**APPROPRIATE ASSESSMENT**

**APPLICATION FOR CONSENT UNDER SECTION 36 OF THE ELECTRICITY ACT 1989 AND APPLICATIONS FOR MARINE LICENCES UNDER THE MARINE (SCOTLAND) ACT 2010 FOR THE CONSTRUCTION AND OPERATION OF THE NEART NA GAOITHE OFFSHORE WINDFARM.**

**APPLICATION FOR CONSENT UNDER SECTION 36 OF THE ELECTRICITY ACT 1989 AND APPLICATIONS FOR MARINE LICENCES UNDER THE MARINE (SCOTLAND) ACT 2010 FOR THE CONSTRUCTION AND OPERATION OF THE INCH CAPE OFFSHORE WINDFARM.**

**APPLICATION FOR CONSENT UNDER SECTION 36 OF THE ELECTRICITY ACT 1989 AND APPLICATIONS FOR MARINE LICENCES UNDER THE MARINE (SCOTLAND) ACT 2010 AND THE MARINE AND COASTAL ACCESS ACT 2009 FOR THE CONSTRUCTION AND OPERATION OF THE SEAGREEN ALPHA OFFSHORE WINDFARM.**

**APPLICATION FOR CONSENT UNDER SECTION 36 OF THE ELECTRICITY ACT 1989 AND APPLICATIONS FOR MARINE LICENCES UNDER THE MARINE (SCOTLAND) ACT 2010 AND THE MARINE AND COASTAL ACCESS ACT 2009 FOR THE CONSTRUCTION AND OPERATION OF THE SEAGREEN BRAVO OFFSHORE WINDFARM.**

**MARINE SCOTLAND'S CONSIDERATION OF A PROPOSAL AFFECTING DESIGNATED SPECIAL AREAS OF CONSERVATION ("SACs") OR SPECIAL PROTECTION AREAS ("SPAs")**

**SITE DETAILS:**

**Neart na Gaoithe Offshore Windfarm Limited development ("NNGOWL"), approximately 15.5 km to the east of Fife Ness in the outer Firth of Forth.**

**Inch Cape Offshore Limited development ("ICOL"), approximately 15 km to the east off the Angus Coastline.**

**Seagreen Alpha Wind Energy Limited development ("SAWEL"), approximately 27 km off the Angus coastline.**

**Seagreen Bravo Wind Energy Limited development ("SBWEL"), approximately 38 km off the Angus coastline.**

**These developments when considered collectively are referred to as "the Forth and Tay Developments".**

**APPROPRIATE ASSESSMENT CONCLUSION:** Marine Scotland Licensing Operations Team ("MS-LOT") concludes that, based upon the content of the following assessment the proposed NNGOWL, ICOL, SAWEL and SBWEL developments will not, on their own or in combination with each other (or where

appropriate for consideration, other developments already licenced),, adversely affect the integrity of the Buchan Ness to Collieston Coast SPA, Fowlsheugh SPA, Forth Islands SPA, St Abb's Head to Fast Castle SPA, Moray Firth SAC, Firth of Tay and Eden Estuary SAC, Isle of May SAC, Berwickshire & North Northumberland Coast SAC, River South Esk SAC, River Tay SAC, River Dee SAC, River Teith SAC or River Tweed SAC (where each SPA or SAC is taken as a whole), provided that the conditions set out in 3d are complied with.

Following Marine Scotland Science ("MSS") advice, MS-LOT consider that the most up to date and best scientific evidence available has been used in reaching the conclusion that the developments will not adversely affect the integrity of these sites and are satisfied that no reasonable scientific doubt remains.

**Introduction**

This is a record of the Appropriate Assessment ("AA") of the NNGOWL, ICOL, SAWEL and SBWEL developments and their associated offshore transmission works. The assessment has been undertaken by MS-LOT and MSS on behalf of the Scottish Ministers. This assessment is required to be undertaken under Council Directive 92/43/EEC on the conservation of natural habitats of wild fauna and flora ("the Habitats Directive") and Council Directive 79/409/EEC on the conservation of wild birds (as amended, and codified by Directive 2009/147/EC of the European Parliament and of the Council) ("the Wild Birds Directive") as implemented, in particular, by Regulation 25 of the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 for projects beyond 12 nautical miles ("nm") from the mainland of Scotland and by Regulation 48 of the Conservation (Natural Habitats, &c.) Regulations 1994 for projects within 12 nm of the mainland before the Scottish Ministers may decide to give consent to the developments. As the NNGOWL and ICOL developments are located within 12 nm and because the assessment is a cumulative assessment with SAWEL and SBWEL, which are both out with 12 nm, both sets of regulations ("the Habitats Regulations") apply to this assessment.

MS-LOT, on behalf of the Scottish Ministers as the 'competent authority' under the Habitats Regulations, has to be satisfied that the projects will not adversely affect the integrity of any European protected sites (SACs and SPAs) before it may recommend the grant of consent for the projects. The precautionary principle requires to be applied when complying with obligations under the Habitats Directive and in preparing an AA. In accordance with the ECJ case of *Waddenzee*[1] the Scottish Ministers may only authorise a development if they are certain that it will not adversely affect the integrity of European protected sites; and "that is the case where no reasonable scientific doubt remains as to the absence of such effects".

A detailed AA has been undertaken and Scottish Natural Heritage ("SNH") and the Joint Nature Conservation Committee ("JNCC") have been consulted, as is required, under the Habitats Regulations. Those Regulations allow for the competent authority to consult the general public on the AA if they consider it appropriate. This has not been done as the general public have already had the opportunity to respond to the applications through the Environmental Impact Assessment ("EIA") process where

[1] ECJ Case no - C-127/02 – judgment issued on 07.09.2004.

information regarding the potential impacts on European protected sites was available in the Environmental Statements ("ESs") provided for NNGOWL, ICOL, SAWEL and SBWEL. The Supplementary Environmental Information Statements ("SEISs") submitted for NNGOWL, SAWEL and SBWEL were also made publically available and consulted on. Although representations were received from members of the public raising concerns about ornithology and marine mammals, these were not in relation to the potential impacts on SPAs and SACs from these developments, therefore it is not deemed appropriate to consult the general public further. Consultation responses regarding Natura issues were received from the Royal Society for the Protection of Birds, Scotland ("RSPB Scotland"), Whale and Dolphin Conservation ("WDC") and the Association of Salmon Fishery Boards ("ASFB"). In a response to MS-LOT (dated 26th March 2014) concerning the regional assessment completed by the Statutory Nature Conservation Bodies ( " the SNCBs" – SNH and the JNCC), RSPB Scotland expressed significant concerns regarding the potential effects on several seabird species and criticised the assessment methods being used. The RSPB Scotland letter predated a range of mitigation measures proposed by the developers to reduce effects upon seabird populations. The points raised by RSPB Scotland are addressed in Appendix 1. WDC in a letter through Client Earth (dated 30th April 2014) to MS-LOT criticised the approach taken by the SNCB's with regard to the marine mammal assessment, again points raised by WDC are addressed in Appendix 1.

A map showing the locations of the Forth and Tay Developments along with the European protected sites which are considered in this assessment is presented below.

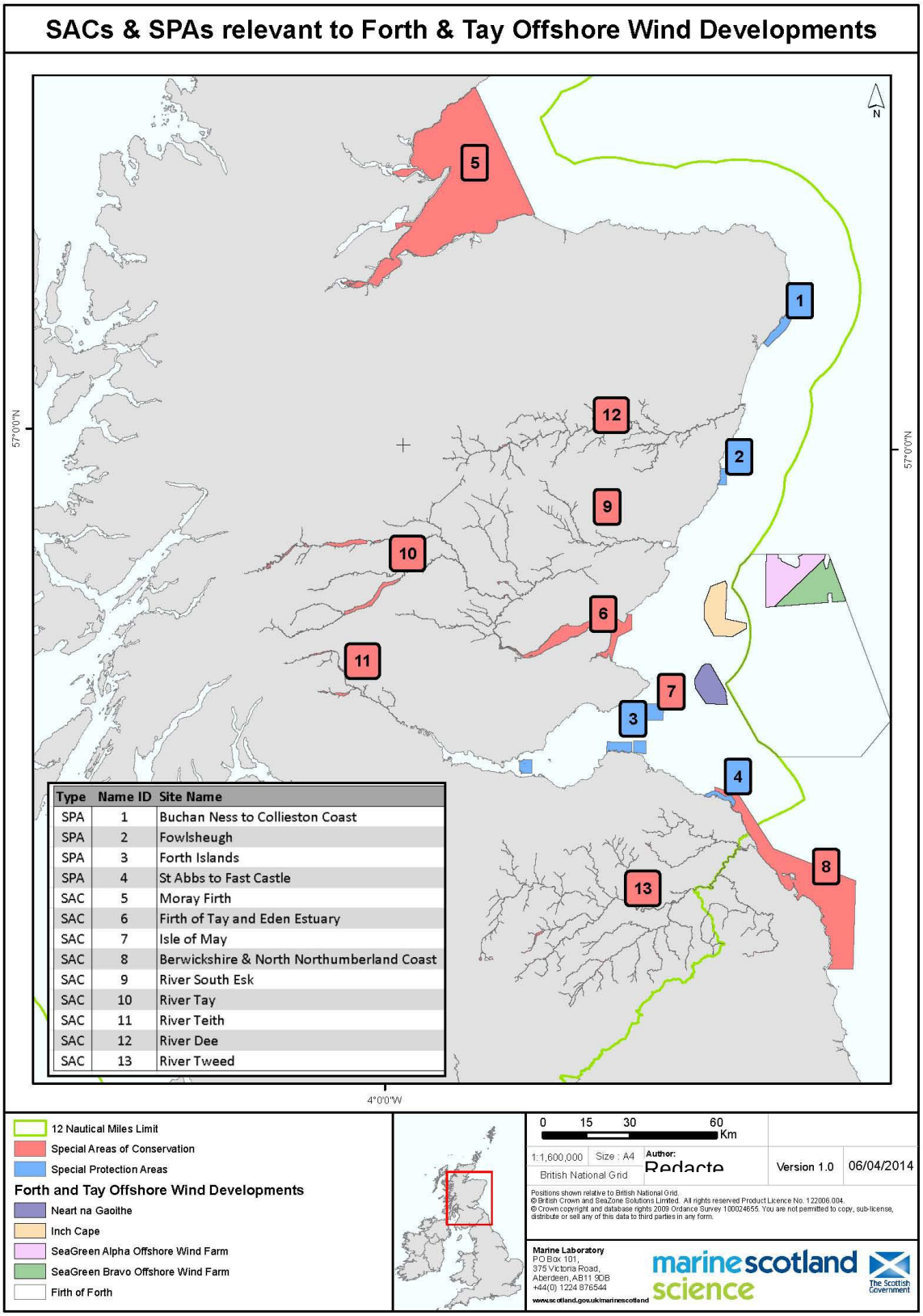


*Figure 1: locations of the Forth and Tay Developments along with the European protected sites which are considered in this assessment*

Section 1a. provides links to the Scottish Natural Heritage Interactive ("SNHi") website where the background information on the sites being considered in this assessment is available. Section 1b. details the qualifying features of the SACs and SPAs in this assessment. The conservation objectives being considered are detailed in section 1c. For the qualifying interests where likely significant effect ("LSE") has been identified (section 3b), the appropriate assessment assesses whether or not the relevant conservation objectives will be achieved. This enables a conclusion to be made in relation to whether or not the Forth and Tay Developments, either alone or in combination with each other and other projects, will adversely affect the integrity of the sites which have been assessed.

**1a. Name of Natura site affected & current status available from:**

| |
|---|
| **1. Buchan Ness to Collieston Coast SPA**<br>http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8473 |
| **2. Fowlsheugh SPA**<br>http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8505 |
| **3. Forth Islands SPA**<br>http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8500 |
| **4. St Abb's Head to Fast Castle SPA**<br>http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8579 |
| **5. Moray Firth SAC**<br>http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8327 |
| **6. Firth of Tay and Eden Estuary SAC**<br>http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8257 |
| **7. Isle of May SAC**<br>http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8278 |
| **8. Berwickshire & North Northumberland Coast SAC**<br>http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8207 |
| **9. River South Esk SAC**<br>http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8364 |
| **10. River Tay SAC**<br>http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8366 |
| **11. River Teith SAC**<br>http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8368 |
| **12. River Dee SAC**<br>http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8357 |
| **13. River Tweed SAC**<br>http://gateway.snh.gov.uk/sitelink/siteinfo.jsp?pa_code=8369 |

**1b. Qualifying interests of each Natura site:**

| | |
|---|---|
| **1. Buchan Ness to Collieston Coast SPA**<br>▪ Fulmar (breeding)<br>▪ Guillemot (breeding)<br>▪ Herring gull (breeding)<br>▪ Kittiwake (breeding)<br>▪ Shag (breeding)<br>▪ Seabird assemblage (breeding) | **2. Fowlsheugh SPA**<br>▪ Fulmar (breeding)<br>▪ Guillemot (breeding)<br>▪ Herring gull (breeding)<br>▪ Kittiwake (breeding)<br>▪ Razorbill (breeding)<br>▪ Seabird assemblage (breeding) |
| **3. Forth Islands SPA**<br>▪ Arctic tern (breeding)<br>▪ Common tern (breeding)<br>▪ Cormorant (breeding)<br>▪ Fulmar (breeding)<br>▪ Gannet (breeding)<br>▪ Guillemot (breeding)<br>▪ Herring gull (breeding)<br>▪ Kittiwake (breeding)<br>▪ Lesser black-backed gull (breeding)<br>▪ Puffin (breeding)<br>▪ Razorbill (breeding)<br>▪ Roseate tern (breeding)<br>▪ Sandwich tern (breeding)<br>▪ Shag (breeding)<br>▪ Seabird assemblage (breeding) | **4. St Abb's Head to Fast Castle SPA**<br>▪ Guillemot (breeding)<br>▪ Herring gull (breeding)<br>▪ Kittiwake (breeding)<br>▪ Razorbill (breeding)<br>▪ Shag (breeding)<br>▪ Seabird assemblage (breeding) |
| **5. Moray Firth SAC**<br>▪ Bottlenose dolphin<br>▪ Subtidal sandbanks | **6. Firth of Tay and Eden Estuary SAC**<br>▪ Common (harbour) seal<br>▪ Estuaries<br>▪ Intertidal mudflats and sandflats<br>▪ Subtidal sandbanks |
| **7. Isle of May SAC**<br>▪ Grey seal<br>▪ Reefs | **8. Berwickshire & North Northumberland Coast SAC**<br>▪ Grey seal<br>▪ Intertidal mudflats and sandflats<br>▪ Reefs<br>▪ Sea caves<br>▪ Shallow inlets and bays |
| **9. River South Esk SAC**<br>▪ Atlantic salmon<br>▪ Freshwater pearl mussel | **10. River Tay SAC**<br>▪ Atlantic salmon<br>▪ Sea lamprey<br>▪ Brook Lamprey<br>▪ River Lamprey |

| | |
|---|---|
| | ▪ Otter<br>▪ Clear-water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels |
| **11. River Teith SAC**<br>▪ Atlantic salmon<br>▪ Sea lamprey<br>▪ Brook Lamprey<br>▪ River Lamprey | **12. River Dee SAC**<br>▪ Atlantic salmon<br>▪ Freshwater pearl mussel<br>▪ Otter |
| **13. River Tweed SAC**<br>▪ Atlantic salmon<br>▪ Sea lamprey<br>▪ Brook Lamprey<br>▪ River Lamprey<br>▪ Otter<br>▪ Rivers with floating vegetation often dominated by water-crowfoot | |

**1c. Conservation objectives for qualifying interests:**

In their scoping advice the SNCBs advised that it is important to recognise that the conservation objectives primarily offer site-based protection and that some of the objectives will not directly apply to species when they are not present within the boundaries of the SPA or SAC in question.

The SNCBs advice (dated 7th March 2014) to MS-LOT in relation to the Forth and Tay Developments is that for the SPAs the relevant conservation objective for this appropriate assessment is to ensure the long-term maintenance of the population as a viable component of each SPA under consideration. The SNCBs also advised that this was the relevant conservation objective for the marine mammals being considered and that the other conservation objectives did not require consideration as they relate to maintenance of favourable conditions at each of the SACs. For the same reasons MS-LOT consider that this is also the relevant conservation objective to be considered in relation to the freshwater SACs.

**Buchan Ness to Collieston Coast, Fowlsheugh, Forth Islands and St Abb's Head to Fast Castle SPAs – breeding seabirds**

To avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained; and

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

**(i) Population of the species as a viable component of the site***

(ii) Distribution of the species within site
(iii) Distribution and extent of habitats supporting the species
(iv) Structure, function and supporting processes of habitats supporting the species
(v) No significant disturbance of the species

*As the potential effects of the proposed development, as identified, occur outside the SPA itself, any disturbance to the qualifying interests is only considered to be significant in terms of the relevant conservation objective if it could undermine the conservation objectives relating to population viability.

**Moray Firth SAC - Bottlenose dolphin**

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

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

**(i) Population of the species as a viable component of the site***
(ii) Distribution of the species within site
(iii) Distribution and extent of habitats supporting the species
(iv) Structure, function and supporting processes of habitats supporting the species
(v) No significant disturbance of the species

*As the potential effects of the proposed development, as identified, occur outside the SAC itself, any disturbance to the qualifying interests is only considered to be significant in terms of the relevant conservation objective if it could undermine the conservation objectives relating to population viability.

**Firth of Tay and Eden Estuary SAC – Harbour seal, and Isle of May and Berwickshire & North Northumberland Coast SACs – Grey seal**

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

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

**(i) Population of the species as a viable component of the site***
(ii) Distribution of the species within site
(iii) Distribution and extent of habitats supporting the species
(iv) Structure, function and supporting processes of habitats supporting the species
(v) No significant disturbance of the species

*As the potential effects of the proposed development, as identified, occur outside the SAC itself, any disturbance to the qualifying interests is only considered to be significant in terms of the relevant conservation objective if it could undermine the conservation objectives relating to population viability.

**River South Esk, River Tay, River Teith, River Dee and River Tweed SACs – Migratory fish and Freshwater Pearl Mussel**

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

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

**(i) Population of the species, including range of genetic types for salmon, as a viable component of the SACs***

(ii) Distribution of the species within site

(iii) Distribution and extent of habitats supporting each species

(iv) Structure, function and supporting processes of habitats supporting each species

(v) No significant disturbance of the species

And for freshwater pearl mussel in particular, to ensure that the following are maintained in the long term:

**(vi) Distribution and viability of freshwater pearl mussel host species***

(vii) Structure, function and supporting processes of habitats supporting freshwater pearl mussel host species

*As the potential effects of the proposed development, as identified, occur outside the SAC itself, any disturbance to the qualifying interests is only considered to be significant in terms of the relevant conservation objective if it could undermine the conservation objectives relating to population viability.

## PROPOSAL DETAILS

### 2a. Proposal titles

NNGOWL, ICOL, SAWEL, SBWEL, all in Scottish waters within the Forth and Tay region.

### 2b. Advice from SNCBs

MS-LOT received advice from the SNCBs regarding the Forth & Tay wind farms on 7th March 2014. This advice addresses the cumulative impacts of the Forth and Tay Developments. It is the key response to refer to as it supersedes the earlier SNCB advice on individual applications. Further advice was received on the 15th April 2014, 30th May 2014, 6th, 10th and 17th June 2014 and the 2nd, 4th,11th and 16th July 2014.

The earlier advice from the SNCBs in relation to NNGOWL alone (28th November 2012) predates the submission of the SEIS for this proposal and no longer has relevance in respect of this appropriate assessment. (It now only has relevance in respect of advice on methods to install the export cable landfall – discussed in section 5 of that response.) Likewise an early response on the 28th March 2013 to the SAWEL and SBWEL applications has also been superseded by the cumulative advice.

SNCBs advice along with advice from MSS is available to view at the Marine Scotland Interactive Website.

### 2c. Details of proposed operation:

As a consequence of the assessment process, iterative changes to the project envelopes were confirmed by Forth and Tay offshore wind farm developers. These mitigation measures mean that different sections of this assessment consider different project envelopes. Details are provided in the relevant sections. Details of the proposals and project envelopes are described below:

**NNGOWL**

Installation and operation of a proposed wind farm, 'Neart na Gaoithe', located 15.5 km to the east of Fife Ness and 16 km from the Isle of May in the outer Firth of Forth. The company estimates that water depths across the site range from approximately 40 m to 60 m. The export cables from the site are proposed to travel southwest from the development and make landfall at Thorntonloch beach to the South of Torness Power Station. The consent, if granted, will be for a period of 25 years.

The original application was for a design envelope of up to 125 wind turbine generators ("WTGs"), and a maximum generating capacity of up to 450 MW. The company later confirmed (in early 2014) that the maximum number of turbines would be 90. On the 10th of April 2014 the company confirmed that the maximum number of turbines would be 75. The original footprint of the development was 105km$^2$, however with the reduction in turbine numbers this was also reduced to

82.7km$^2$.

For each WTG, there will be a substructure, either steel jackets with pin piles or gravity base. For each WTG, there will be a transition piece (including access ladders / fences and landing platforms), turbine tower and nacelle.

Also included in the infrastructure is:

- Up to two Offshore Substation Platforms ("OSPs");
- Between 85-140 km of inter-array cabling linking turbines and OSPs
- Two export cables
- Scour and Cable protection

The construction programme is expected to cover a period of 1.5 years. No date is yet available for commencement of construction, but it is likely to commence in 2015/2016.

A full project description can be found in chapter 5 of the NNGOWL ES and Technical Appendix 1 of the SEIS.

**ICOL**

Installation and operation of the ICOL wind farms which are located 15 km to the east off the Angus coastline, to the east of the Firth of Tay (two section 36 consents have been applied for however, for the purposes of this assessment the two developments are considered together as there are no details on how the site will be split between the two wind farms). The total area of the development is 150 km$^2$. The company estimates that water depths across the site range from approximately 40 m to 57 m. The export cables from the site are proposed to reach a landfall location in East Lothian. Two potential landfall areas have been identified near Cockenzie or Seton Sands. One of these options will be selected as part of the detailed design process. The consent, if granted, will be for a period of 25 years.

The original application was for a design envelope of up to 213 WTGs, and a maximum generating capacity of up to 1,050 MW. The company later confirmed (in early 2014) that the maximum number of turbines would be 110 and that the maximum generating capacity would be 784 MW

For each WTG, there will be a substructure, either steel jackets with driven piles, suction piles, drilled piles or gravity base, or a larger gravity base structure. For each WTG, there will be a transition piece (including access ladders / fences and landing platforms), turbine tower and nacelle.

Also included in the infrastructure is:

- Up to 5 Offshore Substation Platforms ("OSPs");
- Between 147 - 353 km of inter-array cabling linking turbines and OSPs
- Up to 6 offshore export cables
- Scour and Cable protection

- 3 meteorological masts
- 3 metocean buoys

The construction programme is expected to cover a period of 2-3 years. No date is yet available for commencement of construction, but it is likely to commence in 2017.

A full project description can be found in chapter 7, volume 1A of the ICOL ES.

