Rampion 2 Wind Farm

Category 6: Environmental Statement

Volume 4, Appendix 12.3: Offshore and intertidal ornithology collision risk modelling

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1. Introduction

1.1 Purpose of this report

1.1.1 This report has been produced for the purpose of describing collision risk modelling (CRM) methodology and presenting the results, which form part of the Environmental Impact Assessment (EIA) for the proposed Rampion 2 Offshore Wind Farm ('Rampion 2').

1.1.2 Since submission of the Preliminary Environmental Information Report (PEIR) (RED, 2021) in July 2021, Natural England has published updated interim guidance on CRM (Natural England, 2022) and this CRM follows that methodology.

1.2 Project background

1.2.1 Rampion Extension Development (RED; 'the Applicant') is proposing to develop Rampion 2. Rampion 2 will be sited adjacent to the existing Rampion Offshore Wind Farm (OWF), located in the English Channel, 14km off the coast of Brighton & Hove and approximately 30km east of the Isle of Wight. For the purposes of clarification, in this document, the existing Rampion OWF is referred to as 'Rampion 1' hereon in to enable clear differentiation with Rampion 2. The existing Rampion 1 project was developed following award of Zone 6 in the United Kingdom Round 3 offshore wind development leasing round run by The Crown Estate (TCE) in 2009 and occupies 78km^2.

1.2.2 Rampion 2 will comprise both offshore and onshore infrastructure including offshore wind turbine generators (WTGs) and associated foundations and inter-array cabling, offshore substations, offshore export cables within a defined cable corridor, a landfall site, and an onshore substation for connection to the electricity transmission network. The offshore element of Rampion 2 will be located within an Area of Search adjacent to the west and south of the existing Rampion 1 project, together with a small link or 'bridge' area between the two areas for cabling. The location of Rampion 2 is illustrated in **Figure 12.3.1, Volume 3** of the ES (Document Reference 6.3.12).

1.2.3 APEM Ltd (hereafter APEM) was commissioned to undertake a study of offshore and intertidal ornithology that characterise the area that may be influenced by Rampion 2. A separate report (**Appendix 12.1: Offshore and intertidal ornithology baseline technical report** of the ES (Document Reference 6.4.12)) provides the findings from offshore and intertidal ornithology data to determine the receptors that characterise the baseline and are of relevance to the assessment of potential impacts from Rampion 2. This technical appendix has been produced to support **Chapter 12: Offshore and intertidal ornithology, Volume 2** of the ES (Document Reference 6.2.12), to aid the assessment of potential collision to seabirds from Rampion 2.

1.3 Collision risk modelling

1.3.1 There is potential risk to birds from OWFs through collision with WTGs and associated infrastructure. There is an increase in potential risk of collision with WTGs if they are located in areas of high bird densities in which there is a high level of flight activity. That high level of flight activity can be associated with locations where food supplies are concentrated or with areas where there is a high turnover of individuals (possibly commuting daily between nesting and feeding areas or passing through the area on seasonal migrations). The potential collision risk can be estimated by modelling the predicted number of collisions for key seabird species using the known densities of birds in flight from APEM's site-specific baseline surveys of Rampion 2, commissioned by the Applicant.

1.3.2 As detailed in **Section 12.13** of **Chapter 12, Volume 2** of the ES (Document Reference 6.2.12), six seabird species of interest were identified as potentially at risk and of interest for impact assessment. This was refined from that presented in the PEIR (RED, 2021) following the results of the initial collision risk modelling undertaken at PEIR stage.

1.3.3 Therefore, revised CRM has been carried out for Rampion 2 to provide information for the following six seabird species in accordance with Natural England's interim guidance (Natural England, 2022):

- Gannet (*Morus bassanus)*;
- Kittiwake (*Rissa tridactyla)*;
- Common gull (*Larus canus)*;
- Lesser black-backed gull (*Larus fuscus)*;
- Herring gull (*Larus argentatus)*; and
- Great black-backed gull (*Larus marinus)*.

1.3.4 Further consideration for migratory non-seabirds and migratory seabird species is provided in a separate report (**Appendix 12.4: Offshore and intertidal ornithology migratory collision risk modelling** of the ES (Document Reference 6.4.12.4)).

2. Methodology

2.1 Guidance and models

Overview and updates since submission of the PEIR

2.1.1 Since submission of the PEIR (RED, 2021), in July 2021, Natural England has supplied interim guidance on CRM avoidance rates. Therefore, this section presents methods previously used for CRM at the PEIR stage and updated CRM methods used within this report as outlined within Natural England's interim guidance (Natural England, 2022).

2.1.2 The initial CRM for Rampion 2 was undertaken using the stochastic collision risk model (sCRM), developed by Marine Scotland (Donovan, 2018), deterministically as agreed with the Rampion 2 Expert Topic Group (ETG) for offshore ornithology through the Evidence Plan Process (EPP) and also confirmed in the S42 Responses received from Natural England. The avoidance rates applied to the CRMs for each species and model option followed the latest Statutory Nature Conservation Bodies (SNCBs) advice (SNCBs, 2014) at the time of the PEIR.

2.1.3 In response to a review of avoidance rates undertaken by Cook (2021) and Ozsanlev-Harris et al. (2023), Natural England have produced an interim guidance note on collision risk modelling and avoidance rates (Natural England, 2022). The interim guidance supplied by Natural England recommends changes in comparison to previous guidance (SNCBs, 2014) to the CRM for different seabirds. The key changes proposed within Natural England's interim guidance are as follows:

- Recommendation that CRM be run stochastically, including standard deviations of relevant input parameters (where available);
- Avoidance rates have been revised following the evidence reviews undertaken by Cook (2021) and Ozsanlev-Harris et al. (2023). With respect to gannet and kittiwake, the new guidance now recommends significantly higher avoidance rates than previously advocated, with an increase from a central estimate of 0.989 to 0.993. For large gull species, avoidance rates have been reduced slightly from a central estimate of 0.995 to 0.994;
- A recommended stochastic nocturnal activity rate for kittiwake, large gulls and gannet, including a lower nocturnal activity factor for gannet based on Furness et al. (2018) (see **Table**);
- The inclusion of macro avoidance behaviour exhibited by gannets within modelling. This is undertaken by reducing the monthly seabird density input value of gannets in flight within the model. In line with the interim guidance recommendations (Natural England, 2022), results presented for gannet within this report apply a 70% macro avoidance factor.

