more than 10 km from the coast. Cumulative displacement for both receptors in the breeding season is therefore evaluated as a **negligible** impact.

306 For **common gull**, the assessment considered a receptor of moderate sensitivity and cumulative operational displacement effects during the breeding season of negligible magnitude due to the species' predominantly coastal and inland foraging areas (and therefore no habitat loss calculation was undertaken in Table 15.19). Cumulative

displacement is therefore evaluated as a negligible impact, with very small changes to the baseline conditions.

307 For **lesser black-backed gull** (high sensitivity receptor), cumulative operational displacement is considered of a negligible magnitude. Like the other large gulls, this species may forage inland and in coastal/estuarine areas, although it tends to make more use of offshore areas. In addition, lesser black-backed gulls are able to expand their foraging ranges to compensate for changes in the abundance of small fish and discards from fishing vessels (Camphuysen *et al*., 1995) and would therefore be predicted to adapt to a small scale loss of foraging range through displacement from offshore wind farms. Cumulative displacement is therefore evaluated as a **negligible** impact.

308 For **herring gull** and **great black-backed gull** (receptors of high and moderate sensitivity respectively), cumulative operational displacement impacts were similarly considered to be of negligible magnitude. Both species have flexible foraging strategies which include predation on other seabirds at colonies and foraging over inland and coastal/estuarine habitats as well as offshore. Cumulative displacement is therefore evaluated as a **negligible** impact.

309 The assessment considered high sensitivity receptors **kittiwake, guillemot, razorbill** and **puffin** and cumulative operational displacement effects of low magnitude based on the predicted percentage of loss of foraging range. For each species the impact of displacement from the Project alone has been assessed as minor based on the estimated breeding season populations for the wind farm areas and a 2 km buffer, the number of birds predicted to be displaced and investigation of the population consequences of displacement (Table 15.14). As displacement is assessed differently in the Environmental Statements for the other offshore wind farms identified for cumulative impacts (see *Section 15.6.2* under the heading 'assessment of displacement') it is not possible to directly compare the estimated numbers of birds displaced from each wind farm, without some re-working of data. Thus, although the predicted loss of regional foraging area for kittiwake, guillemot, razorbill and puffin from displacement from offshore wind farms is predicted to be less than two per cent of their respective regional foraging ranges (Table 15.19), and small compared with the variation in mean maximum foraging distances for these species (*Appendix 15A*, Table 15A.5), it is considered that some uncertainty surrounding the different assessment approaches used in other ES documents remains, and therefore cumulative displacement is evaluated as a minor/moderate impact.

310 **Post-breeding** aggregations of several seabird species were recorded in the Boat-based Survey Area for the Inch Cape Offshore Wind Farm: **Arctic skua, great skua, common tern, Arctic tern**, **puffin, razorbill, guillemot**, and **kittiwake**. These are likely to comprise breeding adults, fledged young of the year and non-breeding birds. There is potential for cumulative displacement impacts from offshore wind farms to adversely affect these species. However for all species, breeding adults are no longer constrained in their foraging ranges by requirements to attend nest sites, although they may still be feeding fledged young, so that the potential foraging areas are larger than those estimated for the breeding season (Table 15.19). Guillemots, razorbills and puffins will be flightless for a time (chicks of guillemot and

razorbill because they leave nests before wing feathers develop, and adults (of all species) because they undergo a post-breeding moult and moult all flight feathers simultaneously), but nevertheless are able to disperse rapidly offshore into the North Sea and beyond (e.g. Camphuysen, 2002 for guillemot; Harris *et al.,* 2010 and Harris and Wanless, 2011 for puffin). Kittiwakes are known to move away from the region in the post-breeding period in large numbers over a relatively short time-span (Bogdanova *et al*., 2011).

311 The assessment considered the above eight VORs of high or moderate sensitivity and cumulative operational displacement impacts in the post-breeding season of negligible magnitude because birds are not constrained by the need to attend a nest site and are able to forage over large areas and spend only a short period of time in the region before migrating. At this time of year, any displacement is therefore not predicted to affect the survival of individuals and thus no changes in mortality rates are predicted. Displacement during this time of year is evaluated as a **negligible** impact as it is predicted to represent a very slight change from baseline conditions, with any effects likely to fall well within fluctuations of natural variation.

312 During the **non-breeding season**, seabirds are not constrained by the requirement to attend a nest site and may forage over extensive areas. The assessment considered the **all VORs** and cumulative operational displacement impacts in the non-breeding season of negligible magnitude because birds are not constrained by the need to attend a nest site and are able to forage over large areas. At this time of year, any displacement is therefore not predicted to affect the survival of individuals and thus no changes in mortality rates are predicted. Displacement during this time of year is evaluated as a **negligible** impact as it is predicted to represent a very slight change from baseline conditions, with any effects likely to fall well within fluctuations of natural variation.

Barrier Effect - Operation

313 The cumulative assessment of barrier impacts considers offshore wind farms only as the coastal developments are not predicted to be of sufficient height or extent to pose a barrier to seabirds or migratory birds. Offshore wind farms might present cumulative barrier impacts to passage species which encounter several developments during migratory flights. However, the studies that have been done suggest that the costs of the additional distances travelled and the energy costs of deviation around a wind farm are trivial (Pettersson, 2005; Masden *et al.,* 2009; Speakman *et al.,* 2009).

314 The assessment considered VORs of all sensitivities (**migratory birds**) and cumulative barrier effects during the operational phase of negligible magnitude across all seasons. If species do not habituate to the presence of the WTG arrays it is possible that at least a proportion of background populations could be affected throughout the entire operational phase. However, based on the very small spatial extent over which any barrier effect is predicted to occur (the immediate vicinity of each of the offshore wind farm sites) and the likely minimal effects on birds' energy expenditure, cumulative operational barrier effects on all VORs during migratory passage are evaluated as a negligible impact.

315 Barrier effect was also identified as a potential impact on **breeding seabirds**. In practice, however, barrier effects for breeding seabirds are considered to be a component of displacement (see *Section 15.6.2*). Thus the conclusions of the cumulative assessment for breeding seabirds in relation to displacement take into consideration the potential for offshore wind farms within foraging range to act as a barrier to seabirds during trips between nest sites and foraging areas. Therefore no separate conclusions are presented for barrier effects.

Collision Risk - Operation

316 To assess cumulative collision risk on a more or less equal footing, published collision estimates for a range of offshore wind farm developments were used. Areas under consideration consisted of:

- the Moray Firth: Beatrice Offshore Wind Farm, Moray Firth R3 Zone 1 (EDA);
- north-east Scotland: European Offshore Wind Deployment Centre;
- the Firth of Forth: Neart na Gaoithe Offshore Wind Farm, Projects Alpha and Bravo of the Firth of Forth Round 3 Offshore Wind Farm (Firth of Forth Phase 1), Inch Cape Offshore Wind Farm; and
- North-east England: Blyth Offshore Demonstration Project.

317 Where possible, the collision risk methodology used for each of these developments was assessed to establish compatibility with the approach followed for the Inch Cape Offshore Wind Farm. Differences in avoidance rates – relative to the approach followed in this assessment – were accounted for by adjusting available collision estimates for other developments. For example, a published estimate for a given species at 98 per cent avoidance was halved in order to be comparable to an estimate for the same species at 99 per cent avoidance for the Inch Cape Offshore Wind Farm (a collision estimate at 99 per cent is half the size of an estimate at 98 per cent avoidance).

318 Another difference between approaches relates to the breeding status of seabirds: Inch Cape Offshore Wind Farm collision estimates have been based on the assumption that 50 per cent of all birds in adult plumage are in fact breeding birds (as per recommendation from SNH and JNCC), with the exception of kittiwake and gannet, for which the proportion of breeding adults was calculated through a PVA model (*Appendix 15B*; WWT, 2012). These considerations have been used in the individual site impact assessment. For all other developments, estimates appear to represent all birds or all adult birds instead.

319 For seabirds most of the required information on collision risk was available for all offshore wind developments under consideration. For migratory species sufficient information from the other developments was available to cumulatively assess goose species and a selection of waders. For Neart na Gaoithe, information on collision mortality was available for a selection of 15 species, but estimates were based on nominal background populations of 1,000 birds flying through the wind farm site alone. Current guidance recommends the use of flight corridors for migratory species instead, with a range of assumptions about

background populations and flight heights (Wright *et al.,* 2012). To increase compatibility with the underlying assessment, published collision estimates for geese for Neart na Gaoithe were compared against the background populations involved and adjusted to reflect the width of the wind farm (longest distance 14 km) relative to the width of the migration corridor for a given species.

320 Collision estimates for the different developments – where available – were added and compared to existing (adult) background mortality levels or the size of background populations to establish proportional change or proportion of population respectively. Where possible this was done on a seasonal basis.

321 Cumulative assessment of operational collision risk was carried out for a range of seabirds, three goose species and several wader species.

322 Cumulative assessment was not carried out for some species due to lack of observations of birds at risk height in the Inch Cape Boat-based Survey Area (**fulmar**, **shag**, **little gull, common gull, common tern**, **Arctic tern**, **puffin, razorbill, guillemot)**, or species for which the Inch Cape Offshore Wind Farm individually was assessed and no information was available from other developments (**shelduck, tufted duck, long-tailed duck, common scoter, goldeneye, purple sandpiper**, **grey phalarope**).

323 Cumulative assessment was also not carried out for some species during the breeding season as densities in the Inch Cape Development Area were exceedingly low and not considered to significantly differ from zero with too few observations to reliably calculate densities or collision estimates (**lesser black-backed gull, herring gull and great black-backed gull**).

324 Table 15.20 presents the potential cumulative impacts of collision risk on the relevant VORs.

Table 15.20: Potential Cumulative Impacts of Collision Risk on Valued Ornithological Receptors

Species	Cumulative Assessment	Conclusion
Taiga Bean Goose	**Passage Migration** Estimates of collision mortality for Taiga bean geese during migration at 99% avoidance rate are available from two other offshore wind farm developments: Firth of Forth Phase 1 (0.01 geese, adjusted to 99% avoidance) and Neart na Gaoithe Offshore Wind Farm (0.03 geese, adjusted for different collision risk approach). Therefore the cumulative impact including the Inch Cape Offshore Wind Farm (0.01 collisions), at an avoidance rate of 99%, amounts to 0.05 collisions annually, increasing adult annual mortality by 0.1%. The assessment considered a VOR of high sensitivity and cumulative operational collision risk impacts of low magnitude. Considering the very precautionary approach of 'at risk' flights (with 75% of all geese assumed to fly at collision risk height, as per recommendations from Wright *et al.,* 2012), whereas geese in reality have the capacity for long range avoidance behaviour at offshore wind farms (e.g. pink-footed goose, Plonckzier and Simms, 2012), the width of the flyway corridor (Shetland to Firth of Forth, Forrester *et al.,* 2007) and the very small background population involved make the probability of regular flight movements through the wind farm developments under consideration very low, further decreasing the likelihood of collision incidents. Based on the small predicted increase in adult mortality during passage migration, cumulative collision risk is evaluated as a negligible impact as any effect is likely to lie within the limits of natural variation.	**Passage migration** Negligible impact
Pink-footed Goose	**Passage Migration** Estimates of breeding season collision mortality for pink-footed goose during spring and autumn migration are available from four other offshore wind farm developments: Moray Firth R3 Zone 1, EDA (19.8 geese); Beatrice Offshore Wind Farm (36.1 geese); Firth of Forth Phase 1 (11.1 geese, adjusted to 99% avoidance) and Neart na Gaoithe Offshore Wind Farm – 75 geese annually when accounting for the difference in approach). Including the Inch Cape Offshore Wind Farm (23 geese) the cumulative estimate is therefore 165 goose collisions annually. At an adult survival rate of 0.84 (Trinder *et al.,* 2005) and a proportion of juveniles of 19.3% (mean, all-Scotland, 2000 - 2009, Mitchell, 2011), estimated cumulative collision mortality equates to a 0.64% increase of the adult mortality of the Scottish winter population of 200,000 birds. The assessment considered a VOR of moderate sensitivity and cumulative operational collision risk impacts of moderate magnitude. However, the likelihood of such an impact occurring is considered low given the species' high avoidance rates (perhaps as high as 99.9%, Pendlebury, 2006) and capacity to undertake long range avoidance of operational offshore wind farms (Plonczkier and Simms, 2012). In addition, pink-footed geese	**Passage migration** Negligible impact

Species	Cumulative Assessment	Conclusion
	wintering in Scotland (and Britain as a whole) originate from the Greenland and Icelandic breeding populations. The long-term trend for this population is one of steady growth from about 50,000 birds in 1960 to over 360,000 in 2009 – the highest number ever recorded (Mitchell, 2010), despite this being a quarry species with an estimated mortality of at least 38,000 birds each year from shooting in Britain and Iceland (Trinder *et al.,* 2005, Mitchell, 2010). A population model for this species (WWT Consulting, 2008) suggested that the loss of up to 1,000 additional birds each year would result in little or no detectable effect on the probability of population decline. Cumulative collision impacts on pink-footed goose are therefore predicted to result in effects that will lie within the limits of natural variation and is evaluated as a negligible impact.	
Svalbard Barnacle Goose	**Passage Migration** Estimates of breeding season collision mortality for Svalbard barnacle goose during spring and autumn migration at 99% avoidance are available from four other offshore wind farm developments: Moray Firth R3 Zone 1, EDA (0 geese); Beatrice Offshore Wind Farm (0 geese) Firth of Forth Phase 1: (0.78 geese, adjusted to 99% avoidance) and Neart na Gaoithe Offshore Wind Farm (22 collisions, adjusted for flyway approach). With a background population of 35,640 birds at the Solway Firth in 2009 - 2010 (of which 10.8% are juveniles, Holt *et al.,* 2012) this leads to a cumulative estimate of 30 collisions each year when including estimates for the Inch Cape Offshore Wind Farm (seven geese) and represents an increase in annual adult mortality of 1.88% assuming all collisions involve adult birds. The assessment considered a VOR of high sensitivity and operational collision risk impacts of high magnitude. Population modelling of Svalbard barnacle goose by Trinder *et al.* (2005) considered the loss of 350 to 1,000 adults annually of a (then) 27,000 strong Scottish population to lead to a stable to slightly decreasing population. Since 2005 the population has continued to grow substantially (Holt *et al.,* 2012), making it unlikely that additional mortality through cumulative collisions in the Forth and Tay area equates to a significant impact. Based on the very small predicted increase in adult mortality during passage migration and in light of the PVA modelling considerations, collision risk is evaluated as a minor impact as any effect is likely to represent only a small scale change in the context of a strongly increasing population.	**Passage migration** Minor impact
Gannet	**Breeding Season** Estimates of breeding season collision mortality for gannets in the breeding season are available from five other offshore wind farm developments (Firth of Forth Phase 1 (708); European Offshore Wind Deployment Centre (3); Moray Firth R3 Zone 1, EDA (62); Beatrice Offshore Wind Farm (54) and Neart na Gaoithe Offshore Wind Farm (294). At an avoidance rate of 99% these amount to 1,121 adult gannet collisions during the breeding season. This estimate includes corrected estimates for the slightly different breeding seasons used	**Breeding** Minor impact **Non-breeding** Minor impact

Species	Cumulative Assessment	Conclusion
	for other developments. Accounting for that difference by considering April to September only (where possible), the annual cumulative collision estimate for all six developments (including the Inch Cape Offshore Wind Farm, 315 collisions) in the breeding season amounts to 1,436 collisions. In reality this is probably an over-estimate of the cumulative impact on the regional population as, based on the mean maximum foraging range, the regional population for the Inch Cape Offshore Wind Farm includes the Bass Rock and Troup Head colonies (at 58,269 breeding pairs). The former colony makes up 95% of the regional population and lies at a distance from the Moray Firth developments which exceeds the species' mean maximum foraging range. Based on tracking data during the chick-rearing period from 1998, 2002 and 2003 overlap between foraging gannets from Bass Rock and the Moray Firth area is minimal to non-existent (Hamer *et al.,* 2011). As such it is considered unlikely that developments in the Moray Firth add substantially to the cumulative impact on the regional gannet population as a whole. Assuming cumulative impact sources on the regional population are limited to the Aberdeen (European Offshore Wind Deployment Centre) and the three Forth and Tay developments the annual breeding season collision estimate is 1,320 gannets or a 14% increase of annual adult mortality. The assessment considered a VOR of high sensitivity and cumulative operational collision risk impacts of high magnitude. However, population modelling indicates that a harvest of 2,000 birds per year from the Bass Rock colony and 10,000 from the British and Irish population would be required in order for population growth rates to be reduced to a stable level (i.e. no longer growing; WWT, 2012). Therefore the annual cumulative collision rate for all projects under consideration would have to be approximately 33% higher than currently estimated for such an effect to occur. It is concluded that the annual collision estimate for the breeding season represents a small scale change, at worst suppressing the positive growth rate of the gannet population and thus within acceptable limits. Collision risk is therefore evaluated as a minor impact. **Non-Breeding Season** Cumulative collision estimates for the non-breeding season for all six offshore wind farms total annual collisions of 330 gannets (regardless of age class) at 99% avoidance. Given the species' wide-ranging behaviour and the spatial extent of these developments –from the Moray Firth to northern England – it is expected that the impacts are diffused across a larger regional population than used for the Inch Cape Offshore Wind Farm individually (at 31,200 birds). Skov *et al.* (1995) estimate 50,200 gannets to be present between Shetland and the Farnes Deep in mid-winter, with the entire North Sea population estimated at 157,800 during the same time of year. Given the species wide ranging capacity it is considered reasonable to consider the North Sea region as the likely background population during this time of year. Cumulative collision estimates for the	

Species	Cumulative Assessment	Conclusion
	offshore developments assessed here represent 0.21% of the North Sea population. The assessment considered a VOR of high sensitivity and cumulative operational collision risk impacts of low magnitude. Many birds breeding in Great Britain migrate south, for example, Hamer *et al.* (2011) estimate that over 80% of all Bass Rock gannets overwinter outside British waters. Fort *et al.* (2012) present evidence of chain migration in gannets, whereby populations from breeding colonies at different latitudes move southward by a similar distance. Thus gannets recorded in British waters during passage originate from a range of different populations, with those present in winter likely to comprise of birds from breeding colonies further north in Europe. It is considered that any cumulative impact through collision in the non-breeding season is likely to be distributed across a range of different populations, none of which are predicted to be affected other than on a small scale and in a temporary fashion. Based on these considerations evaluation predicts cumulative collision to be a minor impact.	
Oystercatcher	**Passage Migration** Predicted cumulative annual collisions from all three Forth and Tay developments (totalling 25 birds) represent 0.01% of the background population of 200,000 birds, moving twice a year through a corridor extending from Orkney to Kent. These birds are made up of British breeding birds remaining in the UK during winter as well as mainland Europe and Scandinavian (largely Norwegian) birds wintering in the British Isles (Delany *et al.,* 2009). The assessment considered a VOR of moderate sensitivity and cumulative operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, cumulative collision risk is evaluated as a negligible impact.	**Passage migration** Negligible impact
Golden plover	**Passage Migration** Annual collision estimates for the Inch Cape Offshore Wind Farm and the Firth of Forth Phase 1 total 50 birds at 98% avoidance, and represent less than 0.01% of the Icelandic population (at 930,000 birds) alone. In reality the background population of golden plovers migrating is substantially higher as both populations from north-west Europe (including the British Isles) and northern Europe move to and from staging and wintering areas across the North Sea (Delany *et al.,* 2009). The assessment considered a VOR of moderate sensitivity and cumulative operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, cumulative collision risk is evaluated as a negligible impact.	**Passage migration** Negligible impact

Species	Cumulative Assessment	Conclusion
Ringed plover	**Passage Migration** Predicted cumulative annual collisions from all three Forth and Tay developments (totalling two birds) represent less than 0.01% of the background population of 73,000 birds, moving twice a year through a corridor extending from Orkney to Kent. In reality the background population is much larger (and much more complex), with substantial numbers of ringed plovers from north-east Canada, Greenland and northern Scandinavia moving through the British Isles on spring and autumn migration (Wright *et al.,* 2012). The assessment considered a VOR of moderate sensitivity and cumulative operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, cumulative collision risk is evaluated as a negligible impact.	**Passage migration** Negligible impact
Curlew	**Passage Migration** The predicted cumulative annual mortality for curlew (totalling 28 birds) for all three Forth and Tay developments represents 0.03% of the Scottish wintering population (85,700 birds). The assessment considered a VOR of moderate sensitivity and cumulative operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, cumulative collision risk is evaluated as a negligible impact.	**Passage migration** Negligible impact
Knot	**Passage Migration** Cumulative annual collision estimates for knot (totalling 42 birds) for all three Forth and Tay developments represent 0.02% of the background population of 225,000. The assessment considered a VOR of moderate sensitivity and cumulative operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, cumulative collision risk is evaluated as a negligible impact.	**Passage migration** Negligible impact
Dunlin	**Passage Migration** The predicted annual cumulative mortality for dunlin from all three Forth and Tay developments amounts to 103 birds at 98% avoidance, assuming roughly a third of the population (350,000 birds) from Iceland and Greenland (940,000 - 960,000 birds, 21,000 - 45,000 birds respectively; Delany et al., 2009) migrates through the North Sea twice a year, through a corridor stretching from Lewis (Western Isles) to the Firth of Forth. Both populations appear to be stable (Delany et al., 2009) and annual collision estimates represent 0.03% of the	**Passage migration** Negligible impact

Species	Cumulative Assessment	Conclusion
	assumed passage population. The assessment considered a VOR of moderate sensitivity and cumulative operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background population predicted to be affected through annual collisions, cumulative collision risk is evaluated as a negligible impact.	
Arctic skua	**Post-breeding/Passage** Estimates of collision mortality for Arctic skua during passage are only available from two other offshore wind farm developments (European Offshore Wind Deployment Centre and Beatrice Offshore Wind Farm). Including the Inch Cape Offshore Wind Farm cumulative collision estimates total two birds at 98% avoidance. The Firth of Forth Phase 1, Moray Firth R3 Zone 1, EDA and Neart na Gaoithe developments assume collision risk impacts to be negligible due to the low densities derived from boat survey data. However, as low frequency boat-based surveys are not particularly suitable for capturing migratory population movements, often leading to a dearth of data, current guidance recommends the use of a flyway approach for such species instead (Wright *et al.,* 2012). Although this approach was used for the Inch Cape Offshore Wind Farm assessment, the fact that several other developments have not, means that from a cumulative perspective the cited two annual collisions are possibly an under-estimate. Forrester *et al.* (2007) estimate that 1,000 to 10,000 Arctic skuas pass Scottish coasts in autumn, the majority of which move into the North Sea. Assuming the mid-point of this range as a reasonable background population (5,500 birds), collision estimates represent less than 0.3% of the passage population. However, passage estimates are largely based on land-based counts, and are likely to be higher when taking into account skuas migrating further offshore: the North Sea autumn passage population could conceivably include breeding birds from the UK, Norway, Sweden and the Faeroe Islands, an estimated 25,900 birds (Birdlife International, 2004). If half of that population were to move through the North Sea in late summer and autumn, the cumulative collision impact falls below 0.1%. The assessment considered a VOR of moderate sensitivity and cumulative operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background populations predicted to be affected through annual collisions, which are considered to fall within the limits of natural variation, collision risk is evaluated as a negligible impact.	**Post-breeding/Passage** Negligible impact

Species	Cumulative Assessment	Conclusion
Great skua	**Post-breeding/Passage** Estimates of collision mortality for great skua during passage are only available from two other offshore wind farm developments (European Offshore Wind Deployment Centre and Beatrice Offshore Wind Farm). Including the Inch Cape Offshore Wind Farm, cumulative collision estimates total two birds at 98% avoidance. As with Arctic skua, assessments for other offshore developments largely assume collision risk impacts to be negligible due to the low densities derived from boat survey data. The more appropriate flyway collision risk approach (Wright *et al.,* 2012) was used for the assessment, but not necessarily for other developments considered cumulatively. Thus cumulative collision estimates presented here may be an under-estimate. Skov *et al.* (1995) estimate that up to 10,750 great skuas are present in September - October between Shetland and Flamborough Head. A cumulative estimate of two birds thus represents less than 0.1% of the passage population. The assessment considered a VOR of moderate sensitivity and cumulative operational collision risk impacts of negligible magnitude. Based on the very small proportion of the background populations predicted to be affected through annual collisions, which are considered to fall within the limits of natural variation, collision risk is evaluated as a negligible impact.	**Post-breeding/passage** Negligible impact
Kittiwake	**Breeding Season** Estimates of breeding season collision mortality for kittiwakes are available from five other offshore wind farm developments: Firth of Forth Phase 1 (441); Moray Firth R3 Zone 1, EDA (108); Beatrice Offshore Wind Farm (124), European Offshore Wind Deployment Centre (25) and Neart na Gaoithe Offshore Wind Farm (57). Including estimates for the Inch Cape Offshore Wind Farm (18), at an avoidance rate of 98% these amount to 773 adult kittiwake collisions during the breeding season. This constitutes an increase in annual adult mortality of 5.9% for the regional population (annual adult mortality 12%; Harris *et al.,* 2000; regional population 110,080 breeding birds). However, as defined for the Inch Cape Offshore Wind Farm, based on the mean maximum foraging range (plus 1 SD) of 83.3 km the regional population extends from Peterhead to the Farne Isles. The Moray Firth developments lie at least 100 km from the nearest breeding colony (Buchan Ness to Collieston Coast SPA), making connectivity with the regional population tenuous at best. Instead the European Offshore Wind Deployment Centre and three Forth and Tay offshore wind farms are likely to be the primary impact sources on this population, with colonies on the fringe of the region potentially affected by projects from the Moray Firth as well, albeit only marginally. When considering the cumulative impact on the regional population without the Moray Firth developments, collision estimates amount to 541 kittiwakes, or an increase in adult mortality of 4.1%. At a regional level this is considered to be a high magnitude impact on a VOR of high sensitivity. Given the PVA considerations, and	**Breeding** Major impact-Significant **Non-breeding** Minor impact

Species	Cumulative Assessment	Conclusion
	species' declining population trend in Scotland (SNH, 2012) the cumulative collision impact is evaluated as major and significant. In isolation the predicted impact of the Inch Cape Offshore Wind Farm is predicted to have a minor impact on the regional kittiwake breeding population. As it stands, collision estimates for the Inch Cape Offshore Wind Farm represent 3.32% of the cumulative estimate. If a 99% avoidance rate were deemed appropriate, the estimated cumulative impact would be reduced to 271 adult birds in the breeding season, or an increase in adult mortality of 2.1%. That estimate falls within the range of additional mortalities included in the PVA model – that of removing 123 to 400 birds from the regional population, which is predicted to increase the likelihood of declines over a period of 25 years by circa 2% - 4%. Such an increase is the equivalent to being 'very unlikely' under the IPCC guidance (IPCC, 2010), with no apparent increase in this risk over this range of additional mortality (see *Appendix 15B*, Figure 15B.3) and could thus be considered the basis for an argument for no significant cumulative impact on the regional breeding population. **Non-Breeding Season** Insufficient information was available for other developments to determine collision impacts for the post-breeding season (September – October) or for specific regions during this time of year. In this cumulative assessment estimates for the North Sea population in the non-breeding season (September - March) are used instead. Cumulative collision estimates for the non-breeding season for all six developments total annual collisions of 1,658 kittiwakes (regardless of age class) at 98% avoidance. Given the species' wide-ranging behaviour during this time of year and the spatial extent of these developments –from the Moray Firth to northern England - it is expected that the impacts are diffused across a much larger regional population than used for the Development Area individually (at 84,000 birds). In context, Skov *et al.* (1995) estimate over 1,032,690 birds to be present in the North Sea in the non-breeding season. Thus, cumulative collision estimates for the offshore developments considered here represent 0.16% of the North Sea population in the non-breeding season. During this time of year large numbers of kittiwakes from northern Europe enter the North Sea, mixing with birds from the British Isles (Frederiksen *et al.,* 2011). At a North Sea level the impact is considered to be a low magnitude on a high sensitivity receptor. Given the species' very large North Sea population – in turn originating from a range of breeding populations – it is considered likely that the impact will be spread across those populations to an extent that will not significantly affect the species' growth rate, with any impact likely to be small in scale. Therefore, evaluation considers cumulative collision risk effects on the North Sea population in the non-breeding season to be a minor impact.	

Species	Cumulative Assessment	Conclusion
Herring gull	**Non-Breeding Season** Cumulative annual collision estimates for the non-breeding season for all six developments total 1,365 herring gulls (regardless of age class) at 98% avoidance. Skov *et al.* (1995) estimate at least 200,000 herring gulls to be present between Shetland and Farnes Deep in mid-winter and at least another 250,000 gulls in the northern and central North Sea, with the entire North Sea population estimated at 971,700 during the same time of year. Although the cumulative collision estimates are substantial, even at the most precautionary approach – assuming a background population of around 200,000 wintering birds – these equate to a proportion of 0.68% of the regional population. It is considered the cumulative impact is of a moderate magnitude on a moderate sensitive receptor. However, given the species' abundance in the North Sea, it's high level of mobility and the very large numbers of birds involved from the UK, the continent as well as Scandinavia (Wernham *et al.,* 2002), with cumulative effects distributed across many different populations and small in scale, cumulative collision risk is evaluated as a minor impact.	**Non-breeding** Minor impact
Great black-backed gull	**Non-Breeding Season** Cumulative annual collision estimates for the non-breeding season for all seven developments total 1,014 great black-backed gulls (regardless of age class) at 98% avoidance (of which 147 are attribute to Inch Cape Offshore Wind Farm). Skov *et al.* (1995) estimate at least 21,600 great black-backed gulls to be present between the Firth of Forth and the North East Bank off the Northumberland coast in mid-winter and at least 60,900 gulls in the Moray Firth and the north-west North Sea, with the entire North Sea population estimated at 299,900 during the same time of year. The latter winter population, with birds originating from the UK, the continent as well as Scandinavia (Wernham *et al.,* 2002) is very large and involves long range movements from different populations. Thus it is likely that the regional population is subject to a high turnover rate, with any cumulative impacts affecting many different populations rather than a single, stationary one. Considering a regional population of 81,500 birds (east and north-east Scotland combined), the cumulative collision estimate equates to a population proportion of 1.2%, and 0.34% at a North Sea level. It is considered the cumulative impact is of a moderate to low magnitude on a moderate sensitive receptor. Given the large background population in winter, originating from many different breeding populations across Northern Europe, cumulative collision is evaluated as a minor impact.	**Non-breeding** Minor impact

15.9.2 Cumulative Effects – Offshore Export Cable Corridor Near-shore and Intertidal

325 This section considers the potential cumulative impacts of the intertidal, near-shore and onshore components of the Project with other relevant developments that have been identified within five kilometre of either side of the cable landfall options. As highlighted in *Section 15.2*, consultation with SNH was undertaken to identify the plans and projects to take into account for the cumulative assessment. The developments in Table 15.21 have therefore been identified following this feedback and a subsequent detailed review (in April 2013) of all planning applications within five kilometres either side of the cable landfall options.

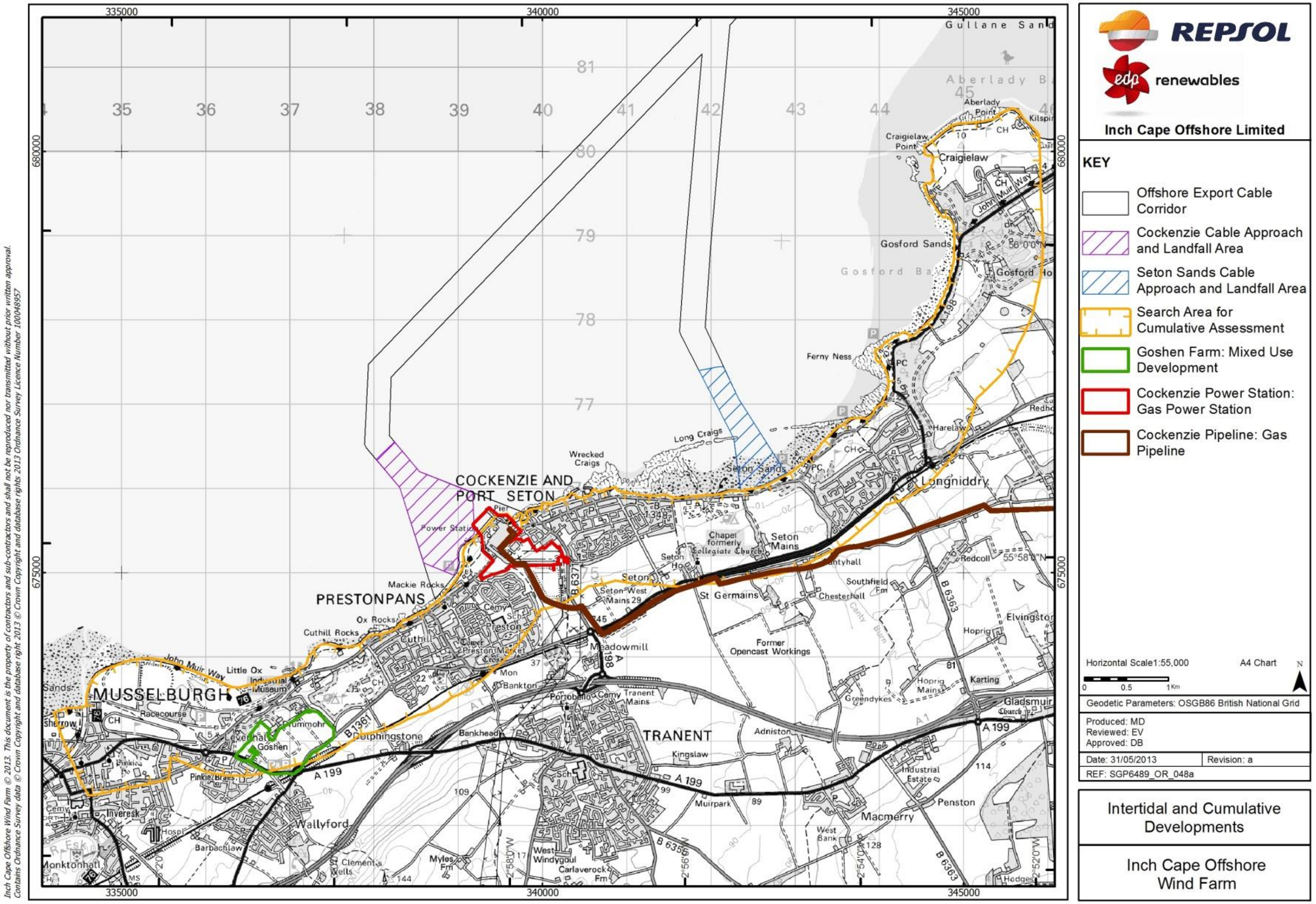
326 A total of three onshore developments have been scoped in for the cumulative assessment: Goshen Farm, Cockenzie pipeline and Cockenzie Combined Cycle Gas Turbine. A short description of the works involved in these projects is provided below. All other developments listed in Table 15.21 are considered sufficiently far away from the intertidal and near-shore part of the Offshore Export Cable Corridor to make a potential cumulative impact exceedingly unlikely. The locations of these developments are presented in Figure 15.3.

Table 15.21: Developments Identified for Potential Cumulative Impacts Near-shore and Intertidal

Project	Distance from the Landfall Location Options	Details and Area	Planning Status	Construction Timescale	Source of Information
Goshen Farm	2 - 6 km	Planning permission in principle for mixed use development covering 49 ha, comprising the erection of up to 1,200 residential units, local centre, primary school, community facilities, open space, landscaping, roads and associated infrastructure.	Pending	Not confirmed as planning status still pending consideration	ES, submitted to East Lothian Council in July 2011 by Ashfield Commercial
Cockenzie pipeline	336 m - 998 m	Construction (duration nine to 12 months) of a cross-country pipeline of approximately 17.5 km in length to transfer gas from	Approved	There is some uncertainty if the developer will progress the project.	ES, submitted to Scottish Ministers in December 2010.

Project	Distance from the Landfall Location Options	Details and Area	Planning Status	Construction Timescale	Source of Information
		the existing gas network to the new Cockenzie Combined Cycle Gas Turbine (see below)			
Cockenzie Power Station Combined Cycle Gas Turbine	0 m - 2196 m (from the landfall location options)	Conversion of the existing power station to gas.	Approved	There is some uncertainty if the developer will progress the project..	ES, submitted to Scottish Ministers in 2009.
Note: distances and surface areas have been rounded to whole numbers					

Figure 15.3: Intertidal and Cumulative Developments



327 The potential for cumulative impacts is considered in terms of direct habitat loss, direct disturbance, and any indirect impacts on bird communities via prey availability.

Onshore Developments Considered for Cumulative Impacts

Goshen Farm

328 Goshen Farm is a proposed mixed use development, comprising housing and other associated uses occupying an area of 49 ha, located about three kilometres west of the Cockenzie landfall option for the Offshore Export Cable and about seven kilometres west of the Seton Sands Landfall option. It lies approximately 365 m from the Firth of Forth SPA at the nearest point (Musselburgh Lagoons) and about 500 m from the coastline of the Firth of Forth (Ashfield Commercial Properties, 2011).

Cockenzie Pipeline

329 The pipeline development consists of the pipe itself, an above ground installation, a site compound, laydown areas and associated infrastructure. The pipeline development will run in an east-west direction from the off-take site at the existing Haddington Above Ground Installation at East Fortune, to the new Combined Cycle Gas Turbine. The development will incorporate a number of road, rail and watercourse crossings. The majority of land along the pipeline development route is used for arable farming.

Cockenzie Combined Cycle Gas Turbine

330 The existing Cockenzie Power Station occupies a 93 hectare site on the south shore of the Firth of Forth in East Lothian. Following cessation of power generation from coal, the consented development is for the conversion of the power station from its original energy source (coal) to natural gas (which will be delivered to the site by the pipeline described above). Given the power station was in operation until March 2013, any effects it had on intertidal and near-shore VORs forms part of the Project baseline as surveys overlapped with the station still being operational. Notably, the birds recorded in the near-shore and intertidal surveys are likely to have habituated to the noise and activity levels resulting from the operational coal-fired power station. The conversion is proposed to take place generally within the existing footprint of the current power station, with two options considered: either to keep the existing twin chimneys, or to demolish these and replace them with shorter stacks. In addition, some seaward works are proposed to the existing jetty and seawall, and depending on the final detailed design, a small jetty may also be constructed into the Firth of Forth. Information on the development and its predicted impacts is taken from its ES (Scottish Power Generation Ltd., 2009).

Direct Habitat Loss

331 There will be no loss of intertidal or sub-tidal habitat as a result of the Goshen Farm or the Cockenzie Pipeline development as neither overlaps with those habitat types. Cumulative impacts during construction are however possible for the Project and the Cockenzie Combined Gas Cycle Turbine (CCGCT). For the latter development, a new slipway may be built that would result in the small-scale loss of sub-tidal habitat and marine habitat of low

ecological importance, resulting in the loss of approximately 0.2 hectares of habitat, equating to less than 0.01 per cent of the entire area of the Firth of Forth (Scottish Power Generation Ltd., 2009). Based on habitat surveys carried out for the CCGCT, the habitat type that would be lost was considered of low ecological value, and not unique to this part of the Firth of Forth, being relatively common and widespread (Scottish Power Generation Ltd., 2009).

332 The extent of intertidal habitat loss at the Cockenzie cable landfall from the Project is estimated to amount to 0.22 hectares, based on a cable length of 56 m across the widest point of the beach in this location. This location lies outside any designated sites within the Firth of Forth, and impacts intertidal habitat of relatively low quality, and of a character that is widespread and extensive within the Firth of Forth (see *Chapter 12*). It is predicted that any indirect impacts during the decommissioning phase is at worst of a similar nature (no further habitat loss is likely to occur during operation).

333 The assessment considered all VORs of all sensitivities and cumulative direct habitat loss during construction and decommissioning of negligible magnitude. Based on the highly localised extent over which direct habitat loss is predicted to occur, its temporary nature, with recovery and recolonisation likely in the short to medium term (see *Chapter 12*), cumulative direct habitat loss for **all VORs** during all seasons represents a very slight change from baseline conditions and is evaluated as a **negligible** impact.

Direct Disturbance

334 There is potential for cumulative impacts from direct disturbance with all three onshore developments if construction, operational and decommissioning activities overlap. Taking available studies into account (see *Section 15.7.2*), it is considered that cumulative direct disturbance impacts from construction activities across the intertidal area will be temporary in nature and are localised - with disturbance for the most susceptible species occurring up to 300 m - 350 m when roosting and up to 200 m - 250 m when foraging, as well as pre-existing baseline levels of disturbance and noise (notably road traffic). It is predicted that any direct disturbance impacts during the operational and decommissioning phases are at worst of a similar nature.

335 The assessment considered **all VORs** of all sensitivities in all seasons and cumulative direct disturbance during construction, operation and decommissioning of negligible magnitude, as it is predicted that such impacts will be localised and temporary in nature. Given the available foraging areas in the wider Firth of Forth during this time of year, the spatial extent of any impact represents a very slight change from baseline conditions. Cumulative direct disturbance is therefore predicted to represent effects which will lie within the limits of natural variation and evaluated as a **negligible** impact.

Indirect Impacts on Birds via Prey Species

336 There is potential for cumulative impacts from indirect disturbance on VORs dependent on intertidal and sub-tidal habitat if construction, operational and decommissioning activities between the Project and the Cockenzie Combined Gas Cycle Turbine overlap. Due to their

onshore locations, Goshen Farm and the Cockenzie pipeline do not affect these habitats and will therefore not contribute cumulatively to indirect disturbance impacts.

337 As outlined in *Section 15.7.2*, due to the nature of the construction activities involved for the Project in the near-shore and intertidal zone, sediment discharges are considered the potential key impact source. However, sediment plumes are predicted to be localised and temporary, with most plumes settling out up to a few hundred metres of the Export Cable, over a period of seconds or minutes. The finest sediment fractions will persist for longer in the water column and be carried further, but will generally not be transported beyond three kilometres from the Export Cable, and will settle out within a few hours of disturbance (see *Chapter 10*, *Section 10.6.1*).

338 The ES for the Cockenzie Combined Gas Cycle Turbine considered the key indirect impact to be displacement of fish with swim bladders due to piling noise during construction of the slipway (if built). Noise modelling carried out as part of the development's ES indicated that the avoidance area for fish populations would extend up to 490 m from the impact source (Scottish Power Generation Ltd., 2009).

339 It is therefore predicted that the extent of any such discharge or noise during construction would be localised and temporary. Birds would be able to feed elsewhere in nearby coastal waters and return quickly to the area once sediment plumes have settled or piling has ceased. It is predicted that any indirect impacts during the operational and decommissioning phases are at worst of a similar nature.

