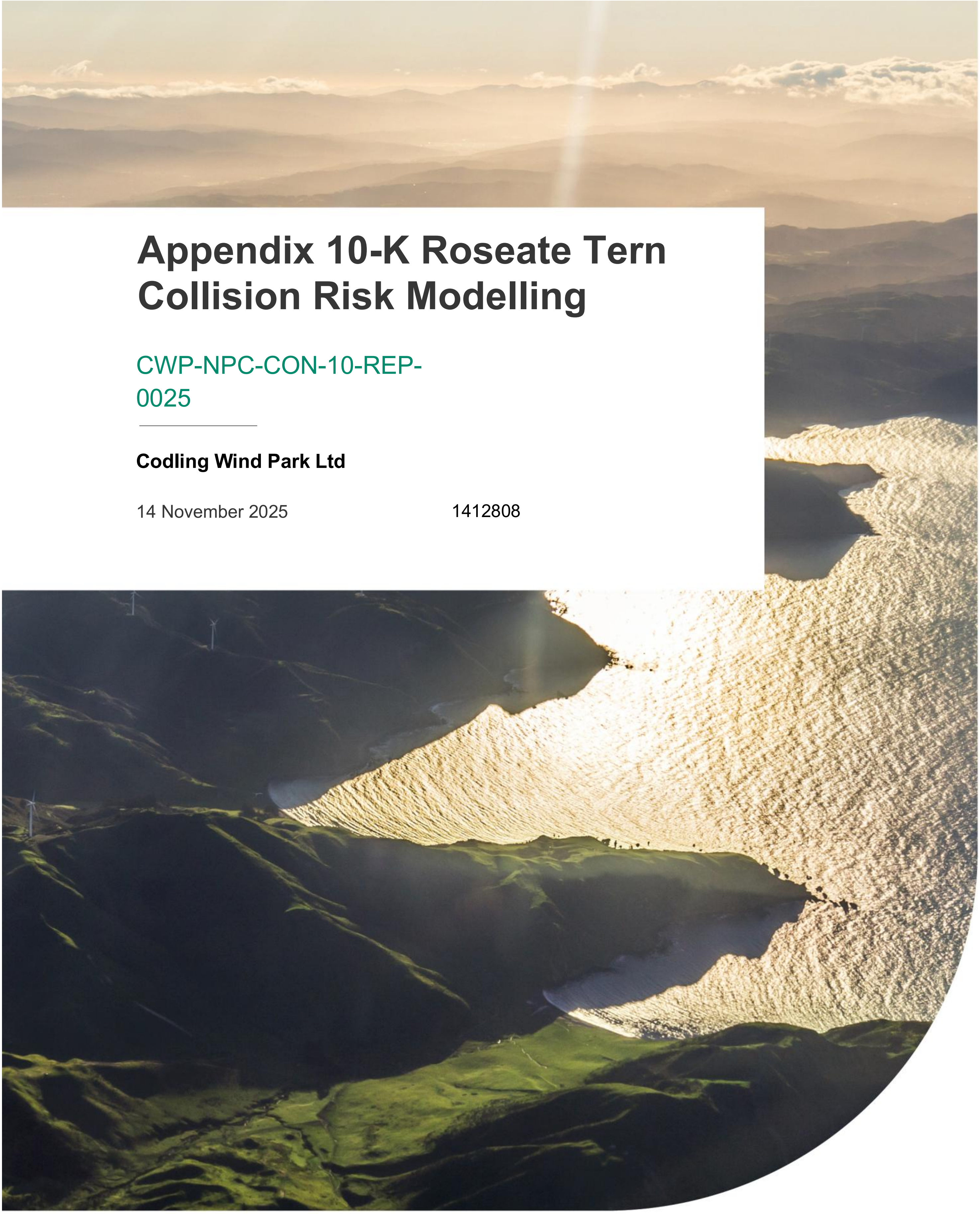
EIAR Addendum

Appendix 10-K Roseate Tern Collision Risk Modelling



Appendix 10-K Roseate Tern Collision Risk Modelling

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Codling Wind Park Ltd

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Document history

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Contents

1. Introduction

1.1. Background

Codling Wind Park Limited (CWPL) is proposing to develop the Codling Wind Park (CWP) Project, which is located in the Irish sea approximately 13 - 22 km off the east coast of Ireland, at County Wicklow.

On Friday 6th September 2024 CWPL (referred to hereafter as the 'Applicant') applied for planning permission to An Coimisiún Pleanála (ACP) (referred to hereafter as the 'Commission') under Section 291 of the Planning and Development Act (PDA) 2000, as amended, for the construction, operation and decommissioning of the CWP Project.