2.1.4 The sCRM (Donovan, 2018) builds on the Band (2012) offshore CRM, together with code written by Masden (2015) to incorporate variation or uncertainty surrounding the input parameters into calculations of collision frequency. The sCRM was accessed via the 'Shiny App' interface, which is a user-friendly graphical user interface accessible via a standard web-browser that uses an R code to estimate collision risk. The advantages of using the 'Shiny App' are that users are not required to use any R code, are not required to install or maintain R, updates to the model are made directly to the server, so are immediately programmed to users, and it is publicly available and free to access (Donovan 2018). Unlike the Band 2012 CRM model, the sCRM also provides a clear and transparent audit trail for all modelling runs, which enables regulators to easily assess and reproduce the results of any modelling scenario. A full report on the sCRM was published by Marine Scotland in 2018 to accompany the User Guide (McGregor et al. 2018). The User Guide for the sCRM Shiny App provided by Marine Scotland (Donovan, 2018) has been followed for the modelling and assessment of impacts predicted for Rampion 2.

2.1.5 As with the Band (2012) model, the sCRM can generate collision estimates by two different methods (basic and extended models), each of which have two different options also. The basic model assumes a uniform flight height distribution across the rotor swept heights, whilst the extended model uses species-specific modelled flight height distributions to account for variation in the distribution of flights across the rotor swept heights (Band, 2012; Johnston et al., 2014a, b). Seabird flight height distributions tend to be skewed towards the lower rotor swept heights, where collision risk is lower (Band, 2012), so that for most species the extended model will give lower collision estimates than the basic for a given avoidance rate and set of wind farm parameters.

2.1.6 Each of the basic and extended models can be run using either site-specific flight height data (i.e. as collected from the array area in question) or generic flight height data, which were derived from pre-construction surveys for wind farm developments at 32 sites in the UK and elsewhere in Europe (Johnston et al., 2014a, b). This gives rise to Options 1 (site-specific flight height data) and 2 (generic flight height data) for the basic model and Options 3 (generic flight height data) and 4 (site-specific flight height data) for the extended model (Band, 2012).

2.1.7 Robustly estimating site-specific flight heights from aerial digital imagery requires a sufficient sample size of birds of each species from which flight height can be determined. Not all individuals are suitable for flight height estimation, as the method requires clear imagery of individuals in straight and level flight, with wings fully extended. Following completion of the full 24 months of site-specific baseline surveys, sample sizes were insufficient to accurately calculate site-specific flight heights for the six species selected for CRM. Therefore, Band Option 1 collision estimates were not considered.

2.1.8 In relation to Band Options 3 and 4, Natural England's interim guidance (Natural England, 2022) currently states that there are no agreed upon avoidance rates for the extended model for use within the sCRM. Therefore, for consideration of collision risk presented within this report, Band Option 2 outputs have been relied upon only.

2.1.9 A summary of the sCRM input parameters are presented in detail in **Section 2.2: CRM input parameters** (below).

2.2 CRM input parameters

Introduction

2.2.1 This report presents the CRM results used to inform the impact assessments **Chapter 12: Offshore and intertidal ornithology, Volume 2** of the ES (Document Reference 6.2.12).

2.2.2 The Applicant has reviewed the information in Natural England's interim guidance and aimed to align the assessment as closely as possible, including using agreed input parameters where applicable.

Rampion 2 maximum design parameters

2.2.3 The input parameters for the Rampion 2 OWF and WTGs are presented in **Table 2-1**. These are based on the Maximum Design Scenario (MDS) as described in **Chapter 4: The Proposed Development, Volume 2** of the ES (Document Reference 6.2.4) and also presented in **Chapter 12: Offshore and intertidal ornithology, Volume 2** of the ES (Document Reference 6.2.12).

2.2.4 The SD for downtime, rotation speed and blade pitch were set to 0 due to unavailability of robust data. However, since it is known that the outputs of CRM are relatively insensitive to these parameters (Chamberlain et al., 2006), it is not considered that this substantially impacts the outcome of this assessment.

Table 2-1 Rampion 2 Maximum Design Scenario input parameters.

Input Parameter (units in brackets)	Value (Maximum Design Scenario)
Latitude (degrees)	50.6 N
Wind farm width (km)	32.9
Maximum number of WTGs	90
Maximum number of blades	3
Maximum blade width (m)	9
Rotor radius (m)	125
Air Gap above HAT (m)[1]	21.3
Tidal offset (m)	4
Large array correction	Yes

[1] Equivalent to 22m Mean High Water Springs (MHWS)

Input Parameter (units in brackets)	Value (Maximum Design Scenario)
Maintenance/repair downtime (annual average %)	1.5
Wind availability (annual average %)	95.47
Rotation speed (rpm)	5
Pitch (º)	0

Species biometrics

2.2.5 The species-specific biometric input parameters used in the CRM are provided in **Table** . The biometrics for all species were derived from Robinson (2005). However, Natural England's interim guidance (Natural England, 2022) was also used where appropriate to ensure that most recent guidance was followed.

Table 2-2 Species biometrics used for CRM.

Species	Body Length (m)	SD	Wingspan (m)	SD
Gannet	0.94	0.0325	1.72	0.0375
Kittiwake	0.39	0.005	1.08	0.0625
Common gull	0.41	0	1.20	0
Lesser black-backed gull	0.58	0.03	1.42	0.0375
Herring gull	0.60	0.0225	1.44	0.03
Great black-backed gull	0.71	0.035	1.58	0.0375

Avoidance rates

2.2.6 The species-specific avoidance rates that were applied in the CRM are presented in **Table** , derived from the input values recommended within the Natural England's interim guidance (Natural England, 2022). Avoidance rates have been revised following the evidence reviews undertaken by Cook (2021) and Ozsanlev-Harris et al. (2023).