340 The assessment considered **all VORs** of all sensitivities in all seasons and cumulative indirect disturbance of bird communities through prey availability during construction, operation and decommissioning of negligible magnitude, as the combined effect of sediment discharges and piling activities are only likely to result in a very slight change from baseline conditions over relatively small areas. Cumulative indirect disturbance is therefore predicted to represent effects well within the limits of natural variation and is evaluated as a **negligible** impact.

15.9.3 Impact Interactions

341 The following potential impact sources associated with the Project were considered with regard to the likelihood of impact interactions occurring during construction, operation and decommissioning:

- Direct (seabed) habitat loss;
- Direct disturbance through vessel movements and construction activities in the Development Area as well as the Offshore Export Cable Corridor;
- Indirect disturbance of bird communities through changes in prey availability, as a result of piling events in particular but also habitat change, disturbance and SSC deposition;
- Displacement during the operational phase, as a result of the physical presence of the WTG array and associated structures;

- Collision risk from built-up structures in the Development Area, in particular operating WTGs; and
- Barrier effect of the WTG array during the operational phase.

Construction

342 As outlined in *Sections 15.6.1 and 15.7.2*, key impacts during the construction phase are direct disturbance through vessel movements and construction activities and indirect disturbance through changes in prey availability. It is considered that for those receptors particularly susceptible to direct disturbance any effect is likely to be limited to within 500 m from vessels or construction locations. Indirect impacts of piling activities (avoidance of areas) on sandeel populations are predicted to be highly localised (0.17 km^2), whereas such impacts on herring/sprat populations are predicted to be much more wide-ranging (2,473 km^2; *Chapter 13*, Table 13.22 and associated text).

343 Considering a worst case scenario – involving a bird species which is susceptible to both direct disturbance as well as indirect impacts through prey availability – impact interactions are not predicted to occur because the spatial extent of the indirect impacts on herring/sprat populations is much larger than any localised effects of direct disturbance of birds, effectively overriding the latter impact for these species during the construction phase.

344 Therefore, it is considered unlikely that during construction both impact sources could interact in a manner that would either exceed the significance levels of their individual effects or create a new, over-arching impact source.

Operation

345 Potential impacts during the operational phase are direct habitat loss, disturbance through vessel movements and maintenance activities, indirect disturbance through changes in prey availability, displacement, barrier effect and collision risk (*Sections 15.6.2 and 15.7.3*).

346 Of these impact sources, direct habitat loss and indirect disturbance are highly localised, occurring on the seabed and in close proximity to underwater structures only, whereas direct disturbance of birds is likely to be limited to within 500 m of vessels or maintenance activities. Therefore, based on spatial extent, any effect of displacement is likely to override both other impacts. In turn, displacement effects up to two kilometres from the Development Area (as a result of the presence of the WTG array) are likely to render disturbance effects inconsequential, as birds that have been displaced are very unlikely to be affected by localised disturbance events within the Development Area.

347 Displacement and barrier effects and collision risk are mutually exclusive: birds displaced from the wind farm or circumventing the wind farm cannot be at the same time at risk of collision of operational WTGs. The avoidance rates used for collision risk modelling take account of displacement by incorporating the effects of macro-avoidance (of the whole wind farm array) as well as micro-avoidance (of individual turbines).

348 Therefore it is considered unlikely that during operation any of these impact sources could interact in a manner that would either exceed the significance levels of their individual effects or create a new, over-arching impact source.

Decommissioning

349 Considerations regarding impact interactions discussed for the construction phase are predicted to be similar for the decommissioning phase. Therefore, it is considered unlikely that during decommissioning both impact sources could interact in a manner that would either exceed the significance levels of their individual effects or create a new, over-arching impact source.

Assessment of Significance

350 The potential for individual impacts identified through the impact assessment to interact and create new, or more significant impacts on all VORS (regardless of sensitivity) has been assessed. No such interactions have been identified.

Impact Interactions – Other Projects

351 The same potential impact sources associated with the Project as listed above were considered with regard to the likelihood of cumulative impact interactions occurring during construction, operation and decommissioning. Due to the likely spatial extent of each these impact sources only the Neart na Gaoithe, Firth of Forth Phase 1, Goshen Farm, Cockenzie pipeline and Cockenzie Combined Gas Cycle Turbine developments are considered in this assessment. All other onshore and offshore developments are considered to be sufficiently far removed from the Project elements, or to exhibit sufficiently small scale, localised effects that impact interactions are predicted to be unlikely.

Construction

352 As considered for the Inch Cape Offshore Wind Farm in isolation, effects from direct disturbance during construction are predicted to be confined to the respective development areas of all three Forth and Tay offshore wind farms as well as three onshore developments considered for the near-shore/intertidal zone, whereas indirect disturbance impacts from piling activities are likely to spatially overlap.

353 Considering a similar theoretical worst case scenario as above – involving a bird species which is susceptible to both direct disturbance as well as indirect impacts through prey availability –impact interactions are not predicted to occur because the cumulative spatial extent of the indirect impacts on herring/sprat populations is much larger than any localised effects of direct disturbance of birds, effectively overriding the latter impact for these species during the construction phase.

354 Therefore it is considered unlikely that during construction both impact sources could interact in a manner that would either exceed the significance levels of their individual effects or create a new, over-arching impact source.

Operation

355 As considered for the Project in isolation, effects from direct habitat loss, direct disturbance, and indirect disturbance effects during operation are predicted to be constrained to the respective development areas of all three Forth and Tay offshore wind farms. Therefore, as spatial overlap is lacking, no impact interactions are predicted for these impact sources.

356 Due to the mutually exclusive nature of displacement/barrier effects and collision risk, no impact interactions are predicted for these impact sources.

Decommissioning

357 Considerations regarding impact interactions discussed for the construction phase are predicted to be similar for the decommissioning phase. Therefore, it is considered unlikely that during decommissioning both impact sources could interact in a manner that would either exceed the significance levels of their individual effects or create a new, over-arching impact source.

Assessment of Significance

The potential for individual impacts identified through the impact assessment to interact with other projects and create new, or more significant impacts on all VORS (regardless of sensitivity) has been assessed. No such interactions have been identified.

15.10 Further Mitigation and Monitoring

15.10.1 Mitigation

358 The ornithology assessment has assessed worst case scenario impacts of the Project, in isolation and cumulatively, and has taken into account the Embedded Mitigation measures listed in *Section 15.3.1* and collated in *Appendix 7A: Draft Environmental Management Plan*. The assessment concluded that residual effects for the Project alone would be at most moderate and no additional mitigation is proposed.

359 The cumulative assessment for the Project with other developments predicted a major impact on the regional breeding kittiwake population through collision risk. Of the total kittiwake collision mortality predicted for all the offshore wind farms (541 birds) the proportion of Inch Cape Offshore Wind Farm alone is 3.3 per cent (18 birds). Consideration has been given to changing the Project parameters but due to the relatively small impact from the Project alone it is considered this would not make a material difference. Therefore no further mitigation is proposed for the Project.

15.10.2 Monitoring

360 It is anticipated that pre-, during and post-construction monitoring will provide valuable data regarding the predicted to actual effects of the Project on bird species. Throughout the duration of offshore wind farm lifecycle, ICOL will work with Marine Scotland, SNH/JNCC, TCE and FTOWDG to share bird data, to inform and further develop best practice measures.

15.11 Conclusions and Residual Impacts

15.11.1 Development Area and Offshore Export Cable Corridor to Near-shore

361 The assessment of impacts on bird species is summarised in Table 15.22 below and considers impacts from the Development Area and the Offshore Export Cable Corridor to near-shore. Both Project elements have been assessed individually but have effectively been merged in the summary table. Assessment of the near-shore/intertidal has been summarised separately due to its different nature (Table 15.23).

362 All Embedded Mitigation identified in *Section 15.3.1* has been included within the assessments above, and therefore in all cases the pre- and post-mitigation effects are the same and only the Post Mitigation Effects have been presented in Table 15.22 below

363 For the Project alone, the assessment has identified no significant impacts for any VOR (i.e. no moderate/major or major impacts were predicted).

364 The cumulative assessment for the Project with other projects predicted a major impact on the regional breeding kittiwake population through collision risk. No other significant impacts were predicted for any VOR.

Table 15.22: Summary of Impact Assessment for the Development Area and the Offshore Export Cable Corridor to Near-shore

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Taiga bean goose	Operation: Barrier impacts	Passage migration	Negligible	Negligible
	Operation: Collision risk impacts	Passage migration	Negligible	Negligible
Pink-footed goose	Operation: Barrier impacts	Passage migration	Negligible	Negligible
	Operation: Collision risk impacts	Passage migration	Negligible	Negligible
Svalbard barnacle goose	Operation: Barrier impacts	Passage migration	Negligible	Negligible
	Operation: Collision risk impacts	Passage migration	Negligible	Minor
Shelduck	Operation: Barrier impacts	Passage migration	Negligible	Negligible
	Operation: Collision risk impacts	Passage migration	Negligible	No data available

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Tufted duck	Operation: Barrier impacts	Passage migration	Negligible	Negligible
	Operation: Collision risk impacts	Passage migration	Negligible	No data available
Long-tailed duck	Operation: Barrier impacts	Passage migration	Negligible	Negligible
	Operation: Collision risk impacts	Passage migration	Negligible	No data available
Common scoter	Operation: Barrier impacts	Passage migration	Negligible	Negligible
	Operation: Collision risk impacts	Passage migration	Negligible	No data available
Goldeneye	Operation: Barrier impacts	Passage migration	Negligible	Negligible
	Operation: Collision risk impacts	Passage migration	Negligible	No data available
Fulmar	Construction: Direct disturbance	Breeding	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Fulmar	Construction: Direct disturbance	Non-breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Non-breeding	Negligible	Negligible
	Operation: Direct disturbance	All seasons	Negligible	Negligible
	Operation: Habitat loss	All seasons	Negligible	Negligible
	Operation: Displacement	Breeding	Negligible	Negligible
	Operation: Displacement	Non-breeding	Negligible	Negligible
	Operation: Indirect impacts on birds via prey species	All seasons	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Fulmar	Operation: Barrier impacts	All seasons	Negligible	Negligible
	Operation: Collision risk impacts	All seasons	N/A	N/A
Gannet	Construction: Direct disturbance	Breeding	Negligible	Negligible
	Construction: Direct disturbance	Non-breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Non-breeding	Negligible	Negligible
	Operation: Direct disturbance	All seasons	Negligible	Negligible
	Operation: Habitat loss	All seasons	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Gannet	Operation: Displacement	Breeding	Negligible	Negligible
	Operation: Displacement	Non-breeding	Negligible	Negligible
	Operation: Indirect impacts on birds via prey species	All seasons	Negligible	Negligible
	Operation: Barrier impacts	All seasons	Negligible	Negligible
	Operation: Collision risk impacts	Breeding	Minor	Minor
	Operation: Collision risk impacts	Non-breeding	Negligible	Minor
Shag	Construction: Direct disturbance	Breeding	Negligible	Negligible
	Construction: Direct disturbance	Non-breeding	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Shag	Construction: Indirect impacts on birds via prey species	Breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Non-breeding	Negligible	Negligible
	Operation: Direct disturbance	All seasons	Negligible	Negligible
	Operation: Habitat loss	All seasons	Negligible	Negligible
	Operation: Displacement	Breeding	Negligible	Negligible
	Operation: Displacement	Non-breeding	Negligible	Negligible
	Operation: Indirect impacts on birds via prey species	All seasons	Negligible	Negligible
	Operation: Barrier impacts	All seasons	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Shag	Operation: Collision risk impacts	All seasons	N/A	N/A
Oystercatcher	Operation: Barrier impacts	Passage migration	Negligible	Negligible
	Operation: Collision risk impacts	Passage migration	Negligible	Negligible
Golden plover	Operation: Barrier impacts	Passage migration	Negligible	Negligible
	Operation: Collision risk impacts	Passage migration	Negligible	Negligible
Ringed plover	Operation: Barrier impacts	Passage migration	Negligible	Negligible
	Operation: Collision risk impacts	Passage migration	Negligible	Negligible
Curlew	Operation: Barrier impacts	Passage migration	Negligible	Negligible
	Operation: Collision risk impacts	Passage migration	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Knot	Operation: Barrier impacts	Passage migration	Negligible	Negligible
	Operation: Collision risk impacts	Passage migration	Negligible	Negligible
Dunlin	Operation: Barrier impacts	Passage migration	Negligible	Negligible
	Operation: Collision risk impacts	Passage migration	Negligible	Negligible
Purple sandpiper	Operation: Barrier impacts	Passage migration	Negligible	Negligible
	Operation: Collision risk impacts	Passage migration	Negligible	No data available
Grey phalarope	Operation: Barrier impacts	Passage migration	Negligible	Negligible
	Operation: Collision risk impacts	Passage migration	Negligible	No data available
Arctic skua	Construction: Direct disturbance	Breeding	Species not present	N/A

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Arctic skua	Construction: Direct disturbance	Post-breeding/passage	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Breeding	Species not present	N/A
	Construction: Indirect impacts on birds via prey species	Post-breeding/passage	Negligible	Negligible
	Operation: Direct disturbance	All seasons	Negligible	Negligible
	Operation: Habitat loss	All seasons	Negligible	Negligible
	Operation: Displacement	Breeding	Species not present	N/A
	Operation: Displacement	Post-breeding/passage	Negligible	Negligible
	Operation: Indirect impacts on birds via prey species	All seasons	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Arctic skua	Operation: Barrier impacts	All seasons	Negligible	Negligible
	Operation: Collision risk impacts	Post-breeding/passage	Negligible	Negligible
Great skua	Construction: Direct disturbance	Breeding	Species not present	N/A
	Construction: Direct disturbance	Post-breeding/passage	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Breeding	Species not present	N/A
	Construction: Indirect impacts on birds via prey species	Post-breeding/passage	Negligible	Negligible
	Operation: Direct disturbance	All seasons	Negligible	Negligible
	Operation: Habitat loss	All seasons	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Great skua	Operation: Displacement	Breeding	Species not present	N/A
	Operation: Displacement	Post-breeding/passage	Negligible	Negligible
	Operation: Indirect impacts on birds via prey species	All seasons	Negligible	Negligible
	Operation: Barrier impacts	All seasons	Negligible	Negligible
	Operation: Collision risk impacts	Post-breeding/passage	Negligible	Negligible
Puffin	Construction: Direct disturbance	Breeding	Negligible	Negligible
	Construction: Direct disturbance	Post-breeding	Negligible	Negligible
	Construction: Direct disturbance	Non-breeding	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Puffin	Construction: Indirect impacts on birds via prey species	Breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Post-breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Non-breeding	Negligible	Negligible
	Operation: Direct disturbance	All seasons	Negligible	Negligible
	Operation: Habitat loss	All seasons	Negligible	Negligible
	Operation: Displacement	Breeding	Minor	Minor/Moderate
	Operation: Displacement	Post-breeding	Negligible	Negligible
	Operation: Displacement	Non-breeding	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Puffin	Operation: Indirect impacts on birds via prey species	All seasons	Negligible	Negligible
	Operation: Barrier impacts	All seasons	Negligible	Negligible
	Operation: Collision risk impacts	All seasons	N/A	N/A
Razorbill	Construction: Direct disturbance	Breeding	Negligible	Negligible
	Construction: Direct disturbance	Post-breeding	Negligible	Negligible
	Construction: Direct disturbance	Non-breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Breeding	Minor	Minor
	Construction: Indirect impacts on birds via prey species	Post-breeding	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Razorbill	Construction: Indirect impacts on birds via prey species	Non-breeding	Negligible	Negligible
	Operation: Direct disturbance	All seasons	Negligible	Negligible
	Operation: Habitat loss	All seasons	Negligible	Negligible
	Operation: Displacement	Breeding	Minor	Minor/Moderate
	Operation: Displacement	Post-breeding	Negligible	Negligible
	Operation: Displacement	Non-breeding	Negligible	Negligible
	Operation: Indirect impacts on birds via prey species	All seasons	Negligible	Negligible
	Operation: Barrier impacts	All seasons	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Razorbill	Operation: Collision risk impacts	All seasons	N/A	N/A
Guillemot	Construction: Direct disturbance	Breeding	Negligible	Negligible
	Construction: Direct disturbance	Post-breeding	Negligible	Negligible
	Construction: Direct disturbance	Non-breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Post-breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Non-breeding	Negligible	Negligible
	Operation: Direct disturbance	All seasons	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Guillemot	Operation: Habitat loss	All seasons	Negligible	Negligible
	Operation: Displacement	Breeding	Minor	Minor/Moderate
	Operation: Displacement	Post-breeding	Negligible	Negligible
	Operation: Displacement	Non-breeding	Negligible	Negligible
	Operation: Indirect impacts on birds via prey species	All seasons	Negligible	Negligible
	Operation: Barrier impacts	All seasons	Negligible	Negligible
	Operation: Collision risk impacts	All seasons	N/A	N/A
Common tern	Construction: Direct disturbance	Breeding	Negligible	Negligible
	Construction: Direct disturbance	Post-breeding	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Common tern	Construction: Direct disturbance	Non-breeding	Species not present	N/A
	Construction: Indirect impacts on birds via prey species	Breeding	Minor/Moderate	Moderate
	Construction: Indirect impacts on birds via prey species	Post-breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Non-breeding	Species not present	N/A
	Operation: Direct disturbance	All seasons	Negligible	Negligible
	Operation: Habitat loss	All seasons	Negligible	Negligible
	Operation: Displacement	Breeding	Negligible	Negligible
	Operation: Displacement	Post-breeding	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Common tern	Operation: Displacement	Non-breeding	Species not present	N/A
	Operation: Indirect impacts on birds via prey species	All seasons	Negligible	Negligible
	Operation: Barrier impacts	All seasons	Negligible	Negligible
	Operation: Collision risk impacts	All seasons	N/A	N/A
Arctic tern	Construction: Direct disturbance	Breeding	Negligible	Negligible
	Construction: Direct disturbance	Post-breeding	Negligible	Negligible
	Construction: Direct disturbance	Non-breeding	Negligible	N/A
	Construction: Indirect impacts on birds via prey species	Breeding	Minor/Moderate	Moderate
	Construction: Indirect impacts on birds via prey species	Post-breeding	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Arctic tern	Construction: Indirect impacts on birds via prey species	Non-breeding	Species not present	N/A
	Operation: Direct disturbance	All seasons	Negligible	Negligible
	Operation: Habitat loss	All seasons	Negligible	Negligible
	Operation: Displacement	Breeding	Negligible	Negligible
	Operation: Displacement	Post-breeding	Negligible	Negligible
	Operation: Displacement	Non-breeding	Species not present	N/A
	Operation: Indirect impacts on birds via prey species	All seasons	Negligible	Negligible
	Operation: Barrier impacts	All seasons	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Arctic tern	Operation: Collision risk impacts	All seasons	N/A	N/A
Kittiwake	Construction: Direct disturbance	Breeding	Negligible	Negligible
	Construction: Direct disturbance	Post-breeding	Negligible	Negligible
	Construction: Direct disturbance	Non-breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Breeding	Negligible	Minor
	Construction: Indirect impacts on birds via prey species	Post-breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Non-breeding	Negligible	Negligible
	Operation: Direct disturbance	All seasons	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Kittiwake	Operation: Habitat loss	All seasons	Negligible	Negligible
	Operation: Displacement	Breeding	Minor	Minor/Moderate
	Operation: Displacement	Post-breeding	Negligible	Negligible
	Operation: Displacement	Non-breeding	Negligible	Negligible
	Operation: Indirect impacts on birds via prey species	All seasons	Negligible	Negligible
	Operation: Barrier impacts	All seasons	Negligible	Negligible
	Operation: Collision risk impacts	Breeding	Minor	**Major**
	Operation: Collision risk impacts	Post-breeding	Negligible	No data available
	Operation: Collision risk impacts	Non-breeding	Negligible	Minor

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Little gull	Construction: Direct disturbance	Breeding	Species not present	N/A
	Construction: Direct disturbance	Non-breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Breeding	Species not present	N/A
	Construction: Indirect impacts on birds via prey species	Non-breeding	Negligible	Negligible
	Operation: Direct disturbance	All seasons	Negligible	Negligible
	Operation: Habitat loss	All seasons	Negligible	Negligible
	Operation: Displacement	Breeding	Species not present	N/A
	Operation: Displacement	Non-breeding	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Little gull	Operation: Indirect impacts on birds via prey species	All seasons	Negligible	Negligible
	Operation: Barrier impacts	All seasons	Negligible	Negligible
	Operation: Collision risk impacts	Breeding	Species not present	N/A
	Operation: Collision risk impacts	Non-breeding	N/A	N/A
Common gull	Construction: Direct disturbance	Breeding	Negligible	Negligible
	Construction: Direct disturbance	Non-breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Non-breeding	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Common gull	Operation: Direct disturbance	All seasons	Negligible	Negligible
	Operation: Habitat loss	All seasons	Negligible	Negligible
	Operation: Displacement	Breeding	Negligible	Negligible
	Operation: Displacement	Non-breeding	Negligible	Negligible
	Operation: Indirect impacts on birds via prey species	All seasons	Negligible	Negligible
	Operation: Barrier impacts	All seasons	Negligible	Negligible
	Operation: Collision risk impacts	Breeding	N/A	N/A
	Operation: Collision risk impacts	Non-breeding	N/A	N/A
Lesser black-backed gull	Construction: Direct disturbance	Breeding	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Lesser black-backed gull	Construction: Direct disturbance	Non-breeding	Negligible	N/A
	Construction: Indirect impacts on birds via prey species	Breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Non-breeding	Species not present	N/A
	Operation: Direct disturbance	All seasons	Negligible	Negligible
	Operation: Habitat loss	All seasons	Negligible	Negligible
	Operation: Displacement	Breeding	Negligible	Negligible
	Operation: Displacement	Non-breeding	Species not present	N/A
	Operation: Indirect impacts on birds via prey species	All seasons	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Lesser black-backed gull	Operation: Barrier impacts	All seasons	Negligible	Negligible
	Operation: Collision risk impacts	Breeding	N/A	N/A
	Operation: Collision risk impacts	Non-breeding	Species not present	N/A
Herring gull	Construction: Direct disturbance	Breeding	Negligible	Negligible
	Construction: Direct disturbance	Non-breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Non-breeding	Negligible	Negligible
	Operation: Direct disturbance	All seasons	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Herring gull	Operation: Habitat loss	All seasons	Negligible	Negligible
	Operation: Displacement	Breeding	Negligible	Negligible
	Operation: Displacement	Non-breeding	Negligible	Negligible
	Operation: Indirect impacts on birds via prey species	All seasons	Negligible	Negligible
	Operation: Barrier impacts	All seasons	Negligible	Negligible
	Operation: Collision risk impacts	Breeding	N/A	N/A
	Operation: Collision risk impacts	Non-breeding	Negligible	Minor
Great black-backed gull	Construction: Direct disturbance	Breeding	Negligible	Negligible
	Construction: Direct disturbance	Non-breeding	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Great black-backed gull	Construction: Indirect impacts on birds via prey species	Breeding	Negligible	Negligible
	Construction: Indirect impacts on birds via prey species	Non-breeding	Negligible	Negligible
	Operation: Direct disturbance	All seasons	Negligible	Negligible
	Operation: Habitat loss	All seasons	Negligible	Negligible
	Operation: Displacement	Breeding	Negligible	Negligible
	Operation: Displacement	Non-breeding	Negligible	Negligible
	Operation: Indirect impacts on birds via prey species	Breeding	Negligible	Negligible
	Operation: Barrier impacts	All seasons	Negligible	Negligible

Species	Impact	Season	Residual Impact (Project Alone)	Residual Impact (Cumulative)[1]
Great black-backed gull	Operation: Collision risk impacts	Breeding	N/A	N/A
	Operation: Collision risk impacts	Non-breeding	Negligible	Minor
[1] 'N/A' indicates that information was not available from other developments for a cumulative assessment				

15.11.2 Offshore Export Cable Corridor- Near-shore to MHWS (including Intertidal)

365 A summary of the impact assessment for this part of the Offshore Export Cable is included in Table 15.23, below. No significant residual impacts are predicted.

366 All Embedded Mitigation identified in *Section 15.3.1* has been included within the assessments above, and therefore in all cases the pre- and post-mitigation effects are the same and only the Post Mitigation Effects have been presented in Table 15.23 below.

Table 15.23: Summary of Impact Assessment for Offshore Export Cable Corridor – Near-shore to MHWS (including Intertidal)

Species	Impact	Season	Residual Impact (The Project Alone)	Residual Impact (Cumulative)
All ornithological receptors	Direct habitat loss during construction	All	Negligible	Negligible
All ornithological receptors	Direct disturbance during all phases	All	Negligible	Negligible
All ornithological receptors	Indirect impacts on birds via prey during all phases	All	Negligible	Negligible

15.12 Habitats Regulations Appraisal

15.12.1 Introduction

367 The following section uses the impact assessment results above and examines whether the Project, in isolation, or in-combination with other plans and projects, has any adverse effect on site integrity of any Special Protection Areas (SPAs).

368 The process through which this examination has to proceed must accord with a set sequence, commonly known as a Habitats Regulations Appraisal (HRA). This involves a defined set of evidence-based, reasoned judgments to determine whether or not all an SPA's qualifying species will be successfully protected if the development proceeds. SPA's form part of a wider international network to protect the most important wildlife sites across member states of the Europe Union. Given these sites' importance, the legislation, associated regulations and case law which frame the HRA process are therefore necessarily thorough. This is not to say that a development cannot proceed near, adjacent, or even within an SPA. A development cannot be consented, however, if it cannot be shown that there will be no adverse effect on the integrity of the SPA in view of its conservation objectives. Unless there are no alternative solutions and there are imperative reasons of overriding public interest and necessary compensatory measures are taken to ensure that the overall coherence of the Natura 2000 network is protected.

369 As much of the information on which the HRA depends has already been provided, to avoid unnecessary repetition, this HRA section either refers back to the relevant sections in this chapter and accompanying appendices and annexes, or highlights the specific evidence related to the conservation objectives of the SPAs.

370 The key preparatory step for the HRA has already been undertaken, in accordance with consultation guidance and planning requirements. In the lead up to the production of this chapter, an HRA Screening Report was submitted for comment on 29 August 2012 to Marine Scotland (and through them to Scottish Natural Heritage (SNH)). The resulting consultation responses to this Screening Report (received on 2 November 2012) have been taken into account throughout this chapter (please refer to Table 15.1 for the response details). The Screening Report itself contains noteworthy detail on the HRA process and important background ornithology information (see *Appendix 15B*, *Annex 15B.1*).

15.12.2 The Requirement for the HRA and the Stages Involved in the HRA Process

371 As detailed in the Screening Report the HRA is required where a development is likely to have a significant effect (LSE) on an SPA and it is not directly connected with or necessary to the management of the site.

372 The steps required for an HRA are set out in Article 6 of the *Habitats Directive* (92/43/EEC). In Scotland, this process is implemented through the *Habitats Regulations*. These regulations apply to sites within Scottish Territorial Waters. The HRA is a three-stage process:

373 **Stage One:** Is the proposal directly connected with or necessary to the management of the site for nature conservation? In the case of this application for consent of the offshore wind farm and its grid connection, it is not. Therefore Stage Two must be followed.

374 **Stage Two:** Is the proposal likely to have a significant effect, alone or in-combination with other plans or projects, on a SPA? This test acts as a screening stage to remove proposals that do not need further consideration under Stage Three. If it is obvious that there are no effects on the qualifying interests of a European site despite a connection between the proposal and the European site, then the conclusion is one of no Likely Significant Effect (LSE). This step takes account of any mitigation measures implemented in the proposals. If there is a LSE on a SPA, then an Appropriate Assessment is required (Stage Three).

375 **Stage Three:** Can it be ascertained beyond reasonable scientific doubt and in light of the best scientific knowledge in the field that the proposal, including any necessary mitigation measures, will not adversely affect the integrity of the SPA? Scottish Office (1995) Circular 6/1995 defined the integrity of a site as 'the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitats and/or, the levels of the populations of the species for which it was classified'. This definition has been subsequently reinforced by European Commission guidance (European Commission, 2000).

376 The competent authority, in this case Marine Scotland (on behalf of Scottish Ministers), carries out the Appropriate Assessment. Consideration of the conservation objectives is required in determining effects on site integrity and an Appropriate Assessment must be carried out in view of these. Conclusions must be made on the basis of there being no reasonable scientific doubt as to the absence of adverse effects.

377 After consideration of the three stages in the HRA, if it cannot be ascertained beyond reasonable scientific doubt that the proposal will not adversely affect the integrity of a SPA, the proposal can only proceed if:

- there are no alternative solutions;
- there are imperative reasons of over-riding public interest for doing so; and
- any necessary compensatory measures are taken to secure the coherence of the Natura 2000 site network which is an EU-wide network of nature protection areas established under the 1992 *Habitats Directive*, the aim of which is to ensure the long term survival of Europe's most valuable and threatened species and habitats.

15.12.3 The SPA Conservation Objectives

378 An appropriate assessment requires consideration of the potential impacts of a development in relation to the SPA conservation objectives, which are defined by SNH. In order to assess whether there will be an adverse effect on site integrity, consideration needs to be given to whether the Project is likely to compromise the achievement of the conservation objectives. The conservation objectives are:

1. Avoid deterioration of the habitats of the qualifying species;

2. Avoid significant disturbance to the qualifying species;

379 Ensure for the qualifying species that the following are maintained in the long term:

3. Population of the bird species as a viable component of the SPA;
4. Distribution of the bird species within the SPA;
5. Distribution and extent of habitats supporting the species;
6. Structure, function and supporting processes of habitats supporting the species;
7. No significant disturbance of the species.

380 The objectives primarily give site-based protection, i.e. protection to those qualifying features that use the area within the SPA boundary. Specifically, **objective 1** relates to the habitats within the SPA supporting the qualifying species, and objectives **2, 4, 5, 6** and **7** also refer to the SPA itself, albeit in the long term.

381 Objective **3** refers to the population of the SPA's qualifying species, but necessarily the viability of this population depends on the habitats used by these SPA birds in and out of the SPA. Therefore, to assess the Project's effect on this particular objective, it is necessary to determine whether or not it causes a significant reduction in population viability, either alone or in-combination. The determinants of this impact would either be added mortality or significantly reduced breeding success, both potentially resulting from either:

- direct disturbance;
- direct habitat loss;
- indirect disturbance of bird communities via prey species;
- displacement;
- barrier effects; or
- from collision mortality.

382 As qualifying interests differ in seasonal occurrence and their susceptibility to these potential impacts, for each SPA, information is provided on which impact source or sources are considered in the assessment.

<u>Consideration of Conservative Assumptions for HRA</u>

383 In determining impact significance, the assessment incorporates a series of conservative assumptions about the Design Envelope (see Tables 15.2 and 15.3) as well as the potential magnitude of impacts of the Project on ornithological receptors. Where possible, the likelihood of an adverse effect is assigned based on scientific research and available information on the population status. Where this empirical evidence has not been available, the ecology of the species has been considered and appropriate conservative assumptions made. *Section 15.4.6* provides an overview of these conservative assumptions and why they are considered to be appropriately conservative. It is considered that as a consequence of these assumptions, confidence that 'likely' impacts (definition for the likelihood of a defined

outcome having occurred or occurring in the future, as defined by the IPCC**)** are within the ranges predicted by the models used is 'high' or 'very high' (quantitatively calibrated levels of confidence used in this assessment as defined by the IPCC) for the assessment undertaken to inform the HRA.

15.12.4 Layout of the Information Provided

384 As screening identified SPAs that had either been designated for their breeding season or predominantly non-breeding season qualifying interests, the structure of the remainder of *Section 15.12* is therefore as follows:

- *Section 15.12.5* presents the SPAs that screening identified as having the potential for a LSE to occur, and it lists the species considered to have the potential to contribute to this LSE;
- *Section 15.12.6* provides information to inform the HRA for the three SPAs designated for their non-breeding season interests, as well as migratory species in general. The SPAs it covers are the Slamannan Plateau SPA, Upper Solway Flats and Marshes SPA, and the Firth of Forth SPA, and it deals with the Project alone, and in-combination with other relevant plans and projects;
- *Section 15.12.7* provides information to inform the HRA for the four SPAs designated for their qualifying interests in the breeding season for which LSE was identified. As the assessment of potential effects for these sites is more complex, and required additional analysis, this section first provides information relevant to all four SPAs and considers the Project alone;
- *Section 15.12.8* provides in-combination information to inform the HRA for the same four SPAs designated for their qualifying interests in the breeding season. This section first provides information relevant to all four SPAs and then considers in-combination effects from the Project and other relevant plans and projects on these SPAs. Finally, it pulls together the summary of the HRA outcome for the Project alone and in-combination for each SPA; and
- *Section 15.12.9* then provides the conclusions of the information to inform the HRA for all seven of the SPAs for which LSE was identified for the Project alone as well as in-combination with other plans and projects.

385 Figures 15.4 to 15.16 relate specifically to the HRA of this chapter and are provided before the references section.

15.12.5 The SPAs Identified for Appropriate Assessment and their Qualifying Species

<u>The SPAs Identified for LSE</u>

386 The HRA Screening Report (see *Appendix 15B*, *Annex 15B.1*) considered potential connectivity between the Project and SPAs. Seven sites in total were identified to have the

potential for LSE and therefore require an Appropriate Assessment. These SPAs have been agreed with SNH (Pers. comm., 2012).

387 Of the seven SPAs where LSE was identified, two (the Slamannan Plateau, and the Upper Solway Flats and Marshes) were designated solely for their over-wintering qualifying interests. The third, (the Firth of Forth) is designated for its over-wintering bird species and Sandwich tern on passage. The remaining four were designated due to their qualifying interests in the breeding season (Forth Islands, Fowlsheugh, St Abb's Head to Fast Castle, and Buchan Ness to Collieston Coast).

The SPA Qualifying Species Identified as Having Potential to Contribute to LSE

388 As well as identifying these SPAs, SNH highlighted the qualifying species they wanted considered for the HRA. This is because not all qualifying species, in their view, were likely to be at risk of any impacts from the Project, and therefore would not contribute to the LSE for the particular SPA in question. The general reasoning behind this advice was that there was sufficient separation of the main locations of these species from potentially harmful elements of the Project that any risk of adverse effects was avoided.

389 Note that in relation to the assessment of a LSE for the Forth Islands SPA, breeding Sandwich tern was identified in the HRA Screening Report as contributing to a conclusion of LSE, but was subsequently screened out based on advice from SNH. It is recognised that the Sandwich tern passage population for the Firth of Forth SPA largely originates from the breeding population at the Farne Islands SPA. However, the latter site was screened out on the basis of no connectivity during the breeding season (see *Appendix 15B*, *Annex 15B.1*).

390 Conversely herring gull was not initially identified as contributing to a LSE for Buchan Ness to Collieston Coast in the HRA screening report but SNH advised that this species should be assessed for its contribution to an adverse effect on site integrity in the HRA of the Buchan Ness to Collieston Coast SPA.

391 In agreement with SNH and Marine Scotland, the following qualifying interests of SPAs were not considered to contribute to LSE:

- Forth Islands SPA: cormorant, roseate tern, Sandwich tern and shag;
- Buchan Ness to Collieston Coast SPA: shag; and
- St Abb's Head to Fast Castle SPA: shag.

392 The SPAs, and their qualifying species screened as potentially contributing to a LSE, are summarised in Table 15.24 and shown in Figure 15.2. Further background is provided in the HRA Screening Report, (*Appendix 15B*, *Annex 15B.1*), and the SNH response to the Screening Report. For reference purposes, a full list of qualifying species for each SPA is included in *Appendix 15B, Annex 15B.1*.

Table 15.24: SPAs for which a LSE has been Identified

SPA for which LSE has been Identified (distance to Development Area in km)	Qualifying Species Potentially Contributing to the LSE from the Project
SPAs designated for qualifying interests in the non-breeding season	
Slamannan Plateau (113 km)	Taiga bean goose
Upper Solway Flats and Marshes (168.6 km)	Svalbard barnacle goose
SPAs designated mainly for qualifying interests in the non-breeding season	
Firth of Forth (27.1 km)	Pink-footed goose
	Shelduck
	Wigeon
	Mallard
	Scaup
	Eider
	Long-tailed duck
	Common scoter
	Velvet scoter
	Goldeneye
	Red-breasted merganser
	Red-throated diver
	Cormorant
	Great crested grebe
	Slavonian grebe
	Oystercatcher
	Golden plover
	Grey plover
	Lapwing
	Ringed plover
	Curlew

SPA for which LSE has been Identified (distance to Development Area in km)	Qualifying Species Potentially Contributing to the LSE from the Project
	Bar-tailed godwit
	Turnstone
	Knot
	Dunlin
	Redshank
	Sandwich tern
SPAs designated for qualifying interests in the breeding season	
Forth Islands (29 km - 86 km)	Fulmar*
	Gannet
	Kittiwake*
	Herring gull
	Lesser black-backed gull
	Common tern
	Arctic tern
	Guillemot*
	Razorbill*
	Puffin
Fowlsheugh (33 km)	Fulmar*
	Kittiwake
	Herring gull*
	Guillemot
	Razorbill*
St Abb's Head to Fast Castle (53 km)	Kittiwake*
	Herring gull*
	Guillemot*
	Razorbill*

SPA for which LSE has been Identified (distance to Development Area in km)	Qualifying Species Potentially Contributing to the LSE from the Project
Buchan Ness to Collieston Coast (82 km)	Fulmar*
	Kittiwake*
	Herring gull
	Guillemot*
* Identifies species which are listed components of the seabird assemblage as per Article 4.2 of the Birds Directive (2009/147/EC). Assemblage species are afforded the same level of protection as species that qualify individually for SPA protection (as per Article 4.1 of the *Birds Directive).*	

15.12.6 Information to Inform the HRA for the Three SPAs designated for their Qualifying Species in the Non-breeding Season (Project Alone and In-Combination)

<u>The SPAs designated for their Qualifying Species in the Non-breeding Season and Qualifying Species Covered by the Assessment</u>

393 Through the screening process, potential connectivity with the Project has been identified for two SPAs with non-breeding (i.e. over-wintering) qualifying interests – the Slamannan Plateau SPA, for which Taiga bean goose is the only qualifying species, and the Upper Solway Flats and Marshes SPA. The Upper Solway Flats and Marshes SPA is classified for several species of over-wintering waders, ducks, geese and swans (JNCC, 2013) but in relation to LSE, only one species, Svalbard barnacle goose, requires assessment in the Appropriate Assessment. Consequently this HRA only provides the information required for the Appropriate Assessment to consider impacts to the designated Svalbard barnacle goose population.

394 The potential impacts on the qualifying interests associated with the Slamannan Plateau SPA and Upper Solway Flats and Marshes SPA could arise from barrier effects during migration or collision during the operational period.

395 In addition to these two SPAs, there is clear connectivity with the Firth of Forth SPA as the Offshore Export Cable Corridor crosses, or passes close to, the site (depending on which of the two potential landfall options are used, see Figure 15.2). The effects of both landfall options on the SPA's integrity are therefore considered.

396 Finally, an assessment is made for migratory species overall, in order to determine the effects on any other SPA for which there is potential connectivity from these migrants.

Will the Project Alone or In-combination with Other Plans or Projects Cause an Adverse Effect on the Integrity of the Slamannan Plateau SPA?

397 The information to inform the HRA for this SPA is set out in Table 15.25 below.

Table 15.25: Summary of HRA outcome for the Slamannan Plateau SPA

Conservation Objective for Qualifying Species	Summary of HRA findings - Slamannan Plateau SPA	Section(s) Where Evidence is Presented
1. Avoid deterioration of habitats of the qualifying species	The Project is a minimum of 113 km from the SPA (see Table 15.24, Figure 15.2) and will not cause any direct or indirect deterioration of Taiga bean goose habitat, during construction, operation or decommissioning. This applies for the Project alone or in-combination with other plans or projects (considered to consist of: Firth of Forth Phase 1 Phase, and Neart na Gaoithe Offshore Wind Farm, see *Section 15.9.1*).	No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.
2. Avoid significant disturbance to the qualifying species	Due to the distance to the SPA, the Project will not cause any disturbance to the Taiga bean goose, during construction, operation or decommissioning. This applies for the Project alone or in-combination with other plans or projects.	No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.
3. The population of qualifying species as a viable component of the site is maintained in the long-term	The Project is not predicted to cause any impacts on the SPA's qualifying interest - Taiga bean goose - from barrier effects. The rationale behind this is that the geese only make two journeys a year (from their Scandanavian breeding grounds to Scotland and back). Therefore assuming they had to fly round the Wind Farm, the amount of additional travelling distance required (and energy expended) would be negligible (e.g. Masden *et al.,* 2010; Speakman *et al.,* 2009; Pettersson, 2005). In addition, recent evidence from six satellite tagged geese from the SPA population suggests that their spring migration route at least does not cross the Project area (Development Area specifically) as they appear to move northeast or southeast from Slamamnan to the Aberdeenshire or Borders coast respectively, before crossing the North Sea. This would seem to indicate their spring migration routes do not involve flight paths in proximity to the Development Area, and therefore no barrier could occur (http://scotlandsbeangeese.wikispaces.com/migration). The risk and consequences of any barrier effects therefore are evidently inconsequential and have no impact on population viability. Modelling of collision risk from the Project, based on highly precautionary assumptions	*Section 15.6.2* Barrier Effects for the Project alone. *Section 15.8.2* Barrier Effects for the Project cumulatively. *Section 15.6.2 Collision Risk* for the Project alone, Table 15.15. *Section 15.8.2* Collision Risk for the Project cumulatively, Table 15.20.

Conservation Objective for Qualifying Species	Summary of HRA findings - Slamannan Plateau SPA	Section(s) Where Evidence is Presented
3. The population of qualifying species as a viable component of the site is maintained in the long-term	(including worst case WTG layout, and 75% of those geese which fly through the Wind Farm do so at collision risk height) predicts <1 additional Taiga bean goose fatalities a year, using a 99% avoidance rate (Table 15.15). This would generate a <0.1% increase in adult mortality. This is considered negligible and would not affect the population viability of the SPA's qualifying interest, particularly taking into account their increasing population trend at Slamannan (Mitchell, 2010). In order to assess 'in-combination' effects, estimates of collision mortality for Taiga bean goose during migration are available from two other offshore wind farm developments (Firth of Forth Phase 1 Phase and Neart na Gaoithe Offshore Wind Farm, see Table 15.20). In-combination with Inch Cape Offshore Wind Farm, these amount to a predicted <1 collisions annually at an avoidance rate of 99%, and a predicted increase in adult annual mortality of 0.1% (Table 15.20). Given that SNH have recently up-dated their advocated avoidance rate for geese to 99.8% (SNH, 2013), the in-combination collision mortality for Taiga bean goose is not considered to represent a significant adverse impact on the long-term population viability of the SPA's qualifying interest.	
4. The distribution of the qualifying species within the SPA is maintained in the long-term	Due to the distance to the SPA, the Project will not cause any direct or indirect impact on Taiga bean goose distribution within the SPA, during construction, operation or decommissioning. This applies for the Project alone or in-combination with other plans or projects.	No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.
5. The distribution and extent of habitat supporting the qualifying species is maintained in the long-term	As outlined under conservation objective 4, the Project will have no impact on the distribution or extent of supporting habitat in the long-term. This applies for the Project alone or in-combination with other plans or projects.	No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.
6. The structure, function and supporting processes of habitats supporting the qualifying species is maintained in the long-term	Due to the distance to the SPA (as outlined under conservation objective 1), the Project will not cause any impacts on the structure, function and supporting processes over the long-term to qualifying species' habitat within the SPA, during construction, operation or decommissioning. This applies for the Project alone or in-combination with other plans or projects.	No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.

