5. ORNITHOLOGY

Executive Summary

The site and surrounding environs of the consented Viking Wind Farm supports moderate numbers of breeding birds of high or medium conservation importance. These include red-throated diver, merlin, whimbrel, golden plover, dunlin, curlew and two skua species. This chapter reports on the assessment of the likely significant effects on bird populations that may result from the proposed varied development (103 turbines with 155 m maximum tip height, based on candidate turbine parameters of 120 m rotor diameter) and examines how these differ from the predicted effects of the consented Viking Wind Farm (103 turbines and 145 m maximum tip height, based on candidate turbine parameters of 110 m rotor diameter).

The assessment focuses on collision risk and disturbance/displacement impacts during the operational stage, and, takes into consideration the changes in wind farm design and baseline conditions. SNH recommended collision risk modelling underpins the assessment of collision impacts and shows that the proposed increase to the turbine rotor diameter leads to an increase in the potential for collision mortality. The assessment also cautiously assumes that the proposed larger /taller turbines will increase potential for displacement of wader and skua pairs breeding in the vicinity of the proposed turbines. The assumptions used for evaluating the displacement risks to red-throated diver and merlin used in the ES Addendum were highly pre-cautionary and so it is considered that these continue to be relevant for the proposed varied development. However there have been changes to the baseline conditions of these species which affect the evaluation of disturbance/displacement.

For all bird species receptors, the categories of significance for both collision and displacement effects that may result from the proposed varied development are the same as those used for the consented Viking Wind Farm.

For the nationally important breeding whimbrel receptor it is concluded that the in-combination effects of collision (based on the SNH recommended but highly precautionary 98% avoidance rate) and displacement could lead to an effect evaluated as **Significant** for the purposes of the 2017 EIA Regulations. However, after mitigation delivered through the proposed Habitat Management Plan, the combined effect is evaluated to be **Not Significant.**

For all the other species examined, the assessment concludes that the in-combination effects of the proposed varied development would lead to effects evaluated as being **Not Significant** for the purposes of the 2017 EIA Regulations.

The potential for the proposed varied development to impact on breeding red-throated diver that is a qualifying interest of the newly designated East Coat Mainland, Shetland proposed SPA is examined. It is concluded that there would be no more the negligible effects on this qualifying interest.

The proposed Habitat Management Plan includes mitigation measures that aim to compensate for collision and displacement losses to bird receptors of high conservation value through enhancing breeding numbers and productivity through habitat management.

5.1 Introduction

5.1.1 This chapter reports on the likely significant effects with respect to ornithology associated with the construction, operation and decommissioning of the proposed varied development.

5.1.2 This chapter is supported by:

- Technical Appendix 5.1: Ornithology Report.

5.1.3 Figures 5.1 – 5.12 are referenced in the text where relevant

5.1.4 As explained in Chapter 1: Introduction, the proposed varied development is considered to fall under paragraph 3 of Schedule 2 to the 2017 EIA Regulations, as 'a change to or extension of' an EIA development which has already been authorised (the consented Viking Wind Farm). As a result, this Chapter is provided to present information on both the predicted ornithological effects of the consented Viking Wind Farm; and, the predicted ornithological effects of the proposed varied development. This will enable a comparison in effects between the two schemes.

5.1.5 In comparison to the consented Viking Wind Farm the proposed varied development would result in an increase in the rotor diameter (from 110 m to 120 m based on candidate turbine parameters) and an increase in the maximum tip height (from a maximum tip height of 145 m to a maximum of 155 m).

5.1.6 The number and location of turbines, the layout of the access tracks and other infrastructure remain the same as for the consented Viking Wind Farm. However, compared to the 127turbine proposal assessed in the ES Addendum, the size of both the consented Viking Wind Farm and the proposed varied development is reduced by the removal of all 24 of the turbines and associated infrastructure from the Delting quadrant. This reduction in size has been taken into account in this Chapter, through re-assessment of the consented Viking Wind Farm where appropriate to allow a direct comparison with the predicted effects of the proposed varied development.

5.1.7 The assessment of the impacts of the proposed varied development also takes into account changes that have occurred in baseline conditions (e.g., in the distribution and abundance of key bird species), site designations, context information and guidance that have occurred since the submission of the ES Addendum.

5.1.8 The approach taken is to assess the magnitude and significance of predicted impacts arising from the consented Viking Wind Farm first, followed by an assessment of the proposed varied development. This enables the Applicant to report how the magnitude and significance of effects associated with the proposed varied development differ to those for the consented Viking Wind Farm. In doing so, changes in bird abundance and distribution that have occurred since consent was granted in April 2012 are taken into account by comparing effect predictions based on the baseline bird surveys undertaken in recent years (Technical Appendix 5.1).

5.2 Methodology

Scope of the Assessment

Scope of Effects Examined

5.2.1 The ES and ES Addendum, and relevant scoping as part of the EIA process, identified that the consented Viking Wind Farm could potentially have the following impacts on bird receptors:

- Habitat loss and change caused by the construction of access tracks, wind turbine foundations and other infrastructure.
- Disturbance/displacement leading to indirect habitat loss caused by construction and decommissioning works, and by the operation of the windfarm.
- Collision mortality to flying birds during the operation of the windfarm.

- Potential benefits to species and habitats delivered through the Habitat Management Plan (HMP).

5.2.2 Two potential effects on birds are scoped-in for assessment on the grounds that the proposed varied development could lead to changes in the magnitude of these effects on some bird receptors. Thus, it is plausible that these effects, alone or acting in combination, could lead to a significant adverse impact. These are:

- Collision risk; and
- Operational disturbance/displacement.

5.2.3 The assessment also examines the potential for cumulative impacts with other wind farms in Shetland, and the potential for effects on sites designated for bird conservation.

5.2.4 The potential effects of habitat loss and change are scoped out. The ES Addendum showed that the magnitude of habitat loss effects was negligible for all bird species, as any losses would be very small in the context of the areas of habitat available. The proposed varied development would result in no changes to the predicted habitat loss and change compared to the consented Viking Wind Farm. Furthermore, there would be significantly less habitat loss (approximately 19% less) than predicted in the ES Addendum. It follows that the effect of habitat loss from the proposed varied development will remain of negligible magnitude and not significant for all bird species receptors, thus this effect is therefore scoped out.

5.2.5 The potential effect of disturbance/displacement during the construction phase is also scoped out. The ES Addendum concluded that the magnitude of construction disturbance would be negligible provided the measures in the Breeding Bird Protection Plan were adhered to. No aspect of the proposed varied development would materially increase the amount or duration of disturbance to birds from construction activities. Furthermore, the deletion of the 24 turbines and associated infrastructure from the Delting quadrant would substantially reduce (by approximately 19%) the overall amount of construction activity required and assessed within the ES Addendum. It follows that, provided the Breeding Bird Protection Plan measures are adhered to, the effect of construction disturbance on birds from the proposed varied development would remain of negligible magnitude and not significant for all bird species, and thus this effect is scoped out.

Spatial Scope

5.2.6 The footprint of the proposed varied development lies entirely within the footprint of the consented Viking Wind Farm and which has been previously consulted on and subject to EIA in the ES Addendum. The red line boundary shown on Figure 1.2 is the revised Section 36C Variation Application Site Boundary (hereinafter referred to as “the site application boundary”, and the area within the site application boundary is referred to as “the revised site area”.

5.2.7 Baseline bird surveys covered the whole of the revised site area and a surrounding buffer around the proposed varied development infrastructure (Figure 5.1). For wader and skua species the buffer extended to at least 500 m, for red-throated diver to at least 1 km and for merlin to at least 2 km. The various survey work undertaken since 2003 have at times extended beyond these areas, as was relevant at the time (details of survey coverage are presented in Technical Appendix 5.1). However, for the purposes of the assessment of the proposed varied development presented in this chapter, the relevant baseline survey geographic coverage is considered to be the revised site area buffered as described above.

Temporal Scope

5.2.8 Baseline bird studies have taken place every year from 2003 to 2018. Up to 2009 these studies were primarily aimed at characterising the baseline ornithological conditions to inform the previous EIA work.

5.2.9 Since 2010 there has been a programme of further bird studies to better understand the flight behaviour and ecology of whimbrel, to inform the Habitat Management Plan (HMP) being produced for the consented Viking Wind Farm, and to monitor priority species.

5.2.10 Between 2014 and 2018 the revised site area and a species-appropriate surrounding buffer was re-surveyed, providing up-to-date information on the baseline bird distribution and abundance to inform the assessment presented in this chapter.

Technical Scope

5.2.11 The following legislation was taken into account during this assessment:

- The Council Directive on the Conservation of Wild Birds 2009/147/EC (EU Birds Directive).
- The Wildlife and Countryside Act 1981 (as amended) (WCA).
- The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) ('the Habitats Regulations').
- The Nature Conservation (Scotland) Act 2004 (as amended).
- The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017.

5.2.12 The following guidance and data sources have been consulted:

- SNH Guidance: Assessing the Significance of Impacts from Onshore Windfarms on Birds outwith Designated Areas (SNH 2006).
- SNH Guidance: Use of Avoidance Rates in the SNH Wind Farm Collision Risk Model (SNH 2010).
- SNH Guidance: Assessing the cumulative impact of onshore wind energy developments (SNH 2012).
- SNH: A Handbook on Environmental Impact Assessment (SNH 2013).
- SNH Guidance: Recommended bird survey methods to inform impact assessment of onshore wind farms (SNH 2014).
- SNH SiteLink web pages (online information on designated sites).
- Chartered Institute of Ecology and Environmental Management (2018). Guidelines for Ecological Impacts Assessment in the UK and Ireland.
- Birds of Conservation Concern 4 (BoCC) 'Red list' (Eaton *et al*. 2015).
- Birds of Shetland (Pennington *et al*., 2004).

Consultation

5.2.13 Up to the end of 2011, the Applicant was involved in extensive consultation with stakeholders over ornithology matters, in particular with SNH and RSPB. These consultations resulted in the commissioning of additional bird studies aimed at better understanding potential risk to priority bird species, in particular whimbrel, and informing the development of the HMP.

5.2.14 A consultation meeting was held in Lerwick on 7th February 2018 with Energy Consents Unit (ECU), Scottish Natural Heritage (SNH), Shetland Islands Council (SIC) and Royal Society for the Protection of Birds (RSPB) at which the scope of the ornithology assessment was discussed. An update call to statutory consultees including SNH was held on 12th September 2018 during which it was confirmed that the scope of the ornithological assessment would consider the East Mainland Coast, Shetland proposed Special Protection Area (pSPA). This pSPA is currently in the process of being designated.

Baseline Conditions

Desk Study

5.2.15 As part of the information gathering required for the assessment, recent literature and other sources of contextual information on species receptor populations were consulted.