Gannet Macro-avoidance

2.2.7 It is noted that a key input parameter to sCRM is the avoidance rate. The avoidance rate reflects behavioural responses of birds to the presence of WTGs and their rotating blades that results in fewer collisions than if birds continued to fly in a manner which took no notice of the presence of WTGs. Although for the sCRM a single avoidance rate is specified as an input (Donovan, 2018), it can be helpful to consider different scales of avoidance (Skov et al., 2018). Total avoidance can be considered to be the product of macro-avoidance (avoiding the OWF entirely), meso-avoidance (entering the OWF array area but avoiding the rotor-swept zone) and micro-avoidance (entering the rotor-swept zone but taking evasive action to avoid the rotor blade). Displacement can, therefore, be considered equivalent to macro avoidance. However, studies used to quantify avoidance typically rely on camera and radar systems installed on WTGs or supporting infrastructure with a limited range. The estimates of avoidance generated typically, therefore, only accommodate meso- and micro-avoidance, which can be directly detected by the monitoring equipment. Therefore, Natural England's interim guidance (Natural England, 2022) recommends considering macro-avoidance separately by applying a reduction to the densities of birds used as an input the sCRM.

2.2.8 Therefore, all revised CRM for gannet, has been undertaken applying a 70% macro-avoidance factor to baseline densities. In order to facilitate easy comparison with the main results, all other input parameters are as standard for the mean scenario. The revised monthly densities of gannet are presented in **Table 2-3**. The results having applied these macro-avoidance rates are included in the gannet section, below.

Table 2-3 Avoidance rates used for CRM.

Species	Avoidance Rate (Basic Model Option 2)	
	Mean	SD
Gannet	0.993	0.0003
Kittiwake	0.993	0.0003
Common gull	0.995	0.0002
Lesser black-backed gull	0.994	0.0004
Herring gull	0.994	0.0004
Great black-backed gull	0.994	0.0004

Flight speeds

2.2.9 Central estimates of flight speeds for all species were derived from Alerstam (2007), except for gannet for which flight speed values were taken from Pennycuick (1997), as outlined in Natural England's interim guidance (Natural England, 2022). Flight speed for all s13pecies are presented in **Table** .

Table 2-4 Flight speeds used for CRM.

Species	Flight speed (ms^{-1})	SD	Flight type
Gannet	14.9	0	Flapping
Kittiwake	13.1	0.4	Flapping
Common gull	13.4	2.9	Flapping
Lesser black-backed gull	13.1	1.9	Flapping
Herring gull	12.8	1.8	Flapping
Great black-backed gull	13.7	1.2	Flapping

Flight heights

2.2.10 As explained in **Section 2.1: Guidance and models** (above) the sample size of site-specific flight height data available was considered too low to use for the purpose of running in the sCRM. Therefore, the Johnston *et al*. (2014a) Maximum Likelihood values, which are built-in to the sCRM were relied upon for all scenarios and therefore do not need to be specified by the user.

Nocturnal activity

2.2.11 The nocturnal activity rates for all species are presented in **Table** .

2.2.12 The values for nocturnal activity are based on the 1 to 5 scoring index for each species in Garthe and Hüppop (2004), except for gannet for which nocturnal activity values were taken from Furness *et al*., (2018), as outlined in Natural England's interim guidance (2022). The nocturnal activity factors taken from Garthe and Hüppop (2004) were converted into nocturnal activity as follows: 1 = 0%, 2 = 25%, 3 = 50%, 4 = 75%, 5 = 100%.

Table 2-5 Nocturnal activity factors used for CRM.

Species	Nocturnal Activity (%)	
	Mean	**SD**
Gannet	0.08	0.1
Kittiwake	0.375	0.0637
Common gull	0.375	0.0637
Lesser black-backed gull	0.375	0.0637
Herring gull	0.375	0.0637
Great black-backed gull	0.375	0.0637

Density of birds in flight

2.2.13 Density estimates and confidence limits were determined for Rampion 2 using data collected from the 24 months of the programme of aerial digital surveys (carried out between April 2019 and March 2021, inclusive), which are presented in **Annex A**. The density data presented in this annex are inclusive of apportionment of unidentified birds and corrections for availability bias, where appropriate.

2.2.14 Each calendar month was surveyed twice during the 24-month survey programme. The density estimate for each calendar month was calculated as the mean density from the two surveys that calendar month.

2.2.15 The monthly densities of each species used for the mean, minimum and maximum CRM scenarios are presented in **Annex A**.