**SAWEL and SBEWL**

Installation and operation of the SAWEL and SBWEL Wind Farms which are located 27 km and 38 km to the east off the Angus coastline respectively. The total areas of the developments is 197 $km^2$ and 194 $km^2$ respectively. The export cables from the sites are proposed to reach a landfall location at Carnoustie (approximately 70 km from the SAWEL site). The consent, if granted, will be for a period of 25 years.

The original applications were for a design envelope of up to 75 WTGs, and a maximum generating capacity of up to 525 MW for each of SAWEL and SBWEL.

For each WTG, there will be a jacket substructure and foundations (either driven piles, suction piles or gravity bases). For each WTG, there will be a transition piece (including access ladders / fences and landing platforms), turbine tower and nacelle.

Also included in the infrastructure for the SAWEL and SWBEL projects combined is:

- Up to five Offshore Substation Platforms (“OSPs”);
- Approximately 710 km of inter-array cabling linking turbines and OSPs
- Up to six export cables
- Up to six meteorological masts
- Scour protection and cable protection

The construction programme is expected to cover a period of approximately 4 years. No date is yet available for commencement of construction, but it is likely to commence in 2017.

A full project description can be found in chapter 5 of the Seagreen ES. SAWEL and SBWEL have committed to increasing the airgap between the rotor blades and the sea by 4m from Lowest Astronomical Tide (“LAT”). The minimum turbine spacing will be 1000m.

**ASSESSMENT IN RELATION TO REGULATION 25 OF THE OFFSHORE MARINE CONSERVATION (NATURAL HABITATS, &C.) REGULATIONS 2007 AND REGULATION 48 OF THE CONSERVATION (NATURAL HABITATS, &C.) REGULATIONS 1994**

**3a. Is the operation directly connected with or necessary to conservation management of the site?**

The operations are not connected with or necessary to conservation management of the sites.

**3b. Is the operation likely to have a significant effect on the qualifying interest?**

During the scoping phase of the EIA processes for the Forth and Tay Developments, the SNCBs advised that there may be a LSE on several SPAs and SACs. Details can be found in the individual scoping opinions using the following links:

NNGOWL Scoping Opinion
ICOL Scoping Opinion
SAWEL and SBWEL Scoping Opinion

This initial list of SPAs and SACs was revised to those sites that are detailed in 1b following dialogue between the applicants and MS-LOT and consideration of the survey work presented in the applicant's ESs. Final details on the list of SPAs and SACs to be included in the AA was provided by the SNCBs in their advice dated 7th March 2014.

**SPAs**

During the consultation phase of the section 36 and marine licence application process, the SNCBs advised on 7th March 2014 that the proposed Forth and Tay Developments both alone and in-combination with each other are likely to have a significant effect on the following qualifying features and SPAs, by virtue of either collision risk and/or displacement:

- Collision risk and/or displacement to kittiwake of Buchan Ness to Collieston Coast, Forth Islands, Fowlsheugh and St Abb's Head to Fast Castle SPAs.
- Collision risk and/or displacement to gannet of Forth Islands SPA.
- Displacement to Atlantic puffin of Forth Islands SPA.
- Displacement to common guillemot of Buchan Ness to Collieston Coast, Forth Islands, Fowlsheugh and St Abb's Head to Fast Castle SPAs.
- Displacement to razorbill of Forth Islands, Fowlsheugh and St Abb's Head to Fast Castle SPAs.
- Collision risk to herring gull of Buchan Ness to Collieston Coast, Forth Islands, Fowlsheugh and St Abb's Head to Fast Castle SPAs.
- Collision risk to lesser black-backed gull of Forth Islands SPA.
- Collision risk and/or displacement to Northern fulmar of Buchan Ness to

Collieston Coast, Forth Islands and Fowlsheugh SPAs.

- Collision risk and/or displacement to common & Arctic tern species of Forth Islands SPA (NNGOWL and ICOL only).

*The remaining species listed in the SPA citations in 1b are scoped out of further consideration in this AA as no LSE was identified - these species were either not recorded in significant numbers on-site, or else there is no pathway for significant impact and/or there is no connectivity with any SPAs.*

The Firth of Forth SPA, designated for wintering wildfowl and waders, and post-breeding Sandwich terns is close to the Forth and Tay Development sites. The SNCBs advised no LSE for this SPA; they support the strategic collision risk assessment commissioned by Marine Scotland and undertaken by the Wildfowl & Wetlands Trust ("WWT") and MacArthur Green Ltd. This project presents a strategic assessment of potential collision risk to migrating wildfowl, waders and other non-seabird species from all current offshore wind farm proposals in Scotland and Robin Rigg, in operation. The modelling confirms that the risk presented by the Forth and Tay Developments would not be significant on their own, nor cumulatively with each other or recently consented Moray Firth offshore wind farms (Beatrice Offshore Wind Farm Limited ("BOWL") and the Moray Offshore Renewables Limited ("MORL") developments), to any of these migratory non-seabird populations. The SNCBs have also advised that there is no connectivity between post-breeding Sandwich terns and the Forth and Tay Development sites. Therefore this qualifying interest of the Forth Islands SPA is not considered further in this assessment.

**SACs**

During the consultation phase of the section 36 and marine licence application process, the SNCBs advised on 7th March 2014 that the proposed Forth and Tay Developments both alone and in-combination with each other are likely to have a significant effect on several of the qualifying features of the SACs listed in 1b. These are listed below along with the effects to be considered for the different species. The SNCBs identified three river SACs where LSE could not be ruled out (River South Esk, River Tay and River Teith). Due to uncertainty surrounding the origin of potentially impacted Atlantic salmon, two additional river SACs (River Dee and River Tweed), which were advised by the ASFB as being at risk, are also considered in this assessment.

- Bottlenose dolphins as the qualifying feature of the Moray Firth SAC. The dolphins range widely beyond the SAC along the east coast of Scotland. Modelling indicates that the noise emitted from pile-driving turbine and substation foundations could extend beyond the wind farm footprints and reach the coastal waters used by dolphins. It is unlikely that noise from other construction activity (which isn't predicted to extend beyond the wind farm sites), could give rise to significant disturbance of bottlenose dolphin. Nor is the noise emitted from operational turbines a significant concern. There may be impacts on the prey species of dolphin, either from placement of infrastructure or due to noise.

- Harbour seals as a qualifying feature of the Firth of Tay and Eden Estuary SAC. Harbour seals range beyond the SAC and may forage in, or transit through, the areas where the wind farms are proposed. Seals could be disturbed by pile-driving noise in particular, but boat movements, cable-laying, rock-dumping and other activities associated with wind farm construction may also affect them. There may be impacts on the prey species of seals, either from placement of infrastructure or due to noise.

- Grey seals as a qualifying feature of the Isle of May SAC and the Berwickshire & North Northumberland Coast SAC. Grey seals range beyond these SACs and may forage in, or transit through, the areas where the wind farms are proposed. Seals could be disturbed by pile-driving noise in particular, but boat movements, cable-laying, rock-dumping and other activities associated with wind farm construction may also affect them. There may be impacts on the prey species of seals, either from placement of infrastructure or due to noise.

- Atlantic salmon as a qualifying feature of the River South Esk, River Tay, River Teith, River Dee and River Tweed SACs due to disturbance from construction noise and possible effects of electro-magnetic fields ("EMF") arising from installed cables. The SNCBs have advised that they have considered the location of the export cable routes and proposed landfall points for each proposal and are satisfied that construction work associated with this cable installation would not result in likely significant effects to salmon. Also operational noise from wind turbines will not result in likely significant effects to salmon.

- Freshwater pearl mussel ("FWPM") as the qualifying feature of the River South Esk and River Dee SACs. Atlantic salmon (and other salmonids) are integral to the life cycle of FWPM, therefore any impacts to Atlantic salmon that prevent them from returning to their natal rivers may have a resulting effect on FWPM populations.

- Lamprey species as qualifying features of the River Tay, River Teith and River Tweed SACs due to disturbance from construction noise and possible effects of EMF arising from installed cables. The SNCBs have advised that they have considered the location of the export cable routes and proposed landfall points for each proposal and are satisfied that construction work associated with this cable installation would not result in likely significant effects to lamprey species. Also operational noise from wind turbines will not result in likely significant effects to sea lamprey.

*The remaining species and habitats listed in the SAC citations in 1b are scoped out of further consideration in this AA as no LSE was identified.*

Otters, as qualifying features of the River Tay, River Dee and River Tweed SACs, are not considered further in this assessment as they are a riverine or coastal species. The location of the wind farms being 15 km (minimum) out to sea from the coast, are significantly out with the habitat of otters. The location of the landfalls of all the Forth and Tay offshore wind farm proposals are sufficiently far from river

SACs to conclude no LSE for otters.

**3c. APPROPRIATE ASSESSMENT of the implications for the site in view of the site's conservation objectives.**

The scope of the assessment envelope went through a number of changes during the assessment process. Assessments based on earlier project iterations identified unacceptably high levels of effect, resulting in a range of mitigation measures being put forward by developers (e.g. reduced numbers of turbines). The assessment for marine mammals is based on the worst case scenarios (i.e. the highest numbers of turbines). This is due to the information on design envelopes which was available when the marine mammal modelling was carried out. Assessments for bird species are based on narrower envelopes (see below).

Ornithology

Advice received from the SNCBs and MSS was based on wind farm iterations that changed over time due to mitigation measures identified by the developers (see *Table 1*). Since receiving the SNCB advice on 7th March 2014 NNGOWL have confirmed that their maximum number of turbines will be 75, and ICOL have confirmed that their maximum number of turbines will be 110. SAWEL and SBWEL have also confirmed a rise in the minimum turbine clearance LAT of 4 m. The SNCBs provided updated advice on

- 15th April 2014 updating previous advice on the gannet threshold.
- 6th June 2014 which included consideration of the lower numbers of WTGs being proposed by the developers, the reduction in footprint by NNGOWL and the Johnston *et al* flight height data.
- 10th June 2014 regarding the most appropriate displacement rates for kittiwake at the SAWEL and SBWEL sites.
- 2nd July 2014 which detailed the Collision Risk Models to include the rise in the minimum turbine clearance from LAT of 4 m by SAWEL and SBWEL.
- 4th July 2014 regarding the most appropriate displacement rates for puffin at the SAWEL, SBWEL and ICOL sites for use in the common currency.
- 11th July 2014 letter advising that the closer effects are to thresholds the greater the risks of adverse effects and providing detail on appropriate monitoring.
- 16th July 2014 regarding the most appropriate displacement rates for auks and kittiwake at the SAWEL, SBWEL and ICOL sites.

The assessment for birds which has been completed by MSS and MS-LOT is based on these revised turbine numbers and clearance height for collision risk. For kittiwake, displacement effects are based on the worst case scenarios as described above for NNGOWL and ICOL, however for SAWEL and SBWEL the lower displacement rates due to substantially greater WTG spacing as advised by the SNCBs in an email dated 10th June 2014 have been used in the kittiwake assessment. For puffin, the CEH displacement model assumes the worst case displacement rate of 60% for all projects, whilst the common currency

displacement assessment uses that displacement rates advised by the SNCBs on July 4th & 16th 2014 (see below).

*Table 1: summary of iterative changes in assessment envelope.*

| Project | Parameter | SNCB Advice 7 March 2014 | MSS advice April 10 2014 | SNCB Advice 6 June 2014 | SNCB Advice June 10 2014 | MSS advice June 12 2014 | SNCB Advice July 4 & 16 2014 | Appropriate Assessment |
|---|---|---|---|---|---|---|---|---|
| All Projects | Flight height data | Cook et al 2012 | Johnston et al 2014 | Johnston et al 2014 | | Johnston et al 2014 | | Johnston et al 2014 |
| | CRM Band Option | 2 & 3 | 3 | 2 & 3 | | 3 | | 3 |
| | CRM Avoidance Rate | 98% | 98% (& 95%) | 98% | | 98% (& 95%) | | 98% (& 95%) |
| | Auk displacement rate (CEH model) | 60% | 60% | 60% | 60% but see SNCB and MSS advice of June 2014 indicating lower displacement rates for some projects | | | |
| | Threshold setting method | ruABC & 5% P of decline (gannet) & PBR & proxy species | ABC & ruABC & PVA P of decline (gannet) | ruABC & 5% P of decline (gannet) & PBR & proxy species | | | | ABC & ruABC & PVA P of decline (gannet) |
| NNGOWL | Turbine No. | 90 | 75 | 75 | 75 | 75 | | 75 |
| | Footprint (km2) | 105 | 105 | 105 | 83 | 83 | | 83 |
| | Effect of mitigation to reduce kittiwake adult survival effect at Forth Islands SPA | 0 | 0 | 0 | | 0.2% | | 0.2% |
| | Puffin displacement rate (Common Currency) | 60% | 60% | 60% | 60% | 60% | 60% | 60% |
| | kittiwake displacement rate (CEH model) | 40% | 40% | 40% | 40% | 40% | 40% | 40% |
| ICOL | Turbine No. | 213 | 110 | 110 | 110 | 110 | | 110 |
| | Footprint (km2) | 150 | 150 | 150 | 150 | 150 | | 150 |
| | Auk displacement rate (CEH | 60% | 60% | 60% | 60% | 53% | | 60% |
| | Puffin displacement rate (Common Currency) | 60% | 60% | 60% | 60% | 53% | 50% | 50% |
| | kittiwake displacement rate (CEH model) | 40% | 40% | 40% | 40% | 35% | 30-40% | 35% |
| SAWEL | Turbine No. | 75 | 75 | 75 | 75 | 75 | | 75 |
| | Footprint (km2) | 197 | 197 | 197 | 197 | 197 | | 197 |
| | Air gap increase | 0 | 0 | 0 | | 4m | | 4m |
| | Auk displacement rate (CEH model) | 60% | 60% | 60% | 50% | 40% | 40% | 60% |
| | Puffin displacement rate (Common Currency) | 60% | 60% | 60% | 60% | 40% | 40% | 40% |
| | kittiwake displacement rate (CEH model) | 40% | 40% | 40% | 30% | 26% | 30% | 30% |
| SBWEL | Turbine No. | 75 | 75 | 75 | 75 | 75 | | 75 |
| | Footprint (km2) | 194 | 194 | 194 | 194 | 194 | | 194 |
| | Air gap increase | 0 | 0 | 0 | | 4m | | 4m |
| | Auk displacement rate (CEH model) | 60% | 60% | 60% | 50% | 40% | 40% | 60% |
| | Puffin displacement rate (Common Currency) | 60% | 60% | 60% | 60% | 40% | 40% | 40% |
| | kittiwake displacement rate (CEH model) | 40% | 40% | 40% | 30% | 26% | 30% | 30% |

## The Scope of In Combination Effects

For certain species, where considered appropriate, in-combination impacts have also been considered from projects further afield:

Aberdeen Bay Offshore Wind farm - to be located 2 to 4.5 km off the coast at Blackdog, Aberdeenshire, comprising 11 turbines with a generating capacity of up to 100MW. This development was consented in 2013 construction has not yet

commenced, consent is for a period of 22 years. This proposal is relevant to consider in respect of kittiwake at Buchan Ness to Collieston Coast SPA and Fowlsheugh SPA.

Methil Wind Turbine – to be located on the coast at Methil, Fife. A single turbine with a generating capacity of up to 7MW. This development is currently operating and has consent to operate for a period of up to 5 years.

Blyth Offshore Wind farm – located just off the Northumberland coast, comprising 2 turbines with a generating capacity of 4MW. This small development has been operating since 2000. This proposal is relevant to consider in respect of gannet at Forth Islands SPA.

Blyth Offshore Wind Demonstration Site - located just off the Northumberland coast, comprising 15 turbines with a generating capacity of up to 100MW. This development was consented in 2013. This proposal is relevant to consider in respect of gannet at Forth Islands SPA.

Teesside Offshore Wind farm – located off the coast of Teesside, England, comprising 27 turbines with a generating capacity of 62MW. Construction was completed in 2013, and the turbines are currently operating. This proposal is relevant to consider in respect of gannet at Forth Islands SPA.

The SNCBs in their advice to MS-LOT dated 6th June 2014 agreed with the inclusion of these developments in the in-combination assessment. The SNCBs highlighted that it has not been possible to check the detail of the underpinning calculations. Marine Scotland have given qualitative consideration of Option 1 (basic version) of the Band CRM done for these sites. MSS advice is that whilst the ideal would be to apply Option 3 for these sites adopting a common currency, this is not practically achievable with the information available. Neither is it necessary to reach a conclusion (see below for discussion on Band CRM Options).

Assessment Methods

Background information on the bird species considered in this assessment can be found at http://seabird.wikispaces.com/

As detailed in section 1c, as the potential effects identified occur outside of the SPAs themselves, the relevant conservation objective for each qualifying interest is to “ensure the population of the species as a viable component of the site” is maintained in the long term. In order to assess the potential effects of the Forth and Tay Developments, alone and in combination, on the achievement of the conservation objective the assessments for relevant species involved:

1.) estimation of the level of predicted effect; and
2.) setting a precautionary level of acceptable change to the population given the statutory requirements. Where it can be shown that the populations of all qualifying interests of concern can be maintained within the thresholds of change it can be concluded that the proposed developments will not adversely affect site integrity.

In their ESs the Forth and Tay developers used varying methods of assessment (e.g. reference populations, collision risk models, methods for apportioning effects to SPA populations, assessment of displacement impacts), making a clear and transparent cumulative assessment extremely difficult. Developers also adopted various approaches to rationalise the acceptability of the effects in their Habitats Regulations Appraisal ("HRA") reports. In order to address this and allow for a more robust cumulative assessment a common currency approach has been used. The SNCBs and MSS have worked together with the developers to establish common approaches and methods which are discussed further below.

1). Estimation of the level of predicted effect

The main effects to bird species are due to:
**a). Collision with Turbines** (of greatest relevance to species which may regularly fly at the same height as the rotating blades e.g. gulls and gannet), and
**b). Displacement and Barrier Effects** resulting in birds either being displaced from foraging areas or having to fly around a wind farm to reach a foraging area (of greatest relevance to species with more limited foraging ranges or greater flight energetic costs e.g. kittiwake and puffin).

**a.) Collision with Turbines** – The Forth and Tay developers all presented Band Collision Risk Models ("CRMs") in their ESs, and in the case of NNGOWL, SAWEL and SBWEL in their SEISs. The SNCBs and MSS support the use of Band CRMs. Band (2012) provides guidance on how to use the CRM for seabird species in respect of offshore wind farms. It includes a 'basic' model (Options 1 and 2) and an 'extended' version (Option 3) as described below:

Option 1 – The 'Basic' model. It assumes a uniform distribution of flight heights and collision risk between lowest and highest levels of the rotors. It also uses figures for the proportion of birds at risk height derived from site-specific surveys.

Option 2 – As Option 1 but the proportion of birds at risk height is derived from modelled flight height data. Johnston et al (2014 *corrigendum*) provides the most up to date information on modelled flight heights and effectively supersedes the previous flight height model (Cook *et al*, 2012).

Option 3 – The 'Extended' model. This differs methodologically from the 'Basic' model in that it does not assume that the density of flying birds is uniform across all heights between the minimum and maximum rotor swept height. Instead, this option uses flight height values for specific height bands (1m flight bands by default) from modelled data to calculate collision rate in each part of the rotor swept area and then integrates that across the rotor disk. It accounts for a number of factors that change with height across the rotor swept area which together result in the collision risk varying with height. For example, the breadth of the circle (and therefore the number of birds flying through the circle) varies with height and the collision risk on transit through the swept area also depends on height (due to for example, variation in rotor speed across the radius). If the density of birds in flight also varies with height (as observed in most seabird species) rather than being uniform, then the result is a different number of predicted collisions than if the flight height distribution were assumed to be uniform (as in Options 1 and 2). The author

of the Band model has clearly stated that the extended model undertakes the more correct calculation and should be used in preference over the basic model where appropriate flight height data allow (emailed note to Avoidance Rate Review project steering group received 14/5/14).

The Forth and Tay developers presented various combinations of these CRMs in their ESs and SEISs. These initial assessments informed the development of both a common currency, and mitigation e.g. through reduced turbine numbers, both of which are necessary considerations for this appropriate assessment.

In their advice to MS-LOT dated 7th March 2014, the SNCBs presented the collisions attributed to the Forth and Tay Developments using both Options 2 and 3 of the Band model using Cook *et al* (2012) modelled flight height data. Option 3 was used in the appropriate assessments recently completed for the BOWL and MORL developments in the Moray Firth. The Renewables Scientific Advice Group ("RSAG" – comprising SNH, JNCC and MSS) met on 25th and 28th June 2013, and considered the use of the outputs from Option 3 in the Moray Firth assessments appropriate. Flight height data were also not available in appropriate flight height bands for SAWEL and SBWEL for use in Option 1 of the CRM.

Since the SNCB advice was received on 7th March 2014, Johnston *et al* (2014 *corrigendum*) has been made available. The Johnston *et al* analysis models the same flight height data as modelled by Cook *et al* (2012) but undertakes the analysis of data using a sample unit of site rather than survey. Some sites had multiple years of survey and this approach overcomes the apparent issue with the Cook *et al* height distributions of individual surveys having an undue influence on derived flight heights.

Where possible, comparison of outputs from Options 1 and 2 was undertaken to identify whether substantial differences in values and therefore flight heights between the site data and the pooled modelled Johnston *et al* 2014 data used in Option 2 and Option 3 existed. There was substantial difference between the number of kittiwake estimated to collide when comparing the ICOL values for Option 1 and 2, with twenty-two times more birds estimated to collide using the modelled flight height data (Option 2) than site-specific data (Option 1) i.e. the ICOL data suggested that substantially less kittiwake were flying within the rotor swept area. There were no reasons to suspect that site specific drivers at ICOL would cause flight heights to differ from the modelled data. It was also accepted that pooling robustness was likely to result in the Johnston *et al* 2014 data being more robust to errors (but not systematic bias) in flight height estimation. Any systematic bias in flight height estimates either from the site specific data or that used by modelled data would be carried through the CRM calculations, regardless of the Option used.

The Johnston *et al* work has been published in a peer-reviewed scientific journal and is considered by MSS to provide the best available evidence. This view was endorsed by the SNCBs in their advice of June 6th 2014. The SNCBs recommended that Option 2 outputs are also used in the assessment. A further revision of the CRM using Option 2 was provided by the SNCBs on 2nd July 2014 which included the commitment by SAWEL and SBWEL to increase the air gap

between the rotor blades and the sea by 4m from LAT. MSS advised that Option 3 provides the most realistic evidence base for use in this AA. The assessment is based on Option 3 outputs.

The Band 2012 CRMs are very sensitive to the avoidance rates used. There has been a debate about whether the default 98% avoidance rate, which has historically been used and applied in conjunction with the 'basic' model (Options 1 and 2), and was used with Option 3 for the BOWL and MORL development appropriate assessments in the Moray Firth, is also appropriate for use with the 'extended' model (Option 3). MSS are currently leading a research project to review seabird avoidance rates for use in these models. The British Trust for Ornithology (BTO) are undertaking the work with a steering group comprised of SNCBs, RSPB and ecological consultants. The draft report to MSS gives support for calculating avoidance rates separately for the basic and extended models. The SNCBs advice (dated 7th March 2014) was issued before the draft report was available and was thus based on a 98% avoidance rate. Although MSS consider the 98% avoidance rate to be appropriate for use in this assessment they also consider it is appropriate to present results for Option 3 assuming an avoidance rate of 95%. This adds additional precaution to the assessment and allows conclusions to be made on the impacts from collision risk where no reasonable scientific doubt remains.