Field Study

5.2.16 An extensive programme of field studies has been undertaken between 2003 and 2018 to quantify the distribution, abundance and flight activity metrics of birds breeding in the vicinity of the site. The studies undertaken are listed below.

5.2.17 Details of the studies undertaken up to 2009 are reported in the ES Addendum. The details of the more recent studies are presented in Technical Appendix 5.1 together with a summary of the findings of the earlier studies. The information presented in Technical Appendix 5.1 focusses on the results of studies that are relevant to the assessment of the proposed varied development.

- Moorland Bird Surveys (MBS) undertaken 2005-2008 to quantify the distribution and abundance of moorland species (e.g. waders, skuas, gulls, wildfowl and passerine species) over the original section 36 (s36) area to provide baseline data for the ornithological sensitivity mapping (used to inform the design of the consented Viking Wind Farm), reported in the 2009 ES and the ES Addendum.
- MBS surveys to quantify the distribution, abundance of waders, gulls, wildfowl and passerine species to inform the development of HMP and to monitor whimbrel population trends and undertaken at selected sites (including some parts of the revised site area) every year between 2010 and 2017.
- MBS surveys to inform the assessment of the proposed varied development undertaken in 2018 covering approx. 75% of revised site area, the remaining parts were covered between 2014 and 2017 (Figure 5.2).
- Surveys of red-throated diver to determine the number of breeding pairs, breeding success and the location of breeding lochs and lochans in the vicinity of the site. Conducted annually from 2003 to 2018 (except 2015).
- Surveys of merlin across Central Mainland to determine the number of breeding pairs, breeding success and the location of breeding sites. Conducted annually 2005 to 2018.
- Generic vantage point flight activity surveys to determine the amounts of flight activity by priority bird species in different parts of the site. These were conducted from 2005 to 2006 from 25 strategic vantage points that between them gave total coverage of the revised site area buffered to 500m and a cumulative coverage of 7940 ha. From these VPs a total of 799 hours of observation was undertaken distributed evenly across the breeding season (April to August), a further 379 hours of observation were made spread across the non-breeding months.
- Flight activity studies of red-throated diver aimed at mapping flight lines across the site and collecting information required for collision risk modelling (CRM). Conducted mainly from 2004 to 2007; minor additional flight line data collected since 20098 incidentally to other survey work. These studies amounted to 1,575 hours of focal watch observation centred on diver breeding sites and other regularly used waterbodies, including all those in the revised site area buffered to 1 km and others lying outside this area which could plausibly be affected by the proposed varied development. In total 2,712 diver flights were logged and mapped.
- Flight activity studies of other priority bird species aimed at quantifying distance-from-observer related bias in the detection of flight activity, flight height distribution and other species-specific metrics required to undertake CRM from the generic vantage point flight activity data. Conducted in 2007 and 2008.

- Studies conducted in 2011 to better understand the flight behaviour of whimbrel breeding in Petta Dale in the vicinity of the Mid Kame Ridge turbines. The Applicant shared the findings of this study with SNH during the consultation process leading up to the consenting of the Viking Wind Farm.

Analysis Methods

5.2.18 The data from the various surveys listed above have been subjected to a range of analytical methods to derive information required to inform the assessment of effects. The analyses undertaken are described in Technical Appendix 5.1 and include the following:

- Analysis of MBS data to determine the number and location of the breeding territories of wader and skua species.
- Analysis of vantage point flight activity data to provide standardised measures of flight activity for use in CRM.
- Analysis of the extent of distance-from-observer detection bias (and other potential biases) in flight activity data and development of methods to correct this bias.
- CRM using the method recommended by SNH and developed by Band *et al*. (2007). CRM is a technique that combines measures of bird flight activity, flying height, flight velocity and size with parameters describing the number, size, rotation speed and operational time of turbines to predict the number of birds that would collide with turbines.
- Analysis of red-throated diver and merlin annual territory occupancy and productivity.
- The use of geographical information software (ArcGIS and QGIS) to analyse spatial data. For example, to determine the numbers of territories or the amount of flight activity within a specified distance of turbines or other proposed windfarm infrastructure.

Cumulative Baseline

5.2.19 SNH guidance on wind farm cumulative impact assessment was followed (SNH, 2012). Five other operational or consented wind farm projects in Shetland were identified as being relevant to the assessment of cumulative impacts. These are: Beaw Field Wind Farm, Yell; Garth Wind Farm, Yell; Luggies Knowe Wind Farm, near Lerwick; Mossy Hill Wind Farm, near Lerwick; and, Burradale Wind Farm, near Lerwick.

Assessment of Effects

Criteria for Assessing Nature Conservation Importance

5.2.20 Nature Conservation Importance is a measure of the conservation value of a species potentially affected by the proposed varied development.

5.2.21 Species that receive a higher level of protection under bird protection legislation are considered to have greater Nature Conservation Importance, e.g., species listed on Annex 1 of the EU Birds Directive or on Schedule 1 of the Wildlife and Countryside Act. Species on these lists tend to have relatively small populations and restricted ranges.

5.2.22 Species are also considered to have greater Nature Conservation Importance if they are recognised as having a poor conservation status through inclusion on the Birds of Conservation Concern 4 Red List (Eaton *et al.,* 2015) or listed by the International Nature Conservation Union (IUCN) as a threatened species.

5.2.23 The Nature Conservation Importance of a species is also heightened if it uses the area potentially affected by the proposed varied development in either nationally important (>1% of the UK population) or regionally important (>1% of the regional population) numbers.

5.2.24 The criteria used to categorise Nature Conservation Importance are defined in Table 5-1.

Table 5-1. Definitions of the Nature Conservation Importance (value) Levels for Bird Receptors	
Value	**Definition**
High	Species that make use of the area potentially affected in nationally important numbers (>1% national population) and that are listed on one or more of: • Annex 1 of the EU Birds Directive. • Schedule 1 of the Wildlife and Countryside Act. • Birds of Conservation Concern 'Red' list. • IUCN threatened list.
Medium	Species that make use of the area potentially affected in regionally important numbers (>1% regional population) and that are listed on one or more of: • Annex 1 of the EU Birds Directive. • Schedule 1 of the Wildlife and Countryside Act. • Birds of Conservation Concern 'Red' list. • IUCN threatened list.
Low	Other species listed on the Birds of Conservation Concern 'Amber' list. Or Non-listed species that make use of the area potentially affected in affected in regionally important numbers (>1% regional population).
Negligible	All other species making use of the area in numbers equating to <0.1% of the regional population.

Criteria for Assessing Sensitivity

5.2.25 Receptor sensitivity is a judgement of the tolerance of a receptor to tolerate an impact. In the case of birds, the receptors are defined as spatially limited populations of a species, for example the Shetland breeding population. Sensitivity to an impact is affected by the population status of a species; for example, declining populations are likely to be more sensitive than species with increasing populations.

5.2.26 Sensitivity is also affected by the habitat and feeding requirements of a particular species. For example, species that have restricted requirements for certain types of habitat for breeding or feeding (e.g., habitat specialists) have greater sensitivity than species that have no such specialist requirements. The criteria used to categorise receptor sensitivity are defined in Table 5-2.

Table 5-2. Criteria for Categorising the Sensitivity of Receptors	
Sensitivity	**Definition**
High	• Receptor population has very limited tolerance of effect. e.g., likely to have no capacity to absorb change, so a population level effect likely. • Likely to be limited to populations with poor existing conservation status
Medium	• Receptor population has limited tolerance of effect. e.g., very minor capacity to absorb change so a population level effect possible. • Likely to include but not be limited to populations with poor existing conservation status.
Low	• Receptor population has some tolerance of effect. e.g., likely to have minor capacity to absorb additional mortality or reduction in productivity or habitat loss, so a population level effect unlikely.
Negligible	• Receptor population generally tolerant of effect. e.g., likely to have moderate capacity to absorb additional mortality or reduction in productivity or habitat loss, so a population level effect very unlikely.

Criteria for Assessing Effect Magnitude

5.2.27 Impacts are judged in terms of magnitude in space and time (Regini, 2000).

5.2.28 Temporal magnitude was categorised according to whether an impact is judged to be short term, medium term or long term, and whether it is considered to be temporary (reversible) or permanent (irreversible).

5.2.29 Spatial magnitude is considered in terms of the proportion of the receptor that would be affected by the impact and classified into five categories (Table 5-3).

5.2.30 Determination of spatial magnitude requires that a species receptor population is appropriately defined (SNH, 2006; IEEM, 2006). The numbers of breeding red-throated diver, whimbrel and Arctic skua that could plausibly be affected by the proposed varied development exceed 1% of the UK population. Therefore, for these species the appropriate receptor population is defined as the national population.

5.2.31 For all other species assessed, the numbers of birds that could plausibly be affected by the proposed varied development exceed 1% of the regional population (but not the UK population). Therefore, for these species, the appropriate receptor population is defined as the regional population. Following SNH guidance, the regional population is defined as the Shetland population (i.e., the sum population in the SNH Shetland Natural Heritage Zone).

Table 5-3. Criteria for Categorising the Magnitude of Effect	
Magnitude	**Definition**
Very high	Total/near total loss of a bird population due to mortality or displacement. Total/near total loss of breeding productivity in a bird population due to disturbance. Guide: • >50% of population affected. • Proportional change to mortality rate of >100% (i.e., at least a doubling of the baseline mortality rate).
High	Major reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Guide: • 26-50% of population affected. • Proportional change to mortality rate of 51-100%.
Moderate	Partial reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Guide: • 6-25% of population affected. • Proportional change to mortality rate of 11-50%.
Low	Small but discernible reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Guide: • 1-5% of population affected. • Proportional change to mortality rate of 2-10%.
Negligible	Very slight reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Reduction barely discernible, approximating to the "no change" situation. Guide: • < 1% population affected. • Proportional change to mortality rate of <2%.

Significance Criteria

5.2.32 Information on the spatial and temporal magnitude of an impact on a receptor is integrated with categories describing the receptor's Nature Conservation Importance, sensitivity to the impact and conservation status to reach a reasoned judgement on the significance of an effect resulting from the identified impacts (Table 5-4). In this integration the form of the spatial magnitude of the impact is considered (e.g. mortality, displacement or failed breeding) as regards its potential influence on the conservation status of the receptor population. Evaluations of effect significance are set in the context of the objective of maintaining favourable conservation status of species receptors, or not impede the recovery of species receptors that currently have an unfavourable conservation status.

5.2.33 In order to reflect the requirements of the 2017 EIA Regulations, each likely effect considered is evaluated and classified as either significant or not significant. Effects categorised as Moderate or Major significance are evaluated as Significant under the 2017 EIA Regulations, whilst those categorised as Low or Negligible significance are evaluated as Not Significant.

5.2.34 Detectable changes in regional or national populations of receptor of high or moderate Nature Conservation Importance are automatically considered to be fundamental effects and therefore significant under the 2017 EIA Regulations.