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3. Results

3.1.1 This section provides the CRM outputs for each of the species considered.

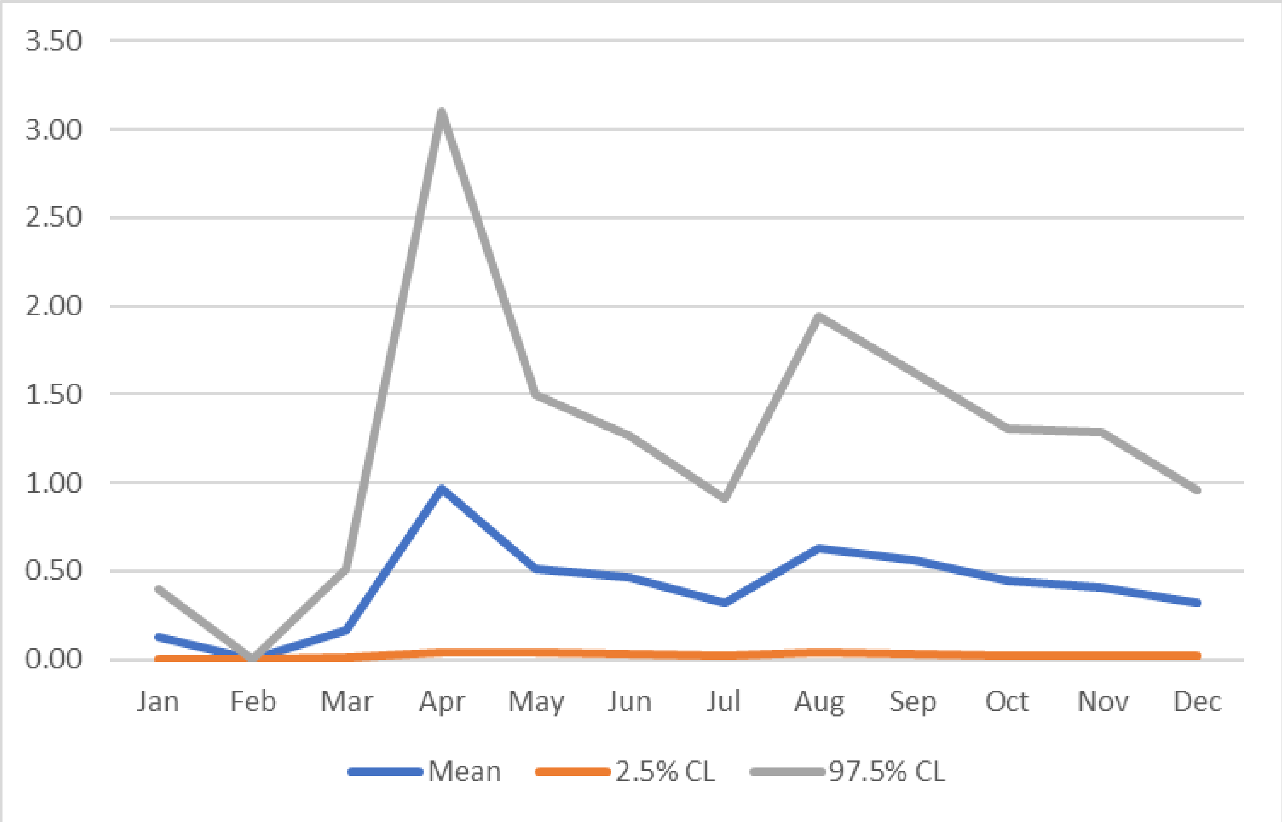
3.2 Gannet

3.2.1 **Table** and **Graphic 3-1** present the collision risk model results for gannet after applying 70% macro avoidance as outlined in Natural England's interim guidance (Natural England, 2022).

Table 3-1 Gannet 70% displacement monthly and annual predicted collisions applying a macro avoidance factor (mean scenario; Band Option 2) presented with Upper and Lower confidence limits (CL)

Month	Mean (70%)	Lower CL (2.5%)	Upper CL (97.5%)
Jan	0.13	0.00	0.40
Feb	0.00	0.00	0.00
Mar	0.16	0.01	0.52
Apr	0.97	0.04	3.10
May	0.51	0.04	1.50
Jun	0.46	0.03	1.27
Jul	0.32	0.02	0.91
Aug	0.63	0.04	1.94
Sep	0.56	0.03	1.63
Oct	0.44	0.02	1.31
Nov	0.41	0.02	1.29
Dec	0.32	0.02	0.95
Annual Total	**4.92**	**0.26**	**14.81**

Graphic 3-1 Gannet 70% displacement monthly predicted collisions applying a macro avoidance factor (mean scenario; Band Option 2) presented with Upper and Lower confidence limits (CL)



