FIVE ESTUARIES OFFSHORE WIND FARM

10.20.12 METHODOLOGICAL DIFFERENCES BETWEEN THE APPLICANT AND NATURAL ENGLAND ON ORNITHOLOGY MATTERS

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In preparation of this document Five Estuaries Wind Farm Ltd has made reasonable efforts to ensure that the content is accurate, up to date and complete for the purpose.

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DEFINITION OF ACRONYMS

Term	Definition
AOE	Alde-Ore Estuary
CRM	Collision risk modelling
DAS	Digital Aerial Survey
FFC	Flamborough and Filey Coast
HRA	Habitats Regulations Assessment
IMP	Implementation and Monitoring Plan
LBBG	Lesser black-backed gull
OTB	Outer Trail Bank
OWF	Offshore Wind Farm
SD	Standard Deviation
SNCB	Statutory Nature Conservation Bodies
SPA	Special Protected Area
UCI	Upper Confidence Interval
VE	Five Estuaries

TERMINOLOGY

Term	Definition
Adult Apportioning	Number of impacts that are considered to be adult birds.
Breeding season	The defined season where the birds are nesting and rearing young, defined from Furness 2015.
Compensation quantum	The number of pairs required to compensate for the predicted impacts.
Collision Risk Modelling (CRM)	A method used to estimate the number of birds colliding with wind turbines.
Displacement	Birds are affected by wind farms by avoiding the area due to disturbance.
Impact	An impact to the receiving environment is defined as any change to its baseline condition, either adverse or beneficial.
Mortality	Number of birds predicted to die from collision and/or displacement.
Natal philopatry	The number of birds that return to the colony where they fledged, to then breed at the same colony.
Non-breeding season	The defined season where the birds are away from the breeding colony, defined from Furness 2015.
Sabbatical rates	During any given year there will be a proportion of the adult population of any species that will not breed.

1 INTRODUCTION

1.1.1 This document is submitted in response to Action Point 14 from the Examining Authority during Issue Specific Hearing 6, held on the 21st and 22nd January 2025. The Action Point stated:

Submission of a technical note on the methodological differences between the Applicant and Natural England on ornithological matters and the resulting differences between the parties with respect to quantifying compensatory measures

1.1.2 This document, therefore, outlines agreements and any outstanding disagreements between the Applicant and Natural England regarding assessment methodologies and compensation calculations across the key ornithological species associated with Five Estuaries (VE), mainly: Lesser Blacked Back Gull (LBBG), Guillemot, Razorbill, Kittiwake and Gannet.

1.1.3 Key terminology has been outlined at the beginning of this document.

1.2 ASSESSMENT

1.2.1 Any disagreements in assessment methodologies have been covered in detail in Section 2 of this report. Further information can be found in the 5.4 Report to Inform Appropriate Assessment – Revision C 6.5.4.15 Apportioning Note [APP-117], and for the relevant species the compensation roadmaps and in principal monitoring plans (IMPs).

1.2.2 Table 2.1 presents the current positions of the Applicant and Natural England for each species.

1.2.3 The Applicant's position regarding Red Throated Diver has been covered in 10.48 Red-Throated Diver Note in Response to Natural England Comments [REP6-052], submitted at Deadline 6.

1.3 COMPENSATION QUANTUMS

1.3.1 The compensation quantum is the compensation requirement i.e. number of breeding pairs, that is required to offset the Project's impact.

1.3.2 There has been no agreement reached with Natural England in regard to the levels of compensation required for any of the species where there is a full derogation or without prejudice case. A range of quanta, as requested by Natural England, has been presented.

1.3.3 Section 3.1 sets out the preferred methods of compensation calculations used to calculate the quanta required.

2 ASSESSMENT DIFFERENCES BETWEEN NATURAL ENGLAND AND FIVE ESTUARIES

2.1.1 This section will present the Applicant's position regarding the methodological differences used by the Applicant and Natural England to calculate the predicted impacts for LBBG, guillemot and razorbill.

2.1.2 The methods and resulting predicted mortalities for gannet and kittiwake are in agreement with both parties so will not be discussed here.

2.2 LESSER BLACK-BACKED GULL

2.2.1 Collision risk modelling (CRM) was carried out for lesser black-backed gull. All the parameters within the CRM were agreed with Natural England and it was agreed with that 40% of adults in the breeding season were to be apportioned to Alde-Ore Estuary SPA, however there are disagreements in the apportioning of adults in the population and the use of sabbatical rates.

ADULT APPORTIONING

2.2.2 The Applicant has used the adult proportion from the stable age distribution, calculated from robust measures of age-specific demographic rates (survival and productivity) based on adult apportioning rates found in Horswill and Robinson (2015). Natural England's position for adult apportioning is to use the site-specific Digital Aerial Survey (DAS) data. Lesser black backed gull can be aged as non-adults from Digital Aerial Survey data for part of their immature life, but then appear as adult, or inseparable from adults in DAS images for some years before reaching maturity. The Natural England approach of aging all these birds as adult, when clearly they are likely to not all be adults, will act to increase the number of adults recorded in a given area, and as such will inaccurately inflate the adult proportion.

2.2.3 The Natural England approach to aging and adult proportions adds unnecessary additional precaution to the breeding season impact assessment for lesser black backed gull. Therefore, the Applicant considers the stable age distribution to be the most appropriate method.

SABBATICAL RATES

2.2.4 Each year, a portion of the adult population in any species does not breed due to ecological constraints (e.g., poor weather, food scarcity) or adaptive decisions in long-lived species to enhance survival and future breeding opportunities (Reed et al., 2015; Leith et al., 2022; Desprez et al., 2011). This behaviour is observed in various species, including kittiwakes (e.g., Desprez et al., 2011) and auks (e.g., Reed et al., 2015).

2.2.5 Sabbatical rates (representing the proportion of birds not breeding in a given year) were incorporated into the Applicant's assessment where available to provide a more accurate approach to the number of adults using the array area that are actually breeding in the SPAs that given year.

2.2.6 The sabbatical rate used for lesser black-backed gull (0.35) is based on available guidance and literature. The sabbatical rates presented align with those recommended by Marine Scotland for the Seagreen Phase 1 Offshore Project (Marine Scotland, 2017).

2.2.7 Research into lesser black-backed gull has also shown that up to 40% of individuals which have previously bred may fail to breed in a given year, and therefore the value of 35% advocated by Marine Scotland (2017) is considered to be both relevant and sufficiently precautionary.

2.2.8 Natural England does not consider the current evidence base sufficient to recommend sabbatical rates of >0 for any seabird species. However, the Applicant considers that the best available evidence should be used for sabbatical rates.

2.3 GUILLEMOT AND RAZORBILL

DISPLACEMENT

2.3.1 An assessment on displacement risks to guillemot and razorbill was carried out and presented in the 5.4 Report to Inform Appropriate Assessment – Revision C.

2.3.2 The Applicant's approach uses 50% displacement, 1% mortality. Natural England approach is to use the more precautionary 70% displacement, 2% mortality.

2.3.3 There is growing evidence that 50% mortality, 1% displacement is a more appropriate precautionary approach (APEM, 2022), with evidence from the Beatrice OWF: Year 2 Post-construction Ornithology Monitoring 2021 report (Trinder *et al*, 2023) highlighting there was little indication of guillemots responding negatively or positively to the presence of an OWF and that the upper end of the displacement rates currently used in assessment and recommended by Natural England i.e 70% displacement and 2% mortality, is over estimating the extent of displacement.

2.3.4 Despite there being limited data on habituation, habituation to OWFs by auks has been clearly demonstrated at the Thanet OWF where statistically significant auk displacement was demonstrated but only in the short term (Royal Haskoning DHV, 2013). Further evidence is constantly being collected as additional post-construction monitoring continues with reports of auk numbers increasing within the windfarm itself (Leopold and Verdaat, 2018). This would strongly suggest that habituation is possible, and the displacement rates may diminish over the operational life of the OWF.

2.4 PREDICTED IMPACTS

2.4.1 The predicted impacts for both the Applicant's approach and Natural England's approach are:

- Lesser black-backed gull from collision:
  - **Applicant approach = 5.7 individuals**
  - Natural England's approach = 11.31 individuals
- Guillemot from displacement:
  - **Applicant approach = 0.82 individuals**
  - Natural England's approach = 2.28 individuals
- Razorbill from displacement:
  - **Applicant approach = 0.22 individuals**
  - Natural England's approach = 0.63 individuals

Table 2.1 Summary of Applicant's and Natural England's position for each species

Species	Predicted mortalities VE Approach	Predicted mortalities NE Approach	Differences	Agreements
Lesser black-backed gull (AOE SPA)	5.70	11.31	Adult apportioning: VE: 0.595 NE: 0.800 VE: Use of sabbatical rates	All collision risk modelling (CRM) parameters 40% apportionment to AOE SPA
Guillemot (FFC SPA)	0.82	2.28	VE: 50% displacement and 1% mortality NE: 70% displacement and 2% mortality	Non-breeding season only
Razorbill (FFC SPA)	0.22	0.63	VE: 50% displacement and 1% mortality NE: 70% displacement and 2% mortality	Non-breeding seasons only
Kittiwake (FFC SPA)	0.82		N/A	Everything agreed. Non-breeding season connectivity only
Gannet (FFC SPA)	0.28 displacement		N/A	Everything agreed. Adult apportioning: 82.0% FFC SPA apportioning: 74%
	0.14 collision		N/A	

3 COMPENSATION CALCULATION DIFFERENCES

3.1 COMPENSATION QUANTUMS

LESSER BLACK-BACKED GULL

3.1.1 The Applicant's position on calculating the compensation quantum for lesser black-backed gull is to use the HOW4 approach, using the mean mortality rate and a 2:1 ratio for the site at Orford Ness and a 3:1 ratio for the Outer Trial Bank.

3.1.2 **This results in a quantum of 42.8 pairs for Orford Ness site and 64.2 pairs for the Outer Trail Bank site.** The differences in ratios used are due to the connectivity of the sites to the impacted SPA (Alde Ore Estuary SPA) (Table 3.1).

3.1.3 Natural England's preferred approach uses the Upper Confidence Interval (UCI) mortality rate and includes a consideration of natal dispersal (to determine how many birds will recruit to the impacted colony), which results in 1,270.6 pairs. This adds even more precaution to the calculation and is not representative of the impacts (5.7 birds). This is especially unnecessary when compensation is being implemented at the impacted colony.

3.1.4 The Applicant does not agree that the upper confidence intervals should be used when calculating the compensation requirements. There are several additive levels of precaution already within the assessment process and the use of the upper confidence intervals and a ratio of 3:1 inappropriately further inflates the compensation requirements. Therefore, the application of a ratio and an upper confidence interval is not required.

Table 3.1 Compensation quantums for lesser black-backed gull using Hornsea 4 methods and Hornsea 4 including natal dispersal (Green= Applicant's preferred quantum for the Orfordness site, Blue = Applicant's preferred quantum for the OTB site, Orange = Natural England's preferred quantum for both sites).

LBBG compensation quantum								
	Mortalities = 5.7 and 11.31 (mean) & 26.74 and 53.07 (UCI)							
Method	**HOW4 Applicant**				**HOW4 NE**			
	Mean	UCI	Mean (including Natal dispersal)	UCI (including Natal dispersal)	Mean	UCI	Mean (including Natal dispersal)	UCI (including Natal dispersal)
1:1	21.4	100.3	45.5	213.4	42.4	199.1	90.3	423.5
2:1	**42.8**	200.6	91.0	426.8	84.8	398.1	180.5	847.1
3:1	**64.2**	300.9	136.5	640.2	127.3	597.2	270.8	**1270.6**

KITTIWAKE

3.1.5 As with lesser black-backed gull, for kittiwake the Applicant's position is the same (using the mean mortality rate and HOW4 method) and Natural England's preferred approach is using the UCI mortality rate and HOW3 stage 2 methods (Table 3.2).

3.1.6 The Applicant does not agree that the use of upper confidence interval impact numbers are more appropriate than using the mean, especially when applying a 3:1 compensation ratio. Uncertainties are already factored in when calculating the impacts through collision risk modelling and therefore adding further levels of precaution would result in a compensation quantum that is unrealistic. The Applicant considers that seven pairs is sufficient, NE's approach would lead to a requirement of 46 pairs to compensate for less than one bird, which outcome is clearly disproportionate to the impact.