Conservation Objective for Qualifying Species	Summary of HRA findings - Slamannan Plateau SPA	Section(s) Where Evidence is Presented
7. No significant disturbance of the species in the long-term	As outlined under conservation objective 2, the distance between the SPA and the Project is such that the Project will not cause any disturbance to Taiga bean goose qualifying interest in the long term, i.e. during construction, operation or decommissioning. This applies for the Project alone or in-combination with other plans or projects.	See conservation objective 2 (above).

Conclusion Regarding Site Integrity of the Slamannan Plateau SPA

398 Having considered the conservation objectives of the Slamannan Plateau SPA in relation to the Project's predicted impacts (Table 15.25), it is possible to conclude beyond reasonable scientific doubt that there will be no adverse effect on site integrity, either alone or in combination with other plans and projects.

Will the Project Alone or In-combination with Other Plans or Projects Cause an Adverse Effect on the Integrity of the Upper Solway Flats and Marshes SPA?

399 The information to inform the HRA for this SPA is set out in Table 15.26.

Table 15.26: Summary of HRA outcome for the Upper Solway Flats and Marshes SPA

Conservation Objective for Qualifying Species	Summary of HRA findings - Upper Solway Flats and Marshes SPA	Section(s) Above Where Evidence is Presented
1. Avoid deterioration of habitats of the qualifying species.	The Project is a minimum of 168.6 km from the SPA (see Figure 15.2) and will not cause any direct or indirect deterioration of Svalbard barnacle goose habitat, during construction, operation or decommissioning. This applies for the Project alone or in-combination with other plans or projects (considered to consist of: Moray Firth R3 Zone 1 Eastern Development Area (EDA); Beatrice Offshore Wind Farm, Firth of Forth Phase 1, and Neart na Gaoithe Offshore Wind Farm, see Table 15.20).	No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.
2. Avoid significant disturbance to the qualifying species.	Due to the distance to the SPA, the Project will not cause any disturbance to the Svalbard barnacle goose qualifying interest during construction, operation or decommissioning. This applies for the Project alone or in- combination with other plans or projects.	No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.
3. The population of qualifying species as a viable component of the site is maintained in the long-term.	The Project is not predicted to cause any impacts on the SPA's barnacle geese from barrier effects. For the same reasons that apply to Taiga bean goose (Table 15.25), for the twice yearly migration to and from Svalbard, the risk and consequences of any barrier effects on Svalbard barnacle goose are considered inconsequential and have no impact on population viability. Modelling of collision risk from the Project alone, based on highly precautionary assumptions (including worst case WTG layout), the estimated annual collision mortality of Svalbard barnacle geese is seven birds at the highly precautionary 99% avoidance (see *Appendix 15A*, *Table 15A.38*), representing an increase of up to 0.4% in the adult mortality of the SPA population. Given the increasing population trend of this species (see Table 15.15) the Project alone is not considered to represent an adverse impact on	*Section 15.6.2* Barrier Effects for the Project alone. *Section 15.8.2* Barrier Effects for the Project cumulatively. *Section 15.6.2* Collision Risk for the Project alone, Table 15.15. *Section 15.8.2* Collision Risk for the Project cumulatively, Table 15.20.

Conservation Objective for Qualifying Species	Summary of HRA findings - Upper Solway Flats and Marshes SPA	Section(s) Above Where Evidence is Presented
3. The population of qualifying species as a viable component of the site is maintained in the long-term.	the viability of the SPA population. For in-combination impacts, predicted mortality for Svalbard barnacle goose during spring and autumn migration are available from four other offshore wind farm developments (Moray Firth R3 Zone 1 (EDA); Beatrice Offshore Wind Farm, Firth of Forth Phase 1, and Neart na Gaoithe Offshore Wind Farm, see Table 15.20). Including Inch Cape Offshore Wind Farm, the total number of predicted collisions (corrected to account for differences in calculation methods) is 30 per year (based on the highly precautionary 99% avoidance rate), representing an increase in annual adult mortality of 1.88%. Given the secure status of the population - showing sustained growth since 2005 – and the recently up-dated recommended avoidance rate for geese of 99.8% (SNH, 2013) - it is considered that the predicted in-combination mortality would not lead to a significant impact on the viability of the SPA population of qualifying interest in the long term.	
4. The distribution of the qualifying species within the SPA is maintained in the long-term.	Due to the distance to the SPA (see conservation objective 1), the Project will not cause any long-term direct or indirect impact on the distribution of the qualifying interest within the SPA, during construction, operation or decommissioning. This applies for the Project alone or in-combination with other plans or projects.	No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.
5. The distribution and extent of habitat supporting the qualifying species is maintained in the long-term.	As outlined under conservation objective 4, the Project will have no impact on the distribution or extent of supporting habitat in the long-term. This applies for the Project alone or in-combination with other plans or projects.	No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.
6. The structure, function and supporting processes of habitats supporting the qualifying species is maintained in the long-term.	Due to the distance to the SPA (as outlined under conservation objective 1), the Project will not cause any impacts on the structure, function and supporting processes over the long-term to qualifying species' habitat within the SPA, during construction, operation or decommissioning. This applies for the Project alone or in-combination with other plans or projects.	No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.

Conservation Objective for Qualifying Species	Summary of HRA findings - Upper Solway Flats and Marshes SPA	Section(s) Above Where Evidence is Presented
7. No significant disturbance of the species in the long term.	As outlined under conservation objective 2, the distance between the SPA and the Project is such that the Project will not cause any significant, long term disturbance to the Svalbard barnacle goose qualifying interest during construction, operation or decommissioning. This applies for the Project alone or in-combination with other plans or projects.	See conservation objective 2 (above).

Conclusion Regarding Site Integrity of the Upper Solway Flats and Marshes SPA

400 Having considered the conservation objectives of the Upper Solway Flats and Marshes SPA in relation to the Project's predicted impacts (Table 15.26), it is possible to conclude beyond reasonable scientific doubt that there will be no adverse effect on the site integrity, either alone or in-combination with other plans and projects.

Will the Project Alone or In-combination with Other Plans or Projects Cause an Adverse Effect on the Integrity of the Firth of Forth SPA?

401 Consideration is given to all the Project's elements, although the Export Cable landfall options at Cockenzie and Seton Sands are particularly relevant, given their respective proximity and overlap with the site (Figure 15.2). The onshore Export Cable, substation and grid connection (i.e. the Onshore Transmission Works (OnTW)), are considered as well (although this will be subject to a separate consent application to East Lothian Council, see *Section 7.15*).

402 The potential impacts on the qualifying interests associated with the Firth of Forth SPA could arise from direct disturbance during all phases of the Project, direct habitat loss during the construction phase, and indirect disturbance of bird communities via prey species during the construction, operational and decommissioning phases.

Qualifying Interests of the SPA Contributing to the Appropriate Assessment

403 The Firth of Forth SPA is designated for its wintering bird species which include waders, wildfowl, seaducks and grebes, as well as Sandwich tern on passage.

404 Table 15.27 presents the Firth of Forth SPA qualifying interests that have been recorded within the intertidal and near shore survey sectors that overlap with the two Export Cable landfall options (Figure 15.1 and Figure 15C.1). Full details of population counts per sector are provided in *Appendix 15C*.

405 Species scoped in for consideration were those recorded in the Cable Landfall Study Area with the potential to be affected directly or indirectly by the Project. A range of factors were taken into account for this scoping, including the species' sensitivity (Table 15.5), frequency of occurrence, and the importance of the number of birds present. Although not used as a selection criteria in itself, consideration was also given to the birds' abundance within the Cable Landfall Study Area, as a percentage of the SPA population, to help identify the localities' overall context for Firth of Forth SPA populations. Thus, consideration was given to:

- recorded peak counts of at least one per cent of their current SPA population within the Cable Landfall Study Area (survey sectors A, B or E), indicating that a sizeable proportion of the SPA population makes use of this section of the SPA for at least some of the time;
- recorded peak counts fall below one per cent of their current SPA population within the Cable Landfall Study Area (survey sectors A, B or E) but were recorded in considerably

higher peak numbers during WeBS core counts in the wider survey sectors (this helps to consider intermittent and unpredictable movements, e.g. interannual fluctuations); and

- recorded peak counts fall below one per cent of their current SPA population within the Cable Landfall Study Area (survey sectors A, B or E) but the Firth of Forth SPA population is in unfavourable condition, and/or an associated WeBS Alert.

406 Table 15.27 shows the 14 Firth of Forth SPA qualifying interests where a LSE could not be discounted (shaded grey). For each qualifying species, WeBS core counts within the wider survey sectors corresponded well with results of the Cable Landfall Study Area surveys, with the Seton Sands Export Cable landfall options and surrounding area generally holding higher peak numbers than Cockenzie survey sectors in both studies, and similar relative abundances between species. Although comparative WeBS five year peak counts generally exceed one per cent of each qualifying interest's population, it should be noted that these survey sectors cover a much wider area than the cable landfall options, and are therefore more likely to hold more individuals without necessarily being of particular importance within an SPA context. The Cable Landfall Study Area surveys produced counts that were broadly in line with the abundance and species presence shown by the WeBS counts and it was therefore concluded that no additional species should be included in the Appropriate Assessment. Consequently, it can be confidently predicted for these qualifying interests that impacts from the Project would not contribute to a LSE on site integrity. One species, grey plover, had a peak count of <1 per cent of the SPA population, but was included in the assessment based on the species' declining SPA population and an associated WeBS alert.

407 Having thus established the qualifying interests which require further information for the Appropriate Assessment in Table 15.27, the information to inform the HRA for the Firth of Forth SPA is subsequently set out in Table 15.28.

Table 15.27: Population Trend and Site Condition of Firth of Forth SPA Qualifying Interests

Qualifying Bird Species	Peak Population Estimate (as a percentage of current SPA pop. within sector)	5-Year Peak WeBS Population Estimate (as a percentage of current SPA pop. within sector)	SPA Population at Classification (from SPA citation)	Most Recent SPA Population Estimate[1]	SPA Site Condition[2]	WeBS Alert[3]	Further Information Provided for the Appropriate Assessment?
Pink-footed goose	0.0%	0.0%	10,852	5,141	FM	Not evaluated	NO
Shelduck	0.0%	0.1% (Port Seton-Craigielaw)	4,509	934	FD	-	NO
Wigeon	2.9% (E)	4.8% (Port Seton-Craigielaw)	2,139	1,502	FR	-	YES
Mallard	0.0%	2.2% (Port Seton-Craigielaw)	2,564	8,235	UD	Medium	NO
Scaup	0.0%	0.0%	437	928	UD	High	NO
Eider	7.2% (E)	7.6% (Port Seton-Craigielaw)	9,400	1,340	FD	Medium	YES
Long-tailed duck	7.7% (E)	13.2% (Port Seton-Craigielaw)	1,045	1,166	UD	High	YES
Common scoter	2.5% (E)	7.0% (Port Seton-Craigielaw)	2,880	653	UD	Medium	YES
Velvet scoter	13.0% (E)	17.3% (Port Seton-Craigielaw)	635	2,251	FM	-	YES
Goldeneye	1.5% (A)	2.5% (Preston Grange-Port Seton)	3,004	139	UD	High	YES
Red-breasted merganser	8.1% (E)	29.1% (Port Seton-Craigielaw)	670	1,080	FD	High/ Medium	YES

Qualifying Bird Species	Peak Population Estimate (as a percentage of current SPA pop. within sector)	5-Year Peak WeBS Population Estimate (as a percentage of current SPA pop. within sector)	SPA Population at Classification (from SPA citation)	Most Recent SPA Population Estimate[1]	SPA Site Condition[2]	WeBS Alert[3]	Further Information Provided for the Appropriate Assessment?
Red-throated diver	5.9% (E)	12.7% (Preston Grange-Port Seton)	90	102	FM	Not evaluated	YES
Cormorant	2.8% (B)	11.0% (Preston Grange-Port Seton)	682	4,567	FM	Medium	YES
Great crested grebe	1.4% (B)	17.3% (Preston Grange-Port Seton)	720	469	UD	High	YES
Slavonian grebe	6.9% (A,B,E)	41.4% (Port Seton-Craigielaw)	84	1037	FD	Not evaluated	YES
Oystercatcher	0.5% (E)	4.7% (Port Seton-Craigielaw)	7,846	347	FM	-	NO
Golden plover	0.1% (E)	5.4% (Port Seton-Craigielaw)	2,949	3527	FM	High	NO
Grey plover	0.6% (E)	14.9% (Port Seton-Craigielaw)	724	5480	FD	High/Medium	YES
Lapwing	0.0%	3.1% (Port Seton-Craigielaw)	4,148	220	FM	High/ Medium	NO
Ringed plover	0.0%	2.4% (Port Seton-Craigielaw)	328	60	FM	-	NO
Curlew	0.2% (E)	2.7% (Port Seton-Craigielaw)	1,928	6,988	FM	-	NO
Bar-tailed godwit	1.2% (E)	14.0% (Port Seton-Craigielaw)	1,974	1,502	FD	Medium	YES

Qualifying Bird Species	Peak Population Estimate (as a percentage of current SPA pop. within sector)	5-Year Peak WeBS Population Estimate (as a percentage of current SPA pop. within sector)	SPA Population at Classification (from SPA citation)	Most Recent SPA Population Estimate[1]	SPA Site Condition[2]	WeBS Alert[3]	Further Information Provided for the Appropriate Assessment?
Turnstone	2.4% (E)	9.3% (Port Seton-Craigielaw)	860	2,808	FM	-	YES
Knot	0.0%	3.3% (Port Seton-Craigielaw)	9,258	25,888	UD	High/ Medium	NO
Dunlin	0.0%	0.2% (Port Seton-Craigielaw)	9,514	5,925	FD	High	NO
Redshank	0.3% (E)	2.4% (Port Seton-Craigielaw)	4,341	4,047	FM	-	NO
Sandwich tern	3.7%	4.0% (Port Seton-Craigielaw)	1,617	4,088	FD	-	NO

1 SPA Pop = the most up to date population estimate for each SPA Qualifying species based on BTO WeBS 5-year peak monthly counts for the equivalent Firth of Forth SPA WeBS count sectors over the period 2006/07 - 2010/11.

2 Taken from SNH's SiteLink website [http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8499]; Site condition: FM = Favourable, maintained; FD = Favourable, declining; UD = Unfavourable, declining; FR = Favourable, recovering.

3 Wetland Bird Survey (WeBS) Alerts for Firth of Forth, based on population trends up to 2007/08. Note that a species can have a high alert status for a short-term decline, but also a medium alert status for long-term decline for example. If declines exceed 50%, then a High-Alert is issued and if declines exceed 25% then a Medium-Alert is issued.

Table 15.28: Summary of HRA Outcome for the Firth of Forth SPA

<table>
<tr><th>Conservation Objective for Qualifying Species</th><th>Summary of HRA findings – Firth of Forth SPA</th><th>Section(s) Above Where Evidence is Presented</th></tr>
<tr><td>1. Avoid deterioration of habitats of the qualifying species.</td><td>The only SPA habitat affected by the Project will be the inter-tidal area crossed by the Export Cable, either at Cockenzie or Seton Sands. Habitat disturbance at the Cockenzie landfall would be approximately 2,216 m² which equates to 2.0% of total beach area (measured from the Cockenzie Power station to East Cuthill Rocks). This is based on the tidal range at widest point of the beach, and therefore cable length across the intertidal area of 56 m.

The intertidal area disturbed at Seton Sands landfall would be approximately 14,636 m² which equates to 1.1% of total beach area measure from Wrecked Craigs to Fenny Ness (based on the Export Cable length across the intertidal area of 401 m).

In either case, the deployment of a suitably qualified Ecological Clerk of Works to oversee installation is also an important feature of the installation, specifically to work with contractors to minimise habitat impacts, including strict adherence to defined working corridors, and adherence to comprehensive pollution prevention measures to minimise the risk of any spill from machinery (these measures would be implemented through Method Statements prior to any works on site, and approved by SNH, Scottish Environment Protection Agency and Marine Scotland).

The nature, scale and significance of the Cockenzie or Seton Sands habitat losses has been fully assessed for qualifying species, drawing on information from Chapter 12 as well as comprehensive bird data collected for the Project, WeBS data, and surveys for the Cockenzie Combined Cycle Gas Turbine Power Station project. For both locations therefore, the evidence considered encompasses site-specific survey data collected for the Project and also from a wide range of published literature.

It is considered that waders – due to their habitat preferences - are the species group with the potential to be affected most by the Export Cable works within the intertidal area, and therefore information is presented in more detail on the qualifying species recorded during surveys:

• Bar-tailed godwit were absent from survey Sectors A and B (corresponding with the Cockenzie Landfall Area), but were recorded between September and March in the</td><td>Section 15.7.2 Effects of Construction (Project alone).

Section 15.7.3 Effects of Operation (Project alone).

Section 15.9.2 Cumulative effects Offshore Export Cable Corridor – Near-shore and Intertidal.</td></tr>
</table>

Conservation Objective for Qualifying Species	Summary of HRA findings – Firth of Forth SPA	Section(s) Above Where Evidence is Presented
1. Avoid deterioration of habitats of the qualifying species.	intertidal sandflats in Sector E . Numbers were relatively stable throughout this period, peaking at 18 birds. The abundance of suitable mud or sandflats in the wider area, and the regular movements of the species within the Firth (Symonds *et al*., 1984) both indicate that the localised and temporary nature of habitat loss from the Project will not cause deterioration of the SPA habitat available for this qualifying species. • **Grey plover** were absent from Cable Landfall Study Area (survey Sectors A and B), but present in low numbers in Sector E, mainly during autumn passage (peak of three individuals). Although identified by Symonds *et al.* (1984) as being relatively sedentary during winter, the low absolute numbers of grey plovers recorded within each survey sector suggests that the habitat is not of high suitability, and comparative alternative habitat would likely be available in the nearby vicinity during the period during which any habitat loss would occur. Therefore, the Project will not cause deterioration of the SPA habitat available for this qualifying species. • **Turnstone** were recorded in all three Cable Landfall Study Area survey sectors during winter months with a peak of 21 birds in Sector A, and 22 birds in Sector E, representing up to 2.4% of the current SPA population. Symonds *et al.* (1984) considered the species to be relatively sedentary in winter months in the Forth Estuary, but even so, the species does not appear to be overly restricted in its choice of habitat or diet, and so the short term effects of the works would not cause deterioration of this qualifying species' habitat. Based on species preferences and the likely abundance of habitat within the SPA, no qualifying species are expected to have habitat requirements that are specific to the area of the Export Cable works, with even the most sensitive of species (likely to be grey plover and turnstone, based on their sedentary tendencies) able to find alternative habitat in the adjoining habitats, if affected. The temporary loss of 2% or less of local habitat will therefore not cause deterioration of habitats for any SPA qualifying species from the Project alone. For all **seaduck, duck, grebe, diver** and **tern species** that feed in the area at high tide on fish and invertebrates, localised habitat loss from Export Cable laying of <1% of the available habitat across the SPA is concluded to be inconsequential, given its limited	

Conservation Objective for Qualifying Species	Summary of HRA findings – Firth of Forth SPA	Section(s) Above Where Evidence is Presented
1. Avoid deterioration of habitats of the qualifying species.	extent and its largely temporary nature and will therefore not cause deterioration of habitats for any of these SPA qualifying interests. There will be no deterioration of SPA habitats of any qualifying species from the OnTW, as it will be located inland, outside the SPA boundary and with no direct or indirect pathway to cause any habitat impacts. Overall, the **Project alone** therefore avoids deterioration of the habitats of the SPA's qualifying species. Consideration has also been given to in-combination habitat impacts, taking into account the proposed Goshen Farm development, the Cockenzie Gas Pipeline, and the Cockenzie Combined Cycle Gas Turbine Power Station (see Table 15.21). Only the latter has the potential to cause direct or indirect habitat loss, and then only in the Cockenzie landfall area. The spatial scale of such loss is extremely small and the development's HRA concluded it would avoid deterioration of habitat for any of the SPA's qualifying species. In conclusion, the Project, alone and in-combination, will avoid deterioration of habitats of the qualifying species.	
2. Avoid significant disturbance to the qualifying species.	The main sources of disturbance during installation will be unpredictable noise events associated with construction activities, trenching equipment and excavators, although the presence of workers may also cause disturbance. The exact degree of disturbance to each species from the Offshore Export Cable installation across the near shore and intertidal areas will depend on the installation method, the landfall option (Cockenzie or Seton Sands), and the duration and timing of activities. In terms of Embedded Mitigation, the deployment of a suitably qualified Ecological Clerk of Works to oversee installation is of note, as they will work with contractors to minimise disturbance to any qualifying species, as far as practical. A wide range of evidence is available to assess the risk of significant disturbance occurring, and its spatial extent and duration. Together with comprehensive field surveys, this enabled full consideration to be given to the Project's potential disturbance impact.	*Section 15.7.2* Effects of Construction (Project alone). *Section 15.7.3* Effects of Operation (Project alone). *Section 15.9.2* Cumulative effects Offshore Export Cable Corridor – Near-shore and Intertidal.

Conservation Objective for Qualifying Species	Summary of HRA findings – Firth of Forth SPA	Section(s) Above Where Evidence is Presented
2. Avoid significant disturbance to the qualifying species	Cutts *et al.* (2009) found from a review of shorebird responses to disturbance, that sensitivity is likely to be greatest in the spring and autumn passage periods, as well as in periods of hard weather conditions when food supply and habitat is limited. Generally, for the Offshore Export Cable landfall options, peak counts for all species were recorded during winter and passage months. Any potential impacts are therefore likely to be greatest if installation is undertaken during these periods. On the basis that Export Cable installation may take place at any time of year, a worst-case scenario of installation during winter months is considered here. **Waders** The evidence considered in *Section 15.7.*) suggests that for waders in general, any displacement within the Offshore Export Cable Corridor will be localised and temporary. The qualifying species recorded in the Export Cable landfall areas are considered below: • **Bar-tailed godwit** The possible displacement of up to 18 bar-tailed godwits in Sector E (Seton Sands) during winter months equals 1.2% of the most recent SPA population estimate. In the wider Port Seton to Craigielaw WeBS sector, a peak of 211 birds was recorded (14.0% of the most recent SPA population estimate). This indicates that the Seton Sands cable landfall option is part of a much wider area used by the species. The distribution of birds recorded shows it is possible that the landfall option is used as a high tide roost, and although as a larger bird, they may be more sensitive to roost disturbance (as per Stillman *et al.,* 2005), the abundance of suitable mud or sandflats in the wider area, and the regular movements of the species within the Firth (Symonds *et al.,* 1984) are sufficient to conclude that there will be no significant disturbance resulting from the Project alone for this species. • **Grey plover** Grey plovers were absent from Sectors A and B, and were only present in low numbers in Sector E, mainly during autumn passage (peak of three individuals). In the wider corresponding WeBS sectors, up to 70 birds were recorded in the Port Seton-Craigielaw sector (equivalent to Cable Survey Sector E), which represents 14.9% of the SPA population. This corresponds with the general low density distribution of the species	

Conservation Objective for Qualifying Species	Summary of HRA findings – Firth of Forth SPA	Section(s) Above Where Evidence is Presented
2. Avoid significant disturbance to the qualifying species.	known at other estuaries. Cutts *et al.* (2009) identified the species as being particularly sensitive to roosting disturbance. Although there is relatively little work directly on this species, (Smit and Visser, 1993; Burton *et al*., 2002) reaction distances may however be similar to golden plover, where in a worst-case situation a significant number of roosting or feeding SPA birds may be displaced within 100 m of human activity (as predicted from Smit and Visser, 1993). A small number of grey plovers may therefore be temporarily displaced by installation activities, but this would not represent significant disturbance from the Project. • **Turnstone** Turnstone was recorded in all three cable landfall survey sectors during winter months , although never in high numbers, with a peak of 21 birds in Sector A, and 22 birds in Sector E. This represents up to 2.4% of the current estimated SPA population. According to Cutts *et al.* (2009), turnstones may habituate relatively easily to disturbance, but do have a narrow habitat range. In the corresponding WeBS sectors, up to 87 birds were recorded in the Port Seton-Craigielaw sector (equivalent to Cable Survey Sector E), which represents 9.3% of the current SPA population estimate. This shows that the Export Cable landfall options are part of a wider area of habitat generally suitable for the species. Overall, a small number of turnstones may be disturbed during Export Cable installation but given its localised and temporary nature, it is concluded that the Project will not cause significant disturbance to this species. **Seaducks, ducks, grebes, divers and terns** Excluding waders, most other qualifying interests of the Firth of Forth SPA are predominantly found on the water when the intertidal area is submerged, or within the adjacent near-shore environment although in the case of some species (e.g. **eider, wigeon**), birds may also utilise the intertidal area for loafing or feeding. The main sources of disturbance to these species are likely to be those activities taking place closer to the lower tide limit, or in the near-shore area, i.e. the Export Cable installation vessel, other support vessels and the Export Cable itself. These have the potential to displace birds from feeding or loafing activities throughout the duration of the installation phase (up to 12 weeks per year, see Table 15.3), particularly if the vessels	

Conservation Objective for Qualifying Species	Summary of HRA findings – Firth of Forth SPA	Section(s) Above Where Evidence is Presented
2. Avoid significant disturbance to the qualifying species.	remain in place throughout. In a review of the sensitivity of various species of birds (including seaducks, divers, terns and grebes) to the development of offshore wind-farms, Furness and Wade (2012) considered that seaducks and divers had a relatively high vulnerability score in relation to disturbance by ship traffic, compared to more moderate vulnerability for grebes and terns. Kaiser *et al.* (2006) has noted for instance that large flocks of common scoter were observed being put to flight at a distance of two kilometres from a 35 m vessel, though smaller flocks were less sensitive and put to flight at a distance of one kilometre. Common scoter were observed in lowest numbers or were absent from areas of Liverpool Bay in which anthropogenic disturbance (shipping activity) was relatively intense, even when these areas held a high prey biomass (Kaiser *et al*., 2006). **Divers** are also sensitive to approaching boats and may dive or fly off when vessels are more than one kilometre away (Schwemmer *et al.,* 2011; Topping and Petersen, 2011). **Common eider** had a 208 m median flush distance from ships, while some flocks on the water showed no reaction (Schwemmer *et al.,* 2011). Although few sources of information are available specifically for impacts of disturbance on near-shore birds, it is likely that relative sensitivities described above are relevant in both the offshore and near-shore environment. The species with the highest proportion of SPA population found near-shore in the vicinity of the Export Cable landfall options have a greater likelihood of suffering disturbance (e.g. **red-breasted merganser, Slavonian grebe, velvet scoter**), but since in each case it is apparent from both Export Cable landfall surveys and WeBS counts in the wider sectors, that the Cable Landfall Study Area from Prestonpans to Seton Sands provides suitable habitat, any localised temporary disturbance is judged to be not significant. <u>Conclusion</u> As reported in the habitat loss section above, no species are expected to have habitat requirements that are specific to the area of the Offshore Export Cable Corridor works. Disturbance to waders, seaducks and other species is therefore predicted to temporarily displace birds around the area of activity for the duration of the installation works. Peak	

Conservation Objective for Qualifying Species	Summary of HRA findings – Firth of Forth SPA	Section(s) Above Where Evidence is Presented
2. Avoid significant disturbance to the qualifying species.	displacement will likely occur if construction takes place during the winter months. Although some species are recorded in potentially significant numbers within the context of their respective SPA populations, the wider area around the Offshore Export Cable landfall options provides suitable habitat for any disturbed birds to move to, without a reduction in fitness or additional mortality as a result. In relation to this conservation objective, it is concluded that the Project alone will not cause significant disturbance to any qualifying species of the SPA. Of the three developments considered for in-combination effects, no significant disturbance to any qualifying species is predicted, either because of sufficiently large separation from the SPA, or, in the case of the Cockenzie Combined Cycle Gas Turbine Power Station, because the mitigation incorporated during construction and operation will ensure disturbance is avoided. As a result therefore, providing mitigation for the power station and Project are put in place, it can be concluded that significant disturbance to qualifying species will be avoided, from the Project alone, and in-combination with other plans and projects.	
3. The population of qualifying species as a viable component of the site is maintained in the long-term	The pathways through which population impacts could arise from the Project are habitat loss, reduction in prey availability and disturbance. If of sufficiently large and prolonged magnitude, each of these could potentially impact survival or breeding success, and therefore have a knock-on impact on the species' population viability in the long-term. <u>Habitat Loss</u> As concluded for the first conservation objective above, the Project is not predicted to have any significant long-term impact on habitats. Instead, impacts are relatively short-term and temporary and therefore the Project alone will not result in a reduction in population viability of qualifying species in the long-term. <u>Reduction in Prey Availability</u> Any reduction in prey availability will be sufficiently localised and short-term so that it does not cause any impacts on population viability for any qualifying species.	*Section 15.7.2* Effects of Construction (Project alone). *Section 15.7.3* Effects of Operation (Project alone). *Section 15.9.2* Cumulative effects Offshore Export Cable Corridor – Near-shore and Intertidal.

Conservation Objective for Qualifying Species	Summary of HRA findings – Firth of Forth SPA	Section(s) Above Where Evidence is Presented
3. The population of qualifying species as a viable component of the site is maintained in the long-term	<u>Disturbance</u> Disturbance can interrupt shorebird activity during foraging or roosting, resulting in increased energetic expenditure and therefore reduced individual fitness and survival if significant in magnitude and duration. Therefore, disturbance could potentially compromise population viability. As outlined by Gill (2007), the likelihood of a population-level impact for a particular species will be influenced by: • the quality of the area for feeding, roosting etc.; • the availability and relative quality of alternative areas; or • relative predation risk at current and alternative sites. Considering the qualifying species of the Firth of Forth SPA, the birds most likely to be adversely affected by disturbance are those for which the fitness costs are high but which have little excess habitat to move to and are therefore constrained to stay in disturbed areas and suffer costs of reduced survival or reproductive success. This is likely to be more pertinent for estuarine wader species such as turnstone and grey plover that are more habitat-limited given that their foraging habitat is inundated by the tide twice a day, compared to seaducks, grebes, terns and divers in the wider near-shore area. As concluded for the second conservation objective however, disturbance from the Project alone is not predicted to be significant, due to its localised temporary nature, the relatively low use of the landfall areas by qualifying species, and the availability of alternative habitat for the qualifying species that are present. Therefore, the temporary, short-term disturbance from the Project is not predicted to cause any reduction in population viability in the long-term for all qualifying wader species. **Seaducks, grebes, divers and terns** The species with the highest proportion of SPA population found near-shore in the vicinity of the cable landfall options have a greater likelihood of a population-level impact (**red-breasted merganser, Slavonian grebe, velvet scoter**), but in each case it is apparent from both Cable Landfall Study Area surveys and WeBS counts in the wider sectors, that the whole survey area from Prestonpans to Seton Sands provides suitable habitat. Due to the predicted localised, temporary disturbance impacts, it is concluded that there will be no effect on the SPA population viability for any of the qualifying species.	

Conservation Objective for Qualifying Species	Summary of HRA findings – Firth of Forth SPA	Section(s) Above Where Evidence is Presented
3. The population of qualifying species as a viable component of the site is maintained in the long-term	Conclusion Having examined the potential pathways through which population viability of qualifying species could be affected, the firm conclusion has been reached that the Project alone will avoid any impact on this conservation objective. Taking into account the in-combination habitat loss, reduction in prey availability and disturbance, from Goshen Farm, the Cockenzie Combined Cycle Gas Turbine Power Station, and the associated Cockenzie Gas Pipeline, it is also considered there is sufficient evidence to conclude that any in-combination effects will be sufficiently localised and short-term to enable the population of qualifying species to be maintained as a viable component of the site in the long-term.	
4. The distribution of the qualifying species within the SPA is maintained in the long-term	Drawing on the information already presented for the conservation objectives 1 to 3 – with localised and largely short term impacts, and alternative habitat widely available, it is concluded that the Project alone will not cause any direct or indirect impact on the distribution of qualifying species within the SPA in the long-term. This applies for the Project alone, and in-combination with other plans and projects.	*Section 15.7.2* Effects of Construction (Project alone). *Section 15.7.3* Effects of Operation (Project alone). *Section 15.9.2* Cumulative effects Offshore Export Cable Corridor – Near-shore and Intertidal.
5. The distribution and extent of habitat supporting the qualifying species is maintained in the long-term	As stated above for conservation objective 1 (highly localised, temporary habitat loss), the Project alone will have no impact on the distribution or extent of supporting habitat in the long-term. This applies for the Project alone, and in-combination with other plans and projects.	No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.
6. The structure, function and supporting processes of habitats supporting the qualifying species is maintained in the long-term	The habitat used by prey species may be reduced in quality due to increased suspended sediment disturbance and deposition or changes in underlying substrate structure. As a consequence, these impacts might reduce the availability of food for birds in the area, leading to the redistribution of bird species, and possible reductions in fitness and survival (hence the conservation objectives highlighted above may be relevant). The implications for qualifying species of indirect effects on availability of prey species is	*Section 15.7.2* Effects of Construction (Project alone). *Section 15.7.3* Effects of Operation (Project alone). *Section 15.9.2* Cumulative

Conservation Objective for Qualifying Species	Summary of HRA findings – Firth of Forth SPA	Section(s) Above Where Evidence is Presented
6. The structure, function and supporting processes of habitats supporting the qualifying species is maintained in the long-term	generally determined by a combination of factors such as variety of diet, foraging technique and range, and habitat flexibility. In general most species have a large enough foraging range in winter months to cope with localised redistributions or losses of prey, particularly those whose prey is mobile and subject to constant redistribution (e.g. fish, marine invertebrates). This means that seaducks, divers, grebes and terns are likely to be able to cope with localised prey redistribution or reductions more easily than wader species, particularly the site-faithful wader species (grey plover, turnstone) in the Forth Estuary identified by Symonds *et al.* (1984). Wader species may feed on a variety of invertebrates within the underlying substrate, located by sight or touch, and so disruption to the sediment regime or water levels may adversely affect birds' ability to obtain sufficient prey items and consequently reduce fitness levels. The construction activities that have been identified that are most likely to affect prey species in are the Export Cable installation processes (e.g. ploughing, jetting trenchers , directional drilling, rock wheel cutting or open cut trenching) . Impacts on prey species considered in *Benthic Ecology* (*Chapter 12*) and *Natural Fish and Shellfish* (*Chapter 13*) Chapters during construction include direct temporary disturbance of habitats, increases in suspended sediment concentrations (SSC) and associated smothering. Due to the limited areas of temporary disturbance at Cockenzie and Seton Sands (4.1 and 0.7 per cent of the intertidal area respectively) there are at most minor/moderate impacts expected for the most sensitive prey species. In the intertidal environment some construction activities may be undertaken at high water (i.e. continuation of the subtidal ploughing), which may cause an increase in the level of suspended sediments within the near-shore environment, and affect prey items as well as impede visual foraging of seaducks and other diving birds. Sediment modelling results presented in *Chapter 10*, showed that based on conservative assumptions, the associated plumes of elevated suspended sediments will be localised to within three kilometres of the Offshore Export Cable Corridor, with the large majority (98%) of the material settling out in five to 10 minutes, and the remaining fine material settling within one hour. Predicted levels are unlikely to significantly impede foraging efficiency for any qualifying bird species. Considering the highly mobile and dynamic nature of the environment, the	effects Offshore Export Cable Corridor – Near-shore and Intertidal.

Conservation Objective for Qualifying Species	Summary of HRA findings – Firth of Forth SPA	Section(s) Above Where Evidence is Presented
6. The structure, function and supporting processes of habitats supporting the qualifying species is maintained in the long-term	predicted levels are well within the tolerances of the benthic species present, which are tolerant of high scour or mobile sedimentary environments (Budd, 2008a). It is also predicted to have at most minor/moderate significance for the most sensitive prey species (*Chapter 12*, *Chapter 13*). In addition to this, work will mainly be undertaken at low tide. As such even more limited increases in SSC are predicted during Export Cable installation. At high tide some localised increases in suspended sediment may occur, and no more than those considered for works taken at high water considered above. As such, temporary changes in sediment and habitat loss are unlikely to impact on the habitat quality for prey items and therefore the structure and function of near-shore habitats for all qualifying bird species of the Firth of Forth SPA. **Seaducks, ducks, grebes, divers** and **terns** generally require clear water to feed and so any sediment discharge into shallow coastal waters of the Firth of Forth may affect the ability of birds to locate and obtain fish. It is, however, considered unlikely that the extent of any such discharge would be great enough to prevent birds from successfully foraging elsewhere in nearby adjacent coastal waters. The other potential source of impact on the structure, function and supporting processes of the habitats supporting the qualifying species is pollution from any fuel, oil, lubricants etc. In order to avoid or minimise this risk, a range of pollution prevention measures will be put in place through a Construction Environment Management Plan, overseen by an Ecological Clerk of Works. With these measures in place, impacts on this conservation objective will be avoided. The habitat surrounding the Export Cable laying activities is generally widespread throughout the intertidal and near-shore areas of the outer Firth of Forth, and temporary prey reduction or redistribution as a result of construction activities is not predicted to be significant in relation to any of the species' SPA qualifying species' current populations. The sandy habitat at Seton Sands and Cockenzie is highly dynamic and so any disturbance or changes in substrate or suspended sediment is likely to be easily tolerated by prey species, with any effects being localised and temporary. This is also likely to be the case for the prey assemblage taken by qualifying SPA bird species associated with rocky shores of the Cockenzie land fall option (e.g. turnstones), which are also relatively mobile and	

Conservation Objective for Qualifying Species	Summary of HRA findings – Firth of Forth SPA	Section(s) Above Where Evidence is Presented
6. The structure, function and supporting processes of habitats supporting the qualifying species is maintained in the long-term	likely to re-distribute over the short-term in response to changes in prey availability. In relation to this conservation objective, the **Project alone** will not cause any impacts on the structure, function and supporting processes over the long-term to qualifying species' habitat within the SPA, as a result of construction, operation or decommissioning. In relation to in-combination effects, due to the distance to the SPA the Goshen Farm development and Cockenzie Gas Pipeline lack any pathways through which they could have a long-term impact on the structure, function or supporting processes of the habitats supporting the qualifying species of the SPA. The Cockenzie Combined Cycle Gas Turbine Power Station could potentially have in-combination impacts on habitat, but its ES commits mitigation and pollution prevention measures being in place to ensure that this conservation objective is met. As a result, it can therefore be concluded that the Project, both alone and in-combination with other plans and projects, will not compromise the long-term maintenance of the structure, function, and supporting processes of habitats supporting the SPA's qualifying species.	
7. No significant disturbance of the species in the long-term	The same conclusion applies as with conservation objective 2 above. Disturbance through activities will be short-term and localised in nature. The Project alone or in combination with other plans or projects will not cause significant, long-term disturbance to qualifying species, during construction, operation or decommissioning.	See conservation objective 2.

Conclusion Regarding Site Integrity of the Firth of Forth SPA

408 Having considered the conservation objectives of the Firth of Forth SPA in relation to the Project's predicted impacts (Table 15.28), it is possible to conclude beyond reasonable scientific doubt that from the Project alone and in combination with other plans or projects there will be no adverse effect on site integrity.

Other SPA Migratory Species with the Potential to Contribute to LSE

409 A number of other migratory bird species are likely to pass through the Development Area whilst travelling between breeding and wintering areas. For species which are qualifying features of SPAs within Scotland and the UK, it is possible that these passage birds may also be part of SPA populations. A long list of SPA species which might fly through the outer Forth and Tay offshore area, based on migratory corridors identified by Wright *et al.* (2012), is set out in the HRA Screening Report (see *Appendix 15B*, *Annex 15B.1*). These species may be subject to barrier impacts and collision risk from the Wind Farm. The following sections consider the potential for adverse impacts on this wider suite of SPAs. In terms of potential impacts and impact pathways, as the physical separation of the Project and these SPAs are extensive, there are no direct or indirect mechanisms through which impacts could arise on any of the conservation objectives other than population viability. Population viability could be affected by collision or barrier effects, and so information is presented below on both of these potential impacts.

Collision Risk for Migratory Species in the Non-breeding Season

410 Collision risk for migratory species potentially from SPAs in relation to the Wind Farm has been estimated using the approach set out in Wright *et al*. (2012) (see *Appendix 15A*, Table 15A.38). The species considered most likely to migrate through the Wind Farm and predicted collision risk mortality are given in Table 15.29 below. In each case the predicted annual mortality represents less than 0.01 per cent of the source population (the British wintering population or the passage population from which birds are likely to derive). SPAs in the UK are usually selected on the basis of supporting at least one per cent of the British (for species listed on Annex 1 of the *Birds Directive* (2009/147/EC)) or International populations (for regularly occurring migratory bird species) (Stroud *et al*., 2001). Thus the numbers predicted to collide with WTGs at the Wind Farm are very small in relation to the thresholds for SPA selection. Even if all the birds passing through the Development Area were to derive from a single SPA population, then the proportion of deaths in relation to the SPA population is predicted to be very low. In reality, birds migrating through the Development Area will derive from a number of populations, including SPA and non-SPA birds. Because of the small numbers of predicted deaths, and the likelihood that any impacts will be spread over a number of sites, no adverse effect on site integrity is predicted on the populations of qualifying interests of any SPAs.

Table 15.29: Collision Risk for Non-breeding Season Migratory Species Passing through the Development Area which are Identified as Qualifying Species of SPAs

Species	Avoidance Rate (%)	Predicted Annual Mortality at Inch Cape	% of British Wintering/Passage Population[1]
Pink-footed goose*	99%	23	<0.01
Shelduck	98	1	<0.01
Tufted duck	98	1	<0.01
Long-tailed duck	98	<1	<0.01
Common scoter	98	1	<0.01
Goldeneye	98	<1	<0.01
Oystercatcher	98	3	<0.01
Golden plover	98	36	<0.01
Ringed plover	98	1	<0.01
Curlew	98	2	<0.01
Knot	98	5	<0.01
Dunlin	98	8	<0.01
Purple sandpiper	98	<1	<0.01

1. See Table 15.15 for details of the relevant background populations used for comparison.

* The recommended avoidance rate for geese has recently been increased to 99.8% by SNH (2013), so this predicted mortality is highly precautionary.