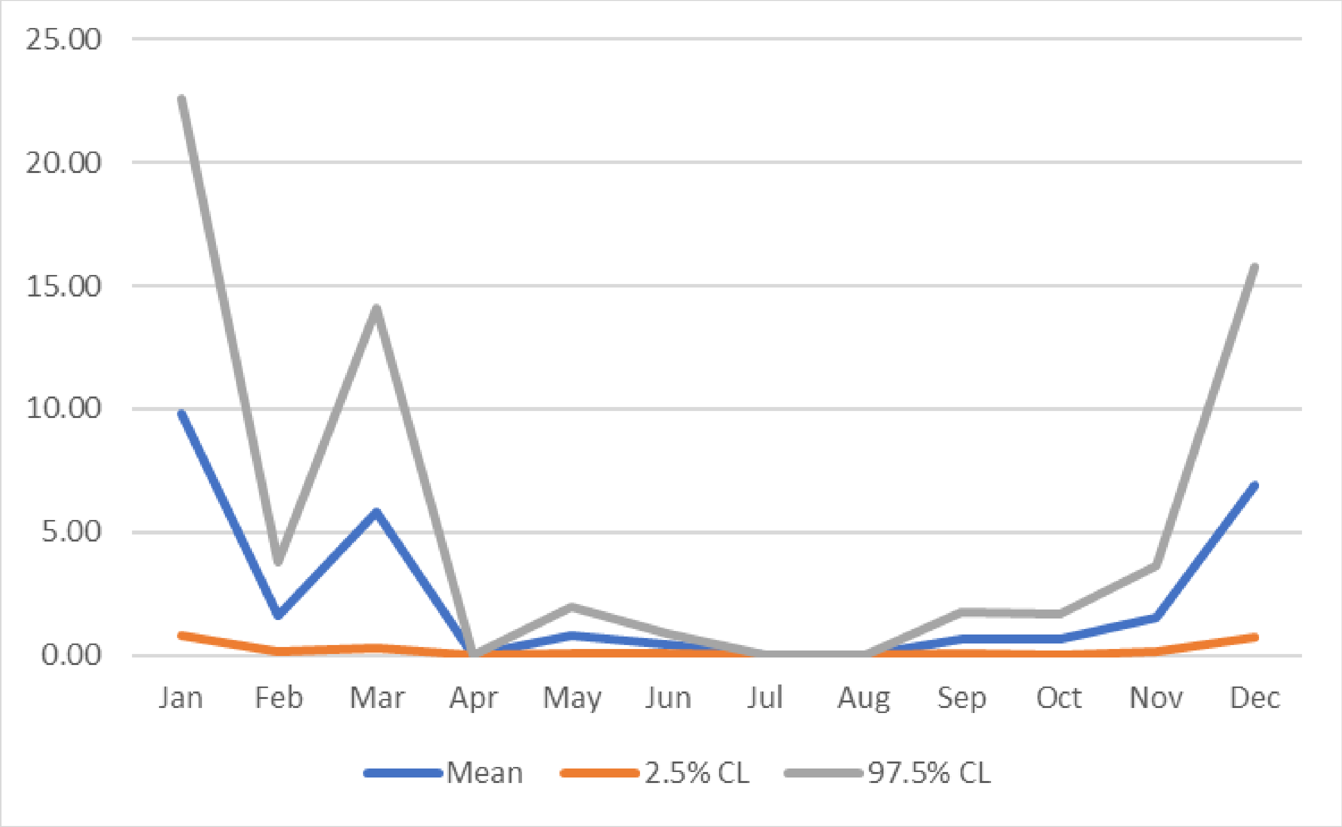
3.3 Kittiwake

3.3.1 **Table** and **Graphic 3-2** present the collision risk model results for kittiwake.

Table 3-2 Kittiwake mean monthly and annual predicted collisions (Band Option 2) presented with Upper and Lower confidence limits (CL)

Month	Mean	Lower CL (2.5%)	Upper CL (97.5%)
Jan	9.80	0.78	22.57
Feb	1.61	0.13	3.75
Mar	5.85	0.31	14.11
Apr	0.00	0.00	0.00
May	0.79	0.04	1.98
Jun	0.42	0.07	0.86
Jul	0.00	0.00	0.00
Aug	0.00	0.00	0.00
Sep	0.67	0.05	1.72
Oct	0.65	0.03	1.65
Nov	1.55	0.14	3.64
Dec	6.92	0.70	15.73
Annual Total	**28.25**	**2.25**	**66.01**

Graphic 3-2 Kittiwake mean monthly predicted collisions (Band Option 2) presented with Upper and Lower confidence limits (CL)



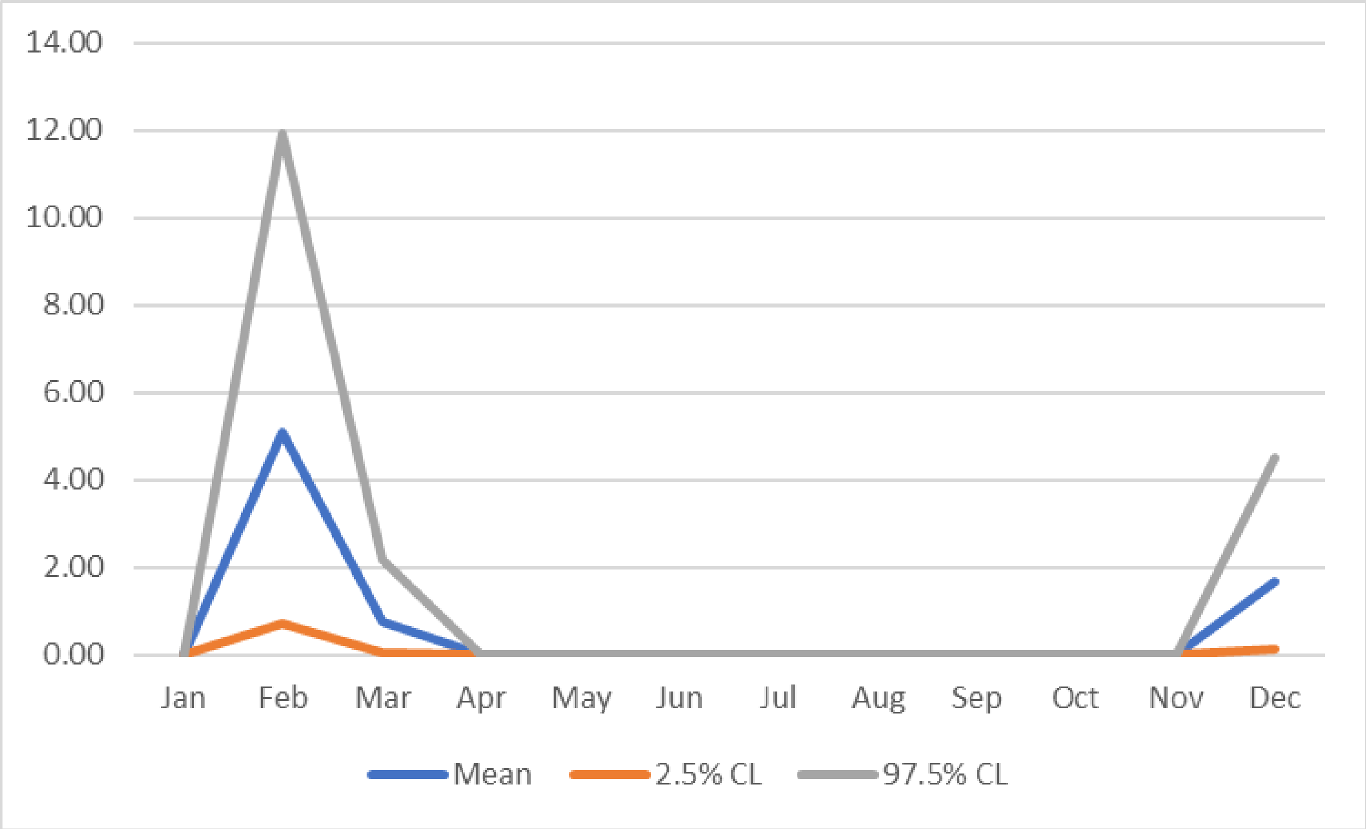
3.4 Common gull

3.4.1 **Table** and **Graphic** present the collision risk model results for common gull.