Table 3.2 Compensation quantums for kittiwake using Hornsea 4 methods and Hornsea 3 methods (Green= Applicant's preferred quantum, Orange = Natural England's preferred quantum).

Kittiwake compensation quantum						
	Mortalities = 0.82 (mean) & 2.35 (UCI)					
Methods	**HOW4**		**HOW3 stage 1**		**HOW3 stage 2**	
	Mean	**UCI**	**Mean**	**UCI**	**Mean**	**UCI**
1:1	2.2	6.3	2.5	7.1	5.3	15.2
2:1	4.4	12.6	4.9	14.2	10.6	30.4
3:1	**6.6**	**18.9**	**7.4**	**21.2**	**15.9**	**45.7**

GUILLEMOT AND RAZORBILL

3.1.7 Using the HOW4 methods, the mean mortality rates from 50% displacement and 1% mortality and a 3:1 ratio (due to the measure's lack of connectivity to FFC SPA), the Applicant considers that 11.1 pairs for guillemot (Table 3.3) and 5.8 pairs for razorbill (Table 3.4) is adequate to compensate for the small impacts from the Project.

3.1.8 The Natural England approach would use a 70% displacement, 2% mortality, upper confidence intervals and a consideration of natal dispersal, and/or the Hornsea 3 stage 2 approach (Table 3.5 and Table 3.6). Natural England's position regarding this approach is that where uncertainty exists a precautionary approach should be adopted however, as mentioned in paragraph 2.3.3, there is growing evidence that 50% displacement and 1% mortality is more than precautionary enough. Furthermore, when applying precaution at every level, this leads to a layering effect that increases the impacts and quantums to unsustainable levels given the very low predicted impacts.

3.1.9 These three additional levels of precaution would increase the required compensation quantums to 72 pairs (Table 3.3) or 154 pairs (Table 3.5) for guillemot, and 293 pairs (Table 3.4) or 1,625 pairs (Table 3.6) for razorbill. The Applicant considers that these are not proportionate to an impact of less than 1 bird.

Table 3.3 Compensation quantums for guillemot using Hornsea 4 methods and Hornsea 4 including natal dispersal (Green= Applicant's preferred quantum, Orange = Natural England's preferred quantum).

Guillemot compensation quantum HOW4								
	Mortalities = 0.82 (mean) & 1.10 (UCI) for 50/1 & Mortalities = 2.28 (mean) & 3.08 (UCI) for 70/2							
Methods	**50/1**		**50/1**		**70/2**		**70/2**	
	Mean	**UCI**	**Mean (including Natal dispersal)**	**UCI (including Natal dispersal)**	**Mean**	**UCI**	**Mean (including Natal dispersal)**	**UCI (including Natal dispersal)**
1:1	3.7	5.0	6.4	8.6	10.3	13.9	17.8	24.0
2:1	7.4	10.0	12.8	17.2	20.6	27.9	35.6	48.1
3:1	11.1	15.0	19.2	25.7	31.0	41.8	53.4	72.1

Table 3.4 Compensation quantums for razorbill using Hornsea 4 methods and Hornsea 4 including natal dispersal (Green= Applicant's preferred quantum, Orange = Natural England's preferred quantum).

Razorbill compensation quantum HOW4								
	Mortalities = 0.22 (mean) & 0.34 (UCI) for 50/1 & Mortalities = 0.63 (mean) & 0.98 (UCI) for 70/2							
Methods	**50/1**		**50/1**		**70/2**		**70/2**	
	Mean	**UCI**	**Mean (including Natal dispersal)**	**UCI (including Natal dispersal)**	**Mean**	**UCI**	**Mean (including Natal dispersal)**	**UCI (including Natal dispersal)**
1:1	1.9	3.0	21.9	33.8	5.5	8.6	62.7	97.5
2:1	3.9	6.0	43.8	67.6	11.0	17.2	125.4	195.0
3:1	5.8	8.9	65.7	101.4	16.6	25.7	188.1	292.5

Table 3.5 Compensation quantums for guillemot using Hornsea 3 stage 2 methods as recommended, where poossible, by Natural England (Orange = Natural England.s preferred quantum).

Guillemot compensation quantum HOW3 stage 2				
	Mortalities = 0.82 (mean) & 1.10 (UCI) for 50/1 & Mortalities = 2.28 (mean) & 3.08 (UCI) for 70/2			
Methods	**50/1**		**70/2**	
	Mean	**UCI**	**Mean**	**UCI**
1:1	13.7	18.3	38.0	51.3
2:1	27.3	36.6	75.9	102.6
3:1	41.0	54.9	113.9	**153.8**

Table 3.6 Compensation quantums for razorbill using Hornsea 3 stage 2 methods as recommended, where possible, by Natural England (Orange = Natural England's preferred quantum).

Razorbill compensation quantum HOW3 stage 2				
	Mortalities = 0.22 (mean) & 0.34 (UCI) for 50/1 & Mortalities = 0.63 (mean) & 0.98 (UCI) for 70/2			
Methods	**50/1**		**70/2**	
	Mean	**UCI**	**Mean**	**UCI**
1:1	121.6	187.9	348.2	541.6
2:1	243.2	375.8	696.3	1083.2
3:1	364.7	563.7	1044.5	**1624.7**

3.1.10 Further discussion on the levels of precaution leading to the unsustainable compensation quantums can be found in Section 4.

4 LEVELS OF PRECAUTION

4.1.1 The Precautionary Principle is embedded into HRA decision making, ensuring that where there is uncertainty as to an impact, that a precautionary approach to decision making is applied. It does not, however, dictate that precaution in approach should be inappropriately applied to every input parameter of the assessment and the development of mitigation or compensation measures. It is not necessary to apply precautionary assumptions at every possible stage resulting in an approach that leads cumulatively to a wholly unrealistic output, rather the overall assessment must take a precautionary approach.

4.1.2 NPS EN-3 does not refer to precaution in the development of compensation, citing considerations of suitability, securability and effectiveness (paragraph 3.8.291). Whilst a precautionary approach should be considered in the round (i.e. at the stage of decision making), Natural England's approach to this does not take this holistic view and instead seeks to apply it at every stage of survey, assessment and calculation of quantum. This leads to results that are divorced from the reality of the impact and what is reasonably required to compensate.

4.1.3 With regards to ornithology assessments specifically, precaution is introduced to address uncertainties in apportioning and impact assessment, including spatial apportioning, offshore population demographics, biometric data variability (e.g., flight heights, speeds, nocturnal activity, avoidance rates for Collision Risk Modelling), pressure impacts (displacement and mortality rates), and sabbatical rates.

4.1.4 The Applicant acknowledges that while precaution is necessary to address uncertainty, it should serve as a tool to help decision-makers reasonably assess risk using the best available scientific evidence. The identified risk must be both plausible and real, and the precautionary principle should not be applied speculatively or universally. As mentioned above, adding multiple layers of precaution, especially when addressing the same issue, can lead to an overly cautious approach. If applied excessively, the precautionary principle may distort the assessment process and final decision by producing unrealistic risk projections. This, in turn, could result in disproportionate compensation requirements, contrary to established guidance.

4.1.5 The Applicant submits that t applying multiple layers of precaution throughout the assessment, apportioning, and compensation calculation processes is inappropriate and leads to disproportionate compensation requirements. The Applicant maintains that its assessment and compensation calculations already incorporate a sufficient level of precaution to account for the uncertainties involved in predicting impacts on ornithological species.

4.2 COLLISION RISK ASSESSMENT (CRM) – LESSER BLACK-BACKED GULL AND KITTIWAKE

4.2.1 There is growing evidence through specific studies that, whilst not definitive, the assessment of collision risk is highly precautionary (Vattenfall, 2023). The species-specific avoidance rates are far higher in Vattenfall (2023) than the species group rates used in the assessment. Habitats assessments must be based on the up-to-date evidence and this recent data should accordingly be taken into account and given weight.

4.2.2 CRM was carried out for lesser black-backed gull and kittiwake. The inputs and outputs of the CRM can be found in 6.5.4.8 Collision Risk Modelling Inputs and Outputs [APP-110]. During every stage of the assessment there are levels of precaution introduced. There are several parameters included in the CRM assessment:

- Avoidance rate
- Flight height
- Flight speed
- Nocturnal activity.

4.2.3 For each of these parameters the SNCB advised rates have been used when modelling collisions and the results have been presented within the 5.4 Report to Inform Appropriate Assessment – Revision C.

AVOIDANCE RATES

4.2.4 The avoidance rate used in the CRM for kittiwake was 99.2% and 99.4% for lesser black-backed gull as advised in Joint Advice note from the SNCBs regarding bird collision risk modelling for offshore wind developments. A review of relevant datasets carried out by Ozsanlav-Harris *et al* (2022) endorsed the use of an avoidance rate of 99.7% for kittiwake and 99.54% for lesser black. Using the species-specific rate from Ozsanlav instead of the advised rates would significantly reduce the collision rates for kittiwake and lesser black-backed gull. Therefore, the results from the assessment can be deemed to be precautionary.

FLIGHT HEIGHT

4.2.5 The stochastic collision risk model uses four flight height assignment options, selecting Band Option 2 as recommended by SNCBs. This approach relies on generic flight height data from Johnston et al. (2014) and Masden (2015), primarily based on boat-based observations (27 of 35 datasets). However, drone trials with altimeters show that observers misassigned flight heights up to 70% of the time, often overestimating (Thaxter et al., 2016). Consequently, these reviews likely overestimate bird flight heights, leading to an inflated number assumed to be at risk of collision.

FLIGHT SPEED

4.2.6 The Applicant's stochastic collision risk model is sensitive to flight speed inputs. Using SNCB-advised speeds can overestimate collisions compared to site-specific tracking data. The model also accounts for speed over ground, factoring in headwinds, which reduces predicted collisions (Masden et al., 2021).

4.2.7 The Band model assumes flight speeds are over ground. Using airspeed as a proxy increases ground speed, which leads to an increase in bird flux through the rotor swept area, ultimately raising total collision estimates (Norfolk Boreas, 2020).

4.2.8 Natural England's recommended kittiwake flight speed of 13.1 m/s for CRM is based on just two birds and measures airspeed, not ground speed, conflicting with Band model assumptions. This is significantly higher than the 10.8 m/s mean ground speed from eight studies covering 47 birds and 287 laser rangefinder readings. Using this speed is precautionary and likely overestimates collisions.

NOCTURNAL ACTIVITY

4.2.9 Nocturnal activity levels assess nighttime collision risk. For kittiwakes, tracking data from various colonies, including FFC SPA, show lower nocturnal activity than Natural England's recommended rate of 0.4. In five of six years, activity ranged from 0.25 to 0.37, averaging 0.30, meaning the 0.4 rate inflates impact estimates. One outlier year recorded 0.61 but deviates significantly from the usual range.

4.2.10 The Applicant has been using the StochLab methods in 6.5.4.8 Collision Risk Modelling Inputs and Outputs [APP-110] where a NAF of 37.5% was used which is still higher than the standard rates at FFC SPA, therefore the use of these rates should be considered to be precautionary.

4.3 DISPLACEMENT ASSESSMENT – GUILLEMOT AND RAZORBILL

4.3.1 Displacement impacts are calculated by applying displacement and mortality rates to the densities calculated from the DAS data. The preferred approach is to present impact levels across a displacement range, with Natural England recommending 30–70% based on species. For guillemot and razorbill, the preferred rate is 70%.

4.3.2 A review by Orsted (APEM, 2022) analysed data from 21 offshore wind farms, some showing no significant displacement or attraction. It recommended a precautionary 50% displacement rate for guillemot and razorbill. A separate study at Beatrice Wind Farm found no turbine avoidance or displacement effect (Trinder, 2024).

4.3.3 Natural England's higher displacement rates are based on studies like Peschko et al. (2024), which has methodological concerns. It uses a BACI approach with few environmental covariates, lacks model fit presentation, and compares pre- and post-wind farm data from different survey methods spanning decades. Differences in abundance are attributed solely to wind farm effects without considering other factors like prey distribution. Additionally, assessing distance effects without a wind farm in the pre-period raises reliability concerns.

4.3.4 The Applicant considers, based on the available evidence that a 50% displacement rate is the most appropriate, yet precautionary, rate to use given the evidence available.