On 1st August 2025, having reviewed the application documentation, including the Environmental Impact Assessment Report (EIAR) and the Natura Impact Statement (NIS), the Commission issued a Further Information Request (FIR) in relation to the CWP Project.

This Technical Appendix forms part of the Applicant's response to Item 7e of the Commission's FIR and supports **Section 10** of the **EIAR Addendum**. Specifically, this Technical Appendix presents detailed methods and results of avian Collision Risk Modelling carried out for Roseate tern (*Sterna dougallii*) at the CWP array site. Item 7e of the Commission's FIR states that:

"Breeding Roseate Tern Sterna dougallii is a Special Conservation Interest (SCI) of the Rockabill SPA, which supports a population of 1,642 breeding pairs (Burnell et al., 2023). Roseate Tern migrate across the Irish Sea including between this colony and Coquet Island SPA (188 breeding pairs) in the UK. Migrating Roseate Tern may pass through the Codling Wind Park (CWP) array site (Redfern et al., 2020). While Roseate Tern usage of the array site can be informed by Digital Aerial Survey (DAS) data, these data are not appropriate to inform passage of migratory birds through an area. The applicant does not appear to have considered any Roseate Tern tracking studies (e.g., Redfern et al., 2020) in their assessment.

The Commission requests that the applicant obtains or sources additional information on Roseate Tern flux/passage through the CWP array site and submits revised assessments fully informed and updated by the additional Roseate Tern data".[1]

1.2. Collision Risk for Roseate Tern

There is potential for avian mortality arising from collisions with the rotating blades of wind turbines (Drewitt and Langston, 2006). Satellite tagging data for Roseate tern does show that some individuals from the Rockabill SPA and Coquet SPA Roseate tern colonies may pass through the CWP array site on migration (Redfern *et al.,* 2020), and therefore, may be at risk of collision.

This species was not previously considered during the assessment of collision mortality to seabird species and therefore collision risk modelling has been undertaken for this species independently here.

1.3. Scenarios modelled

Two proposed turbine configurations are being considered at the CWP Project. The first comprises 75 x 250 m diameter turbines (Design Option A) and the second comprises 60 x 276 m diameter turbines (Design Option B).

The Roseate tern collision risk models were run for both Design Options.

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[1] Note, there is an error in the RFI response in that the most recently published count for Roseate tern from Coquet Island SPA is of 118 breeding pairs rather than 188 breeding pairs (Burnell *et al.,* 2023, Harris *et al.,* 2024). A more recent count of 1776 breeding pairs of Roseate terns is also now available for the Rockabill SPA (Coughlan et al., 2024).

2. Methods

2.1. Collision Risk Model

2.1.1. Migratory CRM

Collision risk modelling for Roseate tern was carried out using the beta version of the stochastic avian migration collision risk model (mCRM) tool developed by Marine Scotland (Caneco et al., 2022). This tool implements a version of the Band (2012) offshore avian collision risk model for migratory species, using the Band Option 2 approach. It has been developed for UK populations and estimates the proportion of migration flights within migration pathways between the UK and other countries that will pass through a proposed wind farm footprint (assuming straight line paths between the UK and non-UK coastlines), using bootstrapping to derive uncertainty around that estimate. It then uses this along with details of the size of the population migrating, the wind farm parameters, the migratory periods to be modelled and biometric and behavioural data relating to the species being modelled to predict the number of collisions within each migratory bio-season specified.

Migration corridors were originally defined for species included in the beta version of the mCRM by the British Trust for Ornithology (BTO). For the purpose of this study, the Roseate tern was added to the list of assessed species. To enable their inclusion, biological and flight parameters were manually defined based on most up to date references, including body size, wingspan, flight speed, and avoidance rate (see Section 2.1.2.2 – Section 2.1.2.5). Seasonal migration periods were also specified for the species, distinguishing pre-breeding and post-breeding movements.

As the mCRM tool does not include information on the Roseate tern migration corridor, and information on flight heights for this species is lacking, an overly precautionary approach was adopted which assumes the worst-possible case scenario. In this worst-case scenario, it assumes that all Roseate terns from modelled populations fly through the windfarm footprint. To achieve this, the boundary of the array site was used as a proxy to represent their migratory pathway. This boundary was spatially transformed to be aligned with existing corridor data and integrated into the model’s spatial framework. To estimate the proportion of the population potentially passing through the wind farm, a bootstrapping approach was applied: 20,000 random points were generated along the Codling OWF boundary and paired to form 10,000 straight-line trajectories passing through the site. These lines were used to simulate migratory paths and assess overlap with the wind farm area.