Table 3-3 Common gull mean monthly and annual predicted collisions (Band Option 2) presented with Upper and Lower confidence limits (CL)

Month	Mean	Lower CL (2.5%)	Upper CL (97.5%)
Jan	0.00	0.00	0.00
Feb	5.07	0.73	11.91
Mar	0.76	0.03	2.16
Apr	0.00	0.00	0.00
May	0.00	0.00	0.00
Jun	0.00	0.00	0.00
Jul	0.00	0.00	0.00
Aug	0.00	0.00	0.00
Sep	0.00	0.00	0.00
Oct	0.00	0.00	0.00
Nov	0.00	0.00	0.00
Dec	1.68	0.12	4.51
Annual Total	**7.51**	**0.88**	**18.58**

Graphic 3-3 Common gull mean monthly predicted collisions (Band Option 2) presented with Upper and Lower confidence limits (CL)



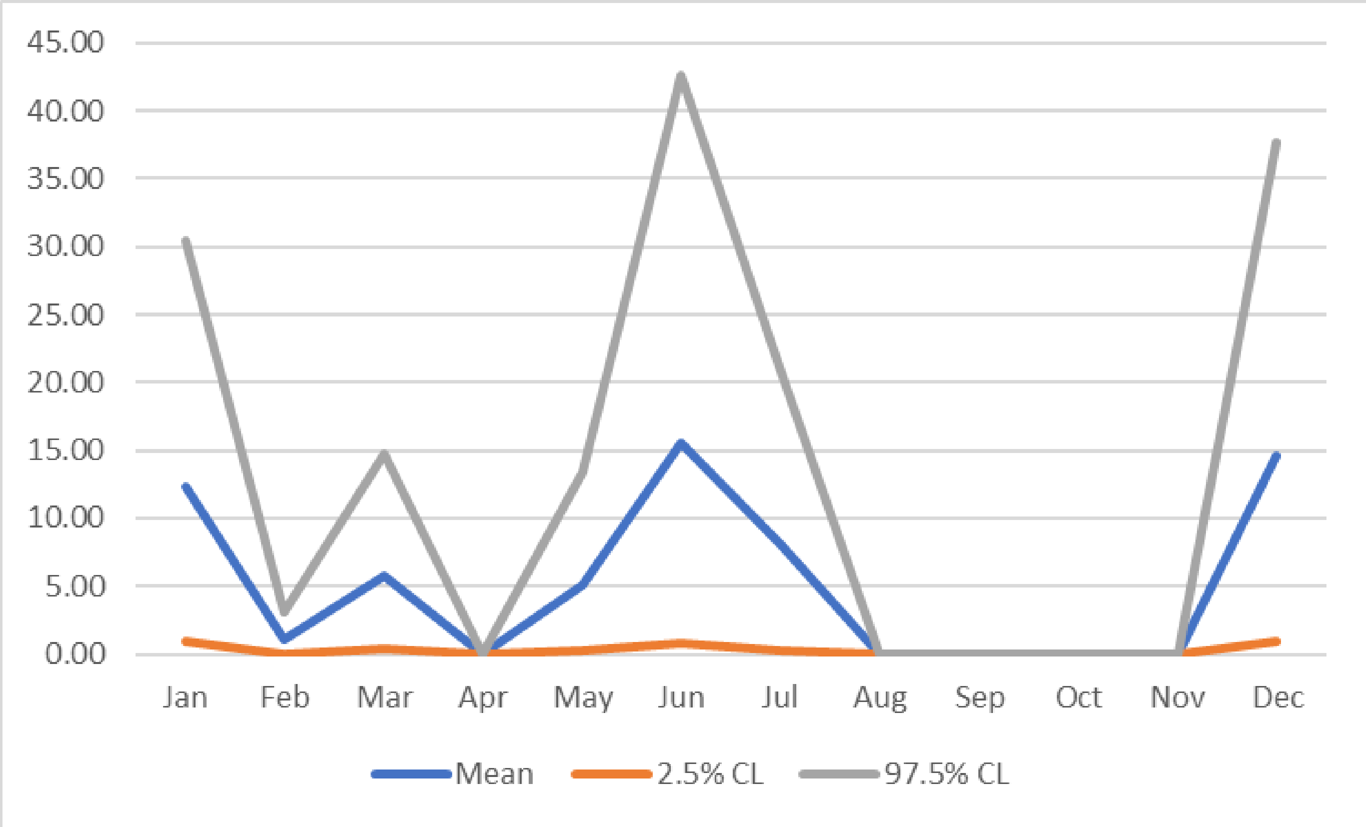
3.5 Herring gull

3.5.1 **Table** and **Graphic 3-4** present the collision risk model results for herring gull.

Table 3-4 Herring gull mean monthly and annual predicted collisions (Band Option 2) presented with Upper and Lower confidence limits (CL)

Month	Mean	Lower CL (2.5%)	Upper CL (97.5%)
Jan	12.40	0.95	30.44
Feb	1.13	0.06	3.11
Mar	5.82	0.39	14.77
Apr	0.00	0.00	0.00
May	5.05	0.24	13.40
Jun	15.61	0.79	42.68
Jul	8.03	0.25	20.71
Aug	0.00	0.00	0.00
Sep	0.00	0.00	0.00
Oct	0.00	0.00	0.00
Nov	0.00	0.00	0.00
Dec	14.57	0.88	37.69
Annual Total	**62.62**	**3.56**	**162.80**

Graphic 3-4 Herring gull mean monthly predicted collisions (Band Option 2) presented with Upper and Lower confidence limits (CL)