The assessment is intended to be precautionary in its estimation of effect to ensure that its conclusions are also precautionary in nature. In addition to the choice of avoidance rate, precaution is provided by the density estimates not including a factor to account for attraction to survey vessels of species known to associate with fishing vessels i.e. gannet, kittiwake, and large gulls. This attraction is likely to lead to higher density estimates of these species and thus higher numbers predicted to collide with the turbines.

**In summary, this assessment is based upon estimates of the breeding season collision effect using extended Band model Option 3 with Johnston *et al* (2014 *corrigendum*) and an assumed avoidance rate of 98%. The same conclusions are also reached using a more precautionary avoidance rate of 95%.**

**b.) Displacement and Barrier Effects** – It is recognised that increased activity in a sea area, or the establishment of structures such as wind farms, has the potential to displace birds. Initial monitoring of other European offshore wind farms shows contrasting results between species and for the same species, (e.g. Leopold *et al*., 2011, Canning *et al*., 2012, Furness *et al.*, 2013). Most of this monitoring focuses on the non-breeding season as this is when the wind farms being monitored were considered to have greatest impact. There is little available data to inform assessment of displacement / barrier effects to seabirds during the breeding season. There is limited understanding of the individual or population level effects of displacement or barrier effects, via increased energetic costs, reduced nest attendance or provisioning of chicks.

It is recognised that the assessment of displacement/ barrier effects is particularly challenging. In October 2012 Marine Scotland therefore commissioned the Centre

for Ecology and Hydrography ("CEH") to develop a time and energy expenditure model (Searle *et al*, 2014) to investigate the potential displacement / barrier effects on seabird species that could arise from the proposed wind farms. This modelling was undertaken for guillemot, razorbill, puffin, kittiwake and gannet, addressing these possible responses to the presence of a wind farm:

- displacement, where birds that otherwise wanted to forage in the area decide to forage elsewhere, and
- barrier effects, where birds that want to forage in locations beyond the wind farm decide to fly around it rather than through it. A 1km buffer has been applied to each of the Forth & Tay wind farm footprints supplied by the developers.

The modelling assumes a 60% displacement / barrier rate for auk species and gannet, and either 30% or 40% for kittiwake, as initially advised by the SNCBs (but see below). It is informed by available tracking data for each species and provides outputs for two types of assumed prey distribution:

- 'Flat' which assumes an even (homogeneous) distribution of prey across the region.
- GPS which uses bird tracking data to inform variable (heterogeneous) prey distribution.

CEH have advised that the flat and GPS modelled outputs encompass the range of possible displacement / barrier effects. In their advice of June 6th 2014 the SNCBs indicated that the decision on which outputs were used should be based on the sample size of tagged birds, number of years for which tagging data were available and the confidence that CEH had in the estimates of effects. This rationale has been used in this assessment.

The CEH displacement modelling only considers the consequences of adult breeding birds being displaced or extending flights to avoid entering a wind farm, with effects on adult body mass, nest attendance and chick provisioning rate all being estimated. A limitation of the model is that it does not assess the effect of reduced fledging weight on subsequent chick survival and recruitment into the population of breeding adults. It was however considered that due to very limited available data there were substantial difficulties in attempting to quantify this effect, and that the effect was likely to be very small due to naturally relatively high mortality within the first year.

There are two versions of the displacement model, the 'full' and the 'lite'. The 'full' model was most biologically realistic but modelled the energetic consequences of barrier effects in an unrealistic manner, was computationally expensive to run, and was unable to run scenarios with large sets of simulated birds. The 'lite' model was developed to address these issues and the final simulations used both 'full' and 'lite' versions of the foraging model to capitalise on their respective strengths.

CEH advise that 'lite' model output version 0 gives the most realistic calculation of barrier effects compared to version 1, however, the 'full' model better captures the available foraging options for birds in the presence of a wind farm. CEH have

therefore calculated an adjustment factor that allows the full model outputs to be used, but incorporates the better estimate of barrier effects derived from the 'lite' model. Both the adjustment method and corrected outputs have been provided by CEH to the project steering group (represented by SNCBs, developers' ecological consultants and RSPB) and it is these which the SNCBs and MSS have used in their advice.

The CEH displacement outputs address the cumulative development scenario of all four Forth and Tay wind farms in combination as well as each individual wind farm in isolation (provided for all species, excepting gannet). The SNCB advice of June 6th 2014 and this Appropriate Assessment are based on the final version of the CEH displacement report.

SNCB advice on June 10th 2014 and the 4th and 16th July 2014 indicated that due to greater turbine spacing at some projects it would be appropriate for lower displacement rates to be used in the estimation of effects. MSS advice on June 12th 2014 also indicated that due to the greater turbine spacing at SAWEL and SBWEL and the substantial increase in WTG spacing at ICOL following their reduction in turbine number from 213 to 110, reduced displacement rates should be applied to these projects in the cumulative impact assessment. The SNCB advice on displacement rates (see *Table 2*) have been used for the puffin common currency assessment of displacement. For the CEH displacement models, the original displacement/barrier rates advised by the SNCBs (40% kittiwake and 60% auks, gannet and large gulls) have been used with the exception of kittiwake at SAWEL and SBWEL where displacement rates of 30% have been assumed. Incorporation of the revised displacement rates advised by MSS and the SNCBs would require the re-running of the CEH models. Instead, the displacement rates used in the CEH model for kittiwake at ICOL, SAWEL and SBWEL are viewed as precautionary based on the rates advised by MSS.

*Table 2: Summary of displacement rates advised by the SNCBs and MSS, and those used in the CEH displacement models.*

| | Development Area (km2) | No. WTG | MSS Advice | SNCB Advice | MSS Advice | SNCB Advice | Auk, gannet and large gull | Kittiwake |
|---|---|---|---|---|---|---|---|---|
| **NNGOWL** | 83 | 75 | 60 | 60 | 40 | 40 | 60 | 40 |
| **SAWEL** | 197 | 75 | 40 | 40 | 26 | 30 | 60 | 30 |
| **SBWEL** | 194 | 75 | 40 | 40 | 26 | 30 | 60 | 30 |
| **ICOL** | 150 | 110 | 53 | 50 | 35 | 30-40 | 60 | 40 |

As with collision risk modelling the CEH modelling of displacement is considered to have been applied in a precautionary manner, to ensure the overall assessment is precautionary. The two main areas of precaution in the use of the displacement model are:

1. The assumption that the displacement/barrier rate is constant across the entire 1km buffer rather than declining with increasing distance from the wind farm boundary.
2. With the exception of kittiwake at SAWEL and SBWEL, the displacement/ barrier rates assumed in the CEH models are based on those originally advised by the SNCBs and do not therefore take into account the reductions advised by MSS and the SNCBs to account for the mitigating effects of

increased turbine spacing (see Table 2).

2.) Setting a precautionary level of acceptable change

Several methods have been used to set and sense-check thresholds of acceptable change and these are discussed below:

- Population Modelling;
- Interpreting population model outputs using Acceptable Biological Change ("ABC");
- Interpreting population model outputs using reduced uncertainty Acceptable Biological Change ("ruABC");
- Interpreting gannet population model using the probability of population decline at the end of the 25 year period of effect being lower than the starting population;
- Interpreting puffin population model using the probability of population decline in any year of the 25 year period of effect;
- Potential Biological Removal ("PBR");
- Ratios of median change to populations with and without the acceptable effects.

**Population Modelling**

Marine Scotland contracted CEH in October 2012 to produce population models (Freeman *et al*, 2014) for several species (kittiwake, guillemot, razorbill, puffin, herring gull) using colony counts from 1985 to 2012 inclusive, along with productivity and survival data. The Bayesian framework used by CEH enabled fitting in 'state-space' form, which allows for 'observation error' and environmental stochasticity (variations in environmental conditions) simultaneously within the same model. Where data made it feasible to do so, Integrated Population Modelling ("IPM") was undertaken which provides the additional advantage that all sources of data contribute to the estimates of all parameters, such that sampling uncertainty is correctly accounted for. State-space models were undertaken on all species. IPMs were also undertaken on guillemots and razorbills.

The baseline models were fitted to, and compared with, past colony counts to assess their validity. Generally, the models fitted colony counts well, especially for those colonies which had been counted annually, the exception being the puffin model. Consequently, CEH advised caution in relation to the puffin model's use in any assessment of wind farm impacts on the puffin population at Forth Islands SPA and for this reason the CEH puffin model outputs have not been used in the setting of thresholds for this species.

A number of impact scenarios were modelled for each population. Annual adult survival and productivity rates were reduced for a 25 year period, corresponding to the operation of a wind farm, and a five year 'recovery' period during which no reduction in survival and productivity beyond natural mortality was also modelled. Survival and productivity was reduced, as follows:

- adult annual survival rates: reduction of 1%, 2%, 3% or 4%;

- annual productivity: reduction of 1%, 5%, 10% or 20%; and
- both annual survival and productivity: 1% survival, 1% productivity; 2% survival, 5% productivity; 3% survival, 10% productivity; 4% survival, 20% productivity.

Population model outputs are in the format of annual predicted population sizes from 2015 to 2045. In order to set thresholds the SNCBs excluded the 5 year recovery period and used the outputs at year 2040 as the final population. This assessment is based upon a 25 year period of effect with no post wind farm recovery period assumed as advised by the SNCBs.

The models were designed to incorporate natural variability in the key vital rates. Each run of the model therefore gave slightly different outputs due to the variance incorporated into the stochastic population model. In order to express this variability the median population size each year plus quantiles of the multiple runs for each scenario were presented. The quantiles provided by the CEH outputs were 5%, 33%, 50%, 66% and 95%. These outputs were used to set thresholds of acceptable change for kittiwake, guillemot, razorbill and herring gull as follows:

**Interpreting population model outputs using Acceptable Biological Change ("ABC")**

The ABC tool was previously applied in the BOWL and MORL appropriate assessments. This tool establishes an acceptable level of change based on the forecast trajectory assuming no additional adult mortality. An outline of the ABC tool is attached in Appendix 2 of this assessment.

The tool uses the Intergovernmental Panel on Climate Change ("IPCC") terminology to determine thresholds of acceptable change. With the CEH population models, application of ABC used the median forecast of 0.5. The median value sits within the IPCC 'about as likely as not' category (probability range of 0.333-0.667). The magnitude of acceptable effect is taken as the difference between the median forecast and the 33% quantile under baseline conditions i.e. in the absence of any additional effect.

**Interpreting population model outputs using reduced uncertainty Acceptable Biological Change ("ruABC")**

The SNCBs recommended adopting a variation to the original ABC tool. The objective of the modification is to address a known limitation of the ABC method that results in larger decreases in adult survival being determined 'acceptable' for models which have higher variation or uncertainty. This is a concern when the variation is likely to be an artefact of sampling error with respect to the population in question rather than true natural variability. Setting thresholds that allow for natural fluctuations in population sizes is important, but it is also important to minimise the impact of sampling error.

To overcome this effect the ruABC method uses uncertainty in the larger regional population models produced by CEH to adjust the threshold of acceptable change

in SPA specific models. ruABC is calculated by taking the difference between the median and the 33% quantile as a proportion of the median using the regional model. This measure is then multiplied against the median population size of the colony of interest, and the standard ABC calculation is then applied to the resultant value. The underlying rationale of the approach is that by applying the regional model measure of uncertainty to all SPA-specific models, natural variation in population size is retained but sampling error is minimised. For the majority but not all species and SPAs modelled by CEH, the ruABC approach results in lower thresholds of acceptable change. The SNCBs applied ruABC to determine thresholds for all populations that were modelled by CEH, except puffin.

MSS have advised that whilst the underlying rationale that the effects of natural variation will tend to act at larger spatial scales is likely to be often the case, change can occur at multiple spatial scales including very localised areas. It is for this reason that SPA-specific PVAs were developed for the Forth and Tay, rather than single regional models. Applying ruABC to kittiwake at St Abb's Head to Fast Castle SPA, for which there are regular count data, would have the peculiar result of increasing the threshold for a population despite the ABC approach (which capitalises on the good site-specific data included in the PVA) indicating that a lower threshold would be appropriate. Given the downward trajectory of the population it would be inappropriate to dilute the evidence from the colony with regional analysis in order to justify a greater level of effect through the use of ruABC.

In summary, reliance upon regional scale models means that the ruABC tool is not able to provide a higher standard of evidence than good quality colony scale PVAs. Use of ruABC is justified where there is good reason e.g. limited colony information being available or data quality concerns at the colony scale. Table 2.1 on page 7 of the CEH report provides a summary of data for each model. MSS advise use of ABC for those colonies with counts that are a regular census (a count of the whole colony) or subplot survey (a count of part of the colony) and ruABC if counts are sporadic or supporting information on the colony limited (*Table 3*).

*Table 3: MSS advice on the use of ABC or ruABC thresholds (SNCBs advise that ruABC should be used in all circumstances).*

| Species | SPA | ABC/ruABC |
|---|---|---|
| kittiwake | Forth Islands | ABC |
| | St. Abbs | ABC |
| | Fowlsheugh | ruABC |
| | Buchan Ness | ruABC |
| guillemot | Forth Islands | ABC |
| | St. Abbs | ABC |
| | Fowlsheugh | ABC |
| | Buchan Ness | ruABC |
| razorbill | Forth Islands | ABC |
| | St. Abbs | ABC |
| | Fowlsheugh | ruABC |
| herring gull | Forth Islands | ABC |
| | St. Abbs | ABC |

**Interpolation between adult survival and productivity ABC thresholds**

The thresholds established using either ABC or ruABC are taken from the CEH simulations that investigated combined changes to adult survival and productivity (e.g. 1% +1%, 2% + 5%, etc.). Interpolation between the integers presented by CEH allows thresholds to be set that fall between the categories of change modelled and the SNCB advice was based on this approach. However, a maximum allowable population level effect could be reached through a range of combinations of adult survival and chick productivity reductions that are not captured by the interpolated values (e.g. a reduction might be driven by change to only productivity or only adult survival). To accommodate an assessment that is based upon the estimated effects, MSS advised a second stage to the interpolation of thresholds that allows the productivity effects estimated by the CEH model to be taken into consideration in setting the threshold for adult survival. This has the advantage of matching the level of reduced productivity in the threshold calculation to that estimated, and also of providing an adult survival threshold that can be used as the focus of mitigation and assessment. Further details of this interpolation method are provided in Appendix 3.

The SNCBs advised that ruABC thresholds, using their approach to interpolation, be used for all species and SPAs where available whilst MSS advised that the derived thresholds (using their extended interpolation) presented below in dark grey are used in the assessment (*Table 4*).

*Table 4: Summary of auk and kittiwake thresholds derived ABC and ruABC approaches*

| Species | SPA Population | SNCB threshold ruABC decrease in adult survival | SNCB threshold ruABC decrease in productivity | MSS threshold ABC derived adult survival decrease* | MSS threshold ruABC derived adult survival decrease* |
|---|---|---|---|---|---|
| KITTIWAKE | | | | | |
| Forth Islands | 7552 | -1.5% | -3.0% | **-2.4%** | |
| St Abbs | 12635 | -1.6% | -3.4% | **-2.0%** | |
| Fowlsheugh | 18674 | -1.3% | -2.3% | | **-1.3%** |
| Buchan Ness | 25084 | -1.6% | -3.2% | | **-2.4%** |
| GUILLEMOT | | | | | |
| Forth Islands | 29169 | -0.6% | -0.6% | **-0.9%** | |
| St Abbs | 58617 | -0.8% | -0.8% | **-1.3%** | |
| Fowlsheugh | 60193 | -0.6% | -0.6% | **-1.1%** | |
| Buchan Ness | 25857 | -0.5% | -0.5% | | **-0.5%** |
| RAZORBILL | | | | | |
| Forth Islands | 4950 | -0.9% | -0.9% | **-0.9%** | |
| St Abbs | 4588 | -1.3% | -2.0% | **-1.7%** | |
| Fowlsheugh | 7048 | -1.0% | -1.0% | | **-1.2%** |

* Interpolation between adult survival and productivity thresholds applied

**Potential Biological Removal ("PBR")**

PBR was used by the SNCBs to inform the puffin thresholds. The PBR equation is based on a simple form of population modelling, which was first formulated for marine mammals (Wade 1998) to estimate allowable by-catch. PBR requires the setting of a recovery factor (f), the value of which is a conservation management decision. Rationales in support of choice of f values rely upon criteria that are open to debate. PBR calculates the number of additional mortalities that can be sustained annually by a population, accepting the assumptions and goals of the method. However there are concerns relating to the realism of PBR's assumptions about population dynamics. MSS recommend that reliance upon PBR should be limited to those scenarios where it constitutes the best available evidence, and this is unlikely to include scenarios where bespoke population models are available. Although not used by MSS or MS-LOT in reaching conclusions, the PBR f values are presented in table 5 below.

**Presentation of threshold values using different metrics and methods**

The population forecasts produced by the PVAs can be used to explore the consequences for the population assuming levels of effects in comparison to forecasts without those effects. The ratio between the two (without/with effects), which is a "counterfactual", does not of itself provide a threshold or acceptable change. It is an additional metric by which predicted impacts, or thresholds may be considered (see *Table 5*).

It is important that metrics are used in the appropriate context:

- With the exception of the St Abb's guillemot, the population models do not account for any density dependence of growth or survival. At lower population densities, competition for resources tends to decline, and growth rate or demographic rates increase). The models will over-estimate levels of increase and decrease and, in this respect, represent worst case scenarios in terms of the forecast changes;
- The numbers presented in *Table 5* (with the exception of puffin) refer to the maximum allowable effects, not the effects estimated by the assessment. The estimated effects are less than the thresholds and in addition the magnitude of the effects have been estimated in a precautionary manner;
- Some of the populations are forecast to decline over the 25 year period in the absence of any wind farms, most likely as a consequence of reductions in food supply owing to factors that cannot be controlled at a local level, such as climate change. These changes are far greater than the magnitude of the estimated effects associated with the wind farm proposals e.g. the median Fowlsheugh kittiwake population is forecast to decline by up to 85% during the 25 year period in the absence of any wind farms. Consideration of the likely outcomes to the populations is informed by an understanding of the variance associated with the baseline forecasts. This provides meaningful context. In the case of the Fowlsheugh kittiwake population for example, based on the PVA outputs, a reduction of up to the range between 78% and 88% is as likely as not in the absence of any wind farms. Assuming the maximum allowable reduction in annual adult survival rate for kittiwake at Fowlsheugh in the presence of wind farms of -1.3%, a reduction of up to between 83% and 91% is as likely as not.
- Taking the example of Fowlsheugh kittiwake and considering only the

median values, the population is forecast to decline by up to 85% in the absence of a wind farm and by up to 89% (a difference of -4%) assuming the maximum allowable reduction in annual adult survival of -1.3%. However, the ratio of the end population assuming maximum allowable effect: end population excluding any wind farm effect is 0.73, potentially being interpreted as suggesting a 27% decline to the population. It is therefore important that these values are taken in context.

*Table 5: Comparison of forecast changes to the starting population for key species and SPAs in the absence of wind farm effects and assuming the maximum allowable reduction in annual adult survival, and equivalent PBR f-values required to obtain the same thresholds of change.*

| Species | SPA Population (Individuals) | Maximum allowable reduction in annual adult survival rate | The outcome range that is as likely as not in the absence of wind farm as a percentage of starting population | The outcome range that is as likely as not assuming the maximum allowable effect as a percentage of starting population | Ratio of end population assuming the maximum allowable effect: end population without any wind farm | Equivalent PBR f-value |
|---|---|---|---|---|---|---|
| KITTIWAKE | | | | | | |
| Forth Islands | 7552 | -2.4% | 45-81% | 29-55% | 0.69 | 0.40 |
| St Abbs | 12635 | -2.0% | 28-39% | 19-28% | 0.72 | 0.30 |
| Fowlsheugh | 18674 | -1.3% | 12-22% | 9-17% | 0.79 | 0.20 |
| Buchan Ness | 25084 | -2.4% | 48-78% | 31-52% | 0.66 | 0.22 |
| GUILLEMOT | | | | | | |
| Forth Islands | 29169 | -0.9% | 122-142% | 103-123% | 0.88 | 0.30 |
| St Abbs | 58617 | -1.3% | 111-131% | 95-112% | 0.88 | 0.45 |
| Fowlsheugh | 60193 | -1.1% | 99-127% | 86-109% | 0.99 | 0.30 |
| Buchan Ness | 25857 | -0.5% | 104-123% | 94-105% | 0.93 | 0.30 |
| RAZORBILL | | | | | | |
| Forth Islands | 4950 | -0.9% | 167-212% | 146-181% | 0.88 | 0.25 |
| St Abbs | 4588 | -1.7% | 89-117% | 71-94% | 0.78 | 0.34 |
| Fowlsheugh | 7048 | -1.2% | 35-53% | 27-40% | 0.79 | 0.30 |
| GANNET* | | | | | | |
| Forth Islands | 110964 | -1.2% | 112-164% | 87-129% | 0.79 | 0.25 |
| PUFFIN** | | | | | | |
| Forth Islands | 62231 | -2.0% | 369-397% | 278-301% | 0.75 | 0.25 |

* *For gannet % range is 95% confidence limits due to the format of the PVA outputs*
** *For puffin the % reduction in adult survival is that estimated using the common currency table as an upper threshold was not set for this species*

Additional presentation of the predicted effects is provided in Appendix 7.

Summary of population modelling approaches

All the methods described are considered to be precautionary and in compliance with the statutory requirements in that they allow assessments on the maintenance of the populations as viable components of protected sites (the primary conservation objective under consideration) to be carried out, enabling conclusions on site integrity to be reached. Where a choice of method is available, the approach that provides the best available evidence has been used.

A common feature of these methods is that they establish baselines for the assessment that are future points in time. Consequently, assessments in relation to the statutory requirements are based on modelled scenarios. A number of the

populations assessed have declined over recent time. Seabird population sizes and trends in the UK are thought to be principally regulated by food supply. There is considerable uncertainty over the range of factors that contribute to variations in food availability over time, with several of the factors thought to operate over large spatial scales (e.g. climate change). Future research may inform our understanding of seabird population management over larger spatial scales. The underlying drivers of population change are not considered to be a consequence of activities that require cumulative assessment under the terms of the Habitats Regulations. The inherent uncertainties associated with the populations and their trends are taken into account by the assessment methods used.

Combining and apportioning effects to breeding colonies

Where the predicted collision or displacement effects are derived from boat-based data, they are apportioned to the different SPAs using the draft SNH method on apportioning. The CEH displacement modelling does not use boat-based data or the SNH apportioning method, rather GPS data are used to determine the foraging destinations of individual birds breeding at each SPA. For species impacted by both collision and displacement, the collision effects were summed with the displacement effects. The summed effect is compared against the thresholds of change to inform an overall conclusion with regard to potential for adverse effect on site integrity.

Assessments conclusion for each species and colony

The results of application of the assessment methods described above are presented for each species, as a qualifying interest of the relevant colony SPA. Conclusions are reached on site integrity with respect to the individual qualifying features of the sites being considered; and an overall conclusion on site integrity considering all qualifying features is also provided.