411 For in-combination impacts, collision risk estimates for migratory species are available for only a few bird species and a small number of wind farms identified for potential in-combination effects with Inch Cape Offshore Wind Farm (Table 15.20). For pink-footed goose the cumulative annual collision mortality from four other proposed offshore wind farms (Firth of Forth Phase 1, Beatrice Offshore Wind Farm, Moray Firth Round 3 (Eastern Development Area) and Neart na Gaoithe Wind Farm) is 165 (Table 15.20). This total, which represents < 0.05 per cent of the British wintering population, cannot be attributed to any specific SPA(s) and is likely to derive from a mixture of birds from different SPAs and non-SPA populations. In the context of an increasing population trend for this species, despite an estimated mortality of at least 38,000 birds each year from shooting in Britain and Iceland (Trinder *et al.,* 2005; Mitchell *et al.,* 2010) this is considered likely to be not significant. A recent population model for this species (WWT Consulting, 2008) suggested that the loss of up to 1,000 additional birds each year would result in little or no detectable effect on the

probability of population decline. For golden plover (<0.01 per cent), ringed plover (<0.01 per cent) oystercatcher (0.01 per cent), dunlin (0.03 per cent), knot (0.01 per cent) and curlew (0.03 per cent), cumulative estimates of mortality also represent a very low proportion of the background populations (Table 15.20) and passage birds are again likely to involve populations from a number of sites – both SPA and non-SPA.

412 A number of species, that include SPA populations, that have the potential to occur on migration only at the Development Area were identified during HRA screening but were not seen during boat-based surveys. Following discussions with SNH and JNCC it was agreed that it would be very unlikely that any predicted impacts would have an adverse effect on site integrity on any one SPA as impacts are likely to be spread across a wider population and multiple designated sites, thus impacts on any one site would likely be very small in the long term. However, an HRA compliant process was required to demonstrate that potential impacts would have no adverse effect on site integrity within the terms of the Waddenzee Judgement. Subsequently, Marine Scotland has begun the process of assessing the potential impacts on species that are not seabirds, are SPA qualifying species and have the potential to occur on migration only at offshore wind farms around Scotland. This will follow the methodology developed by The Crown Estates SOSS group (Wright *et al*., 2012).

413 The analyses being conducted for Marine Scotland does not require input from data collected on site and will be able to report on the in-combination impacts in a fully Natura compliant manner. Given that these analyses have not yet been reported and that from discussions with SNH and JNCC it can be concluded that there is no adverse effect on site integrity to any of these SPAs as the likelihood of effects on any one SPA being sufficient to affect the ecological integrity of a site is extremely low both alone and in-combination with other reasonably foreseeable plans and projects.

414 The species that were listed in the HRA screening report as meeting the above criteria and having the potential to contribute to a LSE at one or more SPA are: whooper swan, Icelandic greylag goose, Svalbard light-bellied brent goose, teal, pintail, shoveler, pochard, goosander, hen harrier, osprey, spotted crake, dotterel, sanderling, black-tailed godwit, whimbrel, greenshank, wood sandpiper, red-necked pharalope and short-eared owl.

Barrier Effect for Non-breeding Migratory Species

415 Potential offshore wind farms could present in-combination barrier impacts to passage species which encounter several developments during migratory flights. However, investigations into the energy costs of deviation around individual wind farms have concluded these are trivial (Pettersson, 2005; Masden et al., 2009; Speakman et al., 2009). This indicates that in combination barrier impacts of the Wind Farm and the offshore wind farms listed in Table 15.16 are not predicted for any migratory species.

15.12.7 Information to Inform the HRA for the Four SPAs with Qualifying Interests in the Breeding Season – Project Alone

Introduction and Structure of this Section

416 For these four SPAs, conservation objectives were assessed in the same way as for the SPAs designated for their non-breeding season qualifying features. However, the Conservation Objective 3 required detailed additional analysis on population viability, particularly for in-combination effects, and therefore this is reflected in the layout of this section. The information provided is therefore as follows:-

- *Conservation Status of the SPAs*: This gives the populations, site condition and confidence in population trends for the relevant qualifying species for each SPA;
- *Apportionment of SPAs*: This explains the process through which seabirds recorded in the Boat-based Survey Area have been apportioned to SPA and non-SPA colonies;
- *Disturbance to SPA Qualifying Species in the Breeding Season from Construction*;
- *Indirect Impacts on Breeding Success from Construction Disturbance to Fish Prey: Approach and Outcomes for Consideration of These Impacts*;
- *Direct Displacement of Qualifying Species During Operation and Maintenance in the Breeding Season:* This section presents the key findings of potential displacement effects on each of the SPAs' qualifying species. This identifies the four species (kittiwake, razorbill, guillemot and puffin) for which PVA was required. The sub-section *Population Viability Analysis to Model the Impacts of Direct Displacement During Operation and Maintenance* provides the modelling results for each of these species in turn. The reason why the information is presented on a species basis first (before presenting the outcomes specifically for each SPA), is that it avoids the high degree of repetition that would otherwise be necessary to give consideration to the different seasonal, spatial and population factors that have been taken into account;
- *Barrier Effect:* This section provides an overview of this potential impact source on breeding seabird qualifying interests of each SPA; and
- *Collision risk for SPAs with breeding qualifying species*: This section summarises the findings of potential collision mortality on each of the SPAs' qualifying species, and identifies that in order to inform the HRA, one species, kittiwake, required more detailed assessment using PVA. The sub-section *Population viability analysis for Kittiwake to model impacts of collision mortality on SPAs for which it is a qualifying species* presents the results of this PVA modelling.

Conservation Status of Species in These SPAs

417 The site condition of qualifying species within the four SPAs identified for a LSE is shown in Table 15.30 below. The table shows the last assessed condition of the feature taken from the SNH *Sitelink* website and the population trend taken from a recent review of seabird populations in Scottish SPAs (Lewis *et al*., 2012).

418 SPA Site Condition Monitoring provides categories to describe the condition of each qualifying species of an SPA. ‘Favourable Maintained’ means the attribute targets set for the qualifying species have been met, and the species is likely to be secure on the site under present conditions; ‘Favourable Declining’ also means the attribute targets have been met, however evidence suggests that condition will worsen unless remedial action is taken. ‘Unfavourable No Change’ means one or more of the attribute targets have not been met, and recovery is unlikely under the present management and activity on site; ‘Unfavourable Declining’ also means one or more of the attribute targets have not been met, and evidence suggests that condition will worsen unless remedial action is taken (*SNH Sitelink*).

419 Confidence in SPA population trends was assigned using the proportion of count sites counted and years (since the Seabird 2000 census) in which data were collected (Lewis *et al*., 2012).

Table 15.30: Site Condition of Qualifying Species from SPAs Screened in for Appropriate Assessment

SPA for which a LSE has been identified	Qualifying Species	SPA Population at Designation (from SPA citation, pairs)[1]	Most recent SPA Population Estimate (pairs)[2]	Year/s of Most Recent Estimate (SMP database)	Site Condition[1]	SPA Population Trend[3]	Confidence in Trend[3]
Forth Islands	Fulmar	798	569	2012	Favourable Maintained	Unclear	N/A
	Gannet	21,600	55,482	2009	Favourable Maintained	Increase	Moderate
	Kittiwake	8,400	3,766	2012	Unfavourable Declining	Decrease	Very high
	Herring gull	6,600	5,376	2002, 2004, 2009-10	Favourable Maintained	Stable	High
	Lesser black-backed gull	1,500	3,419	2002, 2005-6, 2009, 2011-12	Favourable Maintained	Increase	High
	Common tern	334	20	2007, 2011	Favourable Maintained	Stable	Moderate
	Arctic tern	540	265	2007, 2010	Favourable Declining	Decrease	Moderate
	Guillemot	16,000 (pairs)	22,615 individuals (15,152 pairs)	2007, 2011-12	Favourable Maintained	Decrease	Very high
	Razorbill	1,400 (pairs)	3,704 individuals (2,482 pairs)	2007, 2012	Favourable Maintained	Stable	Very high

SPA for which a LSE has been identified	Qualifying Species	SPA Population at Designation (from SPA citation, pairs)[1]	Most recent SPA Population Estimate (pairs)[2]	Year/s of Most Recent Estimate (SMP database)	Site Condition[1]	SPA Population Trend[3]	Confidence in Trend[3]
	Puffin	14,000	59,622	2009, 2012	Favourable Maintained	Unclear	N/A
Fowlsheugh	Fulmar	1,170	119	2012	Favourable Maintained	Decrease	Low
	Kittiwake	30,452	9,337	2012	Favourable Maintained	Decrease	Low
	Herring gull	3,190	259	2012	Unfavourable Declining	Unclear	N/A
	Guillemot	56,450	44,920 individuals (30,096 pairs)	2012	Favourable Maintained	Decrease	Low
	Razorbill	5,800	5,260 individuals (3,524 pairs)	2012	Favourable Maintained	Unclear	N/A
St Abb's Head to Fast Castle	Kittiwake	21,170	9,459	2000, 2012	Unfavourable Declining	Decrease	Moderate
	Herring gull	1,160	606	2000, 2012	Unfavourable Declining	Decrease	Moderate
	Guillemot	31,750	36,205 individuals (24,257 pairs)	2001, 2008	Favourable Maintained	Decrease	Low
	Razorbill	2,180	2,630 (1,762 pairs)	2000, 2012	Favourable Maintained	Decrease	Low

SPA for which a LSE has been identified	Qualifying Species	SPA Population at Designation (from SPA citation, pairs)[1]	Most recent SPA Population Estimate (pairs)[2]	Year/s of Most Recent Estimate (SMP database)	Site Condition[1]	SPA Population Trend[3]	Confidence in Trend[3]
Buchan Ness to Collieston Coast	Fulmar	1,765	1,389	2007	Unfavourable Declining	Decrease	Low
	Kittiwake	36,650	14,133	2007	Unfavourable No Change	Stable	Moderate
	Herring gull	4,292	3,114	2007	Unfavourable No Change	Stable	Low
	Guillemot	8,640 (pairs)	20,858 individuals (13,975 pairs)	2007	Favourable Declining	Decrease	Low

1. From SNH *Sitelink* note that estimates for guillemot and razorbill at SPA classification have been published as pairs for some SPAs. These have been indicated as pairs in the table, all other estimates at classification are of individuals.
2. Most recent SPA estimates for guillemot and razorbill have been expressed in individuals on land as per the SMP database, with the approximate corresponding number of pairs in brackets (using a 0.67 correction factor as outlined in *Appendix 15A*, *Section 15A.3.2.17* and *Section 15A.3.2.18*).
3. From Lewis *et al*., 2012; confidence in SPA population trends was assigned using the proportion of count sites counted and years (since the Seabird 2000 census) in which data were collected. N/A indicates no data available.

SPA Apportionment

420 Of all the Project components (the Wind Farm, OfTW and OnTW), it is the Wind Farm that is considered to have the main potential for affecting breeding seabird qualifying species. Given that SPAs' seabird breeding colonies are situated at different distances from the Development Area, and the fact that different species have different foraging ranges, a process of apportioning baseline seabird populations estimated to be present in the Boat-based Survey Area to SPA and non-SPA colonies is required. Apportionment was based on distance from the Development Area, colony size and taking account potential flight directions between the colony and the site (see *Appendix 15B*, *15B.2.1.4*). The resulting proportion of birds within the Boat-based Survey Area estimated to derive from individual SPAs and non-SPA breeding colonies within foraging range is shown in Table 15.31. This apportionment is a pre-requisite for considering the effects of the Project as a whole on the SPAs where these species are qualifying interests.

Table 15.31: Apportionment of Inch Cape Offshore Wind Farm Seabird Populations to SPAs during the Breeding Season

Species	SPA	Proportion of Population Predicted to Originate from SPA and Non-SPA birds
Fulmar	Forth Islands	0.0505
	Fowlsheugh	0.0157
	Buchan Ness to Collieston Coast	0.0200
	Non-SPA birds	0.8881
Gannet	Forth Islands (Bass Rock)	0.9945
	Non-SPA birds	0.0055
Kittiwake	Forth Islands	0.0747
	Fowlsheugh	0.2202
	St Abb's Head to Fast Castle	0.0481
	Buchan Ness to Collieston Coast	0.0173
	Non-SPA birds	0.6397
Herring Gull	Forth Islands	0.0290
	Fowlsheugh	0.0218
	St Abb's Head to Fast Castle	0.0091

Species	SPA	Proportion of Population Predicted to Originate from SPA and Non-SPA birds
	Buchan Ness to Collieston Coast	0.0200
	Non-SPA birds	0.9201
Lesser black-backed gull	Forth Islands	0.6946
	Non-SPA birds	0.3054
Arctic tern	Forth Islands	0.8698
	Non-SPA birds	0.1302
Common tern	Forth Islands	0.0199
	Non-SPA birds	0.9801
Guillemot	Forth Islands	0.1137
	Fowlsheugh	0.5401
	St Abb's Head to Fast Castle	0.1083
	Buchan Ness to Collieston Coast	0.0098
	Non SPA birds	0.2281
Razorbill	Forth Islands	0.1018
	Fowlsheugh	0.2712
	St Abb's Head to Fast Castle	0.0381
	Non SPA birds	0.5889
Puffin	Forth Islands	0.8743
	Non-SPA birds	0.1257

421 For gannet, puffin, lesser black-backed gull and Arctic tern, SPA apportionment predicts that the majority of birds observed at the Development Area during the breeding season derive from the Forth Islands SPA and for guillemot the majority of birds are predicted to come from the Fowlsheugh SPA. For other species the predicted proportion of birds from SPAs is lower.

422 Tracking studies of seabirds in eastern Scotland provide some information against which to assess the predicted apportionment. For guillemot, tracking of a sample of birds breeding at the Isle of May (within the Forth Islands SPA) indicated that overlap between the foraging range and the Development Area varied between 0–13.5 per cent in the four years 1999, 2002, 2003 and 2010 (Daunt *et al*., 2011a, 2011b). Observations of trip durations and flight directions suggest that guillemots from St Abb's Head may not forage within the site regularly, however the site may be within the core foraging area of guillemots breeding at Fowlsheugh (Daunt *et al*., 2011c). The predicted apportionment of guillemots within the Development Area suggests that over 50 per cent of birds are likely to come from Fowlsheugh, with about 11 per cent of birds from both the Forth Islands and St Abb's Head to Fast Castle SPAs.

Disturbance to SPA Qualifying Species in the Breeding Season from Construction

423 Disturbance impacts through activities during construction, operation or decommissioning for the Wind Farm has been assessed on the basis of the distance between the Project and SPA breeding colonies (Table 15.24, Figure 15.2). Where relevant, this approach is used to address conservation objectives 2 and 7 for each SPA.

Indirect Impacts to Breeding Success from Construction Disturbance to Prey Species: Approach and Outcomes for Consideration of These Impacts for the Project 'Alone' and 'In-combination'

424 The indirect impact of construction disturbance via impacts on prey species for the Project alone is considered in detail in Table 15.13 and associated text. Drawing on the findings of *Chapter 12 and Chapter 13*, this presents evidence from which it is concluded that construction disturbance from the Project alone will have minimal and localised effects on sandeels – a key prey species of the seabirds that are qualifying species of the SPAs screened in for LSE. There may be some re-distribution of 'hearing specialist' fish (including herring and sprat which are also taken by seabirds) due to avoidance of areas around piling locations, and this may affect their availability within seabird foraging ranges. However, any effects will be temporary, as piling at the Development Area is due to take place over two years only (and not continuously during that period – an estimated 11 to 23 per cent of the time over two years of piling activities, see Table 15.2). Thus no adverse indirect effects are predicted on the populations of any Forth Islands qualifying species for the Project alone.

425 For the in combination assessment, however, a quantitative approach was undertaken, as it was considered that due to the likely overlap of construction activities between the three Forth and Tay developments, this combined indirect impacts via prey species might have the potential to cause an adverse effect on population viability of qualifying species, and therefore on these SPAs (see *Section 15.12.8*).

Direct Displacement on Breeding Qualifying Species during Operation and Maintenance

426 Displacement for regional populations of seabirds in relation to the Wind Farm has been assessed in the EIA by predicting the proportion of birds of each species likely to be

displaced when the wind farm is in operation, and estimating the numbers of birds likely to be displaced in relation to estimated site populations from boat-based survey data (Table 15.8). Predictions of displacement rates are based on a detailed review of the available evidence for changes in seabird numbers at operational wind farms, compared with the numbers present pre-construction. Definitive and consistent findings are nonetheless relatively scarce, as discussed in Table 15.14. This has been taken account of by incorporating a number of assumptions into the assessment process, based on a precautionary interpretation of the available evidence. Modelling of the impacts of displacement indicates that birds may need to spend more time and energy in foraging, and this is likely to affect breeding success (MacDonald *et al.,* 2012). Thus it has been assumed that all, or a proportion, of displaced birds fail to breed (for a rationale see discussion under the heading of 'displacement' in *Section 15.6.2* above) and the assessment considers the potential impacts of the predicted reduction in breeding success on SPA populations. The best available scientific evidence has been used to inform the assumptions on which the assessment of impacts has been based.

427 This approach is applied below to SPA populations for species from sites where a LSE was concluded in relation to the Project. For each species, the total number of birds predicted to be displaced from the Development Area and 2 km buffer is assigned to individual SPAs based on the proportions in Table 15.31 above. This is used to estimate the reduction in breeding success of the SPA population assuming all displaced individuals of a species are from separate breeding pairs, and all or 50 per cent of displaced birds fail to breed successfully depending on the species (Tables 15.32 and 15.33). An assessment of displacement for each species at each SPA is included in Table 15.34.

428 Note that for common and Arctic tern no breeding failure is predicted in relation to displacement due to a minimal overlap between both species mean maximum foraging ranges and the Development Area.

Table 15.32: Seabird Populations at the Development Area and 2 km Buffer during the Breeding Season and Predicted Displacement

Bird Species	Breeding season site population: all age classes[1]	Breeding season site population: breeding adults[2]	Predicted displacement rate[3]	Predicted no. of breeding adults displaced	Predicted breeding failure for displaced birds[3]
Fulmar	72	36	100%	36	50%
Gannet	1,335	1,298	75%	973	50%
Kittiwake	2,248	1,673	30%	502	100%
Herring gull	20	8	30%	2	100%
Lesser black-backed gull	37	16	30%	5	100%

Bird Species	Breeding season site population: all age classes[1]	Breeding season site population: breeding adults[2]	Predicted displacement rate[3]	Predicted no. of breeding adults displaced	Predicted breeding failure for displaced birds[3]
Arctic tern	29	11	30%	3	0%*
Common tern	2	1	30%	<1	0%*
Razorbill	1,636	1,435	50%	718	100%
Guillemot	4,371	3,654	50%	1,827	100%
Puffin	3,600	2,956	50%	1,478	100%

1. The peak mean population for the Development Area and a 2 km buffer (see species tables in *Appendix 15A*, *Annex 15A.5*).

2. For kittiwake, razorbill, guillemot and puffin the proportion of breeding adults is based on age distributions estimated from PVA (*Appendix 15B*); for gannet it is assumed that all adult plumage birds are breeding (WWT Consulting, 2012); for other species it is assumed that 50% of adult plumage birds are breeding, based on advice from SNH (NIRAS 2012, Appendix 1).

3. Rationale for the displacement rate and the percentage of breeding failure resulting from displacement given in Table 15.14.

* For common and Arctic tern no breeding failure is predicted in relation to displacement due to a minimal overlap between both species mean maximum foraging ranges and the Development Area.

Table 15.33: Predicted Effects of Displacement on SPA Populations of Seabirds in Terms of Reduced Breeding Success

Bird Species	SPA	Predicted no. of Breeding Adults Displaced[1]	SPA Breeding Population and Breeding Success (pairs, chicks per pair per year)[2]	Predicted Productivity for SPA population (no. chicks)	Predicted no. of Chicks 'Lost' to Displacement[3]	Predicted Reduction in Breeding Success
Fulmar	Forth Islands	2	569 0.28	159	0.28	0.18%
	Buchan Ness to Collieston Coast	1	1,389 0.28	389	0.14	0.04%
	Fowlsheugh	1	119 0.28	33.3	0.14	0.42%
Gannet	Forth Islands	968	55,482 0.77	42,721	373	0.87%
Kittiwake	Forth Islands	37	3,766 0.466	1,755	17	0.97%
	Buchan Ness to Collieston Coast	9	14,133 0.695	9,822	6	0.06%
	Fowlsheugh	111	9,337 0.988	9,225	110	1.19%

Bird Species	SPA	Predicted no. of Breeding Adults Displaced[1]	SPA Breeding Population and Breeding Success (pairs, chicks per pair per year)[2]	Predicted Productivity for SPA population (no. chicks)	Predicted no. of Chicks 'Lost' to Displacement[3]	Predicted Reduction in Breeding Success
	St Abb's Head to Fast Castle	24	9,459 0.486	4,597	12	0.26%
Herring gull	Forth Islands	<1	5,376 0.98	5,268	<1	<0 .01%
	Buchan Ness to Collieston Coast	<1	3,114 0.98	3,052	<1	<0.01%
	Fowlsheugh	<1	259 0.98	254	<1	<0.01%
	St Abb's Head to Fast Castle	<1	606 0.98	594	<1	<0.01%
Lesser black-backed gull	Forth Islands	3	3,419 0.88	3,009	3	0.10%
Razorbill	Forth Islands	73	2,482 0.60	1,489	44	2.95%
	Fowlsheugh	195	3,524 0.60	2,114	117	5.53%

Bird Species	SPA	Predicted no. of Breeding Adults Displaced[1]	SPA Breeding Population and Breeding Success (pairs, chicks per pair per year)[2]	Predicted Productivity for SPA population (no. chicks)	Predicted no. of Chicks 'Lost' to Displacement[3]	Predicted Reduction in Breeding Success
	St Abb's Head to Fast Castle	27	1,762 0.60	1,057	16	1.51%
Guillemot	Forth Islands	208	15,152 0.66	10,000	137	1.37%
	Buchan Ness to Collieston Coast	18	13,975 0.66	9,224	12	0.13%
	Fowlsheugh	987	30,096 0.66	19,863	651	3.28%
	St Abb's Head to Fast Castle	198	24,257 0.66	16,010	131	0.82%
Puffin	Forth Islands	1,292	59,622 0.60	35,773	775	2.17%

Bird Species	SPA	Predicted no. of Breeding Adults Displaced[1]	SPA Breeding Population and Breeding Success (pairs, chicks per pair per year)[2]	Predicted Productivity for SPA population (no. chicks)	Predicted no. of Chicks 'Lost' to Displacement[3]	Predicted Reduction in Breeding Success
1. Based on the estimated site population of breeding adults (Table 15.26) and the proportion of the population estimated to derive from a given SPA (Table 15.25). 2. The most recent estimates of the number of breeding pairs within the SPA (Table 15.24) and mean annual breeding success (chicks per pair; various sources see Table 15.11). 3. Assumes that all or a proportion of displaced birds fail, depending on species (see Table 15.26 above), and that the breeding success of displaced birds would otherwise have been the average for the SPA population. * For Kittiwake, razorbill, guillemot and puffin has been assumed that all displaced birds fail to breed and derive from separate breeding pairs. Note: for common and Arctic tern no breeding failure is predicted in relation to displacement (Table 15.32) and neither species is therefore included in this table.						

Table 15.34: Assessment of Displacement for SPA Breeding Qualifying Species

Bird species	SPA	Assessment of Displacement
Fulmar	Forth Islands	Displacement from the Development Area and 2 km buffer is predicted to reduce the breeding success of fulmars by 0.18% (Table 15.33). The population trend of this species within the Forth Islands SPA is unclear (Lewis *et al*., 2012). This small change in breeding success is considered unlikely to affect the fulmar SPA population in the long term, given that this is a long lived species for which population growth is predicted to be considerably more sensitive to decline as a result of reductions in adult survival rates rather than breeding success. Although no specific population model for fulmar has been developed, a model for a demographically similar (high adult survival and low fecundity rate) species, gannet, indicated that changes in reproductive rates (over a range of ± 4%) had little impact on population growth (WWT Consulting, 2012).
	Buchan Ness to Collieston Coast	Displacement from the Development Area and 2 km buffer is predicted to reduce the breeding success of fulmars by 0.04% (Table 15.33). Fulmars are decreasing within Buchan Ness to Collieston Coast SPA but confidence in the trend is low (Lewis *et al*., 2012). This very small predicted change in breeding success is considered unlikely to negatively affect the fulmar population.
	Fowlsheugh	Displacement from the Development Area and 2 km buffer is predicted to reduce the breeding success of fulmars by 0.42% (Table 15.33). Fulmars are decreasing within Fowlsheugh SPA but confidence in the trend is low (Lewis *et al*., 2012). This small predicted change in breeding success is considered unlikely to negatively affect the fulmar population.
Gannet	Forth Islands (Bass Rock)	Displacement from the Development Area and 2 km buffer is predicted to reduce the breeding success of gannets by 0.87% (Table 15.33). Gannet numbers at Bass Rock (the only breeding colony in the Forth Islands SPA) are increasing with moderate confidence in the trend (Lewis *et al*., 2012). A population model for gannets in the British Isles indicated that changes in reproductive rates (over a range of ± 4%) had very little predicted impact on population growth rate (WWT Consulting, 2012) i.e. there was no increased risk of population decline. No negative effects are predicted.
Kittiwake	Forth Islands	Displacement from the Development Area and 2 km buffer is predicted to reduce the breeding success of kittiwakes by 0.97% (Table 15.33). Kittiwakes are decreasing within the Forth Islands SPA with very high confidence in the trend (Lewis *et al*., 2012). It seems possible that this level of change in productivity might affect the population of the species as a viable component of the site. PVA has been carried out to investigate this further and is discussed below.

Bird species	SPA	Assessment of Displacement
	Buchan Ness to Collieston Coast	Displacement from the Development Area and 2 km buffer is predicted to reduce the breeding success of kittiwakes by 0.06% (Table 15.33). The kittiwake population at Buchan Ness to Collieston Coast is stable with moderate confidence in the trend (Lewis *et al.*, 2012). The predicted change in breeding success is much smaller than other SPAs. However to consider whether that this might affect the population of the species as a viable component of the site PVA has been carried out to investigate this further and is discussed below.
	Fowlsheugh	Displacement from the Development Area and 2 km buffer is predicted to reduce the breeding success of kittiwakes by 1.19% (Table 15.33). The kittiwake population at Fowlsheugh is decreasing but with low confidence in the trend (Lewis *et al.*, 2012). It seems possible that this level of change in productivity might affect the population of the species as a viable component of the site. PVA has been carried out to investigate this further and is discussed below.
	St Abb's Head to Fast Castle	Displacement from the Development Area and 2 km buffer is predicted to reduce the breeding success of kittiwakes by 0.26% (Table 15.33). The kittiwake population at St Abb's Head to Fast Castle is decreasing with moderate confidence in the trend (Lewis *et al.*, 2012). It seems possible that this level of change in productivity might affect the population of the species as a viable component of the site. PVA has been carried out to investigate this further and is discussed below.
Herring gull	Forth Islands	Displacement from the Development Area and 2 km buffer is predicted to reduce the breeding success of herring gulls by <0.01% (Table 15.33). A reduction of that magnitude is not considered to significantly affect the population. The herring gull population of the Forth Islands is considered stable with high confidence in the trend (Lewis *et al.*, 2012).
	Buchan Ness to Collieston Coast	Displacement from the Development Area and 2 km buffer is predicted to reduce the breeding success of herring gulls by <0.01% (Table 15.33). A reduction of that magnitude is not considered to significantly affect the population. The herring gull population of Buchan Ness to Collieston Coast is considered stable but with low confidence in the trend (Lewis *et al.*, 2012).
	Fowlsheugh	Displacement from the Development Area and 2 km buffer is predicted to reduce the breeding success of herring gulls by <0.01% (Table 15.33). The population trend of this species at Fowlsheugh is unclear (Lewis *et al.*, 2012). However, given the very small predicted reduction in breeding success, no negative effect is predicted.
	St Abb's Head to Fast Castle	Displacement from the Development Area and 2 km buffer is predicted to reduce the breeding success of herring gulls by <0.01% (Table 15.33). The population trend of this species at St Abb's Head to Fast Castle is decreasing with moderate

Bird species	SPA	Assessment of Displacement
		confidence in the trend (Lewis *et al*., 2012). However, given the very small predicted reduction in breeding success, no negative effect is predicted.
Lesser black-backed gull	Forth Islands	Displacement from the Development Area and 2 km buffer is predicted to reduce breeding success by 0.10% (Table 15.33). Lesser black-backed gulls are increasing at the Forth Islands SPA with high confidence in the trend (Lewis *et al*., 2012). Given the very small predicted reduction in breeding success, no negative effect is predicted.
Arctic tern	Forth Islands	Displacement from the Development Area and 2 km buffer is not predicted to reduce breeding success (Table 15.32). The mean maximum foraging range (plus one SD) of Arctic tern (30.5 km, Thaxter *et al.,* 2012; *Appendix 15A*, Table 15A.5) only has a minimal overlap with the Development Area. Furthermore, it is known that during the breeding season the species' core foraging range extends to 10 km from nesting colonies (BirdLife International Seabird Database 2012; Thaxter *et al.,* 2012). Baseline surveys over two breeding seasons recorded very low numbers of Arctic terns during this time of year (see Table 15.14). Therefore the Development Area – at 29 km from the Forth Islands at the nearest point (Table 15.24) is evidently not an important foraging area during the breeding season and no impacts on breeding success are predicted (see the species assessment in Table 15.14 for more detail). No negative effect is therefore predicted.
Common tern	Forth Islands	Displacement from the Development Area and 2 km buffer is not predicted to reduce breeding success (Table 15.32). The mean maximum foraging range (plus one SD) of common tern (26.4 km, Thaxter *et al.,* 2012; *Appendix 15A*, Table 15A.5) only has a minimal overlap with the Development Area. Furthermore, it is known that during the breeding season the species' core foraging range extends to 8.0 km from nesting colonies (BirdLife International Seabird Database 2012; Thaxter *et al.,* 2012). Baseline surveys over two breeding seasons recorded very low numbers of common terns during this time of year, with none recorded within the Development Area (see Table 15.14). Therefore, the Development Area – at 29 km from the Forth Islands at the nearest point (Table 15.24) is evidently not an important foraging area during the breeding season and no impacts on breeding success are predicted (see the species assessment in Table 15.14 for more detail). No negative effect on population viability is therefore predicted.
Razorbill	Forth Islands	Displacement from the Development Area and 2 km buffer is predicted to reduce breeding success by 2.95% (Table 15.33). The razorbill population is considered to be stable at the Forth Islands SPA with very high confidence in the trend (Lewis *et al*., 2012). It seems possible that this level of change in productivity might affect the population of the species as a viable component of the site. Population viability analysis has been carried out to investigate this further, discussed below.

Bird species	SPA	Assessment of Displacement
	Fowlsheugh	Displacement from the Development Area and 2 km buffer is predicted to reduce breeding success by 5.53% (Table 15.33). The population trend of razorbills at Fowlsheugh is unclear (Lewis *et al*., 2012). It seems possible that this level of change in productivity might affect the population of the species as a viable component of the site. Population viability analysis has been carried out to investigate this further, discussed below.
	St Abb's Head to Fast Castle	Displacement from the Development Area and 2 km buffer is predicted to reduce breeding success by 1.51% (Table 15.33). Razorbills are decreasing at St Abb's Head to Fast Castle but with low confidence in the trend (Lewis *et al*., 2012). It seems possible that this level of change in productivity might affect the population of the species as a viable component of the site. Population viability analysis has been carried out to investigate this further, discussed below.
Guillemot	Forth Islands	Displacement from the Development Area and 2 km buffer is predicted to reduce breeding success by 1.37% (Table 15.33). Guillemots are decreasing at the Forth Islands SPA with very high confidence in the trend (Lewis *et al*., 2012). It seems possible that this level of change in productivity might affect the population of the species as a viable component of the site. Population viability analysis has been carried out to investigate this further, discussed below.
	Buchan Ness to Collieston Coast	Displacement from the Development Area and 2 km buffer is predicted to reduce breeding success by 0.13% (Table 15.33). Guillemots are decreasing at Buchan Ness to Collieston Coast but with low confidence in the trend (Lewis *et al*., 2012). Although a very small reduction in potential breeding success is predicted, the possibility that this might affect a declining population has been investigated through population viability analysis, discussed below.
	Fowlsheugh	Displacement from the Development Area and 2 km buffer is predicted to reduce breeding success by 3.28% (Table 15.33). Guillemots are decreasing at Fowlsheugh but with low confidence in the trend (Lewis *et al*., 2012). It seems possible that this level of change in productivity might affect the population of the species as a viable component of the site. Population viability analysis has been carried out to investigate this further, discussed below.
	St Abb's Head to Fast Castle	Displacement from the Development Area and 2 km buffer is predicted to reduce breeding success by 0.82% (Table 15.33). Guillemots are decreasing at St Abb's Head to Fast Castle but with low confidence in the trend (Lewis *et al*., 2012). Although a small reduction in potential breeding success is predicted, the possibility that this might affect a declining population has been investigated through population viability analysis, discussed below.

Bird species	SPA	Assessment of Displacement
Puffin	Forth Islands	Displacement from the Development Area and 2 km buffer is predicted to reduce breeding success by 2.17% (Table 15.33). The population trend of puffins at the Forth Islands SPA is unclear (Lewis *et al*., 2012). It seems possible that this level of change in productivity might affect the population of the species as a viable component of the site. Population viability analysis has been carried out to investigate this further, discussed below.

Population Viability Analysis to Model the Impacts of Direct Displacement during Operation and Maintenance

429 As explained in Table 15.34, PVA has been carried out to further investigate the population impacts of displacement for kittiwake, razorbill, guillemot and puffin. In each case, population models were developed based on empirical estimates of demographic parameters (rates of survival and reproduction) from regional populations with potential connectivity to the Development Area. Full details are included in Appendix 15B. These regional population models are used here to inform the assessment of impacts on these four species at the level of each SPA population.

430 The Population Viability Analysis carried out here assesses whether the predicted impacts could affect the annual population processes such that the long term viability of the population is compromised. While the models produced predicted effects up to 25 years into the future, the ability to predict further into the future was only limited by the uncertainties in the model processes. As is typical with population modelling, the ability of this model to make usable predictions beyond 25 years is low. However, since the predicted impacts from the Project were concluded not to impact population viability through the annual processes it is likely, within the assumptions of the model, that this conclusion would be maintained in the longer term.

Kittiwake

431 For the population model, information on survival was derived from kittiwakes on the Isle of May, and breeding success was estimated as a mean of data from all four SPAs where a LSE was concluded. The model predicts a decline in the regional breeding population of about 50 per cent over 25 years with no additional impacts (see *Appendix 15B*, *15B.3.2.1*). Predicted declines from the population model are consistent with trends for three SPAs, as identified in a recent review of seabird populations at Scottish SPAs (Lewis *et al*., 2012): Forth Islands, St Abb's Head to Fast Castle and Fowlsheugh (declines identified with respectively high, moderate and low confidence). The SPA population at Buchan Ness to Collieston Coast is considered to be stable (with moderate confidence). Kittiwakes at Scottish colonies have declined steadily since the late 1980s and in 2011 reached the lowest point yet recorded. It seems likely, given the declining trend in productivity recorded since 1986 that the decline will continue (JNCC, 2012). These changes have been driven by declines in the abundance of

sandeels, the main prey species in the breeding season, the latter in turn affected by fishing effort and increases in sea surface temperatures (Frederiksen *et al*., 2004). Thus the population model developed here is considered to provide predictions which are consistent with the observed trends for the regional kittiwake population and populations at three of the four SPAs for which an LSE has been identified.

432 Incorporating the predicted effects of displacement (30 per cent of birds displaced, of which 100 per cent fail to breed) into the model produces a 0.9 per cent reduction in annual breeding success (i.e. the percentage reduction in the estimated number of fledglings produced by the population under this displacement scenario relative to that in the absence of any impacts – see *Appendix 15B*, Table 15B.10). This has a very small effect on the population growth rate (changing it from 0.9718 to 0.9716) and reduces the predicted population size after 25 years by about 400 birds (equivalent to <0.5 per cent of the 25-year population size predicted in the absence of any displacement impacts). Compared to a model with no displacement impacts, 30 per cent displacement causes very marginal differences, and the mean probability of the population decline under the two scenarios is statistically not-significant, at all levels of decline (*Appendix 15B*, Figure 15B.5).

433 The PVA was applied to the regional breeding population but an assessment of how the findings from the PVA relate to the individual SPA populations can be made. This involves comparing the predicted impact of displacement on the breeding success of the regional population with that predicted for the different SPA populations (based on the predicted numbers of birds displaced - at 30 per cent displacement - and the assumption that all displaced birds are from separate pairs which will fail – see Table 15.32). The effect of displacement on the respective SPA populations can then be assessed by direct inference from the PVA, based upon the extent of the predicted reduction in breeding success relative to that for the regional population (to which the PVA relates). Thus, from the PVA, displacement is predicted to reduce the breeding success of the regional breeding population by 0.9 per cent, which is greater than the predicted impact (from the estimated numbers displaced) on the breeding success of both the Buchan Ness to Collieston Coast and St Abb's Head to Fast Castle SPA populations (at 0.06 per cent and 0.26 per cent, respectively) and close to that for the Forth Islands SPA population (at 0.97 per cent). Therefore, the predicted effects of displacement (from the estimated number of birds displaced) on each of these SPA populations will be less than, or similar to, that for the regional breeding population (from PVA). The reduction in breeding success resulting from displacement that is predicted to occur (based on the estimated numbers of birds displaced) in the Fowlsheugh SPA population is slightly greater than for the regional breeding population, at 1.19 per cent. However, given the small magnitude of effects predicted on the regional breeding population, the predicted effects on this SPA population are also likely to be small. Certainly, the predicted effects on the regional breeding population from PVA remain relatively small, even when the assumed displacement rate is doubled from 30 per cent to 60 per cent, which produces a 1.8 per cent reduction in breeding success (see *Appendix 15B*, *Section 15B.3.2.3*).

434 Taking into account the precautionary assumptions used to assess displacement effects (e.g. that displacement levels in the 2.0 km buffer are equal to those within the Development Area and that all displaced birds fail to breed), this suggests that displacement as a result from the Project alone is not considered likely to cause adverse impacts on the population viability for the kittiwake qualifying interest at any of the SPAs for which a LSE has been identified.

Razorbill

435 For razorbill, specific information on survival and breeding success has been found only for the Isle of May population (Forth Islands SPA). A model based on these parameters predicts an increasing population over the next 25 years, with a probability of about 0.5 of a 50 per cent increase (see *Appendix 15B*, *Section 15B.3.4.1*). Incorporating the potential impacts of displacement (in terms of reduced breeding success) indicates that the effect on the regional breeding population is to limit the predicted population increase. Assuming 50 per cent displacement (with 100 per cent breeding failure amongst displaced birds) indicates a near 10 per cent decrease in the likelihood of the population increasing by at least 50 per cent (see *Appendix 15B*, *Section 15B.3.4.2*). Thus, based upon the PVA used here, the predicted rates of displacement (via reduced breeding success) from the Project alone are highly unlikely to cause population decline, but may limit growth. The extent to which displacement may limit growth is predicted to be greatest for situations of relatively high population growth (i.e. for population increases of 25 – 75 per cent, displacement decreases the likelihood of achieving such increases by c.6 – 10 per cent). However, for more moderate levels of population increase, the risk of displacement impacts are reduced (Figure 15B.11). The razorbill PVA also investigated the effects of 25 per cent displacement and (for both 50 per cent and 25 per cent displacement) of smaller reductions in breeding success (i.e. 75 per cent and 50 per cent of displaced birds failing to breed, with each displaced bird from a separate breeding pair, as opposed to 100 per cent). As would be expected, these predicted impacts are considerably less when 25 per cent displacement is assumed, so that the likelihood of achieving relatively high population growth of 25 - 75 per cent is reduced by only 3 - 4 per cent (see *Appendix 15B*, Table 15B.12). Similarly, reducing the assumed level of breeding failure amongst displaced birds reduces the predicted impact. With 50 per cent displacement, a reduction from 100 per cent to 75 per cent in the assumed breeding failure amongst displaced birds produces marginal differences only, but with 50 per cent breeding failure the predicted reduction in the likelihood of the population achieving relatively high growth is at most 5 per cent (see *Appendix 15B*, Table 15B.12).

436 As detailed earlier in this chapter (see razorbill assessment in Table 15.14), in some respects there is greater uncertainty concerning the predicted population trends from the razorbill population model than for those from the models developed for the other species on which PVA was undertaken, due to a lack of availability of recent data from the region (i.e. the Scottish east coast) on certain demographic parameters for razorbill. Additionally, the available data on razorbill population trends within the region are of limited value in assessing the likely reliability of the model outputs, with no clear overall trend apparent from the monitoring data (Lewis *et al.,* 2012), so that they neither provide strong support for the modelled trends nor sufficient evidence to conclude that the modelled trends are a poor

representation of the real situation (see Table 15.14). However, given that; (i) the assessment of breeding season displacement impacts involves several precautionary assumptions (e.g. that displacement levels in the 2.0 km buffer are equal to those within the Development Area and that all displaced birds fail to breed and derive from separate breeding pairs), and (ii) the PVA predicts that displacement even under the most precautionary scenario considered (i.e. 50 per cent with all displaced birds failing to breed) is likely to limit population growth, as opposed to changing the trajectory to one of stability or decline; then breeding season displacement is likely to have a minor impact only on the regional breeding population (see Table 15.14).

437 An assessment of how the findings from the PVA relate to the individual SPA populations can be made through comparisons of the predicted impact of displacement on the breeding success of the respective populations. Thus, for the regional breeding population, as examined in the PVA, displacement (at the 50 per cent level, with an assumption that all displaced birds fail to breed) is predicted to reduce the breeding success of the regional breeding population by 5.03 per cent (i.e. the percentage reduction in the estimated number of fledglings produced by the population under this displacement scenario relative to that in the absence of any impacts – see *Appendix 15B*, Table 15B.10). This, is substantially greater than the reduction in breeding success predicted for both the Forth Islands and St Abb's Head to Fast Castle SPA populations (at 2.95 per cent and 1.51 per cent, respectively, based on the numbers of birds from each SPA predicted to be displaced, Table 15.33). This indicates that impacts of displacement on changes in population growth rates of the Forth Islands and St Abb's Head to Fast Castle SPA populations will be less than those predicted for the overall regional breeding population. In the case of the Forth Islands SPA population, the predicted reduction in breeding success (under 50 per cent displacement and 100 per cent breeding failure amongst displaced birds) is similar to that generated for the regional breeding population from PVA under the scenario of 25 per cent displacement and 100 per cent breeding failure amongst displaced birds (which gives a 2.6 per cent reduction in breeding success), whilst for the St Abb's to Fast Castle SPA population it is similar to that generated for the regional breeding population under the scenario of 25 per cent displacement and 50 per cent breeding failure amongst displaced birds (which gives a 1.3 per cent reduction in breeding success). As described above (and detailed in *Appendix 15B*, *Section 15B.3.42*), these scenarios are predicted to produce considerably smaller impacts on the regional breeding population in terms of changes in population growth rates. This suggests that the impacts on both of these SPA populations will be small, even when 50 per cent displacement and 100 per cent breeding failure amongst displaced birds is assumed.

