6 Ornithology

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6 Ornithology

6.1 Executive Summary

6.1.1 This chapter provides an update to the 2019 ornithological assessment to account for a revised 2020 Layout, and to address consultee comments received in response to the 2019 EIA Report.

6.1.1 The assessment has accounted for measures designed into the Proposed Development and those that will be committed to in the Proposed Development Construction Environment Management Plan. The assessment has also considered the Proposed Development in combination with other wind farm schemes in Shetland.

6.1.2 The assessment has concluded that residual effects of disturbance and displacement during the construction and operation phases are unlikely to be significant at more than the Local level. Any displaced territories will be accommodated through habitat enhancement to create more favourable nesting habitat. It is expected that displacement effects can be fully mitigated through habitat enhancement.

6.1.3 Collision-related mortality is predicted to be not significant for all species and of a magnitude where it is expected that there will be no discernible population-level effect above natural mortality levels.

6.1.4 Overall, construction and operational phase ornithological effects are likely to be localised. Decommissioning phase impacts are likely to be similar to those predicted for the construction phase.

6.2 Introduction

6.2.1 The Proposed Development is a reduction of the 2019 Layout as described in Chapter 3. The purpose of this chapter is, therefore, to update the existing assessment of likely significant effects of the Proposed Development on birds. The updated assessment is based on the updated 2020 Layout and also addresses comments received from stakeholders on the ornithological assessment in the 2019 EIA Report. This document should be read in conjunction with the 2019 EIA Report submission.

6.2.2 Updates to the layout of the Proposed Development upon which the 2020 Supplementary Environmental Information (SEI) is based are:

- Removal of T1, T2, T3, T4, T7 and T29;
- Removal of associated access track;
- Removal of borrow pits G and I;
- Removal of construction compound 3;
- Decrease in height to 180 m of T5, T16, T19, T20, T24, T25, T26, T27 and T28; and
- Retaining a tip height of 200 m for all other turbines.

6.3 Assessment Methodology

Survey Area

6.3.1 The definitions of Survey Area relate to a given perimeter of turbine locations based on the 2019 Layout. The extent of the Survey Area remains the same for the purposes of this assessment (despite a reduction in turbines). The data informing the 2019 assessment still remains valid and is used here to inform the 2020 Layout. The extent of the site remains unchanged.

Desk Study and Field Survey

6.3.2 The scope of desk study and field survey is presented in the 2019 EIA Report. Any additional sources of information used to inform the assessment within the 2020 SEI are referenced in the text.

6.3.3 In summary, survey work undertaken to inform the assessment included:

- Vantage Point (VP) surveys. VP survey work was completed between April to August 2016 and September 2017 to August 2018 inclusive resulting in a total of 108 hours of observation from each of six VPs. The combined viewsheds from VPs 1, 2, 3 and 6 provide full visual coverage of the 2020 layout. The VP locations and viewsheds for each VP location are presented in Figure 6.1 of the 2020 SEI. The methods followed SNH (2017) guidance.
- Red-Throated Diver VP Survey. Watches a VP located between the Otterswick and Graveland Peninsula SPA (which is designated for breeding red-throated diver) and the site were undertaken between mid-April and mid-August 2016, resulting in 36 hours of observation.
- Breeding Diver Surveys. Watches were undertaken from 13 VP locations within the Proposed Development site and 1 km of the site boundary between May and August 2018. The work aimed to record a total of at least 20 incoming and outgoing flights to allow identification of regular flight routes (in accordance with survey methods recommended in SNH, 2014).
- Breeding raptor surveys. Walked transects were conducted to search for moorland nesting raptors between April and July 2016 and April and July 2018 inclusive. The survey methods followed those recommended by SNH (2005) and Hardey *et al*. (2009).
- Moorland breeding bird surveys. Four visits were conducted during the period mid-April to early July in each of 2016 and 2018, and based on the Brown & Shepherd (1993) method as recommended by SNH (2017).
- Wintering Bird Walkover Survey. Walkover survey visits were completed in November 2017 and March 2018 covering the site and a 500 m perimeter area.

EcIA Assessment Process

6.3.4 The evaluation and assessment within this chapter has been undertaken with reference to relevant parts of the 2018 Guidelines for Ecological Impact Assessment in the United Kingdom developed by the Chartered Institute of Ecology and Environmental Management (CIEEM, September 2018). The methods for determining importance of ecological features, characterising effects, and determining significance are outlined in the 2019 EIA Report and are based on the CIEEM guidance which states that: “a beneficial or adverse effect is determined to be significant or not, in ecological terms, in relation to the integrity of the defined site or ecosystem(s) and/or the conservation status of habitats or species within a given geographical area, which relates to the level at which it has been valued”.

Collision Risk Analysis

6.3.5 Consultees identified some inaccuracies relating to the collision risk analysis used in the 2019 EIA Report. These have been addressed to update the analysis within the 2020 SEI. Further details are provided in Section 6.5.

6.4 Baseline Conditions and Evaluation of Resources

6.4.1 The 2019 EIA Report assessment “scoped out” some species and statutory sites that are not likely to be significantly affected (for example by virtue of the design or operation of the Proposed Development, (for species) because they are very commonplace and / or of very low conservation value, or (for designated sites) because impacts on the qualifying features or conservation objectives

of the site are unlikely to occur). Those sites and species scoped out of the assessment within the 2019 EIA Report are not considered here. Those that are considered in this assessment are provided in Table 6.1 below. The evaluation given for each receptor is presented in terms of the importance of that receptor within a defined geographical context (following the CIEEM (2018) guidelines). The following frame of reference has been used:

- International: European.
- National: United Kingdom.
- Country: Scotland.
- Regional: Shetland.
- County: Yell.
- Local: mid and north Yell.
- Site (the red line application boundary of the Proposed Development).

6.1.1 **Table 6.1 - The importance of the site (evaluation) for each receptor considered in the 2019 EIA.**

Receptor		**Evaluation**
Statutory Sites (SPA/pSPA)	Bluemull and Colgrave Sounds	International
	Otterswick and Graveland	International
	Fetlar	International
	Herma ness, Saxa Vord and Valla Field	International
Statutory Sites (SSSI)	East Mires	National
	Graveland	National
	Valla Field	National
	Hascosay	National
	North Fetlar	National
	Hill of Colvadale and Sobul	National
	Lamb Hoga	National
Birds	Greylag Goose	Local
	Mallard	Site
	Red-throated diver	International
	Curlew	National
	Dunlin	National

Receptor		Evaluation
	Golden plover	National
	Lapwing	Site
	Oystercatcher	Local
	Redshank	Local
	Ringed Plover	Local
	Whimbrel	National
	Snipe	Regional
	Great skua	International
	Arctic skua	National
	Arctic tern	County
	Fulmar	County
	Great black-backed gull	Local
	Lesser black-backed gull	Local
	Herring gull	Local
	Black-headed gull	Local
	Common gull	Local
	Merlin	Regional
	Other Species	Site (for breeding passerines only)

6.5 Response to Consultation Responses

6.5.1 The 2019 EIA Report received objections on ornithological grounds from:

- Scottish Natural Heritage (SNH) (dated 15 July 2019);
- Royal Society for the Protection of Birds (RSPB) Scotland (dated 31 July 2019);
- Shetland Bird Club (SBC) (dated 22 July 2019) and
- Shetland Amenity Trust (SAT) (dated 18 July 2019).

6.5.2 The comments from each are summarised below, each followed with the Applicant response.

SNH

Collision risk analysis

6.5.3 SNH stated that "*At present it is not possible to conclude with certainty that there will be no adverse effect on the integrity of Bluemull and Colgrave Sounds proposed Special Protection Area (pSPA). … Our advice is that it is not* possible *to conclude on the basis of the assessment provided in the EIAR that there will not be an adverse effect on site integrity as the collision risk analysis appears to be flawed.*"

6.5.4 The Applicant has reviewed the collision risk analysis, both in light of the 2020 Layout and turbine dimensions, and the specific comments below. It was confirmed (in an email from SNH received by BSG Ecology on 27 January 2020) that "*[SNH] have reviewed the shadow HRA and agree with its conclusions other than with regard to Bluemull and Colgrave Sounds pSPA where we don't believe that impacts on site integrity can be ruled out until the collision risk for red-throated diver is clarified.*" (refer to 2020 SEI Appendix 6.2). The following section, and information presented in Appendix 6.1 of the 2020 SEI, presents the relevant information with regard to clarifying the collision risk analysis to allow SNH to reach a conclusion on the likely effect on the integrity of the pSPA and enable the Scottish Ministers to determine the likely effect on the integrity of the pSPA.

Hours watched and area covered from each VP

6.5.5 SNH stated that "*The collision risk calculations are laid out in Appendix 6.1 of the EIAR, but it is difficult to judge whether the model has been applied properly as some information is missing. In particular there is no summary of hours watched nor the area covered from each VP*."

6.5.6 The Applicant can confirm that a table detailing the dates and times of all watches from all VP locations is presented in Appendix 6.2 of the 2019 EIA Report. A summary of hours watched from each VP has been added to the worked collision risk analysis presented in Appendix 6.1 of the 2020 SEI. In addition, the viewshed and visible area at 30 m from ground level for each VP (which define the collision risk area as used in the collision risk analysis) is presented in Figure 6.1 of the 2020 SEI.

6.5.7 SNH go on the state that "*Section 6.4.16 states that VPs were watched for 96 hours across two breeding seasons and one winter, but this doesn't accord with the tabulated calculations which suggest 180 hours of observation*"

6.5.8 The total observation time at each VP location was 108 hours. The stated 96 hours in the 2019 EIA Report was a typo. This total is based on 36 hours of observation in each of two breeding seasons and one winter season per VP. The number of hours of observation was consistent for all six VPs and, therefore, a total of 216 hours of observation was completed for each season.

6.5.9 The 180 hours of observation related to the total observation period from five VPs (VPs 1, 2, 3, 4 and 6) for one season (36 hours x 5 VPs). The time spent in observation from VP 5 was excluded from the model used in the 2019 EIA Report as the viewshed from this VP did not overlook any of the proposed turbine locations.