5.2.35 If a potential effect is determined to be likely significant, mitigation measures to avoid, reduce or remedy the effect are identified wherever possible.

Table 5-4. Criteria used to Categorise Significance of an Effect

Significance of Effect	Description
Major	Detectable changes in national or regional receptor population of nature conservation importance that is likely to have a severe effect on conservation status.
Moderate	Detectable changes in national or regional receptor population of nature conservation importance that is likely to have a low or moderate effect on conservation status.
Minor	Small or barely detectable changes that are unlikely to have an effect on the conservation status of a national or regional population of nature conservation importance.
Negligible	No or non-detectable changes in the conservation status of national or regional receptor population of nature conservation importance.

Assumptions and Limitations

Displacement Assumptions

5.2.36 The potential for operational disturbance to lead to displacement of breeding birds is approached in a quantitative way, the same approach as used in the ES Addendum. Assumptions are made regarding the distance from turbines and access roads inside which breeding birds are considered to be at risk of disturbance and on the proportion of these birds that would respond by displacement. The choice of the threshold distance for identifying pairs at risk and the choice of the assumed proportion that would be displaced is informed by published literature and expert judgement (this subject is discussed in detail in ES Addendum appendix 1). The estimates of the numbers of breeding pairs of a species that would be displaced expressed as a proportion of that receptors' population sizes are then used as the basis for determining the magnitude of any disturbance/displacement impact.

5.2.37 The assessment of operational disturbance for wader and skua species is based on estimating the number of breeding pairs at risk and assuming that 50% of these pairs are displaced. This is the same approach that was taken in the ES Addendum. The numbers of breeding pairs at risk was estimated from the number of MBS nominal territory centres that are within 250 m of a turbine or 100m of an access road (Technical Appendix 5.1) using the most recent survey results (Technical Appendix 5.1). In recognition that it is reasonable to assume that turbines of a larger size and greater rotor diameter and tip height are likely to have greater potential to disturb and displace wader and skua species, the threshold distance between a pair's territory centre and a wind turbine used to identify the pairs considered to be at risk was increased. A precautionary value of 250 m was chosen, 25% greater than the value of 200 m used in the ES Addendum, an increase exceeding the increase in the turbine rotor swept area (19%) due to increasing turbine size.

5.2.38 For red-throated diver, a total Disturbance Vulnerability Index (DVI) score was calculated for each breeding site in the revised site area buffered to 1 km using the method described in Technical Appendix 5.1. The potential for operational disturbance to cause a pair at breeding sites to be displaced (i.e., for disturbance to result in an occupied site becoming unoccupied) and to experience lower productivity was estimated using the criteria defined in Table 5-5. These are the same criteria as used in the ES Addendum assessment but were applied to up-to-date information on the number and distribution of diver breeding sites.

Table 5-5. Criteria for Estimating Changes in Occupancy and Breeding Success at Red Throated Divers Breeding Sites in Response to the Intensities of Operational Disturbance as Determined by the Disturbance Vulnerability Index (DVI) Values		
DVI Value	**Assumed Reduction in Occupancy**	**Assumed Reduction in Breeding Success**
0	None	None
1 – 499	None	25%
500 – 999	None	50%
1000 – 1499	50%	50%
>1500	100%	100%

Displacement Assumptions for Merlin

5.2.39 Breeding merlins have not been studied with respect to their susceptibility to disturbance or displacement by wind farms. A review of disturbance tolerance by birds reported that the median expert-opinion threshold at which breeding merlin show a response to human disturbance was 225m during the incubation stage and 400m during chick-rearing (Whitfield *et al.,* 2008). However, based upon review of other raptors, Madders and Whitfield 2006 suggest that it is highly unlikely that merlins will be displaced by operational wind farms. In view of the limited information on displacement available to date, it is conservatively assumed for the purpose of this assessment that nesting merlins would be displaced from areas within 500m of operating turbines, the same assumption as made in the ES Addendum assessment.

5.3 Baseline Conditions

Current Baseline

5.3.1 The extensive programme of ornithology survey work (summarised earlier) means that there is a considerable quantity of baseline survey data available. The results of surveys designed to measure the distribution abundance of breeding territories that are relevant to the current assessment are summarised in Technical Appendix 5.1.

5.3.2 The number of pairs and breeding success of red-throated diver inside the revised site area buffered to 1 km in each year since 2005 are presented in Table 5-7. No surveys were conducted in 2015 and therefore there are no data for this year. Over this period a total of 35 sites inside the revised site area buffered to 1 km were used for breeding. The distribution of these sites is illustrated in Figure 5.3. In this figure the size of the dot showing the location of a breeding site is scaled according to the importance of the site in terms of frequency of occupation and productivity - the larger the dot size the more important the site.

5.3.3 The numbers of pairs of merlin breeding in the Kergord and Nesting quadrants of Central Mainland are presented in Table 5-8. All the merlin breeding in the Kergord and Nesting quadrants were within the revised site area buffered to 2 km (Figure 5.4) and were therefore likely to undertake at least some of their hunting activity within the layout of the proposed infrastructure.

5.3.4 For wader and skua species scoped-in for EIA (see below), the number of pairs breeding within the revised site area derived from MBS data for 2005-2008 (results for these surveys provided baseline data for ES Addendum) are compared with numbers in the same area derived from MBS data for 2014-2018 (Table 5-1). For the eight wader and skua species scoped-in for assessment, the distribution of breeding territories based on the most recent MBS data (2015-2018) are illustrated in Figures 5.5 to 5.10.

Table 5-6. The Number of Territories of Priority Water and Skua Species Inside Revised Site Area

Species	2005-2008	2014-2018	% Change	Accuracy and Confidence in Survey Results
Golden Plover	73	87	19%	High
Dunlin	55	43	-22%	Moderate, some territories likely to be over looked due to the relatively low detectability of this species.
Whimbrel	32	33	3%	High
Curlew	160	115	-28%	Moderate. Curlew territories are difficult to count accurately because of their large size.
Arctic Skua	30	11	-63%	Very high
Great Skua	51	41	-20%	High. Counts include non-breeding territories

Table 5-7. The Annual Numbers of Pairs and Breeding Success of Red-Throated Diver Located Inside the Revised Site Area Buffered to 1km Area. No Survey Work was Conducted in 2015

Metric	2006	2007	2008	2009	2010	2011	2012	2013	2014	2016	2017	2018
No. Pairs	24	21	19	18	25	25	23	22	23	24	26	25
Number of Chicks Reared	18	4	9	12	12	11	13	17	12	13	17	13
% Pairs Successful	54%	14%	32%	44%	36%	40%	39%	59%	39%	42%	50%	40%
Chicks Reared per Pair	0.75	0.19	0.47	0.67	0.48	0.44	0.57	0.77	0.52	0.54	0.65	0.52
Chicks per Successful Pair	1.38	1.33	1.50	1.50	1.33	1.10	1.44	1.31	1.33	1.30	1.31	1.30

Table 5-2. The Number of Pairs of Merlin in the Kergord and Nesting Quadrants Between 2005 and 2018. All Pairs were Inside the Revised Site Area Buffered to 2 km

Year	Kergord Quadrant	Nesting Quadrant	No. of Breeding Pairs
2005	1	no data	1
2006	2	1	3
2007	2	3	5
2008	2	3	5
2009	2	2	4
2010	1	2	3
2011	2	3	5
2012	3	1	4
2013	2	0	2
2014	1	1	2
2015	4	1	5
2016	5	1	6
2017	2	1	3
2018	5	2	7

Changes in Bird Population Status

5.3.5 Since the ES Addendum new estimates of population size for Shetland's breeding birds have been published (Wilson *et al*., 2015). These new estimates are used in the assessment to determine the likely magnitude of impacts and, through comparison with earlier estimates (*Pennington* et al., 2004), provide an insight into recent population trends.

5.3.6 Information on the conservation status of national bird populations is regularly updated in light of new information. Since 2010 the Birds of Conservation Concern (Eaton, 2015) has been updated with the effect that some species have been Red-listed for the first time. Newly red-listed species include curlew and ringed plover. The IUCN international European conservation status of curlew has also been revised upwards and is now categorised as 'Near Threatened'.

5.3.7 Changes to bird populations in Central Mainland Shetland are apparent from the bird monitoring work undertaken in connection with the consented Viking Wind Farm (Technical Appendix 5.1). This monitoring suggests that over the past decade, the numbers of red-throated diver, merlin and golden plover have increased, that numbers of whimbrel (and perhaps curlew also) have remained approximately stable, and that numbers of Arctic skua in particular and to a lesser extent dunlin and great skua have declined.

5.3.8 Arctic skuas have shown a widespread serious decline across Scotland and the large declines (63% decline) observed in the revised site area closely accord with the wider picture reported across northern Scotland (JNCC, 2016). The decline is linked to changes in the availability of marine fish prey.

5.3.9 Great skua has also shown recent declines in some parts of Shetland, and this too may be linked to changes in the marine environment (JNCC, 2016).

5.3.10 The apparent 28% decline of curlew (Table 5-6) may be genuine, or may be due in part or in entirety to the small change to the survey field method designed to reduce the incidence of double recording (Technical Appendix 5.1). The decline is most apparent at higher elevations, where

breeding density is relatively low (presumably due to lower habitat quality). Curlews are known to be declining on mainland Scotland.

Receptor Population Size

5.3.11 For the purpose of assessment reference receptor population sizes are taken from Wilson et al., (2015), with the exception of merlin and Arctic skua. Wilson *et al*. estimate the Shetland merlin population to be 30 pairs. However, survey work across Shetland in 2018 located 50 pairs (P Ellis personal communication). The size of the Shetland merlin population is known to undergo moderate year-to-year fluctuations; for the purposes of assessment it is considered that a figure of 40 pairs is suitably precautionary.

5.3.12 For Arctic skua, it is assumed that the Shetland population continues to decline year-on-year at same rate as shown by the JNCC seabird trend study (JNCC, 2016), and that the current population size is 65% lower than the Seabird 2000 census figure (Mitchell *et al*., 2004).

5.3.13 For golden plover, dunlin and curlew, the Shetland breeding populations estimated by Wilson *et al*., (2015) are derived from habitat models and are provided with statistical confidence limits. In line with adopting a precautionary approach, the lower 95% confidence limit estimate is taken as being the most appropriate population estimate for assessment.

Future Baseline

5.3.14 EIA should identify existing processes of change in the environment so that any changes that are predicted to occur due to a project can be distinguished from those which are expected to occur anyway. This is commonly referred to in EIA as the '*do nothing scenario*'.

5.3.15 All bird species are subject to a certain amount of annual local variation in their abundance and distribution. Bird populations may also be subject to more widespread longer-term trends of increase or decline leading to changes in their overall population size and conservation status. As discussed above, changes in bird numbers and distribution are very apparent in the 15 years of bird monitoring results collected in connection with the consented Viking Wind Farm.