4.3.5 Displacement mortality rates typically range from 1% to 10%, with Natural England favouring 5%, while recent Secretary of State decisions have used 2%. These rates are difficult to quantify. An APEM (2022) study on Hornsea Four predicted a maximum mortality rate of ~1%, was likely overestimated due to modelling assumptions. The Applicant considers 1% a suitably precautionary rate for assessment.

4.4 ADULT APPORTIONING

4.4.1 To calculate the proportion of mortalities that would be attributed to each SPA, the NatureScot (2018) apportioning tool (recommended by the best practice guidance from Natural England (Parker *et al*, 2023c)) requires the number of breeding adults that are impacted by the OWF (as opposed to individuals which are calculated by CRM and displacement). For the Applicant's approach to the assessment, the proportion of adults in the population during the breeding season was derived from the tables in Appendix A of Furness (2015). These adult proportions are only applied during the breeding season apportioning.

4.4.2 The site-specific DAS data for aged birds is unreliable and incomplete with over 50% of birds unaged for three key species; kittiwake, lesser black-backed gull and gannet. Guillemot, razorbill and red-throated diver were not aged from the DAS data. The aging of lesser black-backed gulls from DAS data can be complex with difficulties differentiating between juvenile and immature birds as well as the inability to separate birds that are 3rd and 4th calendar year or adult-like birds.

4.4.3 Given that the uncertainties with aging are from non-adult birds and that some ages are less likely to be recorded than others, the Project does not believe that the DAS data is reliable enough to use for adult apportioning.

4.4.4 The data presented in Furness (2015) are considered to provide a more accurate representation of population age structure than site-based data, since only a small proportion of individuals for each species could be positively aged within the latter, especially due to the low number of recorded birds during the non-breeding season within the site-specific surveys. During the full breeding bio-season the proportion of adult birds within the array was derived from Appendix A: Table 16 of Furness (2015) for the FFC SPA.

4.5 SABBATICAL RATES

4.5.1 During any given year there will be a proportion of the adult population of any species that will not breed. There is a range of likely reasons for this, with some birds being limited by ecological constraints that do not allow birds to breed in a given year (e.g., poor weather conditions or food availability), while other long-lived species will regularly make an adaptive decision to avoid breeding in certain years to ensure long term survival and future breeding opportunities (Reed et al., 2015; Leith et al., 2022; Desprez et al., 2011). This behaviour is evidenced across a wide range of species, including kittiwake (e.g., Desprez et al., 2011) and auks (e.g., Reed et al., 2015).

4.5.2 Sabbatical rates (representing the proportion of birds not breeding in a given year) were incorporated into the assessment where available to provide a more accurate approach to the number of adults using the array area that are actually breeding in the SPAs that given year.

4.5.3 Rates used by the Applicant are based on available guidance and literature. The sabbatical rates presented align with those recommended by Marine Scotland for the Seagreen Phase 1 Offshore Project (Marine Scotland, 2017), in the absence of any guidance from Natural England regarding sabbatical rates.

4.5.4 For lesser black-backed gull, research has also shown that up to 40% of individuals which have previously bred may fail to breed in a given year, and therefore the value of 35% advocated by Marine Scotland (2017) is considered to be both relevant and sufficiently precautionary.

4.6 COMPENSATION CALCULATIONS

4.6.1 The amount of compensation required to adequately cover the predicted impacts is calculated using various factors, including philopatry rates, survival rates. The basic compensation calculation (Hornsea 4 methods) takes the number of birds required to be compensated and calculates how many additional breeding pairs would be required to generate that many young birds. This is the Applicant's preferred approach, especially based on the low impacts for each species. Natural England's preferred method is to use philopatry rates and the 95% Upper Confidence Interval (UCI) outputs of displacement and CRM assessments rather than the mean impacts.

4.6.2 When calculating displacement impacts. the mean outputs better reflect reality than the 95% UCI, which Natural England advocates which adds extra precaution. Further precaution comes from using mean peak count, precautionary displacement rates, adult apportioning rates, and mean max foraging ranges plus 1 SD.

4.6.3 CRM uses an online tool to run 1,000 bootstrapped scenarios, averaging results to minimize outliers and better reflect real-life conditions. While bootstrapped outputs have a small margin of error, mean impact values are more representative than 95% UCI impacts. Natural England's preference for 95% UCI adds extra precaution to already conservative parameters like adult apportioning and mean max foraging ranges plus 1 SD.

4.6.4 Natural England also advocate the use of philopatry rates and/or using the Hornsea 3 stage 2 methods. The Hornsea 3 methods also take into consideration mortality and emigration of the birds that have been generated from the compensation measure. Table 4.1 presents each stage in the compensation calculation for razorbill and Figure 4.2 illustrates the impact each stage has on the compensation calculation outcome. Table 4.2 presents the number of stages required for both the HOW4 and HOW3 stage 2 methods.

Table 4.1 Stages of the compensation calculations for razorbill

	Applicant's approach	Natural England's approach
Displacement rates	50%	70%
Mortality rates	1%	2%
Estimated mortality	0.22 (mean)	0.98 (UCI)
Natal philopatry	N/A	0.088
Compensation calculation	HOW4 methods	HOW3 stage 2 methods
Ratio	3:1	3:1

Table 4.2 Stages in the compensation calculations for the HOW4 and HOW3 stage 2 methods

	HOW 4 method	HOW 3 stage 2 method
Survival until adulthood	✓	✓
Productivity	✓	✓
Natal philopatry	×	✓
Natural mortality of additional pairs	×	✓
Dispersal of additional pairs	×	✓

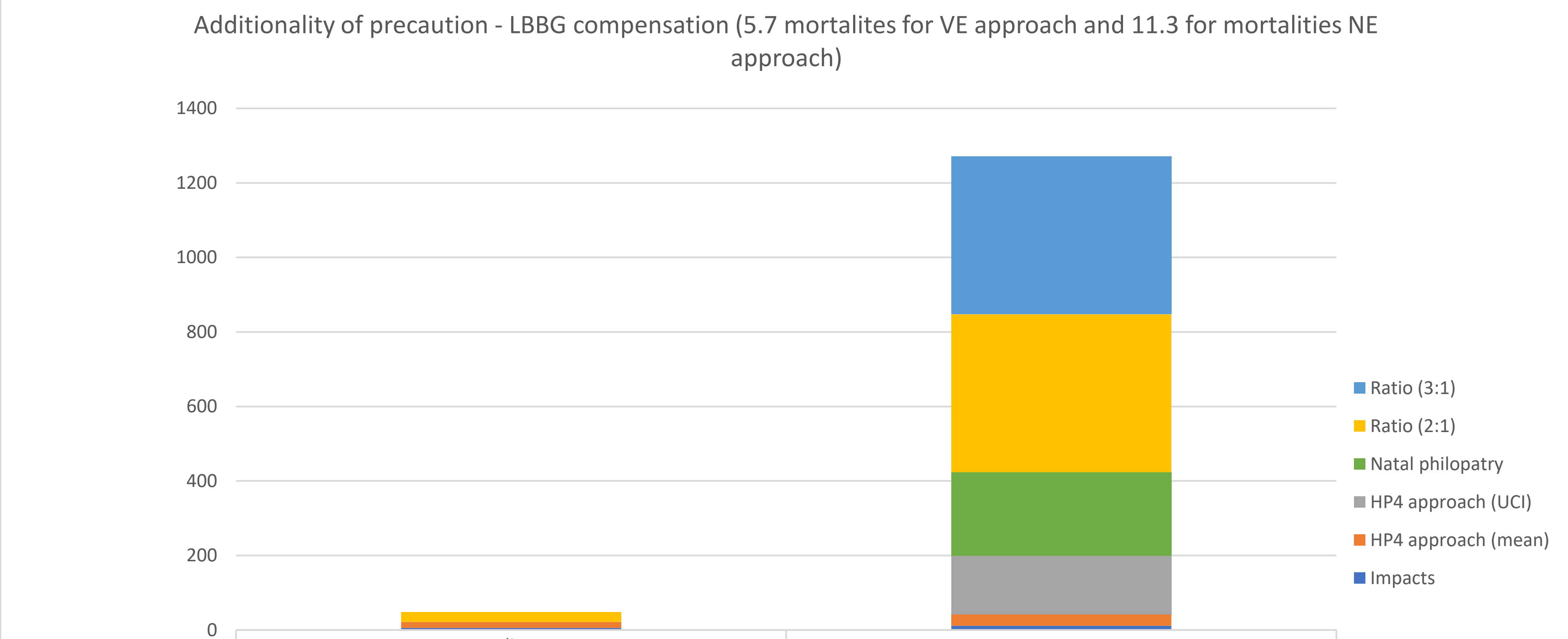
4.6.5 The extra levels of precaution used in Natural England's preferred approaches for calculating compensation quantums, not including the levels of precaution to calculate the impacts discussed above, are:

- Use of UCI from the 70% displacement and 2% mortality impacts.
- Use of natal philopatry rates
- Hornsea Three stage 2
- Compensation ratios

4.6.6 The inclusion of philopatry rates (rates at which fledglings at a particular colony will leave that colony to breed at another site) inflates the compensation numbers to unsustainable numbers. For example, when calculating the quantum required for razorbill (0.2 individuals) the Applicant's approach would result in a quantum of 6 pairs.

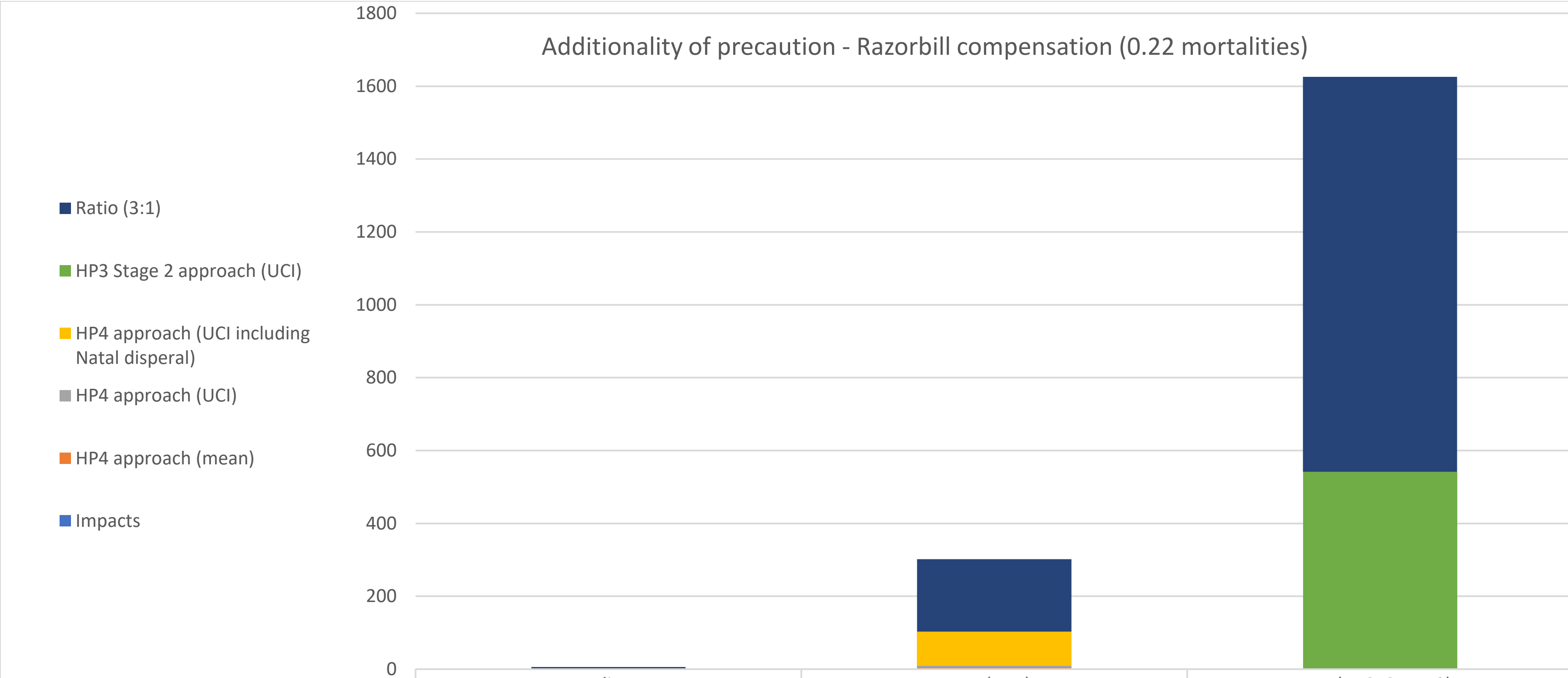
4.6.7 Using the Natural England methods described above and the quantum would be 293 pairs. This would increase further to 1,625 pairs using the Hornsea 3 stage 2 methods. The Applicant considers that these are not representative of the impacts of less than one bird, in fact it is clearly unsustainable to suggest that over 1.300 pairs are required to compensate for an impact of 0.2 birds.