6.5.10 The collision risk analysis has been updated in Appendix 6.1 of the 2020 SEI. The amendments are provided in detail within the covering text in the appendix, and include:

- An amendment to the number of turbines from 29 to 23 to reflect the 2020 Layout.
- Removal of the observational time and all flights recorded at VP 4 from the analysis (the viewshed of VP 4 only includes one proposed turbine location (T16) which was also visible from VP 3). The combined observational time at VPs 1, 2, 3 and 6, and all flightlines at collision risk height recorded from these VP locations were entered into the model.
- An amendment to the "wind farm area" as defined in the model to equal the combined visible area from VPs 1, 2, 3 and 6 (for the 2019 EIA Report, the wind farm area was taken as a 280 m perimeter around proposed turbine locations).

6.5.11 The worked collision risk analysis for greylag goose, red-throated diver, curlew, whimbrel, golden plover, great skua, arctic skua, arctic tern and fulmar is provided in Appendix 6.1 of the 2020 SEI.

6.5.12 The combined visible area as entered into the model is shown on Figure 6.1 of the 2020 SEI. Flightlines at collision risk height (< 40 m) for each species are presented in Figures 6.2 to 6.10 of the 2020 SEI.

Adjustment for daylight hours

6.5.13 SNH state that "*The mean daylight hours used in the calculations are also incorrect, for example, the figure used for July is 14 hours, whereas the correct figure for Shetland is almost 18 hours. These errors in the calculation would lead to a serious underestimate in collision mortality.*"

6.5.14 The Applicant can confirm that the mean daylight hours entered into the analysis were incorrect for Shetland. This has been amended in the collision risk analysis (Appendix 6.1 of the 2020 SEI) used to inform an assessment of the 2020 Layout.

Numbers of non-breeding divers

6.5.15 SNH state that "*Section 6.9.99 of the EIAR states that up to 103 individual red-throated divers were present in July 2016. With 10 proven breeding pairs and a further 20 possible or probable this would imply the presence of between 43 and 83 non-breeding individuals, which appears improbably high. Non-breeding divers tend to move between water bodies and this can result in double counting which may explain the high numbers reported. If this is the case then the assertion in 6.9.100 that most collisions are likely to involve non-breeding birds is questionable.*"

6.5.16 The Applicant acknowledges that the number of reported non-breeding individuals is high, and this was noted by the surveyors[1]. Simon Pinder completed the survey work in 2018 and is very experienced with surveying red-throated diver. Simon Pinder is an experienced ornithologist with relevant survey experience extending back to 1995, most of which has involved work on Shetland. He has been a warden at a number of reserves throughout the UK, including Fair Isle in 2002. He is an experienced European Seabirds At Sea (ESAS) observer and trainer, and has undertaken bird surveys on Shetland to inform the Viking Wind Farm development. Simon Pinder (pers. comm.) noted that there were more divers present than suitable breeding habitat available, and that the colony included a relatively high number of immature birds based on his experience. A large proportion of the flightlines recorded during the work in both years were a result of immature birds flying between lochans and circling in groups, especially later in the season. This is represented in the flightline data, and illustrated in Figure 6.3 of the 2020 SEI, which indicates a large proportion of wheeling and looping flights typical of non-breeding birds.

6.5.17 Red-throated divers are reasonably predictable in their flight behaviour when brooding and provisioning young. Furness (2015; referencing Furness, 1983 and Eriksson, *et al.* 1990) indicate that flights by breeding birds are direct between the nest site and foraging areas at sea, and occur at a consistent frequency. Figure 6.3 of the 2020 SEI illustrates the flight routes used, based on flightline data, between lochans within the site (breeding sites) and the sea (foraging area). It is reasonable to conclude from the flightlines presented in the figure, and based on observations by Furness (2015), that the majority of flights by breeding birds are unlikely to pass within the volume occupied by turbine rotors.

6.5.18 Pennington *et al.* (2013) indicate that the majority of chicks fledge in August, and are then accompanied by the adults to the sea. Breeding adults are, therefore, unlikely to make regular flights around turbines post-breeding unless nests fail, in which case, some breeding adults may make more unpredictable movements over land. Nevertheless, it remains reasonable to conclude that non-breeding birds, by virtue of not only of their number, but also their flight behaviour, are more likely to collide with turbines than are breeding adults. The predicted collision risk of between 0.18

[1] As a point of reference, red-throated diver surveys completed in 2005 and 2006 to inform the Viking Wind Farm application estimated that approximately 35% (39/111 birds) and 34% (49/145 birds), respectively were non-breeding (Natural Research Projects, 2009).

and 0.22 birds per year, or between 5 and 7 collisions over the operational lifespan of the Proposed Development, is therefore likely to be weighted towards collisions of non-breeding birds. It is considered that the effect on the population is, therefore, likely to be imperceptible, as rates of fledgling (due to predation) and overwintering survival for first year birds are likely to be low (as suggested by O'Brien *et al*, 2018). If adult / breeding birds were killed, this would potentially open up an opportunity for the recruitment of sub adults into the breeding population to replace them (which is likely given the number of non-breeding birds present).

Assessment of cumulative impacts

6.5.19 SNH state that "*The assessment of cumulative impacts is inadequate to assess impacts on Natural Heritage Zone (NHZ) populations of a number of species of high conservation importance. Given the existence in Shetland of other consented wind farms that are likely to have an impact on birds, particularly on red-throated diver, a proper quantitative analysis is required following the methodology set out in SNH guidance.*"

6.5.20 The cumulative impact assessment provided in the 2019 EIA Report concluded that the residual impacts arising as a result of the Proposed Development would not be significantly greater when taken in combination with other wind farm developments than in isolation (significant at no more than the Local level). In reaching this conclusion, all consented or operational wind farms within the Shetland NHZ for which ornithological data were available were considered. In light of the comment received from SNH, the assessment has been presented as a quantitative analysis, and is presented in Section 6.8 of this report.

RSPB Scotland

6.5.21 RSPB Scotland's response included concerns over population estimates for a number of species, and displacement distances referenced for waders and skuas within the assessment. RSPB Scotland also raised concern regarding incorrect mean daylight hours used in the collision risk analysis, and an inadequate assessment of cumulative effect; both of which have been addressed in the response to SNH's comments above.

6.5.22 In addition to those comments addressed below, RSPB Scotland has indicated that they have "*considerable concerns regarding the size and location of this proposed development*" and that "*Insufficient mitigation and offsetting measures have been proposed to address the potentially significant effects (including displacement and cumulative effects) of the proposed development on several nationally and internationally important bird species (including red-throated diver, merlin, golden plover and curlew).*"

6.5.23 The 2020 Layout has a much lessened development footprint, along with reduced collision risk for all species (on account of six fewer turbines and reduced maximum tip height of six of the remaining turbines), and reduced risk of construction and operational phase disturbance and/or displacement. Mitigation for loss of breeding and foraging habitat as a result of land take, displacement and / or disturbance has been refined (in Appendix 7.1 of the 2020 SEI) to provide further detail and evidence a commitment to delivery of a habitat management plan.

Population size

6.5.24 RSPB Scotland states that "*In our opinion the effects on various birds of conservation concern / listed in Annex 1 of the Birds Directive / listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) are likely to be substantially greater than predicted in the EIA Report. This is due to inappropriate population estimates and insufficiently precautionary assumptions about displacement, amongst other issues, and we request that assessments (including in-combination effects) are redone."*

6.5.25 RSPB Scotland go on to state that "*It is important to note that the figures from Wilson et al are derived from Massimino et al. (2011) which have the following caveat 'Estimates for these two regions are likely to be significant over-estimates of true abundance, due to the limited data from these regions which mean that the spatial smooth fitted to the GAM is fitted with considerable*

uncertainty (see text for more details)'. Shetland is one of the two regions to which this caveat refers. In view of this, RSPB Scotland considers that the 2015 golden plover population number is likely to be an over estimate and that the assessment should be redone based on the 2004 estimate."

6.5.26 Table 6.2 (below) replicates the table provided by RSPB Scotland to illustrate the variation between population estimates provided by Pennington *et al*. (2004) and those on which the 2019 assessment was based (referencing Wilson *et al*, 2015).

6.1.2 **Table 6.2 – Population comparison (taken from RSPB Scotland's consultation response).**

Species	Pennington *et al.* 2004 (pairs)	EIA Report (pairs)
Curlew	2,300 – 4,479	4,227
Dunlin	1,700	2,054
Golden plover	1,450	5,665
Snipe	1,800-7,721	6,728
Arctic skua	250-300	516

Curlew

6.5.27 It is acknowledged that the Wilson *et al.* (2015) estimate is based on figures contained in Massimino *et al.* (2011), but also supported by O'Brien *et al.* (2002) and O'Brien & White (2004). The Massimino paper is a peer-reviewed BTO research study commissioned to predict the impacts on waders by wind farms based on BBS densities and a range of habitat and environmental variables. However, Wilson *et al.* note that the estimate for Shetland should be treated with caution (based on doubt expressed by RSPB staff relating to the differences between the Shetland and Orkney and North Caithness estimates). Given this, it is likely that the lower 95 % confidence limit figure of 3,643 pairs provided by Wilson *et al.* is likely to be more reflective of the current population than the 4,227 (or indeed the upper 95% confidence limit of 4811) estimate. This is within the 2,338 and 4,479 pairs suggested by Harvey (2003) (as referenced in Pennington *et al*. 2004), and more recent than the 2,300 pairs estimate, which was based on surveys completed in 1998 and 1999.

6.5.28 It is clear from the results of the British Trust for Ornithology (BTO) Breeding Bird Survey (Harris *et al.,* 2019) that curlew are in decline throughout the UK. It is therefore unlikely that the population in Shetland has seen an increase since either the Pennington *et al.* or Wilson *et al*. estimates were made. However, curlew are still a common breeding resident throughout Shetland (SBC, 2019), and the population density in Shetland remains high (Balmer *et al*, 2013). In the absence of any recent estimate of the population, it is considered appropriately precautionary to use the lower 95 % confidence limit figure of 3,643 pairs provided by Wilson *et al*. (2015). The number of territories recorded within the site and surrounding areas during survey work in 2016 and 2018 therefore comprise between 0.4 and 0.6 % of the Shetland NHZ population. The importance of the site for breeding curlew is unlikely to extend beyond the **National (UK)** Level, and the evaluation presented in the 2019 EIA Report (see Table 6.1) remains valid.