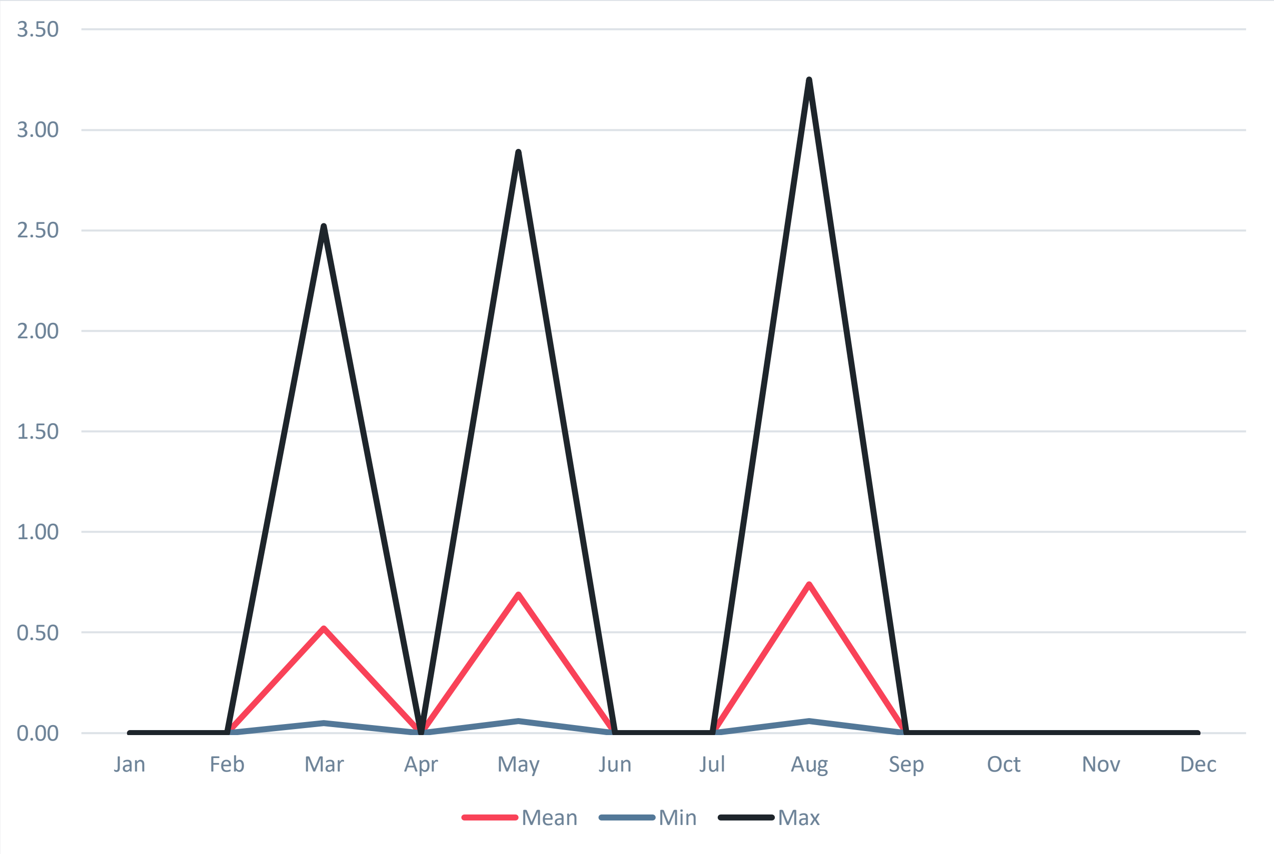
3.6 Lesser black-backed gull

3.6.1 **Table** and **Graphic** present the collision risk model results for lesser black-backed gull.

Table 3-5 Lesser black-backed gull mean monthly and annual predicted collisions (Band Option 2) presented with Upper and Lower confidence limits (CL)

Month	Mean	Lower CL (2.5%)	Upper CL (97.5%)
Jan	0.00	0.00	0.00
Feb	0.00	0.00	0.00
Mar	1.23	0.05	3.53
Apr	0.00	0.00	0.00
May	1.51	0.09	4.69
Jun	0.00	0.00	0.00
Jul	0.00	0.00	0.00
Aug	1.63	0.08	4.74
Sep	0.00	0.00	0.00
Oct	0.00	0.00	0.00
Nov	0.00	0.00	0.00
Dec	0.00	0.00	0.00
Annual Total	**4.37**	**0.22**	**12.95**

Graphic 3-5 Lesser black-backed gull mean monthly predicted collisions (Band Option 2) presented with Upper and Lower confidence limits (CL)