5.3.16 Changes in numbers and distribution can be caused by many factors and may be driven by conditions in Shetland (e.g., breeding habitat quality and predation pressure) or away from Shetland (e.g. on a species' wintering grounds). In most cases the reasons for bird population changes are unknown or only poorly understood.

5.3.17 The key bird species are all associated with peatland habitats. The ecology work undertaken in connection with the consented Viking Wind Farm has identified that large areas of these habitats are degraded by active peat erosion. Left unchecked peat erosion will lead to further habitat degradation over the next three decades and beyond. Of particular concern is the potential for peat erosion over the years ahead to further degrade and even destroy some of the small peatland lochans that are used as breeding sites by red-throated diver. The HMP includes a range of measures designed to restore eroded peatland and safeguard the integrity of diver lochans using tested methods. Without the wind farm it is unlikely this work to be undertaken and therefore the peatlands and lochans would continue to deteriorate.

Identified Sensitive Receptors

5.3.18 The species scoping that was undertaken was designed to identify the species for which impacts that may possibly give rise to significant effects are plausible.

5.3.19 Bird species are considered for EIA on the basis of the following:

- Conservation status (regional or national).
- Legal protection status.

- The importance of the development site for the proposed varied development and its environs for the regional or national receptor populations.
- The magnitude of the potential impact as assessed in the ES Addendum.

5.3.20 Species are scoped-in for EIA if they meet all of the following criteria:

- They have an unfavourable regional or national conservation status, and/or they are listed on either Annex 1 of the EU Birds Directive or Schedule 1 to the Wildlife and Countryside Act 1981.
- The site and its environs regularly support at least 4% of the specie's regional breeding population or 1% of the national breeding population.
- The ES Addendum concluded there was potential for impact of at least low magnitude for one or more of the effects assessed.

5.3.21 Although great skua and dunlin did not meet the screening criteria (because the ES Addendum concluded all effects assessed had negligible magnitude), following consultation with RSPB it was decided that, in the interest of a precautionary approach, these two species should nevertheless be included for assessment.

5.3.22 On the basis of the criteria described above the following bird species are identified for consideration in the EIA Report:

- Red-throated diver
- Merlin
- Arctic skua
- Great skua
- Whimbrel
- Curlew
- Golden plover
- Dunlin

5.3.23 All other bird species are scoped out and are not therefore considered further in the EIA Report.

Designated Sites

5.3.24 The potential for the proposed varied development to affect the features of Nature Conservation Sites designated for ornithological interests is also scoped in for EIA.

5.3.25 No part of the revised site area is designated for its ornithological interest, for example as a Special Protection Area (SPA) or Ramsar site.

5.3.26 Since the publication of the ES Addendum the UK Government commenced the process of designation for a marine area adjacent to the revised site area, the East Mainland Coast, Shetland pSPA. This pSPA is designed to give protection to the marine feeding grounds of breeding red-throated divers and includes coastal waters to the east of the Nesting (Figure 5.11). It is therefore likely that some of the red-throated diver feeding in the pSPA having breeding sites within the revised site area and could therefore potentially be affected by the proposed varied development.

5.3.27 Apart from the new East Mainland Coast Shetland pSPA, there is no evidence or expectation that the individual birds using the site have more than negligible linkage to other designated sites.

5.4 Assessment of Effects

Effect 1. Collision Mortality

5.4.1 The proposed varied development potentially increases the potential for bird collision mortality as the turbines will occupy a larger volume of air space. However, the proposed minimum rotor

surface clearance remains unchanged at 35 meters above ground level. Maintaining the same ground clearance will limit the potential for increased collision risk because flight activity of all priority bird species is disproportionally concentrated in the lower air space (i.e., below 35 m).

Collision Mortality Predictions

5.4.2 Collision mortality for each species receptor was estimated using CRM (Band, 2007) as described in Technical Appendix 5.1. The CRM mortality predictions for the proposed varied development take into consideration the changes in turbine diameter and tip height. They also take into consideration changes in the estimated amount of baseline flight activity in the vicinity of the turbines due to changes in bird abundance and distribution since the ES Addendum (Technical Appendix 5.1), the results of new flight activity studies (Technical Appendix 5.1), and changes to guidance on avoidance rates.

5.4.3 CRM outputs are highly sensitive to the assumed amount of baseline flight activity in the vicinity of turbines. A considerable effort has been put into obtaining accurate estimates of baseline flight activity across the site. This has involved extensive field studies and the development of new techniques to correct for bias in the raw flight activity data that left uncorrected would lead to a flight activity being significantly underestimated. For example, the tendency for observers to increasingly under-record flight activity as distance increases. These flight activity studies and the analytical methods developed to correct for bias are described in Technical Appendix 5.1. The mapping of red-throated diver flight activity received particular attention as this species was considered to be at heightened vulnerability to collision risk due to its frequent rotor-height commuting flights between breeding lochs and inshore marine feeding grounds (Figure 5.12). Figure 5.12 shows the pattern of diver flight activity derived from flight activity data collected up to 2007, (i.e. this is the same figure presented in the 2010 ES Addendum). The 200 x 200 m grid square flight activity values for breeding and non-breeding birds were used as the starting point to derive estimates of flight activity at each turbine location for CRM, as explained in Technical Appendix 5.1.

5.4.4 It should be borne in mind that had under-detection biases in flight activity data not been corrected for (as is usually the case for flight activity studies at wind farms) then the collision rate estimates would be much lower for all the species considered.

5.4.5 Consultation with SNH after the submission of the ES Addendum, identified the potential for collision mortality of breeding whimbrel to be an issue of major concern. In response to this, additional studies were undertaken on whimbrel flight behaviour and improved flight activity estimation methods developed (Technical Appendix 5.1). Based on these additional studies and MBS data from monitoring whimbrel numbers, two estimates of whimbrel baseline flight activity were calculated for CRM, each derived by a different method. Method 1 is the same method that was used for the ES Addendum and is also the method used for the other wader and skua species. It is based on a correlation between flight activity measures and the density of territories in the vicinity of turbines (full details in Technical Appendix 5.1). Method 2 took a similar approach accept that it estimates flight activity based on mean density of individual records (not territories) in the vicinity of turbines over multiple years of survey, a method that is likely to give a more reliable measure of long-term flight activity. The CRM predictions for flight activity derived by the two methods are similar (Table 5-10), so much so that evaluation of impact magnitude and significance categories are the same for both predictions.

5.4.6 The results of studies of red-throated diver flight activity in the vicinity of the proposed varied development provide strong empirical evidence that this species show very strong avoidance behaviour and, on this basis SNH has increased the recommended avoidance rate for this species (and for skua species also) to 99.5% (Furness, 2015; SNH, 2017). Based on avoidance behaviour studies SNH recommend the use of an avoidance rate of 99% for geese species and golden eagle (SNH, 2010). A study of wind farm mortality of gull species commissioned by the Scottish

government recommends avoidance rates of 99.5% for large gull species and 99.2% for small gull species and point out that these rates do not take into consideration any macro-avoidance of the wind farm that may occur (any macro-avoidance would increase the avoidance rate) (Cook *et al.*, 2014).

5.4.7 There have been no empirical studies on the avoidance behaviour for most of species considered in this EIA and therefore avoidance rates for these species are unknown. In this situation, SNH recommend the use of the default avoidance rate of 98% for assessing the impact of collision mortality (SNH, 2017). However, a 98% rate for these species is considered to be unnecessarily conservative; experience from operational windfarms elsewhere indicates that true rates are likely to be higher (Whitfield, 2007). Furthermore, it is not biologically reasonable for the avoidance rates of geese, swans, red kite, golden eagle, hen harrier, skuas and gull species to be greater than that of smaller and more agile species such as waders; on the contrary such species are likely to be more capable of avoiding turbine rotors. Given the uncertainty regarding the most appropriate rate to use, the collision mortality estimates for merlin, wader species and skua species are presented for 98%, 99% and 99.5% avoidance rates.

Change in Collision Risk due to Variation

5.4.8 The magnitude of the impact of collision mortality is considered in terms of the potential effect it would have on the adult mortality rate of species receptor populations (Table 5-10 and Table 5-11). CRM outputs are in terms of a predicted number of collisions per year without taking behavioural avoidance into consideration. The CRM prediction is then adjusted downwards by multiplying it by an avoidance rate (Band, 2007). The avoidance rate used has a large effect on the predicted number of collisions and potentially on the final significance conclusion of the assessment.

5.4.9 The predicted annual collision mortality is summarised for each receptor for avoidance rates of 98%, 99% and 99.5% for the proposed varied development (Table 5-10). Corresponding predictions are also presented for the consented Viking Wind Farm (Table 5-11) (i.e. 103 turbines with 110m rotor diameter and a tip height of 145m and based on the same up-to-date estimates of bird flight activity). In Tables 5-10 and 5-11 the pink-shaded cells indicate the collision prediction and the proportional change in the mortality rate for the SNH recommended avoidance rate.

5.4.10 For all species examined, a like-for-like comparison of collision risk for the proposed varied development and the consented Viking Wind Farm (i.e., the values in Tables 5.9 compared to the values in Table 5.10) shows that the effect of the Variation is to increase the predicted collision risk by between 9 and 18%. The species-specific increases in collision risk are as follows:

- Red-throated diver, increase by 9.1%.
- Merlin, increase by 17.2%.
- Golden plover, increase by 14.6%.
- Dunlin, increase by 18.4%.
- Whimbrel, increase by 16.4%.
- Curlew, increase by 14.8%.
- Artic skua, increase by 15.0%.
- Great skua, increase by 14.9%.

5.4.11 The reason why different species are affected to different degrees is explained by species-specific differences in the frequency distribution of flying height.