In their advice dated 6th June 2014, the SNCB's presented in Appendices 2a & 2b the predicted effects of the Forth and Tay Developments individually and in combination, and their thresholds calculated for each of the species and SPA of concern. This SNCB advice used Johnston *et al* (2014 corrigendum) to assess collision risk, with updated advice received on the 2nd July including the 4m increase in turbine clearance above LAT committed to by SAWEL and SBWEL. The SNCB advice of 6th June and 2nd July only presents values for Option 2. As such, it differs from the content of this assessment. (see *Table 1*at start of section 3c).

Appendices 5 & 6 provide a summary of the divergences in the advice on assessment methods and conclusions between the SNCBs and MSS.

**Kittiwake - Buchan Ness to Collieston Coast, Forth Islands, Fowlsheugh, St Abb's Head to Fast Castle SPAs**

In their advice dated 7th March 2014 the SNCBs provided information on the population trends for kittiwake:

- Scottish and UK trends show a strong decline (-47%) for kittiwake between

2000 and 2012, following a shallower but significant decline at the end of the 20th century (-25% between the 1985-88 and 1999-2002 census periods).

- Although individual colonies vary, the common pattern is for a strong, possibly increasing, rate of decline. The population models developed by CEH predicted all four kittiwake colonies to decline between 45% and 90% over the next 30 years (Freeman *et al*. 2014).
- The numbers breeding at Forth Islands, Fowlsheugh and St Abb's Head to Fast Castle SPAs have declined in line with these general trends.
- Recent counts from Buchan Ness to Collieston Coast SPA are not available but numbers declined from 14091 pairs in 2000 to 12542 pairs in 2007.

Looking over a longer time period, kittiwake populations in the Forth and Tay region experienced a period of rapid growth during the 1960's-1980's before declining during the late 20th century and early 21st century (*Figure 2*). The RSPB have concluded that climate change is a key driver of declines in UK seabird populations, including kittiwake.

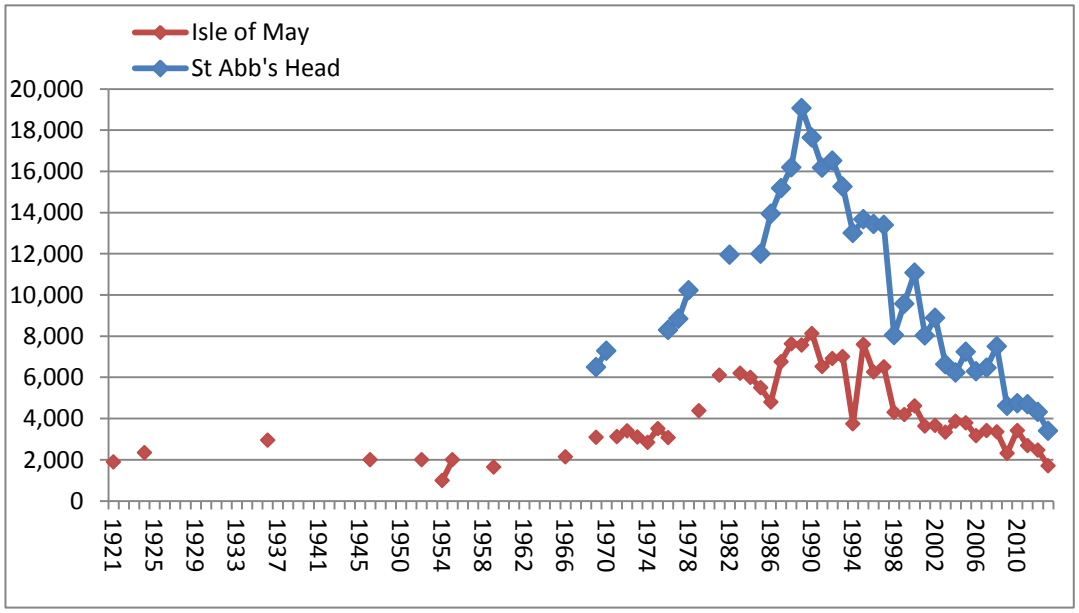


*Figure 2: Kittiwake populations at the Isle of May and St Abb's Head 1921- 2013 (from Mainstream letter 26 March 2014 and derived from Harris & Galbraith 1983, Harris 1994, SMP 2014, Da Prato & Da Prato 1980, Rideout & Paterson 1997)*

The conclusion reached by the SNCBs (based on Option 2 of the Band CRM and ruABC threshold) was that the combined effects of the Forth and Tay Developments would adversely affect the integrity of the Forth Islands and Fowlsheugh SPAs. This advice did not take into consideration NNGOWL's requirement (through a condition of s36 consent, copied as condition 13 below) to reduce their negative effect on adult survival of kittiwakes from Forth Islands SPA by 0.2% nor the reduction in displacement/barrier rates at SAWEL and SBWEL due to the greater WTG spacing. Taking account of these issues the combined effects, whilst reduced, would still exceed the ruABC threshold advised by the SNCBs. Displacement model outputs using the reduced displacement rates at ICOL advised by the SNCBs and MSS due to their halving of the number of WTGs were

not available for this assessment and so effects at ICOL should be seen as precautionary.

The effect identified on kittiwake is the combined effect from both collision and displacement (*Table 6*). As explained above the collision effect is based on the most likely scenarios (i.e. reduced turbine numbers and increased clearance height).The displacement effect is based on the most likely scenarios for NNGOWL, SAWEL and SBWEL, and the worst case scenario for ICOL. The relative importance of the collision and displacement effects differed between the SPAs. The results of the assessment completed by MSS are presented below with effects and thresholds using the common metric of reduction in adult survival rate (as a percentage point change). The assessment is based on percentage point changes to adult survival rates as it is considered that this is the most useful metric for assessing the impacts to long lived species such as seabirds. The adult survival threshold has been derived through interpolation of the CEH population outputs having ensured that the productivity effects are already accounted for using the same approach.

*Table 6: Summary of estimated collision and displacement/ barrier effects on kittiwake SPAs from the four wind farm projects (see Table 3 for thresholds).*

| SPA | Effect | TOTAL | SAWEL | SBWEL | ICOL | NNGOWL |
|---|---|---|---|---|---|---|
| **Buchan Ness** | **Displacement (Ad. Survival)** | | | | | |
| | Adjusted model FLAT | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Collision** | | | | | |
| | Option 3 95% | -0.07 | -0.02 | -0.03 | -0.02 | 0.00 |
| | Option 3 98% | -0.03 | -0.01 | -0.01 | -0.01 | 0.00 |
| | **TOTAL** | | | | | |
| | Option 3 95% | **-0.07** | **-0.02** | **-0.03** | **-0.02** | **0.00** |
| | Option 3 98% | **-0.03** | **-0.01** | **-0.01** | **-0.01** | **0.00** |
| **Fowlsheugh** | **Displacement (Ad. Survival)** | | | | | |
| | Adjusted model Flat | -0.35 | -0.39 | -0.18 | 0.00 | 0.00 |
| | **Collision** | | | | | |
| | Option 3 95% | -0.78 | -0.28 | -0.29 | -0.23 | -0.01 |
| | **Option 3 98%** | -0.31 | -0.11 | -0.12 | -0.09 | 0.00 |
| | **TOTAL** | | | | | |
| | Option 3 95% | **-1.14** | **-0.67** | **-0.47** | **-0.23** | **-0.01** |
| | Option 3 98% | **-0.66** | **-0.50** | **-0.30** | **-0.09** | **0.00** |
| **Forth Islands** | **Displacement (Ad. Survival)** | | | | | |
| | Adjusted model GPS | -1.42 | -0.26 | -0.20 | -0.47 | -0.88 |
| | **Collision** | | | | | |
| | Option 3 95% | -0.37 | -0.05 | -0.06 | -0.15 | -0.11 |
| | Option 3 98% | -0.14 | -0.02 | -0.02 | -0.06 | -0.04 |
| | **TOTAL** | | | | | |
| | Option 3 95% | **-1.78** | **-0.31** | **-0.26** | **-0.62** | **-0.99** |
| | Option 3 98% | **-1.56** | **-0.28** | **-0.22** | **-0.53** | **-0.92** |
| **St Abbs** | **Displacement (Ad. Survival)** | | | | | |
| | Adjusted model Flat | -0.18 | 0.00 | -0.05 | 0.00 | -0.05 |
| | **Collisions** | | | | | |
| | Option 3 95% | -0.30 | -0.07 | -0.07 | -0.10 | -0.05 |
| | Option 3 98% | -0.12 | -0.03 | -0.03 | -0.04 | -0.02 |
| | **TOTAL** | | | | | |
| | Option 3 95% | **-0.48** | **-0.07** | **-0.12** | **-0.10** | **-0.10** |
| | Option 3 98% | **-0.30** | **-0.03** | **-0.08** | **-0.04** | **-0.07** |

For kittiwake the displacement model accounts for the majority of the identified

effect in relation to NNGOWL and Forth Islands SPA, and CEH conclude that this effect is primarily due to barrier effects rather than displacement. The barrier effect of the NNGOWL project accounts for the largest proportion of the overall cumulative effects on kittiwake at Forth Islands SPA. To mitigate this effect as much as reasonably possible; the CEH modelling of the final construction design must demonstrate a reduction to the negative effect on adult survival of kittiwakes from Forth Islands SPA by 0.2% from NNGOWL. This assessment is based on an assumed rate of 40% for displacement and barrier effects for NNGOWL and ICOL and 30% displacement for SAWEL and SBWEL.

Other projects whose potential for cumulative effects are given more qualitative consideration are the offshore wind demonstration projects at: Aberdeen Bay and Methil. Collision risk modelling has been undertaken for these sites using the basic Band model. The Methil turbine is estimated to have less than 2 kittiwake collide per year. At Aberdeen Bay Offshore Wind farm the breeding season adult mortality was predicted to be 25 birds which is attributable to Buchan Ness to Collieston Coast SPA (19 birds) and Fowlsheugh SPA (6 birds), equating to 0.008% of the populations at each SPA. The additional effects associated with these projects have not been included in a common currency for the purposes of this assessment as the magnitude of the effects are considered to be negligible.

Despite the different assessment methods being used, MSS and the SNCBs agree that the proposed Forth and Tay Developments will not adversely affect the integrity of the Buchan Ness to Collieston Coast SPA or the St. Abb's Head to Fast Castle SPA with respect to kittiwake. SNCB advice however is that an assessment adopting their approaches for ruABC and also use of Option 2 collision risk modelling at 98% avoidance rate is unable to demonstrate no adverse effect on site integrity to kittiwake at Forth Islands SPA and Fowlsheugh SPA. MSS advice is that no adverse affect to the integrity of kittiwake colonies is demonstrated using the best available evidence which includes the MSS derived thresholds (using either ABC or ruABC as detailed in Table 3 and their interpolation method) and Option 3 of the Band CRM at 98% and 95% avoidance rates.

**For kittiwake different conclusions regarding the Forth Islands and Fowlsheugh SPAs are reached by the SNCBs and MSS due to different methods being used to set thresholds, and also different Options of the Band CRM model being used. The details provided on pages 20-21 of this assessment lead MS-LOT to consider that Option 3 of the Band CRM is the most appropriate. MS-LOT also consider that MSS provide good reasons for why their method for setting the threshold is the most appropriate as detailed on pages 26-27. In addition the estimated effects are likely to be over-estimates as the reduced displacement rate for the ICOL site as advised by the SNCBs and MSS has not been used in the modelling. MS-LOT therefore concludes that the Forth and Tay offshore wind farm proposals alone or in combination with the demonstration projects at Aberdeen Bay and Methil will not adversely affect the site integrity of the Buchan Ness to Collieston Coast, Fowlsheugh, Forth Islands and St. Abb's Head to Fast Castle SPAs with respect to kittiwake, provided that the conditions included in 3d are complied with.**

**Gannet – Forth Islands SPA**

In their advice dated 7th March 2014 the SNCBs provided information on population trends for gannet:

- UK gannet populations are exhibiting significant positive growth rates, continuing a long period of expansion over the past 100 years.
- Scotland holds 182,511 apparently occupied nests ("AONs") of gannets and the Bass Rock is the largest, most important colony on the Scottish east coast.
- The Bass Rock (Forth Islands SPA) gannet population has doubled from 21,591 AONs in 1985 to 48,065 AONs in 2004, and increased further to 55,482 AONs at the time of the last census in 2009.

The work commissioned by the Crown Estate for Strategic Ornithological Support services ("SOSS") report 04 (WWT 2012) aimed to build a gannet population model that could assess impacts of additional mortality from collisions with wind farms on gannets in UK waters. Two forms of an age-based stochastic matrix model were developed under the SOSS contract, one with density dependence and the other with no density dependence. Both models gave similar results and the model authors recommended using the density-independent model. Colony-specific demographic rates were generally lacking and, where available, showed no significant difference to the generic UK-wide population model, so a non-colony specific model was developed.

The original SOSS model assumed collisions across all age classes within the population model, apportioning impacts according to prevalence of that age class in the population. However, c. 97% of gannets recorded within the wind farm footprints of all the Forth & Tay development proposals were adult plumaged birds. Consequently, the model was reworked, with only adult gannets suffering assumed mortality from wind farm collisions. The collision estimates were calculated using adult birds only, but this is precautionary in its approach as it assumes that all adult plumaged birds are part of the breeding population.

The Bass Rock gannet population, which forms the entire northern gannet breeding population of Forth Islands SPA, has been increasing and this is forecast to continue. Population size may ultimately be regulated by available colony space on Bass Rock, or potentially by food availability. The metric used for establishing a threshold is the probability that the population size at the end point will be lower than the starting population. The utility of this metric is that it informs an interpretation that considers the likelihood the population trajectory will change as a consequence of the effects. Following MSS advice (April 2014) this assessment has been based on thresholds derived from outputs from the PVA that modelled:

- additional adult mortality only,
- a starting population based on the 2009 census data,
- 25 years of wind farm operation but no post wind farm recovery period,
- the Probability of the population size at the end of the 25 year period being lower than the starting population.

The estimated effects were then calculated as a % of the SPA population for each wind farm cumulatively (*Table 7*).

*Table 7: Summary of estimated collision and displacement/ barrier effects on gannet at Forth Islands SPA from the four wind farm projects.*

| SPA | Effect | TOTAL | SAWEL | SBWEL | ICOL | NNGOWL |
|---|---|---|---|---|---|---|
| **Forth Islands** | **Displacement** | | | | | |
| | GPS Model | -0.04% | -0.02% | -0.01% | -0.01% | -0.01% |
| | **Collision** | | | | | |
| | Option 3 95% | -1.02% | -0.30% | -0.19% | -0.32% | -0.20% |
| | Option 3 98% | -0.41% | -0.12% | -0.08% | -0.13% | -0.08% |
| | **TOTAL** | | | | | |
| | Option 3 95% | **-1.05%** | **-0.32%** | **-0.20%** | **-0.33%** | **-0.21%** |
| | Option 3 98% | **-0.44%** | **-0.14%** | **-0.08%** | **-0.14%** | **-0.09%** |

Interpretation of the population model outputs has provided a threshold of -1.17% using the following approach:

- SNCBs and MSS recommend a threshold that limits the likelihood of population change to a 0.05 likelihood of the population decreasing by 5% from the starting population size. Applied to the updated population model, this results in a threshold of 'acceptable' annual mortality of a -1.17% in the adult survival rate. This advice was received from the SNCBs via email on the 15th April 2014.

The SNCBs and MSS are in agreement regarding the appropriate threshold for gannet of -1.17%, which provides appropriate safeguard that the outcome for the gannet population it would be extremely unlikely to be a decline. This threshold would result in the median ratio value for end population with allowable effect: end population without allowable effect of 0.81. A PBR f-value of 0.25 would be required to produce the same threshold (as detailed in table 5).

The CEH displacement model identified a negligible displacement effect, assuming a displacement rate of 60% and this has been combined with the collision estimates to provide the project specific and cumulative effect totals.

The cumulative total of collisions for gannet using the basic Band model are presented in the appropriate assessments for Blyth Offshore Wind Demonstrator undertaken by the MMO in 2013, for Blyth Offshore Demonstration project combined with the existing offshore turbines at Blyth and the Teesside project. The annual predicted mortality is 30, with the assessment recording that breeding birds would be most likely to be from Bass Rock which is within the Forth Islands SPA. This is a low number when considered against the identified threshold of -1.17%. The Aberdeen Bay appropriate assessment records up to 17 collisions per year for the Aberdeen Offshore Wind Farm using the basic Band model, and indicates that the majority of these birds are likely to be from Troup Head on the Moray coast.

SNCB advice is that an assessment adopting Option 2 of the Band CRM at 98% avoidance rate is unable to demonstrate no adverse effect on site integrity to gannet at Forth Islands. MSS advice is that no adverse effect to the integrity of gannet at Forth Islands is demonstrated using the best available evidence which

includes Option 3 of the Band CRM at 98 and 95% avoidance rates.

**For gannet it is the use of different options of the Band CRM model which results in different conclusions between the SNCBs and MSS. The details provided on pages 20-21 of this assessment lead MS-LOT to consider that Option 3 of the Band CRM is the most appropriate. Therefore, MS-LOT concludes that the Forth and Tay offshore wind farm proposals will not adversely affect the site integrity of the Forth Islands SPA with respect to gannet, either alone or in-combination with the recently consented Aberdeen Offshore Wind Farm, Blyth Offshore Wind Demonstrator and the constructed Blyth and Teesside Offshore Wind Farm developments.**

**Puffin – Forth Islands SPA**

In their advice dated 7th March 2014 the SNCBs provided information on the populations trends for puffin:

- The UK population at the time of Seabird 2000 was just over 500,000 pairs, following steady and significant increases from previous censuses. The most recent estimate of the Scottish population is 493,000 pairs.
- Puffins in the Forth Islands SPA are some of the most intensively studied in the world, but recent volatility in numbers (periods of increase and population crashes) has frustrated attempts to understand local population dynamics.
- On the Isle of May (the site that holds the majority of the SPA puffin population) a strongly increasing population (12,000 in 1984 and 20,106 in 1992) dropped from 69,300 apparently occupied burrows ("AOBs") in 2003 to 44,971 AOBs in 2009 and increased slightly in 2013 to 46,200 AOBs.
- Within the SPA, the other large colony at Craigleith dropped from 28,000 pairs in 1999 to 12,100 pairs in 2003 and then further to just 4,500 pairs in 2009.
- Overall, the Forth Islands SPA population was most recently estimated as 50,282 pairs.

The assessment of puffin encountered two issues that influenced the overall approach:

1. The principle effect is assumed to be in relation to displacement, however the reliability of the displacement model's results for puffin are unclear. Two prey distributions were used in the CEH displacement models. The GPS prey distribution assumes that the birds have perfect knowledge of the location of their prey, whilst the flat prey distribution assumes that the birds have no prior knowledge of prey distribution. CEH have indicated that they would expect the truth to be somewhere between the two extremes, but that the former may be more realistic. For all other species, there is relatively little difference between the outputs from the two prey distributions, but in puffin the differences diverge noticeably, with flat prey distribution effects being considerably larger (*Table 8*).

*Table 8: Summary of displacement/ barrier effects on adult survival* of puffin at Forth Islands SPA estimated using CEH displacement model assuming homogeneous and heterogeneous prey distributions.*

| CEH Model Prey Type | Cumulative effect (Adult Survival) |
|---|---|
| Forth Islands (flat) | **-3.32%** |
| Forth Islands (GPS) | -0.04% |

* Changes to productivity are incorporated into the assessment but are not presented to simplify presentation of results

Both prey models use puffin tracking data. The tracking study used in the puffin displacement model undertaken on the Isle of May was limited to seven birds during a single breeding season. This low sample size was further exacerbated by these birds behaving differently from a set of 'control' birds that were not tagged (Harris et al. 2012). Whilst it is possible that the puffin tracking data may under-represent foraging trips of shorter duration, it is unclear how this effects the relative use of the sea near or far from the colony. Due to this very small sample size and the apparent behavioural response of the tagged birds, the SNCBs consider that the GPS prey model outputs should not be used for puffin. However, both flat and GPS prey distribution models used the GPS data to determine foraging locations. It is therefore unclear why it would be appropriate to use outputs using one prey distribution but not the other as both use the GPS tracking data to inform the distribution of the birds. MSS advised that it would be unreliable to assess the displacement and barrier effects using the CEH model given the limitations of the data from tagged birds. The SNCBs advised that only the displacement model outputs for the cumulative wind farm scenario should be used for puffin, but that the outputs for each individual wind farm should not be used in any ranking. However, as the cumulative effects estimates use the same input data as the individual wind farm estimates, MSS consider that it would be unsafe to use the former but disregard the latter.

For these reasons, MSS advised MS-LOT that for puffin only, the displacement model outputs should not be used in the assessment and the common currency approach to estimating the displacement effects used in the Moray Firth should be considered. This approach has the advantage of using at-sea abundance estimates derived from site surveys to be incorporated into the assessment. It makes a small number of assumptions about the birds present at sea in terms of apportioning to specific colonies, proportion of birds that are breeding adults and the proportion displaced that either fail to breed successfully or die.

The common currency approach for puffin (see Appendix 4) makes very similar assumptions to that used in the Moray Firth. In their advice of June 10th 2014 the SNCBs indicate that both the proportion of immatures and the proportion of non breeding adults should be dramatically reduced based on information from the long term study on the Isle of May. However, MSS advised that the information presented by the SNCBs did not provide justification for the suggested changes (MSS advice June 23rd 2014). At a meeting between the SNCBs and MS-LOT on the 27th June 2014 agreement was reached on the most appropriate parameters for use in the puffin common currency.

The results of the common currency assessment of the displacement effect are presented as either declines in adult survival, or alternatively as declines in productivity (see *Table 9* and Appendix 4).

*Table 9: Summary of displacement/ barrier effects on puffin at Forth Islands SPA estimated using the common currency approach.*

| Forth Islands | Total | SAWEL | SBWEL | ICOL | NNGOWL |
|---|---|---|---|---|---|
| adult survival | -2.01% | -0.43% | -0.51% | -0.50% | -0.57% |
| productivity | -4.02% | -0.86% | -1.02% | -1.00% | -1.14% |

The assumptions used for the common currency assessment are considered to be precautionary: the mean maximum abundance estimate of all birds are used to estimate numbers displaced, it is assumed that either 50% of displaced birds will die, or that 100% of displaced birds will fail to breed successfully, and that each displaced bird represents a separate pair.

2. CEH attempted to model the puffin population at Forth Islands SPA, using the same form of modelling that was used for other species, but they reported low confidence in the reliability of the model outputs. Puffins, as burrow nesters, are difficult to count and the Forth Islands population has only been counted every c. 5 years since 1980. The eight counts of the population between 1980 and 2013 suggest that the population is increasing rapidly (a five-fold increase since 1980), with an exceptionally high count in 1993, followed by a decrease at the next census. These generally increasing yet widely fluctuating counts cause the model to predict the puffin population to continue increasing at a fast rate. It predicts a population greater than 100,000 AOBs by 2025, with wide credibility intervals illustrating the uncertainty around the forecast. In reality, density dependent population regulation will slow the rate of increase at some point, e.g. areas suitable for burrows may become limiting. However, without knowing the form the population regulation will take and at what population size it will occur, it is difficult to predict future population size for this puffin population with any confidence.