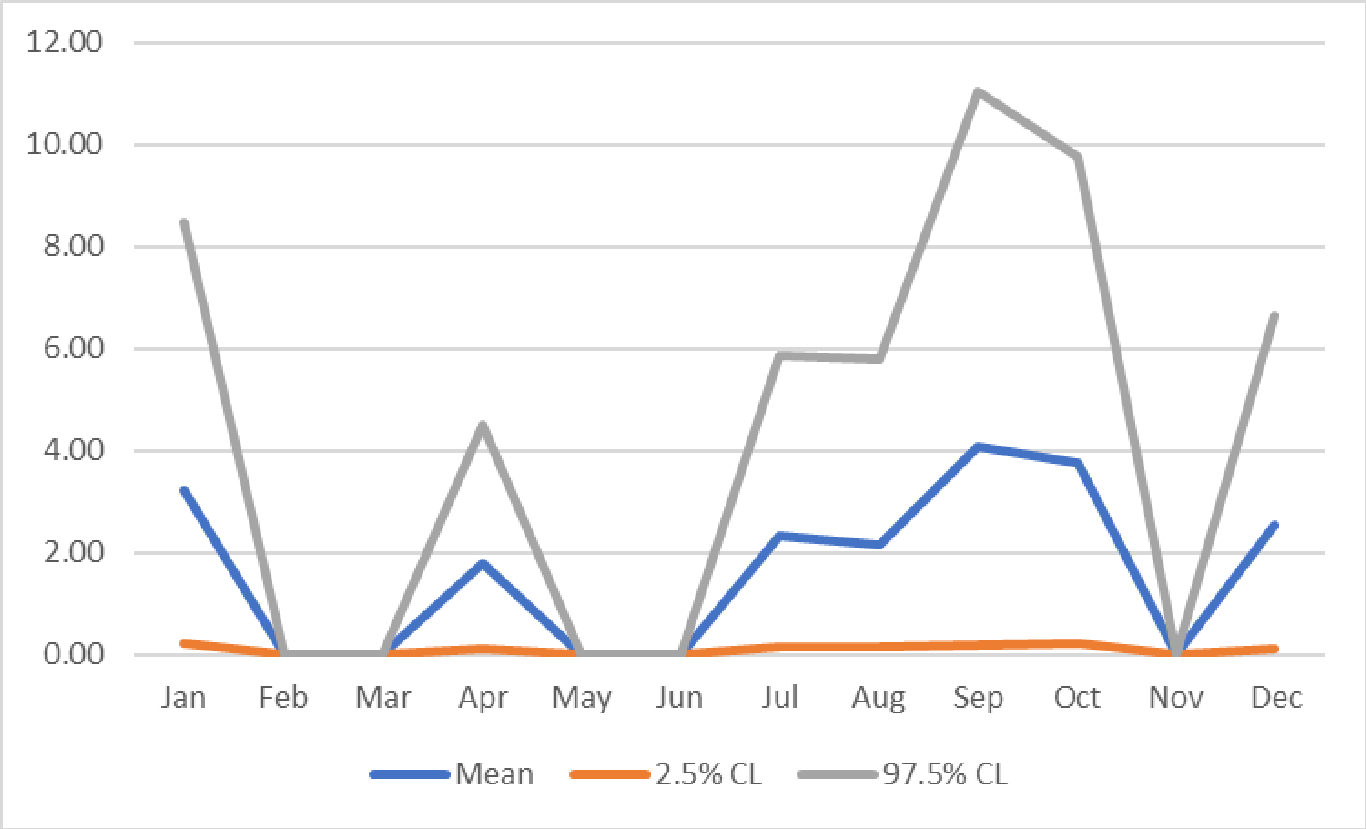
3.7 Great black-backed gull

3.7.1 **Table** and **Graphic** present the collision risk model results for great black-backed gull.

Table 3-6 Great black-backed gull mean monthly and annual predicted collisions (Band Option 2) presented with Upper and Lower confidence limits (CL)

Month	Mean	Lower CL (2.5%)	Upper CL (97.5%)
Jan	3.20	0.23	8.48
Feb	0.00	0.00	0.00
Mar	0.00	0.00	0.00
Apr	1.80	0.11	4.52
May	0.00	0.00	0.00
Jun	0.00	0.00	0.00
Jul	2.32	0.14	5.87
Aug	2.13	0.13	5.78
Sep	4.09	0.17	11.06
Oct	3.74	0.23	9.74
Nov	0.00	0.00	0.00
Dec	2.55	0.13	6.66
Annual Total	**19.84**	**1.14**	**52.11**

Graphic 3-6 Great black-backed gull mean monthly predicted collisions (Band Option 2) presented with Upper and Lower confidence limits (CL)



4. Glossary of terms and abbreviations

Table 4-1 Glossary of terms and abbreviations

Term (acronym)	Definition
CL	Confidence Limits
CRM	Collision Risk Modelling
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).
EIA	Environmental Impact Assessment
ES	Environmental Statement
ETG	Expert Topic Group
km	Kilometres
MHWS	Mean High Water Springs
OWF	Offshore Wind Farm
PEIR	Preliminary Environmental Information Report
RED	Rampion Extension Development Limited (the Applicant)
RSPB	Royal Society for the Protection of Birds
sCRM	Stochastic Collision Risk Modelling
SNCB	Statutory Nature Conservation Bodies
WTG	Wind Turbine Generators
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).

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Annex A
Monthly Densities of Birds in Flight in Rampion 2 Array Area

Table A.1 Gannet monthly densities used for CRM (with 70% displacement as outlined in Natural England's interim guidance; Natural England, 2022)

Month	Density (70%)	SD
Jan	0.009	0.012
Feb	0.000	0.000
Mar	0.008	0.012
Apr	0.057	0.060
May	0.029	0.023
Jun	0.026	0.020
Jul	0.018	0.014
Aug	0.035	0.033
Sep	0.036	0.034
Oct	0.033	0.028
Nov	0.033	0.037
Dec	0.024	0.031

Table A.2 Kittiwake monthly densities used for CRM

Month	Density (mean)	SD
Jan	0.749	0.563
Feb	0.113	0.113
Mar	0.395	0.317
Apr	0.000	0.000
May	0.031	0.047
Jun	0.028	0.014
Jul	0.000	0.000
Aug	0.000	0.000
Sep	0.031	0.047
Oct	0.031	0.047
Nov	0.116	0.091
Dec	0.552	0.432

Table A.3 Common gull monthly densities used for CRM

Month	Density (mean)	SD
Jan	0.000	0.000
Feb	0.326	0.188
Mar	0.025	0.039
Apr	0.000	0.000
May	0.000	0.000
Jun	0.000	0.000
Jul	0.000	0.000
Aug	0.000	0.000
Sep	0.000	0.000
Oct	0.000	0.000
Nov	0.000	0.000
Dec	0.078	0.092

Table A.4 Herring gull monthly densities used for CRM

Month	Density (mean)	SD
Jan	0.376	0.306
Feb	0.025	0.039
Mar	0.132	0.146
Apr	0.000	0.000
May	0.107	0.107
Jun	0.295	0.377
Jul	0.150	0.183
Aug	0.000	0.000
Sep	0.000	0.000
Oct	0.000	0.000
Nov	0.000	0.000
Dec	0.395	0.447

Table A.5 Lesser black-backed gull monthly densities used for CRM

Month	Density (mean)	SD
Jan	0.000	0.000
Feb	0.000	0.000
Mar	0.025	0.039
Apr	0.000	0.000
May	0.028	0.041
Jun	0.000	0.000
Jul	0.000	0.000
Aug	0.031	0.047
Sep	0.000	0.000
Oct	0.000	0.000
Nov	0.000	0.000
Dec	0.000	0.000

Table A.6 Great back-blacked gull monthly densities used for CRM

Month	Density (mean)	SD
Jan	0.081	0.066
Feb	0.000	0.000
Mar	0.000	0.000
Apr	0.028	0.041
May	0.000	0.000
Jun	0.000	0.000
Jul	0.031	0.047
Aug	0.031	0.047
Sep	0.063	0.094
Oct	0.063	0.094
Nov	0.000	0.000
Dec	0.053	0.066