Dunlin

6.5.29 The Wilson *et al.* (2015) derived population estimate of 2,054 is based on the 1987 estimate given in Pennington *et al*., (2004) of 1,700 pairs and updated to reflect abundance change data between the 1990 Atlas (Buckland *et al.*, 1990) and 2011 Atlas (Francis, *et al.*, 2011) data for north-east Scotland. Despite the very aged estimate suggested by Pennington *et al*., it is acknowledged that the Wilson *et al*. estimate is also now unlikely to be accurate given the reported declines of dunlin throughout their range (BirdLife International, 2019). In light of this, it is agreed that the lower figure of 1,700 pairs (provided by Pennington *et al*.) is used. Given the observed contractions of the UK breeding population, and location of the Proposed Development site within the core breeding range of the species, it is considered likely that the site is of **National (UK)** Importance for dunlin. The

evaluation presented in the 2019 EIA Report (see Table 6.1 of this 2020 SEI chapter) remains valid as the importance of the Site for dunlin is unlikely to extend beyond the National level.

Golden Plover

6.5.30 The Wilson *et al.* (2015) population estimate for golden plover (5,665 pairs) is markedly different to the estimate provided in Pennington *et al*., (2004) (1,450 pairs). However, the Pennington *et al*. estimate is based on survey data from the 1980s, and is therefore unlikely to reflect the current situation. Hayhow *et al,* (2017) reported a 20 % decrease between 1995 and 2015; however, SNH (2019) suggest that golden plover have shown a recent short-term increase of more than 10 % in Scotland, and an overall long-term increase of 3 % since 1994.

6.5.31 RSPB Scotland make reference to the consultation response of the Viking Wind Farm, in which an estimate of 2,600 pairs is used as a basis for assessment (based on 50 % of the lower 95 % confidence limit given in Wilson *et al*., 2015). The RSPB maintain that this is still an overestimate; however, there is little supporting information to indicate a lower population (given the absence of recent estimates). It is our opinion that an estimate of 2,600 pairs would be sufficiently precautionary, given the recent increases reported for Scotland.

6.5.32 The 2019 EIA report indicates that impacts on birds using the site may have effects at the UK population level, although, given the extent of the species' breeding range outside of the UK, these are unlikely to have significance at the European level. This assessment is valid irrespective of the Shetland NHZ population estimate. The value of the site for golden plover is therefore considered important at the **National (UK)** level, and is consistent with the evaluation presented in Table 6.1 of the 2020 SEI.

Snipe

6.5.33 The Wilson *et al.* (2015) estimate of 6,728 pairs is towards the upper figure in the range of 1,800 – 7,721 referenced by Pennington *et al.* (2004). However, Pennington *et al.* notes that the lower figure in the range was based on a comparatively small sample survey undertaken in 1998 and 1999, with an adjustment made to previous estimates to reflect an apparent decline. The decline had not been supported by other anecdotal evidence of breeding successes, and therefore was considered by Pennington *et al*. to be too low. Subsequent work completed by the Shetland Biological Records Centre in 2002 produced a population estimate of between 4,642 and 7,721 pairs, which is broadly reflective of the 95 % confidence intervals of 5,672 and 8,576 given by Wilson *et al*.

6.5.34 Whilst recent declines have occurred in lowland populations throughout the UK, Balmer *et al* (2013) suggest increases in Scotland of 30% between 1995 and 2010 and SNH (2019) note a 43 % increase in abundance between 1994 and 2018. Hayhow *et al.* (2017) also report a UK-wide increase of 19 % between 1995 and 2015. In light of these reported increases, it is reasonable to conclude that the Wilson *et al.* (2015) estimate of 6,728 pairs is likely to be reflective of the current population. The 2019 EIA report concludes that the site is important for breeding snipe to the level of the **Region (Shetland)**. This is considered to remain valid as the importance of the site is unlikely to extend to the Country level given the extent of the population throughout Scotland.

Arctic Skua

6.5.35 It is acknowledged that the population estimate given by Wilson *et al.* (2015) is unlikely to be representative of the current situation, and further evidence of declines has been presented in the 2019 EIA Report.

6.5.36 The 2017 Shetland Bird Report (SBC, 2019) indicates that just 19 apparent occupied territories (AOT's) were recorded during a whole-island survey of Yell, contrasting with the 118 AOTs recorded during the Seabird 2000 work. SBC (2019) also report that productivity throughout Shetland was low; with only 4 chicks fledged from 58 monitored nests.

6.5.37 A total of 113 AOTs were reported to Shetland Bird Club in 2017. It is unlikely that the reports are wholly representative of the Shetland population, as records do not include all islands, and reports from mainland are sparse. However, given noted declines, the Wilson *et al.* estimate is likely to

represent an upper limit. The 2018 Viking EIA Report (Natural Research Projects, 2018) suggest that the current population on Shetland is 395 pairs, and base this estimate on the reported population trend (JNCC, 2016) since the Seabird 2000 census figure (Mitchell *et al* , 2004). This is higher than the range suggested by the Shetland Amenity Trust of 250 – 300 pairs. Therefore, on a precautionary basis, the upper limit of the estimate provided by the Shetland Amenity Trust has been used in this assessment.

6.5.38 The 2019 EIA Report concludes that the importance of the Proposed Development site is unlikely to extend to the European level due to the relatively low density of apparent occupied territories (when compared with the territories present locally). However, given the limited extent of the breeding range of this species within the UK, it is considered the site is of **National (UK)** importance for Arctic skua. This evaluation is considered to remain valid.

Displacement of waders

6.5.39 RSPB Scotland state that "*The EIA Report assumes that displacement of some nesting waders (golden plover, dunlin, lapwing, oystercatcher and redshank) around turbines will occur only within a distance of 200m from turbines in the proposed scheme and there is reference to a number of published studies including Pearce-Higgins et al. (2009). However, it is considered that this may be an underestimate of the displacement when compared to more recent papers e.g. Sansom et al. (2016) found that breeding golden plover abundance may be reduced by 79% up to 400 m away from operational turbines.*"

6.5.40 The disturbance distances applied to waders (with the exception or curlew, whimbrel and snipe) are considered precautionary, given that observations by Pearce-Higgins *et al*. (2012) found that there was no significant difference between golden plover, lapwing or dunlin densities at wind farm sites between pre-construction, construction and post-construction phases. Evidence collected by Fielding & Haworth (2012) between 2006 and 2011 at Farr Wind Farm, Mull also suggested that there was no displacement of golden plover as a result of turbine operation. In addition, McLoughlin *et al.* (2012) conducted post construction monitoring at Out Newton Wind Farm, in the East Riding of Yorkshire. This study, which recorded considerable baseline use of the area by wintering plovers pre-construction, did not suggest that birds were displaced, as slightly elevated use of the airspace close to the turbines was recorded following construction.

6.5.41 Recent studies by BSG Ecology[2] at a wind farm in East Yorkshire have recorded golden plover in winter flocks *foraging* close to the base of an operational wind turbine, suggesting that golden plovers are tolerant of turbines, albeit the observations were conducted outside of the breeding season. BSG Ecology has also observed flocks of lapwing in fields around the edge of an operational wind farm in Fenland (Cambridgeshire). In this situation considerable alternative farmland was available to the lapwing, and despite also using this area, birds were seen roosting within 100 m of turbines (albeit not between turbines).

6.5.42 Table 6.3 (*below*) presents the number of territories recorded during survey work in 2016 and 2018 within 400 m of proposed turbine locations within the 2020 Layout. A reduction in abundance within this area of 79% is also applied as an estimate of displacement impacts. Central territory locations recorded during survey work in 2016 and 2018, and a perimeter around proposed turbine locations relating to species-specific disturbance distances are presented in Figures 6.11 to 6.19 of the 2020 SEI.

[2] http://www.bsg-ecology.com/golden-plover-operational-wind-farm/

Table 6.3 – Number of wader territories recorded within 400 m of proposed turbine locations, and applied reduction in abundance of 79% as suggested by Sansom *et al*. (2016).

Species	Number of territories recorded within 400 m of proposed turbine locations	Applied reduction in abundance of 79%
Golden plover	4-10	3.2 - 7.9
Dunlin	20-21	15.8 – 16.6
Lapwing,	0	0
Oystercatcher	0	0
Redshank	1-2	0.8 - 1.6

6.5.43 On the basis of the impacts identified in 2020 SEI Table 6.3, the effects on lapwing and oystercatcher are evidently *negligible* and not significant.

6.5.44 The reduction in abundance of golden plover suggested in the 2019 EIA Report was between eight and 11 territories based on a 200 m perimeter of the 2019 Layout. This has now reduced based on the 2020 Layout to between four and ten territories (a reduction of abundance by 3.2 – 7.9 territories) of a total 13 territories recorded within the Survey Area in 2016 and 15 recorded in 2018 (see Figure 6.13 of the 2020 SEI). Disturbance / displacement impacts will therefore affect between 0.12 and 0.3 % of the Shetland NHZ population (based on a population of 2,600 pairs as presented above). Effects are likely to be adverse, but significant at no more than the Local (mid and north Yell) level, given the availability of suitable habitat (beyond the likely extent of displacement) within the Proposed Development site and locally, and likelihood (based on research referenced in the 2019 EIA Report) that population-level effects will not occur.

6.5.45 For dunlin, the 2019 EIA Report predicted displacement effects on between 20 and 25 territories (of a total 32 recorded in 2016 and 41 recorded in 2018). A reduction of abundance by 15.8 – 16.6 territories is predicted as a result of the 2020 Layout (see Figure 6.14 of the 2020 SEI). The conclusions of the 2019 EIA Report therefore remain valid (particularly given that impacts are likely to be limited to between 0.93 and 0.98 % of the Shetland population (1,700 pairs)), and effects will be adverse and significant at the Regional (Shetland) level.

6.5.46 The 2019 EIA Report identified two of eight redshank territories recorded during the 2018 survey work as being at risk of displacement impacts (based on the 2019 Layout), and that these impacts would be minor and effects unlikely to be of greater significance than at the Local level. The level of predicted impact has now reduced for the 2020 Layout (between 0.8 and 1.6 territories affected), and the assessment of effects provided in the 2019 EIA Report is considered to be accurate.

6.5.47 For curlew, whimbrel and snipe the disturbance and displacement distances referred to in the 2019 EIA Report are retained as the basis for assessment. These are based on Pearce-Higgins *et al.* (2012), which found that densities reduced by up to 40 % within 620 m (for curlew) and 500 m (for snipe) during construction and post-construction phases.