4.6.8 Figure 4.1 and Figure 4.2 are examples using lesser black-backed gull and razorbill to illustrate the effects the layering of precaution has on the compensation quantums.



	Applicant	NE
Ratio (3:1)		423.5
Ratio (2:1)	27.1	423.6
Natal philopatry		224.4
HP4 approach (UCI)		156.7
HP4 approach (mean)	15.7	31.09
Impacts	5.7	11.31

Figure 4.1 Lesser black-backed gull compensation quantum layering for the Applicants preferred approach and Natural England's preferred approach



	Applicant	NE (HP4)	NE (HP2, Stage 2)
Ratio (3:1)	4.12	199.08	1084.08
HP3 Stage 2 approach (UCI)			540.62
HP4 approach (UCI including Natal disperal)		93.42	
HP4 approach (UCI)		4.08	
HP4 approach (mean)	1.68	4.52	
Impacts	0.22	0.98	0.98

Figure 4.2 Razorbill compensation quantum layering for the Applicants preferred approach and Natural England's preferred approach

4.7 SUMMARY

4.7.1 The Applicant considers that the additive nature of the levels of compensation do not result in realistic mortality impacts or compensation quantums. The Applicant believes that their preferred approaches described above provide both a suitably precautionary approach and a sustainable and achievable quantum. The following key points highlight the Applicant's positions:

- The precautionary principle has been misapplied by Natural England, the principle applies to the overall decision making, it is not and never has been an absolute requirement to apply precaution additively at every single stage of calculation;
- Precaution has been applied to assessments already, NE additions are not supported by evidence or published literature;
- Emerging studies demonstrate that collision risk and disturbance is lower than assessed supporting the position that the assessment is already precautionary;
- Compensation quantum calculations are useful, but do not need the additional precaution proposed by NE and should be reviewed as to whether they result in something that is plausible, reasonable and deliverable.

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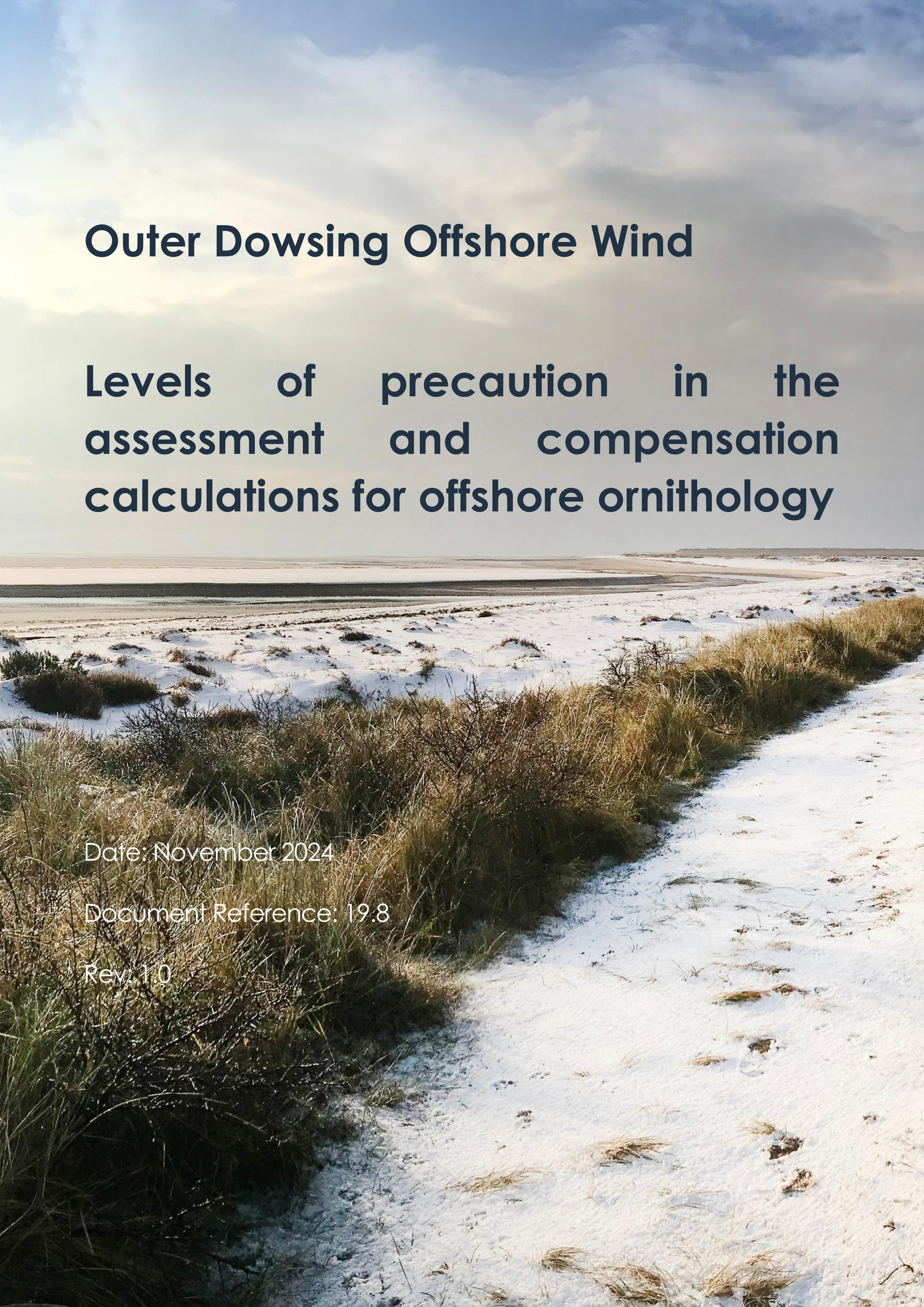
6 APPENDIX 1 - OUTER DOWSING OFFSHORE WIND: 19.8 LEVELS OF PRECAUTION IN THE ASSESSMENT AND COMPENSATION CALCULATIONS FOR OFFSHORE ORNITHOLOGY



Outer Dowsing Offshore Wind

Levels of precaution in the assessment and compensation calculations for offshore ornithology

Date: November 2024

Document Reference: 19.8

Rev: 1.0

Company:	**Outer Dowsing Offshore Wind**		Asset:		**Whole Asset**	
Project:	**Whole Wind Farm**		Sub Project/Package:		Whole Asset	
Document Title or Description:	Levels of precaution in the assessment and compensation calculations for offshore ornithology.					
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1.0	October 2024	Draft	GoBe	Outer Dowsing	Shepherd and Wedderburn	Outer Dowsing

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Acronyms & Definitions

Abbreviations / Acronyms

Abbreviation / Acronym	Description
AEoI	Adverse Effect on Integrity
BACI	Before-After-Control-Impact
CRM	Collision Risk Modelling
DAS	Digital Aerial Survey
FFC SPA	Flamborough and Filey Coast Special Protection Area
GT R4 Ltd	The Applicant. The special project vehicle created in partnership between Corio Generation (and its affiliates), Gulf Energy Development and TotalEnergies
HOW3	Hornsea Offshore Wind 3
HOW4	Hornsea Offshore Wind 4
JNCC	Joint Nature Conservation Committee
MMFR	Mean Maximum Foraging Range
N/A	Not Applicable
NSN	National Site Network
ODOW	Outer Dowsing Offshore Wind (The Project)
ORCP	Offshore Reactive Compensation Platform
RIAA	Report to Inform Appropriate Assessment
sCRM	Stochastic Collision Risk Modelling
SD	Standard Deviation
SNCB	Statutory Nature Conservation Bodies
SoS	Secretary of State
UCI	Upper Confidence Interval
UK	United Kingdom
WTG	Wind Turbine Generator

Terminology

Term	Definition
The Applicant	GT R4 Limited (a joint venture between Corio Generation (and its affiliates), TotalEnergies and Gulf Energy Development), trading as Outer Dowsing Offshore Wind
Apportioning	The process by which impacts from an offshore project are allocated to colonies or other aggregations
Array area	The area offshore within which the generating station (including wind turbine generators (WTG) and inter array cables), offshore accommodation platforms, offshore transformer substations and associated cabling will be positioned.
Baseline	The status of the environment at the time of assessment without the development in place.

Bioseason	A biologically defined period of a bird's annual cycle based on the location and/or behaviour of the bird
Compensation	Measures secured by the appropriate authority and taken to ensure that the overall coherence of the National Site Network is protected, following a finding of AEoI by a project on a particular qualifying feature of a European site and a derogation case.
Compensation requirement	The amount of compensation needed, usually expressed in numbers of breeding pairs
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the sensitivity of the receptor, in accordance with defined significance criteria.
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Regulations, including the publication of an Environmental Statement (ES).
Environmental Statement (ES)	The suite of documents that detail the processes and results of the EIA.
Export Cables	High voltage cables which transmit power from the Offshore Substations (OSS) to the Onshore Substation (OnSS) via an Offshore Reactive Compensation Platform (ORCP) if required, which may include one or more auxiliary cables (normally fibre optic cables).
Impact	An impact to the receiving environment is defined as any change to its baseline condition, either adverse or beneficial.
Landfall	The location at the land-sea interface where the offshore export cables and fibre optic cables will come ashore.
Offshore Reactive Compensation Platform (ORCP)	A structure attached to the seabed by means of a foundation, with one or more decks and a helicopter platform (including bird deterrents) housing electrical reactors and switchgear for the purpose of the efficient transfer of power in the course of HVAC transmission by providing reactive compensation
Onshore Infrastructure	The combined name for all onshore infrastructure associated with the Project from landfall to grid connection
Outer Dowsing Offshore Wind (ODOW)	The Project
The Project	Outer Dowsing Offshore Wind, an offshore wind generating station together with associated onshore and offshore infrastructure
Sabbatical	The proportion of adult birds within a population that do not breed in a given year
Study Area	Area(s) within which environmental impact may occur – to be defined on a receptor-by-receptor basis by the relevant technical specialist.
Wind Turbine Generator (WTG)	A structure comprising a tower, rotor with three blades connected at the hub, nacelle and ancillary electrical and other equipment which may include J-tube(s), transition piece, access and rest platforms, access ladders, boat access systems, corrosion protection systems,

	fenders and maintenance equipment, helicopter landing facilities and other associated equipment, fixed to a foundation

Reference Documentation

Document Number	Title
19.9	Consideration of bioseasons in the assessment of guillemot
19.10.	Rates of displacement in guillemot and razorbill
19.11	Lead-in periods for kittiwake breeding on Artificial Nesting Structures

1 Executive Summary

Following completion of the Report to Inform Appropriate Assessment for the Project (RIAA; AS1-095), the potential for an Adverse Effect on Integrity (AEoI) to the kittiwake feature of the Flamborough and Filey Coast (FFC) Special Protection Area (SPA) FFC SPA due to mortality from collisions with the wind turbine generators in combination with other plans or projects cannot be ruled out. A full derogation case for kittiwake (from in-combination effects) has therefore been developed alongside appropriate compensation measures.

With regard to guillemot and razorbills, the RIAA has concluded that there is no potential for an AEoI alone or in-combination. However, given the advice received from Natural England that they may not be able to rule out the potential for AEoI for these species, a 'without prejudice' derogation case and compensation measures are being developed for these species.

At pages 289, 292 and 294 of the Applicant's Responses to Relevant Representations (PD1-071), in response to concerns raised by Natural England in relation to the scale of compensation proposed, in particular, the use of a 1:1 ratio, the Applicant highlights that the scale of compensation proposed is appropriate due to the levels of precaution introduced within the assessment, apportioning and compensation calculation stages.