Table 5-9. Collision Predictions for the Proposed Varied Development (T103 x 120m at 155m tip height) and the Effect of Collision Mortality on the Annual Adult Mortality Rate of Receptor Populations for a Range of Avoidance Rates (A.R.) Pink Shading Indicates the Predictions Used for Assessment

Receptor Population	Assumed Population Size (Individuals)	Assumed Annual Baseline Adult Survival Rate	Baseline Deaths p.a.	CRM Prediction for 98% A.R.		CRM Prediction for 99% A.R.		CRM Prediction for 99.5% A.R.	
				No. Deaths p.a.	Change to Mortality Rate	No. Deaths p.a.	Change to mortality rate	No. Deaths p.a.	Change to Mortality Rate
Red-Throated Biver, Non-Breeding. Shetland Population	310	0.860	43	2.7	6.3%	1.4	3.1%	0.68	1.6%
Red-Throated Diver, Breeding Shetland Population	814	0.860	114	1.3	1.1%	0.6	0.6%	0.32	0.3%
Merlin, Shetland population	80	0.650	28	0.1	0.5%	0.1	0.2%	0.0	0.1%
Golden Plover, Shetland Population	10,390	0.820	1870	39.9	2.1%	19.9	1.1%	10.0	0.5%
Dunlin, Shetland Population	3,534	0.806	686	1.4	0.2%	0.7	0.1%	0.4	0.1%
Whimbrel, UK Population Method 1 [1]	600	0.880	72	1.45	2.0%	0.7	1.0%	0.4	0.5%
Whimbrel, UK Population Method 2 [1]	600	0.880	72	1.69	2.3%	0.8	1.2%	0.4	0.6%
Curlew, Shetland Population	7,286	0.800	1457	11.5	0.8%	5.8	0.4%	2.9	0.2%
Arctic Skua, Shetland Population	790	0.800	158	1.8	1.1%	0.9	0.6%	0.4	0.3%
Great Skua, Shetland Population	2,0754	0.889	2308	35.1	1.5%	17.6	0.8%	8.8	0.4%

[1] Collision modelling for whimbrel was undertaken for estimates of flight activity derived from two methods. Method 1 is based on the density of breeding territories in the vicinity of turbines as determined from surveys undertaken between 2014 and 2018 (this is the same method used for the other wader and skua species). Method 2 is based on the density of all records (not territories) of breeding birds (mean number of records per survey visit) using all survey data from 2005 to 2018.

Table 5-10. Collision Predictions for the Consented Viking Wind Farm (T103 x 110m at 145m tip height) and the Effect of Collision Mortality on the Annual Adult Mortality Rate of Receptor Populations for a Range of Avoidance Rates (A.R.) Pink Shading Indicates the Predictions Used for Assessment

Receptor Population	Assumed Population Size (Individuals)	Assumed Annual Baseline Adult Survival Rate	Baseline Deaths p.a.	CRM Prediction for 98% A.R.		CRM Prediction for 99% A.R.		CRM Prediction for 99.5% A.R.	
				No. Deaths p.a.	Change to Mortality Rate	No. Deaths p.a.	Change to Mortality Rate	No. Deaths p.a.	Change to Mortality Rate
Red-throated diver, non-breeding. Shetland population	310	0.860	43	2.5	5.8%	1.3	2.9%	0.63	1.4%
Red-throated diver, breeding Shetland population	814	0.860	114	1.2	1.0%	0.6	0.5%	0.3	0.3%
Merlin, Shetland population	80	0.650	28	0.1	0.4%	0.1	0.2%	0.0	0.1%
Golden Plover, Shetland population	10390	0.820	1870	34.8	1.9%	17.4	0.9%	8.7	0.5%
Dunlin, Shetland population	3534	0.806	686	1.2	0.2%	0.6	0.1%	0.3	0.0%
Whimbrel, UK population Method 1 [1]	600	0.880	72	1.2	1.7%	0.6	0.9%	0.3	0.4%
Whimbrel, UK population Method 2 [1]	600	0.880	72	1.5	2.0%	0.7	1.0%	0.4	0.5%
Curlew, Shetland population	7286	0.800	1457	10.0	0.7%	5.0	0.3%	2.5	0.2%
Arctic Skua, Shetland population	790	0.800	158	1.5	1.0%	0.8	0.5%	0.4	0.2%
Great Skua, Shetland population	20754	0.889	2308	30.6	1.3%	15.3	0.7%	7.6	0.3%

[1] Collision modelling for whimbrel was undertaken for estimates of flight activity derived from two methods. Method 1 is based on the density of breeding territories in the vicinity of turbines as determined from surveys undertaken between 2014 and 2018 (this is the same method used for the other wader and skua species). Method 2 is based on the density of all records (not territories) of breeding birds (mean number of records per survey visit) using all survey data from 2005 to 2018.

Impact Characterisation

5.4.12 For all receptors, collision mortality is categorised as a long-term temporary adverse effect that would operate throughout the life of the proposed varied development. For all receptors considered the probability of collision mortality occurring is considered to be high. However, as a result of the cautious assumptions made in estimating collision mortality it is likely that the amount of collision mortality that transpires will be less than that predicted.

5.4.13 The whimbrel, red-throated diver and Arctic skua receptors are categorised as having High Nature Conservation Importance. Apart from being listed on one or more conservation-listing (Table 5-1) the revised site area supports more than 1% of the UK populations of these species. All the other species receptor populations considered are categorised as having Medium Nature Conservation Importance (Table 5-1).

5.4.14 The receptor populations of curlew, whimbrel, Arctic skua and dunlin are categorised as having Medium sensitivity to collision mortality on the basis that there is evidence that they are either declining or recovering from previous decline. The receptor populations of golden plover, red-throated diver, great skua and merlin are categorised as having low sensitivity to collision mortality on the basis that there is evidence that they are increasing or stable and therefore have greater ability to tolerate some additional mortality.

5.4.15 For red-throated diver, great skua and Arctic, and using the SNH recommended 99.5% avoidance rate, collision mortality is categorised as an impact of **negligible magnitude.** This is the case for both the proposed varied development and the consented Viking Wind Farm**.**

5.4.16 For golden plover and whimbrel collision mortality is categorised as an impact of **low magnitude** using the SNH recommended default 98% avoidance rate. However, if a more plausible avoidance rate of 99% is used for these species (see discussion above), the magnitude category reduced to **negligible magnitude**. This is the case for both the proposed varied development and the consented Viking Wind Farm**.**

5.4.17 For dunlin, curlew and merlin, and using the SNH recommended default 98% avoidance rate, collision mortality is categorised as an impact of **negligible magnitude.** This is the case for both the proposed varied development and the consented Viking Wind Farm**.**

Impact Significance

5.4.18 For the UK whimbrel receptor population the impact of collision mortality resulting from the proposed varied development and predicted using the SNH default 98% avoidance rate is judged as being of **borderline Low significance** (Table 5-12)**.** This judgement for a 98% avoidance rate is reached because collision deaths are predicted to result in a proportional increase to the baseline mortality rate of >2% and in light of the small size of the receptor population (approx. 300 breeding pairs) and its unfavourable conservation status. In this case the judgement of a significant impact is borderline because the 2% mortality rate change threshold is only slightly exceeded; the predicted proportional change to the mortality rate is 2.0 – 2.3% depending on the baseline flight activity estimate used in CRM (Table 5-12).

5.4.19 However, the impact of collision mortality on the UK whimbrel receptor population when predicted using a more plausible avoidance rate of 99% is judged to be of **Negligible significance (**Table 5-12**).** This judgement for a 99% avoidance rate is reached because collision deaths are predicted to result in a proportional increase to the baseline mortality rate of less than 2%, a change so small that is considered not likely to have a detectable effect on the receptor population.

5.4.20 The impact of collision mortality on the regional receptor populations of golden plover and predicted using an avoidance rate of 98% is judged is judged to be of **borderline Low significance (**Table 5-12**)**. This reduces to **Negligible significance** for a more plausible avoidance rate of 99%.

5.4.21 The impact of collision mortality on the regional receptor populations of red-throated diver, Arctic skua and great skua, and predicted using an avoidance rate of 99.5%, is judged to be **Negligible significance (**Table 5-12**)**.

5.4.22 The impact of collision mortality on the regional receptor populations of merlin, dunlin, curlew, and predicted using an avoidance rate of 98%, is judged to be of **Negligible significance (**Table 5-12**)**.

5.4.23 Although collision death is categorised as an impact of either low or negligible significance (and therefore considered Not Significant under the 2017 EIA Regulations) the possible deaths through turbine strike of low to moderate numbers of individuals of species of medium or high conservation importance (including Schedule 1 and Annex 1 species) is highly undesirable. With this in mind measures would be implemented through the HMP for the proposed varied development that aim to offset the adverse effects of collision mortality.

Table 5-11. Summary of Assessment of Collision Risk for the Proposed Varied Development. For Some Species Summaries are Presented for more than One Avoidance Rate (A.R.)

Receptor Population	Nature Conservation Importance	Sensitivity to Effect	Magnitude of Effect	Duration of Effect	Significance Category
Red-Throated Diver Shetland Pop. (99.5% A.R.)	High	Low	Negligible [3]	Long-term	Negligible
Merlin Shetland Pop. (98% A.R.)	Medium	Medium	Negligible [1]	Long-term	Negligible
Whimbrel UK Pop. (98% A.R.)	High	Medium	Low [1]	Long-term	Borderline Low
Whimbrel UK Pop. (99% A.R.)	High	Medium	Negligible [2]	Long-term	Negligible
Curlew Shetland Pop. (98% A.R.)	Medium	Medium	Negligible [1]	Long-term	Negligible
Golden Plover Shetland Pop. (98% A.R.)	Medium	Low	Low [1]	Long-term	Borderline Low
Golden Plover Shetland Pop. (99% A.R.)	Medium	Low	Negligible [2]	Long-term	Negligible
Dunlin Shetland Pop. (98% A.R.)	Medium	Medium	Negligible [1]	Long-term	Negligible
Arctic Skua Shetland Pop. (99.5% A.R.)	High	High	Negligible [3]	Long-term	Negligible
Great Skua Shetland Pop. (99.5% A.R.)	Medium	Medium	Negligible [3]	Long-term	Negligible

[1] Based on predictions using a 98% avoidance rate

[2] Based on predictions using a 99% avoidance rate

[3] Based on predictions using a 99.5% avoidance rate

Effect 2. Operational Disturbance

5.4.24 Operational disturbance may occur when birds respond to the ground-based activities of maintenance operations, for example technicians working on turbines or vehicles travelling along access roads. Birds may also show a disturbance response to the presence of large structures such as a wind turbine, choosing to avoid their vicinity. The net effect of such disturbance, if severe enough, is to displace birds from areas of habitat they would otherwise choose to use and is thus equivalent to habitat loss. Disturbance can also affect the time and energy budgets of birds, potentially leading to reduced feeding and breeding success. Although displaced birds may be able to successfully relocate to vacant habitat elsewhere, for the purposes of assessment it is cautiously assumed that displaced bird are not able to relocate and do not breed successfully, i.e., they are effectively lost from the population.

Change in Displacement Risk to Waders and Skuas from the Proposed Varied Development

5.4.25 The assessment of the proposed varied development cautiously assumes that the larger size and greater tip height of the proposed turbines would mean there is a greater likelihood that waders and skuas would show a displacement response compared to the smaller turbines of the consented

Viking Wind Farm. Indeed, the assumed size of the potential disturbance zone around turbines is cautiously increased by 28% (area of a 200 m radius circle *vs* the area of a 250 m radius circle).

5.4.26 The predicted number of breeding pairs of waders and skuas species estimated to be a risk of operational disturbance from the proposed varied development is presented in (Table 5-13). The corresponding numbers estimated for the consented Viking Wind Farm is presented in (Table 5-14).