6.5.48 Between 4 and 6 curlew territories were recorded within 620 m of the proposed 2020 Layout turbine locations during the 2018 and 2016 survey seasons respectively (see Figure 6.11 of the 2020 SEI). Applying a 40 % reduction in abundance within this area gives a total of between 1.6 and 2.4 territories impacted. This represents approximately 0.04 - 0.07 % of the Shetland NHZ population of curlew (3,643 pairs). Effects are therefore considered likely to be adverse, but significant at no more than the Local level.

6.5.49 There were 23 snipe territories in each of the 2016 and 2018 survey seasons within 500 m of the turbine locations of the 2020 Layout (see Figure 6.12 of the 2020 SEI). Applying a 40 % reduction in abundance within this area gives a total of 9.2 territories impacted. Given that this represents a very

low proportion (0.13 %) of the Shetland population (estimated to be 6728 pairs), effects are considered likely to be adverse and significant at no more than the Local level.

6.5.50 The assessment of effects for whimbrel in the 2019 EIA Report is maintained. The report concludes that "*Baseline survey work at the Proposed Development site has not recorded whimbrel breeding within this distance of the Proposed Development (the nearest breeding pair were noted approximately 2.4 km from the nearest infrastructure). Operational phase displacement impacts on whimbrel are therefore likely to negligible and not significant at any geographic level."*

Displacement of skuas

6.5.51 RSPB Scotland state that "*RSPB Scotland is unaware of any published information on the displacement of either great or Arctic skuas due to terrestrial wind farm development affecting breeding habitat. In view of the lack of evidence and the importance of both species, it would be appropriate to apply the precautionary principle and assume a similar disturbance to waders as outlined above as we consider the values used in the EIA report to not be sufficiently precautionary.*"

6.5.52 As outlined in the 2019 EIA Report, and following observations made in Furness & Wade, 2012; Garthe & Hüppop 2004, it is considered that skuas are unlikely to demonstrate wide-ranging disturbance or displacement responses during construction or operation of wind farms. However, in the absence of focused studies of disturbance at on-shore wind farms, the impacts on arctic skua and great skua have been re-assessed on the precautionary basis that (as indicated for waders) abundance may be reduced by 79 % up to 400 m away from operational turbines. Based on the 2020 Layout, 27 great skua apparent occupied territories (AOT) (of a total 48 recorded during survey work in 2018) are within 400 m of proposed turbine locations (see Figure 6.16 of the 2020 SEI). Applying the 79 % reduction in abundance gives a total 21.3 AOT impacted by the Proposed Development. This is an increase of territories impacted, from 12 reported in the 2019 EIA Report (based on impacts extending to 100 m of the development footprint). The number of AOTs impacted by the 2020 Layout represents 5.4 % of the Yell population (currently 392 AOT; SBC, 2019) and 0.2 % of the Shetland NHZ population (10,377 AOT; Wilson, *et al*. 2015). This assessment is highly precautionary; however, given the large and expanding population of great skua on Shetland, effects are likely to be adverse but remain significant at no more than the County (Yell) level.

6.5.53 For arctic skua, two AOTs are located within 400 m of turbines with the 2020 Layout (see Figure 6.17 of the 2020 SEI). Applying the 79 % reduction in abundance gives a total 1.58 AOT impacted by the Proposed Development. This represents an increase of impacts from one AOT considered at risk of disturbance and displacement in the 2019 EIA Report. However, the number of AOTs impacted by the 2020 Layout represents 8.32 % of the Yell population (currently 19 AOT; SBC, 2019) and 0.53 % of the Shetland NHZ population (300 AOT; as indicated in paragraph 6.5.37). Effects are therefore considered likely to be adverse, but significant at no more than the County (Yell) Level.

Shetland Bird Club

6.5.54 The SBC state that "*We consider that the Environmental Impact Assessment (EIA) Report seriously* underestimates *the adverse effects of this proposed development on important species and habitat in the area. We consider that the development would have a serious adverse effect on the populations of red-throated diver, merlin, golden plover, dunlin, whimbrel, curlew and arctic skua…*"

6.5.55 The importance of these species have been re-evaluated above, and residual impacts assessed in the following sections based on the 2020 Layout.

6.5.56 The SBC go on to state that "*The habitat management plan should be much more detailed and extensive. It should include the enhancement of potential merlin nesting habitat, as the EIA Report currently has contradictory statements on this.*"

6.5.57 The Applicant can confirm that habitat management to benefit merlin will be undertaken to compensate for the loss of suitable foraging and nesting habitat resulting from land-take and displacement effects. The areas surrounding existing territories within the Proposed Development site will be protected from over-grazing through provision of stock fencing. The extent and location

of stock fencing will be detailed in the HMP, but protected areas should be more than 500 m from the nearest turbines, and will aim to support the objectives of the Shetland Action Plan for this species. In addition, off-site habitat management will be undertaken to provide wider benefit to merlin. A summary of off-site management is detailed in the Draft HMP in Appendix 7.1 of the 2020 SEI, Shetland Amenity Trust would be part of the HMP stakeholder group.

Shetland Amenity Trust

6.5.58 The SAT reiterates the comments made by SNH and RSPB Scotland relating to population estimates, cumulative assessment and collision risk analysis (in respect of the figures for mean daylight hours used in the analysis). These comments have been addressed in the response to the SNH comments above.

6.6 Additional Mitigation

Construction Phase Mitigation

General Measures for Ground-Nesting Birds

6.6.1 The mitigation measures summarised in the 2019 EIA Report will be applied in respect of the 2020 Layout. The Habitat and Red-throated Diver Plans are provided in the accompanying Draft Habitat Management Plan (see 2020 SEI Appendix 7.1).

6.6.2 Specific measures to avoid and mitigate construction phase impacts will be detailed within a Construction Environment Management Plan (CEMP).

Additional Species-Specific Measures

6.6.3 In addition to general measures for mitigating impacts on nesting birds during construction, the 2019 EIA Report also sets out measures to avoid disturbance effects based on published species-specific disturbance distances. For some species, the disturbance distances have been re-assessed based on comments received from stakeholders (and addressed in Section 6.5 of the 2020 SEI). Therefore, in variation to the methods set out in the 2019 EIA Report, work exclusion zones for each species will be set in accordance to the revised disturbance distances contained in Table 6.4 of the 2020 SEI (below).

6.6.4 To identify the requirement for an exclusion zone, the Ecological Clerk, Works (ECoW) will scan for breeding birds within a perimeter of 620 m of the Proposed Development footprint ahead of the active works. If breeding is confirmed within the disturbance distance for the species in relation to the Proposed Development footprint, then active works will be prohibited in that area (as marked out by the ECoW) with allowance for passage by low-level construction traffic only until the ECoW is satisfied that the nesting attempt has been concluded / the young are capable of dispersal. The outcome of all recorded nests will be recorded by the ECoW and included in an annual report.

Table 6.4 - Breeding season search perimeters and exclusion zones around the Proposed Development footprint.

Species	Search/exclusion distance
Curlew	620 m
Whimbrel	620 m
Lapwing	400 m
Golden Plover	400 m

Species	Search/exclusion distance
Dunlin	400 m
Great Skua	400 m
Arctic Skua	400 m
Merlin	500 m

Operational Phase Mitigation

6.6.5 Post-construction management of breeding bird habitats within the Proposed Development site will be undertaken for the operational life of the Proposed Development (30 years). General measures to benefit red-throated diver, waders and merlin have been provided in the 2019 EIA Report. These have been developed further within this 2020 SEI and are detailed within 2020 SEI Appendix 7.1.

Decommissioning Phase Mitigation

6.6.6 Decommissioning will broadly follow measures proposed for construction of the Proposed Development. Mitigation will be tailored to avoidance of impacts (through disturbance and displacement) on those species that breed, roost or forage within the Proposed Development site at that time.

6.7 Assessment of Residual Effects

6.7.1 Following the change in design of the Proposed Development a re-assessment of the residual effects of the Proposed Development upon the receptors identified in the 2020 SEI has been undertaken. This assessment assumes that all mitigation detailed within the 2019 EIA Report is undertaken. The following text presents an overview of residual effects during construction and operation of the Proposed Development based on the 2020 Layout. Table 6.5 provides further detail of residual effects on ornithological receptors. These include a comparison of residual effects between the 2019 and 2020 Layout for construction phase disturbance and displacement, operational phase disturbance, displacement and collision mortality.

Construction

6.7.2 The 2020 SEI identified the following construction phase effects:

- Disturbance and displacement of greylag goose (up to 15 territories[3]), red-throated diver (up to 3 territories), curlew (up to 2.4 territories), dunlin (up to 16.6 territories), golden plover (up to 7.9 territories), redshank (up to 1.6 territories), ringed plover (1 territory), snipe (up to 13.2 territories), great skua (up to 21.3 territories), Arctic skua (1 territory), and merlin (2 territories).

6.7.3 Construction phase effects will be minimised through the timing of the work and the use of buffer zones. Pre-development surveys and the adoption of habitat management measures will ensure that death or injury of any bird is not likely.

Operation

6.7.4 During the operation phase the following impacts may occur due to the presence of turbines:

[3] Based on the maximum number of territories recorded /year within published disturbance distance of infrastructure.

- Displacement of red-throated diver (up to 3 territories), curlew (up to 6 territories), dunlin (up to 16.6 territories), golden plover (up to 7.9 territories), redshank (up to 1.6 territories), snipe (up to 13 territories), great skua (up to 21.3 territories), and Arctic skua (1 territory).
- Collision with turbines of greylag goose (1 bird every 6.6 to 7.1 years), red-throated diver (1 bird every 4.5 to 5.5 years), whimbrel (1 bird every 50 years), curlew (1 bird every 100 to 142 years), golden plover (1 bird every to 2.9 to 250 years), great skua (1 bird every 2.5 years), Arctic skua (1 bird every 100 to 250 years), Arctic tern (1 bird every 45 to 83 years) and fulmar (1 bird every 5 to 20 years)

6.7.5 Any displaced territories will be accommodated through retained habitat, and areas of enhancement to create more favourable nesting habitat. It is expected that displacement effects can be fully mitigated through habitat enhancement.

6.7.6 Collision-related mortality is predicted to be low for all species and of a magnitude where it is expected that there will be no discernible population-level effect above natural mortality levels.