This document discusses the levels of precaution that are introduced at each stage of the process that ultimately defines the levels of compensation potentially required for each species. The introduction of precaution occurs where uncertainties lie regarding apportioning and assessment of impacts, e.g. the spatial apportioning approach, demographic structures in offshore populations, variation in published biometric information (the flight heights, speeds, nocturnal activity and avoidance rates used for Collision Risk Modelling (CRM)), uncertainty regarding the impact of a pressure (the displacement and mortality rates used) and sabbatical rates.

The document shows how the precautionary nature of impact assessment is likely to result in a requirement for considerable over-compensation. For example, the uncertainty regarding the apportioning of impact of displacement on breeding guillemot at FFC SPA includes:

- precaution in apportioning all birds to FFC SPA;
- assigning all birds as adults;
- no consideration of sabbatical rates;
- the application of precautionary displacement and mortality rates;
- the addition of a bespoke 'post-breeding' bioseasons.

In combination, these levels of precaution can increase the compensation requirement substantially.

The Applicant considers that, although precaution is required to address uncertainty, it is a tool to enable decision makers to make a reasonable assessment of the associated risk using the best scientific evidence available. The risk must be plausible and real and the precautionary principle should not be applied speculatively. The compounding effect of the addition of many levels of precaution, some of which address the same issue, will result in an over-precautionary position. If the precautionary principle is applied excessively, there is a risk that the over-precautionary position presented could interfere with the assessment, and the resulting decision, by generating outputs which are unrealistic compared to the environmental risk in question. In turn, this would lead to a disproportionate compensation requirement, contrary to guidance.

As such, the Applicant requests that the Examining Authority recognises that the use of compounding precaution during the assessment, apportioning and compensation calculation processes is not appropriate and would result in a disproportionate compensation requirement. The Applicant maintains its position that it has incorporated a sufficient level of precaution into its assessment and the calculation of the scale of compensation required to address the uncertainties inherent in predicting impacts on ornithological species.

2 Introduction

2.1 Project Background

1. GT R4 Limited (trading as Outer Dowsing Offshore Wind (ODOW)) hereafter referred to as the 'Applicant', is proposing to develop Outer Dowsing Offshore Wind (the Project). The Project will include both offshore and onshore infrastructure including an offshore generating station (windfarm) approximately 54km from the Lincolnshire coastline in the southern North Sea, export cables to landfall, Offshore Reactive Compensation Platforms (ORCPs), onshore cables, connection to the electricity transmission network, ancillary and associated development and areas for the delivery of up to two Artificial Nesting Structures (ANS) and the creation of a biogenic reef (see Volume 1, Chapter 3: Project Description (APP-058) for full details).

2.2 Document Purpose

2. Following completion of the Report to Inform Appropriate Assessment for this Project (RIAA; AS1-095), the potential for an Adverse Effect on Integrity (AEoI) to the kittiwake feature of the Flamborough and Filey Coast (FFC) Special Protection Area (SPA) FFC SPA due to mortality from collisions with the wind turbine generators in combination with other plans or projects cannot be ruled out. A full derogation case for kittiwake (from in-combination effects) has therefore been developed alongside appropriate compensation measures.
3. With regard to guillemot and razorbills, the RIAA has concluded that there is no potential for an AEoI alone or in-combination. However, given the advice received from Natural England that they may not be able to rule out the potential for AEoI for these species, a 'without prejudice' derogation case and compensation measures are being developed for these species.
4. The quantum of compensation for all three species has been calculated and presented in the following documents:
    a. Kittiwake Compensation Plan (APP-250)
    b. Without Prejudice Guillemot Compensation Plan (APP-252)
    c. Without Prejudice Razorbill Compensation Plan (APP-255)
5. Each document presents compensation requirements based on a range of impact calculation methods and compensation ratios.
6. The level of compensation potentially required for each species is calculated based on the level of predicted impact. The RIAA calculates the level of predicted impact, arrived at through a series of apportioning and impact calculations. At each stage of the process a level of precaution is introduced. A compensation ratio may then be applied to derive the final compensation requirement.

7. The introduction of precaution is a tool to enable decision makers to make a reasonable assessment of the associated risk, using the best scientific evidence available. The risk must be plausible and real, and the precautionary principle should not be applied speculatively. The use of precaution occurs where there is uncertainty, e.g. spatial apportioning, demographic structures of offshore populations, variation in published biometric information (the flight heights, speeds, nocturnal activity and avoidance rates used for Collision Risk Modelling (CRM)), uncertainty regarding the impact of a pressure (the displacement and mortality rates used), uncertainty on sabbatical rates.
8. This report shows how the precautionary nature of impact assessment, alongside the use of compensation ratios, is likely to result in a requirement for considerable over-compensation.
9. It should be noted that the Applicant recognises that some level of precaution is required due to the uncertainties involved, however, the purpose of this document is to highlight the effect of compounding many levels of precaution into the assessment, apportioning and compensation calculation processes.
10. This report should be read in conjunction with the report on Lead-in periods for ANS (Document Reference 19.11) and is informed in part by the review of displacement levels for Auks (Document Reference 19.10) and the review of guillemot bioseasons (Document Reference 19.9). Together these documents demonstrate that the compounding effect of the addition of many levels of precaution, some of which address the same issue, will result in an over-precautionary position across the assessment, apportioning and compensation calculation processes. The consequence is the generation of assessment conclusions and compensation requirements which are disproportionate.

3 Elements of Precaution

11. Impacts from offshore wind are generally based on the assessment of collision risk and displacement using site specific digital aerial survey (DAS) data attributed to bioseasons. The outputs of these assessments (i.e. the impacts at the project site) are refined through apportioning, the process by which the effects of impacts at the offshore wind farm are attributed to a breeding colony or colonies. Once these impacts have been apportioned, the effect these impacts have on European sites can be assessed. Where the impact is likely to have an adverse effect on the integrity of the European site, the required level of compensation (i.e. the number of pairs of birds required to generate enough young to redress losses caused by the project) can be calculated.
12. Elements of precaution that are introduced through the application of bioseasons, impact assessment (for example, precautionary displacement and mortality rates, precautionary inputs used in CRM, or no sabbatical rates being used), apportioning and compensation are outlined below.

3.1 Assessment

13. Assessment of impact is carried out for species susceptible to collision, displacement, or both. The impacts from both collision and displacement are assessed using different calculation methods. As elements of precaution are different within each process, the assessment of impact from collision and displacement are discussed separately.
14. The decision to use an appropriately precautionary value for each parameter inflates the impacts by compounding the precautionary values for these parameters. The assessment of impacts is modelled (for details see APP-163 for discussion of the approach for CRM and APP-164 for displacement) using a range of input parameters relating to the bird's abundance, biometrics, behaviour, or design elements of the project. There is still uncertainty regarding many of these parameters and in these cases, precaution is used. For CRM, for example, there are eight input parameters related to birds alone. A precautionary approach is used for each of these parameters meaning that, for CRM alone, each species assessment has 8 different precautionary elements added (and this does not include those related to apportioning).

3.1.1 Bioseasons

15. Before any assessment occurs, birds are assigned a suite of bioseasons. These are periods through a species' annual cycle that can be defined by a particular activity, such as breeding or migration. For some species, such as razorbill, a full suite of bioseasons can be assigned that encompasses breeding and non-breeding seasons, and two migration periods per 12-month cycle. However, for other species, such as guillemot, it is not possible to define such specific bioseasons, and options are restricted to assigning a breeding and a non-breeding season, in spite of the migrations that this species undertakes.

16. The definition of bioseasons for guillemot adds an element of precaution to assessment. As the guillemot breeding season (defined as March to July) encompasses a period when many guillemots are behaving as non-breeders, birds occurring on a given site in March and April, and therefore assumed to be breeding birds, could also include a proportion of individuals that are behaving as non-breeding birds or moving towards more distant breeding grounds (see Statutory Nature Conservation Body (SNCB) guidance and bioseasons for guillemot (Document Reference 19.9) and Rates of Displacement in Guillemot and Razorbill (Document Reference 19.10)). As such, a proportion of birds observed at the Study Area that may not show any real connectivity with the FFC SPA, are assumed to do so (with impacts apportioned accordingly) due to the precaution involved in the definition of the breeding season (i.e. the assumption that colony attendance during March and April should be seen as breeding)

17. Additionally, breeding season impact assessments assume these birds are limited by specific foraging ranges based upon data collected from birds actively engaged in incubation or chick rearing. The same spatial limitations are not applicable for individuals on migration. Dunn *et al.,* (2020) demonstrated that colony attendance in guillemots on the Isle of May was substantially lower in March and April than in May and June, revealing that not all birds present in March and April are breeding birds. Given that birds attending the colony in March and most of April are not under the same geographical constraint as during the incubation and chick rearing periods, and that guillemot breeding generally commences in late April at the earliest (i.e. when the earliest eggs are usually seen) and usually occurs *en masse* in early May, it is highly precautionary to include March and April populations within the breeding season impact assessment. Bioseason attribution plays a role in the apportioning process (see Section 4).

3.1.2 Collision risk assessment

18. CRM bases the chance of collisions on the density of birds in flight within a given area. The likelihood of collision is informed by the following species specific, physiological and behavioural parameters:

    a. Flight speed
    b. Flight height
    c. Nocturnal activity
    d. Bird size and wingspan
    e. Avoidance rate

19. Each of these parameters incorporates a substantial amount of precaution. Whilst the Applicant maintains that the combined effect of these layers of precaution results in a potentially over-precautionary result, for each of these parameters the SNCB advised rates have been used when modelling collisions and the results have been presented within the application documents. In order to illustrate the potential consequence of these layers of precaution, the Applicant has provided illustrative worked examples at section 7.

3.1.2.1 Flight speed

20. The stochastic collision risk model used by the Applicant has been demonstrated to be sensitive to changes in flight speed input parameters; the use of SNCB-advised flight speed values, as used by the Applicant, can lead to over-estimation of collisions when compared to site specific flight speeds generated from tracking data. As well as accounting for site specific flight speeds to be generated, the model allows for speed over the ground (as opposed to speed through the air) to be considered, meaning that where birds are slowed down by flying into headwinds, this is taken into account. Where speed over ground is used, numbers of collisions are reduced. (Masden *et al*., 2021).
21. The Band model that underpins collision risk modelling assumes that speeds used are speeds over ground. Changing the flight speed, i.e. increasing the flight speed over the ground by using a speed through the air as a proxy, reduces the likelihood of an individual collision but increases the flux through the area. Therefore, even with reduced likelihood of an individual colliding, the overall effect of increasing flight speed is to increase the number of collisions due to the higher flux of birds through the rotor swept area. (Norfolk Boreas, 2020).
22. The kittiwake flight speed recommended for use in CRM by Natural England of 13.1 m/s is taken from a study that uses data from a sample size of two birds (a very small sample size on which to base a conclusion on flight speed) and presents speed through the air rather than speed over the ground, contrary to the assumptions that underpin the Band model. The speed recommended (13.1 m/s) is substantially higher than the mean ground speed measured over eight studies of kittiwake ground speed (10.8 m/s), based upon a range of data types collected from 47 different birds and a further 287 laser rangefinder readings from which a sample size of birds couldn't be derived). As such, use of this flight speed for kittiwake is considered precautionary and likely to result in an overestimate in collisions.

3.1.2.2 Flight height

23. The stochastic collision risk model used by the Applicant incorporates four options for assigning flight height to birds. The option used by the Applicant (Option 2, as recommended by SNCBs in Joint advice note from the SNCBs regarding bird collision risk modelling for offshore wind developments) uses a generic flight height distribution within the model. The data within the model are based upon those data used in a previous iteration of CRM developed by Masden in 2015. This in turn uses generic flight height data that were published by Johnston *et al.,* in 2014. The majority of datasets that inform this review of flight heights were boat based (27 out of 35), wherein observers estimated height unaided or with the aid of a fixed point on the vessel to guide assignment of birds to a height band. Trials using drones with altimeters have demonstrated that even experienced boat-based observers incorrectly assigned a flying object to a height band between 50 – 70% of the time, with a tendency to over-estimate heights (Thaxter *et al*., 2016). As such, the flight height ranges generated by these reviews are highly likely to over-estimate flight heights leading to the assumption that more birds are within the rotor swept area and therefore at risk of collision.