5.4.27 A like-for-like comparison of assumed displacement risk for the proposed varied development and the consented Viking Wind Farm (i.e., the values in Tables 5.12 compared to the values in Table 5.13) shows that the effect of changes made to the assumed displacement threshold around turbines is to increase the predicted displacement risk by between 38% and 60%. The species-specific increases in displacement risk are as follows:

- Golden plover, increase by 39%.
- Dunlin, increase by 60%.
- Whimbrel, increase by 50%.
- Curlew, increase by 59%.
- Artic skua, increase by 50%.
- Great skua, increase by 38%.

5.4.28 The relatively differences between species reflects the low numbers of pairs in the vicinity of turbines for some species (Arctic skua, whimbrel and dunlin) and the element of chance as to whether a nominal territory centre mapped inside or a little outside the threshold assumed displacement distance.

5.4.29 Although the assessment method adopted predicted an increased potential in displacement risk, there is no empirical evidence that an increase in turbine diameter or tip height by the amount proposed would materially affect the disturbance/displacement risk to these bird species. It is possible that the changes would make no difference to birds' perception of disturbance, especially since the surface clearance of the turbine rotors (i.e., the minimum tip height) remains unchanged at 35 m.

Impact Magnitude – Waders and Skuas

5.4.30 The magnitude of displacement impacts on a receptor is quantified in terms of the proportion of the population that would be displaced. For the purpose of this assessment, it is cautiously assumed that displaced pairs are unable to successfully relocate to an alternative site. i.e., they are lost from the population. For all wader and skua species other than whimbrel the potential impact is categorised as being of **Negligible magnitude because in all cases less than 1% of the receptor population is predicted to be displaced.** This is the case for both the proposed varied development and the consented Viking Wind Farm**.**

5.4.31 For whimbrel the estimated potential magnitude of the operational disturbance is on the borderline of the negligible and low magnitude categories. However, bearing in mind the high nature conservation importance of the whimbrel receptor and its unfavourable conservation status and following a precautionary approach, it is judged that the impact should be categorised as **Low magnitude** (Table 5-13). The potential magnitude of whimbrel displacement for the consented Viking Wind Farm is categorised as **Negligible magnitude.**

Table 5-12. The Potential for the Proposed Varied Development to Displace Waders and Skuas from Breeding Territories

Receptor	Number of Pairs Considered at Risk [1]	Assumed Number of Pairs Displaced [2]	Assumed Size of Receptor Population (Pairs)	Proportion of Population Displaced	Impact Magnitude Category
Golden Plover Shetland Breeding Population	30	15	5,195	0.3%	Negligible
Dunlin Shetland Breeding Population	16	8	1,767	0.5%	Negligible
Whimbrel UK Breeding Population	6	3	300	1.0%	Low
Curlew Shetland Breeding Population	35	17.5	3,643	0.5%	Negligible
Arctic Skua Shetland Breeding Population	3	1.5	395	0.4%	Negligible
Great Skua Shetland Breeding Population	14	7	10,377	0.07%	Negligible

[1] Based on nominal territory centres within 250 m of a turbine location or 100 m of an access track and using survey results for the 2014 to 2018 period.
[2] For assessment purposes 50% of the at-risk territories are assumed to be displaced.

Table 5-13. The Potential for the Consented Viking Wind Farm to Displace Waders and Skuas from Breeding Territories

Receptor	Number of Pairs Considered at Risk 1	Assumed Number of Pairs Displaced 2	Assumed Size of Receptor Population (Pairs)	Proportion of Population Displaced	Impact Magnitude Category
Golden Plover Shetland Breeding Population	23	11.5	5,195	0.2%	Negligible
Dunlin Shetland Breeding Population	10	5	1,767	0.3%	Negligible
Whimbrel UK Breeding Population	4	2	300	0.7%	Low
Curlew Shetland Breeding Population	22	11	3,643	0.3%	Negligible
Arctic Skua Shetland Breeding Population	2	1	395	0.3%	Negligible
Great Skua Shetland Breeding Population	9	4.5	10,377	0.05%	Negligible

[1] Based on nominal territory centres within 200 m of a turbine location or 100 m of an access track and using survey results for the 2014 to 2018 period.
[2] For assessment purposes 50% of the at-risk territories are assumed to be displaced.

Impact Magnitude – Red-Throated Diver

5.4.32 On the basis of the DVI values for diver breeding sites it was identified that there is a potential risk of operational disturbance at 10 breeding sites out of a total of 35 inside the revised site area buffered to 1 km (Table 5-15). The other 25 sites are all more than 500 m from any proposed

turbine or access road and therefore had DVI values of zero and thus are not considered to be at risk of experiencing operational disturbance. It should be noted that many of the 35 breeding lochs are not occupied every year, indeed the average number occupied each year between 2006 and 2018 was 23.

5.4.33 The total DVI score for three breeding lochans (those given identity codes DU, FJ and FM (Figure 5.3) are sufficiently high to result in a likely displacement risk (Table 5-15). For the purposes of assessment, it is considered that these lochans have a 50% likelihood of experiencing operational disturbance of such a level as to cause them not to be occupied in years when they otherwise would be. One of these sites (DU) has long term productivity and occupancy rates categorised as moderate. The other two sites (identity codes FJ and FM) have low suitability for breeding (in terms of size and depth), low or very low long-term productivity and occupancy rates (. In both cases the first recorded breeding at these sites has occurred only in the last few years (in 2010 and 2018 respectively) and hence these sites were not taken into consideration when deciding the layout for the consented Viking Wind Farm.

5.4.34 Seven other breeding sites have total DVI scores that are considered sufficiently high to result in a potential reduction in productivity (Table 5-15). At one lochan (identity code BB) the potential for disturbance is cautiously judged as likely to lead on average to a reduction by 50% in productivity and at six lochans (identity codes AX, AY, BA, BX and LBE) to a reduction by 25% in productivity.

5.4.35 After accounting for loch occupancy rates at the sites considered to be at risk of operational disturbance, it is estimated that on average less than one breeding pair would be displaced (and fail to breed) per year, and approximately one other pair might fail to breed successfully when it would otherwise succeed. Therefore, for the purposes of assessment it is cautiously assumed that operational disturbance would adversely impact on two pairs per year.

5.4.36 The Shetland red-throated diver population is estimated at 407 pairs (Dillon *et al*., 2009). Assuming operational disturbance leads to the effective loss/breeding failure of two pairs, it is estimated that approximately 0.5% of the red-throated diver receptor population would be affected. This is judged to be an impact of **negligible magnitude** (Table 5-16).

5.4.37 The potential for operational disturbance of breeding red-throated divers to occur is considered not likely to be affected by the larger turbine diameter of the proposed varied development. However, compared to the ES Addendum assessment, two new sites are identified as being at risk (FJ and FM as discussed above) due to changes in baseline conditions, and one site in the Delting quadrant that was previously identified as at risk (identity code HM, moderate occupancy and productivity rates) is no longer so.

Table 5-14. The Number of Red-Throated Diver Breeding Sites in the Revised Site Area Predicted to be at Risk of Operational Disturbance and the Numbers Predicted to be Affected by Reduced Occupancy or Productivity. Predictions are based on the Criteria Defined in Table 5-5

Disturbance Vulnerability Index Score (DVI)	No. of Breeding Sites at Risk of Disturbance (i.e. <500 m from a Turbine or Access Track)	No. of Sites Predicted to Become Unoccupied 1	No. of Sites Predicted to Experience Lower Productivity
1 - 499	6	0	1.5
500 - 999	1	0	0.5
1000 - 1499	2	1	1.0
>1500	1	1	1.0
Total	10	2	4.0

[1] Note that the two sites identified as at risk of becoming unoccupied both have low baseline levels of occupancy

Impact Magnitude – Merlin

5.4.38 Baseline surveys indicate that since 2005 merlin have bred at 11 territories within the revised site area buffered to 2 km. In four of these territories birds have on occasions nested within the assumed operational displacement zone (i.e., within 500 m of a proposed turbine location).

5.4.39 One of these territories (Territory C, (Figure 5.4)) is regularly used, and here nesting has occurred within 500 m of one of the proposed Mid Kame ridge turbine locations in 10 out of 14 years (71%). The other three territories are used irregularly; in each case occupation by a pair has been recorded in only one year since 2005.

5.4.40 Of the 47 breeding attempts monitored since 2005 that are within the revised site area buffered to 2 km, 13 attempts (28%) were within 500 m of a turbine. Conservatively assuming an average annual Shetland population size of 35 pairs over this period (in 2018 the population was at least 50 pairs, P Ellis personal communication) and thus giving a total of approximately 490 breeding attempts, this number of 'at-risk' attempts would represent 2.7% of the total number of attempts. This suggests that in a worst-case scenario operational disturbance could lead to a risk of disturbance of around 2.7% of the receptor population annually.

5.4.41 The breeding merlin pairs that are assumed to be at risk of operational disturbance would not necessarily be adversely affected. Some pairs nesting within 500 m of a turbine may not be displaced or show a productivity response. Furthermore, merlin territories typically have a number of alternative nesting areas, thus it is likely that were a pair to show a displacement response they could simply switch to nesting at one of the alternative sites in their territory.

5.4.42 For the purposes of assessment, it is cautiously assumed that 50% of merlin breeding attempts that are considered to be at risk of operational disturbance are adversely affected, i.e., as a result of the proposed varied development they are unable to breed successfully. On this basis it is estimated that operational disturbance could adversely affect up to approximately 1.3% of the merlin receptor population. This is judged to be an impact of **low magnitude (**Table 5-16).

5.4.43 The potential for operational disturbance of breeding Merlin's to occur is considered not likely to be affected by the larger turbine diameter of the proposed varied development. However, the potential for operational disturbance to affect breeding merlin has changed since the assessment presented in the ES Addendum due to changes in baseline conditions (i.e., the distribution of nest sites in recent years) and the reduction in the number of turbines. Despite these changes the magnitude category of the impact remains unchanged.

Effects Significance

5.4.44 For all receptors, operational disturbance is categorised as a direct long-term temporary adverse effect that would operate throughout the life of the proposed varied development. For all receptors considered the probability of disturbance occurring is considered to be high. However, as a result of the cautious assumptions made in estimating potential disturbance, it is considered likely that the number of pairs affected by disturbance and the consequences would be less than assumed in the assessment. For example, displaced birds may be able to successfully resettle at an alternative site.

5.4.45 The whimbrel, red-throated diver and Arctic skua receptors are categorised as having High Nature Conservation Importance. All the other species receptor populations considered are categorised as having Medium nature conservation importance (Table 5-1).

5.4.46 The receptor populations of curlew, whimbrel, Arctic skua and dunlin are categorised as having medium sensitivity to disturbance/displacement on the basis that there is evidence that these species are either declining or recovering from previous decline. The receptor populations of golden plover, red-throated diver, great skua and merlin are categorised as having low sensitivity to disturbance/displacement on the basis that there is evidence that they are increasing or stable.