Decommissioning

6.7.7 During the decommissioning phase impacts may occur that are similar to those predicted for the construction phase.

Table 6.5 - Summary of Residual Effects

Description of Effect	2019 Layout Residual Effects		Comparison of effects	2020 Layout Residual Effects	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Construction					
Bluemull and Colgrave Sounds SPA: disturbance and displacement of red-throated diver	Negligible	Adverse	Displacement effects may occur at up to 3 red-throated diver territories based on the 2020 Layout. The 2019 EIA Report predicted that up to 6 territories may be affected. Residual effects are likely to remain Negligible.	Negligible	Adverse
Fetlar SPA: disturbance and displacement of dunlin and great skua	Negligible	Adverse	The 2019 EIA Report predicted that between 20 and 25 Dunlin territories would be impacted. This is reduced under the 2020 Layout to 15.8 – 16.6 territories. For great skua, the predicted number of territories disturbed or displaced has increased from 12 in the 2019 EIA Report to 20.54 as a result of variation of assessment. However, the number of territories potentially affected (in the absence of mitigation) represents 0.2 % of the Shetland NHZ population. Residual effects are likely to remain Negligible.	Negligible	Adverse
East Mires SSSI: disturbance and displacement of moorland breeding birds	Negligible	Adverse	The footprint of the 2020 Layout is smaller than that of the 2019 Layout. Residual effects are likely to remain negligible.	Negligible	Adverse

Description of Effect	2019 Layout Residual Effects		Comparison of effects	2020 Layout Residual Effects	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Construction					
Hascosay SSSI: disturbance and displacement of dunlin	Negligible	Adverse	The 2019 EIA Report predicted that between 20 and 25 Dunlin territories would be impacted. This is reduced under the 2020 Layout to 15.8 – 16.6 territories. Residual effects are likely to remain Negligible.	Negligible	Adverse
North Fetlar SSSI: disturbance and displacement of great skua	Negligible	Adverse	The predicted number of great skua territories disturbed or displaced have increased from 12 in the 2019 EIA Report to 20.54 as a result of variation of assessment. However, the number of territories potentially affected (in the absence of mitigation) represents 0.2 % of the Shetland NHZ population. Residual effects are likely to remain Negligible	Negligible	Adverse
Lamb Hoga SSSI: disturbance and displacement of dunlin and great skua	Negligible	Adverse	The 2019 EIA Report predicted that between 20 and 25 Dunlin territories would be impacted. This is reduced under the 2020 Layout to 15.8 – 16.6 territories. For great skua, the predicted number of territories disturbed or displaced have increased from 12 in the 2019 EIA Report to 20.54 as a result of variation of assessment. However, the number of territories potentially affected (in the absence of mitigation) represents 0.2 % of the Shetland NHZ population. Residual effects are likely to remain Negligible.	Negligible	Adverse

Description of Effect	2019 Layout Residual Effects		Comparison of effects	2020 Layout Residual Effects	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Construction					
Greylag Goose disturbance and displacement	Negligible	Adverse	Adopting the 2020 Layout, between 9 and 15 previously used territories (recorded during the breeding seasons of 2018 and 2016 respectively) may be affected (based on disturbance effects extending to 100 m from infrastructure). The 2019 EIA report predicted between 11 and 18 territories would be affected. Residual effects are likely to remain Negligible.	Negligible	Adverse
Red-throated diver disturbance and displacement	Local	Adverse	Displacement effects may occur at up to 3 red-throated diver territories based on the 2020 layout. The 2019 EIA Report predicted that up to 6 territories may be affected. Residual effects are likely to be reduced for the 2020 Layout compared with the 2019 Layout.	Local	Adverse
Curlew disturbance and displacement	Local	Adverse	The 2019 EIA Report predicted that up to 8 curlew territories would be disturbed or displaced as a result of the 2019 Layout. The number of curlew territories recorded within 620 m of the 2020 Layout infrastructure was 7 (in 2016) and 4 (in 2018). Applying a 40 % reduction in abundance within this area gives a total of between 1.6 and 2.8 territories impacted. Residual effects are likely to be reduced for the 2020 Layout compared with the 2019 Layout.	Local	Adverse

Description of Effect	2019 Layout Residual Effects		Comparison of effects	2020 Layout Residual Effects	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Construction					
Dunlin disturbance and displacement	Local	Adverse	The 2019 EIA Report predicted that between 20 and 25 Dunlin territories would be impacted. This is reduced under the 2020 Layout to 15.8 – 16.6 territories. Residual effects are likely to be reduced for the 2020 Layout compared with the 2019 Layout.	Local	Adverse
Golden plover disturbance and displacement	Local	Adverse	The 2019 EIA Report predicted that the number of territories potentially affected was between 8 and 11 for the 2019 Layout (based on presence within 200 m of the infrastructure footprint). Between 4 and 9 territories were present within 400 m of turbine locations within the 2020 Layout during survey work in 2016 and 2018 respectively. This would result in a reduction of abundance by 3.2 – 7.1 territories. Residual effects are likely to be reduced for the 2020 Layout compared with the 2019 Layout.	Local	Adverse
Redshank disturbance and displacement	Negligible	Adverse	One territory was recorded within 400 m of the 2020 Layout infrastructure in each of 2016 and 2018. The 2019 EIA Report considered that up to 3 territories could be affected within 200 m of infrastructure Residual effects are likely to remain Negligible.	Negligible	Adverse

Description of Effect	2019 Layout Residual Effects		Comparison of effects	2020 Layout Residual Effects	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Construction					
Ringed Plover disturbance and displacement	Negligible	Adverse	There is no difference in infrastructure layout within 200 m of the ringed plover territory recorded during survey work. Residual effects are likely to remain Negligible.	Negligible	Adverse
Snipe disturbance and displacement	Local	Adverse	Between 31 (based on 2016 data) and 42 (based on 2018 data) territories were recorded within 500 m of the 2019 Layout. This is reduced to 23 to 33 territories based on the 2020 Layout. Residual effects are likely to be reduced for the 2020 Layout compared with the 2019 Layout.	Local	Adverse
Great skua disturbance and displacement	Local	Adverse	The predicted number of great skua territories disturbed or displaced has increased from 12 in the 2019 EIA Report to 20.54 as a result of variation of assessment. However, the number of territories potentially affected (in the absence of mitigation) represents 0.2 % of the Shetland NHZ population. Residual effects are unlikely to be greater for the 2020 Layout, and the conclusion of significance remains the same.	Local	Adverse
Arctic skua disturbance and displacement	Local	Adverse	The 2019 EIA Report considered that impacts on 2 territories within 100 m of infrastructure would occur.	Local	Adverse

Description of Effect	2019 Layout Residual Effects		Comparison of effects	2020 Layout Residual Effects	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Construction					
			The 2020 Layout may result in disturbance and displacement of 1.58 Arctic skua territories (based on a reduction in abundance of 72 % within 400 m of infrastructure). Residual effects are likely to be reduced for the 2020 Layout compared with the 2019 Layout.		
Merlin disturbance and displacement	Local	Adverse	The reduced footprint of the 2020 Layout will result in loss of a small proportion of the total nesting and foraging habitat available. The 2020 Layout is in excess of 500 m from recorded nest sites. Residual effects are likely to be reduced for the 2020 Layout compared with the 2019 Layout.	Local	Adverse

Description of Effect	2019 Layout Residual Effects		Comparison of effects	2020 Layout Residual Effects	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Operation					
Bluemull and Colgrave Sounds SPA: displacement of red-throated diver	Negligible	Adverse	Displacement effects may occur at up to 3 red-throated diver territories based on the 2020 layout. The 2019 EIA Report predicted that up to 6 territories may be affected. Residual effects are likely to remain Negligible.	Negligible	Adverse
Fetlar SPA: displacement of dunlin and great skua	Negligible	Adverse	The 2019 EIA Report predicted that between 20 and 25 Dunlin territories would be impacted. This is reduced under the 2020 Layout to 15.8 – 16.6 territories. For great skua, the predicted number of territories disturbed or displaced has increased from 12 in the 2019 EIA Report to 20.54 as a result of variation of assessment. However, the number of territories potentially affected (in the absence of mitigation) represents 0.2 % of the Shetland NHZ population. Residual effects are likely to remain Negligible.	Negligible	Adverse
East Mires SSSI: displacement of moorland breeding birds	Negligible	Adverse	The footprint of the 2020 Layout is smaller than that of the 2019 Layout. Residual effects are likely to remain Negligible.	Negligible	Adverse
Hascosay SSSI: displacement of dunlin	Negligible	Adverse	The 2019 EIA Report predicted that between 20 and 25 Dunlin territories would be impacted. This is reduced under the 2020 Layout to 15.8 – 16.6 territories.	Negligible	Adverse

Description of Effect	2019 Layout Residual Effects		Comparison of effects	2020 Layout Residual Effects	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Operation					
			Residual effects are likely to remain Negligible.		
North Fetlar SSSI: displacement of great skua	Negligible	Adverse	The predicted number of great skua territories disturbed or displaced has increased from 12 in the 2019 EIA Report to 20.54 as a result of variation of assessment. However, the number of territories potentially affected (in the absence of mitigation) represents 0.2 % of the Shetland NHZ population. Residual effects are likely to remain Negligible	Negligible	Adverse
Lamb Hoga SSSI: displacement of dunlin and great skua	Negligible	Adverse	The 2019 EIA Report predicted that between 20 and 25 Dunlin territories would be impacted. This is reduced under the 2020 Layout to 15.8 – 16.6 territories. For great skua, the predicted number of territories disturbed or displaced has increased from 12 in the 2019 EIA Report to 20.54 as a result of variation of assessment. However, the number of territories potentially affected (in the absence of mitigation) represents 0.2 % of the Shetland NHZ population. Residual effects are likely to remain Negligible.	Negligible	Adverse
Greylag goose collision	Negligible	Adverse	Modelling has resulted in a predicted rate of collision of between 0.14 (2016) and 0.15 (2017/18) birds per annum (based on 99.8 % avoidance). This equates to one bird killed every 6.8 to 7.1 years. The 2019 EIA report predicted between 0.12 and 0.15 collisions per year.	Negligible	Adverse