3.1.2.3 Nocturnal activity

24. Levels of nocturnal activity are used to assess the risk of collisions at night. For kittiwake, nocturnal activity has been assessed using tracking data from a range of colonies, including the FFC SPA. The nocturnal activity rate recommended by Natural England is 0.4 (i.e. a proportion of 0.4 of the night is spent active). However, data from FFC SPA show that nocturnal activity is generally much lower in birds from this colony than the other colonies sampled, although nocturnal activity fluctuated annually. In five of the six years studied, nocturnal activity ranged between 0.25 and 0.37, averaging at 0.30, substantially lower than the rate of 0.4 advised, the use of which inflates impacts calculated for these birds. One year presented a nocturnal activity proportion of 0.61 but this is so far outside the rather consistent range demonstrated for other years that it is considered an outlier.
25. The potential for strong variation between years, and the difference between the relatively low levels of nocturnal activity demonstrated by birds from FFC SPA compared to more northerly colonies, suggests that standard rates used for nocturnal activity are not representative of nocturnal activity in birds from FFC SPA as they are lower, and as such, use of these recommended rates should be considered as precautionary.

3.1.2.4 Bird size and wingspan

26. Biometrics used in collision risk modelling use measurements of body length and wingspan which are applied to a simplified cross-shaped assumption of bird shape. Measurements are taken from sources such as Snow and Perrins (1998) which are derived from museum specimens or live birds measured in the hand, and therefore represent the full length of either the wingspan or body length of the bird, including the bill and tail length, and assume the bird is consistently at its full extent.
27. Birds vary in body size and wing length within species (and between subspecies of the same species), but these variations are minor. However, the number of collisions calculated will be increased by the use of the full extent measurements. Even in gliding flight, kittiwake do not hold their wings fully outstretched, meaning that natural flight wingspans are shorter than those presented in the literature. It is not possible to calculate the extent to which these full extent measurements would over-estimate the wingspan in natural flight, but for a bird with a wingspan of around 1 m such as the kittiwake, a reduction in the region of five to 10 cm could be expected. Body lengths are measured from the tip of the bill to the tip of the tail. A turbine striking the tip of a bird’s tail or the wing tip may not result in mortality, which the model assumes as 100% certain.
28. As such, the body and wing measurements used to inform collision risk modelling are likely to be either larger than the measurements demonstrated in the field, or to represent a size larger than the area from which mortality would occur if a bird was struck. Therefore, this element of the assessment should be considered to be precautionary.

3.1.2.5 Avoidance rates

29. The avoidance rate recommended for collision risk monitoring of kittiwake is 0.993, which is a generic rate recommended for all gulls. In a review of avoidance rates, Cook *et al*., (2021) calculated the avoidance rate of kittiwake to be a minimum of 0.9947 (using an extended stochastic collision risk model (sCRM) approach) and potentially as high as 0.9979 (using a basic sCRM approach) (Cook 2021). A review of the datasets informing this analysis carried out by Ozsanlav-Harris (2022) endorsed the use of an avoidance rate of 0.997 for kittiwake. For Great black-backed gull, the recommended avoidance rate is 0.994. The reviews carried out by Cook (2021) and Ozsanlav-Harris (2022) aligned on an avoidance rate of 0.9991 for this species.
30. As the Project has used an avoidance rate of 99.29% for kittiwake (as advised in Joint advice note from the SNCBs regarding bird collision risk modelling for offshore wind developments), results of the impact assessment should be considered precautionary in light of the recent evidence reviews. Using species specific avoidance rates compared to the species group rates reduces collisions by 55% for kittiwake and 85% for great black-backed gull.

3.1.3 Displacement assessment

31. Assessment of the impacts of displacement is carried out by applying rates of displacement and mortality to densities of birds derived from DAS.

3.1.3.1 Displacement rates

32. When assessing impacts from displacement, the preferred methodology is to present levels of impact based upon a range of displacement, with Natural England recommending a range of 30% to 70% displacement depending on the species under consideration. The displacement rate preferred by Natural England for guillemot and razorbill is 70%, i.e. a consequence of the presence of an offshore windfarm is that 70% of guillemots and razorbills will be displaced. A review of displacement rates carried out by Orsted (APEM, 2022), included data (selected based on data quality) from 21 offshore wind farms, some of which found no significant displacement or attraction effect. This review recommended that a 50% displacement rate should be viewed as precautionary for both guillemot and razorbill (APEM, 2022). A review of displacement at the Beatrice Wind Farm showed that there was no avoidance of Wind Turbine Generator (WTG) at all, and as such, there was no displacement effect (Trinder, 2024).
33. The higher displacement rates advocated by Natural England are based on those proposed by studies such as Peschko *et al.,* (2024). The Peschko 2024 paper uses a Before-After-Control-Impact (BACI) approach with very few environmental covariates (e.g. depth and distance to land). This paper has a number of methodological concerns. For example, model fits are not presented, the before and after periods use different survey methods and the before period uses data from as far back as the 1990s to compare to surveys as recent as 2020. Any differences in abundance between the before and after periods are attributed to wind farm effect (and therefore displacement) without investigation of any other potential explanations, such as, for example, changes in prey distribution. Distance effect is assessed using a response variable as part of the BACI approach, but as there was no wind farm present during the before period, it is questionable how reliable this approach is.

34. The Peschko study focuses on displacement during the post-breeding dispersal period. It is reasonable to assume that displacement rates may differ between the breeding season, where birds are constrained by the need to provision young at a central place, and the non-breeding season where there are no such constraints. As such, even if the displacement effect presented by Peschko *et al*., (2024) is real, the displacement rates provided are not necessarily applicable to the breeding season.
35. A more thorough analysis of displacement rates based upon reviews by APEM 2022 and Lamb *et al.*, 2024 is presented in Rates of displacement in guillemot and razorbill (Document Reference 19.10). This analysis concludes that the use of a 50% displacement rate would be suitably precautionary for both the breeding season and across the annual cycle.

3.1.3.2 Mortality rates

36. Mortality rates from displacement used within assessments usually range from 1% to 10%. Natural England has a preferred mortality rate of 5%, although recent consenting decisions by the Secretary of State (SoS) have used a 2% mortality rate. Mortality rates from displacement as a result of the presence of an offshore wind farm are difficult to calculate. The APEM 2022 review of displacement and mortality rates modelled the impacts of displacement on auk adult survival in relation to the Hornsea Four Offshore Wind Farm. This study predicted a maximum mortality rate of approximately 1%. This rate is considered to be precautionary as estimates of mortality were likely to have been over-estimated by the model as the distance between the Hornsea Four array (the project used within the model scenario) and the FFC SPA used in the model was lower than the actual distance, thus the contribution of mortalities from the project may have been over-estimated. Based on the APEM 2022 study, the Applicant considers that the use of the 1% mortality rate in its assessment is suitably precautionary.

3.1.3.3 Inclusion of flying birds

37. Digital aerial surveys that characterise a site record both birds on the water and birds in flight. Birds sitting on the water are considered to be 'using the site' and therefore are potentially displaced. Birds in flight are considered to be 'passing through' and as such are potentially impacted by barrier effects. Displacement assessments include birds in flight as there are no formal methods to assess barrier impacts, so this ensures barrier effects are taken into consideration. While this does not affect outcomes for the Project (as key displacement species are not assessed for collisions) it does highlight an area which increases the potential to over-estimate impacts. For species such as gannet, that are susceptible to both collisions and displacement, considering impacts on flying birds from collisions and displacement does over-estimate overall impacts as both events are mutually exclusive.
38. At long ranges from colonies (as with the Project from FFC SPA), barrier effects are unlikely to be encountered regularly (e.g. during foraging flights from the colony) due to the unlikelihood of a regular interaction between birds from the colony and a barrier well beyond the mean maximum foraging range and as such, the displacement and mortality rates applied to what are likely to be occasional incidences of barrier effect, are likely to over-estimate impacts.

39. The decision to use an appropriately precautionary value for each parameter inflates the impacts by compounding the precautionary values for each parameter. The Applicant's displacement assessment includes birds observed in flight as well as those observed on the water.

3.1.3.4 Sabbatical rates

40. In any given year, a small proportion of adult birds at any colony will not breed. As such, when apportioning impacts to colonies, a number of the birds deemed to be adults associated with a given colony will not be breeding in that year. Natural England recommend that sabbatical rates are not used, as they are variable, and use of a particular sabbatical rate could over-represent the number of sabbaticals actually taken.
41. However, in any given year at least some sabbaticals will be taken, so an assumption of no sabbaticals is therefore a highly precautionary position. Given that an actual sabbatical rate could be either higher than a published rate, or anywhere between a published rate or zero, an appropriately precautionary position would be to apply a sabbatical rate of half the published rate (i.e. a mean of the published rate and zero). The Applicant's assessment has not used any sabbatical rates.

4 Apportioning

4.1 Spatial apportioning

42. The approach to apportioning impacts to specific colonies uses a calculation that considers the mean maximum foraging range plus one standard deviation to determine which colonies have potential breeding season connectivity with an offshore development. The approach assumes that distribution within the area defined is even, whereas in reality birds are more likely to forage closer to the shore (and therefore closer to a colony), assuming that food availability is uniform, in order to maximise the efficiency of their foraging. In species such as kittiwake, guillemot and razorbill, tracking data from FFC SPA demonstrate that the majority of birds forage close inshore or at hotspots away from the Project array area. As such, with the Project being 54 km offshore, far from the colony and beyond the identified offshore foraging hotspots for kittiwake, the use of mean maximum foraging ranges over-apportions birds to the FFC SPA.
43. Another element of spatial apportioning that introduces precaution is that there is no consideration of the reduction in foraging range between the periods of incubation and chick rearing. The use of mean maximum foraging ranges plus one standard deviation means that apportioning is applied across an unrepresentative area during the chick rearing period.
44. The final precautionary element is that spatial apportioning is based upon the mean maximum foraging range (so, the mean from the maximum ranges defined across a range of studies) with the addition of one standard deviation. Using this measure will naturally define a larger area than is used by the vast majority of birds. The addition, the standard deviation, effectively doubles the foraging range used for apportioning for some species. For example, the mean maximum foraging range for kittiwake is 156.1 km, and the standard deviation is 144.5 km. For guillemot, the mean maximum foraging range is 73.2 km and the standard deviation is 80.5 km. For razorbill, the mean maximum foraging range is 88.7 km and the standard deviation is 75.9 km (ABPMer, 2020). Effectively this defines linkages between colonies and projects where in reality there is little or no connectivity. For example, at approximately 95 km from the FFC SPA colony, it is unlikely that guillemot and razorbill from the colony regularly attend the Project array area. A very small proportion may attend the array area, and a larger proportion may do so occasionally, but to assume the impact is on all birds at this scale is very precautionary, especially given that there are no specific features of the array area that suggest that it would be preferable compared to the habitat within the wider region.
45. In combination, the three elements detailed above indicate that the spatial element of the apportioning process is highly precautionary.

4.2 Adult apportioning

46. In species where aging across the immature period of a bird's life is not possible from digital aerial survey images, the assumption that Natural England's preferred approach makes is that all of these birds are adults.

47. For guillemot and razorbill, ageing from DAS is impossible, and thus the assumption is that all birds are adult, apart from during the post-breeding dispersal and moult season where an adult proportion has been defined using local productivity rates for each species. The assumption that all of the birds in any given area, and especially an area so far offshore (and beyond the mean maximum foraging range of both guillemot and razorbill), are adult, is highly precautionary. There are no known offshore aggregations comprised of only adult guillemot and razorbill. The distance from the colony (well beyond the mean maximum foraging range for these species, which are also inflated through the use of data from Fair Isle, where birds showed greatly increased foraging ranges compared to all other colonies) means that the likelihood of regular visits from FFC SPA breeding birds is reduced, and that birds using this area may be more likely to not have any association with any colony (either due to sabbatical being taken or due to the birds being immature).
48. In some species (such as kittiwake), birds can be aged for part of their immature period but then develop adult-like plumage well before they are sexually mature. These birds can be aged as non-adults from DAS data for part of their immature life, but then appear as adult, or inseparable from adult in DAS images, for some years before reaching maturity. Aging these birds as adult will increase the number of adults recorded in a given area, and as such will increase the adult proportion. Increasing the adult proportion increases the number of birds that are apportioned to colonies – therefore inflating the impact at these colonies. Therefore, this approach to aging and adult proportions adds further precaution to the breeding season impact assessment.