5.4.47 For the UK whimbrel receptor population, the impact of operational disturbance resulting from the proposed varied development is judged to be an impact of borderline **low significance** (Table 5-16**).** In this case the judgement of a significant impact is borderline because the predicted proportion of the population affected (exactly 1%) lies on the threshold (also 1%) used to separate the negligible and low impact magnitude categories.

5.4.48 The impact of operational disturbance on the receptor populations of merlin and golden plover is judged to be of **low significance** (Table 5-16).

5.4.49 The impact of operational disturbance on the receptor populations of red-throated diver, dunlin, curlew, Arctic skua and great skua is judged to be of **negligible significance** (Table 5-16).

5.4.50 Although operational disturbance is categorised as an impact of either low or negligible significance for all receptors (and therefore considered Not Significant under the 2017 EIA Regulations), the possible displacement of low to moderate numbers of birds of species of medium or high conservation importance including Schedule 1 and Annex 1 species is undesirable. With this in mind measures would be implemented through the HMP for the proposed varied development that aim to offset the adverse effects of operational disturbance.

Table 5-15. Summary of Assessment of Operational Disturbance for the Proposed Varied Development. The Summary for the Consented Viking Wind Farm is the Same					
Receptor Population	**Nature Conservation Importance**	**Sensitivity to Effect**	**Magnitude of Effect**	**Duration of Effect**	**Significance of Effect**
Red-Throated Diver, Shetland Pop.	High	Low	Negligible	Long-term	Negligible
Merlin, Shetland Pop.	Medium	Low	Low	Long-term	Low
Dunlin, Shetland Pop.	Medium	Medium	Negligible	Long-term	Negligible
Golden Plover, Shetland Pop.	Medium	Low	Low	Long-term	Low
Whimbrel, UK Pop.	High	Medium	Low	Long-term	Low
Curlew, Shetland Pop.	Medium	Medium	Negligible	Long-term	Negligible
Arctic Skua, Shetland Pop.	High	Medium	Negligible	Long-term	Negligible
Great Skua, Shetland Pop.	Medium	Medium	Negligible	Long-term	Negligible

Effects in Combination

5.4.51 Collision and displacement effects are likely to act antagonistically to a greater or lesser extent. For example, if birds are strongly displaced from the vicinity of turbines (e.g., they move to an alternative site) then there would be a corresponding reduction in collision risk. Similarly, a bird that is killed by collision strike cannot also be displaced. As a result of this antagonism the net impact of both effects would be expected to be substantially less than the sum of the two effects operating in isolation. Furthermore, when assessing the net combined effects on a receptor, care needs to be exercised to ensure that the precaution factored into assessing each effect in isolation does not result in unrealistic inflation of magnitude of the combined effect. These matters are taken into consideration in evaluating the significance of effects in combination (Table 5.16).

5.4.52 It is possible that two effects both rated (say) as having negligible magnitude combine to an overall low magnitude effect, and similarly for the higher magnitude categories. Both collision and operational disturbance are assessed quantitatively and therefore in evaluating the likely combined effect it is possible to take into consideration how close the estimated size of an effect is to the thresholds use to categorise magnitude.

Table 5-16. Summary of Magnitude and Significance Categories of Operational Stage Effects in Isolation and in Combination, and Receptor Conservation Status

Receptor	Nature Conservation Importance	Operational Disturbance/ Displacement	Collision Mortality	Effects Combined before Mitigation	Receptor Conservation Status
Red-Throated Diver, Shetland Population	High	Negligible mag. Negligible sig.	Negligible mag. Negligible sig.	Low mag. Low sig.	Favourable
Merlin, Shetland Population	Medium	Low mag. Low sig.	Negligible mag. Negligible sig.	Low mag. Low sig.	Favourable
Golden Plover, Shetland Population	Medium	Negligible mag. Negligible sig.	Low mag. Borderline Low sig. (98% A.R.)	Low mag. Low sig.	Favourable
Dunlin, Shetland population	Medium	Negligible mag. Negligible sig.	Negligible mag. Negligible sig.	Negligible Negligible	Probably Favourable
Whimbrel, UK Population	High	Low mag. Low sig.	Low mag. Borderline Low sig. (98% A.R.)	Low mag. Moderate sig.	Unfavourable
Curlew, Shetland Population	Medium	Negligible mag. Negligible sig.	Negligible mag. Negligible sig.	Negligible mag. Negligible sig.	Probably Favourable
Arctic Skua, Shetland Population	High	Negligible mag. Negligible sig.	Negligible mag. Negligible sig.	Negligible mag. Negligible sig.	Unfavourable
Great Skua, Shetland Population	Medium	Negligible mag. Negligible sig.	Negligible mag. Negligible sig.	Negligible mag. Negligible sig.	Probably Favourable

5.4.53 In the case of whimbrel, low magnitude impacts are concluded for both collision impact assessed at 98% avoidance rate and operational displacement. However, both impacts in isolation only slightly exceed the low magnitude category threshold, thus the combined effect on the whimbrel receptor is also judged to be of low magnitude (Table 5-17). Given the small size of the UK whimbrel population (approx. 300 pairs) and its unfavourable conservation status it is judged that the displacement of one pair (Table 5-13) plus the death through collision of up to two adults per year (Table 5-10) could lead to detectable population change. Therefore, if the assumed collision avoidance rate is 98%, then the impact of the effects combined is judged to be of **Moderate significance (**Table 5-17). As such this impact would be judged to be **Significant** for the purposes of the 2017 EIA Regulations.

5.4.54 The impact of the effects combined on whimbrel using a 99% avoidance rate for estimating collision is also judged to be of Low magnitude. However, in this scenario it is judged that the impact of the combined effect is likely to be too small to lead to detectable population change, and therefore it is judged to be of **Low significance (**Table 5-17). As such the impact is judged to be **Not Significant** for the purposes of the 2017 EIA Regulations.

5.4.55 Thus, the judgement of significance under the 2017 EIA Regulations of the impact of combined effects of collision mortality and operational disturbance on the whimbrel receptor critically depends on whether a 98% or 99% (or higher) avoidance rate is used. As discussed earlier, SNH recommend the use of the default 98% avoidance rate for whimbrel, but a rate of 99% is considered to be more realistic.

5.4.56 For red-throated diver, both impacts in isolation are categorised as negligible, however in both cases the size of the impact was only a little below the negligible/low magnitude threshold. Therefore, for this species it is judged that the combined impact on the receptor population is an impact of low magnitude (Table 5-17). Nevertheless, the combined impact is judged to be of Low Significance on a receptor with a favourable conservation status, and as such is judged **Not Significant** for the purposes of the 2017 EIA Regulations.

5.4.57 For merlin and golden plover, both receptors with a favourable conservation status, the effects combined are judged to be of Low magnitude and Low significance and as such are judged **Not Significant** for the purposes of the EIA Regulations (Table 5-17).

5.4.58 For dunlin, curlew, Arctic skua and great skua the effects combined are judged to be of Negligible magnitude and Negligible significance and as such are judged **Not Significant** for the purposes of the 2017 EIA Regulations (Table 5-17).

Effects on Designated Sites

5.4.59 Consideration of effects on designated sites is limited to the East Mainland Coast, Shetland pSPA, the only proposed designated Nature Conservation Site identified that could potentially be affected by the proposed varied development. This site is designated as a feeding habitat for breeding red-throated divers and wintering diver, grebe and seaduck species. It is estimated that the pSPA provides feeding habitat for up to 209 pairs of red-throated divers breeding on nearby Shetland Mainland and Whalsay (SNH, 2016). Possible effects from the proposed varied development on the pSPA are limited to the red-throated diver qualifying interest.

5.4.60 Examination of the red-throated feeding flights mapped in baseline survey work indicates that the birds breeding at nine of the 35 sites (26%) within the revised site area buffered to 1 km are likely to undertake at least some of their feeding inside the pSPA. On average, approximately seven of these sites are occupied in any one year.

5.4.61 Based on the proportion of sites likely to be linked to the pSPA (26%), it is cautiously assumed that 30% of the predicted collision mortality of red-throated diver for the proposed varied development as a whole (Table 5-10) would affect individuals that undertake foraging in the SPA. On this basis it is estimated that collision mortality would kill one breeding adult that forages in the SPA every five years (an average of 0.2 collision deaths per year). Given that the pSPA is estimated to provide foraging habitat for around 418 adults and that on average approximately 58 of these will die from baseline mortality causes each year, this level of additional mortality is categorised as negligible.

5.4.62 Based on examination of the diver breeding site DVI values (Table 5-15) it is identified that operational disturbance could lead to the displacement of red-throated breeding from only one site with likely linkage to the pSPA. This site has very low occupancy rates (breeding has been recorded there in only one year since 2003). Given that the pSPA is estimated to provide foraging habitat for around 209 pairs, the occasional potential loss of up to one pair (more likely displaced birds would be able to relocate) is categorised as negligible.

5.4.63 The proposed varied development would have negligible (indirect) impacts on the marine environment (for example through changes to surface runoff). Therefore, it would not affect the capacity of the East Mainland Coast, Shetland pSPA to support foraging red-throated divers.

5.4.64 It is concluded that effects of the proposed varied development on the red-throated diver feature of the East Coast Mainland, Shetland SPA are **Not Significant** under the EIA Regulations.

Cumulative Effects

5.4.65 There is limited potential for the impacts of the proposed varied development to increase cumulatively with impacts from other projects because there are only a few other wind farm projects in Shetland and these are all of a relatively small size. Five other developments are considered that are either constructed or consented. These are as follows:

- Burradale Wind Farm, near Lerwick (5 turbines, operational).
- Luggies Knowe Wind Farm, Gremista, near Lerwick (3 turbines, consented).
- Mossy Hill Wind Farm, near Lerwick (12 turbines, in planning).
- Garth Wind Farm, Yell (5 turbines, operational).
- Beaw Field Wind Farm, Yell (17-turbines consented).

5.4.66 No information is available on the impacts on ornithology of the Burradale Wind Farm. However, it is known that the neither red-throated diver nor whimbrel breed in close proximity to the site (D. Jackson, personal observation).

5.4.67 The assessment for the Luggies Knowe Wind Farm (also referred to as Gremista Wind Farm) reported that all impacts on important bird receptors were negligible (Amec, 2011).

5.4.68 The ornithological assessment of the Mossy Hill Wind Farm (Peel Energy, 2018), concluded that impacts on wader and skua species, merlin and red-throated diver would all be negligible. In particular it concluded there would be no effects on whimbrel as this species was not present in the Mossy Hill development site, and that collision mortality of red-throated diver at less than one bird every ten years (using a 99.5% avoidance rate) would be negligible. It is predicted that there would be a potential loss of up to two pairs of breeding curlew and golden plover and up to one pair of Arctic skua (one pair of this bred in only one of the two years of baseline study) due to disturbance and displacement effects. These potential losses are all negligible in the context of the regional populations of these species.