The SNCBs therefore set thresholds for puffin using a combination of PBR and using the ruABC thresholds for proxy species (razorbills and guillemots as these are the species most closely related to puffin). CEH recommended using proxy species' thresholds with caution, it is recognised that razorbills and guillemots differ from puffins in a number of ways, for example nesting on cliff ledges, rather than in burrows, thus their demographics and thresholds may differ. The SNCBs acknowledge this and many of the limitations associated with the proxy approach. They recommend a threshold of -1.4% for the adult survival rate which is in the middle of the range of thresholds they calculated (-0.5% to -2.5%). The threshold of -1.4% equates to a PBR value calculated assuming age of first breeding at 7 years and a recovery factor of 0.3. MSS advised that adopting the same approaches, but applying them to ABC rather than ruABC for proxies, and calculating PBR using age of first breeding at 5 years (which is consistent with the formula's assumption of maximum productivity) gives a value of -1.7% assuming an f-value of 0.3. MSS also advise that adoption of a recovery factor of more than 0.3 would be appropriate for this puffin population, which is thought to be increasing. The threshold range obtained by MSS is -0.8% to -2.9%.

MSS commissioned MacArthur Green to produce a PVA for Forth Islands puffin (Trinder, May 2014). The model design is based on that used for gannet. Compared to the CEH model it is computationally simpler and avoids the need to fit historic counts. This provides a projection that contains less uncertainty than the CEH model, which was one of the key concerns raised with respect to the CEH modelled outputs. The MacArthur Green model is also density independent; and the projected trajectory is very similar to the CEH model: strong population growth towards a population size that is likely to be an overestimate. Owing to the strong growth forecast, the model outputs were insensitive to the metric used to interpret the gannet model (probability of end population being lower than start population size). For this reason, the metric used for interpretation was the probability of the population being lower than the starting population in any of the 25 years of wind farm effects.

In advice provided by the SNCBs on the 4th July 2014, concerns were raised regarding the MacArthur Green puffin PVA as the SNCBs queried if an age class was not included within the model. MSS, having sought clarification from MacArthur Green, have advised that all the age classes are contained in the model (email of 4th July 2014 MSS to MS-LOT). The other point raised by the SNCBs was that juvenile survival rate is assumed to equal adult survival rate. MSS recognise this, and advise that whilst likely to be biologically unrealistic (juvenile survival would be expected to be less than adult survival) this approach represents appropriate use of the best available evidence.

The MacArthur Green puffin PVA (May, 2014) was used to inform understanding of the potential risk to the puffin population. The baseline population growth rate was 1.064 (i.e. an annual growth rate of 6.4%). The risk of decline in any year of the simulation is 5.6% under baseline conditions. Assuming a reduction of 2.01% to the adult survival rate, the probability of decline of 5% in any year would increase to less than 1%. Assuming a reduction of 4.02% to the productivity rate, the probability of a 5% decline in any year would increase to less than 1%. MSS advice is that these magnitudes of change do not increase the risk of the population declining during the period of effects to levels that differ meaningfully from baseline conditions. Based upon the outputs of the population model, a reduction in adult survival of 2.01%, or a reduction in productivity of 4.02% as estimated by the common currency approach to displacement would not affect the population as a viable component of the site. The estimated effect from the common currency would result in the median ratio value for end population with estimated wind farm effect: end population without wind farm effect of 0.75. A PBR f-value of 0.25 would be required to produce the same effect (as detailed in table 5).

SNCB advice is that an assessment based upon their use of PBR and proxy species to establish thresholds, combined with the estimation of effects using flat outputs of the CEH displacement model and/or their recommended assumptions using the common currency approach is unable to demonstrate no adverse effect on site integrity to the Forth Islands SPA with respect to puffin. MSS advice is that no adverse effect to the integrity of the Forth Islands SPA with respect to puffin is demonstrated using the best available evidence which includes the MacArthur

Green puffin population model and the common currency approach, as used in the Moray Firth appropriate assessment.

**Having considered the advice provided by the SNCBs and MSS regarding the different assessment methods for puffin, MS-LOT acknowledge the issues advised by CEH over the use of their model of puffin and the limitations advised by MSS of reliance upon use of proxy species and PBR for setting thresholds. MS-LOT consider that the justification provided by MSS on the use of the common currency for estimating effects and the MacArthur Green model for looking at the population consequences use the best available evidence and the most suitable techniques. MS-LOT therefore concludes that the Forth and Tay wind farm proposals will not adversely affect the site integrity of the Forth Islands SPA with respect to puffin, either alone or in combination. No other projects have been identified as having an effect which requires an in combination assessment for puffin.**

**Razorbill - Forth Islands, Fowlsheugh, St Abb's Head to Fast Castle SPAs**

In their advice dated 7th March 2014 the SNCBs provided information on the populations trends for razorbill:

- UK razorbill populations increased strongly between 1970 to 2000, but (like guillemot) then slowed (only a 3% increase between 2000 and 2012).
- The most recent population estimate for Scotland is 93,300 pairs.
- Of the three SPAs under consideration, Fowlsheugh holds the high number of razorbills (5,260 birds in 2012) showing a slight declined from the peak count of 6,827 individuals in 1992.

Razorbill are not considered to be at risk of collision due to their low flight heights - none were recorded at collision risk height during any of the Forth and Tay boat surveys carried out by the developers.

Displacement modelling identified practically no effects upon razorbill at Fowlsheugh and St. Abb's Head to Fast Castle SPAs. An effect of -0.8% decline in adult survival is modelled for razorbill at Forth Islands SPA from the Forth and Tay Developments combined. The modelled effects assume a displacement rate of 60% at all sites.

Despite the different assessment methods used, the SNCBs and MSS agree that the Forth and Tay Developments will not adversely affect the integrity of the Fowlsheugh and St. Abb's Head to Fast Castle SPAs with respect to razorbill. SNCB advice is that adverse effect on site integrity of the Forth Islands SPA with respect to razorbill cannot be ruled out. MSS advice is that no adverse effect on site integrity of the Forth Islands SPA with respect to razorbill is demonstrated based on the thresholds that they advise (*Table 5*) and their view that the thresholds take account of the trajectories of the species assessed and therefore as long as the threshold is not exceeded a conclusion of no adverse effect on site integrity is appropriate. MSS also consider that there is uninformative precaution built into the estimation of the effect: e.g. the reduced displacement rates advised by MSS and the SNCBs for SAWEL, SBWEL and ICOL have not been accounted

for.

**For razorbill different conclusions regarding the Forth Islands SPA are reached by the SNCBs and MSS due to different methods being used to set thresholds. The SNCBs used ruABC whereas MSS used ABC and the interpolation method. MS-LOT consider that MSS has used the most appropriate method for setting thresholds due to the reasons described on page 26-27 of this assessment. MS-LOT also recognise that the estimated effects are likely to be over-estimates due to the modelling not taking account of the reduced displacement rates advised by the SNCBs and MSS at the SAWEL, SBWEL and ICOL sites. MS-LOT therefore concludes that the Forth and Tay offshore wind farm projects will not adversely affect the site integrity of the Forth Islands, Fowlsheugh and St. Abb's Head to Fast Castle SPAs with respect to razorbill, either alone or in combination. No other projects have been identified as having a magnitude of effect which requires in combination assessment for razorbill.**

**Guillemot - Buchan Ness to Collieston Coast, Forth Islands, Fowlsheugh, St Abb's Head to Fast Castle SPAs**

In their advice dated 7th March 2014 the SNCBs provided information on the populations trends for guillemot:

- UK guillemot populations increased strongly between 1970 and 2000, but then slowed markedly in the last decade (4% increase between 2002 and 2012), following declines in productivity in the early 2000s.
- In Scotland, guillemot numbers declined by 24% between 1986 and 2011, with 791,400 pairs estimated to be breeding in Scotland in 2012.
- The four SPAs under assessment here held an estimated 163,920 birds in their most recent counts.

Guillemot are not considered to be at risk of collision due to their low flight heights - none were recorded at collision risk height during any of the Forth and Tay boat surveys carried out by the developers.

The effects of displacement upon guillemot were modelled for the colonies at Buchan Ness to Collieston Coast, Fowlsheugh, Forth Islands and St. Abb's Head to Fast Castle SPAs. No effects were identified, either alone or in combination, with the exception of the NNGOWL project on Forth Islands SPA. The effect of -0.3% decline in adult survival is below the identified threshold using ABC of -0.8%. The SNCBs advised that the Forth and Tay Developments would not adversely affect the integrity the four SPAs with respect to guillemot. MSS agree with this conclusion.

**MS-LOT concludes that the Forth and Tay offshore wind farm projects will not adversely affect the site integrity of the Forth Islands, Buchan Ness to Collieston Coast, Fowlsheugh and St. Abb's Head to Fast Castle SPAs with respect to guillemot, either alone or in combination. No other projects further afield have been identified as having a magnitude of effect which requires in combination assessment for guillemot.**

**Herring gull - Buchan Ness to Collieston Coast, Forth Islands, Fowlsheugh,**

**St Abb's Head to Fast Castle SPAs**

In their advice dated 7th March 2014 the SNCBs provided information on the populations trends for herring gull:

- The number of herring gulls breeding in the UK has fallen rapidly since 1970 when current widespread monitoring started. Between 1970 and 1985 the population declined by 48%, followed by a shallower decline to the year 2000 and then a rapid decline again since the start of this century.
- In Scotland the population fell by more than half (-58%) between 1986 and 2011. There are 72,100 pairs currently estimated to breed in Scotland.
- The fortunes of herring gull at the four SPAs mirror this trend. Since 1986 all 4 have shown declines in the populations inhabiting the sites, although the declines have generally been smaller than those seen overall nationally.

NNGOWL, SAWEL and SBWEL recorded herring gull on-site during the breeding season, flying at collision risk height, so assessment for these proposals has been undertaken. ICOL recorded extremely low numbers of herring gull on site.

Collision risk modelling identified practically no effects upon herring gull at Buchan Ness to Collieston Coast, Forth Islands, Fowlsheugh and St. Abb's Head to Fast Castle SPAs. An effect of -0.1% decline in adult survival for Forth Islands SPA from NNGOWL was identified but this is against a threshold of -2.0%. The SNCBs advised that the Forth and Tay Developments would not adversely affect the integrity of the four SPAs with respect to herring gull. MSS agree with this conclusion. At Aberdeen Bay offshore wind farm the breeding season adult mortality was predicted to be 11 birds of which 2 birds were attributed to Buchan Ness to Collieston Coast SPA and 1 bird to Fowlsheugh SPA.

**MS-LOT concludes that the Forth and Tay offshore wind farm projects will not adversely affect the site integrity of the Buchan Ness to Collieston Coast, Forth Islands, Fowlsheugh and St. Abb's Head to Fast Castle SPAs with respect to herring gull, either alone or in combination including with Aberdeen Bay Offshore Wind Farm.**

**Lesser black-backed gull – Forth Islands SPA**

In their advice dated 7th March 2014 the SNCBs provided information on the populations trends for lesser black-backed gull:

- The population of lesser black-backed gulls in Scotland is currently estimated to be 25,000 pairs.
- In the UK as a whole following a period of increase from 1970 to 2000 (29% increase between 1970 and 1985 and 40% between 1985 and 2000) there has been a strong decline since (-51% since 2000).
- All the colonies within the Forth Islands SPA were last counted in 2002 when there were 2011 pairs of lesser black-backed gulls breeding. Since then there have been several partial counts of some islands, which do not reveal any strong trend in the local population. Previous to 2002 all sites except Bass Rock (which only held 1 pair in 2002) were counted in 1999 –

the total that year being 2496 pairs. In 2012 Isle of May alone held 2310 pairs.

NNGOWL, SAWEL and SBWEL recorded lesser black-backed gull on-site during the breeding season, flying at collision risk height, so assessment for these proposals has been undertaken. ICOL recorded extremely low numbers of lesser black-backed gull on site.

Collision risk modelling identified practically no effects upon lesser black-backed gull at Forth Islands SPA. An effect of < -0.1% decline in adult survival for Forth Islands SPA from NNGOWL was identified but this is against a threshold of -1.8%. The SNCBs advised that the Forth and Tay Developments would not adversely affect the integrity of the Forth Islands SPA with respect to lesser black-backed gull. MSS agree with this conclusion.

**MS-LOT concludes that Forth and Tay offshore wind farm projects will not adversely affect the site integrity of the Forth Islands SPA, with respect to lesser black-backed gull, either alone or in combination. No other projects have been identified as having a magnitude of effect which requires in combination assessment for lesser black-backed gull.**

**Fulmar - Buchan Ness to Collieston Coast, Forth Islands, Fowlsheugh SPAs**

In their advice dated 7th March 2014 the SNCBs provided information on the populations trends for fulmar:

- The fulmar population has undergone a huge increase since the mid 1800s, when the only two breeding sites were in Iceland and on St Kilda.
- By 2004 there were an estimated 501,600 pairs in the UK, with the Scottish total being 486,000 pairs in 2007. This increase is thought to have been fuelled by discards from commercial fishing activity. After growing by 77% between 1970 and 1985, there was a small decline in the UK population between 1985 and 2000, followed by a steeper (13%) decline to 2012. The Scottish population declined by 7% between 1986 and 2011, productivity has declined over the same period.
- The three SPAs with fulmar as a qualifying interest reflect the general trend in populations, although recent declines have been greater than the national average. At Buchan Ness to Collieston Coast SPA the population peaked in 1995 at 2823 pairs, but had declined to 1389 pairs by 2007, at Fowlsheugh there were 416 pairs in 1992, declining to 119 pairs in 2012. The Forth Islands SPA held 1053 pairs in 1997, but then the population has fallen steadily to 569 by 2012.

Survey work completed by the Forth and Tay developers found insignificant numbers of fulmar at collision risk height, therefore the main potential for impact is considered to be from displacement. The SNCBs advised that fulmar have large foraging ranges and are adapted for efficient gliding flight, so that the energetic costs of covering extra distances due to displacement will be small and will not give rise to significant impacts on this species. The SNCBs advised that the Forth and Tay developments would not adversely affect the integrity the three SPAs with

respect to fulmar. MSS agree with this conclusion. At Aberdeen Bay Offshore Wind farm the effect on adult mortality was predicted to be only 7 birds per year.

**MS-LOT concludes that the Forth and Tay offshore wind farm projects will not adversely affect the site integrity of Forth Islands, Buchan Ness to Collieston Coast and Fowlsheugh SPAs with respect to fulmar, either alone or in combination.**

**Common and Arctic Tern – Forth Islands SPA**

In their advice dated 7th March 2014 the SNCBs provided information on the populations trends for common and Arctic tern:

- Arctic terns are much more numerous in Scotland than common terns, approximately 88% of the UK population of 53,400 pairs of Arctic tern breed in Scotland, whereas only 40% of the UKs 11,800 pairs of common terns breed here.
- Both species increased between 1970 and 1985 (Arctic tern by 50%, common tern by 9%), but both have suffered substantial reductions in numbers since (Arctic tern down by 36% since 1985 and common tern by 35%). The declines are due mainly to a sustained period of low of productivity blamed on low prey abundance in summer.
- In the Forth Islands SPA both species formerly bred on a number of the islands. The main colonies are on the Isle of May and Inchmickery, with a fairly large common tern colony on Long Craig. Common terns were most numerous at the end of the 1990s (533 pairs in 1999), with Arctic tern numbers peaking in 2001 (916 pairs). Since then both have declined and in 2012 only 20 pairs of common terns and 250 pairs of Arctic terns nested in the SPA.

NNGOWL and ICOL recorded low numbers of common and Arctic tern on-site during the breeding season. There was no connectivity between these species and SAWEL or SBWEL. The SNCBs advised that the Forth and Tay Developments would not adversely affect the integrity of the Forth Islands SPA with respect to common or Arctic tern. MSS agree with this conclusion.

**MS-LOT concludes that the Forth and Tay offshore wind farm projects will not adversely affect the site integrity of Forth Islands SPA with respect to Arctic tern and common tern, either alone or in combination.**

**Overall Conclusions on Site Integrity**

In the assessments above MS-LOT have considered the conservation objective of "maintaining the population of the species as a viable component of the site" on the individual qualifying features of the SPAs. As the effects of the Forth and Tay Developments on the populations were found to be within acceptable thresholds for all the species being considered in this assessment MS-LOT concluded that the Forth and Tay Developments will not adversely affect the integrity of the SPAs with respect to the individual qualifying features.

**Having determined that the NNGOWL, ICOL, SAWEL and SBWEL Developments will not have a negative effect on the constitutive elements of the sites concerned, on having regard to the reasons for which the sites were designated and their associated conservation objectives, MS-LOT concludes that the proposed developments will not, on their own or in combination with each other (or where appropriate for consideration, other developments already licensed), adversely affect the integrity of the Buchan Ness to Collieston Coast SPA, the Fowlsheugh SPA, the Forth Islands SPA or the St Abb's Head to Fast Castle SPA (where each SPA is taken as a whole), subject to the compliance of conditions.**

The Marine Scotland Science Advisory Board ("SAB") has reviewed the ABC method, and considered concerns raised by the RSPB concerning the method. The SAB has advised that the methods used and the scientific evidence applied in assessing the potential effects of the proposed Forth and Tay wind farms were judged to have been undertaken using an objective and impartial application of available science, and the science used in the assessment was the best available at the time. The SAB also judged that MSS consulted with the relevant experts on the development of the methods employed, and the evaluation was conducted in an open and transparent way. MS-LOT consider that the most up to date and best scientific evidence available has been used in reaching the conclusion that any decision to approve the NNGOWL, ICOL, SAWEL and SBWEL Developments will not adversely affect integrity of the sites concerned and are satisfied that no reasonable scientific doubt remains.

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**SACs**
**Bottlenose dolphin - Moray Firth SAC**

Summary

The principal conservation objective to consider is the maintenance of the bottlenose dolphin population as a viable component of the Moray Firth SAC. This encompasses any significant disturbance to individuals while they are outside the SAC, such as underwater noise impacts arising from wind farm construction.

The potential underwater noise impacts to bottlenose dolphins during construction have been modelled. Predicted zones of disturbance from pile-driving the turbine foundations are predicted to extend into areas used by bottlenose dolphins.

Further modelling of whether any resulting disturbance to individuals from wind farm pile driving construction could lead to population level effects was undertaken by Prof Paul Thompson (University of Aberdeen and Marine Scotland Science Advisory Board) on request by MSS (Thompson & Brookes, 2014). This modelling found that there are no long-term effects from underwater noise disturbance on the bottlenose dolphin population of the Moray Firth SAC.

The potential for disturbance from, for example, the installation of export cable routes, may if necessary be managed through construction programming, including for example a vessel management plan (refer to conditions identified in Section 3(d)). The conclusion of this assessment is that the Forth and Tay offshore wind farms in combination with previously consented offshore wind farms and port redevelopments will, subject to the compliance of conditions set out in 3d, **not adversely affect site integrity of the Moray Firth SAC**. Conditions to further mitigate the effects of noise are identified in Section 3(d).

The scope of in combination effects

Other developments have been identified as having LSE on bottlenose dolphins from the Moray Firth SAC as a consequence of noisy construction activities and these are included in the in combination assessment:

1. BOWL and MORL Offshore Wind Farms in the Moray Firth – Installation and operation of up to 140 WTGs (BOWL) and up to 186 WTGs (MORL) in the outer Moray Firth. The utility of modelling the cumulative effects of these consented projects combined with the Forth and Tay projects to inform a cumulative assessment was agreed between the SNCBs and MSS.

2. Aberdeen Bay Offshore Wind Farm - Installation and operation of a European Offshore Wind Deployment Centre consisting of 11 turbines, inter-array and export cables. To be located 2-4.5 km off the coast at Blackdog, Aberdeenshire, and likely to be constructed in 2016-2017. The licensee predicts that the installation of the 11 turbines will take place over a period of approximately 2 weeks and at most 4 turbines might be installed using piling techniques. The relatively small magnitude of the effects combined with mitigation measures required by the consent means that population consequences are not likely to be measurable in a modelling

framework.

3. Global Energy Nigg Ltd ("GEN") : South quayside proposal, Nigg – The south quayside extension will comprise of a solid berthing structure, with structural steel combi sheet piles forming the external perimeter and in-filled with material dredged from the seabed local to the proposed works. Most of the piling will be undertaken with vibro-piling and the remainder undertaken through impact piling. The construction will extend the south quayside some 135m to 155m into the adjacent Cromarty Firth, and provide an additional 750m to 800m of berthing facilities for vessels. The dredge burden associated with the south quayside extension amounts to approximately 240,000m³ - 250,000m³. Dredge material is targeted for offshore disposal at the long established disposal ground at the "Sutors". The marine licence for this development has recently been issued. The AA for the proposal concluded that, subject to the compliance of conditions, it would **not adversely affect site integrity of the Moray Firth SAC**.

4. CFPA: Berth development, Invergordon
The proposal involves the construction of an additional deep water berth and lay-down area by widening of the existing finger of the Queen's Dock and construction of a 150m berth structure for the south end of the finger. The project involves dredging of approximately 20,000 – 25,000m³ with disposal at "Sutors"; vibro and impact piling; 3.48 hectares of land reclamation and block paving. The marine licence for this development has recently been issued. The AA for the proposal concluded that, subject to the compliance of conditions, it would **not adversely affect site integrity of the Moray Firth SAC**.

5. POAL: Port development, Ardersier
The proposal involves the construction of new deep water quay facilities and an associated dredged access channel. The new quay wall will comprise of a combi-wall construction, a combination of tubular and sheet piling, driven to the required design depth. All piling works are to take place using vibro-piling techniques. The amount of material from the capital dredge will be in the region of 2,000,000m³. Proposals for the use of this material are currently under consideration and are likely to involve all, or the vast majority of the dredge material, being brought ashore. The details of the method of construction are not known at this time. At the current time a revision to the marine licence application is pending.

Mitigation measures being adopted through discharging of consent conditions at Nigg and Invergordon mean that the effects of impact piling will be considerably less than was assumed as a "worse case" scenario in the appropriate assessments for those projects. The quantity of impact piling will be significantly less (e.g. now expected to be maximum of 15 days of piling at Nigg and Invergordon instead of the 51 assessed). Any impact piling will avoid sensitive times of year. Additionally noise thresholds have been set to mitigate the risk of a disturbance effect to known foraging areas e.g. Sutors. The relatively small magnitude of the effects combined with mitigation measures required by the consent means that population consequences arising from the port redevelopments are not likely to be meaningfully measurable in a cumulative modelling framework.

<u>Details of assessment</u>

The conservation objectives for the Moray Firth SAC in relation to the bottlenose dolphin are detailed in section 1c.

SNCB advice is the proposals under discussion may potentially affect objectives (i). MSS advice is that the assessment undertaken against objective (i) also encompasses objective (v).