5 Compensation calculation

49. Where AEoI cannot be ruled out, a project can still proceed where it is established that there are no feasible alternatives and there are imperative reasons of overriding public interest, known as a “derogation”. In the event that the Secretary of State is minded to grant consent for a project through a derogation, they must secure adequate compensation measures to ensure the overall coherence of the national site network is protected. The Applicant has submitted a Derogation Case with its application (APP-242). The derogation case includes the following compensatory measures:
    - Predator eradication and habitat management benefitting guillemot and razorbill at the Plémont Seabird Reserve,
    - ANS designed for kittiwake, guillemot and razorbill, and
    - A suite of measures addressing disturbance, habitat management and potentially predator control across a network of sites with breeding guillemot and razorbill in south-western England.
50. The scale of these measures is defined by the scale of the impact and other factors such as philopatry rates (i.e. the proportion of those birds that would return to breed at their natal colony) and survival rates. The scale of compensation to be delivered is defined by compensation calculation.

5.1.1.1 Confidence intervals

51. In calculating compensation, Natural England’s preference is for the use of 95% Upper Confidence Interval (UCI) outputs of baseline surveys in displacement assessments, and for the 95% UCI outputs of CRM to be apportioned to European sites. Using the 95% UCI means that it is possible to be 97.5% certain that the true population size (for displacement) or impact (for CRM) is below the UCI estimate and is thus considered highly precautionary. Results of the CRM for kittiwake across one year, and using the 95% UCI outputs, increases the average density of kittiwake estimated across the array area from a mean output of 2.57 birds/km^2 to 6.42 birds/km^2. For the displacement assessment of guillemot, use of the 95% UCI increases the breeding season population used in the assessment from 11,364 birds to 15,606 birds.

52. Displacement assessments apply displacement and mortality rates to populations that have been calculated from DAS data. Using a model-based approach (such as MRSea, as used by the Applicant and advised by Natural England) ensures that a robust population estimate is derived for the Survey Area and buffers. This is because the model uses various covariates (environmental factors that drive bird distribution), ensuring greater accuracy from the densities (and therefore the populations) modelled. The mean outputs of this process are much more likely to be representative of reality than the 95% UCI outputs. The use of 95% UCI outputs from baseline surveys in displacement assessments, as advocated by Natural England, adds further precaution to assessments that already utilise precautionary input values, i.e., the use of mean of peak counts in each bioseason. More precaution is then added within the displacement assessment itself, i.e., the use of precautionary displacement rates, adult apportioning rates and mean maximum foraging ranges plus 1 SD.
53. CRM is carried out using an online tool which runs 1000 CRM scenarios based on the data provided to the model (bootstrapping). This allows for the variation within the model to be accounted for and presents impacts that average the model (bootstrapped) outputs, thus eliminating the chance of a single (unbootstrapped) run giving outputs that are not representative of a real-life scenario. Whilst there may be a small margin of error in the bootstrapped outputs, the mean impact values will be much more representative of the real-life scenario than the UCI impacts. The use of 95% UCI outputs from the CRM, as advocated by Natural England, adds further precaution to the use of already precautionary parameters, i.e., adult apportioning rates and mean maximum foraging ranges plus 1 SD.

5.1.1.2 Hornsea 3 compensation calculation

54. For measures such as ANS that offer additional breeding habitat, the basic compensation calculation takes the number of birds required to be compensated (i.e. the impact) and calculates how many additional breeding pairs would be required to generate that many young birds. In many approaches, the philopatry rate is also considered. The Hornsea Three compensation calculation also considers the natural wastage (i.e. mortality and emigration) from an ANS colony and the continued draw this would have on a source colony. Considering this for kittiwakes on ANS structures results in an increased compensation requirement, with a proportion of that requirement addressing (i.e. compensating for) the annual flux of birds from the source colony to take up spaces that result from natural wastage. This is a precautionary position as it assumes that all recruitment to an ANS will be from the source colony (in this case the FFC SPA) and it also assumes that all recruitment will be emigrating adult birds.
55. With a healthy population of breeding kittiwakes on offshore structures just a short distance from the ANS search areas, it is not certain that the FFC SPA will provide all, or even any of the birds first colonising the ANS and subsequently recruiting to it to maintain numbers, with recruitment from closer offshore colonies considered more likely. In the event that young birds dispersing from the ANS recruit to other offshore platforms, the National Site Network (NSN) still benefits from having a healthy offshore breeding population with young subsequently dispersing into the NSN.

56. Also it is not certain that birds recruiting will be adults that have previously bred at FFC SPA, as only a small proportion of birds that are available to recruit to an ANS, and that have originated from the FFC SPA (either dispersing as an adult or juvenile), will be adults (based on adult and juvenile dispersal and survival rates).

57. Therefore, any compensation calculation method that makes these assumptions should be seen as highly precautionary. The Applicant considers that, as recruitment of adults to an ANS directly from the FFC SPA is unlikely to account for most recruitment and instead recruitment from nearby offshore structures is more likely, the Hornsea 3 compensation calculation method is not appropriate in this instance. Use of the Hornsea 3 method calculates a compensation requirement at least double that of the method used for Hornsea 4 (the compensation calculation for which was accepted by the Secretary of State for that project).

5.1.1.3 Compensation ratios

58. Compensation ratios (effectively multiplication factors for compensation requirements) are applied where there is some uncertainty over a given measure or suite of measures' ability to deliver the required level of compensation back to an impacted site. The uncertainly may result from the distance between the measure and the impacted site, or from uncertainty that a measure will deliver the amount of compensation that it is designed to deliver. Compensation ratios address this by doubling (in the case of a 2:1 ratio) or trebling (in the case of a 3:1 ratio) the compensation, thus increasing the likelihood that the compensation requirement will be met. This approach is precautionary as the ratios are arbitrarily set at whole numbers and applied through an unscientific process (essentially a judgement is made based on how effective measures will be to deliver the required level of compensation). Where concerns regard connectivity, the application of a compensation ratio may do nothing to address that (i.e. where there is no connectivity, doubling the requirement does not double the compensation delivered to the impacted colony). Currently the Applicant is not aware of Natural England's position regarding the application of a compensation ratio, other than that a ratio of greater than 1:1 is needed to account for any uncertainty. However, given Natural England's concerns regarding, for example, connectivity between measures for guillemot and the impacted FFC SPA, their position will be likely to include a compensation ratio.

59. The precautionary elements of the assessment are shown for the key species in Table 1 .

6 Precautionary elements for key ODOW species

Table 1 Precautionary elements for key ODOW species.

Element of Precaution	Kittiwake	Guillemot	Razorbill
Bioseasons		Impact assessment for guillemot in the breeding season uses peaks from April which are considered likely to comprise a potentially large proportion of birds not breeding at FFC SPA. The addition of a bespoke post-breeding bioseason for guillemot also adds a level of precaution and assesses the same impact (displacement) on the same population of birds as assessed for the breeding season (Document Reference 19.9)	
CRM – Flight speeds	Generic flight speeds used, based on speed through the air from a very small sample of birds, is highly likely to overestimate collisions		
CRM – Flight heights	Generic flight heights supplied within the sCRM model are generated for the most part from visual observations and are as such, likely to be over-estimated.		
CRM – Nocturnal activity	The recommended rate for nocturnal activity in kittiwake is an over-estimate when		

Element of Precaution	Kittiwake	Guillemot	Razorbill
	compared to rates of nocturnal activity in birds from FFC SPA.		
CRM - Biometrics	Generic ‘full extent’ measurements accentuate wingspans demonstrated in the field, and body lengths used do not represent the area of a bird that if struck would result in mortality.		
CRM – Avoidance rates	Recommended avoidance rates for kittiwake are much lower than recently calculated species-specific avoidance rates (0.993 compared to 0.997), a 55% reduction in collisions from this one parameter alone.		
Displacement – Displacement rates		Recommended displacement rates are 70%, whereas a recent review (Document Reference 19.10) demonstrated that a 50% displacement rate should be seen as being suitably precautionary.	Recommended displacement rates are 70%, whereas a recent (Document Reference 19.10) review demonstrated that a 50% displacement rate should be seen as being suitably precautionary.
Displacement – Mortality rates		Recommended mortality rates are assumed to be 2%. Modelled impacts from mortality suggest that 1% mortality should be considered precautionary. The use of the 2% mortality rate doubles the impact seen with the use of the Applicant’s preferred 1% mortality rate.	Recommended mortality rates are assumed to be 2%. Modelled impacts from mortality suggest that 1% mortality should be considered precautionary. The use of the 2% mortality rate doubles the impact seen with the Applicant’s preferred use of the 1% mortality rate.

Element of Precaution	Kittiwake	Guillemot	Razorbill
Displacement – inclusion of flying birds		Displacement and mortality rates applied to what are likely to be occasional incidences of barrier effect are likely to over-estimate impact.	Displacement and mortality rates applied to what are likely to be occasional incidences of barrier effect are likely to over-estimate impact.
Apportioning – Spatial apportioning	Apportioning based on mean max foraging range plus 1 Standard Deviation (SD), assuming a uniform spatial distribution over the whole breeding season is highly precautionary.	Apportioning based on mean max foraging range plus 1 SD, assuming a uniform spatial distribution over the whole breeding season is highly precautionary, especially in the case of the Project, which is beyond Mean Maximum Foraging Range (MMFR) for auks.	Apportioning based on mean max foraging range plus 1 SD, assuming a uniform spatial distribution over the whole breeding season is highly precautionary, especially in the case of the Project, which is beyond MMFR for auks.
Apportioning – Adult apportioning	Assuming that all birds that appear as adults in DAS imagery are adults is a precautionary position.	Assuming that all birds in the survey area are adult, simply because it is not possible to determine age in the field, is highly precautionary.	Assuming that all birds in the survey area are adult, simply because it is not possible to determine age in the field, is highly precautionary.
Apportioning - Sabbaticals	Assuming that no sabbaticals are taken in a given year is a precautionary position.	Assuming that no sabbaticals are taken in a given year is a precautionary position.	Assuming that no sabbaticals are taken in a given year is a precautionary position.
Compensation calculation – Hornsea Three method	This method assumes that initial recruitment and all subsequent recruitment through the lifetime of the ANS will be of breeding age birds recruiting directly from FFC SPA to the ANS.		
Compensation calculation –	The arbitrary multiplication of compensation requirements by	The arbitrary multiplication of compensation requirements by two or three	The arbitrary multiplication of compensation requirements by two or

Element of Precaution	Kittiwake	Guillemot	Razorbill
Compensation ratios	two or three does not address some sources of uncertainty so should be considered to be highly precautionary.	does not address some sources of uncertainty so should be considered to be highly precautionary.	three does not address some sources of uncertainty so should be considered to be highly precautionary.

7 Case Studies

60. The following case studies for kittiwake and guillemot demonstrate the contribution that each measurable element of the precautionary approach makes to the compensation requirement. The tables present the impact that each precautionary element has on the compensation requirement acting alone on an otherwise unmodified realistic calculation. The alternative input parameters are discussed in Section 3.
61. The case study tables present the effects of each precautionary element on the compensation requirement using the mean (rather than the 95% UCI) outputs of the baseline surveys. The effect that the use of the 95% UCI would have is summarised in the text below each case study.
62. These tables do not present the full extent of how precautionary the processes are, as some elements are not presented due to a lack of data informing an alternative approach, for example the spatial aspects of the apportioning process. It should be noted that the Applicant does not consider that individually these precautionary elements are not justified. The purpose of this document is to highlight the effect of compounding many levels of precaution into the assessment, apportioning and compensation calculation processes, and in particular, to demonstrate that a compensation ratio of greater than 1:1 is not necessary to address uncertainties.

7.1 Case Study 1 – Kittiwake at FFC SPA

63. The case study for kittiwake (Table 2) details how precautionary elements affect the overall compensation requirement over the course of a year.
64. Applying these alternative rates to CRM parameters, apportioning, and compensation calculation in combination delivers a CRM output predicting 10.9 collisions. Applying the Furness (2015) adult proportion to this, and accounting for sabbaticals at the rate published in Horswill and Robinson (2015), gives an apportioned impact of 5.2 birds per year. Applying the Hornsea 3 stage 1 compensation calculation to this gives a compensation requirement of 15.7 breeding pairs. In comparison, use of the suite of precautionary parameters and rates, with the Hornsea 3 stage 2 calculation returns a compensation requirement of 184.9 breeding pairs. The level of compensation required using the precautionary approach applied to the 95% UCI outputs of the CRM is 461.3 breeding pairs. As such, use of all of the precautionary elements throughout the process of displacement assessment and apportioning increases the compensation requirement from 15.7 breeding pairs to 461.3 breeding pairs.