Description of Effect	2019 Layout Residual Effects		Comparison of effects	2020 Layout Residual Effects	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Operation					
			It is unlikely that the predicted collision mortality will have a discernible effect on the local or wider population. Residual effects are likely to remain Negligible.		
Red-throated diver displacement	Local	Adverse	Displacement effects may occur at up to 3 red-throated diver territories based on the 2020 layout. The 2019 EIA Report predicted that up to 6 territories may be affected. Residual effects are likely to be reduced for the 2020 Layout compared with the 2019 Layout.	Local	Adverse
Red-throated diver collision	Negligible	Adverse	Modelling has resulted in a predicted rate of collision of between 0.18 (2016) and 0.22 (2018) birds per annum (based on 99.8 % avoidance). This equates to one bird killed every 4.5 to 5.3 years. This represents a slight increase of up to 0.04 collisions per annum compared to the collision rate predicted in the 2019 EIA report. The assessment provided in the 2019 EIA report is considered to remain valid. Based on an average productivity rate of 6.38 birds per year within the site (following mean success rates recorded in SBC, 2018), a reduction of productivity by up to 0.22 birds per annum is considered unlikely to have a significant adverse effect on population of red-throated diver. Residual effects are likely to remain Negligible.	Negligible	Adverse

Description of Effect	2019 Layout Residual Effects		Comparison of effects	2020 Layout Residual Effects	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Operation					
Curlew displacement	Local	Adverse	The 2019 EIA Report predicted that up to 8 curlew territories would be disturbed or displaced as a result of the 2019 Layout. The number of curlew territories recorded within 620 m of turbines in the 2020 Layout was 7 (in 2016) and 4 (in 2018). Applying a 40 % reduction in abundance within this area gives a total of between 1.6 and 2.8 territories impacted. Residual effects are likely to be reduced for the 2020 Layout compared with the 2019 Layout..	Local	Adverse
Curlew collision	Negligible	Adverse	Modelling has resulted in a predicted rate of collision of between 0.01(2016) and 0.007 (2018) birds per annum (based on 99 % avoidance). This equates to one bird killed every 50.8 to 125.2 years. This predicted rate of collision is lower than that presented in the 2019 EIA Report (between 0.02 and 0.03 collisions per annum) Taking this predicted rate of collision, it is unlikely that the Proposed Development will kill any curlew during its 30-year operation. Residual effects are likely to remain Negligible.	Negligible	Adverse
Whimbrel displacement	Negligible	Adverse	Impacts on whimbrel are limited to very minor loss of suitable habitat as a result of land take. However, whimbrel territories have not been recorded within the site.	Negligible	Adverse

Description of Effect	2019 Layout Residual Effects		Comparison of effects	2020 Layout Residual Effects	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Operation					
			Residual effects are likely to remain Negligible.		
Whimbrel collision	Negligible	Adverse	Modelling has resulted in a predicted rate of collision of 0.02 (2016) birds per annum (based on 99 % avoidance). This equates to one bird killed every 48.8 years, and is a reduction in the mortality rate predicted in the 2019 EIA Report). Taking this predicted rate of collision, it is unlikely that the Proposed Development will kill any whimbrel during its 30-year operation.	Negligible	Adverse
Dunlin displacement	Site	Adverse	The 2019 EIA Report predicted that between 20 and 25 Dunlin territories would be impacted. This is reduced under the 2020 Layout to 15.8 – 16.6 territories. Residual effects are likely to be reduced for the 2020 Layout compared with the 2019 Layout..	Site	Adverse
Golden plover displacement	Site	Adverse	The 2019 EIA Report predicted that the number of territories potentially affected was between 8 and 11 for the 2019 Layout (based on presence within 200 m of the infrastructure footprint). Between 4 and 9 territories were present within 400 m of turbine locations within the 2020 Layout during survey work in 2016 and 2018 respectively. This would result in a reduction of abundance by 3.2 – 7.1 territories.	Site	Adverse

Description of Effect	2019 Layout Residual Effects		Comparison of effects	2020 Layout Residual Effects	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Operation					
			Residual effects are likely to be reduced for the 2020 Layout compared with the 2019 Layout.		
Golden plover collision	Negligible	Adverse	Modelling has resulted in a predicted rate of collision of between 0.004 (2016) and 0.35 (2018) birds per annum (based on 98 % avoidance). This equates to one bird killed every 2.8 to 203.8 years. The collision rate predicted in the 2019 EIA report was between 0.004 and 0.2 collisions per annum. The predicted mortality rate based on 2018 data is likely to be an overestimate, based on the exceptionally low mortality rate recorded by Dürr (2020), and likelihood that a 99 % avoidance rate can be applied to golden plover. Collision is considered unlikely to result in a significant impact on the local population, and effects will be indiscernible over the life of the Proposed Development. Residual effects are likely to remain Negligible.	Negligible	Adverse
Redshank displacement	Site	Adverse	One territory was recorded within 400 m of the 2020 Layout infrastructure in each of 2016 and 2018. The 2019 EIA Report considered that up to 3 territories could be affected within 200 m of turbines Residual effects are likely to be reduced for the 2020 Layout compared with the 2019 Layout.	Negligible	Adverse

Description of Effect	2019 Layout Residual Effects		Comparison of effects	2020 Layout Residual Effects	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Operation					
Snipe displacement	Local	Adverse	Between 31 (based on 2016 data) and 42 (based on 2018 data) territories were recorded within 500 m of the 2019 Layout. This is reduced to 23 to 33 territories based on the 2020 Layout. Residual effects are likely to be reduced for the 2020 Layout compared with the 2019 Layout.	Local	Adverse
Great skua displacement	Local	Adverse	The predicted number of great skua territories disturbed or displaced has increased from 12 in the 2019 EIA Report to 20.54 as a result of variation of assessment. However, the number of territories potentially affected (in the absence of mitigation) represents 0.2 % of the Shetland NHZ population. Residual effects are likely to be reduced for the 2020 Layout compared with the 2019 Layout.	Local	Adverse
Great skua collision	Negligible	Adverse	Modelling has resulted in a predicted rate of collision of 0.4 (2018) birds per annum (based on 99.5 % avoidance). This equates to one bird killed every 2.5 years, and is a slight increase to the collision rate predicted in the 2019 EIA Report (0.35 collisions per annum). Given the current great skua population increases reported in Shetland, and likely high productivity of the Proposed Development site, it is considered unlikely that a loss of 0.25 great skua per year as a result of collision with turbines will have any discernible effect on the population at any geographic level.	Negligible	Adverse

Description of Effect	2019 Layout Residual Effects		Comparison of effects	2020 Layout Residual Effects	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Operation					
			Residual effects are likely to be negligible for the 2020 Layout.		
Arctic skua displacement	Local	Adverse	The 2019 EIA Report considered that impacts on 2 territories within 100 m of infrastructure would occur. Based on the number and location of apparent occupied skua territories recorded during the 2018 survey work, the 2020 Layout may result in disturbance and displacement of 1.58 Arctic skua territories, representing 8.32 % of the Yell population and 0.53 % of the Shetland NHZ population. Residual effects are likely to be reduced for the 2020 Layout compared with the 2019 Layout.	Local	Adverse
Arctic skua collision	Negligible	Adverse	Modelling has resulted in a predicted rate of collision of between 0.004 (2016) and 0.01 (2018) birds per annum (based on 99.5 % avoidance). This equates to one bird killed every 80.5 to 237 years, and is a slight increase to the collision rate predicted in the 2019 EIA Report (of between 0.0003 and 0.02 collisions per annum) Taking this predicted rate of collision, it is unlikely that the Proposed Development will kill any Arctic skua during its 30-year operation. Residual effects are likely to be negligible for the 2020 Layout.	Negligible	Adverse
Arctic tern collision	Negligible	Adverse	Modelling has resulted in a predicted rate of collision of between 0.1 (2016) and 0.02 (2018) birds per annum (based on 98 % avoidance). This	Negligible	Adverse

Description of Effect	2019 Layout Residual Effects		Comparison of effects	2020 Layout Residual Effects	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Operation					
			equates to one bird killed every 10.2 to 64.2 years. This reflects the collision rate predicted in the 2019 EIA Report. The actual avoidance rate for Arctic tern may be greater than the default 98 % since no collisions have been documented in Europe by Dürr (2020) for this species, and the flight habits of terns are akin to gulls and skuas for which an accepted avoidance of 99.5 % is applied. The likelihood of collision of Arctic tern over the term of operation of the Proposed Development is very low. Residual effects are likely to be negligible for the 2020 Layout.		
Fulmar collision	Negligible	Adverse	Modelling has resulted in a predicted rate of collision of between 0.05 (2018) and 0.2 (2016) birds per annum (based on 98 % avoidance). This equates to one bird killed every 3.7 to 18.4 years. The 2019 EIA Report predicted a collision rate of between 0.06 and 0.18 collisions per annum. Collision risk is more likely to impact on dispersing juvenile birds than breeding adults. In addition, the number of fatalities is likely to be less than the worst-case prediction due to variations in activity over the site (as borne out by the differences of model output between years) and likelihood that avoidance rates in fulmar exceed the default 98 % (as suggested by Maclean *et al*., 2009). Residual effects are likely to be negligible for the 2020 Layout.	Negligible	Adverse

6.8 Assessment of Cumulative Effects

6.8.1 SNH (2012) guidance states that a cumulative ornithological assessment should assess the effects of the proposal in combination with:

- existing development, either built or under construction;
- approved development, awaiting implementation; and,
- proposals awaiting determination within the planning process with design information in the public domain.

6.8.2 Cumulative effects are most likely to result with regard to those receptors for which a significant residual effect is predicted, particularly if the core range of these receptors includes other planned, consented or built development. SNH noted (in their scoping opinion, dated 08 February 2018) that the Shetland NHZ should be the appropriate scale for consideration of cumulative impacts. SNH further advised that the key species for cumulative assessment should be red-throated diver, merlin, curlew and dunlin.

Wind farm Developments Considered

6.8.3 There are five consented or operational wind farms within the Shetland NHZ for which information has been sought. These are presented in Table 6.6.

Table 6.6 - Wind farm Developments Considered as part of Cumulative Assessment.

Wind farm	Distance (km)	Number of turbines	Footprint (ha)	Status
Garth	1.5	5	3	Consented
Beaw Field	15.3	17	8	Consented
Viking	37.3	103	97	Consented
Gremista	53.2	3	7.2	Consented
Mossy Hill	55.6	12	3	Consented

6.8.4 The availability of quantitative data is limited, particularly for the Garth and Gremista wind farms. For Garth, impact assessment was focussed on red-throated diver and great skua, with little information regarding likely displacement effects for other species. For Gremista, negligible effects were reported for all species, but no information is available for quantitative assessment. However, the reported impacts for both schemes were not significant for all species, and therefore, the absence of a full range of quantitative data is unlikely to affect the validity of the cumulative assessment. In addition, both schemes are relatively small, and unlikely to result in an increase in the significance of effects of the Proposed Development.