SNCB and MSS advice on assessment

*a) Reference population*

The relevant population unit for bottlenose dolphins is the "Coastal East Scotland" unit, which extends to 12 nm, from the north coast of the Scottish mainland (including Orkney) to the border with England (UK SNCB 2013). This is because there is strong evidence of a large degree of connectivity between animals in the SAC and animals regularly using other areas, extending to the Forth. This is consistent with the approach taken in relation to other proposals (e.g. offshore wind farms, seismic surveys, harbour maintenance works) where assessments are routinely made at the whole east coast population scale.

The current estimate is 195 animals, with 95% highest posterior density intervals (Bayesian equivalent to confidence intervals) ranging from 162 to 253 (Cheney et al. 2013).

*b) Level of effect and assessment framework*

The Forth & Tay developers have each modelled potential impacts to bottlenose dolphin arising from pile-driving at the four proposed wind farm sites during construction. They have modelled a range of scenarios for these sites, individually and in combination. The model outputs – the zones of predicted impacts – are highly dependent on factors such as pile size, blow energy, location of piles and number of piles driven simultaneously. For the 'worst case' scenarios, the predicted zones of noise disturbance / displacement could reach the coastal waters used by bottlenose dolphins. The temporary disturbance / displacement of individual animals has the potential to affect their energy budgets with potential consequences on their health and vital rates.

A cumulative assessment was undertaken in January 2014 by Prof Paul Thompson based on modelling assumptions agreed by MSS and the SNCBs to form a cumulative worst case scenario. The approach used the same project envelopes as MORL E and ICOL I for the Forth & Tay. Subsequent to this both the Moray Firth and the Forth and Tay developers have confirmed reduced numbers of turbines. VORTEX was used to model the viability of the east coast bottlenose dolphin population using the PVA model previously published in Thompson et al. (2000). The model allows for stochastic effects, and so each time it is run, slightly different results will be achieved.

This model was based upon best available demographic and life history values, adjusted to produce, on average, a population that was stable or very slightly

increasing, to reflect our understanding of the current population trend (Cheney et al. 2012). This baseline scenario was run 1000 times to provide a distribution of final population sizes after 25 years. The revised cumulative scenarios could then be compared with this baseline by running each scenario 100 times and presenting both the population trajectories and a histogram of final population sizes. Additionally, the mean population size and 95% confidence intervals can be plotted to allow easier comparison between scenarios.

Potential worst case impacts of displacement were implemented by harvesting calves or adults respectively from the population to simulate the types of effects of behavioural displacement that were used in the Moray Firth seal assessment framework (Thompson et al. 2013).

Displacement was assumed to result in a reduction in reproduction, proportional to the proportion of the population that was displaced in each construction year. As outlined in more detail in relation to harbour seal assessments, this is highly conservative to provide a worst case scenario.

Calculations were based on there being an average of 4 female and 4 male calves produced in each year from a stable population of 196 bottlenose dolphins, so if 100% of the population was displaced, all 8 calves were harvested the next year. This impact was always implemented as worst case, rounding up numbers of calves harvested and always taking more females than males if there were an odd number of calves.

The results indicate that there could be short to medium term impacts on bottlenose dolphin during the estimated five years of construction, however, there should be no significant long-term effect on the population over the modelled period of 25 years. The predicted population outcomes for the impacted scenario (median of 193 individuals) are similar to those predicted for the baseline with no piling (median of 202). The effects shown indicate that the long-term viability of the population is unlikely to be adversely affected by the Forth & Tay proposals in combination with BOWL and MORL in the Moray Firth.

The SNCBs and MSS have advised that, subject to the compliance of conditions set out in 3d**,** impacts arising from the offshore wind farms in the Forth and Tay in combination with other previously consented developments will **not adversely affect site integrity.**

*c) Mitigation and monitoring*
It is likely that bottlenose dolphins will experience disturbance as a result of each project independently, and cumulatively. Developers should therefore take steps to mitigate this where possible by adhering to JNCC guidelines on piling.

Monitoring of both noise levels and bottlenose dolphin responses to the noise should be undertaken to confirm the assessment of the extent to which dolphins may be disturbed and to improve the knowledge base to inform future licensing decisions. This should preferentially be undertaken with acoustic methods for detecting dolphins, since they will provide greater power to detect change than visual methods (e.g. Thompson et al. 2013).

Conclusion

**MS-LOT concludes that the Forth and Tay projects in-combination with the projects already consented, namely – BOWL, MORL, Aberdeen Bay Offshore Wind Farm, GEN South Quayside, Nigg and CFPA berth development, Invergordon – will, subject to the compliance of conditions set out in 3d, not adversely affect the site integrity of the Moray Firth SAC with respect to bottlenose dolphins. Since the modelling work was completed both NNGOWL and ICOL have both confirmed a reduced number of turbines, therefore the effects will be less than that modelled.**

**References**

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Thompson, P.M., & Brookes, K.L. (Jan, 2014) Cumulative bottlenose dolphin modelling for east coast of Scotland renewable developments. Advice commissioned by Marine Scotland Science.

Thompson, P.M., Hastie, G.D., Nedwell, J., Barham, R., Brookes, K.L., Cordes, L.S., Bailey, H. & McLean, N. (2013) Framework for assessing impacts of pile-driving noise from offshore wind farm construction on a harbour seal population. *Environmental Impact Assessment Review*, **43**, 73-85.

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**Harbour seals - Firth of Tay & Eden Estuary SAC.**

The harbour seal impact assessment framework initially developed for the Moray Firth (Thompson et al. 2013) has been applied to the Forth and Tay wind farm projects. This framework considers whether any noise impacts to individuals would result in population level effects. These effects are all based on the assumption that disturbance will affect breeding success. No direct mortality is predicted as a result of construction.

The Forth & Tay developers have modelled the zones of predicted impacts in relation to noise injury and disturbance for harbour seal. The framework uses a dose response curve to determine the proportion of the population exposed to noise levels sufficient to cause disturbance. The breeding success (number of pups) of the population is reduced by the same proportion. The number of animals predicted to receive noise levels sufficient to induce PTS was also calculated and these animals were assumed to have a 25% mortality rate (through for example a reduced ability to detect predators). The loss of these adults (through PTS) and pups (through disturbance) was included in a population model.

The reference population used for the harbour seal framework assessment is the east coast management unit, which includes the population at the Firth of Tay & Eden Estuary SAC. This SAC population is in severe decline, as modelled by SMRU (using data from 2011) on behalf of SNH and Marine Scotland. The counts from 2012 and 2013 indicate that the actual rate of decline may be faster than that predicted through the modelling. The drivers of this decline are not sufficiently well understood to enable measures to be undertaken to reverse it, but Marine Scotland is funding a broad programme of research to address these questions.

The number of seals that could potentially suffer PTS or that could be disturbed/displaced is calculated by overlaying the 'worst case' zones of each predicted impact with estimates of seal density derived from the Sea Mammal Research Unit ("SMRU") 'at sea' usage maps. Each of the Forth & Tay developers has considered the population consequences of these impacts, with ICOL and SAWEL and SBWEL providing population models to help inform assessment (ES Appendix 14D and HRA Appendix 6, respectively). This work concluded that potential noise impacts to harbour seals arising from the Forth & Tay offshore wind farm proposals will make no material difference to the predicted decline of this species in the east coast management unit. Pile-driving, as modelled, is the noisiest and most disturbing activity during construction. The SNCBs confirm that other impacts such as indirect effects on prey, or disturbance to seals from boat movements, cable-laying or rock-dumping are unlikely to result in population-level effects.

Advice from the SNCBs and MSS is that this framework constitutes an appropriate approach to impact assessment for harbour seals. It sets out a process for considering the outcomes of noise disturbance and behavioural displacement as a reduction in the individual fitness of animals and then models the consequences of this for the population, using reproductive success as the key parameter that is affected. Key areas of scientific uncertainty are highlighted, including their significance to the assessment framework. The advice is that the construction and operation of these proposed offshore wind farms in the Forth & Tay will not adversely affect the site integrity of the Firth of Tay & Eden Estuary SAC, subject to the compliance of conditions set out in Section 3(d).

In-Combination Impacts

The SNCBs note that there may be a link between the use of vessels with ducted propellers and fatal injuries (corkscrew lacerations) to harbour seals recorded over the last couple of years. The SNCBs and MSS advise that this issue could be

addressed via a 'Vessel Management Plan', secured via condition. Marine Scotland and SNH have commissioned research from SMRU on this issue.

The potential for in-combination effects with port development in the Tay estuary has not been taken any further because at the time of their submissions there were too few details about what work would be undertaken. The redevelopment of the port at Dundee is at the scoping stage , and the Forth and Tay offshore wind farms will be included in the cumulative impact assessment for Dundee port if it progresses to application.

**Having considered advice from the SNCBs and MSS, MS-LOT concludes that the Forth and Tay Developments, either alone or in-combination, will not adversely affect the integrity of the Firth of Tay and Eden Estuary SAC, subject to the compliance of conditions set out in 3d. Again the SNCB advice was based on the worst case scenarios and NNGOWL and ICOL have since confirmed a reduced number of turbines, thus the effects will be less than those predicted.**

**References**

Thompson, P.M., Hastie, G.D., Nedwell, J., Barham, R., Brookes, K.L., Cordes, L.S., Bailey, H. & McLean N. (2013) Framework for assessing impacts of pile-driving noise from offshore wind farm construction on a harbour seal population. *Environmental Impact Assessment Review*, **43**, 73-85.

**Grey seals - Isle of May SAC and the Berwickshire & North Northumberland Coast SAC.**

The SNCBs and MSS advised that for the purposes of HRA the reference population for grey seals should be the east coast management unit, which includes the relevant populations in each of these SACs.

The advice is that the Forth & Tay applicants have modelled the zones of predicted impacts in relation to noise injury and disturbance for grey seal. Depending on the wind farm / piling scenarios modelled, the zones of predicted impacts could overlap with areas that seals may use. However, these noise impacts to individuals, along with effects on prey species and/or disturbance to seals arising from other construction activities, will not significantly affect the grey seal population of the east coast management unit. The SAC populations and the population overall are robust and currently increasing and will not suffer any long-term impacts from wind farm construction.

The SNCBs and MSS consider that conditions in respect of bottlenose dolphin and harbour seal will also address potential noise disturbance and other construction impacts of these wind farm proposals on grey seal.

**Having considered advice from the SNCBs and MSS, MS-LOT concludes that the Forth and Tay Developments, either alone or in-combination, will not adversely affect the integrity of the Isle of May or the Berwickshire & North Northumberland Coast SACs, subject to the compliance of conditions in 3d.**

**Atlantic Salmon - River South Esk, River Tay, River Teith, River Dee, River Tweed SACs**

The relevant conservation objective to consider is whether or not the wind farm proposals in the Forth and Tay would, alone or in combination, result in any impacts on the viability of Atlantic salmon populations, including range of genetic types supported by the above SACs.

It is considered that underwater noise from piling foundations would be the most significant effect. However, due to lack of knowledge concerning migratory movements of Atlantic salmon in Scottish waters, and the effects of underwater noise on Atlantic salmon behaviour, it is not considered feasible to ascertain whether any noise disturbance to individual salmon could result in population level change at SACs. It should be noted that these knowledge gaps could not reasonably be remedied by scientific research for the purpose of these applications. It is considered feasible to avoid adversely affecting site integrity of any sites by agreement of working practice and mitigation that relate to the effects via conditions to address the following issues:

1. Soft start for piling work - to help mobile fish move out of the area and thereby assist in mitigating against noise disturbance to individuals during construction.

2. Piling schedules and construction programmes should be designed to reduce impacts on Atlantic salmon. They should be further discussed, post-consent, between MS-LOT, MSS, the ASFB, the SNCBs and developers, once layouts, numbers and foundation choices have been confirmed. It is noted that the zone of predicted noise impacts for Atlantic salmon is based on a 'worst case' scenario which will not occur.

3. Strategic monitoring and research will help to improve the knowledge base on salmon population ecology and migratory movements in Scottish waters and may help inform mitigation.

The installation of the export cables close to shore could take a matter of days so that mitigation, or avoidance, of impacts to smolts could be possible by timing the work to avoid peak smolt runs (if the timing of these can be established). This mitigation should be progressed in post-consent discussions between MS-LOT, MSS, the ASFB, the SNCBs and developers. In relation to potential cumulative impacts arising from the EMF around intra-array and export cables, proposed mitigation to shield / bury cables will help to reduce EMF. For Atlantic salmon, sufficiently deep burial or directional drilling will remove the risk of any operational effect. The SNCBs advised up to 3m, where possible and appropriate i.e. for export cables in shallower water approaching landfall (water depths of up to ~20m). Where cable burial or directional drilling is not possible, rock armouring or a similar protective layer should be considered.

It is considered that potential impacts from cable installation can be reduced or avoided and that while there may be some noise disturbance to individual salmon, the residual effects after mitigation do not risk the viability of SAC populations, but

do merit further research and quantification. The SNCBs have advised that operational noise will not result in likely significant effects to salmon.

MSS advice is that the resilience of populations to both short term and longer term change in numbers of salmon successfully migrating, and returning to spawn, will vary from river to river and with different stock components. MSS considers on the basis of information currently to hand that with the adoption of mitigation measures there will be no adverse effects on the integrity of these SAC populations.

**Having considered advice from the SNCBs and MSS, MS-LOT concludes that the Forth and Tay offshore wind farm proposals, in combination or individually, will not adversely affect site integrity of these five SACs with respect to Atlantic salmon provided that the conditions detailed in 3d are complied with**.

In-combination Impacts

MS-LOT has also considered the in-combination impacts with the MeyGen Phase 1 development, the Aberdeen Bay offshore wind farm and the Moray Firth wind farm projects, as these developments were also considered to have LSE on the qualifying features of all or some of the river SACs being considered in this assessment. Both the Moray Firth and Aberdeen Bay Offshore wind farms have conditions attached to the consents to mitigate potential impacts to Atlantic Salmon. The AA completed for MeyGen Phase 1 concluded that the MeyGen development will not adversely affect site integrity if conditions designed to reduce impacts were adhered to. Collision risk with the tidal turbines was identified as an issue; however the limit of the first phase to 6 turbines will mitigate this.

Due to the limited knowledge surrounding Atlantic salmon migration routes and behaviour there is some uncertainty regarding the natal rivers that potentially affected Atlantic salmon belong to. For the purposes of this assessment, MS-LOT have followed the advice of the SNCBs and consider that in showing that the proposed developments will not adversely affect site integrity for the rivers closest to the developments, this addresses Natura concerns which other consultees may have regarding further afield River SACs.

**Freshwater Pearl Mussel ("FWPM") - River Dee and River South Esk SACs**

Atlantic salmon (and other salmonids) are integral to the life cycle of FWPM, therefore any impacts to Atlantic salmon that prevent them from returning to their natal rivers may have a resulting effect on FWPM populations. Potential indirect impacts to FWPM populations will be addressed via mitigation to avoid adverse impacts to Atlantic salmon populations as outlined above. As there will not be population level effects to Atlantic salmon, nor significant effects to other salmonid species, the SNCBs advised that there will be no indirect effects on FWPM in the River South Esk.

**Having considered advice from the SNCBs and MSS, MS-LOT concludes that the Forth and Tay offshore wind farm proposals, in combination or individually, will not adversely affect site integrity of the River South Esk SAC**

**with respect to the FWPM provided that the conditions detailed in section 3d are complied with.**

In-Combination Impacts

MS-LOT have also considered the in-combination impacts with the MeyGen Phase 1 development and the Aberdeen Bay Offshore Wind Farm and Moray Firth wind farms due to the reasons detailed above. The conclusion is that **the Forth and Tay offshore wind farm proposals in-combination with these other developments will not adversely affect site integrity of the River Dee and River South Esk SACs with respect to FWPM provided that the conditions detailed in section 3d are complied with.**

**Sea Lamprey, River Lamprey and Brook Lamprey - River Tay, River Tweed and River Teith SACs**

The assessment considers the commitment from Forth and Tay wind farm projects to adopt soft-start piling methods to help mitigate any noise disturbance during construction and burial of cables to reduce EMF during operation. These mitigation methods will further reduce impacts to individual animals. The relevant conservation objective to consider is whether or not the proposed developments would result in any impacts on the viability of the lamprey populations of the River Tay, River Tweed and River Teith SACs. While there may be some level of noise disturbance to individuals during construction, and the potential for EMF to be detectable by sea lamprey, it is concluded that the developments will not adversely affect site integrity with respect to sea lamprey once the mitigation measures are incorporated. MS-LOT is satisfied that operational noise would not result in likely significant effects to sea lamprey.

**Having considered advice from the SNCBs and MSS, MS-LOT concludes that the Forth and Tay offshore wind farm proposals, in combination or individually, will not adversely affect site integrity of the River Tay, River Tweed and River Teith SACs with respect to lamprey, either alone or in combination with other regulated activities provided that the conditions detailed in section 3d are complied with.**

In-combination Impacts

There are no other developments which require an in combination assessment for lamprey.

## Conclusions

**Having determined that the NNGOWL, ICOL, SAWEL and SBWEL Developments will not have a negative effect on the constitutive elements of the sites concerned, on having regard to the reasons for which the sites were designated and their associated conservation objectives, MS-LOT concludes that the proposed developments will not, on their own or in combination with each other (or where appropriate for consideration, other developments already licensed) adversely affect the integrity of the Buchan Ness to Collieston Coast SPA, Fowlsheugh SPA, Forth Islands SPA, St Abb's Head to Fast Castle SPA, Moray Firth SAC, Firth of Tay and Eden Estuary SAC, Isle of May SAC, Berwickshire & North Northumberland Coast SAC, River South Esk SAC, River Tay SAC, River Dee SAC, River Teith SAC or River Tweed SAC (where each SPA or SAC is taken as a whole), subject to the compliance of conditions.**

Following MSS advice, MS-LOT consider that the most up to date and best scientific evidence available has been used in reaching the conclusion that any decision to approve the NNGOWL, ICOL, SAWEL and SBWEL Developments will not adversely affect the integrity of the sites concerned and are satisfied that no reasonable scientific doubt remains.

**3d. Conditions proposed.**
*Indicate conditions/modifications required to ensure adverse effects are avoided, & reasons for these.*

**All the conditions below except for condition 13 are applicable to all the Forth and Tay Developments. Condition 13 applies only to NNGOWL.**

| *Condition:* | *Reason:* |
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| 1). The Company must, no later than 6 months prior to the Commencement of the Development, submit a Construction Programme ("CoP"), in writing, to the Scottish Ministers for their written approval. Such approval may only be granted following consultation by the Scottish Ministers with SNH, the JNCC, SEPA, MCA, NLB, RSPB Scotland, the Planning Authority and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers. The Development must, at all times, be constructed in accordance with the approved CoP (as updated and amended from time to time by the Company). Any updates or amendments made to the CoP by the Company must be submitted, in writing, by the Company to the Scottish Ministers for their written approval.<br><br>The CoP must set out:<br><br>a. The proposed date for Commencement of Development;<br>b. The proposed timings for mobilisation of plant and delivery of materials, including details of onshore lay-down areas;<br>c. The proposed timings and sequencing of construction work for all elements of the Development infrastructure;<br>d. Contingency planning for poor weather or other unforeseen delays; and<br>e. The scheduled date for Final Commissioning of the Development. | To confirm the timing and programming of construction. |
| 2). The Company must, no later than 6 months prior to the Commencement of the Development submit a Construction Method Statement ("CMS"), in writing, to the Scottish Ministers for their written approval. Such approval may only be granted following consultation by the Scottish Ministers with SNH, the JNCC, SEPA, MCA, NLB, RSPB Scotland, the Planning Authority and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers. The CMS must set out the construction procedures and good working practices for installing the Development. The CMS must be in accordance with the construction methods assessed in the ES and must include details of how the construction related mitigation steps | To ensure the appropriate construction management of the Development, taking into account mitigation measures to protect Natura interests |

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| proposed in the ES are to be delivered. The Development must, at all times, be constructed in accordance with the approved CMS (as updated and amended from time to time by the Company). Any updates or amendments made to the CMS by the Company must be submitted, in writing, by the Company to the Scottish Ministers for their written approval.<br><br>The CMS must, so far as is reasonably practicable, be consistent with the DS, the EMP, the VMP, the Navigational Safety Plan ("NSP"), the Piling Strategy ("PS"), the CaP and the Lighting and Marking Plan ("LMP"). | |
| 3). The event that pile foundations are to be used, the Company must, no later than 6 months prior to the Commencement of the Development, submit a Piling Strategy ("PS"), in writing, to the Scottish Ministers for their written approval. Such approval may only be granted following consultation by the Scottish Ministers with SNH, the JNCC and any such other advisors as may be required at the discretion of the Scottish Ministers. The Development must, at all times, be constructed in accordance with the approved PS (as updated and amended from time to time by the Company). Any updates or amendments made to the PS by the Company must be submitted, in writing, by the Company to the Scottish Ministers for their written approval.<br><br>The PS must include:<br><br>a. Full details of the proposed method and anticipated duration of pile-driving at all locations;<br>b. Details of soft-start piling procedures and anticipated maximum piling energy required at each pile location; and<br>c. Details of mitigation and monitoring to be employed during pile-driving, as agreed by the Scottish Ministers.<br><br>The PS must be in accordance with the ES and reflect any surveys carried out after submission of the Application. The PS must demonstrate how the exposure to and / or the effects of underwater noise have been mitigated in respect of the following species: bottlenose dolphin; harbour seal; grey seal; Atlantic salmon; cod; and herring.<br><br>The PS must, so far as is reasonably practicable, be consistent with the EMP, the PEMP and the CMS. | To mitigate the underwater noise impacts arising from piling activity |
| 4). The Company must, no later than 6 months prior to the Commencement of the Development, submit an Environmental Management Plan ("EMP"), in writing, to the Scottish Ministers for their written approval. Such approval may only be granted following consultation by the Scottish Ministers with SNH, the JNCC, SEPA, RSPB Scotland, WDC, ASFB and any such other advisors or organisations as may | To mitigate the impacts on the Natura interests during construction and operation. |

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| be required at the discretion of the Scottish Ministers. The Development must, at all times, be constructed and operated in accordance with the approved EMP (as updated and amended from time to time by the Company). Any updates or amendments made to the EMP by the Company must be submitted, in writing, by the Company to the Scottish Ministers for their written approval.<br><br>The EMP must provide the over-arching framework for on-site environmental management during the phases of development as follows:<br><br>a. all construction as required to be undertaken before the Final Commissioning of the Development; and<br>b. the operational lifespan of the Development from the Final Commissioning of the Development until the cessation of electricity generation. (Environmental management during decommissioning is addressed by condition 3).<br><br>The EMP must be in accordance with the ES and SEIS as it relates to environmental management measures. The EMP must set out the roles, responsibilities and chain of command for the Company personnel, any contractors or sub-contractors in respect of environmental management for the protection of environmental interests during the construction and operation of the Development. It must address, but not be limited to, the following over-arching requirements for environmental management during construction:<br><br>a. Mitigation measures to prevent significant adverse impacts to environmental interests, as identified in the ES and pre-consent and pre-construction surveys, and include the relevant parts of the CMS;<br>b. Pollution prevention measures and contingency plans;<br>c. Management measures to prevent the introduction of invasive non-native marine species;<br>d. Measures to minimise, recycle, reuse and dispose of waste streams; and<br>e. The reporting mechanisms that will be used to provide the Scottish Ministers and relevant stakeholders (including, but not limited to, SNH, the JNCC, SEPA, RSPB Scotland, MCA and NLB) with regular updates on construction activity, including any environmental issues that have been encountered and how these have been addressed.<br><br>The Company must, no later than 3 months prior to the Final Commissioning of the Development, submit an updated EMP, in writing, to cover the operation and maintenance activities | |