438 Based on the numbers of birds predicted to be displaced, a 5.53 per cent reduction in razorbill breeding success is predicted for Fowlsheugh SPA (Table 15.33). This is marginally larger than the reduction in breeding success predicted for the regional breeding population by PVA, and therefore predicted effects of displacement on this population, in terms of changes in population growth rate, are likely to be marginally greater than those predicted on the regional breeding population.

439 Therefore, based upon the PVA predictions for the regional breeding population, in conjunction with the reductions in breeding success estimated to result from displacement in the respective SPA populations, it is likely that displacement will have a substantially lower impact on both the Forth Islands and St Abb's Head to Fast Castle SPA populations than on the regional breeding population. Although, the reduction in breeding success from displacement for the Fowlsheugh SPA population is estimated to be higher than that for the regional breeding population, the difference is marginal and so the predicted impacts on the Fowlsheugh SPA population are likely to be of similar magnitude to those predicted for the regional breeding population (assessed as a minor impact in relation to the EIA, Table 15.14). As such, displacement as a result from the Project alone is not considered likely to cause adverse impacts on the population viability for the razorbill qualifying interest at any of the SPAs for which a LSE has been identified.

440 It is noted that two post-construction monitoring reports for offshore wind farms – for Robin Rigg, Scotland (Walls *et al*., 2013) and Blighbank, Belgium (Vanermen *et al.,* 2012), have suggested that any reduction in razorbill densities after WTGs are in place may in fact be relatively small.

<u>*Guillemot*</u>

441 For guillemot, specific information on survival and breeding success has also been found only for the Isle of May population (part of the Forth Islands SPA). The model predicts a decline of about 25 per cent in the regional breeding population over 25 years with no additional impacts (see *Appendix 15B*, *Section 15B.3.3.1*), which fits with reported declines at all four SPAs identified for LSE, although confidence in the trend is low at all except the Forth Islands SPA (Table 15.30; Lewis *et al.*, 2012). More widely, the population trend of guillemots in Scotland increased slightly between the early 1990s and 2001 but numbers have since declined, with recent low breeding productivity across Scotland and possible reductions in adult survival rates suggesting that declines are likely to continue into the future (JNCC, 2012). Although it is affecting a declining population, the population model predicts that displacement (50 per cent of birds displaced, with all displaced birds failing to breed) has a negligible effect on increasing the chance of population decline up to about 10 per cent and of large reductions of ≥75 per cent. For population reductions of 25 or 50 per cent, the effect of displacement is to increase the likelihood of such declines by approximately 2 per cent (Figure 15B.8, Appendix 15B).

442 An assessment of how the findings from the PVA relate to the individual SPA populations can be made through comparisons of the predicted impact of displacement on the breeding success of the respective populations. Thus, for the regional breeding population, as examined in the PVA, displacement is predicted to reduce the breeding success of the regional breeding population by 1.5 per cent (i.e. the percentage reduction in the estimated number of fledglings produced by the population under this displacement scenario relative to that in the absence of any impacts – see *Appendix 15B*, Table 15B.10). This is greater than the reduction in breeding success predicted (based on the estimated number of SPA birds displaced) for all SPA populations other than Fowlsheugh (Table 15.33). Thus, predicted effects of displacement on the Forth Islands, St Abb's Head to Fast Castle and Buchan Ness

to Collieston Coast SPA populations will be similar to or smaller than those predicted for the regional breeding population.

443 A 3.28 per cent reduction in breeding success is predicted to occur in the Fowlsheugh SPA population (based on the estimated number of birds displaced) as a result of displacement, which is slightly more than double that predicted for the regional breeding population. Therefore, in terms of population trends and the probabilities of decline, the predicted effects of displacement on this SPA population are likely to be analogous to those predicted by the PVA to arise in the regional breeding population from 100 per cent displacement (with all displaced birds failing to breed), which produces a 3 per cent reduction in breeding success. Under this scenario, the likelihood of population reductions of 25–50 per cent is increased by 3-5 per cent compared to the 'no-impact' scenario, as opposed to an approximate 2 per cent increase in likelihood when 50 per cent displacement is assumed (see *Appendix 15B*, Figure 15B.8).

444 Given that the population model developed for the Project regional breeding guillemot population (including populations of SPAs where a LSE was concluded) indicates that displacement from the Wind Farm is not likely to cause a biologically important change in the population growth rate, this is also likely to be the case for the three SPAs at which the predicted reduction in breeding success is less than that for the regional breeding population. In particular, for the SPA populations at Buchan Ness to Collieston Coast and St Abb's Head to Fast Castle, the predicted reductions in breeding success are sufficiently small (at 0.13 per cent and 0.82 per cent, respectively) that little discernible effects of displacement are likely. Although a greater reduction in breeding success is predicted to occur within the Fowlsheugh SPA population, when this is interpreted in the context of the PVA outputs it still indicates a relatively small impact on the population. Thus, the likelihood of the Fowlsheugh SPA population undergoing a moderate to large decline is likely to increase by 3-5 per cent, which is still equivalent to a 'very unlikely' event according to IPCC guidance (IPCC, 2010). Further, taking into account the precautionary assumptions used to assess displacement effects (e.g. that displacement levels in the 2.0 km buffer are equal to those within the Development Area and that all displaced birds fail to breed and derive from separate breeding pairs), this suggests that displacement as a result from the Project alone is not considered likely to cause adverse impacts on the population viability for the guillemot qualifying interest at the Fowlsheugh SPA.

Puffin

445 Data for the population model were derived from the Isle of May within the Forth Islands, the only SPA where this species contributed to a conclusion of LSE. The population model predicts an increase of about 10 per cent in the regional breeding population over 25 years, although with considerable variability about the mean values for population size, which indicates a high degree of uncertainty in the predictions (see *Appendix 15B*, *Section 15B.3.5.1*). Displacement has little impact on the likelihood of the population achieving particular thresholds of population increase. Such impacts only become consistent and marked if displacement affects close to 100 per cent of birds.

446 An assessment of how the findings from the PVA relate to the population for the single SPA for which a LSE was concluded can be made by comparing the predicted impact of displacement on the breeding success of the regional breeding population from the PVA with that for the Forth Islands SPA population. Thus, breeding success is predicted to be reduced by 1.5 per cent in the regional population (as examined in the PVA) and by 2.17 per cent in the Forth Islands SPA population (Table 15.33), indicating that the predicted effects of displacement will be greater on the SPA population than on the regional breeding population. However, the predicted effect remains small. This is evident from the fact that, in terms of population trends and the probabilities of decline, the predicted effects of displacement on the SPA population are likely to be analogous to those predicted to arise in the regional breeding population from 75 per cent displacement (with all displaced birds failing to breed), which produces a 2 per cent reduction in breeding success. Under this scenario, displacement is also predicted to have very little discernible effect on the likelihood of population increases (see *Appendix 15B*, Figure 15B.14).

447 Lewis *et al*. (2012) indicate that the recent trend of puffins in the Forth Islands SPA is unclear. Harris and Wanless (2011) report that on the Isle of May, numbers increased steadily from the mid 1950s until 2003 but had declined by about 30 per cent by 2008, which seemed to be associated with two consecutive winters (2006/07 and 2007/08) of aberrant low adult survival; similar changes appear to have taken place at other colonies within the Forth Islands SPA. Adult survival rates appear to have increased to more typical levels in the past two years, so it is unclear whether the recent population declines will be of a short or long-term nature.

448 Recent UK and Scottish trends for puffins are not available due to the logistical difficulties of regular monitoring of these burrow-nesting birds. Numbers were estimated in national seabird censuses in 1969–70, 1885–88 and 1998–2002, indicating an increase in the UK population over this period (JNCC, 2012).

449 Based on the above, although there is considerable variation around the model predictions, displacement impacts (via reductions in breeding success) are not considered likely to cause population declines, even with the precautionary assumptions, but to limit population growth, with the predicted effects being small (see *Appendix 15B*, *Section 15B.3.5.2*). Displacement as a result from the Project alone is not considered likely to cause adverse impacts on the population viability for the puffin qualifying interest at the Forth Islands SPA.

Barrier effect

450 Barrier effect was identified as a potential impact on breeding seabirds as part of the HRA screening process. In practice, however, barrier effects for breeding seabirds are considered to be a component of displacement. Breeding seabirds will make repeated journeys from nest sites to foraging areas. Displacement – the reduction of numbers of seabirds of a given species within a wind farm post-construction – may result from a combination of scenarios whereby (i) all or a proportion of individuals of a given species that would have used the Development Area prior to the Wind Farm construction move elsewhere to forage, and (ii) all or a proportion of birds travelling to foraging areas beyond the Wind Farm fly around it

rather than through. Thus the costs to seabirds of repeatedly flying around rather than through a wind farm are considered to be contributory to the prediction of reduced breeding success which has been used to assess displacement. This approach is consistent with the modelling approach to displacement that has been developed by CEH on behalf of Marine Scotland for guillemot (MacDonald *et al*,. 2012). Thus the conclusions of the assessment for breeding seabirds in relation to displacement take into consideration the potential for the Wind Farm to act as a barrier to seabirds during trips between nest sites and foraging areas. Therefore no separate conclusions are presented for barrier effects.

Collision risk for SPAs with Breeding Qualifying Species

451 The risk of collision with WTGs was not identified as contributing to a LSE due to impacts on fulmar, common and Arctic tern, razorbill, guillemot and puffin, as these species did not generally fly at potential collision height (see *Appendix 15A*, *Section 15A.4.1*).

452 Herring gull and lesser black-backed gull were uncommon in the Development Area during the breeding season. For both species there were too few records of birds in flight during the breeding season to reliably estimate flight density for collision risk modelling (Table 15.15). Consequently collision risk during the breeding season is considered to be extremely low for these species, given the level of flight activity recorded during the baseline survey programme.

453 For gannet and kittiwake collision mortality for regional populations of seabirds in relation to the Wind Farm has been assessed by using the Band (2012) collision risk model to predict the number of deaths and comparing this to available information on survival rates for a given species. Collision risk has been assessed on the basis of increased rates of adult mortality, with the most precautionary scenarios assuming that all birds killed as a result of collisions are part of the breeding population, although this is unlikely to be the case in reality. The worst case scenario applied for collision risk was 213 large WTGs. An avoidance rate of 99 per cent was applied for gannet, and 98 per cent for kittiwake, although figures derived from the 99 per cent avoidance rate are also presented in the assessment to provide context - see discussion of collision risk and avoidance rates in *Section 15.6.2* (under the heading '*Collision Risk*').

454 This approach is applied below to the gannet and kittiwake qualifying features of SPAs where a LSE was concluded in relation to the Wind Farm. For each species, the total number of birds predicted to be killed due to collisions with WTGs at the Wind Farm during the breeding season (under the worst case scenario) is assigned to individual SPA populations based on the proportions in Table 15.31 above. This is used to estimate the potential increase in mortality for the SPA population (Table 15.35). An assessment of collision risk mortality during the breeding season for each relevant population of the qualifying features of the SPAs where a LSE was concluded is included in Table 15.36.

Table 15.35: Predicted Effects of Collision Mortality on SPA Breeding Seabird Populations in Terms of Increased Adult Mortality

Bird Species	Predicted Breeding Season Collision Mortality: Breeding Adults (Avoidance Rate) [1]	SPA	Collision Mortality Apportioned to SPA[2]	SPA Breeding Population (individuals)[3]	Adult Survival Rate (per year)[4]	Predicted Increase in Mortality from Collision[5]
Gannet	315 (99%)	Forth Islands (Bass Rock)	313	110,964	0.919	3.48%
Kittiwake	18 (98%) 9 (99%)	Forth Islands	1 (0.5)	7,532	0.88	0.11% (0.06%)
		Buchan Ness to Collieston Coast	<1 (<1)	28,266		0.01% (<0.01%)
		Fowlsheugh	4 (2)	18,674		0.18% (0.09%)
		St Abb's Head to Fast Castle	1 (0.5)	18,918		0.04% (0.02%)

1. From Table 15.15.

2. See Table 15.31 for apportionment to SPAs Collision mortality for kittiwake at 99% avoidance is provided in brackets.

3. SPA population estimates expressed as individuals by doubling the no. of pairs.

4. Sources of adult survival rates in *Appendix 15A*, Table 15A.4;

5. For kittiwake predicted mortality increase at 99% avoidance is provided in brackets.

Table 15.36: Assessment of Breeding Season Collision Risk for SPA Qualifying Species

Bird species	SPA	Assessment of Collision Risk
Gannet	Forth Islands (Bass Rock)	Collision with WTGs at the Wind Farm is predicted to kill 313 breeding adult gannets from the Forth Islands SPA during the breeding season and increase the mortality of adults by 3.48% (Table 15.35). This assumes that 100% of the estimated site population of adult birds is breeding (WWT Consulting, 2012). Gannet numbers at Bass Rock (the only breeding colony in the Forth Islands SPA) are increasing with moderate confidence in the trend (Lewis *et al*., 2012). A population model for gannets in the British Isles (WWT Consulting, 2012) has assessed the potential numbers that could be killed without a high risk of population decline (before the average population growth rate will fall to one, equivalent to stability). This has estimated a harvest of 2,000 birds per year for the Bass Rock colony and 10,000 for the British and Irish population. The predicted breeding season collision mortality for gannets in the Forth Islands falls well within this limit.
Kittiwake	Forth Islands	Collision with WTGs at the Wind Farm is predicted to kill one breeding adult kittiwake per season from the Forth Islands SPA (at an avoidance rate of 98%) during the breeding season and increase the mortality of adults by 0.11% (Table 15.35). Just considering predicted collision mortality during the breeding season, however, could potentially under-estimate the impact on the SPA breeding population of kittiwakes, as birds from this population might also be at risk of collision during the post-and non-breeding season. Kittiwakes are decreasing within the Forth Islands SPA with high confidence in the trend (Lewis *et al*., 2012). PVA was carried out to further investigate the effect of collision risk, as described below.
	Buchan Ness to Collieston Coast	Collision with WTGs at the Wind Farm is predicted to kill less than one breeding adult kittiwake per year from the Buchan Ness to Collieston Coast SPA during the breeding season and increase the mortality of adults by 0.01% (Table 15.35). Just considering predicted collision mortality during the breeding season, however, could potentially under-estimate the impact on the SPA breeding population of kittiwakes, as birds from this population might also be at risk of collision during the post-and non-breeding season. The kittiwake population at Buchan Ness to Collieston Coast is stable with moderate confidence in the trend (Lewis *et al*., 2012). PVA was carried out to further investigate the effect of collision risk, as described below.
	Fowlsheugh	Collision with WTGs at the Wind Farm is predicted to kill four breeding adult kittiwakes per year from the Fowlsheugh SPA during the breeding season and increase the mortality of adults by 0.18% (Table 15.29). Just considering predicted collision mortality during the breeding season, however, could potentially under-estimate the impact on the SPA breeding population of kittiwakes, as birds from this population might also be at risk of collision during the post-and non-breeding season. The kittiwake population at Fowlsheugh is decreasing but with low confidence in the trend (Lewis *et al*., 2012). PVA was carried out to further investigate the effect of collision risk, as described below.

Bird species	SPA	Assessment of Collision Risk
	St Abb's Head to Fast Castle	Collision with WTGs at the Wind Farm is predicted to kill one breeding adult kittiwake per year from the St Abb's Head to Fast Castle SPA during the breeding season and increase the mortality of adults by 0.04% (Table 15.29). Just considering predicted collision mortality during the breeding season, however, could potentially under-estimate the impact on the SPA breeding population of kittiwakes, as birds from this population might also be at risk of collision during the post-and non-breeding season. The kittiwake population at St Abb's Head to Fast Castle is decreasing with moderate confidence in the trend (Lewis *et al*., 2012). PVA was carried out to further investigate the effect collision risk, as described below.

Population Viability Analysis for Kittiwake to Model Impacts of Collision Mortality on SPAs' for which it a Qualifying Species

455 Although the predicted mortality of breeding adult kittiwakes in the breeding season is very low for all four SPAs identified for LSE (Table 15.35), an unknown number of adults from these SPA populations may also be at risk of collision during the post-breeding and non-breeding seasons. Four different scenarios (see *Appendix 15B*, *Section 15B.3.2.2*) were considered for incorporating collision mortality into the kittiwake PVA for the regional population – which includes these four SPAs. The most precautionary of these used the collision estimate derived with the 98 per cent avoidance rate and assumed that all kittiwakes predicted to be killed during all seasons are part of the regional breeding population. This is highly unlikely, as tracking of kittiwakes from the Isle of May has revealed that many of the birds that breed in this region winter in the Atlantic (including the far west), with a substantial proportion (>50 per cent of those tracked) having moved out of the North Sea region by early September (Bogdanova *et al.,* 2011; Frederiksen *et al.,* 2012). Many of the kittiwakes recorded within the Development Area during the post-breeding and winter periods are likely to derive from Arctic and subarctic breeding colonies (Frederiksen *et al.*, 2012). Therefore, collision mortality was also incorporated into the PVA under the assumption that 100 per cent, 50 per cent and 25 per cent of birds recorded during the breeding, post-breeding and winter periods, respectively, belonged to the regional breeding population. These two scenarios were also considered using the collision estimate derived with the 99 per cent avoidance rate. Thus, the number of birds from the regional breeding population that were assumed to be killed ranged from 123 (of which 76 were breeding adults) under the least precautionary scenario (99 per cent avoidance, with a proportion of the post-breeding and wintering birds from other breeding populations) to 548 (of which 335 were breeding adults) under the most precautionary scenario (98 per cent avoidance, with all birds from all seasons assumed to be from the regional breeding population).

456 Considering the effects of a range of additional mortalities (equivalent to 123 - 1000 birds per year, representing the mortality level from the least precautionary of the four collision estimate scenarios to one which was almost double that from the most precautionary of these scenarios) on the probability of the population declining to a range of thresholds,

shows relatively little effect of additional mortality on the probability of declining by up to 25 per cent (see *Appendix 15B*, Figure 15B.2 and Figure 15B.3). This is largely because of the high probability of decline to such thresholds even in the absence of additional mortality. However, for thresholds of 50 per cent and 75 per cent decline, additional mortality has a more marked effect on the probability of attaining a decline of such magnitude, although this is strongly influenced by the level of additional mortality. Thus, additional mortalities equivalent to removing 123 - 400 birds from the starting population increase the likelihood of such declines by c.2 - 4 per cent, with no apparent increase in this risk over this range of additional mortality (see *Appendix 15B*, Figure 15B.3). This range encompasses three of the four scenarios considered for the additional mortality resulting from the estimated collisions (i.e. all but the most precautionary scenario of 98 per cent avoidance with all collisions from all seasons assumed to involve birds from the regional breeding population). Higher levels of additional mortality produce a greater increase in the likelihood of the population experiencing declines of at least 50 per cent and 75 per cent, with the most precautionary collision mortality scenario producing an increase of c.7 – 8 per cent in the likelihood of such declines. The baseline population modelling suggests that there is more than a 70 per cent chance of the kittiwake population declining by 50 per cent in the absence of additional mortality, so that a decline of this magnitude may be considered as a ‘likely’ (IPCC, 2010), or ‘probable’ event (IEEM, 2010).

457 Applying SPA apportionment (Table 15.31) to the estimated breeding season mortality of kittiwakes at the Wind Farm predicts that very few breeding adult kittiwakes from all four SPAs where a likely significant effect was concluded will be affected during the breeding season: four birds from Fowlsheugh, one bird respectively from the Forth Islands and St Abb’s Head to Fast Castle, and less than one bird from Buchan Ness to Collieston Coast (Table 15.29). This was estimated to represent an increase of between 0.01 per cent (at Buchan Ness to Collieston Coast) and 0.18 per cent (at Fowlsheugh) in the expected annual mortality for each of these SPA populations (Table 15.35). By comparison, breeding season collisions represented an increase of 0.14 per cent in the annual mortality of the breeding adult age class in the regional breeding population (i.e. equivalent to the estimated collision mortality of breeding adults expressed as a percentage of the ‘natural’ annual mortality of the breeding adults amongst the regional breeding population, based upon an annual mortality rate of 0.12 per cent – see *Appendix 15B*, Table 15B.4). Thus, the predicted impact of collisions on the regional breeding population (on which the PVA was developed) was substantially greater than on the St Abb’s Head to Fast Castle and Buchan Ness to Collieston Coast SPA populations, slightly more than on the Forth Islands and slightly less than that for the Fowlsheugh SPA populations (Table 15.35).

458 However, the apportionment algorithm that has been developed (see *Appendix 15B*, *Section 15B.2.1.4*) is intended to give an indication of the relative numbers of birds in the Development Area that are likely to derive from each SPA, rather than a precise estimate. Outside the breeding season birds will range further from colonies as their movements are not restricted by having to return to the colony to breed and rear chicks, and so the apportionment calculations cannot be applied over such periods. Thus, kittiwakes breeding on the Isle of May leave for wintering grounds in the Atlantic Ocean between mid-July and

August, with the majority moving far from the region by September or October (Bogdanova *et al*., 2011; Frederiksen *et al.*, 2012). It is highly likely that birds from the other SPA colonies will make similar movements (Frederiksen *et al*., 2012). Therefore, although an unknown proportion of the estimated collision risk mortality for the post- and non-breeding periods will derive from SPA colonies, it is likely that only a relatively small proportion of such predicted collisions will involve local breeding birds, of which only some will be from SPAs identified for LSE.

459 With respect to the risk of collision mortality in the breeding season, tracking data is available for kittiwakes at the Forth Islands (Isle of May), Fowlsheugh and St Abb's Head (Daunt *et al*., 2011a, 2011b, 2011c). Data from the Isle of May (Forth Islands) indicate respective overlaps of 41 per cent, 0 per cent and 73 per cent between the foraging areas of tracked kittiwakes and the Development Area in the three years 2001, 2002 and 2010. For Fowlsheugh and St Abb's Head to Fast Castle SPA, tracking data are available only for 2010, when the respective overlap between the core foraging areas of tracked kittiwakes and the Development Area was 30 per cent and 0 per cent. Thus tracking data indicate that the Development Area falls within the foraging areas of kittiwakes from the Forth Islands SPA (29 - 86 km from the Development Area) and the Fowlsheugh SPA (33 km from the Development Area) (*Appendix 15B*, *Annex 15B.1*) in some years at least, and that the Development Area was not used for foraging by tracked kittiwakes from the St Abb's Head to Fast Castle SPA (53 km from the Development Area) in 2010.

460 No tracking data is available for kittiwakes nesting at Buchan Ness to Collieston Coast SPA, situated 82 km from the Development Area. Although the Development Area falls within the potential foraging range of kittiwakes from this SPA, it is unlikely that it forms part of the core foraging area for this breeding colony given a mean maximum foraging range of 60 km (standard deviation 23.3 km; Thaxter *et al*., 2012). This is reflected by the very small increase in mortality that is predicted to arise from collisions (Table 15.35). In addition, the available trend data suggest that kittiwakes at this colony are stable (Lewis *et al*., 2012). Thus collision risk at the Wind Farm is not predicted to cause adverse effects on the kittiwake breeding population as a viable component of the SPA population at Buchan Ness to Collieston Coast.

461 Kittiwakes breeding at St Abb's Head to Fast Castle SPA are also considered unlikely to forage regularly at the Development Area, which is reflected in the small increase in mortality predicted to arise from collisions (Table 15.35). Although the population is declining, collision risk at the Wind Farm is not predicted to cause adverse effects on the population of the species as a viable component of the SPA.

462 Tracking data from kittiwakes breeding within the Forth Islands and Fowlsheugh SPAs indicate that the core foraging ranges of kittiwakes from these SPAs overlap with the Development Area in at least some years and therefore breeding adult birds are subject to collision risk. SPA apportionment predicts that very low numbers of adult collision victims during the breeding season originate from these SPAs, although the precision of the apportionment is unknown, the approach taken is based on the best available information. Furthermore, as described above, some additional mortality of breeding adults from these SPAs may occur during the post- and non-breeding seasons, but the SPA apportionment

cannot be applied outside the breeding season to estimate the level of this. However, the available evidence indicates that the majority of SPA birds will migrate away from the Development Area during the post-breeding period, so that they are likely to form only a small proportion of the mortality predicted to occur outside of the breeding season. Overall, the increase in mortality amongst the breeding adult age class during the breeding season estimated to arise as a result of collisions for these two SPAs (Forth Islands, 0.11 per cent and Fowlsheugh, 0.18 per cent) is similar to that for the regional breeding population (0.14 per cent), suggesting that predictions from the PVA may be particularly applicable to these populations.

463 For the regional population, the predicted impact of additional mortality on the probability of population decline, suggests that over a range of 100 to 400 collisions per year (involving birds from the regional breeding population, including SPAs), there is a 2-4 per cent increase in the likelihood that the population will decline by 50 to 75 per cent over the 25 year projection period. Importantly, over this range of additional mortality there is no discernible increase in the level of population impact with increased additional mortality, so that the impacts remain relatively small across this range. This range of additional mortality is also considered to encompass the most realistic of the two scenarios examined for the seasonal allocation of collisions to the regional breeding population (i.e. 100 per cent, 50 per cent and 25 per cent of collisions during the breeding, post-breeding and winter periods, respectively, as opposed to all collisions in all seasons), and is therefore considered most applicable to assessing impacts on the SPA populations. Thus, considering the PVA outputs in conjunction with the fact that predicted increases in mortality from collisions are expected to affect the breeding adult age class of both the Forth Islands and Fowlsheugh SPA populations to a similar extent as the regional breeding population (and that there is no reason to expect any differential effects on these populations outside the breeding season), suggests that collision risk at the Wind Farm is not predicted to cause adverse effects on the kittiwake population as a viable component of the Forth Islands or Fowlsheugh SPAs.

15.12.8 Information to Inform the HRA for the four SPAs with Breeding Season Qualifying Species - In Combination

Introduction

464 The Habitats Directive requires an appropriate assessment of a plan or project if it would be likely to have a significant effect on a European site either individually or in-combination with other reasonably foreseeable plans or projects. This aims to ensure that European sites are not damaged by the cumulative effects of multiple plans or projects (David Tyldesley and Associates, 2012; Defra, 2012).

465 Projects identified for possible in-combination effects with the Wind Farm are included in Tables 15.21. These are based on the lists included in the HRA Screening Report (see *Appendix 15B*, *Annex 15B.1*). Potential in-combination effects are considered below.

466 Maps of the estimated foraging ranges of seabird species at SPAs, and the locations of offshore wind farms identified for potential in-combination effects, are shown in Figures 15.4 to Figure 15.13 (see Figures *Section 15.13*).

467 For certain types of potential impact, such as direct disturbance, the in-combination impacts are straightforward to assess. However, those in relation to indirect effects via prey species, displacement and collision in particular, require more complex consideration from which to inform the assessment. In the following sub-sections therefore, consideration is given to the range of potential in-combination effects. Following on from this, a summary of the information to inform the HRA for each of the four SPAs follows, for the Project alone and in-combination.

Disturbance to SPA Qualifying Species in the Breeding Season from Construction

468 As discussed above (Table 15.24; *Section 15.12.7*), because of the distance between the wind farm areas and SPA breeding colonies, no significant at site disturbance to any species at any of these SPAs is predicted as a result of construction noise, for the Project alone, or in-combination with other submitted or approved plans and projects (see *Section 15.9.1*). Where relevant, this approach is used to address conservation objectives 2 and 7 for each SPA.

Indirect Impacts on SPA Qualifying Species during the Breeding Season through Disturbance of Prey Species

469 Construction disturbance may have in-combination indirect impacts on seabirds due to impacts on the abundance and distribution of prey species. Pile driving for the installation of substructures has been identified as the worst case scenario in this respect, as the resultant noise may adversely affect some fish prey species, causing them to move away from areas around the source of piling noise. Minimal impacts are predicted on the abundance and availability of sandeels, a key prey species of seabirds during the breeding season as very small-scale avoidance is predicted for this species around piling events (*Section 15.6.1*, Table 15.12). However herring and sprat (clupeids), which also feature in the breeding season diet of seabirds and may provide alternative prey in years when sandeel abundance is lower (Wanless *et al*., 2005; Furness and Tasker, 2000), are predicted to be displaced over larger areas from piling activities. Further background to this, including cross references to relevant sections of *Chapter 13*, is provided in *Section 15.6.1.*

470 Of the offshore wind farms identified for in-combination assessment, indirect construction impacts for most seabirds are likely only in relation to the Inch Cape Offshore Wind Farm, Neart na Gaoithe and Firth of Forth Phase 1, as these sites are in close proximity and, under the worst case scenario, may be under construction simultaneously, at least in some years. In-combination noise impacts will be temporary in nature and are only likely if piling is used for the foundations of WTGs and other structures at all sites. The available information on construction timetables suggests that in-combination effects of construction disturbance from piling activities for all three wind farms are likely over only one breeding season – 2016 (although timescales may change) and then only if piling activities take place simultaneously at all sites during the breeding season.

471 With the exception of **gannet and fulmar**, Table 15.37 below provides the combined avoidance areas for sandeel and herring/sprat as percentages of the breeding season

foraging range for all other seabirds from individual SPAs. Gannet and fulmar are considered to be so wide-ranging as to not require further detail on overlap of relatively small impact areas versus foraging areas. An assessment of indirect construction disturbance is included in Table 15.38 for all species.

Table 15.37: Overlap Between the Foraging Areas of SPA Qualifying Species in the Breeding Season and Potential Fish Avoidance Areas from the Development Area, Neart na Gaoithe and Firth of Forth Phase 1

Bird Species	SPA	Foraging Area[1] (km^2)	Overlap with Combined Avoidance Area for Sandeel[2] (km^2)	Overlap as % of Foraging Area (sandeel)	Overlap with Combined avoidance Area for Herring and Sprat[2] (km^2)	Overlap as % of Foraging Area (Herring and Sprat)
Kittiwake	Forth Islands	9,938	0.432	<0.01%	4,555.8	45.8%
	Fowlsheugh	11,673	0.432	<0.01%	4,097.1	35.1%
	Buchan Ness to Collieston Coast	15,215	0.0	0%	731.7	4.8%
	St Abb's Head to Fast Castle	12,164	0.432	<0.01%	3,573.7	29.4%
Herring gull	Forth Islands	14,566	0.432	<0.01%	4,758.3	32.7%
	Fowlsheugh	19,897	0.432	<0.01%	4,758.3	23.9%
	Buchan Ness to Collieston Coast	25,016	0.193	<0.001%	2,258.2	9.0%
	St Abb's Head to Fast Castle	18,130	0.432	<0.01%	4,758.3	26.2%
Lesser black-backed gull	Forth Islands	24,971	0.432	<0.01%	4,758.3	19.1%
Arctic tern	Forth Islands	2,189	0.152	<0.01%	1,426.6	65.2%
Common tern	Forth Islands	1,704	0.152	<0.01%	1,146.4	67.3%
Guillemot	Forth Islands	22,794	0.432	<0.01%	4,758.3	20.1%

Bird Species	SPA	Foraging Area[1] (km^2)	Overlap with Combined Avoidance Area for Sandeel[2] (km^2)	Overlap as % of Foraging Area (sandeel)	Overlap with Combined avoidance Area for Herring and Sprat[2] (km^2)	Overlap as % of Foraging Area (Herring and Sprat)
	Fowlsheugh	33,938	0.432	<0.01%	4,758.3	14.0%
	Buchan Ness to Collieston Coast	42,148	0.432	<0.01%	3,828.5	9.1%
	St Abb’s Head to Fast Castle	27,673	0.432	<0.01%	4,758.3	17.2%
Razorbill	Forth Islands	9,988	0.432	<0.01%	4,566.0	45.7%
	Fowlsheugh	11,743	0.432	<0.01%	4,105.4	35.0%
	St Abb’s Head to Fast Castle	27,673	0.432	<0.01%	3,589.3	13.0%
Puffin	Forth Islands	28,543	0.432	<0.01%	4,758.3	16.7%

1. The potential offshore foraging area available to a species at a given SPA, based on the estimated foraging range (see *Appendix 15A*, Table 15A.5).

2. The maximum predicted avoidance areas for sandeel and herring/sprat under the scenario of simultaneous construction at all wind farms.

Note: Gannet and fulmar are considered to be so wide-ranging as to not require further detail on overlap of relatively small impact areas versus foraging areas.

Table 15.38: Assessment of In-combination Indirect Disturbance Impacts on SPA Breeding Seabirds via Prey Species

Bird species	SPA	Assessment of in-combination indirect disturbance
Fulmar	Buchan Ness to Collieston Coast	Foraging areas of fulmar from the Buchan Ness to Collieston Coast SPA (based on a mean maximum range of 400 km, Thaxter *et al.,* 2012) encompass all offshore wind farms identified for potential in-combination effects (Table 15.17 and associated text), so birds might encounter indirect impacts at other sites besides those in the outer Forth and Tay. However, given the species' very extensive foraging area, its flexible foraging strategy - with prey items ranging from a wide variety of fish, zooplankton, squid and fisheries discards, the displacement of 'hearing specialist' fish species from a relatively small area which only form a part of their diet is not likely to be a constraint on survival or reproduction. Therefore it is predicted that no negative, in-combination effect of indirect construction disturbance on the Buchan Ness to Collieston Coast SPA population will occur.
Fulmar	Forth Islands	Foraging areas of fulmar from the Forth Islands SPA (based on a mean maximum range of 400 km, Thaxter *et al.,* 2012) encompass all offshore wind farms identified for potential in-combination effects (Table 15.17 and associated text), so birds might encounter indirect impacts of construction noise at other sites besides those in the outer Forth and Tay. However, given the species' very extensive foraging area, its flexible foraging strategy - with prey items ranging from a wide variety of fish, zooplankton, squid and fisheries discards, the displacement of 'hearing specialist' fish species from a relatively small area which only form a part of their diet is not likely to be a constraint on survival or reproduction. Therefore it is predicted that no negative, in-combination effect of indirect construction disturbance on the Forth Islands SPA population will occur.
Fulmar	Fowlsheugh	Foraging areas of fulmar from the Fowlsheugh SPA (based on a mean maximum range of 400 km, Thaxter *et al.,* 2012) encompass all offshore wind farms identified for potential in-combination effects (Table 15.17 and associated text), so birds might encounter indirect impacts of construction noise at other sites besides those in the outer Forth and Tay. However, given the species' very extensive foraging area, its flexible foraging strategy - with prey items ranging from a wide variety of fish, zooplankton, squid and fisheries discards, the displacement of 'hearing specialist' fish species from a relatively small area which only form a part of their diet is not likely to be a constraint on survival or reproduction. Therefore it is predicted that no negative, in-combination effect of indirect construction disturbance on the Fowlsheugh SPA population will occur.
Gannet	Forth Islands	Foraging areas of gannet from the Forth Islands SPA (based on a mean maximum range of 229.4 km, Thaxter *et al.,* 2012) encompass the European Offshore Wind Deployment Centre and the three Forth and Tay offshore wind farms identified for

Bird species	SPA	Assessment of in-combination indirect disturbance
		potential in-combination effects (Table 15.17 and associated text) However, given the species' extensive foraging range and flexible foraging strategy, including substantial exploitation of fisheries discards, the displacement of 'hearing specialist' fish species from a relatively small area which only form part of their diet is not likely to be a constraint on survival or reproduction. Therefore it is predicted that no negative, in-combination effect of indirect construction disturbance on the Forth Islands SPA population will occur.
Kittiwake	Forth Islands	The maximum potential avoidance area for sandeels in relation to piling activities represents less than 0.01% of the estimated foraging area for kittiwake, whereas the avoidance area for hearing specialist fish (including herring and sprat) overlaps with 45.8% of the foraging range (Table 15.37). Kittiwake diet during the breeding season consists mainly of sandeels (80%, Furness and Tasker, 2000; 87%, Daunt *et al,.* 2008; 44–89% of the diet of birds at the Isle of May (Forth Islands) in 2007–2012, CEH, 2012) although it also includes sprat and herring (herring; 12–5 % of the diet between 2007–2012, CEH, 2012). Breeding success increases with the abundance of sandeels (Daunt *et al.*, 2008) and clupeids may only be taken when sandeels are unavailable (Harris and Wanless, 1997). If proposed offshore wind farms at the Development Area, Neart na Gaoithe and Forth Phase I are in construction at the same time, then minimal impacts are predicted on sandeels - kittiwakes' key prey species – due to highly localised, short term impacts on sandeels from each of the wind farms (see Table 15.37). Redistribution of herring and sprat in response to piling noise may result in these species being absent from large areas of the kittiwake foraging range – for at least some of the time during construction (see Table 15.37). However as kittiwake breeding success is apparently unrelated to the abundance of these species (herring and sprat), no negative effects of indirect construction disturbance via prey species on the Forth Islands SPA population are predicted.
Kittiwake	Fowlsheugh	The maximum potential avoidance area for sandeels in relation to piling activities represents less than 0.01% of the estimated foraging area for kittiwake, whereas the avoidance area for hearing specialist fish (including herring and sprat) overlaps with 35.1% of the foraging range (Table 15.37). Applying the rationale set out above for the Forth Islands SPA, i.e. minimal impacts on the key prey species of kittiwake, no negative effects of indirect construction disturbance on the Fowlsheugh SPA population are predicted.
Kittiwake	Buchan Ness to Collieston Coast	The maximum potential avoidance area for sandeels in relation to piling activities represents 0% of the estimated foraging area for kittiwake, whereas the avoidance area for hearing specialist fish (including herring and sprat) overlaps with 4.8% of the foraging range (Table 15.37). Based on the rationale set out above for the Forth Islands SPA, i.e. minimal impacts on the key prey species of kittiwake, no negative effects of indirect

Bird species	SPA	Assessment of in-combination indirect disturbance
		construction disturbance on the Buchan Ness to Collieston Coast SPA population are predicted.
Kittiwake	St Abb's Head to Fast Castle	The maximum potential avoidance area for sandeels in relation to piling activities represents less than 0.01% of the estimated foraging area for kittiwake, whereas the avoidance area for hearing specialist fish (including herring and sprat) overlaps with 29.4% of the foraging range (Table 15.37). Based on the rationale set out above for the Forth Islands SPA, i.e. minimal impacts on the key prey species of kittiwake, no negative effects of indirect construction disturbance on the St Abb's Head to Fast Castle SPA population are predicted.
Herring gull	Forth Islands	Herring gulls are omnivorous and may feed onshore and offshore, although chicks may be selectively fed fish and the meat of birds and mammals (Nogales *et al*., 1995). On the Isle of May, for example, gulls frequently predate young puffins and kleptoparasitise adults as they return to the colony with fish; and gulls have been controlled on the island to reduce their impacts on other seabirds (Finney *et al*., 2003). The maximum potential avoidance area for sandeels in relation to piling activities represents less than 0.01% of the estimated foraging area for herring gull at each SPA, whereas the avoidance area for hearing specialist fish (including herring and sprat) overlaps with 9 - 32.7% of the foraging range (Table 15.37). However, as the species takes a range of prey, in-combination construction disturbance is not considered likely to cause negative indirect impacts on herring gulls at any of these four SPAs.
	Fowlsheugh	
	Buchan Ness to Collieston Coast	
	St Abb's Head to Fast Castle	
Lesser black-backed gull	Forth Islands	The species makes use of inland (including urban) and coastal/intertidal habitats as well as offshore areas for foraging, although it spends more time feeding at sea than other large gulls (Kim and Monaghan, 2006; Bustnes *et al.,* 2010). The maximum potential avoidance area for sandeels in relation to piling activities represents less than 0.01% of the estimated foraging area for lesser black-backed gull, whereas the avoidance area for hearing specialist fish (including herring and sprat) overlaps with 19.1% of the foraging range (Table 15.37). However, as the species takes a range of prey, in-combination construction disturbance is not considered likely to cause negative indirect impacts on lesser black-backed gulls.
Arctic tern	Forth Islands	There is evidence from colonies on the east coast of Britain that sandeels predominate in the diet early in the breeding season, and then other species such as clupeids and sprat become more important; clupeids/sprat may comprise 30% – 40% of the breeding season diet of Arctic terns at Coquet Island and over 60% at the Farne Islands (both sites off the north-east coast of England) (BirdLife International, 2012). Sandeels were found to comprise 34% of the diet of terns (Arctic and common) in south east Scotland between 1996 and 2003 (Daunt *et al*., 2008). The maximum potential avoidance area for sandeels in relation to piling activities represents less than 0.01% of the estimated foraging area for Arctic tern, whereas the avoidance area for

Bird species	SPA	Assessment of in-combination indirect disturbance
		hearing specialist fish (including herring and sprat) overlaps with 65.2% of the foraging range (Table 15.37). Thus piling activities during the breeding season might affect the availability of some fish species which form part of the breeding season diet. Current information on timetables suggests that construction activities at all three Forth and Tay sites are likely for only one year, so that the maximum predicted overlap between Arctic tern foraging areas and herring/sprat avoidance areas is likely only in one year and then only if piling activities are ongoing at all three sites during the seabird breeding season. Arctic terns are declining at the Forth Islands SPA, with moderate confidence in the trend (Lewis *et al.*, 2012). The reasons for changes in numbers of Arctic terns in Scotland are poorly understood; in the far north, food shortages are implicated, but further south changes may reflect predation at breeding colonies, weather, human disturbance and movements between regions (Forrester *et al.*, 2007). The productivity of Arctic terns is consistently the lowest of any seabird breeding in the UK (below 0.5 chicks per pair per year on average since 1986), with very unproductive years associated with prey shortages, in particular sandeels (JNCC, 2012). Thus construction at the Development Area in-combination with Neart na Gaoithe and Firth of Forth Phase 1 may affect the distribution of some prey fish (herring and sprat) in relation to the foraging range of breeding birds at the Forth Island SPA. A combined effect of all three sites is only predicted over one breeding season and is therefore not considered likely to negatively affect the Forth Islands SPA population in the long term.
Common tern	Forth Islands	As for Arctic tern, there is evidence from some colonies on the east coast of Britain that sandeels predominate in common tern diet during April and May, with clupeids becoming relatively more important in late July. The diet of breeding common terns at Leith Docks (Firth of Forth, about 25 km from the Isle of May) was found to comprise more than 60% clupeids in 2009 (Jennings, 2012). The maximum potential avoidance area for sandeels in relation to piling activities represents less than 0.01% of the estimated foraging area for common tern, whereas the avoidance area for hearing specialist fish (including herring and sprat) overlaps with 67.3% of the foraging range (Table 15.37). Thus piling activities during the breeding season might affect the availability of some fish species which form part of the breeding season diet. Current information on timetables suggests that construction activities at all three Forth and Tay sites are likely for only one year, so that the maximum predicted overlap between common tern foraging areas and herring/sprat avoidance areas is likely only in one year and then only if piling activities are ongoing at all three sites during the seabird breeding season. The common tern population at the Forth Islands SPA is identified as stable with moderate confidence in the trend (Lewis *et al.*, 2012). The productivity of common terns as recorded by the Seabird Monitoring Programme fluctuates, although the species is

Bird species	SPA	Assessment of in-combination indirect disturbance
		usually more productive than the Arctic tern, and has a broader diet than many tern species so is less affected by prey availability (JNCC, 2012). Thus construction at the Development Area in-combination with Neart na Gaoithe and Firth of Forth Phase 1 may affect the distribution of prey fish (herring and sprat) in relation to the foraging range of breeding birds at the Forth Island SPA. A combined effect of all three sites is only predicted over one breeding season, is therefore not considered likely to negatively affect the Forth Islands SPA population in the long term.
Guillemot	Forth Islands	The maximum potential avoidance area for sandeels in relation to piling activities represents less than 0.01% of the estimated foraging area for guillemot, whereas the avoidance area for hearing specialist fish (including herring and sprat) overlaps with 20.1% of the foraging range (Table 15.37). Sandeels have been identified as the main prey species of guillemots in south-east Scotland during the breeding season, comprising 80 – 84 % of the diet (Furness and Tasker, 2000; Daunt *et al*., 2008); however recent data from the Isle of May indicates that sprat dominated in the diet between 2007 – 2012, comprising 67 – 92% (CEH, 2012). Despite their importance in the diet, the breeding success of guillemots was not found to be related to the abundance of sandeels, which may be explained by their capacity to dive and gain access to a greater proportion of the sandeel population, even in years of lower abundance (Daunt *et al*., 2008). Guillemot is considered a species with capacity in its time and energy budget to increase foraging effort in response to adverse environmental conditions (Daunt *et al*., 2008; 2011a and 2011b). Widespread breeding failure of guillemots on the Isle of May in 2004 was recorded however, coinciding with a year when sprat formed 98% of the diet, although in this case the unusually low energy content of prey fish was considered to be the main cause of breeding failure (Wanless *et al.*, 2005). If proposed offshore wind farms at the Development Area, Neart na Gaoithe and Firth of Forth Phase I are in construction at the same time, then minimal impacts are predicted on sandeel – a key prey species of guillemots - due to highly localised, short term impacts on sandeels from each of the developments (see Table 15.37). Redistribution of sprat in response to piling noise may result in this species being absent from part of the guillemot foraging range for some of the time during the breeding season. However as guillemot breeding success is apparently unrelated to the abundance of sandeels or other prey species, and it is likely that guillemots will be able to respond to short term, temporary changes in food availability that might result from construction disturbance by increasing foraging effort, no long term negative effect on the Forth Islands SPA population is predicted.
Guillemot	Fowlsheugh	The maximum potential avoidance area for sandeels in relation to piling activities represents less than 0.01% of the estimated foraging area for guillemot, whereas the avoidance area for hearing specialist fish (including herring and sprat) overlaps

Bird species	SPA	Assessment of in-combination indirect disturbance
		with 14.0% of the foraging range (Table 15.37). Specific information on guillemot diet at Fowlsheugh has not been found although it is likely to be similar to that of birds at the Forth Islands. Applying the rationale set out above for the Forth Islands SPA, no long term negative effect on the Fowlsheugh SPA population is predicted.
Guillemot	Buchan Ness to Collieston Coast	The maximum potential avoidance area for sandeels in relation to piling activities represents less than 0.01% of the estimated foraging area for guillemot, whereas the avoidance area for hearing specialist fish (including herring and sprat) overlaps with 9.1% of the foraging range (Table 15.37). Specific information on guillemot diet at Buchan Ness to Collieston Coast has not been found although it is likely to be similar to that of birds at the Forth Islands (see above). Applying the rationale set out above for the Forth Islands SPA, no long term negative effect on the Buchan Ness to Collieston Coast SPA population is predicted.
Guillemot	St Abb's Head to Fast Castle	The maximum potential avoidance area for sandeels in relation to piling activities represents less than 0.01% of the estimated foraging area for guillemot, whereas the avoidance area for hearing specialist fish (including herring and sprat) overlaps with 17.2% of the foraging range (Table 15.37). Specific information on guillemot diet at St Abb's Head to Fast Castle SPA has not been found although it is likely to be similar to that of birds at the Forth Islands (see above). Applying the rationale set out above for the Forth Islands SPA, no long term negative effect on the St Abb's Head to Fast Castle SPA population is predicted.
Razorbill	Forth Islands	The maximum potential avoidance area for sandeels in relation to piling activities represents less than 0.01% of the estimated foraging area for razorbill, whereas the avoidance area for hearing specialist fish (including herring and sprat) overlaps with 45.7% of the foraging range (Table 15.37). Sandeels have been identified as the main prey species of razorbills in south east Scotland during the breeding season, comprising 80% of the diet (Furness and Tasker, 2000; Daunt *et al.,* 2008); recent data from the Isle of May indicates that sandeels continued to be the most numerous prey item between 2007–2012, except for 2010 when 67% of the diet was sprat (CEH, 2012). Despite their predominance in the diet, the breeding success of razorbills was not found to be related to the abundance of sandeels, which may be explained by their ability to dive and gain access to a greater proportion of the sandeel population, even in years of lower abundance (Daunt *et al.*, 2008). Given the predominance of sandeels in the diet, which are not likely to be affected by construction disturbance, in-combination disturbance is not predicted to have a negative effect on the Forth Islands SPA population.