6.8.5 The determination of a barrier effects for all wind farms within the cumulative assessment is also difficult to quantify. This difficulty is acknowledged by SNH (2012), and suggests identification of the proportion of a species dispersal or migration route that is occupied by wind farm developments. It is unlikely that any of the wind farms within the Shetland NHZ are within a broad front migratory route for any of the species considered in this assessment. Given the geographical setting of Shetland, it is considered likely that the majority of migratory dispersal will occur over sea. Species most likely to be impacted by barrier effects on Shetland are those that make regular movements between an inland breeding site and foraging grounds at sea. The Proposed Development retains commuting routes for red-throated diver, and therefore no significant barrier effects are predicted. In addition, no turbines within the 2020 Layout are located between seabird colony locations and a

direct route to sea. Barrier effects are also stated to be not significant for any species in the assessment for the Viking, Beaw Field or Mossy Hill Wind Farms[4]. Given that no significant barrier effects are predicted for either the Proposed Development or any other wind farm in the Shetland NHZ, it is unlikely that a cumulative barrier effect will occur.

6.8.6 The below accounts consider cumulative effects for red-throated diver, merlin, curlew and dunlin. This scope of cumulative assessment was agreed by SNH (in their scoping opinion, dated 08 February 2018). An additional assessment has been provided for Arctic skua owing to their rapidly declining population in Shetland. Snipe have not been included in the below accounts, as effects on snipe were scoped out of the assessments for other schemes. However, the Beaw Field EIA Report (Peel Energy, 2016) indicate that between 3 and five pairs (between 0.04 % and 0.07 % of the (Wilson et al. 2015) NHZ population estimate of 6,728 pairs) would be subject to disturbance and displacement effects during operation of the wind farm. Given this, it is considered unlikely that cumulative impacts would be significantly greater than the predicted impacts of the Proposed Development in isolation.

6.8.7 Table 6.7 (below) presents the total collision mortality (birds per year), and Table 6.8 presents the predicted displacement impacts (number of territories lost) reported for the Proposed Development and all wind farms in the scope of cumulative assessment (with the exception of Gremista, for which there is no quantitative data).

6.8.8 For land-take impacts, the effective habitat loss may be larger than the actual footprint area of each development as a result of displacement effects. The extent of effective habitat loss will be different for each species, depending on their tolerance to disturbance and proximity of wind farm infrastructure to suitable habitats. This is difficult to quantify. For red-throated diver, the effective habitat loss is considered to be equal to the number of territories potentially lost due to displacement, since breeding habitat (lochans) are not directly lost to any of the developments. For other species, the effective loss of habitat will depend on the extent of suitable habitat within the footprint and a buffer equal to the likely disturbance distance for that species. This buffer will not be uniform around the footprint of a development, but will likely be greater around turbines, and much lower adjacent to tracks. It is also difficult to determine whether or not a species would have nested in an area within disturbance distance of a wind farm if it was not there, unless baseline survey data confirms its use pre-development. Therefore, the number of territories lost due to displacement is also used as a proxy for habitat loss.

[4] Barrier effects are not fully considered in the assessments for the Garth or Gremista Wind Farms.

Table 6.7 - Cumulative assessment of collision mortality (birds per year).

Species	Population of Shetland NHZ (individuals)	Sum of collision mortality (birds/year) at other wind farms	% of NHZ population potentially killed by other wind farms per annum	Impact magnitude for other wind farms	Collision mortality (birds/year) at the Proposed Development	% of NHZ population potentially killed by the Proposed Development and other wind farms in combination per annum	Impact magnitude of Proposed Development and other wind farms in combination
Red-throated diver	814	1.58 - 2.98	**0.19 - 0.37**	**Local**	0.19 - 0.22	**0.22 - 0.39**	**Local**
Arctic skua	600	2.03	**0.34**	**Local**	0.004 - 0.012	**0.34 - 0.35**	**Local**
Great skua	20,754	10.59	**0.05**	**Negligible**	0.4	**0.05**	**Negligible**
Curlew	7,286	18.28	**0.25**	**Local**	0.02-0.04	**0.25**	**Local**
Whimbrel	600	1.45	**0.24**	**Local**	0.04	**0.25**	**Local**
Golden plover	5,200	37.9 - 39.9	**0.72 - 0.77**	**Local**	0.004 - 0.35	**0.72 - 0.77**	**Local**

6.8.9 Given the very low risk of collision predicted for all species at the Proposed Development, the cumulative impact above the baseline collision impact predicted for other wind farms in the Shetland NHZ will be negligible. The cumulative effects of collision predicted for the Proposed Development in combination with those of other wind farms are likely to be no more than Local in significance.

Table 6.8 - Cumulative assessment of displacement (number of territories adversely impacted by displacement or disturbance during operation).

Species	**Population of Shetland NHZ (pairs)**	**Pairs displaced by other wind farms**	**% of NHZ population affected by other wind farms**	**Impact magnitude for other wind farms**	**Pairs displaced by Proposed Development**	**% of NHZ population affected by Proposed Development and other wind farms in combination**	**Impact magnitude of Proposed Development and other wind farms in combination**
Red-throated diver	407	4 - 5	**0.98 - 1.22**	**Negligible / Local**	2	**1.47 – 1.71**	**Local**
Arctic skua	300	5.5	**1.83**	**Local**	1.58	**2.36**	**Local**
Great skua	10,377	9	**0.09**	**Negligible**	21.3	**0.29**	**Negligible**
Curlew	3,643	25.5	**0.7**	**Negligible**	1.6 - 2.4	**0.74 - 0.77**	**Negligible**
Golden plover	2,600	18	**0.69**	**Negligible**	3.2 - 7.9	**0.96 - 1**	**Negligible to Local**
Dunlin	1,700	11	**0.64**	**Negligible**	15.8 – 16.6	**1.58 - 1.62**	**Local**
Merlin	355	1.45	**4.14**	**Local**	0	**4.14**	**Local**

[5] The Viking 2018 EIA Report states that 2018 surveys of Shetland recorded at least 50 territories and bases the assessment on a precautionary estimate of 35 pairs.

6.8.10 Cumulative displacement impacts are predicted to be negligible for curlew and golden plover (the percentage of the Regional (Shetland NHZ) population affected is predicted to be less than 1 %) and therefore not significant in EIA terms. For all other species, cumulative displacement impacts are considered to be Local significance (affecting between 1.47 % (for red-throated diver) and 4.14 % (for merlin) of the Regional (Shetland NHZ) population.

6.8.11 The assessment has indicated that the magnitude of cumulative displacement impacts on red-throated diver, arctic skua, curlew and merlin will not change significantly during operation of the Proposed Development. For golden plover and dunlin, the magnitude of impacts has been assessed as negligible (affecting < 1 % of the NHZ population) in the absence of the Proposed Development, but of Local significance in combination with the Proposed Development (cumulatively affecting between 0.96 and 1 % of the NHZ population for golden plover, and between 1.58 and 1.62 % of the NHZ population for dunlin. However, the magnitude of impacts on this species remains very low and is likely to be offset through habitat enhancement measures proposed to benefit breeding waders. Even in the absence of mitigation, it is likely that any pairs displaced by the Proposed Development would establish a territory elsewhere, and the significance of effects at the population level would be negligible.

Table 6.9 – Summary of 2019 Layout Report 2020 Layout 2019 EIA Layout 2020 Layout Cumulative Effects

Receptor	Effect	Cumulative Developments	2019 Layout Cumulative Effect		2020 Layout Cumulative Effect	
			Significance	Beneficial/ Adverse	Significance	Beneficial/ Adverse
Red-throated diver	Collision mortality	Garth, Beaw Field, Viking, Gremista, Mossy Hill	Local	Adverse	Local	Adverse
	Operational phase disturbance and displacement	Garth, Beaw Field, Viking, Gremista, Mossy Hill	Local	Adverse	Local	Adverse
Arctic skua	Collision mortality	Garth, Beaw Field, Viking, Gremista, Mossy Hill	Local	Adverse	Local	Adverse
	Operational phase disturbance and displacement	Garth, Beaw Field, Viking, Gremista, Mossy Hill	Local	Adverse	Local	Adverse
Great skua	Collision mortality	Garth, Beaw Field, Viking, Gremista, Mossy Hill	Local	Adverse	Negligible	Adverse
	Operational phase disturbance and displacement	Garth, Beaw Field, Viking, Gremista, Mossy Hill	Local	Adverse	Negligible	Adverse

Receptor	Effect	Cumulative Developments	2019 Layout Cumulative Effect		2020 Layout Cumulative Effect	
			Significance	Beneficial/ Adverse	Significance	Beneficial/ Adverse
Curlew	Collision mortality	Garth, Beaw Field, Viking, Gremista, Mossy Hill	Local	Adverse	Local	Adverse
	Operational phase disturbance and displacement	Garth, Beaw Field, Viking, Gremista, Mossy Hill	Local	Adverse	Negligible	Adverse
Whimbrel	Collision mortality	Garth, Beaw Field, Viking, Gremista, Mossy Hill	Not assessed	-	Local[6]	Adverse
Golden plover	Collision mortality	Garth, Beaw Field, Viking, Gremista, Mossy Hill	Local	Adverse	Local	Adverse
	Operational phase disturbance and displacement	Garth, Beaw Field, Viking, Gremista, Mossy Hill	Local	Adverse	Negligible	Adverse

[6] This is the baseline cumulative effect in the absence of the Proposed Development. When taken in isolation, impacts on whimbrel arising as a result of the Proposed Development are considered to be negligible.

Receptor	Effect	Cumulative Developments	2019 Layout Cumulative Effect		2020 Layout Cumulative Effect	
			Significance	Beneficial/ Adverse	Significance	Beneficial/ Adverse
Dunlin	Operational phase disturbance and displacement	Garth, Beaw Field, Viking, Gremista, Mossy Hill	Local	Adverse	Local	Adverse
Merlin	Operational phase disturbance and displacement	Garth, Beaw Field, Viking, Gremista, Mossy Hill	Local	Adverse	Local	Adverse

6.9 Comparison of Effects

6.9.1 Table 6.5 details the comparison of residual effects between the 2019 and 2020 Layout for both the construction and operational phases of the Proposed Development. The differences presented reflect a combination of the reduced development size, adjustment to the population estimates used as a basis for the assessment, and amendments to the collision risk analysis.