5.4.69 The ornithological assessment of the Garth Wind Farm on Yell predicted there would be one red-throated diver collision every 10-11 years using a 95% avoidance rate (i.e. a negligible impact) and that impacts on all other species were also negligible (North Yell Development Council, 2009).

5.4.70 The ornithological assessment of the Beaw Field Wind Farm concluded that there would be no impact on whimbrel as this species was not breeding close to the wind farm site (Peel Energy, 2016). It also concluded that impacts on all other species were shown to be negligible.

5.4.71 Based on information that is publicly available, all impacts on important ornithological receptors from the five Shetland wind farms considered in the cumulative assessment are considered negligible. It is concluded that the impacts on receptor populations predicted for the proposed varied development would not be exacerbated by more than a trivial amount by the impacts from other windfarms in Shetland acting cumulatively.

5.5 Mitigation

5.5.1 The assessment shows that the proposed varied development will not lead to any additional significant impacts on bird receptors compared to the consented Viking Wind Farm and therefore no mitigation measures additional to those previously proposed are required.

5.5.2 The ES Addendum proposed a programme of measures to benefit bird receptors that would be delivered through the Habitat Management Plan that has been developed for the consented Viking Wind Farm (RPS, 2016). The HMP is a package of practical measures designed to mitigate the potential adverse effects on key wildlife species (in particular on whimbrel, red-throated diver and merlin) and to address existing bird habitat quality issues including peat erosion. The implementation of an approved HMP is a condition of the existing consent and the Applicant is committed to delivering an appropriate HMP.

5.5.3 Since the Viking Wind Farm was consented there has been considerable work on developing the details of the HMP in terms of the type and scale of measures to be included, the sites where work would occur and in gaining the consent of landowners and crofters (RPS, 2016). The results of the new assessment will be taken into account in the implementation of the HMP.

5.5.4 The proposed mitigation measures delivered through the HMP focus on targeted habitat management work aimed at restoring degraded habitat, or, safeguarding existing good habitat or enhancing habitat quality. In combination the various measures are expected to lead to the HMP area supporting larger populations of and improved breeding success for key bird species. The measures are also designed to stabilise or reverse some of the ongoing habitat degradation caused by peat erosion.

5.5.5 The ES Addendum also proposed a Breeding Bird Protection Plan (BBPP), the aim of which would be to limit to acceptable levels, disturbance to breeding birds during the construction stage. The implementation of an approved BBPP is a condition of the existing consent. Neither the proposed varied development nor the results of the new assessment affect the need for implementing a BBPP.

5.6 Residual Effects

Table 5-3. Summary of Residual Effects and Impact Significance after Mitigation

Receptor	Nature Conservation Importance	Receptor Conservation Status	Significance Category before Mitigation	Residual Significance Category after Mitigation	Significance after Mitigation
Red-Throated Diver, Shetland Population	High	Favourable	Low	Negligible	Not Significant
Merlin, Shetland Population	Medium	Favourable	Low	Negligible	Not Significant
Golden Plover, Shetland Population	High	Favourable	Borderline Low	Borderline Low	Not Significant
Dunlin, Shetland Population	Medium	Probably Favourable	Negligible	Negligible	Not Significant
Whimbrel, UK Population	Medium	Unfavourable	Moderate	Negligible	Not Significant
Curlew, Shetland Population	Medium	Probably Favourable	Negligible	Negligible	Not Significant
Arctic Skua, Shetland Population	High	Unfavourable	Negligible	Negligible	Not Significant
Great Skua, Shetland Population	Medium	Probably Favourable	Negligible	Negligible	Not Significant

5.6.1 In designing the proposed wind farm layout, turbine locations were avoided in bird-sensitive areas as far as was practical. These bird sensitive areas were areas where a relatively high risk of displacement or collision was identified for red-throated diver, whimbrel and merlin.

5.6.2 The proposed mitigation measures aim to compensate for collision and displacement losses through enhancing breeding numbers and productivity through habitat management. It is for this reason that some of the HMP measures to benefit birds are planned to be delivered at sites away from the vicinity of the turbines.

5.7 Summary and Conclusions

5.7.1 The EIA presented examines the potential for impacts on bird receptors to arise from collision risk and disturbance/displacement during the operational stage of the proposed varied development. The EIA has focussed on examining these two effects because the proposed varied development is not predicted to have potentially significant effects from other activities, for example habitat loss or disturbance during the construction stage.

5.7.2 The EIA takes into consideration the changes associated with the proposed varied development since the previous assessment presented in the ES Addendum: in particular the increase to the proposed maximum diameter and tip height of the wind turbines. It also takes into consideration changes in the baseline conditions (determined through new survey work) and assessment guidance that have occurred since the assessment reported on in the ES Addendum; and re-assesses the magnitude and significance of the predicted effects of the consented Viking Wind

Farm using the updated baseline data, to enable a more direct comparison with the proposed varied development.

5.7.3 The proposed increase to the rotor diameter and maximum tip height increase the per turbine potential for collision risk for a given amount of baseline flight activity by between 9% and 18% depending on species. For wader and skua species the risk of displacement due to increasing the size and height of the proposed turbines is also assumed to increase. The assumed at-risk distance range was cautiously increased from 0-200 m (used in ES Addendum) to 0-250 m, a change that resulted in the estimated numbers of displaced pairs increasing by between 39% and 60% (depending on species). Despite these increases in collision and displacement risk, the impact magnitude and significance categories for collision and displacement effects arising from the proposed varied development are generally the same (for all receptors they are either negligible or low) as the magnitude categories for the consented Viking Wind Farm based on a like-for-like comparison. As a consequence, for all receptor/impact combinations the evaluation of significance for the purposes of the 2017 EIA Regulations is the same for both the proposed varied development and the consented Viking Wind Farm.

5.7.4 For the national breeding whimbrel receptor, the assessment concludes that the in-combination effect of the proposed varied development could lead to an impact of sufficient magnitude to be judged as **Significant** under the 2017 EIA Regulations. However, this conclusion only holds provided collision mortality is estimated using a 98% avoidance rate. If the more realistic 99% (or greater) avoidance rate is used, then the impact of the effects combined is reduced to a level that is judged to be **Not Significant** for the purposes of the 2017 EIA Regulations. In either case, after mitigation delivered through the HMP the impact of the effects combined is judged to be **Not Significant.**

5.7.5 For all the other species examined the assessment concludes that the in-combination effects of the proposed varied development would lead to impacts judged to be **Not Significant** for the purposes of the 2017 EIA Regulations.

5.7.6 The practical measures to benefit birds that will be delivered through the implementation of the HMP are designed to more than offset any adverse effects to birds arising from the proposed varied development. In addition, they will address the existing deterioration in peatland bird habitats on the site caused by peat erosion.

References

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

Band, W., Madders, M. and Whitfield, D.P. (2007). Developing field and analytical methods to assess avian collision risk at windfarms. In: de Lucas, M, Janss, G. & Ferrer, M. (eds). Birds and Wind Power. Lynx Edicions, Barcelona.

CIEEM (2018). Guidelines for Ecological Impacts Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine.

Cook, ASCP, Humphreys, EM, Masden, EA & Burton, NHK (2014) The avoidance rates of collision between birds and offshore turbines. Scottish Marine and Freshwater Science vol. 5. Marine Scotland Science.

Dillon I.A, Smith, T.D., Williams, S.J., Haysom, S. and Eaton M. (2009). Status of Red-throated Divers *Gavia stellata* in Britain in 2006. Bird Study 56, 147-157.

Eaton, M., Aebischer, N., Brown, A., Hearn, R., Lock, L., Musgrove, A., Noble, D., Stroud, D. and Gregory, R. (2015). Birds of Conservation Concern 4: the population status of birds in the UK, Channel Islands and Isle of Man. *British Birds* **108***,* 708-746.

Furness, R.W. (2015) A review of red-throated diver and great skua avoidance rates at onshore wind farms in Scotland.NH Commissioned Report No. 885.Available at http://www.snh.org.uk/pdfs/publications/commissioned_reports/885.pdf

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 .

Mitchell, P.I., Newton S.Fulmar., Ratcliffe, N. and Dunnn, T.E. (2004). Seabird populations of Britain and Ireland. Christopher Helm, London.

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

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

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

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

Regini, K. (2000). Guidelines for ecological evaluation and impact assessment. Ecology and Environmental Management. In Practice, 29 (September), pp. 1, 3-7. Winchester, Institute of Ecology and Environmental Management.

RPS (2016). Viking Wind Farm Habitat Management Plan 2016. Report prepared for Viking Energy Wind Farm LLP by RPS and Natural Research (Projects) Ltd.

Scottish Government (2013). Planning Advice Note 1/2013: Environmental Impact Assessment http://www.gov.scot/Resource/0043/00432581.pdf

Scottish Natural Heritage (2006). Assessing significance of impacts from onshore windfarms on birds outwith designated areas.

SNH (2010). Guidance. Use of Avoidance Rates in the SNH Wind Farm Collision Risk Model. SNH, Battleby.

SNH (2012). Assessing the cumulative impact of onshore wind energy developments. SNH Battleby, UK.

SNH (2013). A Handbook on Environmental Impact Assessment. 4th edition. SNH, Battleby.

SNH (2014). Guidance: Recommended bird survey methods to inform impact assessment of onshore wind farms. SNH, Battleby, UK.

SNH (2016). East Mainland Coast, Shetland Proposed Special Protection Area (pSPA) No. UK9020311. SPA Site Selection Document: Summary of the scientific case for site selection.

SNH (2017) Avoidance rates for the onshore SNH Wind Farm Collision Risk Model. SNH guidance note. https://www.nature.scot/wind-farm-impacts-birds-guidance-avoidance-rates-guidance

Whitfield, D.P. (2007). The effects of wind farms on shorebirds (waders: Charadrii), especially with regard to wintering golden plovers. Report from Natural Research to Your Energy. Natural Research Ltd, Banchory.

Whitfield, D.P., Ruddock, M. and Bullman, R. (2008). Expert opinion as a tool for quantifying bird tolerance to human disturbance. Biological Conservation 141: 2708-2717.

Wilson, M. W., Austin, G. E., Gillings S. and Wernham, C. V. (2015). Natural Heritage Zone Bird Population Estimates. SWBSG Commissioned report number SWBSG_1504. pp72. Available from:www.swbsg.org

Glossary and Abbreviations

BBPP	Breeding Bird Protection Plan
CRM	Collision rate modelling
DVI	Disturbance Vulnerability Index (for red-throated diver breeding sites)
HMP	Habitat management plan
MBS	Moorland Bird Survey
SNH	Scottish Natural Heritage
SPA	Special Protection Area