Bird species	SPA	Assessment of in-combination indirect disturbance
Razorbill	Fowlsheugh	The maximum potential avoidance area for sandeels in relation to piling activities represents less than 0.01% of the estimated foraging area for razorbill, whereas the avoidance area for hearing specialist fish (including herring and sprat) overlaps with 35.0% of the foraging range (Table 15.37). Specific information on razorbill diet at Fowlsheugh has not been found although it is likely to be similar to that of birds at the Forth Islands (see above). Assuming sandeels predominate in the diet, in-combination disturbance is not predicted to have a negative effect on the Fowlsheugh SPA population.
Razorbill	St Abb's Head to Fast Castle	The maximum potential avoidance area for sandeels in relation to piling activities represents less than 0.01% of the estimated foraging area for razorbill, whereas the avoidance area for hearing specialist fish (including herring and sprat) overlaps with 13.0% of the foraging range (Table 15.37). Specific information on razorbill diet at St Abb's Head to Fast Castle has not been found although it is likely to be similar to that of birds at the Forth Islands (see above). Assuming sandeels predominate in the diet, in-combination construction disturbance is not predicted to have a negative indirect effect on the razorbill population of the St Abb's Head to Fast Castle SPA.
Puffin	Forth Islands	The maximum potential avoidance area for sandeels in relation to piling activities represents less than 0.01% of the estimated foraging area for puffin, whereas the avoidance area for hearing specialist fish (including herring and sprat) overlaps with 16.7% of the foraging range (Table 15.37). Sandeels have been identified as the main prey species of puffins in south east Scotland during the breeding season, comprising 81% of the diet (Furness and Tasker, 2000; Daunt *et al.*, 2008); recent data from the Isle of May indicates that sandeels continued to be the most numerous prey item between 2007 – 2012, comprising 63% – 91% of the diet (CEH, 2012). Given the predominance of sandeels in the diet, which are not likely to be affected by construction disturbance, in-combination construction disturbance is not considered likely to adversely affect the puffin population of the Forth Islands SPA.

<u>Disturbance to Breeding SPA Qualifying Species During Operation and Maintenance</u>

472 Given the distances between proposed wind farm areas and SPA breeding colonies (Table 15.2, Figure 15.4 to Figure 15.13), no significant on site disturbance to any qualifying interest species at any SPAs is predicted as a result of operation and maintenance activities, for the Project alone, or in-combination with other plans and projects (Table 15.24).

Displacement to SPA Qualifying Species During the Breeding Season-Operation and Maintenance

473 The in-combination assessment of displacement and barrier effects considers offshore wind farms only. Coastal developments at Dundee and Edinburgh waterfront and the Forth Replacement Crossing (as described in *Section 4.7.3*) are not considered likely to displace qualifying seabirds from SPAs where LSE was concluded, as because of their coastal locations these developments are likely to have very limited, if any connectivity to the SPAs under assessment or to the key offshore foraging areas of the qualifying interests. None of these developments are situated between seabird breeding colonies and foraging areas or migration routes, so are not predicted to contribute to displacement effects by posing a barrier to the movements of birds between nesting sites and foraging areas.

474 During the breeding season, qualifying seabirds will potentially be subject to in-combination displacement impacts through loss of potential foraging habitat from offshore wind farms within their foraging ranges from breeding colonies. Direct comparison of the predicted number of birds displaced from each wind farm is not possible without re-analysing the data presented because the Environmental Statements for individual developments take different approaches to displacement (see *Section 15.9.1*; e.g. predictions of the percentage reduction in numbers for a given species within a wind farm vary between developments).

475 The in-combination assessment considers the potential loss of foraging habitat for individual seabird species from SPAs where a LSE was concluded. This was based on overlap between the SPA foraging ranges and the total area of wind farm developments considered for the in-combination assessment(plus a 2 km buffer as birds may be displaced from areas close to a wind farm) within foraging range (see Table 15.39 below). The estimated loss of foraging area takes account of the predicted displacement (per cent reduction in numbers within a wind farm) for each species. Maps of the estimated foraging ranges of seabird species at SPAs, and the locations of offshore wind farms identified for potential in-combination effects, are shown in Figure 15.4 to Figure 15.13.

476 This use of area comparisons to estimate in-combination displacement is a relatively basic, but reasonable, approach, which provides an indication of the overall scale of potential habitat loss from multiple developments. It does assume, however, that all areas of sea within foraging range for a given species are of equal value as foraging habitat, which is not the case. The assessment considers the status of a species, diet and foraging flexibility and the likely capacity of a species to adapt to loss of foraging areas e.g. by travelling further in search of alternative habitat. As discussed, above (see Table 15.18 and associated text above) the approach is considered sufficient robust as all the available review information has been fully considered.

477 The potential in-combination displacement impacts of wind farms within the foraging ranges of species from SPAs where a LSE was concluded are shown in Table 15.39 below.

478 Foraging ranges of seabirds from SPAs have been identified based on the mean maximum foraging range of seabird species (in most cases plus one SD, *Appendix 15A*, Table 15.A.5).

Examination of these ranges and their standard deviations (*Appendix 15A*, Table 15.A.5) shows that in most cases the SDs are large compared with the actual foraging range values. For example, for kittiwake, the mean maximum foraging range is estimated at 60 km with a SD of 23.3 km, thus the SD is 39 per cent of the mean, for herring gull the SD is 72 per cent of the mean, and for Arctic tern the SD is 26 per cent of the mean (*Appendix 15A*, Table 15.A.5). As the foraging areas of the relevant SPA qualifying species have been identified, and their size estimated based on these mean maximum values, there is inevitably a degree of uncertainty about the total surface area thus derived. However, predicted in-combination losses of between 0.2 and 5.0 per cent of the SPA qualifying species foraging areas due to displacement from offshore wind farms (Table 15.39) are likely to represent a minor shift from baseline conditions.

479 With the exception of **gannet and fulmar**, Table 15.39 below provides the potential loss of foraging ranges due to in-combination displacement for all other seabirds from individual SPAs. Gannet and fulmar are considered to be so wide-ranging as to not require further detail on overlap of relatively small impact areas versus foraging areas.

480 An assessment of in-combination operational displacement effects is provided in Table 15.40.

Table 15.39: Potential Loss of Foraging Range due to In-combination Displacement from Offshore Wind Farms for SPA Qualifying Species Requiring an Appropriate Assessment

Bird species	SPA	Foraging Area (km^2)	Overlap between Foraging Area and Development Area plus 2 km buffer (% of foraging range)	Overlap between Foraging Area and Wind Farms plus 2 km buffer (km^2)	Assumed Displacement	Predicted % of Foraging Area Lost	Wind Farms within Foraging Area– in Addition to the Project
Kittiwake	Forth Islands	9,938	0.8%	1,073	30%	3%	Firth of Forth Phase 1; Neart na Gaoithe
	Fowlsheugh	11,673	0.7%	1,146	30%	3%	European Offshore Wind Deployment Centre; Firth of Forth Phase 1; Neart na Gaoithe
	Buchan Ness to Collieston Coast	15,215	0%	132	30%	0.3%	European Offshore Wind Deployment Centre; Firth of Forth Phase 1
	St Abb's Head to Fast Castle	12,164	0.7%	855	30%	2%	Firth of Forth Phase 1; Neart na Gaoithe
Herring gull	Forth Islands	14,566	0.6%	1,073	30%	2%	Firth of Forth Phase 1; Neart na Gaoithe
	Fowlsheugh	19,897	0.4%	1,146	30%	2%	European Offshore Wind Deployment Centre; Firth of Forth Phase 1; Neart na Gaoithe
	Buchan Ness to Collieston Coast	25,016	0.2%	1,340	30%	2%	Firth of Forth Phase 1; European Offshore Wind Deployment Centre; Beatrice Offshore Wind Farm; Moray Firth R3 Zone 1 Eastern Development Area (EDA)

Bird species	SPA	Foraging Area (km^2)	Overlap between Foraging Area and Development Area plus 2 km buffer (% of foraging range)	Overlap between Foraging Area and Wind Farms plus 2 km buffer (km^2)	Assumed Displacement	Predicted % of Foraging Area Lost	Wind Farms within Foraging Area– in Addition to the Project
	St Abb's Head to Fast Castle	18,130	0.5%	1,201	30%	2%	Firth of Forth Phase 1, Neart na Gaoithe, Blyth Offshore Wind Demonstration Site
Lesser black-backed gull	Forth Islands	24,971	0.3%	1,276	30%	1.5%	European Offshore Wind Deployment Centre; Firth of Forth Phase 1; Neart na Gaoithe, Blyth Offshore Wind Demonstration Site
Arctic tern	Forth Islands	2,189	0.01%	199	30%	3%	Neart na Gaoithe
Guillemot	Forth Islands	22,794	0.6%	1,260	50%	3%	European Offshore Wind Deployment Centre; Firth of Forth Phase 1; Neart na Gaoithe; Blyth Offshore Wind Demonstration Site
	Fowlsheugh	33,938	0.4%	1,155	50%	2%	Firth of Forth Phase 1; Neart na Gaoithe; European Offshore Wind Deployment Centre
	Buchan Ness to Collieston Coast	42,148	0.3%	2,030	50%	2%	Firth of Forth Phase 1; European Offshore Wind Deployment Centre; Beatrice Offshore Wind Farm; Moray Firth R3 Zone 1 (EDA), Neart na Gaoithe
	St Abb's Head to Fast Castle	27,673	0.5%	1,201	50%	2%	Firth of Forth Round 3 Phase 1; Neart na Gaoithe, Blyth Offshore Wind Demonstration Site

Bird species	SPA	Foraging Area (km^2)	Overlap between Foraging Area and Development Area plus 2 km buffer (% of foraging range)	Overlap between Foraging Area and Wind Farms plus 2 km buffer (km^2)	Assumed Displacement	Predicted % of Foraging Area Lost	Wind Farms within Foraging Area– in Addition to the Project
Razorbill	Forth Islands	9,988	1.4%	1,073	50%	5%	Firth of Forth Phase 1; Neart na Gaoithe
	Fowlsheugh	11,743	1.2%	1,156	50%	5%	Firth of Forth Phase 1; Neart na Gaoithe; European Offshore Wind Deployment Centre
	St Abb's Head to Fast Castle	12,230	1.1%	862	50%	4%	Firth of Forth Phase 1; Neart na Gaoithe
Puffin	Forth Islands	28,543	0.5%	1,234	50%	2%	European Offshore Wind Deployment Centre; Firth of Forth Phase 1; Neart na Gaoithe; Blyth Offshore Wind Demonstration Site
Note: Gannet and fulmar are considered to be so wide-ranging as to not require further detail on overlap of relatively small impact areas versus foraging areas.							

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Table 15.40: Assessment of In-combination Displacement during the Breeding Season for SPA Qualifying Species

Bird species	SPA(s)	Assessment of In-combination Displacement
Fulmar	Forth Islands Fowlsheugh Buchan Ness to Collieston	Foraging ranges for fulmar are very extensive in comparison to the surface areas of the offshore wind farms identified for in-combination assessment (see Figure 15.13). In addition, the species has a particularly flexible foraging strategy. In-combination displacement from offshore wind farms is therefore not predicted to negatively affect the fulmar population at any of these SPAs.
Gannet	Forth Islands (Bass Rock)	The foraging range of gannet breeding on the Forth Islands is extensive in comparison to the surface areas of the offshore wind farms identified for in-combination assessment (see Figure 15.12), and the species has a very flexible foraging strategy. In-combination displacement from offshore wind farms is therefore not predicted to negatively affect the gannet population at this SPA.
Kittiwake	Forth Islands	It is predicted that in-combination displacement from offshore wind farms will result in the effective loss of 3% of the foraging area for kittiwakes at the Forth Islands SPA (Table 15.39 and Figure 15.4). This might require birds to travel further to feed, and the breeding success of kittiwakes may be reduced if they have to travel greater distances (Daunt *et al.*, 2011a). Kittiwakes are declining at the Forth Islands SPA (Lewis *et al*., 2012). Population modelling has indicated that displacement from the Development Area and 2 km buffer alone (via reductions in breeding success) is not predicted to negatively affect SPA population growth rates (see Table 15.33 and associated discussion of PVA results). The overall proportion of foraging area predicted to be lost is small compared with the variation in mean maximum foraging distances for this species (*Appendix 15A*, Table 15A.5). Therefore, no negative effect on the kittiwake population of the Forth Islands SPA is predicted as a result of in-combination displacement.
Kittiwake	Fowlsheugh	It is predicted that in-combination displacement from offshore wind farms will result in the effective loss of 3% of the foraging area for kittiwakes (Table 15.39). Kittiwakes are declining at the Fowlsheugh SPA (Lewis *et al*., 2012). Applying the rationale presented above for kittiwakes at the Forth Islands SPA, no negative effect on the kittiwake population of the Fowlsheugh SPA is predicted as a result of in-combination displacement.
Kittiwake	Buchan Ness to Collieston Coast	A very small amount of effective habitat loss (0.3%) is predicted for kittiwakes from in-combination displacement from offshore wind farms within foraging range (Table 15.39). The kittiwake population at Buchan Ness to Collieston Coast is stable (Lewis *et al*., 2012). Applying the same rationale as outlined for the Forth Islands SPA, no negative impacts of in-combination displacement are predicted for the Buchan Ness to Collieston Coast SPA.

Bird species	SPA(s)	Assessment of In-combination Displacement
Kittiwake	St Abb's Head to Fast Castle	It is predicted that in-combination displacement from offshore wind farms will result in the effective loss of 2% of the foraging area (Table 15.39). Kittiwakes are declining at the St Abb's Head to Fast Castle SPA (Lewis *et al.*, 2012). Applying the rationale presented above for kittiwakes at the Forth Islands SPA, no negative effect on the kittiwake population of the St Abb's Head to Fast Castle SPA is predicted as a result of in-combination displacement.
Herring gull	Forth Islands Fowlsheugh Buchan Ness to Collieston Coast St Abb's Head to Fast Castle	At each of the four SPAs where a LSE was identified, in-combination displacement is predicted to result in the effective loss of 2% of offshore foraging habitat for herring gulls (Table 15.39 and Figure 15.5). The overall proportion of foraging area predicted to be lost is small compared with the variation in mean maximum foraging distances for this species (*Appendix 15A*, Table 15A.5). Herring gulls are omnivorous and may feed onshore and offshore, although chicks may be selectively fed fish and the meat of birds and mammals (Nogales *et al.*, 1995). On the Isle of May, for example, gulls frequently predate young puffins and kleptoparasitise adults as they return to the colony with fish; and gulls have been controlled on the island to reduce their impacts on other seabirds (Finney *et al.*, 2003). Because they forage in a variety of terrestrial, coastal and offshore habitats, including taking discards from fishing vessels, in-combination displacement from offshore areas is not considered likely to cause negative impacts on herring gull populations at any of these four SPAs.
Lesser black-backed gull	Forth Islands	In-combination displacement is predicted to result in the effective loss of 1.5% of offshore foraging habitat for lesser black-backed gulls at the Forth Islands SPA (Table 15.39). The overall proportion of foraging area predicted to be lost is small compared with the variation in mean maximum foraging distances for this species (*Appendix 15A*, Table 15A.5 and Figure 15.6). The species takes a range of prey during the breeding season (eggs, nestlings and adults of other seabirds as well as intertidal and marine invertebrates, fish and discards from fishing vessels, e.g. Buckley, 2009). Therefore, no negative in-combination effects of displacement are predicted on the SPA population.
Arctic tern	Forth Islands	In-combination displacement is predicted to result in the effective loss of 3% of offshore foraging habitat for Arctic terns at the Forth Islands SPA (Table 15.39). The overall proportion of foraging area predicted to be lost is small compared with the variation in mean maximum foraging distances for this species (at 30.5 km, *Appendix 15A*, Table 15A.5). However, nesting birds tend to feed primarily within 10 km of breeding colonies (BirdLife International Seabird Database, 2012; Thaxter *et al.*, 2012). There is effectively a very small overlap (0.01%) with the Development Area (see Figure 15.7) and therefore no negative in-combination impacts of displacement are predicted on the SPA population.

Bird species	SPA(s)	Assessment of In-combination Displacement
Guillemot	Forth Islands Fowlsheugh Buchan Ness to Collieston Coast St Abb's Head to Fast Castle	In-combination displacement is predicted to result in the effective loss of 3% of offshore foraging habitat for guillemots at the Forth Islands SPA, and 2% at each of the other three SPAs (Table 15.39 and Figure 15.9). The overall proportion of foraging area predicted to be lost is small compared with the variation in mean maximum foraging distances for this species (*Appendix 15A*, Table 15A.5). For guillemots at the Isle of May (Forth Islands SPA) breeding success was not found to differ significantly between years of broader versus more restricted foraging ranges and it was suggested that guillemots have sufficient leeway in their time-activity budgets to increase foraging effort (e.g. travelling further) in response to adverse conditions (Daunt et al., 2011a). Guillemots are also able to dive to depths of 180 m (Daunt et al., 2011a) and exploit prey throughout the water column. Although the species is declining at all four SPAs (Lewis et al., 2012), population modelling has indicated that displacement from the Development Area and 2 km buffer alone (via reductions in breeding success) is not predicted to negatively affect SPA population growth rates (see Table 15.33 and associated discussion of PVA results). The overall proportion of foraging area predicted to be lost is small compared with the variation in mean maximum foraging distances for this species (*Appendix 15A*, Table 15A.5). No negative impacts are therefore predicted on guillemot populations at any of the four SPAs identified for LSE.
Razorbill	Forth Islands	In-combination displacement is predicted to result in the effective loss of 5% of offshore foraging habitat for razorbill (Table 15.39 and Figure 15.10). No evidence has been found that razorbill breeding success varies with foraging distance or whether razorbills, like guillemots, have leeway in their time-activity budgets to increase foraging effort (e.g. travelling further) in response to adverse conditions (Daunt *et al*., 2011a). Like guillemots, razorbills are able to dive to considerable depths (150 m, Daunt *et al*., 2011a) and exploit prey throughout the water column. The population at the Forth Islands SPA is considered to be stable (Lewis *et al*., 2012). Population modelling has indicated that displacement from the Development Area and 2 km buffer alone (via reductions in breeding success) is not predicted to negatively affect SPA population growth rates (see Table 15.33 and associated discussion of PVA results). The overall proportion of foraging area predicted to be lost is small compared with the variation in mean maximum foraging distances for this species (*Appendix 15A*, Table 15A.5). No negative impact is therefore predicted on the razorbill population of the SPA.
Razorbill	Fowlsheugh	In-combination displacement is predicted to result in the effective loss of 5% of offshore foraging habitat for razorbill (Table 15.39). The population trend of razorbills at Fowlsheugh SPA is unclear (Lewis *et al.*, 2012). Population modelling has indicated that displacement from the Development Area and 2 km buffer alone (via reductions in breeding success) is not predicted to negatively affect SPA population growth rates (see Table 15.33 and associated discussion of PVA results). The overall

Bird species	SPA(s)	Assessment of In-combination Displacement
		proportion of foraging area predicted to be lost is small compared with the variation in mean maximum foraging distances for this species (*Appendix 15A*, Table 15A.5). No negative impact is therefore predicted on the razorbill population of the SPA.
Razorbill	St Abb's Head to Fast Castle	In-combination displacement is predicted to result in the effective loss of 4% of offshore foraging habitat for razorbill (Table 15.39). Razorbills at St Abb's Head to Fast Castle SPA are decreasing but with low confidence in the trend (Lewis *et al.*, 2012). Population modelling has indicated that displacement from the Development Area and 2 km buffer alone (via reductions in breeding success) is not predicted to negatively affect SPA population growth rates (see Table 15.33 and associated discussion of PVA results). The overall proportion of foraging area predicted to be lost is small compared with the variation in mean maximum foraging distances for this species (*Appendix 15A*, Table 15A.5). No negative impact is predicted on the razorbill population of the SPA.
Puffin	Forth Islands	In-combination displacement is predicted to result in the effective loss of 2% of offshore foraging habitat for puffins (Table 15.39 and Figure 15.11). Little tracking data is available for puffins (Daunt *et al*., 2011b) and no evidence has been found that breeding success varies with foraging distance or whether puffins, like guillemots, have leeway in their time-activity budgets to increase foraging effort (e.g. travelling further) in response to adverse conditions (Daunt *et al*., 2011a). Puffins are able to dive to considerable depths, although not as far as guillemots or razorbills (Daunt *et al*., 2011b) so they can exploit prey throughout the water column. The population trend of puffin at the Forth Islands SPA is unclear (Lewis *et al.*, 2012). Population modelling has indicated that displacement from the Development Area and 2 km buffer alone (via reductions in breeding success) is not predicted to negatively affect SPA population growth rates (see Table 15.33 and associated discussion of PVA results). The overall proportion of foraging area predicted to be lost is small compared with the variation in mean maximum foraging distances for this species (*Appendix 15A*, Table 15A.5). No negative impact is predicted on SPA population.
For common terns at the Forth Islands SPA there is no overlap between foraging range and the Development Area (see Figure 15.8) and therefore no negative in-combination impacts of displacement are predicted on the SPA population.		

Collision risk to SPA Qualifying Species in the breeding season- Operation and Maintenance.

481 As noted above, the risk of collision with WTGs was not identified as contributing to a likely significant effect due to impacts on fulmar, common and Arctic tern, razorbill, guillemot and puffin at any SPA requiring an Appropriate Assessment, as these species did not fly at potential collision height (see *Appendix 15A*, *Section 15A.4.1*). No further information on the risk of collision for herring gull and lesser black-backed gull associated with the Project is provided because of the very small number of observations of each species within the Development Area.

482 For the other two species (gannet and kittiwake), collision mortality from proposed offshore wind farms identified as having potential in-combination effects with the Project is shown in Table 15.41. An avoidance rate of 99 per cent was applied for gannet, and 98 per cent and 99 per cent for kittiwake. Total predicted mortality for each species is assessed in Table 15.42.

Table 15.41: In-combination predicted Annual Collision Mortality During the Breeding Season for SPA Qualifying Species Requiring Further Information to Inform an Appropriate Assessment

Bird species	Avoidance rate[1]	Development[3]						
		Inch Cape Offshore Wind Farm	Neart na Gaoithe[2]	Firth of Forth Phase I (Project Alpha)	Firth of Forth Phase I (Project Bravo)	European Offshore Wind Deployment Centre	Beatrice Offshore Wind Farm	Moray Firth R3, Zone 1 (EDA)
Gannet	99%	313	294	438	270	3	54	62
Kittiwake	98%	**18**	**57**	**189**	**252**	**25**	124	108
	99%	**9**	**29**	**95**	**126**	**13**	62	54

1. Where different avoidance rates were used in published Environmental Statements for developments, these have been adjusted to the avoidance rate given in the table.

2. Published collision estimate was adjusted for difference in definition of gannet breeding season.

3. The Beatrice Demonstrator Wind Farm was in operation at the time that bird survey data for Inch Cape Offshore Wind Farm were being collected, and is considered to be part of the baseline.

Table 15.42: Assessment of In-combination Collision Risk for Breeding SPA Qualifying Species

Bird species	SPA	Assessment of Collision Risk
Gannet	Forth Islands (Bass Rock)	Collision risk estimates for six offshore wind farms in addition to the Wind Farm are presented in Table 15.41 above. Developments in the Moray Firth are considered beyond the predicted foraging range of breeding gannets at Bass Rock (see Table 15.18). In-combination collision risk for the remaining developments amounts to 1,318 birds. A population viability analysis of the UK gannet population estimates an annual harvest rate of 2,000 gannets from the Bass Rock colony to be possible without driving the colony into negative population growth (WWT Consulting, 2012). The predicted in-combination impacts fall within this total and no negative impacts are predicted on the Forth Islands SPA population.
Kittiwake	Forth Islands Buchan Ness to Collieston Coast Fowlsheugh St Abb's Head to Fast Castle	Collision risk estimates for six offshore wind farms in addition to the Wind Farm are presented in Table 15.41 above. However developments in the Moray Firth are beyond the predicted foraging range of breeding kittiwakes at all SPAs (see Table 15.18). Considering the cumulative impact on the regional population without the Moray Firth developments, breeding season collision estimates amount to 541 kittiwakes at 98 per cent avoidance (to which the Project contributes an estimated 18 adult breeding birds annually in the breeding season). With reference to the population viability analysis for this declining species (see *Appendix 15B*).

Summary of HRA outcome for the SPAs with Qualifying Interests in the Breeding Season (Project Alone and In-combination)

483 In this section the HRA outcome for each SPA individually is considered in the tabular form used for the over-wintering SPAs. The information in *Section 15.12.7* (Project alone) and *Section 15.12.8* (in-combination with other plans and projects) is used and in particular to support consideration of the population viability conservation objective of these four SPAs.

484 The section tables (Table 15.43 to 15.46) address in turn, *Will the Project Alone and In-combination Have an Adverse Impact on the Integrity of the Forth Islands SPA, Fowlsheugh SPA, St Abb's Head to Fast Castle SPA, and Buchan Ness to Collieston Coast SPA.* After each of these summaries, the conclusion is given, covering the Project alone and in-combination, to give insight into the relative conformity with the Habitats Regulations of the Project in comparison to the other offshore wind farm developments being considered.

Will the Project Alone or In-combination Cause an Adverse Effect on the Integrity of the Forth Islands SPA?

485 The information to inform the HRA for this SPA is set out in Table 15.43 below.

Table 15.43: Summary of HRA Outcome for Seabird Populations at the Forth Islands SPA

Conservation Objective for Qualifying Species	Summary of HRA Findings for the Breeding Season – Forth Islands SPA	Section(s) Above Where Evidence is Presented
1. Avoid deterioration of habitats of the qualifying species	The Development Area lies 29 km from the Forth Islands SPA at the nearest point, the Isle of May (Table 15.24). The offshore islands that make up the SPA provide nesting habitats for qualifying species – on cliffs and rocky or grassy habitats. The SPA also includes inshore marine areas surrounding the islands, which are used for preening, bathing, displaying and other maintenance behaviours by seabirds at the colony. There is no overlap between the Development Area and the SPA boundary, nor is there overlap of the latter with any of the other plans or projects. Therefore no deterioration of the habitats of qualifying species is predicted during construction, operation or decommissioning either for the Project alone or in-combination. The Offshore Export Cable Corridor passes through the marine extensions to the Forth Islands SPA around the islands of Fidra, the Lamb and Craigleith (see Figure 15.2). The main potential for impact is during construction, when the Offshore Export Cables will be laid on the seabed, but disturbance will be temporary and localised and no long term deterioration in habitat is predicted. Due to the nature of the activities associated with the Offshore Export Cable (see Table 15.3; Section 15.7.2) no deterioration of the habitats of qualifying species is predicted during construction, operation or decommissioning of the Offshore Export Cable. The Project, either **alone** or **in-combination with other plans or projects**, will not cause any direct or indirect deterioration of qualifying (including breeding assemblage) species habitat within the SPA, during construction, operation or decommissioning. Any effects on supporting habitat outside the SPA have been fully considered in relation to the ‘viable population’ objective (see below).	Development Area: Figure 15.2; Table 15.24. Offshore Export Cable Corridor: *Section 15.7.2* Effects of Construction; *Section 15.7.3* Effects of Operation; Table 15.3.
2. Avoid significant disturbance to the qualifying species	Due to the distance between the Development Area and the SPA (at 29 km from its nearest point) there will be no disturbance to qualifying species while they are present within the SPA. Construction and operational maintenance of the Offshore Export Cable, where it passes through or close to marine extensions around the islands of Fidra, the Lamb, Craigleith and the Bass Rock (Figure 15.2) will cause temporary and localised disturbance but this is not considered significant in terms of this conservation objective.	Development Area: Figure 15.2; Table 15.24. Offshore Export Cable Corridor: *Section 15.7.2* Effects of Construction; *Section 15.7.3*

Conservation Objective for Qualifying Species	Summary of HRA Findings for the Breeding Season – Forth Islands SPA	Section(s) Above Where Evidence is Presented
2. Avoid significant disturbance to the qualifying species	Therefore, the Project, either **alone** or **in-combination with other plans or projects**, will not cause any significant disturbance to qualifying (including breeding assemblage) species within the SPA, during construction, operation or decommissioning. Any effects on qualifying species outside the SPA have been fully considered in relation to the 'viable population' objective (see below).	Effects of Operation; Table 15.3
3. The population of qualifying species as a viable component of the site is maintained in the long-term	Ten qualifying species from this SPA have been identified as contributing to a LSE (Table 15.24). For **fulmar, herring gull, lesser black-backed gull, common tern and Arctic tern** there is clear evidence from survey data and relevant scientific studies, without recourse to PVA, that the Project (alone or in-combination, and during either the construction phase, operation or decommissioning) will not significantly affect the population viability (*Sections 15.6, 15.7, 15.9, 15.12.7, 15.12.8*). This conclusion takes account of assessments in relation to displacement and barrier effect (operation), collision risk (operation), direct disturbance (construction and operation) and indirect impacts via disturbance of prey (construction and operation). Impacts during decommissioning are considered to be equivalent to or less than those during construction. For **gannet**, the predicted impacts from displacement, barrier effect and collision, from the Project alone, and in-combination with other plans and projects, have been evaluated using published population modelling work on this species. Even though almost all the gannets recorded at the Development Area are predicted to originate from the SPA, no reduction in population viability from the Project is predicted, alone, or in-combination. Direct disturbance resulting from the construction or operation of the Project will be temporary and localised and is not predicted to negatively affect population viability, either alone or in-combination with other projects. Indirect disturbance during construction or operation, via impacts on prey, is also not predicted to negatively affect population viability in the long term, alone or in-combination with other projects. In relation to displacement and barrier effect, for the Project alone precautionary assumptions were made for **kittiwake** of 30% displacement from the Development Area and a 2.0 km buffer, and 100% breeding failure for all displaced birds, assuming each is from a pair. Using a population model, displacement was not predicted to affect the viability of the Forth Islands SPA population, for the Project alone (Table 15.34 and	*Section 15.6* Impact Assessment – Development Area. *Section 15.7* Impact Assessment – Offshore Export Cable Corridor. *Section 15.9* Cumulative Impacts from the Project with other Developments. *Section 15.12.7* Information to Inform the HRA for the four SPAs with Qualifying Interests in the Breeding Season – Project Alone. *Section 15.12.8* Information to Inform the HRA for the four SPAs with Qualifying Interests in the Breeding Season – In-combination.

Conservation Objective for Qualifying Species	Summary of HRA Findings for the Breeding Season – Forth Islands SPA	Section(s) Above Where Evidence is Presented
3. The population of qualifying species as a viable component of the site is maintained in the long-term	associated text describing PVA). Using the conclusions from the PVA to provide context, in-combination effects with other projects were similarly predicted to not affect population viability (Table 15.40). Collision risk from the Project alone (Table 15.36 and associated text describing PVA) was not predicted to affect the viability of the **kittiwake** SPA population. This conclusion is based on an avoidance rate of 98% and PVA modelling which predicts an increase in the likelihood of population decline in relation to collision mortality. Direct disturbance resulting from the construction or operation of the Project will be temporary and localised (*Section 15.12.7* and *Section 15.12.8*) and is not predicted to negatively affect the population viability of **kittiwakes**, either alone or in-combination with other projects. Indirect disturbance during construction or operation of the Project was not predicted to affect **kittiwakes** via impacts on prey, either alone or in-combination with other Projects (*Section 15.12.7*; Table 15.38). For **guillemot**, no collision mortality is predicted, as surveys detected no flight activity at collision risk height. For displacement for the Project alone, precautionary assumptions were made of 50% displacement from the Development Area and a 2.0 km buffer, and 100% breeding failure as a result. Population modelling was used to assess the scale of impacts. Although the SPA population of guillemot is declining, the predicted 1.37% decrease in breeding success resulting from displacement (Table 15.33) is not likely to significantly affect the population growth rate. No reduction in the viability of the SPA population is predicted in relation to displacement from the Project, alone (Table 15.34 and associated text in relation to PVA) or in-combination with other projects (Table 15.40). Direct disturbance resulting from the construction or operation of the Project, alone and in-combination with other projects, will be temporary and localised and is not predicted to negatively affect population viability. Indirect disturbance during construction of the Project was not predicted to affect guillemot populations, via impacts on prey, either alone, or in-combination with other projects (*Section 15.12.7*; Table 15.38). Indirect disturbance during the operation of the Project is also not predicted to have negative effects on population viability, either alone	

Conservation Objective for Qualifying Species	Summary of HRA Findings for the Breeding Season – Forth Islands SPA	Section(s) Above Where Evidence is Presented
3. The population of qualifying species as a viable component of the site is maintained in the long-term	or in-combination with other wind farms. For **razorbill**, no collision mortality is predicted, as surveys detected no flight activity at collision risk height. Using precautionary assumptions of 50% displacement from the Development Area and 100% breeding failure as a result, a 2.95% reduction in breeding success of the SPA population was predicted for the Project alone (Table 15.33). Population modelling was used to assess the impact on population viability. Although there was some uncertainty over the match between the predicted trends of the PVA and available information on the SPA trend (PVA predicts an increasing population whereas the SPA population is considered to be stable), the likely decrease in breeding success resulting from displacement is not predicted to significantly affect the population growth rate (Table 15.34 and associated text in relation to PVA). No reduction in the viability of the SPA population is predicted in relation to displacement from the Project alone (Table 15.34 and associated text in relation to PVA) or in-combination with other projects (Table 15.40). Direct disturbance resulting from the construction or operation of the Project, alone and in-combination with other Projects, will be temporary and localised and is not predicted to negatively affect population viability. Indirect disturbance during construction, via impacts on prey, is not predicted to negatively affect population viability, considering the Project alone, and in-combination with other projects (*Section 15.12.7*; Table 15.38). Indirect disturbance during the operation of the Wind Farm is also not predicted to have negative effects on population viability, either alone or in-combination with other wind farms. For **puffin**, surveys detected no flight activity at collision risk height, and no collision mortality is predicted. Using the same precautionary assumptions for the Project alone about 50% displacement from the Wind Farm and 100% breeding failure, as applied for guillemot and razorbill, predicts a 2.17% reduction in breeding success (Table 15.33). Population modelling indicated that displacement impacts are not considered likely to cause population declines, but to limit population growth, and the predicted effects are small. No adverse effects on puffins as a viable component of the Forth Islands SPA are predicted, either from the Project alone (Table 15.34 and associated text in relation to PVA) or in-	

Conservation Objective for Qualifying Species	Summary of HRA Findings for the Breeding Season – Forth Islands SPA	Section(s) Above Where Evidence is Presented
3. The population of qualifying species as a viable component of the site is maintained in the long-term	combination with other projects (Table 15.40). Direct disturbance resulting from the construction or operation of the Project, alone or in-combination with other projects, will be temporary and localised and is not predicted to negatively affect population viability. Indirect disturbance during construction and operation, via impacts on prey, is not predicted to negatively affect population viability, either alone or in-combination with other projects (*Section 15.12.7*; Table 15.38). Therefore, the Project alone will not negatively affect the population viability of any qualifying interest within the SPA, during construction, operation or decommissioning. No overall conclusion is presented in relation to in-combination effects as, at the time of writing, information was not available to allow apportionment of kittiwake collision mortality from other projects to individual SPAs and allow conclusions to be presented on the in-combination effects on the population of kittiwake as a viable component of the Forth Islands SPA. However, the total kittiwake collision mortality from The Project in-combination with other plans and projects is predicted to be 541 (from the regional population during the breeding season), of which 18 adult birds are apportioned to the Project alone (3.3%), see Table 15.35. Of the total of 18 from the Project alone only one adult bird is apportioned to the Forth Islands SPA. In comparison, of the total 541 birds, 57 are apportioned to Neart na Gaoithe, 189 to Firth of Forth Phase 1 (Project Alpha), 252 to Firth of Forth Phase 1 (Project Bravo) and 25 to European Offshore Wind Deployment Centre (see Table 15.41).	
4. The distribution of the qualifying species within the SPA is maintained in the long-term	The Forth Islands SPA comprises seven islands in the Forth estuary, at distances of 29 km (Isle of May) to 86 km (Long Craig Island) from the Development Area (Table 15.24). If the Project impacted disproportionately on birds of a given species nesting on a particular island, and caused a species to decline to extinction or abandon that island, then it is possible there might be a change in the distribution of that species within the SPA. The possibility of such an impact would depend on whether populations of a given species nesting on a particular island have exclusive foraging areas, or whether populations from different islands mix on the foraging grounds. Tracking data for some seabirds are only available from the Isle of May within the Forth Islands, so it is not	Figure 15.2; Table 15.24. No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.

Conservation Objective for Qualifying Species	Summary of HRA Findings for the Breeding Season – Forth Islands SPA	Section(s) Above Where Evidence is Presented
4. The distribution of the qualifying species within the SPA is maintained in the long-term	possible to conclude whether or not birds from different colonies might share foraging grounds. The closest area of the Forth Islands SPA to the Development Area is the Isle of May – so it is likely that birds nesting here would forage most regularly in the vicinity of the Development Area. The Isle of May is also the closest part of the Forth Islands SPA to other offshore wind farms identified for in-combination impacts, so any effects are most likely on birds breeding at the Isle of May. With the exception of gannet, all seabird species assessed here breed on the Isle of May. Based on means of available count data since 2000, the Isle of May supported large percentages of the Forth Islands populations for each species: fulmar (24%), kittiwake (65%), herring gull (74%), lesser black-backed gull (77%), common tern (47%), Arctic tern (87%), guillemot (82%), razorbill (96%), and puffin (90%) (percentages based on colony count data in Lewis *et al*., 2012). For each species assessed, except common tern, the Isle of May population of a species is the largest within the Forth Islands SPA. Thus, although birds at the Isle of May are most likely to encounter the Wind Farm, the large size of the Isle of May populations suggest that these populations will persist despite any adverse effects of the Project and there will be no effect on the distribution of the species within the site. Furthermore, for all species, no negative impacts on population viability are predicted as a result of the Project, and an in-combination effect only for kittiwake in relation to collision risk. The in-combination adverse effect of collision for kittiwake is not predicted to be of a scale that would result in the loss of this species from the Isle of May or the Forth Islands SPA during the operational life of the Project. Gannets do not breed on the Isle of May – the only colony within the Forth Islands is on Bass Rock. No negative impact on population viability is predicted for this species in relation to the Wind Farm and thus no change is predicted in the distribution of the species within the SPA. Therefore, the Project **alone** and **in-combination with other plans or projects** will not negatively affect the distribution of any qualifying interest within the SPA, during construction, operation or decommissioning.	