6.9.2 The extent of predicted disturbance and displacement impacts on most species during construction and operation of the Proposed Development has reduced for the 2020 Layout. For great skua, predicted impacts have increased due to consideration of a lower tolerance to disturbance than assumed in the 2019 EIA Report. However, even if the lower disturbance threshold is assumed for this species, the significance of disturbance effects remains low, and predicted residual effects unchanged from the 2019 EIA Report.

6.9.3 Changes made to the collision risk analysis through reduction of the Proposed Development, and amendments to the application of the model as suggested by stakeholders, has resulted in minor differences in the number of predicted collisions. The significance of collision risk effects is considered to be negligible for all species.

6.10 References

Amec, (2011). Gremista Wind Turbine Project Environmental Statement. Unpublished

Balmer D., Gillings, S., Caffrey, B., Swann, B., Downie, I., & Fuller, R. (2013). Bird Atlas 2007 – 2011. The breeding and wintering birds of Britain and Ireland. BTO Books, Thetford.

Band, W, Madders, M, & Whitfield, D.P. (2007) Developing field and analytical methods to assess avian collision risk at wind farms. In: Janss, G, de Lucas, M & Ferrer, M (eds.) Birds and Wind Farms. Quercus, Madrid. 259-275

BirdlLife International (2004) Birds in Europe: population estimates, trends and conservation status. BirdLife Conservation Series No. 12, Cambridge, UK.

2019.BirdLife International (2019). Calidris alpina (amended version of 2017 assessment). The IUCN Red List of Threatened Species 2019

Brown, A.F. & Shepherd, K.B (1993). A Method for Censusing Upland Breeding Waders. Bird Study, Vol. 40: 3, pp. 189 -195.

Buckland, S.T., Bell, M.V. & Picozzi, N. (1990) The birds of north-east Scotland. Scottish Ornithologists' Club, Aberdeen

Chamberlain, D.E., Freeman, S.N., Rehfisch, M.R., Fox, T. & Desholm, M. (2005). Appraisal of Scottish Natural Heritage's wind farm collision risk model and its application. BTO Research Report 401. British Trust for Ornithology, Thetford.

CIEEM (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester

Cramp, S. (1977). Handbook of the Birds of Europe the Middle East and North Africa. The Birds of the Western Palearctic. Ostrich to Ducks. RSPB / Oxford University Press.

Cramp, S. (1983). Handbook of the Birds of Europe the Middle East and North Africa. The Birds of the Western Palearctic. Waders to Gulls. RSPB / Oxford University Press.

Dürr, T. (2020). Vogelverluste an Windenergieanlagen / bird fatalities at wind turbines in Europe. Available at: http://ow.ly/wusS9. Accessed 30 January 2020

Eriksson, M.O.G., Blomqvist, D., Hake, M. & Johansson, O.C. (1990) Parental feeding in the red-throated diver Gavia stellata. Ibis, 132, 1-13.

Fielding, A.H., & Haworth, P.F. (2012) Farr Windfarm - Monitoring of breeding golden plover2006 to 2011. Haworth Conservation.

Finney, S.K., Pearce-Higgins, J.W. & Yalden, D.W. (2005) The effect of recreational disturbance on an upland breeding bird, the golden plover Pluvialis apricaria. Biological Conservation, 121, 53–63.

Francis, I., Cook, M., & Watson, A. (2011) The Breeding Birds of North-East Scotland. Scottish Ornithologists' Club, Aberdeen

Furness, R.W. (1977) Effects of Great Skuas on Arctic Skuas in Shetland. British Birds, 70: 96-107

Furness, R.W. (1983). The Birds of Foula. Brathay Hall Trust, Ambleside.

Furness, R.W. (2015). A review of red-throated diver and great skua avoidance rates at onshore wind farms in Scotland. Scottish Natural Heritage Commissioned Report No. 885

Grant, M. C. (1992). The effects of re-seeding heathland on breeding Whimbrel Numenius phaeopus in Shetland. I. Nest distributions. Journal of Applied Ecology 29: 501-508.

Hardey, J., Crick, H., Riley, H., Etheridge, B., and Thompson, D. (2013) Raptors: A field guide to surveys and monitoring. The Stationery Office; 3rd revised edition.

Harris, S.J., Massimino, D., Eaton, M.A., Gillings, S., Noble, D.G., Balmer, D.E., Pearce-Higgins, J.W. & Woodcock, P. (2019). The Breeding Bird Survey 2018. BTO Research Report 717. British Trust for Ornithology, Thetford.

Harvey, P. V. (2003) The Shetland breeding bird survey 2002 and an estimate of the population size of some of Shetland's commoner breeding birds. Shetland Bird Report 2002: 108-110

Hayhow, D. B., Ausden, M. A., Bradbury, R. B., Burnell, D., Copeland, A. I., Crick, H. Q. P., Eaton, M. A., Frost, T., Grice, P. V., Hall, C., Harris, S. J., Morecroft, M. D., Noble, D. G., Pearce-Higgins, J. W., Watts, O., Williams, J. M. (2017), The state of the UK's birds 2017. The RSPB, BTO, WWT, JNCC, NE and NRW, Sandy, Bedfordshire.

JNCC (2016) Seabird Population Trends and Causes of Change: 1986-2015 Report. Joint Nature Conservation Committee. Updated September 2016. Available at: http://www.jncc.defra.gov.uk/page-3201

Maclean, I.M.D., Wright, L.J., Showler, D.A., and Rehfisch, M.M. (2009). *A Review of Assessment Methodologies for Offshore Windfarms*. British Trust for Ornithology Report Commissioned by Cowrie Ltd

Musgrove, A., Aebischer, N., Eaton, M., Hearn, R., Newson, S., Noble, D., Parsons, M., Risley, K & Stroud, D. (2013). Population estimates of birds in Great Britain and the United Kingdom. British Birds 106: 64-100

Natural Research Projects (2009) Viking Wind Farm Environmental Statement. Chapter 11. Ornithology. Viking Energy Partnership

Natural Research Projects (2018) Viking Wind Section 36 Variation Application – EIA Report. Chapter 5. Ornithology. Viking Energy Windfarm LLP

North Yell Development Council. (2009). Garth Wind Farm Environmental Statement. Unpublished

Massimino, D., Johnston, A., Pearce-Higgins, J.W. (2011). Producing Regional Population Estimates for Upland Wader. BTO Research Report 58. BTO, Thetford.

McLoughlin, E., Grant, M., Zisman, S., & Bulman, R. (2012) Winter flight activity of golden plover at operational wind farms. SNH sharing good practice: Accessing the impacts of wind farms on birds.

O'Brien, M., Tharme, A., Jackson, D. (2002). Changes in breeding wader numbers on Scottish farmed land during the 1990s. Scottish Birds. 23. 10-21.

O'Brien, M., White, C. S. (2003). Estimating the breeding wader populations of Scottish uplands and salt marshes. Scottish Birds. 24. 17-28.

O'Brien, S., Ruffino, L., Lehikoinen, P., Johnson, L., Lewis, M., Petersen, A., Petersen, I.K., Okill, D., Väisänen, R., Williams, J. & Williams, S. (2018) Red-Throated Diver Energetics Project - 2018 Field Season Report. JNCC Report No. 627. JNCC, Peterborough, ISSN 0963-8091

Pearce-Higgins, J.W., Stephen, L., Douse, A., Langston, R. (2012) Greater impacts of wind farms on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis. Journal of Applied Ecology. 49, 2, April 2012, 386-394

Peel Energy (2016) Beaw Field Wind Farm Environmental Statement. Chapter 10: Ornithology. Unpublished.

Peel Energy. (2018). Mossy Hill Wind Farm Environmental Statement. Chapter 8 Ornithology. Unpublished

Pennington, M., Osborn, K., Harvey, P., Riddington, R., Okill, D., Ellis, P., Heubeck, M. (2004) The Birds of Shetland. Christopher Helm, London.

Pennycuick CJ, Åkesson S, Hedenström A. 2013. Air speeds of migrating birds observed by ornithodolite and compared with predictions from flight theory. J. R. Soc. Interface 10, 20130419 (10.1098/rsif.2013.0419)

Sansom, A., Pearce-Higgins. & Douglas, D. (2016). Negative impacts of wind energy development on a Breeding Shorebird Assessed with a BACI design. Ibis 158, 3.

Scottish Natural Heritage (2000) Windfarms and Birds - Calculating a theoretical collision risk assuming no avoiding action. SNH Guidance Note. Available at http://www.snh.gov.uk/docs/C205425.pdf

Scottish Natural Heritage (2009). Guidance on Methods for Monitoring Bird Populations at Onshore Wind Farms.. SNH, Inverness

Scottish Natural Heritage (2013). Avoidance rates for wintering species of geese in Scotland at onshore wind farms. SNH, Inverness.

Scottish Natural Heritage (2014). Recommended bird survey methods to inform impact assessment of onshore wind farms. Scottish Natural Heritage, Inverness.

Scottish Natural Heritage (2017). Recommended bird survey methods to inform impact assessment of onshore wind farms. Version 2. Scottish Natural Heritage, Inverness.

Scottish Natural Heritage (2018a). Avoidance Rates for the onshore SNH Wind Farm Collision Risk Model. Version 2. Scottish Natural Heritage, Inverness.

Scottish Natural Heritage (2018b). Assessing Significance of Impacts from Onshore Wind Farms Outwith Designated Areas. Scottish Natural Heritage, Inverness.

Scottish Natural HeritageSNH (2019) Index of Abundance for Scottish Terrestrial Breeding Birds, 1994 to 2018. Scottish Natural Heritage, Inverness.

Shetland Bird Club (2018) Shetland Bird Report 2016. Shetland Bird Club

Shetland Bird Club (2019) Shetland Bird Report 2017. Shetland Bird Club

Wilson, M.W., Austin, G.E., Gillings, S. and Wernham, C.V. (2015) Natural Heritage Zone Bird Population Estimates. SWBSG Commissioned Report: 1504.

Yalden, D.W. & Yalden, P.E. (1989). The sensitivity of breeding Golden Plovers Pluvialis apricaria to human intruders. Bird Study 36: 49–55.

Yalden, P.E. & Yalden, D.W. (1990). Recreational disturbance of breeding Golden Plovers Pluvialis apricaria. Biol. Conserv. 51: 243–262