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| for the Development to the Scottish Ministers for their written approval. Such approval may be given only following consultation with SNH, the JNCC, SEPA, RSPB Scotland and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers. The EMP must be regularly reviewed by the Company and the Forth and Tay Regional Advisory Group ("FTRAG") over the lifespan of the Development, and be kept up to date (in relation to the likes of construction methods and operations of the Development in terms of up to date working practices) by the Company in consultation with the FTRAG<br><br>The EMP must be informed, so far as is reasonably practicable, by the baseline surveys undertaken as part of the ES and the PEMP. | |
| 5). The Company must, no later than 6 months prior to the Commencement of the Development, submit a Vessel Management Plan ("VMP"), in writing, to the Scottish Ministers for their written approval. Such approval may only be granted following consultation by the Scottish Ministers with SNH, the JNCC, WDC and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers. The Development must, at all times, be constructed and operated in accordance with the approved VMP (as updated and amended from time to time by the Company). Any updates or amendments made to the VMP by the Company must be submitted, in writing, by the Company to the Scottish Ministers for their written approval:<br><br>The VMP must include, but not be limited to, the following details:<br><br>a. The number, types and specification of vessels required;<br>b. Working practices to minimise the unnecessary use of ducted propellers;<br>c. How vessel management will be coordinated, particularly during construction but also during operation; and<br>d. Location of working port(s), how often vessels will be required to transit between port(s) and the site and indicative vessel transit corridors proposed to be used.<br><br>The confirmed individual vessel details must be notified to the Scottish Ministers in writing no later than 14 days prior to the Commencement of the Development, and thereafter, any changes to the details supplied must be notified, as soon as practicable, to the Scottish Ministers prior to any such change being implemented in the construction or operation of the Development.<br><br>The VMP must, so far as is reasonably practicable, be consistent with the CMS, the EMP, the PEMP, the NSP, and | To mitigate disturbance or impact to marine mammals and birds |

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| the LMP.<br><br>6). The Company must, no later than 3 months prior to the Commissioning of the first WTG, submit an Operation and Maintenance Programme ("OMP"), in writing, to the Scottish Ministers for their written approval. Such approval may only be granted following consultation by the Scottish Ministers with the JNCC, SNH, SEPA, MCA, NLB, RSPB Scotland, the Planning Authority, and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers. The OMP must set out the procedures and good working practices for operations and the maintenance of the WTG's, substructures, and inter-array cable network of the Development. Environmental sensitivities which may affect the timing of the operation and maintenance activities must be considered in the OMP.<br><br>Operation and maintenance of the Development must, at all times, proceed in accordance with the approved OMP (as updated and amended from time to time by the Company). Any updates or amendments made to the OMP by the Company must be submitted, in writing, by the Company to the Scottish Ministers for their written approval.<br><br>The OMP must, so far as is reasonably practicable, be consistent with the EMP, the PEMP, the VMP, the NSP, the CaP and the LMP. | To safeguard Natura interests during operation of the offshore generating station. |
| 7). The Company must, no later than 6 months prior to the Commencement of the Development, submit a Cable Plan ("CaP"), in writing, to the Scottish Ministers for their written approval. Such approval may only be granted following consultation by the Scottish Ministers with SNH, the JNCC, MCA, SFF, ECIFG and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers. The CaP must be in accordance with the ES. The Development must, at all times, be constructed and operated in accordance with the approved CaP (as updated and amended from time to time by the Company). Any updates or amendments made to the CaP by the Company must be submitted, in writing, by the Company to the Scottish Ministers for their written approval.<br><br>The CaP must include the following:<br><br>a. Details of the location and cable laying techniques for the inter array cables;<br>b. The results of survey work (including geophysical, geotechnical and benthic surveys) which will help inform cable routing;<br>c. Technical specification of inter array cables, including a desk based assessment of attenuation of electro-magnetic field strengths and shielding; | To ensure Natura issues are considered for the location and construction of the inter array cables. |

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| d. A burial risk assessment to ascertain if burial depths can be achieved. In locations where this is not possible then suitable protection measures must be provided;<br>e. Methodologies (eg for over trawl surveys of the inter array cables through the operational life of the wind farm where mechanical protection of cables laid on the sea bed is deployed; and<br>f. Measures to address and report to the Scottish Ministers exposure of inter array cables.<br><br>8). The Company must, no later than 6 months prior to the Commencement of the Development, submit a Project Environmental Monitoring Programme ("PEMP"), in writing, to the Scottish Ministers for their written approval. Such approval may only be granted following consultation by the Scottish Ministers with SNH, the JNCC, RSPB Scotland, WDC, ASFB and any other ecological advisors as required at the discretion of the Scottish Ministers. The PEMP must be in accordance with the ES as it relates to environmental monitoring.<br><br>The PEMP must set out measures by which the Company must monitor the environmental impacts of the Development. Monitoring is required throughout the lifespan of the Development where this is deemed necessary by the Scottish Ministers. Lifespan in this context includes pre-construction, construction, operational and decommissioning phases.<br><br>Monitoring should be done in such a way as to ensure that the data which is collected allows useful and valid comparisons as between different phases of the Development. Monitoring may also serve the purpose of verifying key predictions in the ES. Additional monitoring may be required in the event that further potential adverse environmental effects are identified for which no predictions were made in the ES.<br><br>The Scottish Ministers may agree that monitoring may cease before the end of the lifespan of the Development.<br><br>The PEMP must cover, but not be limited to the following matters:<br><br>a. Pre-construction, construction (if considered appropriate by the Scottish Ministers) and post-construction monitoring surveys as relevant in terms of the ES and any subsequent surveys for:<br><br>1. Birds;<br>2. Sandeels;<br>3. Marine Fish; | To ensure that appropriate and effective monitoring of the impacts of the Development is undertaken |

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| 4. Diadromous fish;<br>5. Benthic communities; and<br>6. Seabed scour and local sediment deposition.<br><br>b. The participation by the Company in surveys to be carried out in relation to marine mammals as set out in the MMMP; and<br>c.<br>The participation by the Company in a National Strategic Bird Monitoring Framework ("NSBMF") and surveys to be carried out in relation to regional and / or strategic bird monitoring including but not limited to:<br>I. the avoidance behaviour of breeding seabirds around turbines;<br>II. flight height distributions of seabirds at wind farm sites;<br>III. displacement of kittiwake, puffin and other auks from wind farm sites; and<br>IV. effects on survival and productivity at relevant breeding colonies<br><br>All the initial methodologies for the above monitoring must be approved, in writing, by the Scottish Ministers and, where appropriate, in consultation with the FTRAG. Any pre-consent surveys carried out by the Company to address any of the above species may be used in part to discharge this condition.<br><br>The PEMP is a live document and must be regularly reviewed by the Scottish Ministers, at timescales to be determined by the Scottish Ministers, in consultation with the FTRAG to identify the appropriateness of on-going monitoring. Following such reviews, the Scottish Ministers may, in consultation with the FTRAG, require the Company to amend the PEMP and submit such an amended PEMP, in writing, to the Scottish Ministers, for their written approval. Such approval may only be granted following consultation with FTRAG and any other ecological, or such other advisors as may be required at the discretion of the Scottish Ministers. The PEMP, as amended from time to time, must be fully implemented by the Company at all times.<br><br>The Company must submit written reports of such monitoring surveys to the Scottish Ministers at timescales to be determined by the Scottish Ministers in consultation with the FTRAG. Subject to any legal restrictions regarding the treatment of the information, the results are to be made publicly available by the Scottish Ministers, or by such other party appointed at their discretion.<br><br>9). The Company must participate in any Forth and Tay | To ensure effective environmental |

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| Regional Advisory Group ("FTRAG") established by the Scottish Ministers for the purpose of advising the Scottish Ministers on research, monitoring and mitigation programmes for, but not limited to, ornithology, diadromous fish, marine mammals and commercial fish. Should a SSMEG be established (refer to condition 10), the responsibilities and obligations being delivered by the FTRAG will be subsumed by the SSMEG at a timescale to be determined by the Scottish Ministers. | monitoring and mitigation is undertaken at a regional scale |
| 10). The Company must participate in any Scottish Strategic Marine Environment Group ("SSMEG") established by the Scottish Ministers for the purposes of advising the Scottish Ministers on research, monitoring and mitigation programmes for, but not limited to, ornithology, diadromous fish, marine mammals and commercial fish. | To ensure effective environmental monitoring and mitigation is undertaken at a national scale |
| 11). Prior to the Commencement of the Development, the Company must at its own expense, and with the approval of the Scottish Ministers in consultation with SNH and the JNCC, appoint an Ecological Clerk of Works ("ECoW"). An ECoW must be appointed no later than 9 months post consent and the position remain until the Final Commissioning of the Development<br><br>The responsibilities of the ECoW must include, but not be limited to:<br><br>a. Quality assurance of final draft versions of all plans and programmes required under this consent;<br>b. Providing advice to the Company on compliance with consent conditions, including the conditions relating to the CMS, the EMP, the PEMP, the PS (if required), the CaP and the VMP;<br>c. Monitoring compliance with the CMS, the EMP, the PEMP, the PS (if required), the CaP and the VMP;<br>d. Providing reports on point c) above to the Scottish Ministers at timescales to be determined by the Scottish Ministers; and<br>e. Inducting site personnel on site / works environmental policy and procedures. | To ensure that appropriate and effective monitoring of the impacts of the Development is undertaken |
| 12). The Company must, to the satisfaction of the Scottish Ministers, participate in the monitoring requirements as laid out in the 'National Research and Monitoring Strategy for Diadromous Fish' so far as they apply at a local level(the Forth and Tay). The extent and nature of the Company's partic | To ensure effective monitoring of the effects on migratory fish at a local level (Forth and Tay) |
| 13).*The Company must, prior to the submission of the Design Statement ("DS") to the Scottish Ministers, submit an optimal design of the Development, in writing, to the Scottish Ministers for their written approval. Such approval may only | To ensure there is no adverse effect on the integrity of the Forth Islands SPA in relation to kittiwakes. |

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| be granted following consultation with SNH and the JNCC, and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers. The optimal design of the Development must be undertaken using the Centre for Ecology and Hydrography ("CEH") displacement model to minimise the barrier and displacement effects on kittiwake. The optimal design of the Development must demonstrate a reduction to the negative effect on adult survival of kittiwakes from Forth Islands SPA by 0.2%. The Development must, at all times, be constructed and operated in accordance with the approved optimal design.<br><br>** applies only to NNGOWL* | |

| | |
|---|---|
| **Name of assessor:** | Redacted |
| **Date:** | 16/07/2014 |
| **Name of approver:** | Redacted |
| **Date:** | 07/10/2014 |

## Appendix 1 – Addressing concerns raised by RSPB Scotland and WDC

### RSPB Scotland

RSPB Scotland have responded to each of the Forth and Tay wind farm consultations separately and also provided a regional response to MS-LOT on 26th March 2014 following consideration of the SNCB advice and assessment methods. A further response relating to the MacArthur Green model for setting gannet threshold was received by MS-LOT on 1st May 2014. The concerns raised are discussed below:

### Collision Risk Models

RSPB Scotland raised concerns over the CRMs due to:

- Lack of validation of the model;
- Accuracy of input data and use of generic data;
- Inappropriate use of avoidance rate;
- Expression of uncertainty.

RSPB Scotland recommended the use of Option 1 of the Band CRM at 98% avoidance rate.

Marine Scotland considers that the Band Collision Risk Model provides the best available method for quantifying the potential collision risk of birds with offshore wind farms. The author of the Band model has recently made it clear in correspondence to the Avoidance Rate Review project steering group (on which RSPB are represented) that in his view the extended model is undertaking the more correct calculation. This is because the 'extended' version does not assume a uniform density of birds throughout the risk height i.e. it accounts for the fact that there may be very different numbers of birds crossing the lower parts of the rotor than the upper. This pattern is widely observed in seabirds, with a high proportion flying at relatively low heights that coincide with the lower parts of the rotor. The extended version of the Band model therefore provides the best available model for estimating collision risk. A detailed discussion on the Band Model Options is provided at pages 19-20 of this AA.

Where possible, comparison of outputs from Options 1 and 2 was undertaken to identify whether substantial differences in values and therefore flight heights between the site data and the pooled modelled data used in Option a and 3 existed. There was substantial difference between the number of kittiwake estimated to collide when comparing the ICOL values for Option 1 and 2, with twenty-two times more birds estimated to collide using the modelled flight height data (Option 2) than site-specific data (Option 1) i.e. the ICOL data suggested that substantially less kittiwake were flying within the rotor swept area. There were no reasons to suspect that site specific drivers at ICOL would cause flight heights to differ from the modelled data. It was also accepted that pooling robustness was likely to result in modelled data being more robust to errors (but not systematic bias) in flight height estimation, and so it was felt appropriate to use the Johnston *et al* 2014 flight height data.

RSPB Scotland highlight that they do not accept the outputs of Option 3 using a 98% avoidance rate. Marine Scotland considers this avoidance rate to be appropriate, however have also presented results and conclusions using Option 3 and a 95% avoidance rate. This AA concludes that the Forth and Tay Developments will not adversely affect the integrity of any of the SPAs being considered using both 98% and 95% avoidance rates in Option 3 of the CRM.

In order to address uncertainty RSPB Scotland suggested that it would be appropriate to use 95% confidence limits presented in Cook *et al* (2012) to rerun the Band model and thereby estimate the range of uncertainty associated with flight height. The uncertainty around the flight height estimates presented in Johnston *et al* 2014 are clearly presented in their paper, and this uncertainty has been taken into consideration in the assessment alongside the range of other uncertainties encountered when estimating the magnitude of any impacts. However, since no mechanism currently exists to quantify the various sources of uncertainty present, this has been done in a qualitative manner. In the future Marine Scotland would be very keen to develop quantitative methods for accounting for the various sources of uncertainty.

Marine Scotland are committed to reducing uncertainties surrounding seabird flight heights and avoidance rates, for example though our participation in Offshore Renewables Joint Industry Programme ("ORJIP") and other activities. When new information becomes available this will of course be appropriately incorporated into assessments.

**Displacement**

RSPB Scotland recognise that the CEH final draft report on the displacement and barrier effects does represent "the best scientific knowledge in the field" in terms of its application to the Forth and Tay wind farm proposals, both in its methodology, and also in the caveats attached by the authors to its outputs. In particular, the work necessarily incorporates a number of uncertainties arising from a lack of data underpinning some of the assumptions made in the modelling (for example, the relationship between adult body mass and survival). RSPB Scotland echo the comments of the report's authors at sections 4.2 and 4.3 that the outputs should be "interpreted with considerable caution." Marine Scotland consider that this has been done. The authors' recommendations in relation to interpretation of the outputs have been followed. In addition the assessment does not rely on the outputs for puffin where significant concerns were raised by the authors. The CEH report identifies current knowledge gaps that will help inform future research priorities.

**Population Viability Analysis ("PVA")**

RSPB Scotland welcome the contribution made by the CEH PVA for the Forth and Tay in assisting with the with the assessment of predicted environmental impacts associated with the proposed offshore wind farms on the SPAs and qualifying seabird species. RSPB Scotland are broadly satisfied with the PVA, recognising that it incorporates additional mortality from collision and/or displacement for adult birds, only during the breeding season, for the range of 0-4% reduction in adult survival

and reductions in breeding productivity ranging from 0-20%. The range of reductions incorporated in the PVA is of adequate magnitude to account for the predicted range of additional mortality arising from the applicants' assessments of collision and displacement. RSPB Scotland reserve judgement on whether the PVA incorporates the appropriate range of reductions in adult survival due to concerns already detailed over the CRM. RSPB Scotland advised that the PVA outputs would be of limited assistance in assessing effects on puffin. As detailed in this AA the puffin assessment did not rely on the CEH PVAs.

**Cumulative/ in-combination Effects**

RSPB Scotland raised concerns regarding the ability of Marine Scotland to undertake a comprehensive in-combination assessment as part of the HRA and are unclear how non-breeding impacts are being considered in the context of the Forth and Tay proposals. SNCB advice was that the SPA's being considered are protected for breeding seabird colonies and that the scope of the in-combination assessments being completed for the Forth and Tay wind farms should consider the breeding season effects. Marine Scotland have included other projects in the assessment where it is considered that there is the potential for in-combination effects during the breeding season including Aberdeen Bay Offshore Windfarm, Methil Demonstrator, Blyth Offshore Wind Demonstration Site, Blyth Offshore Windfarm and Teeside Offshore Windfarm. Marine Scotland Science advise that gannet from the Bass Rock colony (Forth Islands SPA) are the species that is likely to have the largest foraging distances from the SPA during the breeding season. The best available evidence of gannet's breeding colony foraging area published in the journal Science is Wakefield *et al* (2013), and this analysis demonstrates that the Dogger Bank area is unlikely to form part of the dominant foraging grounds of breeding gannet from Bass Rock. Marine Scotland recognise that there is potential connectivity between breeding colonies in Scotland and offshore wind farms that are out with the foraging range during the breeding season. Marine Scotland are also mindful of the considerable uncertainty that would be associated with apportioning out of breeding season effects to breeding colonies. As a first step, we consider that assessing non-breeding season effects against non-breeding season populations is more appropriate, given the current evidence base. As RSPB are aware, Natural England have contracted MacArthur Green to define regional non-breeding season populations, which will assist with these assessments in the future.

**Reduced Uncertainty ABC & PBR - Interpretation of Effects**

RSPB Scotland consider that PBR is a wholly inappropriate tool for use in these assessments and ABC is not sufficiently precautionary. Marine Scotland have not relied on PBR for reaching any conclusions on site integrity in this AA. RSPB Scotland raise concerns at the arbitrary nature of thresholds adopted by MSS and the fact that these do not necessarily have any biological basis. MSS advise that the ABC tool has been developed to help in the setting of thresholds using the outputs from PVAs. It was developed to provide a clear and transparent approach for using outputs from PVAs. MSS are of the view that, where available, PVAs provide the best available evidence for informing thresholds.

MSS are aware of the ratio of the population size at the end of the wind farm to the population at the end of the same period in the absence of a wind farm (as used by the RSPB in the examination of the Hornsea 1 project). This metric adds to the range of other metrics available for potential use in setting a threshold or determining whether an estimated effect is acceptable or not. MSS note that whilst this counterfactual provides a descriptive metric, it is not of itself a method of determining whether a predicted level of effect is acceptable. MSS recognise that many metrics may have merits, however question the idea that the relative size at end of forecast period is necessarily the most useful. The metric lacks the context provided by those that use changes in probability, and there is no clear approach for the interpretation or use of counterfactual. RSPB acknowledge the limitations of models to forecast reliably over longer periods of time, which raises issues of what timescale the counterfactual might suitably be applied over.

The ecology and biology that informs the theoretical basis of ABC is contained within the population models upon which it relies. These models should use the best available evidence for modelling ecological and biological processes. MSS acknowledge that allowing for a specific level of change is ultimately a societal choice that is heuristic. This is no different to many other choices that the Birds and Habitats Directives require: such as those that inform the designation of protected area boundaries. MSS note that RSPB have expressed a preference for using the ratio of end population size (counterfactuals) and these figures have been presented in this AA. MSS are not aware of a method for translating this metric into an acceptable level of effect that would avoid being arbitrary.

**Reasonable Timescales for Consultation**

RSPB Scotland consider that work which has been undertaken following the last opportunity for public consultation (in October 2013) under the EIA regulations comprises additional environmental information and as such requires statutory public consultation under the EIA regulations (Electricity Works (EIA) (Scotland) Regulations 2000 and the EIA (Scotland) Regulations 1999 - both as amended). The work to which they refer is:

- establishment of common currency and re-assessment of collision risk using revised model parameters and CRM options by SNH
- outputs from CEH commissioned research

MS-LOT do not agree with this view. The work which has been carried out by the Forth and Tay Developers, MSS and the SNCB's was undertaken to inform the AA to allow a more robust cumulative assessment and therefore should be considered under the Habitats Regulations. The regional AA has been carried out under Regulation 48 of the Conservation (Natural Habitats, & c.) Regulations 1994 and Regulation 25 of The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007. As the NNGOWL and ICOL developments are within Scottish Territorial Waters, and the SAWEL and SBWEL developments are out with 12 nautical miles, both sets of regulations apply. Under these regulations "a person applying to a competent authority for any consent, permission or other authorisation shall provide such information as the competent authority may reasonably require for

the purposes of the assessment". There is no statutory requirement under these regulations for public consultation. It should be noted that MS-LOT previously required both NNGOWL and SAWEL and SBWEL to submit further information where it was our advice that the information should be considered under the EIA regulations. NNGOWL and SAWEL and SBWEL submitted addendums in June 2013 and October 2013 respectively under regulation 13 of the Electricity Works (EIA) (Scotland) Regulations 2000 (as amended). These were consulted on as per the requirements set out in regulation 14. The models used to inform the AA have been shared with the RSPB, and MS-LOT and MSS have engaged with the RSPB Scotland to keep them informed of the assessment process.

Bass Rock Population Viability Analysis for Gannets (letter dated 1st May 2014)
RSPB Scotland recommend using the counterfactual of population size, or in other words: the ratio of end population size. The reason being they consider this metric to be the most suitable, as they consider it more robust to model error than the metrics presented with the probability of decline and probability that the final population will be smaller than the starting population.

The AA is based on the probability that the final population will be smaller than the starting population, with the threshold being that there should be no more than a 5% probability that the final population will be smaller than the starting population. This was advised by the SNCBs and also MSS. This metric is routinely used in assessments where populations are forecast to increase.

A fundamental issue associated with RSPB Scotland's recommended metric of counterfactual of end populations is that there are no recommendations, from any organisation on what or how a threshold should be established using the metric. The metric has however been presented for information in this AA.

One of RSPB Scotland's concerns relates to the uncertainty in relation to the magnitude of effect. A precautionary approach to assessing the effect is taken in the AA. The utility of testing the sensitivity of any metric to this is therefore questionable.

## WDC and Client Earth

WDC and Client Earth wrote to Marine Scotland on 30th April 2014 raising concerns over the advice provided by the SNCBs on 7th March 2014 with regard to marine mammals. The WDC and Client Earth concerns related to the bottlenose dolphin qualifying interest of the Moray Firth SAC and the harbour seal qualifying interest of the Firth of Tay and Eden Estuary SAC. The concerns raised are summarised below.

For bottlenose dolphins the main concerns raised were that:
1. That the conservation objectives in relation to the Moray Firth SAC have not been adequately addressed.
2. That a short to medium term impact is not acceptable and that operational noise of wind turbines may constitute a long term impact

For harbour seals the main concerns raised were that:

3. That the harbour seal population of the Firth of Tay and Eden Estuary SAC is already in decline
4. The potential impact of spiral lacerations to seals (termed “corkscrew seals”) as a result of vessel movements.

MS-LOT received correspondence from SNH (email of 3rd July 2014) and MSS (advice note of 4th July 2014) regarding the WDC and Client Earth letter.