Conservation Objective for Qualifying Species	Summary of HRA Findings for the Breeding Season – Forth Islands SPA	Section(s) Above Where Evidence is Presented
5. The distribution and extent of habitat supporting the qualifying species is maintained in the long-term	The SPA is situated 29 km from the Development Area (Table 15.24) at the nearest point. The habitats supporting qualifying species within the SPA comprise nesting sites (mainly cliff ledges) and inshore marine areas used for preening, bathing, displaying and other maintenance behaviours by seabirds at the colony. Except for the laying of a small section of the Offshore Export Cable in the vicinity of Fidra, the Lamb, Craigleith and the Bass Rock, there will be no works within or close to the SPA boundary. Offshore Export Cable laying within the SPA boundary will cause minor disturbance to benthic habitats, and the habitats will recover after works have taken place. The Project, either **alone** or **in- combination with other plans or projects**, will not cause any change to the distribution or extent of any qualifying species' supporting habitat within the SPA over the long-term, during construction, operation or decommissioning.	Figure 15.2; Table 15.24. No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.
6. The structure, function and supporting processes of habitats supporting the qualifying species is maintained in the long-term	Almost all of the activities associated with the construction and operation of the Project will take place outside the SPA boundary, and the Development Area is 29 km from the SPA. Activities for none of the other projects overlap with the SPA either. As disturbance to habitats within the SPA will therefore be minimal, and these habitats are predicted to recover after construction activities works (see *Section 15.7.2*) the Project, either **alone** or **in-combination with other plans or projects**, will not cause any impacts on the structure, function and supporting processes over the long-term to qualifying (including breeding assemblage) species' habitat within the SPA, during construction, operation or decommissioning.	Development Area: Figure 15.2; Table 15.24. Offshore Export Cable Corridor: *Section 15.7.2* Effects of Construction; *Section 15.7.3* Effects of Operation; Table 15.3
7. No significant disturbance of the species in the long-term	The same conclusion applies as for the conservation objective 2 above. The Project **alone** or **in-combination with other plans or projects** will not cause significant disturbance to qualifying species, during construction, operation or decommissioning.	See conservation objective 2 (above).

Conclusion Regarding Site Integrity of the Forth Islands SPA

486 Having considered the conservation objectives of the Forth Islands SPA, it is concluded beyond reasonable scientific doubt (within the precautionary assumptions of the assessment) that there will be no adverse effect on site integrity from construction, operation and decommissioning of the Project alone.

487 No overall conclusion is presented in relation to in-combination effects as, at the time of writing, information was not available to allow apportionment of kittiwake collision mortality from other projects to individual SPAs and allow conclusions to be presented on the in-combination effects on the population of kittiwake as a viable component of the Forth Islands SPA. However, the total kittiwake collision mortality from The Project in-combination with other plans and projects is predicted to be 541 (from the regional population during the breeding season), of which 18 adult birds are apportioned to the Project alone (3.3%), see Table 15.35. Of the total of 18 from the Project alone only one adult bird is apportioned to the Forth Islands SPA. In comparison, of the total 541 birds, 57 are apportioned to Neart na Gaoithe, 189 to Firth of Forth Phase 1 (Project Alpha), 252 to Firth of Forth (Project Bravo) and 25 to European Offshore Wind Deployment Centre (see Table 15.41).

Based on the best available scientific information, it is considered that the in-combination effects will not compromise the achievement of any of the other conservation objectives for kittiwake or any of the conservation objectives for any of the other qualifying features of the Forth Islands SPA.

Will the Project (Alone)or In-combination Cause an Adverse Effect on the Integrity of the Fowlsheugh SPA?

488 The information to inform the HRA for this SPA is set out in Table 15.44 below.

Table 15.44: Summary of HRA Outcome for Seabird Populations at the Fowlsheugh SPA

Conservation Objective for the Qualifying Species	Summary of HRA Findings – Fowlsheugh SPA	Section(s) Above Where Evidence is Presented
1. Avoid deterioration of habitats of the qualifying species	The Development Area is 33 km from Fowlsheugh SPA (Figure 15.24) and there is no overlap between the Offshore Export Cable Corridor and the SPA (nor is there for any of the other projects). The habitats supporting qualifying species within the SPA comprise nesting sites (mainly cliff ledges) and inshore marine areas used for preening, bathing, displaying and other maintenance behaviours by seabirds at the colony. There will be no works within or close to the SPA. The Project, either alone or in-combination with other plans or projects, will not cause any direct or indirect deterioration of qualifying (including breeding seabird assemblage) species' habitat within the SPA, during construction, operation or decommissioning. Any effects on supporting habitat outside the SPA have been fully considered in relation to the 'viable population' objective (see below). It is therefore firmly concluded beyond reasonable scientific doubt that the Project **alone**, or **in-combination with other plans or projects**, will not cause any deterioration of habitats within the Fowlsheugh SPA.	Development Area: Figure 15.2; Table 15.24. Offshore Export Cable Corridor: *Section 15.7.2* Effects of Construction; *Section 15.7.3* Effects of Operation; Table 15.3
2. Avoid significant disturbance to the qualifying species	The Project, either alone or in-combination with other plans or projects, will not cause any significant disturbance to qualifying (including breeding assemblage) species within the SPA, during construction, operation or decommissioning. This is because the Project (specifically the Development Area) is situated 33 km from the SPA, nor are any of the other projects sufficiently close to the SPA, so there will be no disturbance to qualifying species while they are present within the SPA. It is firmly concluded beyond reasonable scientific doubt that the Project **alone**, or **in-combination with other plans or projects**, will not cause any significant disturbance to birds within the SPA. Any effects on qualifying species outside the SPA have been fully considered in relation to the 'viable population' objective (see below).	Figure 15.2; Table 15.24. No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.

Conservation Objective for the Qualifying Species	Summary of HRA Findings – Fowlsheugh SPA	Section(s) Above Where Evidence is Presented
3. The population of qualifying species as a viable component of the site is maintained in the long-term	Five species from this SPA have been identified as contributing to a LSE (Table 15.24). For **fulmar** and **herring gull** there is clear evidence from survey data, without recourse to PVA, that the Project (alone or in-combination, and during either the construction phase, operation or decommissioning) has no potential to significantly affect the population viability. This conclusion takes account of assessments in relation to displacement (operation), collision risk (operation), direct disturbance (construction and operation) and indirect impacts via disturbance of prey (construction and operation). Impacts during decommissioning are considered to be equivalent to or less than those during construction. In relation to displacement and barrier effect for the Project alone, precautionary assumptions were made for **kittiwake** of 30% displacement from the Development Area and a 2.0 km buffer, and 100% breeding failure for all displaced birds. Taking into account the PVA results, displacement was not predicted to affect the viability of the SPA population, for the Project alone (Table 15.34 and associated text describing PVA) or – based on potential loss of foraging range calculations - in-combination with other projects (Table 15.40). Collision risk for the Project alone was also not predicted to affect the viability of the **kittiwake** SPA population (Table 15.36 and associated text describing PVA). This conclusion is based on an avoidance rate of 98% and PVA which predicts an increase in the likelihood of population decline in relation to collision mortality. In relation to in-combination collision impacts, the predicted mortality for the Project during the breeding season (a total of 18 adult birds per year from the regional population during the breeding season, of which SPA apportionment predicts four birds from the Fowlsheugh SPA) is substantially lower than other east coast offshore wind farms (Table 15.41) and represents 3.3% of the cumulative total of 541 birds (see assessment in Table 15.42). Direct disturbance resulting from the construction or operation of the Project will be temporary and localised (*Section 15.12.7* and *Section 15.12.8*) and is not predicted to negatively affect the population viability of **kittiwakes**, either alone or in-combination with other projects. Indirect disturbance during construction of the Project was not predicted to affect **kittiwakes** via impacts on prey, either alone or in-combination with other projects (*Section 15.12.7*; Table 15.38). Similarly, indirect disturbance during the operation of the Project is not predicted to have negative effects on population viability, either alone or in-combination	*Section 15.6* Impact Assessment – Development Area. *Section 15.7* Impact Assessment – Offshore Export Cable Corridor. *Section 15.9* Cumulative Impacts from the Project with other Developments. *Section 15.12.7* Information to Inform the HRA for the four SPAs with Qualifying Interests in the Breeding Season – Project Alone. *Section 15.12.8* Information to Inform the HRA for the four SPAs with Qualifying Interests in the Breeding Season – In-combination.

Conservation Objective for the Qualifying Species	Summary of HRA Findings – Fowlsheugh SPA	Section(s) Above Where Evidence is Presented
3. The population of qualifying species as a viable component of the site is maintained in the long-term	with other offshore wind farms. For **guillemot**, no collision mortality is predicted, as surveys detected no flight activity at collision risk height. For displacement for the Project alone, precautionary assumptions were made of 50% displacement from the Development Area and 100% breeding failure as a result. Population modelling was used to assess the scale of impacts. Although the SPA population of guillemot is declining, the predicted 3.28% decrease in breeding success is not likely to significantly affect the population growth rate. No reduction in the viability of the SPA population is predicted in relation to displacement from the Project alone (Table 15.34 and associated text in relation to PVA) or in-combination with other projects (loss of foraging range calculations, Table 15.40). Direct disturbance resulting from the construction or operation of the Project will be temporary and localised and is not predicted to negatively affect population viability, either alone or in-combination with other projects. Indirect disturbance during construction of the Project, via impacts on prey, is not predicted to negatively affect population viability, either alone or in-combination with other projects (*Section 15.12.7*; Table 15.38). Indirect disturbance during the operation of the Project is also not predicted to have negative effects on population viability, either alone or in-combination with other offshore wind farms. For **razorbill**, no impact is predicted from collision, as surveys detected no flight activity at collision risk height. Using precautionary assumptions for the Project alone of 50% displacement from the Development Area and 100% breeding failure as a result, a 5.53% reduction in breeding success was predicted (Table 15.33). Population modelling was used to assess the impact on population viability. Although there was some uncertainty over the match between the predicted trends of the PVA and available information on the SPA trend (PVA predicts an increasing population whereas the SPA trend is unclear), the likely decrease in breeding success resulting from displacement is not predicted to significantly affect the population growth rate (Table 15.34 and associated text in relation to PVA). No reduction in the viability of the SPA population is predicted in relation to displacement from the Project alone (Table 15.34 and associated text in relation to PVA) or in-combination with other projects (Table	

Conservation Objective for the Qualifying Species	Summary of HRA Findings – Fowlsheugh SPA	Section(s) Above Where Evidence is Presented
3. The population of qualifying species as a viable component of the site is maintained in the long-term	15.40). Direct disturbance resulting from the construction or operation of the Project will be temporary and localised and is not predicted to negatively affect population viability of **razorbill**, either alone or in-combination with other projects. Indirect disturbance during construction of the Project was not predicted to affect **razorbill** via impacts on prey, either alone or in-combination with other projects (*Section 15.12.7*; Table 15.38). Indirect disturbance during the operation of the Project is also not predicted to have negative effects on population viability, either alone or in-combination with other offshore wind farms. Therefore, the Project alone will not negatively affect the population viability of any qualifying interest within the SPA, during construction, operation or decommissioning. No overall conclusion is presented in relation to in-combination effects as, at the time of writing, information was not available to allow apportionment of kittiwake collision mortality from other projects to individual SPAs and allow conclusions to be presented on the in-combination effects on the population of kittiwake as a viable component of the Fowlsheugh SPA. However, the total kittiwake collision mortality from The Project in-combination with other plans and projects is predicted to be 541 (from the regional population during the breeding season), of which 18 adult birds are apportioned to the Project alone (3.3%), see Table 15.35. Of the total of 18 from the Project alone only four adult bird is apportioned to the Fowlsheugh SPA. In comparison, of the total 541 birds, 57 are apportioned to Neart na Gaoithe, 189 to Firth of Forth Phase 1 (Project Alpha), 252 to Firth of Forth Phase 1(Project Bravo) and 25 to European Offshore Wind Deployment Centre (see Table 15.41).	
4. The distribution of the qualifying species within the SPA is maintained in the long-term	Fowlsheugh SPA covers an area of 10.15 hectares of mainland cliffs Seabirds breeding here are considered to comprise a single colony and individuals of a given species are likely to share foraging areas. Thus any effects of the Project **alone** or **in-combination with other plans and projects** are predicted to act equally on the site population and not disproportionately on any area within the site. No change is predicted in the distribution of qualifying species considered in the Appropriate Assessment.	Figure 15.2; Table 15.24. No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.

Conservation Objective for the Qualifying Species	Summary of HRA Findings – Fowlsheugh SPA	Section(s) Above Where Evidence is Presented
5. The distribution and extent of habitat supporting the qualifying species is maintained in the long-term	The SPA is situated 33 km from the Development Area (Table 15.24) and there is no spatial overlap with any of the other projects. The habitats supporting qualifying species within the SPA comprise nesting sites (mainly cliff ledges) and inshore marine areas used for preening, bathing, displaying and other maintenance behaviours by seabirds at the colony. There will be no works within or close to the SPA boundary. The Project, either alone or in-combination with other plans or projects, will not cause any change to the distribution or extent of supporting habitat within the SPA for any qualifying (including breeding seabird assemblage) species over the long-term, during construction, operation or decommissioning. It is firmly concluded beyond reasonable scientific doubt that the wind farm **alone**, or **in-combination with other plans and projects**, will not cause any alteration to the distribution or extent of habitats within the SPA.	Figure 15.2; Table 15.24 No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.
6. The structure, function and supporting processes of habitats supporting the qualifying species is maintained in the long-term	Due to the distance between the Development Area and the SPA (33 km) and because there will be no works within or close to the SPA for the Project or any of the projects considered, the Project, either **alone** or **in-combination with other plans or projects**, will not cause any impacts on the structure, function and supporting processes of SPA habitats supporting the species over the long-term, during construction, operation or decommissioning.	Development Area: Figure 15.2; Table 15.24. Offshore Export Cable Corridor: *Section 15.7.2* Effects of Construction; *Section 15.7.3* Effects of Operation; Table 15.3.
7. No significant disturbance of the species in the long-term	The same conclusion applies as for the conservation objective 2 above. The Project **alone** or **in-combination with other plans or projects** will not cause significant disturbance to qualifying species in the long term during construction, operation or decommissioning.	See conservation objective 2 (above)

Conclusion Regarding Site Integrity of the Fowlsheugh SPA

489 Having considered the conservation objectives of the Fowlsheugh SPA, it was concluded beyond reasonable scientific doubt (within the precautionary assumptions of the assessment) that there would be no adverse effect on site integrity in relation to the construction, operation and decommissioning phases of the Project alone.

490 No overall conclusion is presented in relation to in-combination effects as, at the time of writing, information was not available to allow apportionment of kittiwake collision mortality from other projects to individual SPAs and allow conclusions to be presented on the in-combination effects on the population of kittiwake as a viable component of the Fowlsheugh SPA. However, the total kittiwake collision mortality from The Project in-combination with other plans and projects is predicted to be 541 (from the regional population during the breeding season), of which 18 adult birds are apportioned to the Project alone (3.3%), see Table 15.35. Of the total of 18 from the Project alone only four adult bird is apportioned to the Fowlsheugh SPA. In comparison, of the total 541 birds, 57 are apportioned to Neart na Gaoithe, 189 to Firth of Forth Phase 1 (Project Alpha), 252 to Firth of Forth Phase 1(Project Bravo) and 25 to European Offshore Wind Deployment Centre (see Table 15.41).

491 Based on the best available scientific information, it is considered that the in-combination effects will not compromise the achievement of any of the other conservation objectives for kittiwake or any of the conservation objectives for any of the other qualifying features of the Fowlsheugh SPA.

Will the Project (Alone) or In-combination Cause an Adverse Effect on the Integrity of the St Abb's Head to Fast Castle SPA?

492 The information to inform the HRA for this SPA is set out in Table 15.45 below.

Table 15.45: Summary of HRA Outcome for Seabird Populations at the St Abb's Head to Fast Castle SPA

Conservation Objective for the Qualifying Species	Summary of HRA Findings - St Abb's Head to Fast Castle	Section(s) Above Where Evidence is Presented
1. Avoid deterioration of habitats of the qualifying species	The Development Area is 53 km from the SPA (Table 15.24) and there is no overlap between the Offshore Export Cable Corridor and the SPA, nor is there overlap between the SPA and other projects. The habitats supporting qualifying species within the SPA comprise nesting sites (mainly cliff ledges) and inshore marine waters used for preening, bathing, displaying and other maintenance behaviours by seabirds at the colony. The Project, either **alone** or **in-combination with other plans or projects**, will not cause any direct or indirect deterioration of qualifying (including breeding seabird assemblage) species' habitat within the SPA, during construction, operation or decommissioning. This is because there is no overlap between the Development Area and Offshore Export Cable Corridor and the SPA boundary and no works will take place within or close to the SPA. Any effects on supporting habitat outside the SPA have been fully considered in relation to the 'viable population' objective (see below).	Development Area: Figure 15.2; Table 15.24. Offshore Export Cable Corridor: *Section 15.7.2* Effects of Construction; *Section 15.7.3* Effects of Operation; Table 15.3.
2. Avoid significant disturbance to the qualifying species	The Project, either alone or in-combination with other plans or projects, will not cause any significant disturbance to qualifying (including breeding assemblage) species within the SPA, during construction, operation or decommissioning. This is because the Development Area is situated 53 km from the SPA and there will be no works within or close to the SPA boundary (nor do any of the other projects overlap with the SPA), so there will be no disturbance to qualifying species while they are present within the SPA. It is firmly concluded beyond reasonable scientific doubt that the Project **alone**, or **in-combination with other plans and projects**, will not cause any significant disturbance to birds within the SPA. Any effects on qualifying species <u>outside</u> the SPA have been fully considered in relation to the 'viable population' objective (see below).	Figure 15.2; Table 15.24. No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.

Conservation Objective for the Qualifying Species	Summary of HRA Findings - St Abb's Head to Fast Castle	Section(s) Above Where Evidence is Presented
3. The population of qualifying species as a viable component of the site is maintained in the long-term	Four species from this SPA have been identified as contributing to a LSE (Table 15.24). For **herring gull**, there is clear evidence from survey data, without recourse to PVA, that the Project (alone or in-combination, and during either the construction phase, operation or decommissioning) has no potential to significantly affect the population viability. This conclusion takes account of assessments in relation to displacement (operation), collision risk (operation), direct disturbance (construction and operation) and indirect impacts via disturbance of prey (construction and operation). Impacts during decommissioning are considered to be the same as or less than those during construction. In relation to displacement for the Project alone, precautionary assumptions were made for **kittiwake** of 30% displacement from the Development Area and a 2.0 km buffer, and 100% breeding failure for all displaced birds. Using a population model, displacement was not predicted to affect the viability of the SPA population, either for the Project alone (Table 15.34 and associated text describing PVA), or in-combination with other projects (loss of foraging range calculations, Table 15.40). Collision risk at the Wind Farm alone was also not predicted to affect the viability of the **kittiwake** SPA population (Table 15.36 and associated text describing PVA)This conclusion is based on an avoidance rate of 98% and PVA which predicts an increase in the likelihood of population decline in relation to collision mortality. In relation to in-combination collision impacts, the predicted mortality for the Project during the breeding season (a total of 18 adult birds per year from the regional population during the breeding season, of which SPA apportionment predicts only one bird from the St Abb's Head to Fast Castle SPA) is substantially lower than other east coast offshore wind farms (Table 15.41) and represents 3.3% of the cumulative total of 541 birds (see assessment in Table 15.42). Direct disturbance resulting from the construction or operation of the Project will be temporary and localised and is not predicted to negatively affect the population viability of **kittiwakes**, either alone or in-combination with other projects. Indirect disturbance during construction of the Project was not predicted to affect **kittiwakes** via impacts on prey, either alone or in-combination with other projects (*Section 15.12.7*; Table 15.38). Indirect disturbance during the operation of the Project is also not predicted to have negative effects on population viability, either alone or in-combination	*Section 15.6* Impact Assessment – Development Area. *Section 15.7* Impact Assessment – Offshore Export Cable Corridor. *Section 15.9* Cumulative Impacts from the Project with other Developments. *Section 15.12.7* Information to Inform the HRA for the four SPAs with Qualifying Interests in the Breeding Season – Project Alone. *Section 15.12.8* Information to Inform the HRA for the four SPAs with Qualifying Interests in the Breeding Season – In-combination.

Conservation Objective for the Qualifying Species	Summary of HRA Findings - St Abb's Head to Fast Castle	Section(s) Above Where Evidence is Presented
3. The population of qualifying species as a viable component of the site is maintained in the long-term	with other wind farms. For **guillemot**, no collision mortality is predicted, as surveys detected no flight activity at collision risk height. For displacement and barrier effects for the Project alone precautionary assumptions were made of 50% displacement from the Development Area and a 2.0 km buffer, and 100% breeding failure as a result. Population modelling was used to assess the impacts on population viability. Although the SPA population of **guillemot** is declining, the predicted 0.82% decrease in breeding success resulting from displacement (Table 15.33) is not likely to significantly affect the population growth rate. No reduction in the viability of the SPA population is predicted in relation to displacement from the Project, alone (Table 15.34 and associated text in relation to PVA) or in-combination with other projects (foraging range loss calculations, Table 15.40). Direct disturbance resulting from the construction or operation of the Project, alone or in-combination with other projects, will be temporary and localised and is not predicted to negatively affect population viability. Indirect disturbance during construction of the Project was not predicted to affect **guillemot**, via impacts on prey, either alone, or in-combination with other projects (*Section 15.12.7*; Table 15.38). Indirect disturbance during the operation of the Project is also not predicted to have negative effects on population viability, either alone or in-combination with other wind farms. For **razorbill**, no collision mortality is predicted, as surveys detected no flight activity at collision risk height. Using precautionary assumptions for the Project alone of 50% displacement from the wind farm and 100% breeding failure as a result, a 1.51% reduction in breeding success of the SPA population was predicted (Table 15.33). Population modelling was used to assess the impact on population viability. Although there was some uncertainty over the match between the predicted trends of the PVA and available information on the SPA trend (PVA predicts an increasing population whereas the SPA trend is decreasing), the likely decrease in breeding success resulting from displacement is not predicted to significantly affect the population growth rate (Table 15.34 and associated text in relation to PVA). No reduction	

Conservation Objective for the Qualifying Species	Summary of HRA Findings - St Abb's Head to Fast Castle	Section(s) Above Where Evidence is Presented
3. The population of qualifying species as a viable component of the site is maintained in the long-term	in the viability of the SPA population is predicted in relation to displacement from the Project, alone (Table 15.34 and associated text in relation to PVA) or in-combination with other projects (foraging range loss calculations, Table 15.40). Direct disturbance resulting from the construction or operation the Project, alone and in-combination with other projects, will be temporary and localised and is not predicted to negatively affect population viability. Indirect disturbance during construction or operation, via impacts on prey, is also not predicted to negatively affect population viability, considering the Project alone, and in-combination with other projects (*Section 15.12.7*; Table 15.38). Indirect disturbance during operation is also not predicted to have negative effects on population viability, either for the Project alone or in-combination with other wind farms. Therefore, the Project alone will not negatively affect the population viability of any qualifying interest within the SPA, during construction, operation or decommissioning. No overall conclusion is presented in relation to in-combination effects as, at the time of writing, information was not available to allow apportionment of kittiwake collision mortality from other projects to individual SPAs and allow conclusions to be presented on the in-combination effects on the population of kittiwake as a viable component of the St Abb's Head to Fast Castle SPA. However, the total kittiwake collision mortality from the Project in-combination with other plans and projects is predicted to be 541 (from the regional population during the breeding season), of which 18 adult birds are apportioned to the Project alone (3.3%), see Table 15.35. Of the total of 18 from the Project alone only one adult bird is apportioned to the St Abb's Head to Fast Castle SPA. In comparison, of the total 541 birds, 57 are apportioned to Neart na Gaoithe, 189 to Firth of Forth Phase 1 (Project Alpha), 252 to Firth of Forth Phase 1 (Project Bravo) and 25 to European Offshore Wind Deployment Centre (see Table 15.41).	

Conservation Objective for the Qualifying Species	Summary of HRA Findings - St Abb's Head to Fast Castle	Section(s) Above Where Evidence is Presented
4. The distribution of the qualifying species within the SPA is maintained in the long-term	St Abb's Head to Fast Castle SPA comprises an area of sea cliffs and coastal strip stretching over 10 km along the Berwickshire Coast. Seabirds breeding here are considered to comprise a single colony and individuals of a given species are likely to share foraging areas. Thus any effects of the Project **alone** or **in- combination with other plans and projects** are predicted to act equally on the site population and not disproportionately on any area within the site. No change is predicted in the distribution of qualifying species considered in the Appropriate Assessment.	Figure 15.2; Table 15.24. No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.
5. The distribution and extent of habitat supporting the qualifying species is maintained in the long-term	The SPA is situated 53 km from the Development Area (Table 15.24) and does not overlap with it (nor do any of the other projects). The habitats supporting qualifying species within the SPA comprise nesting sites (mainly cliff ledges) and inshore marine areas used for preening, bathing, displaying and other maintenance behaviours by seabirds at the colony. No works will take place within or close to the SPA boundary. The Project, either **alone** or **in-combination with other plans or projects**, will not cause any change to the distribution or extent of supporting habitat within the SPA for any qualifying (including breeding assemblage) species over the long-term, during construction, operation or decommissioning.	Figure 15.2; Table 15.24. No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.
6. The structure, function and supporting processes of habitats supporting the qualifying species is maintained in the long-term	Because of the distance from the SPA (53 km from the Development Area), the Project, either **alone** or **in-combination with other plans or projects**, will not cause any impacts on the structure, function and supporting processes over the long-term to qualifying (including breeding assemblage) species' habitat within the SPA, during construction, operation or decommissioning.	Development Area: Figure 15.2; Table 15.24. Offshore Export Cable Corridor: *Section 15.7.2* Effects of Construction; *Section 15.7.3* Effects of Operation; Table 15.3.
7. No significant disturbance of the species in the long-term	The same conclusion applies as with conservation objective 2 above. The Project **alone**, or **in-combination with other plans and projects**, will not cause significant disturbance to qualifying species, during construction, operation or decommissioning.	See conservation objective 2 (above).

Conclusion Regarding Site Integrity of the St Abb's Head to Fast Castle SPA

493 It was concluded beyond reasonable scientific doubt (within the precautions and assumptions of the assessment) that there would be no adverse effect on site integrity to the St Abb's Head to Fast Castle SPA in relation to the construction, operation and decommissioning of the Project alone.

494 No overall conclusion is presented in relation to in-combination effects as, at the time of writing, information was not available to allow apportionment of kittiwake collision mortality from other projects to individual SPAs and allow conclusions to be presented on the in-combination effects on the population of kittiwake as a viable component of the St Abb's Head to Fast Castle SPA. However, the total kittiwake collision mortality from The Project in-combination with other plans and projects is predicted to be 541 (from the regional population during the breeding season), of which 18 adult birds are apportioned to the Project alone (3.3%), see Table 15.35. Of the total of 18 from the Project alone only one adult bird is apportioned to the St Abb's Head to Fast Castle SPA. In comparison, of the total 541 birds, 57 are apportioned to Neart na Gaoithe, 189 to Firth of Forth Phase 1 (Project Alpha), 252 to Firth of Forth Phase 1 (Project Bravo) and 25 to European Offshore Wind Deployment Centre (see Table 15.41).

495 Based on the best available scientific information, it is considered that the in-combination effects will not compromise the achievement of any of the other conservation objectives for kittiwake or any of the conservation objectives for any of the other qualifying features of the St Abb's Head to Fast Castle SPA.

Will the Project (Alone) or In-combination Cause an Adverse Effect on the Integrity of the Buchan Ness to Collieston Coast SPA?

496 The information to inform the HRA for this SPA is set out in Table 15.46 below.

Table 15.46: Summary of HRA Outcome for Seabird Populations at the Buchan Ness to Collieston Coast SPA

Conservation Objective for the Qualifying Species	Summary of HRA Findings - Buchan Ness to Collieston Coast	Section(s) Above Where Evidence is Presented
1. Avoid deterioration of habitats of the qualifying species	The Development Area is 82 km from the SPA (Table 15.24) and there is no overlap between the Offshore Export Cable Corridor and the SPA, nor do any of the other projects overlap with the SPA. The habitats supporting qualifying species within the SPA comprise nesting sites (mainly cliff ledges) and inshore marine waters used for preening, bathing, displaying and other maintenance behaviours by seabirds at the colony. The Project, either **alone** or **in-combination with other plans or projects**, will not cause any direct or indirect deterioration of qualifying (including breeding assemblage) species' habitat within the SPA, during construction, operation or decommissioning. This is because there is no overlap between the Development Area and Offshore Export Cable Corridor and the SPA boundary and no works will take place within or close to the SPA boundary. Any effects on supporting habitat outside the SPA have been fully considered in relation to the 'viable population' objective (see below).	Development Area: Figure 15.2; Table 15.24. Offshore Export Cable Corridor: *Section 15.7.2* Effects of Construction; *Section 15.7.3* Effects of Operation; Table 15.3.
2. Avoid significant disturbance to the qualifying species	The Project, either alone or in-combination with other plans or projects, will not cause any significant disturbance to qualifying (including breeding assemblage) species within the SPA, during construction, operation or decommissioning. This is because the Development Area is situated over 82 km from the SPA and there will be no works within or close to the SPA boundary (nor will there be any overlap of the other projects with the SPA), so there will be no disturbance to qualifying species while they are present within the SPA. It is firmly concluded beyond reasonable scientific doubt that the Project **alone**, or **in-combination with other submitted plans and projects**, will not cause any significant disturbance to birds within the SPA. Any effects on qualifying species outside the SPA have been fully considered in relation to the 'viable population' objective (see below).	Figure 15.2; Table 15.24 No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.

Conservation Objective for the Qualifying Species	Summary of HRA Findings - Buchan Ness to Collieston Coast	Section(s) Above Where Evidence is Presented
3. The population of qualifying species as a viable component of the site is maintained in the long-term	Four species from this SPA have been identified as contributing to a LSE (Table 15.24). For **fulmar** and **herring gull** there is clear evidence from the assessment (see *Section 15.6* and *Section 15.7*), without recourse to PVA, that the Project (alone or in-combination, and during the construction phase, operation or decommissioning) has no potential to significantly effect the population viability. This conclusion takes account of assessments in relation to displacement (operation), collision risk (operation), direct disturbance (construction and operation) and indirect impacts via disturbance of prey (construction and operation). Impacts during decommissioning are considered to be the same as or less than those during construction. In relation to displacement and barrier effect for the Project alone, precautionary assumptions were made for **kittiwake** of 30% displacement from the Development Area and a 2.0 km buffer, and 100% breeding failure for all displaced birds. Using a population model, displacement was not predicted to affect the viability of the SPA population, either for the Project alone (Table 15.34 and associated text describing PVA) or in-combination with other projects (loss of foraging range calculations, Table 15.40). Collision risk at the Project alone, was not considered to have the potential to negatively affect the viability of the kittiwake SPA qualifying interest (Table 15.36 and associated text describing PVA). This conclusion is based on an avoidance rate of 98% and PVA which predicts an increase in the likelihood of population decline in relation to collision mortality. In relation to in-combination collision impacts, the predicted mortality for the Project during the breeding season (a total of 18 adult birds per year from the regional population during the breeding season, of which SPA apportionment predicts less than one bird from Buchan Ness to Collieston SPA) is substantially lower than other east coast offshore wind farms (Table 15.41) and represents 3.3% of the cumulative total of 541 birds (see assessment in Table 15.42). Direct disturbance resulting from the construction or operation of the Project will be temporary and localised and is not predicted to negatively affect the population viability of **kittiwakes**, either alone or in-combination with other projects. Indirect disturbance during construction of the Project was not predicted to affect **kittiwakes** via impacts on prey, alone or in-combination with other offshore wind farms in the Forth and Tay (*Section 15.12.7*; Table 15.38). Indirect disturbance during the operation of the Project is also not predicted to have negative effects on population viability, either alone or in-	*Section 15.6* Impact Assessment – Development Area. *Section 15.7* Impact Assessment – Offshore Export Cable Corridor. *Section 15.9* Cumulative Impacts from the Project with other Projects. *Section 15.12.7* Information to Inform the HRA for the four SPAs with Qualifying Interests in the Breeding Season – Project Alone. *Section 15.12.8* Information to Inform the HRA for the four SPAs with Qualifying Interests in the Breeding Season – In-combination.

Conservation Objective for the Qualifying Species	Summary of HRA Findings - Buchan Ness to Collieston Coast	Section(s) Above Where Evidence is Presented
3. The population of qualifying species as a viable component of the site is maintained in the long-term	combination with other wind farms, via impacts on prey. For **guillemot**, no collision mortality is predicted, as surveys detected no flight activity at collision risk height. For displacement and barrier effect for the Project alone, precautionary assumptions were made of 50% displacement from the Development Area and a 2.0 km buffer, and 100% breeding failure as a result. Population modelling was used to assess the impacts on population viability. Although the SPA population of guillemot is declining, the predicted 0.13% decrease in breeding success resulting from displacement (Table 15.33) is not likely to significantly affect the population growth rate. No reduction in the viability of the SPA population is predicted in relation to displacement from the Project, alone (Table 15.34 and associated text in relation to PVA) or in-combination with other projects (Table 15.40). Direct disturbance resulting from the construction or operation of the Project will be temporary and localised and is not predicted to negatively affect population viability, either alone or in-combination with other projects. Indirect disturbance during construction, via impacts on prey, is also not predicted to negatively affect population viability; these conclusions apply to the Project alone, and in-combination with other projects (*Section 15.12.7*; Table 15.38). Indirect disturbance during operation, alone or in-combination, is also not predicted to negatively affect population viability. Therefore, the Project alone will not negatively affect the population viability of any qualifying interest within the SPA, during construction, operation or decommissioning. No overall conclusion is presented in relation to in-combination effects as, at the time of writing, information was not available to allow apportionment of kittiwake collision mortality from other projects to individual SPAs and allow conclusions to be presented on the in-combination effects on the population of kittiwake as a viable component of the Buchan Ness to Collieston Coast SPA. However, the total kittiwake collision mortality from The Project in-combination with other plans and projects is predicted to be 541 (from the regional population during the breeding season), of which 18 adult birds are apportioned to the Project alone (3.3%), see Table 15.35. Of the total of 18 from the Project alone less than one adult bird is apportioned to the Buchan	

Conservation Objective for the Qualifying Species	Summary of HRA Findings - Buchan Ness to Collieston Coast	Section(s) Above Where Evidence is Presented
3. The population of qualifying species as a viable component of the site is maintained in the long-term	Ness to Collieston Coast SPA. In comparison, of the total 541 birds, 57 are apportioned to Neart na Gaoithe, 189 to Firth of Forth Phase 1 (Project Alpha), 252 to Firth of Forth (Project Bravo) and 25 to European Offshore Wind Deployment Centre (see Table 15.41).	
4. The distribution of the qualifying species within the SPA is maintained in the long-term	Buchan Ness to Collieston Coast SPA comprises an area of sea cliffs and coastal strip stretching 15 km along the Aberdeenshire Coast. Seabirds breeding here are considered to comprise a single colony and individuals of a given species are likely to share foraging areas. Thus any effects of the Project **alone** or **in- combination with other plans or projects** are predicted to act equally on the site population and not disproportionately on any area within the site. No change is predicted in the distribution of qualifying species considered in the Appropriate Assessment.	Figure 15.2; Table 15.24. No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.
5. The distribution and extent of habitat supporting the qualifying species is maintained in the long-term	The SPA is situated 82 km from the Development Area (Figure 15.2). All other projects lie at similar or larger distances from the SPA. The habitats supporting qualifying species within the SPA comprise nesting sites (mainly cliff ledges) and inshore marine areas used for preening, bathing, displaying and other maintenance behaviours by seabirds at the colony. There will be no works within or close to the SPA boundary. The Project, either alone or in-combination with other plans or projects, will not cause any change to the distribution or extent of any qualifying (including breeding assemblage) species' supporting habitat within the SPA over the long-term, during construction, operation or decommissioning. It is firmly concluded beyond reasonable scientific doubt that the Project **alone**, or **in-combination with other plans and projects**, will not cause any alteration to the distribution or extent of habitats within the SPA.	Figure 15.2; Table 15.24. No further evidence is considered necessary beyond that presented here, as this information is sufficient to reach this conclusion.
6. The structure, function and supporting processes of habitats supporting the qualifying species is maintained in the long-term	Because of the distance from the SPA (82 km) and because there will be no works within or close to the SPA boundary, the Project, either alone or in-combination with other plans or projects, will not cause any impacts on the structure, function and supporting processes over the long-term to qualifying (including breeding assemblage) species' habitat within the SPA, during construction, operation or decommissioning. It is therefore firmly concluded beyond reasonable scientific doubt that the Project **alone**, or **in-combination with other plans and projects**, will not cause any significant disturbance to birds within the SPA.	Development Area: Figure 15.2; Table 15.24 Offshore Export Cable Corridor: *Section 15.7.2* Effects of Construction; *Section 15.7.3* Effects of Operation; Table 15.3.

Conservation Objective for the Qualifying Species	Summary of HRA Findings - Buchan Ness to Collieston Coast	Section(s) Above Where Evidence is Presented
7. No significant disturbance of the species in the long term	The same conclusion applies as with the conservation objective 2 above. The Project **alone** or **in-combination with other plans and projects** will not cause significant, long term disturbance to qualifying species during construction, operation or decommissioning.	See conservation objective 2 (above).

Conclusion Regarding Site Integrity of the Buchan Ness to Collieston Coast SPA

497 It was concluded beyond reasonable scientific doubt (within the precautions and assumptions of the assessment) that there would be no adverse effect on site integrity to the Buchan Ness to Collieston Coast SPA in relation to the construction, operation and decommissioning of the Project alone.

498 No overall conclusion is presented in relation to in-combination effects as, at the time of writing, information was not available to allow apportionment of kittiwake collision mortality from other projects to individual SPAs and allow conclusions to be presented on the in-combination effects on the population of kittiwake as a viable component of the Buchan Ness to Collieston Coast SPA. However, the total kittiwake collision mortality from The Project in-combination with other plans and projects is predicted to be 541 (from the regional population during the breeding season), of which 18 adult birds are apportioned to the Project alone (3.3%), see Table 15.35. Of the total of 18 from the Project alone less than one adult bird is apportioned to the Buchan Ness to Collieston Coast SPA. In comparison, of the total 541 birds, 57 are apportioned to Neart na Gaoithe, 189 to Firth of Forth Phase 1 (Project Alpha), 252 to Firth of Forth (Project Bravo) and 25 to European Offshore Wind Deployment Centre (see Table 15.41).

499 Based on the best available scientific information, it is considered that the in-combination effects will not compromise the achievement of any of the other conservation objectives for kittiwake or any of the conservation objectives for any of the other qualifying features of the Buchan Ness to Collieston Coast SPA.

15.12.9 HRA Summary and Conclusions

Slamannan Plateau SPA

500 The HRA Screening Report for the Project identified a LSE in relation to collision risk and barrier effect for this site, specifically in relation to its Taiga bean goose qualifying interest. Consideration of the predicted collision mortality, and the evidence in relation to barrier effects, predicted no adverse effect on site integrity, either alone or in-combination with other plans or projects.

The Upper Solway Flats and Marshes SPA

501 The HRA Screening Report for the Project identified a LSE in relation to collision risk and barrier effect for this site, specifically in relation to its Svalbard barnacle goose qualifying interest. Consideration of the predicted collision mortality, and the evidence in relation to barrier effects, predicted no adverse effect on site integrity of the Upper Solway Flats and Marshes SPA, either alone or in-combination with other plans or projects.

Firth of Forth SPA

502 The Firth of Forth SPA is classified for its waders, wildfowl, seaducks, grebes, divers and cormorant during the winter, and Sandwich tern on passage.

503 The potential impacts from the Project alone on these qualifying interests were assessed, including the impact on near-shore and intertidal areas from the Offshore Export Cable landfall options. Consideration of these impacts predicted no adverse effect on site integrity of the Firth of Forth SPA, either alone or in-combination with other plans or projects.

Other SPAs for Which Connectivity May Result from Migratory Species

504 A number of migratory bird species are likely to pass through the Development Area whilst travelling between breeding and wintering areas. These species may be subject to barrier impacts and collision risk from the Project. The assessment predicted no adverse impacts of collision risk or barrier effects of a scale that was likely to adversely affect the viability of any SPA populations. It is therefore concluded there is no adverse effect on site integrity for any SPAs with migratory qualifying species, either from the Project alone or in-combination with other plans or projects.

Forth Islands SPA

505 Having considered the conservation objectives of the Forth Islands SPA, it is concluded beyond reasonable scientific doubt (within the precautionary assumptions of the assessment) that there will be no adverse effect on site integrity from construction, operation and decommissioning of the Project alone.

506 No overall conclusion is presented in relation to in-combination effects as, at the time of writing, information was not available to allow apportionment of kittiwake collision mortality from other projects to individual SPAs and allow conclusions to be presented on the in-combination effects on the population of kittiwake as a viable component of the Forth Islands SPA. However, the total kittiwake collision mortality from the Project in-combination with other plans and projects is predicted to be 541 (from the regional population during the breeding season), of which 18 adult birds are apportioned to the Project alone (3.3%), see Table 15.35. Of the total of 18 from the Project alone only one adult bird is apportioned to the Forth Islands SPA. In comparison, of the total 541 birds, 57 are apportioned to Neart na Gaoithe, 189 to Firth of Forth Phase 1 (Project Alpha), 252 to Firth of Forth (Project Bravo) and 25 to European Offshore Wind Deployment Centre (see Table 15.41).

507 Based on the best available scientific information, it is considered that the in-combination effects will not compromise the achievement of any of the other conservation objectives for kittiwake or any of the conservation objectives for any of the other qualifying features of the Forth Islands SPA.

508 Consideration has been given to whether a change in the Project parameters would reduce impacts on kittiwake but, due to the relatively small impact from the Project, it is considered that a change in the Project parameters would not make a material difference.