Table 2. Case study detailing the effects of precautionary elements for kittiwake

Stage	CRM			Apportioning		Compensation calculation	
Precautionary element	Flight speed	Nocturnal activity	Flight height	Avoidance rates	Adult apportioning	Sabbaticals	HOW3 stage 2
Rate	13.1 m/s	0.4	Band Option 2	0.9929	0.92	0	n/a
Proposed alternative	10.8 m/s[1]	0.3	Band Option 3	0.997[2]	0.53[3]	0.9[4]	n/a
Impact with precautionary rate	30.9	30.9	30.9	30.9	30.9	30.9	30.9
Impact with proposed alternative	28	no material difference	5.43	17.9	n/a	n/a	n/a
Apportioned precautionary impact	18.94	n/a	18.94	18.9417	28.428	30.9	18.9417
Apportioned impact with proposed alternative	17.16	n/a		7.955	16.377	27.81	n/a
Compensation required using precautionary rate	123.0	n/a	123.0	123	184.9	201.1	123
Compensation with proposed alternative	111.9	n/a		51.7	106.8	180.9	57.1
Addition to compensation requirement	**112.1**	**n/a**		**72.9**	**78.1**	**20.2**	**65.9**
Notes	HOW3 stage 2 method						Compares HOW 3 stage 2 to HOW 3 stage 1

1 – Based on evidence published in Norfolk Boreas 2020
2 – Based on evidence published in Cook 2021
3 – Based on rates published in Furness 2015
4 – Based on rates published in Horswill and Robinson 2015

7.2 Case Study 2 – Guillemot at FFC SPA

65. The case study for guillemot (Table 3) details how precautionary elements affect the compensation requirement calculated for the breeding season (March – July) only.

66. Applying these alternative rates to bioseasons, displacement parameters, apportioning, and compensation calculation in combination delivers a displacement assessment output predicting 30.6 mortalities. Applying the Furness (2015) adult proportion to this, and accounting for sabbaticals at the rate published in Horswill and Robinson (2015) gives an apportioned impact of 16.1 birds per year. Applying the Hornsea 4 compensation calculation to this gives a compensation requirement of 68.4 breeding pairs. In comparison, use of the suite of precautionary parameters and rates, with the Hornsea 4 calculation, returns a compensation requirement of 978.3 breeding pairs. The level of compensation required using the precautionary approach applied to the 95% UCI outputs of the baseline assessment is 1253.5 breeding pairs. As such, use of all of the precautionary elements throughout the process of displacement assessment and apportioning increases the compensation requirement from 68.4 breeding pairs to 1253.5 breeding pairs.

Table 3. Case study detailing the effects of precautionary elements for guillemot.

Stage	Displacement assessment			Apportioning	
Precautionary element	Bioseasons	Displacement and Mortality rates	Inclusion of flying birds	Adult apportioning	Sabbaticals
Rate	n/a	70:2	100%	100%	0%
Proposed alternative	n/a	50:1	91.70%[2]	57%[3]	7.90%[4]
Impact with precautionary rate	16,445	230.23	16,445	16,445	16,445
Impact with proposed alternative	6,677[1]	82.2	15,080	16,445	16,445
Apportioned precautionary impact	230.23	230.23	230.23	230.23	230.23
Apportioned impact with proposed alternative	93.5	82.2	211.1	131.2	212.0
Compensation required using precautionary rate	978.3	978.3	978.3	978.3	978.3
Compensation with proposed alternative	369.9	349.7	879.0	557.5	900.1
Addition to compensation requirement	**608.4**	**628.6**	**99.3**	**420.8**	**78.2**
Notes Unless otherwise stated, assumes 70:2, 100% apportioning, 100% adult, HOW 4 method					

1 – Uses mean of peaks excluding April from the breeding season

2 – Based on mean proportion of birds in flight from April

3 – Taken from Furness 2015

4 – Taken from Horswill and Robinson 2015

8 Summary of the Applicant and Natural England Positions

67. The Applicant and Natural England positions are summarised in Table 4.

Table 4. Summary of the Applicant and Natural England positions

Parameter	Applicant approach	Natural England Approach
Flight speed	The Applicant considers that the flight speeds advised within the latest SNCB guidance are not representative (for kittiwake) as they are taken from a small sample (just two birds) and report speed through the air rather than speed over the ground. The mean speed over ground measured for kittiwake over 8 studies is 10.8 m/s as opposed to the 13.1 m/s advised by SNCBs. Therefore, the Applicant's preferred position is that 10.8 m/s is an appropriate flight speed for kittiwake. For CRM carried out to date, the Applicant has used Natural England's preferred approach.	Flight speeds as presented in latest SNCB guidance to be used (for Kittiwake this is 13.1 m/s).
Flight Height	Band option 3 uses species specific flight heights as opposed to those from species groups recommended in the most recent SNCB guidance. The majority of datasets that inform the flight heights advised by SNCBs were boat based (27 out of 35), wherein observers estimated height unaided or with the aid of a fixed point on the vessel to guide assignment of birds to a height band. Trials using drones with altimeters have demonstrated that even experienced boat-based observers incorrectly assigned a flying object to a height band between 50 – 70% of the time, with a tendency to over-estimate heights (Thaxter *et al.*, 2016). As such, the flight height ranges generated by these reviews are highly likely to over-estimate flight heights leading to the assumption that more birds are within the rotor swept area and therefore at risk of collision. However, with a lack of site specific data informing alternative flight heights, the Applicant has used Natural England's preferred approach.	Flight heights as presented in latest SNCB guidance to be used. Use of Band option 2 in lieu of site-specific flight heights.
Nocturnal Activity Factors	Data from FFC SPA show that nocturnal activity is generally much lower in birds from this colony than the other colonies sampled, although nocturnal activity fluctuated annually. In five of the six years studied, nocturnal activity ranged between 0.25 and 0.37, averaging at 0.30. Therefore, the Applicant's preferred approach would be to use a Nocturnal Activity Factor of 0.3 for kittiwake at FFC SPA. For	Nocturnal activity factors as presented in latest SNCB guidance to be used (for kittiwake this is 0.4).

	CRM carried out to date, the Applicant has used Natural England's preferred approach.	
Avoidance rates	The Applicant considers that species specific avoidance rates offer a more realistic position than that presented in the latest SNCG guidance, which pools species into wider groups due to uncertainties regarding specific avoidance rates. However, for CRM carried out to date, the Applicant has used Natural England's preferred approach.	Avoidance rates as presented in latest SNCB guidance to be used.
Bioseasons	For guillemot, the Applicant considers that the inclusion of the months of March and April in the breeding season is precautionary but assessments to date have aligned with the Natural England position. The Applicant does not consider that the addition of a discreet post-breeding bioseason, with 100% of birds apportioned to FFC SPA during these months, is appropriate and therefore has not considered this bioseason within their assessment (Document Reference 19.9)	For guillemot, Natural England advise that the breeding season runs from March to July, and that August and September should be considered a discreet post-breeding bioseason.
Displacement rate	The Applicant considers that there is much evidence (Document Reference 19.10) that suggests that a displacement rate of 50% is appropriately precautionary for both guillemot and razorbill and so the Applicant has used this displacement rate in their assessment.	Natural England advise that a displacement rate of 70% is appropriate for guillemot.
Mortality rate	The Applicant considers that there is evidence (APEM, 2022) that suggests that a mortality rate of 1% is appropriately precautionary for both guillemot and razorbill and so the Applicant has used this mortality rate in their assessment.	Natural England advise that a mortality rate of 2% is appropriate for guillemot.
Adult apportioning	The Applicant considers the use of stable age proportions as presented in Furness 2015 as the best available evidence, unless site specific age structures can be derived from the DAS. The Applicant has presented both approaches (AS1-095).	Where site specific age structures cannot be derived from DAS, Natural England advise to assume that all birds are adults.
Use of sabbaticals	The Applicant considers that, although published sabbatical rates may not capture the level of sabbaticals taken in any given year due to variation in the numbers of sabbaticals taken, some sabbaticals are taken every year. As such, published rates should be treated as the best available evidence and used in assessment. However, the Applicant has used Natural England's preferred approach and assessments have not applied a sabbatical rate.	Natural England do not consider the application of sabbatical rates appropriate due to known variation in the numbers of sabbaticals being taken every year in certain species.

Confidence intervals	The Applicant considers that the use of the mean population estimates for displacement (as opposed to the upper 95% confidence intervals), and the mean CRM outputs (i.e. the mean estimated collisions as opposed to the upper 95% confidence interval estimate) provides the most realistic scenario to be taken into the assessment. The Applicant considers the use of the upper 95% confidence intervals as highly precautionary but has presented both approaches.	Natural England advise that assessments should be carried out on the upper confidence interval outputs of CRM and population modelling for displacement.

9 Summary

68. This report should be read in conjunction with the report on Lead-in periods for ANS) and is informed in part by the review of displacement levels for Auks (Document Reference 19.10) and the review of guillemot bioseasons (Document Reference 19.9). Together these documents demonstrate that the compounding effect of the addition of many levels of precaution, some of which address the same issue, will result in an over-precautionary position across the assessment, apportioning and compensation calculation processes. The consequence is the generation of assessment conclusions and compensation requirements which are disproportionate. Therefore, what is already presented within the application should be considered suitably precautionary and as such, a 1:1 compensation ratio is appropriate.
69. This document discusses the levels of precaution that are introduced at each stage of the process that ultimately defines the levels of compensation potentially required for each species. The introduction of precaution occurs where uncertainties lie regarding apportioning and assessment of impacts, e.g. the spatial apportioning approach, demographic structures in offshore populations, variation in published biometric information (the flight heights, speeds, nocturnal activity and avoidance rates used for CRM), uncertainty regarding the impact of a pressure (the displacement and mortality rates used) and sabbatical rates.
70. The report shows how the precautionary nature of impact assessment, alongside the use of compensation ratios, is likely to result in a requirement for considerable over-compensation.
71. The use of precaution is a tool to enable decision makers to make a reasonable assessment of the associated risk, using the best scientific evidence available. The risk must be plausible and real and the precautionary principle should not be applied speculatively. The Applicant considers that, although precaution is required to address uncertainty, the compounding effect of the addition of many levels of precaution, some of which address the same issue, results in an over-precautionary position.
72. For example, the uncertainty regarding the apportioning of impact of displacement on breeding guillemot at FFC SPA using Natural England's preferred approach includes:
    - precaution in apportioning all birds to FFC SPA; (the Applicant has presented their own approach alongside Natural England's preferred approach, which apportions 50% of birds to FFC SPA (Apportioning annex (PD1-092)))
    - assigning all birds as adults; (the Applicant has utilised 100% adult apportioning)
    - no consideration of sabbatical rates; (the Applicant has not applied sabbatical rates)
    - the application of precautionary displacement and mortality rates; (the Applicant has presented their own approach alongside Natural England's preferred approach, which uses a displacement rate of 50% and a mortality rate of 1% (Document Reference 19.10))
    - the addition of a bespoke 'post-breeding' bioseasons. (the Applicant has presented their own approach, alongside Natural England's preferred approach, which does not include the bespoke post-breeding bioseason)

73. In combination, these layers of precaution can increase the compensation requirement substantially.
74. For guillemot the compounded levels of precaution take the compensation requirement from 68.4 breeding pairs to 1253.4 breeding pairs, and for kittiwake from 15.7 breeding pairs to 461.3 breeding pairs. These are increases in compensation requirement of approximately 1800% and 2900% respectively, levels which the Applicant considers disproportionate. This is particularly the case when considering that the lower values in each instance already incorporate a sufficient level of precaution.
75. As such, the Applicant requests that the Examining Authority recognises that the use of compounding precaution during the assessment, apportioning and compensation calculation processes is not appropriate and would result in a disproportionate compensation requirement. The Applicant maintains its position that it has incorporated a sufficient level of precaution into its assessment and the calculation of the scale of compensation required to address the uncertainties inherent in predicting impacts on ornithological species.

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