1. The conservation objectives in relation to the Moray Firth SAC have not been adequately addressed.
SNH advised that as authors of conservation objectives for Natura sites SNH remains of the view that, in most situations (including the Forth and Tay offshore wind farm proposals) it is only the conservation objective regarding maintaining the population as a viable component of the SAC that requires detailed assessment for projects taking place some distance from the site boundary. Other conservation objectives that might be directly affected within the site by activities occurring outwith would normally be assessed in an HRA but we do not consider this to be the case for impacts of the Forth and Tay wind farms on the Moray Firth SAC. MSS agreed and advised that the developments are proposed to occur at least 200km by sea from the SAC, and as such, assessment of any objective other than the maintenance of the population of the species as a viable component of the SAC is not appropriate.

2. A short to medium term impact is not acceptable and that operational noise of wind turbines may constitute a long term impact
SNH advised that all of the conservation objectives for the Moray Firth SAC relate to maintenance of condition in the “long-term”. The time period equating to long-term is not defined in the conservation objectives. SNH have interpreted a predicted short-term negative impact over the 5 years of the construction period, followed by a full recovery within a 25 year timespan as being acceptable. In this respect WDC/ClientEarth take a different perspective from SNH. MS-LOT are not aware of any judicial authority which supports an argument that temporary impacts upon protected sites over a five year period would breach EU nature conservation obligations. Advocate General Sharpston in the *Sweetman* case did not specify how long a temporary loss of amenity had to be in place for it to fall within the first or third situations outlined in paragraphs 58 to 61 of the Opinion, and in any case did not rule on the third situation preferring this point to be decided in a later case. In any event in the *Sweetman* case the feature affected was a key element of the protected sites’ conservation objectives, and the proposed development was to take place within the protected site itself, a very different set of circumstances to those present in the Forth and Tay Offshore Wind Farm Proposals. MSS have advised that the current status of the SAC is favourable (recovered), and that the current population trend was found to be highly likely to be stable or increasing (Cheney *et al*. 2013). It should also be recognised that the population modelling (Thompson and Brookes 2014) used the initial, broad design envelope, worst case scenarios for all developments, and several of these developments have subsequently been scaled back. Consequently, the model outcomes represent a worst case that is unlikely to be realised.

WDC also raise the point that operational noise from the wind farms may affect bottlenose dolphins over the long term. Recent work commissioned by MSS showed

that bottlenose dolphins would be unlikely to hear the noise produced by wind turbines on jacket foundations (the most likely type to be used) above background at distances of 1km or more from the turbine, even in strong wind conditions (Marmo *et al*. 2013). MSS therefore advise that this impact is unlikely to affect bottlenose dolphins, particularly given their typical preference for coastal habitats.

3. The harbour seal population of the Firth of Tay and Eden Estuary SAC is already in decline

SNH are in agreement with WDC that the harbour seal population at the Firth of Tay and Eden Estuary is in a highly unfavourable condition and research is underway to attempt to determine causes and hence potential remedial measures. It was SNH's assessment that the construction and operation of offshore wind farms in the outer Forth and Tay will have no measurable impact on site integrity in relation to population viability. WDC/ClientEarth and SNH disagree on this interpretation. MSS advised that noise impacts from the construction of proposed wind farms in the Forth and Tay will make no material difference to the predicted population trend. This is based on modelling undertaken by the developers, which shows very little difference between the underlying population trend and that under a scenario including pile driving noise. The modelling had to be carried out assuming that the impact occurred from 2008, since predicted numbers of animals at the likely time of construction are too small to model.

4. The potential impact of spiral lacerations to seals (termed "corkscrew seals") as a result of vessel movements

MSS advised that they agree with the advice provided by the SNCBs (on 7th March 2014) that the most appropriate mitigation against spiral lacerations to seals is through a vessel management plan. These lacerations are likely to be caused through interactions between seals and ducted propellers (Thompson *et al.* 2013) , which are commonly used on many vessels, including those that might be used for wind farm construction. At the current time, the developers do not know which vessels they will be using, or from which ports they will be operating. It is therefore not possible for the SNCBs or MSS to provide detailed comments on the plans at this time. It is most appropriate for such discussions to take place once clearer proposals concerning the practicalities involved are available in draft vessel management plans. Marine Scotland is also funding work investigating the mechanisms by which seals may sustain these fatal injuries, and potential mitigation options. We therefore believe that vessel management plans should be developed using the most up to date information at that time, rather than the incomplete information currently available.

References

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http://www.smru.st-and.ac.uk/documents/1282.pdf

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Wakefield *et a*l (2013), Space partitioning without territoriality in gannets. Science Vol. 341 pages 69 & 70.

## Appendix 2

**Outline of the Acceptable Biological Change ("ABC") concept for using population model forecasts to inform assessment of managed effects upon populations**

*Introduction*

This appendix outlines a tool called Acceptable Biological Change that uses probabilistic forecasts from population models to inform management decisions. ABC is a risk based approach to the management of populations, allowing a consistent and transparent approach to be taken in the context of the best available evidence and the uncertainty associated with population models. ABC ensures that the predicted population size following an activity e.g. the construction and operation of a wind farm might reasonably be observed in the absence of that activity.

*The ABC Approach*

Effects of managed activities on populations can be assessed by the construction of population models. Data on the historical changes to the population's size and vital rates (productivity and survival) are used to provide forecasts of future population change. The models can forecast the population assuming the status quo as well as scenarios assuming a range of changes in vital rates e.g. adult survival that may result from managed activities. Population forecasts can be presented as either a deterministic output (in year *x* the population size will be *y*) or as a probabilistic output (in year *x* the probability that the population size will be *y* or less, is *z*). The ABC tool requires probabilistic outputs from population models that provide probabilities of population change (appropriate magnitudes of change must be established) assuming the status quo and a range of impact scenarios.

The ABC tool constrains the acceptable level of change i.e. increases in the probability of a decline occurring between two quantiles taken from a probabilistic forecast. The selection of the quantiles used by ABC is based upon guidance produced by the Intergovernmental Panel on Climate Change ("IPCC") on the consistent use of language in relation to the treatment of uncertainties http://www.ipcc.ch/pdf/supporting-material/uncertainty-guidance-note.pdf (Mastrandrea *et al*, 2010) – see Table 1 below. Usually, ABC will limit allowable change to be the difference between the 0.5 median and the 0.333 quantiles. The 0.5 median being the quantile that is the midpoint of the "as likely as not" category; and the 0.333 quantile being the quantile that is at the lower limit of the "about as likely as not" category using the IPCC's definitions. The ABC tool therefore allows for additional effects which are equivalent to up to a one third change in the probable outcomes to occur.

Table 1. IPCC calibrated language for describing and quantifying uncertainty

| Likelihood Scale | |
|---|---|
| **Term** | **Probability of outcome population size being less than a specific quantity (P)** |
| *Virtually certain* | 99-100% probability |
| *Extremely likely* | 95-100% probability |
| *Very likely* | 90-100% probability |
| *Likely* | 66-100% probability |
| *About as likely as not* | 33-66% probability |
| *Unlikely* | 0-33% probability |
| *Very unlikely* | 0-10% probability |
| *Extremely unlikely* | 0–5% probability |
| *Exceptionally unlikely* | 0–1% probability |

As with any method of determining the significance of an effect, the timescales over which the effect is being assessed must be determined, and the population forecast configured accordingly. This could be when the managed activity ceases, or some agreed point in time after to account of any recovery towards baseline conditions. The rationale for the choice of timescale should be agreed and presented.

## Appendix 3 – MSS Interpolation method

The MSS interpolation method allows for specified magnitudes of effect to be matched against the "about as likely as not" threshold. MSS first calculate the percentage point decrease in chick survival that brings about the same decrease in future population size as a 1% decrease in adult survival. This ratio is used to convert the difference between the chick survival threshold and the predicted reduction in chick survival to an adult survival rate. The SNCBs advised that it is inappropriate to use this approach without more consideration and testing of the underlying assumptions.

The SNCBs advised that the method assumes a linear relationship between decreases in adult or chick survival and population size and this may not be true. The method does not take account of any non-linearity and the population consequences of the higher thresholds have not been tested within the current PVA models undertaken to date. Additionally, the method does not consider any interaction effect between concurrent reductions in adult and chick survival. The assumption that the effects of reductions to chick and adult survival on future population size are interchangeable according to the linear ratio remains to be empirically tested.

MSS agree that assuming a linear relationship will introduce error. The magnitude of the error will be many times (potentially orders of magnitude) less than the error the SNCBs recommend is accepted by not adopting the approach. Error associated with assuming a linear change in rate, is already introduced into the assessment by the SNCBs approach to interpolating thresholds.

The SNCBs also raised concerns that the MSS method increases the risk of impacts coming up to or going beyond the productivity threshold identified.

MSS advice is that the approach does not result in higher thresholds as stated, but in a more realistic interpolation of the adult survival and chick productivity rates with respect to the threshold. The interpolation is applied so that if the productivity threshold is reduced there is a corresponding increase to the adult survival threshold.

The SNCBs also highlighted that the relationship between chick mortality and adult mortality is a feature of the population dynamics of a population, related to age at first breeding and juvenile/immature survival, e.g. if for every seven chicks hatched, only one will reach maturity, the scalar ratio will be 7:1. Whilst Furness et al. (2013) demonstrated that this relationship generally holds true within a species, there will be considerable intra-specific variation among colonies,

MSS have considered the effect of the introduced error. The goodness of fit using the linear trendline is compared to use of a polynomial trend line. This has been investigated for 2 species at opposite ends of the ratio scaler range. Kittiwake Forth Islands which has a 4:1 ratio and guillemot Forth Islands which has a 23:1 ratio.

MSS advice is that the linear trendline provides an extremely good fit. Even in the example of guillemot Forth Islands the $R^2$ value of 0.9925 demonstrates that the variability of the data is explained by the fit of the line. The assessment which uses adult survival rates to one decimal place should not be sensitive to this level of error.

As expected the polynomial trendline derives higher $R^2$ values. The relationship between the linear and the polynomial trendlines is quantified. At low integer values (e.g. between 0 and 1 as used by the interpolation method) the linear trendline will over-estimate the

population change compared to the polynomial trendline. At higher integer values (e.g. between 4 and 5) the opposite is the case.

MSS advice is that the assessments are not sensitive to the magnitude of the error associated with use of the interpolation method. The highest $R^2$ values are in relation to the outputs from kittiwake colonies which, owing to their lower ratio values, are more sensitive to application of the method.

MSS note that additional options are to use the polynomial function within the ratio scalar spread sheet, or to re-run the population models for the specific effects of interest. Marine Scotland would be able to commission CEH to re-run the models for a range of agreed scenarios. The results will not be available for use in this assessment.

The assessment is based on the thresholds of acceptable change, which are the level of variability that is about as likely as not to occur without introducing anthropogenic effects during the breeding season. As such there is no uncertainty about the threshold and how it is used in the assessment. In addition the effects are over-estimated in this assessment to provide insurance that they will not exceed the threshold.

MSS view is that the interpolation method used is not a new or novel method. The amount of error contained in the assessment is reduced through its use

## Appendix 4 – common currency values for puffin

| PUFFIN | FORTH ISLANDS SPA | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NNGOWL | | SAWEL | | SBWEL | | ICOL | | TOTAL | SPA Pop | NNGOWL | SAWEL | SBWEL | ICOL | TOTAL |
| | Factor | Inds | Factor | Inds | Factor | Inds | Factor | Inds | Inds | Inds | % | % | % | % | % |
| **Mean Seasonal Max** | | 2938 | | 3419 | | 4034 | | 3152 | **13543** | 100564 | -2.9 | -3.4 | -4.0 | -3.1 | -13.5 |
| Proportion displaced | **0.6** | 1763 | **0.4** | 1367.6 | **0.4** | 1614 | **0.5** | 1576 | **6320** | | -1.8 | -1.4 | -1.6 | -1.6 | -6.3 |
| Prop SPA | **0.998** | 1759 | **0.976** | 1334.8 | **0.976** | 1575 | **0.984** | 1551 | **6220** | | -1.7 | -1.3 | -1.6 | -1.5 | -6.2 |
| Prop non-breeding and/or immature | **0.35** | 1144 | **0.35** | 867.61 | **0.35** | 1024 | **0.35** | 1008 | **4043** | | -1.1 | -0.9 | -1.0 | -1.0 | -4.0 |
| Prop Die | **0.5** | 572 | **0.5** | 433.8 | **0.5** | 512 | **0.5** | 504 | 2021 | | -0.6 | -0.4 | -0.5 | -0.5 | -2.0 |
| Prop fail to breed successfully | **1** | 1144 | **1** | 867.61 | **1** | 1024 | **1** | 1008 | 4043 | | -1.1 | -0.9 | -1.0 | -1.0 | -4.0 |
| **Productivity 1 Indiv = 1 Pair** | **1** | 1144 | **1** | 867.61 | **1** | 1024 | **1** | 1008 | **4043** | | -1.1 | -0.9 | -1.0 | -1.0 | -4.0 |

| |
|---|
| Adult survival effects |
| Productivity effect |

**N.B.** Effects are on adult survival **OR** productivity not both in combination

## Appendix 5 – Summary of Divergence between SNCB and MSS advice

| Factor | SNCB Advised Approach | MSS Advised Approach | Approach taken in AA | Planned/ current activities to address/ reduce areas of divergence |
|---|---|---|---|---|
| **CRM Band Option** | Options 2 and 3 | Option 3 | Option 3 | - Review of avoidance behaviour data and calculation for the first time of Avoidance Rates using Basic (Option 2) and Extended (Option 3) under way under contract to Marine Scotland.<br>- Offshore Renewables Joint Industry Programme (ORJIP) gathering data on avoidance behaviour under way.<br>- Collection of flight height data using e.g. laser rangefinders, tags |
| **CRM Avoidance Rate** | 98% | 98% (& 95%) | 98% (& 95%) | |
| **CEH puffin displacement model used in assessment** | Should be included within assessment | Should be disregarded due to issues with data | Not used in assessment | - Monitoring effects of wind farms on puffin populations<br>- Additional puffin tagging when technology permits |
| **In combination effects** | Application of CRM for all projects (advice June 6th 2014) | Due to very small magnitude of effects, qualitative assesment of other projects sufficient. | Qualitative assesment undertaken | - Development of Cumulative Impact Assessment (CIA) database that allows estimated effects to be updated for use in future CIAs as estimation of effects methods develop. |
| **Threshold setting method** | ruABC, PBR, proxy species | ABC & ruABC | ABC & ruABC | |
| **Accounting for predicted productivity effects being higher/ lower than those modelled by CEH** | Not accounted for | Interpolated | Interpolated | - Further exploration and assessment of methods for setting thresholds |
| **Threshold Use** | The threshold should not be approached but no indication of how close to a threshold would be acceptable | The threshold should not be exceeded | The threshold should not be exceeded | |
| **Threshold (adult survival)** | | | | |
| Kittiwake Forth Islands SPA | -1.5% | -2.2% | -2.2% | |
| Kittiwake Fowlsheugh SPA | -1.3% | -1.3% | -1.3% | |
| Kittiwake St Abbs SPA | -1.6% | -2.0% | -2.0% | |
| Kittiwake Buchan Ness SPA | -1.6% | -2.4% | -2.4% | - Monitoring wind farm effects on key species<br>- Monitoring interactions (including displacement, collision, barrier effects) between key species and wind farms |
| Gannet Forth Islands SPA | 1300 (using 5% risk of population decline) | 1300 probabilities of declines of 1% and 5% below starting population | 1300 | |
| Guillemot Forth Islands SPA | -0.6% | -0.9% | -0.9% | |
| Guillemot Fowlsheugh SPA | -0.6% | -1.1% | -1.1% | |
| Guillemot St Abbs SPA | -0.8% | -1.3% | -1.3% | |
| Guillemot Buchan Ness SPA | -0.5% | -0.5% | -0.5% | |
| Razorbill Forth Islands SPA | -0.9% | -0.9% | -0.9% | |
| Razorbill Fowlsheugh SPA | -1.0% | -1.2% | -1.2% | |
| Razorbill St Abbs SPA | -1.3% | -1.7% | -1.7% | |
| Puffin Forth Islands SPA | -1.4% | not provided | not provided | |

## Appendix 6 – Summary of Divergence in conclusions based on SNCB and MSS advice

| SPA & Species | Conclusion based on SNCB advice | Conclusion based on MSS advice | AA conclusion | Reasons for Divergence |
|---|---|---|---|---|
| **Kittiwake Forth Islands SPA** | Adverse impact on site integrity | No adverse impact on site integrity | No adverse impact on site integrity | SNCB threshold from ruABC without accounting for estimated displacement effect. To a lesser degree also due to use of Option 2 CRM advised by SNCBs. |
| **Kittiwake Fowlsheugh SPA** | Adverse impact on site integrity | No adverse impact on site integrity | No adverse impact on site integrity | SNCB threshold from ruABC without accounting for estimated displacement effect. To a lesser degree also due to use of Option 2 CRM advised by SNCBs. |
| **Gannet Forth Islands SPA** | Adverse impact on site integrity | No adverse impact on site integrity | No adverse impact on site integrity | Use of Option 2 at 98% advised by SNCBs, Option 3 at 98% and 95% by MSS |
| **Razorbill Forth Islands SPA** | Unable to advise no adverse impact on site integrity | No adverse impact on site integrity | No adverse impact on site integrity | SNCB threshold from ruABC, MSS threshold from ABC |
| **Puffin Forth Islands SPA** | Adverse impact on site integrity | No adverse impact on site integrity | No adverse impact on site integrity | SNCB advise use of CEH displacement model whish MSS advise against using. Proportion immature and non breeding adult advised by SNCBs for common currency approach substantially reduced compared to Moray Firth assessments and MSS advice. |

## Appendix 7 – Additional Presentation of Predicted effects on SPA Populations

### Table A: Estimated magnitude of displacement and collision effects attributed to individual SPAs and species, most recent SPA population estimates, and counterfactuals of forecast populations after 25 years assuming the estimated effects.

| Species & SPA | SPA Population (Individuals) | Estimated baseline annual adult mortality (%) | Baseline annual adult mortality (individuals) in the absence of proposed wind farms | Threshold for additional collision and displacement effect (annual reduction in adult survival) | Estimated additional collision and displacement effects during the breeding season on annual adult survival rate (%) | Number of additional adults dying annually during breeding season assuming estimated magnitude of effect (based latest SPA population esitimate) | COUNTERFACTUALS: | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Counterfactual of end population assuming estimated wind farm effects (%) | Opposite of end population counterfactual (%)- RSPB favoured metric | Counterfactual of change in population size assuming estimated wind farm effects (%) |
| KITTIWAKE | | | | | | | | | |
| Forth Islands | 7552 | 12.0% | 906 | -2.4% | -1.8% | 135 | 76% | 24% | 126% |
| St Abbs | 12635 | | 1516 | -2.0% | -0.5% | 60 | 94% | 6% | 108% |
| Fowlsheugh* | 18674 | | 2241 | -1.3% | -1.1% | 212 | 81% | 19% | 106% |
| Buchan Ness | 25084 | | 3010 | -2.4% | -0.1% | 17 | 99% | 1% | 119% |
| GUILLEMOT | | | | | | | | | |
| Forth Islands | 29169 | 9.0% | 2625 | -0.9% | -0.1% | 15 | 99% | 1% | 95% |
| St Abbs | 58617 | | 5276 | -1.3% | 0.0% | 0 | 100% | 0% | 100% |
| Fowlsheugh | 60193 | | 5417 | -1.1% | 0.0% | 0 | 100% | 0% | 100% |
| Buchan Ness | 25857 | | 2327 | -0.5% | 0.0% | 0 | 100% | 0% | 100% |
| RAZORBILL | | | | | | | | | |
| Forth Islands | 4950 | 9.5% | 470 | -0.9% | -0.9% | 45 | 88% | 12% | 74% |
| St Abbs | 4588 | | 436 | -1.7% | 0.0% | 0 | 100% | 0% | 100% |
| Fowlsheugh | 7048 | | 670 | -1.2% | 0.0% | 0 | 100% | 0% | 100% |
| GANNET | | | | | | | | | |
| Forth Islands* | 110964 | 8.1% | 8988 | -1.2% | -1.1% | 1169 | 79% | 21% | 49% |
| PUFFIN | | | | | | | | | |
| Forth Islands** | 62231 | 12.4% | 7717 | -2.0%* | -2.0% | 1251 | 75% | 25% | 67% |

### Notes on Table A

- Estimated effects combine collision and displacement effects
- Effects have been apportioned to relevant SPA and non-SPA populations, and different age classes, with effects on adults at individual SPAs presented.
- Counterfactual values should not be viewed without appropriate context.
- The counterfactual of end populations is advocated by the RSPB but it is the opposite of this counterfactual that they appear to present (e.g. 25% rather than 75%).
- The counterfactual of change in population size is also provided.
- As with all counterfactuals this has to be very carefully interpreted and must not be taken out of context. The context being the population trends: whether decreasing or increasing numbers of birds.
- In the final column values >100 indicate the % of the baseline population decline from the starting population assuming the estimated wind farm effects (e.g. kittiwake at Fowlsheugh). Values <100 indicate the % of the baseline population increase from the starting population assuming the estimated wind farm effects (e.g. puffin and gannet at Forth Islands).
- * for both kittiwake at Fowlsheugh and gannet at Forth Islands the dominant estimated effect is from collision with turbines. For both species, the number of collisions have been estimated in a highly precautionary manner due to the use of a low avoidance rate of 95% with the extended version of the band model.
- ** For puffin at Forth Islands the dominant effect is via displacement effects and the magnitude of these effects have been estimated using a number of very precautionary assumptions.

- For razorbill, estimated displacement effects ignore the mitigation resulting from reductions in turbine number and large inter-turbine distances at 3 of the four proposed wind farms.
- Counterfactuals of end population are the end population with the wind farm/ end population without wind farm

**Table B: Summary of estimated additional adult mortality effects at individual SPAs during the breeding season from collision and displacement attributed to individual wind farm projects:**

| Species | SPA | Alpha | Bravo | Inchcape | NnG | Cummulative | Threshold | SPA Population |
|---|---|---|---|---|---|---|---|---|
| Gannet | Forth Islands | 355 | 218 | 363 | 233 | 1169 | 1300 | 110964 |
| Kittiwake | Buchan Ness | 5 | 8 | 4 | 0 | 17 | 602 | 25084 |
| | Forth Islands | 24 | 20 | 47 | 75 | 135 | 174 | 7552 |
| | Fowlsheugh | 126 | 87 | 42 | 0 | 212 | 317 | 18674 |
| | St Abbs | 9 | 15 | 13 | 13 | 60 | 265 | 12635 |
| Puffin | Forth Islands | 268 | 317 | 312 | 354 | 1251 | N/A | 62231 |
| Razorbill | Forth Islands | 2 | 4 | 4 | 5 | 41 | 45 | 4950 |

## Notes on Table B

- Estimated effects are based on individual wind farms in isolation or all wind farms in combination.
- Due to interactions between wind farm projects, the estimated cumulative displacement effects are not the sum of the individuals effects. Therefore for species and SPAs where displacement effects have been estimated using the CEH model, the cumulative columns differs from the sum of the effects from individual wind farm.