Fowlsheugh SPA

509 Having considered the conservation objectives of the Fowlsheugh SPA, it was concluded beyond reasonable scientific doubt (within the precautionary assumptions of the

assessment) that there would be no adverse effect on site integrity in relation to the construction, operation and decommissioning phases of the Project alone.

510 No overall conclusion is presented in relation to in-combination effects as, at the time of writing, information was not available to allow apportionment of kittiwake collision mortality from other projects to individual SPAs and allow conclusions to be presented on the in-combination effects on the population of kittiwake as a viable component of the Fowlsheugh SPA. However, the total kittiwake collision mortality from The Project in-combination with other plans and projects is predicted to be 541 (from the regional population during the breeding season), of which 18 adult birds are apportioned to the Project alone (3.3%), see Table 15.35. Of the total of 18 from the Project alone only four adult bird is apportioned to the Fowlsheugh SPA. In comparison, of the total 541 birds, 57 are apportioned to Neart na Gaoithe, 189 to Firth of Forth Phase 1 (Project Alpha), 252 to Firth of Forth Phase 1(Project Bravo) and 25 to European Offshore Wind Deployment Centre (see Table 15.41).

511 Based on the best available scientific information, it is considered that the in-combination effects will not compromise the achievement of any of the other conservation objectives for kittiwake or any of the conservation objectives for any of the other qualifying features of the Fowlsheugh SPA.

512 Consideration has been given to whether a change in the Project parameters would reduce impacts on kittiwake but, due to the relatively small impact from the Project, it is considered that a change in the Project parameters would not make a material difference.

St Abb’s Head to Fast Castle SPA

513 It was concluded beyond reasonable scientific doubt (within the precautions and assumptions of the assessment) that there would be no adverse effect on site integrity to the St Abb’s Head to Fast Castle SPA in relation to the construction, operation and decommissioning of the Project alone.

514 No overall conclusion is presented in relation to in-combination effects as, at the time of writing, information was not available to allow apportionment of kittiwake collision mortality from other projects to individual SPAs and allow conclusions to be presented on the in-combination effects on the population of kittiwake as a viable component of the St Abb’s Head to Fast Castle SPA. However, the total kittiwake collision mortality from The Project in-combination with other plans and projects is predicted to be 541 (from the regional population during the breeding season), of which 18 adult birds are apportioned to the Project alone (3.3%), see Table 15.35. Of the total of 18 from the Project alone only one adult bird is apportioned to the St Abb’s Head to Fast Castle SPA. In comparison, of the total 541 birds, 57 are apportioned to Neart na Gaoithe, 189 to Firth of Forth Phase 1 (Project Alpha), 252 to Firth of Forth Phase 1 (Project Bravo) and 25 to European Offshore Wind Deployment Centre (see Table 15.41).

Based on the best available scientific information, it is considered that the in-combination effects will not compromise the achievement of any of the other conservation objectives for kittiwake or any of the conservation objectives for any of the other qualifying features of the St Abb's Head to Fast Castle SPA.

515 Consideration has been given to whether a change in the Project parameters would reduce impacts on kittiwake but, due to the relatively small impact from the Project, it is considered that a change in the Project parameters would not make a material difference.

Buchan Ness to Collieston Coast SPA

516 It was concluded beyond reasonable scientific doubt (within the precautions and assumptions of the assessment) that there would be no adverse effect on site integrity to the Buchan Ness to Collieston Coast SPA in relation to the construction, operation and decommissioning of the Project alone.

517 No overall conclusion is presented in relation to in-combination effects as, at the time of writing, information was not available to allow apportionment of kittiwake collision mortality from other projects to individual SPAs and allow conclusions to be presented on the in-combination effects on the population of kittiwake as a viable component of the Buchan Ness to Collieston Coast SPA. However, the total kittiwake collision mortality from The Project in-combination with other plans and projects is predicted to be 541 (from the regional population during the breeding season), of which 18 adult birds are apportioned to the Project alone (3.3%), see Table 15.35. Of the total of 18 from the Project alone less than one adult bird is apportioned to the Buchan Ness to Collieston Coast SPA. In comparison, of the total 541 birds, 57 are apportioned to Neart na Gaoithe, 189 to Firth of Forth Phase 1 (Project Alpha), 252 to Firth of Forth (Project Bravo) and 25 to European Offshore Wind Deployment Centre (see Table 15.41).

518 Based on the best available scientific information, it is considered that the in-combination effects will not compromise the achievement of any of the other conservation objectives for kittiwake or any of the conservation objectives for any of the other qualifying features of the Buchan Ness to Collieston Coast SPA.

519 Consideration has been given to whether a change in the Project parameters would reduce impacts on kittiwake but, due to the relatively small impact from the Project, it is considered that a change in the Project parameters would not make a material difference.

15.13 Figures (HRA)

Figure 15.4: Kittiwake Foraging Ranges from SPAs

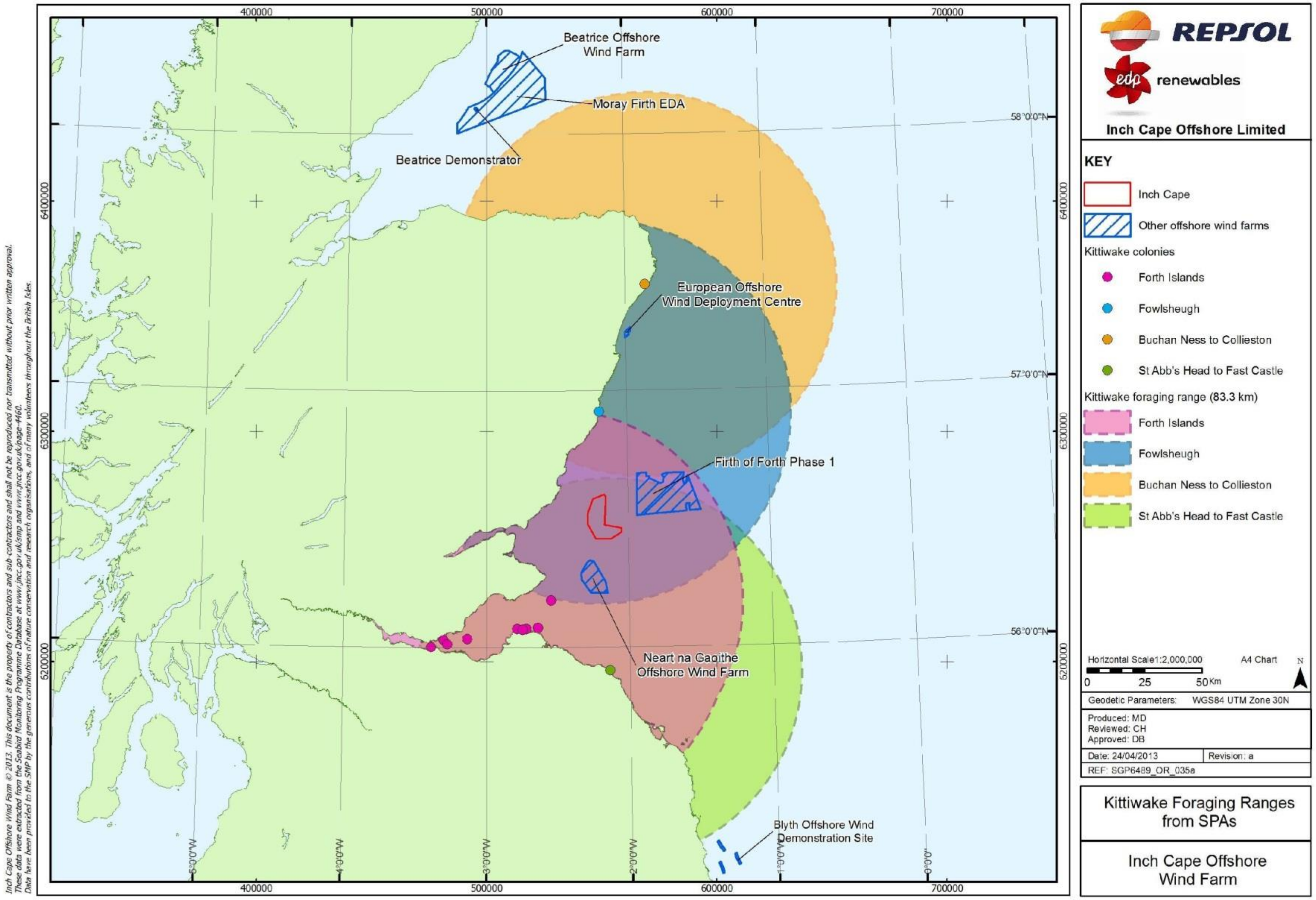


Figure 15.5: Herring Gull Foraging Ranges from SPAs

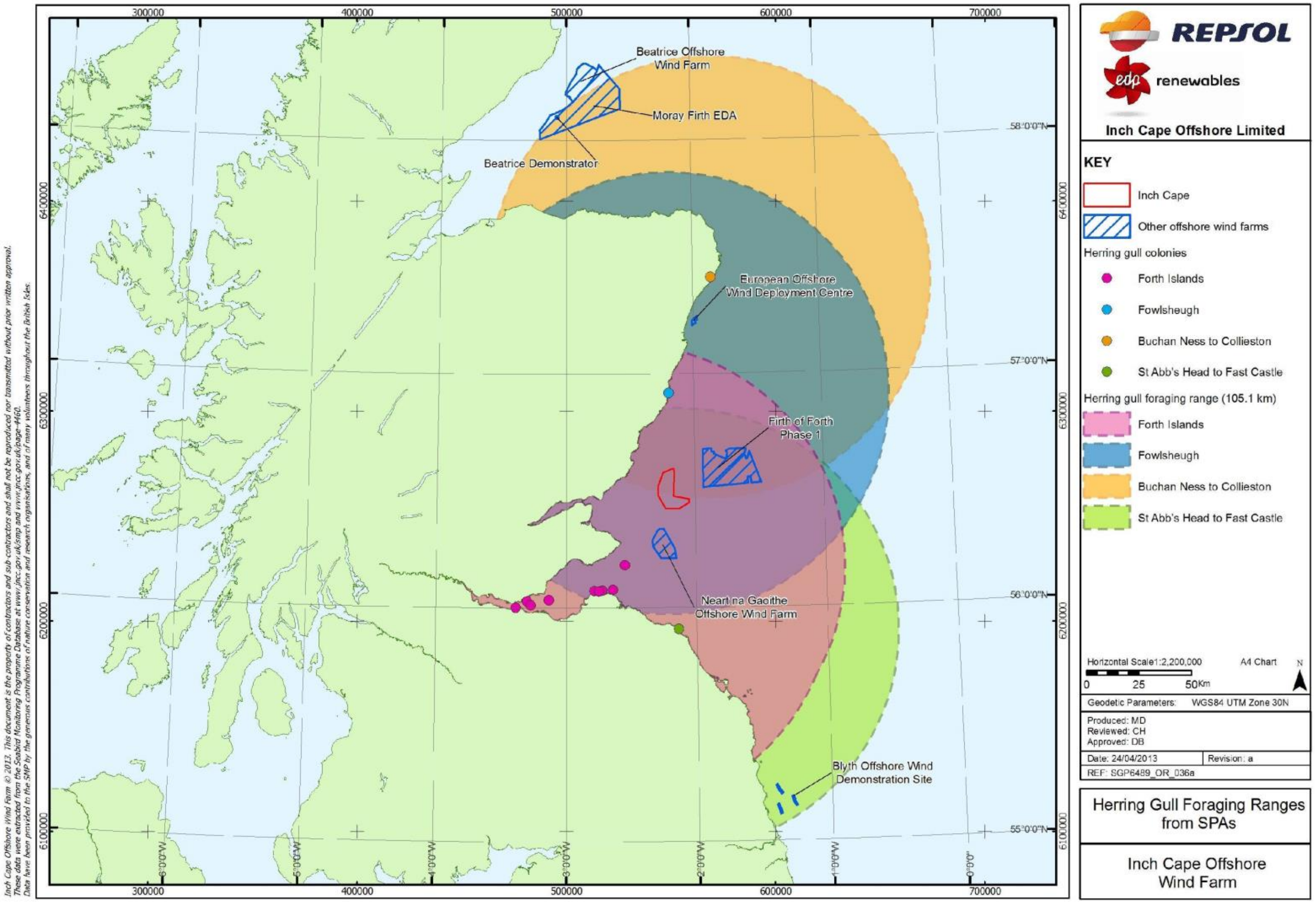


Figure 15.6: Lesser Black-backed Gull Foraging Ranges from SPAs

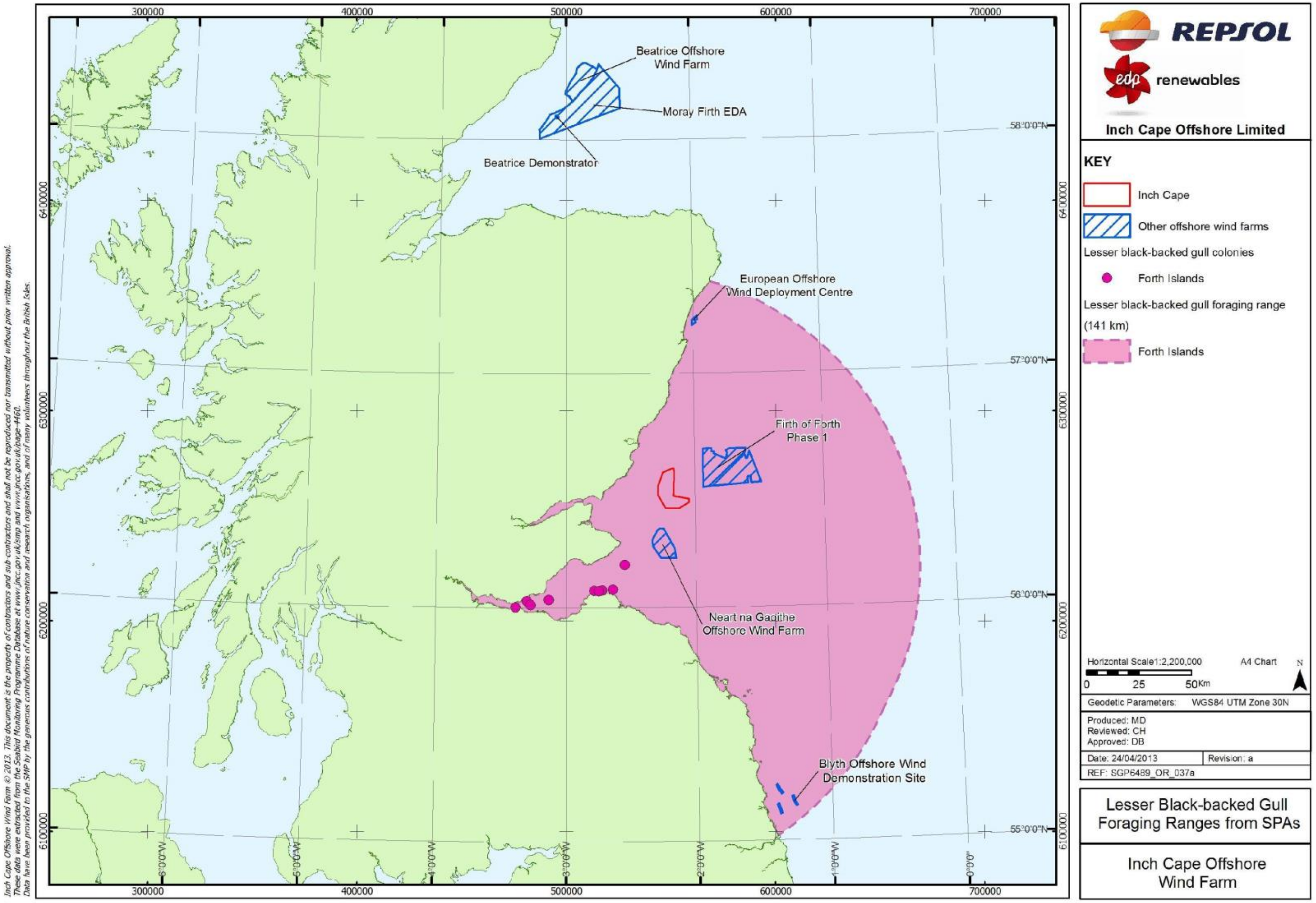


Figure 15.7: Arctic Tern Foraging Ranges from SPAs

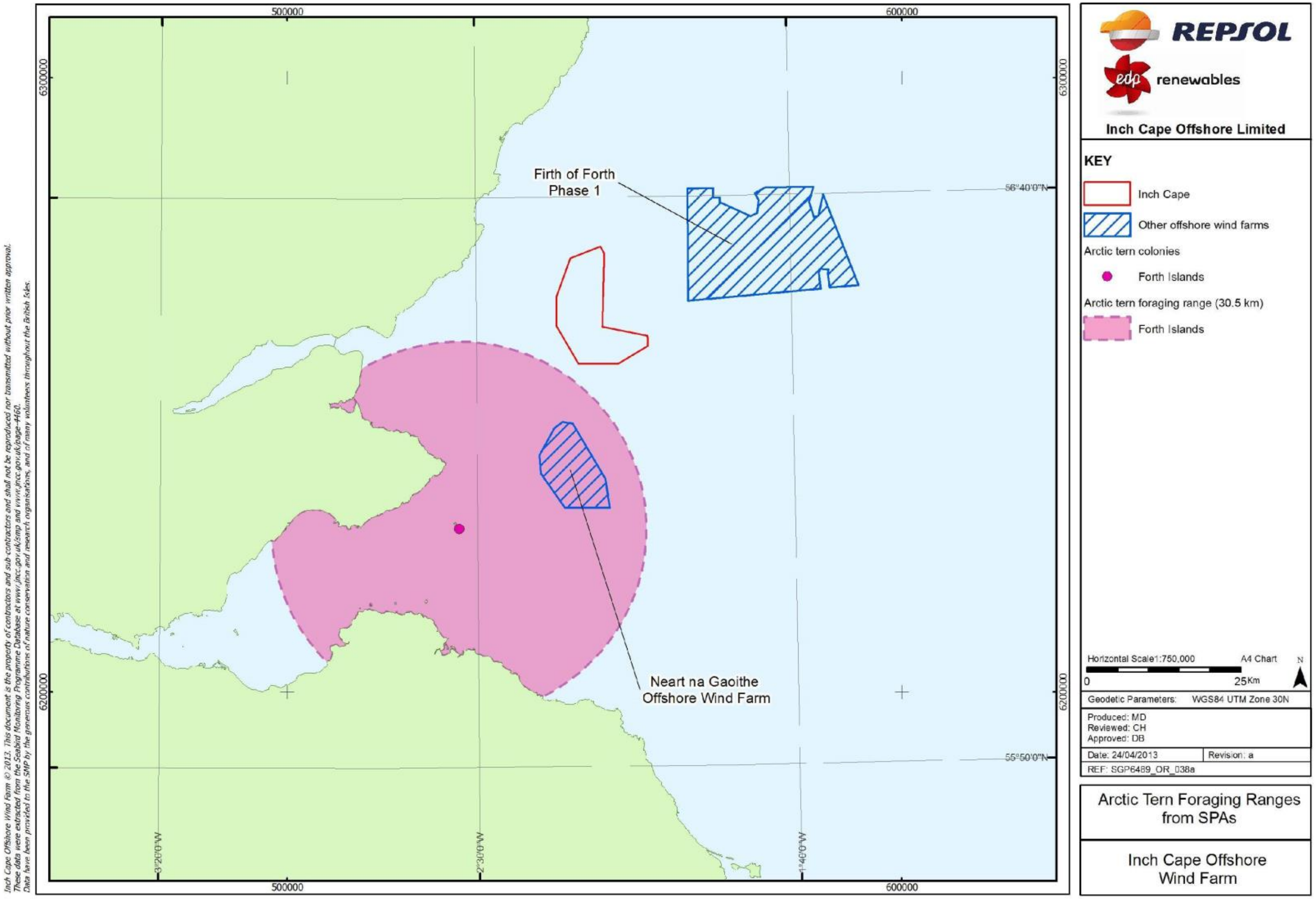


Figure 15.8: Common Tern Foraging Ranges from SPAs

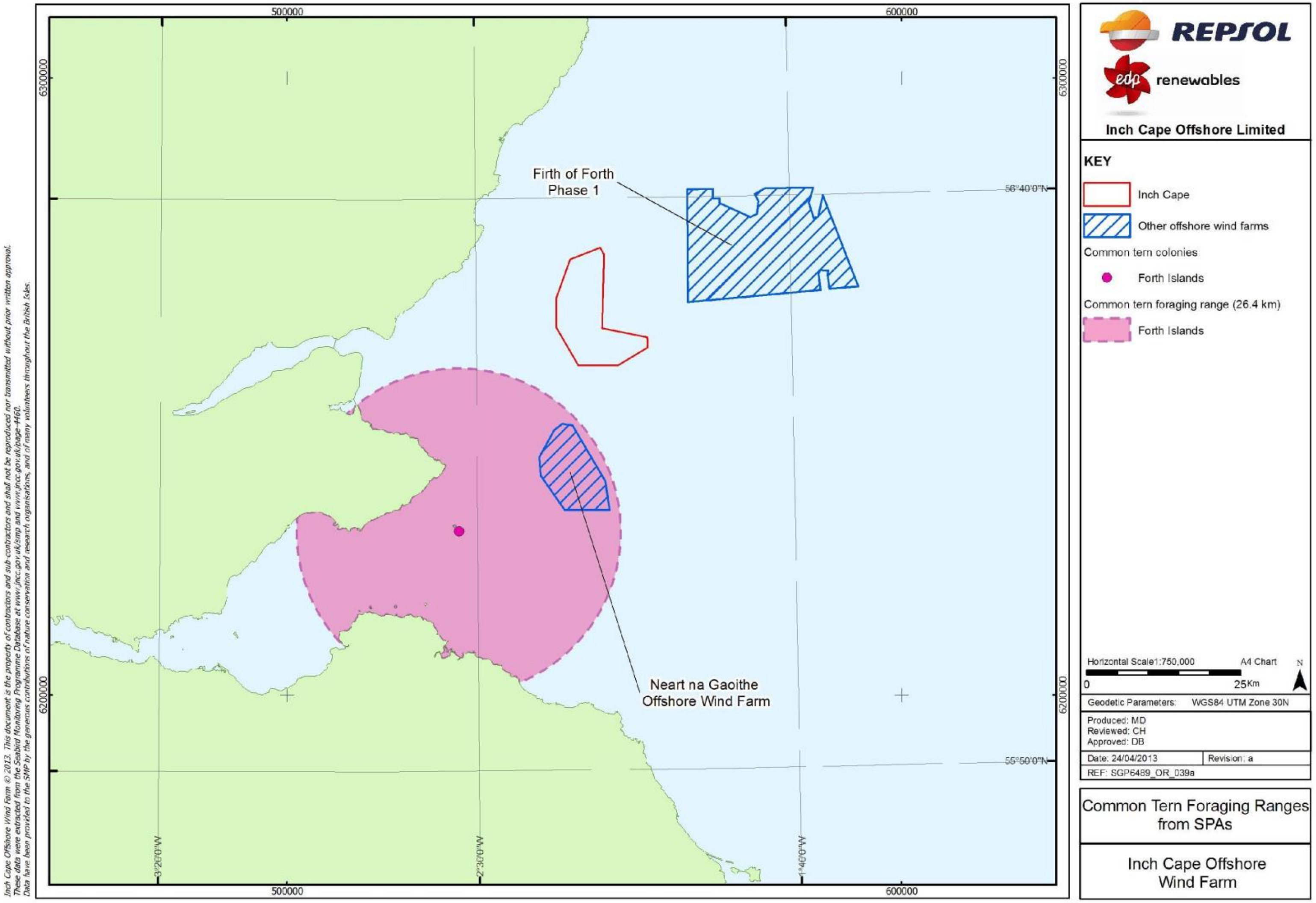


Figure 15.9: Guillemot Foraging Ranges from SPAs

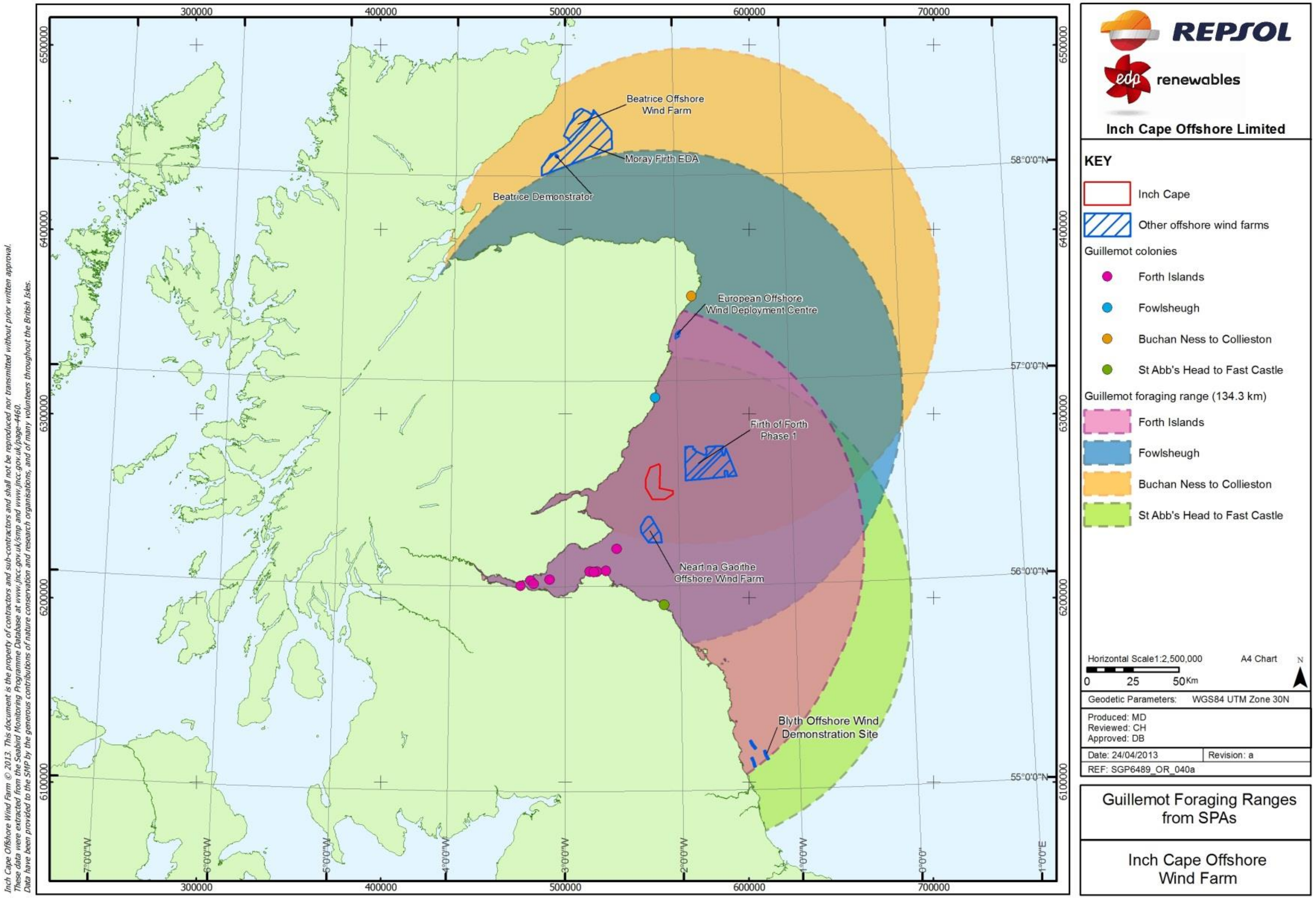


Figure 15.10: Razorbill Foraging Ranges from SPAs

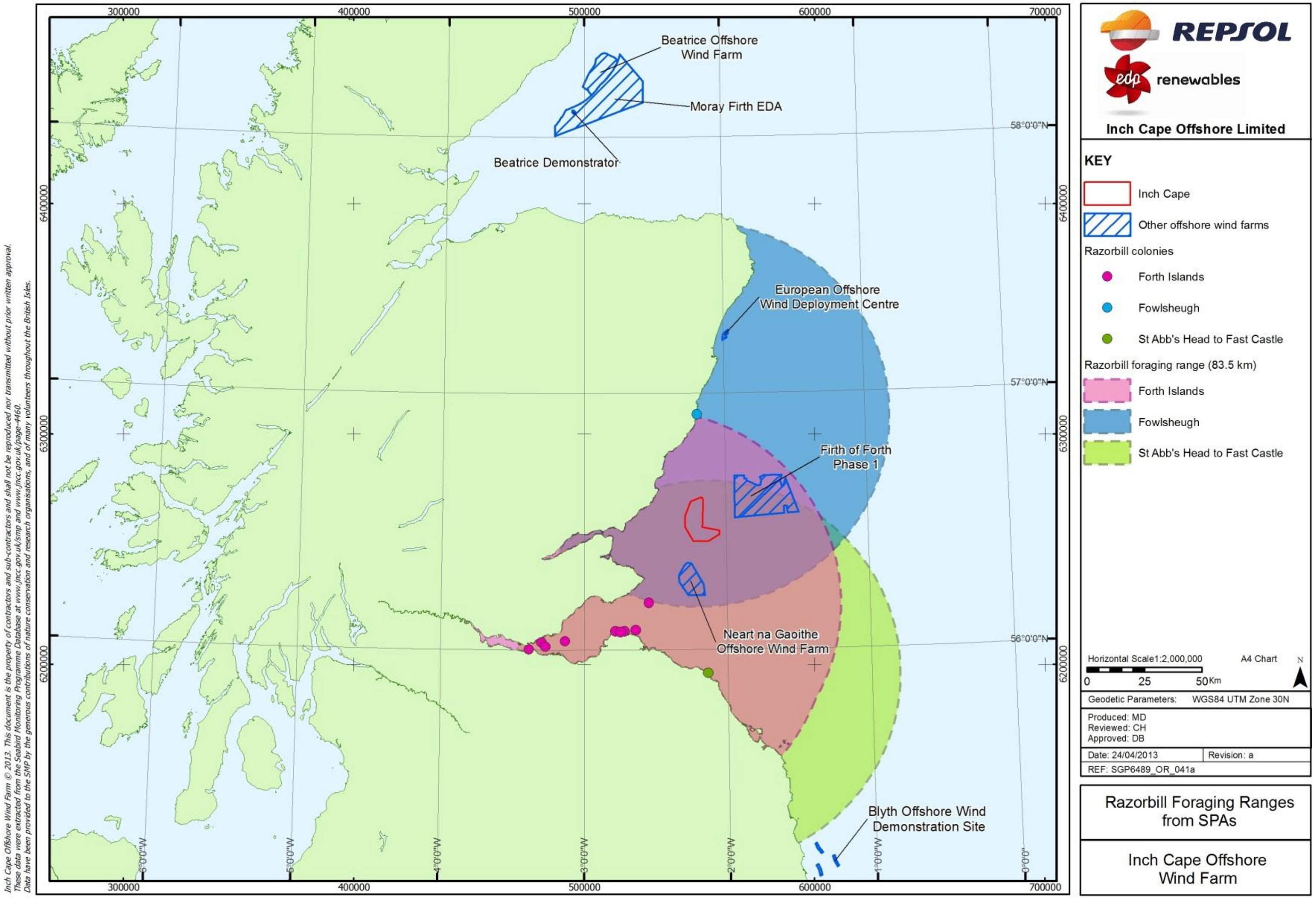


Figure 15.11: Puffin Foraging Ranges from SPAs

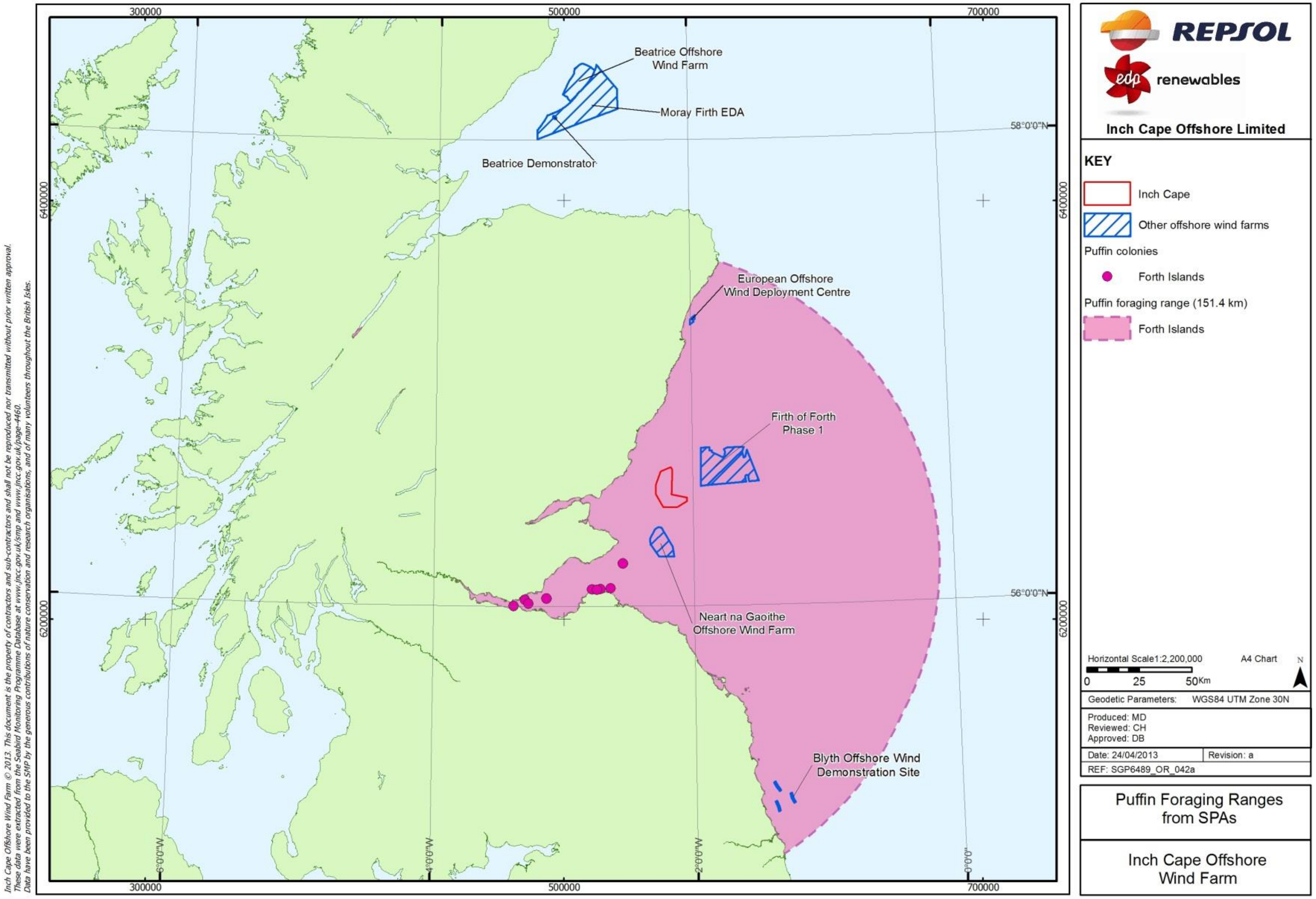


Figure 15.12: Gannet Foraging Ranges from SPAs

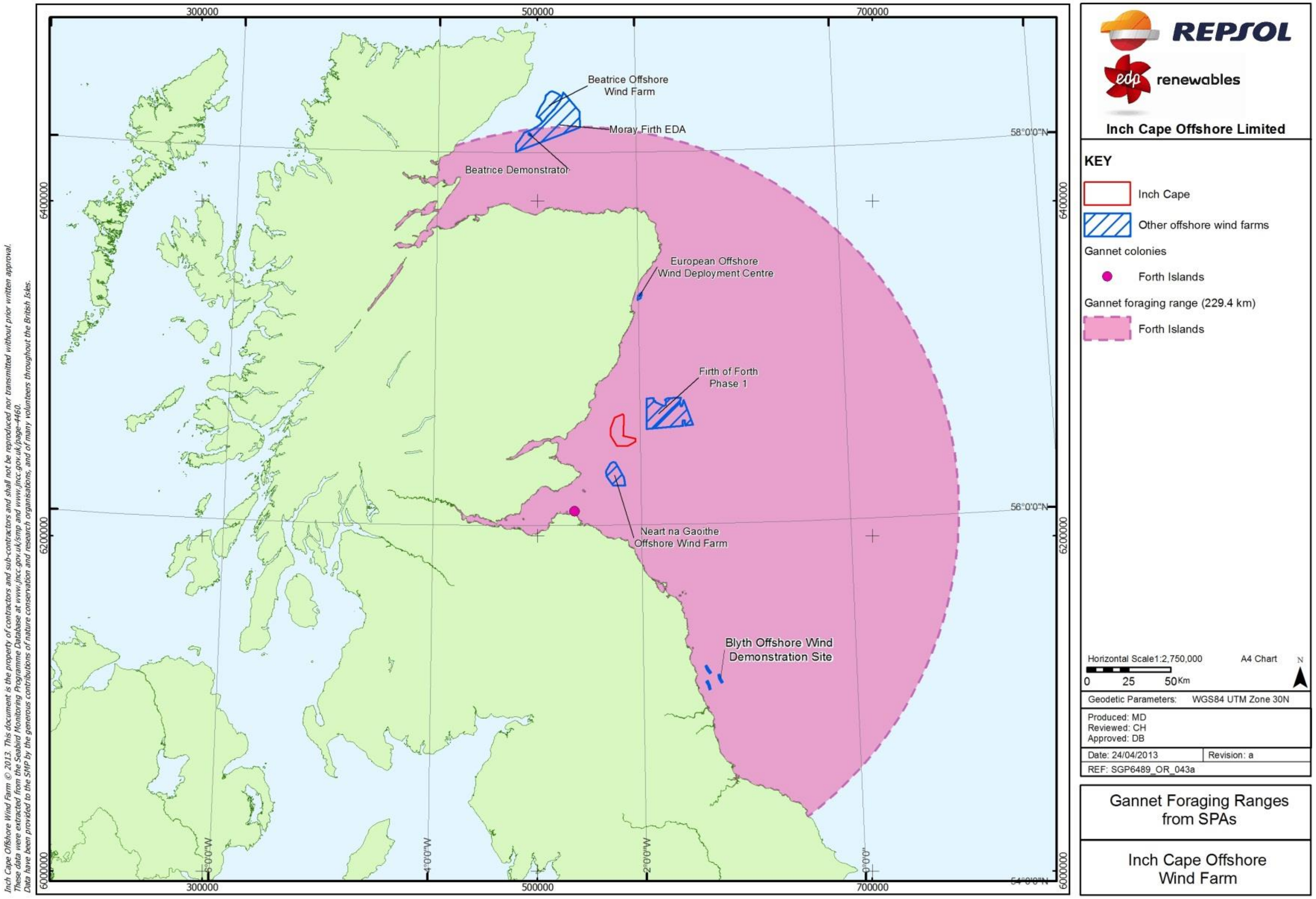
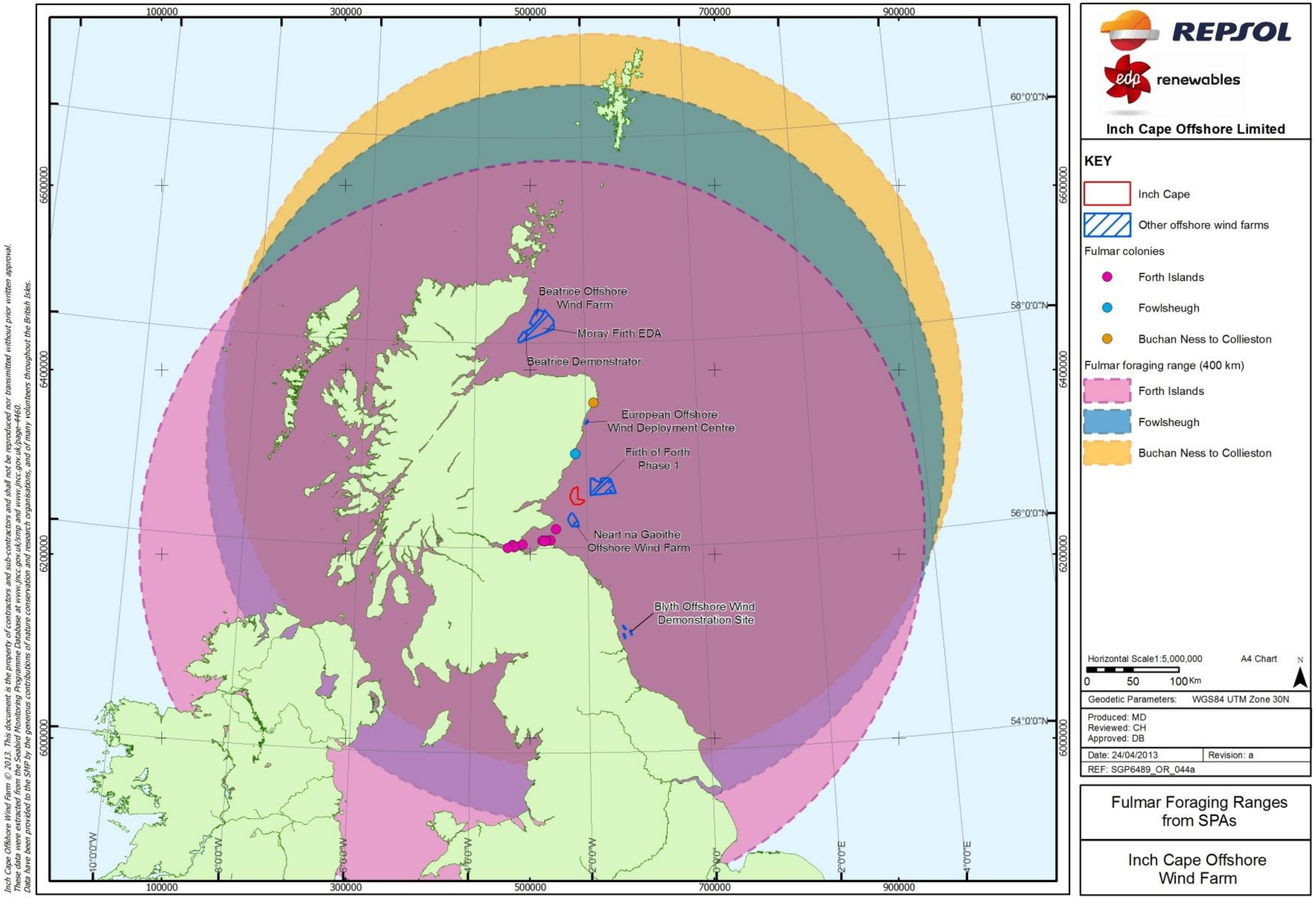


Figure 15.13: Fulmar Foraging Ranges from SPAs



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