A precautionary approach was adopted for the proportion of animals that fly at collision risk height. As limited information on Roseate tern offshore flight height is available, a value of 10% was assumed. This is expected to be a conservative assumption given low proportions of flights at collision risk height for other tern species. When using Johnston *et al.*, (2014) data, 0.30% of arctic tern flew at potential collision risk height (36-286 m), 0.91% of common tern, and 0.82% of Sandwich tern.

2.1.2. Input parameters

2.1.2.1. Turbine parameters

Parameters used for migratory collision risk modelling (mCRM) at CWP are presented below. Turbine parameters used in collision risk modelling for migratory species are presented in Table 2.1 below and the percentage of time the turbines are expected to be operational in Table 2.2. Large array correction was turned off for all models.

Table 2.1: **Turbine parameters used for collision risk modelling. Design Option A is 70 x 250 m diameter turbines and Design Option B is 60 x 276 m diameter turbines. Numbers in brackets are standard deviations**

Parameter	Design Option A	Design Option B
Number of turbines	75	60
Latitude (degrees)	53	53
Upwind flights (%)	50	50
Number of blades	3	3
Rotor radius (m)	125	138
Blade width (m)	7	7.9
Rotation speed (rpm)	6.804 (1.246)	5.591 (1.402)
Pitch (degrees)	6.738 (5.044)	7.248 (6.923)

Table 2.2: **Percentage of time per month that turbines are predicted to be operational. Design Option A is 70 x 250 m diameter turbines and Design Option B is 60 x 276 m diameter turbines**

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Design Option A	89.4	89.8	86.5	83.6	82.5	81.5	81.1	82.7	85.3	88.7	89.5	90.6
Design Option B	89.5	89.7	86.8	84.1	83	82	81.6	83.2	85.8	89	89.4	90.5

2.1.2.2. Species biometric

A number of physical characteristics for Roseate tern were used to parameterize the mCRM. These characteristics influence collision risk and are as follows:

- Bird length;
- Wingspan;
- Flight speed; and
- Flight type (flapping or gliding).

Species biometric data used for the migration collision risk modelling is presented in Table 2.3 below.

Table 2.3: Biometric data used in collision risk modelling

Species	Body length (m) [SD]	Wingspan (m) [SD]	Flight speed (m/s) [SD] *	Flight type	Source
Roseate tern	0.36 [0]	0.76 [0]	10.9 [0.9]	Flapping	BTO; Alerstam et al. (2007)

** In the absence of Roseate tern flight speed data in Alerstam et al. (2007) the value for Arctic tern was assumed to be representative.*

2.1.2.3. Avoidance rate

Since most birds will exhibit avoidance behaviour when faced with wind turbines, a key element of collision risk modelling is the inclusion of a parameter to describe this behaviour. Different species are expected to avoid wind farms to differing degrees (Cook *et al.,* 2012; Johnston *et al.*, 2014) and this avoidance behaviour can be described as:

- Avoidance of the wind farm completely (macro-avoidance);
- Avoidance of turbines within the wind farm (meso-avoidance); and

- Avoidance of individual turbine blades (micro-avoidance).

Total avoidance is therefore made up of a combination of these avoidance rates:

$$Total\ avoidance = 1 - [(1 - macro\text{-}avoidance)\ x\ (1 - meso\text{-}avoidance) x\ (1 - micro\text{-}avoidance)]$$

Meso-avoidance rates are three dimensional and could include vertical changes to bird distributions. That is, birds may fly at different heights within the wind farm to avoid the moving turbine rotors. Thus, the difference in flight heights used to estimate collisions (from data collected without the wind farm present) and the flight heights of birds in the operational wind farm are accounted for in the total avoidance rate. The number of collisions was estimated using the mean avoidance rate and its associated standard deviation (SD) recommended by the most recent guidance issued by NatureScot (2024) for all tern species: 0.9908 (0.0004).

2.1.2.4. Roseate tern migration periods

The migratory season definitions for Roseate tern used in the mCRM for CWP are presented in Table 2.4 below.

Table 2.4: Birds migration period implemented in the mCRM

Migration period	Roseate tern
Pre-breeding	April – May
Post-breeding	September – October

Source: BirdWatch Ireland. (n.d.); Jones, C. (2011).

2.1.2.5. Biogeographic population and proportion in UK

The biogeographic population and the proportion of the population in the UK for the Roseate tern used in the migration CRM are presented in the Table 2.5 below. In this report, the proportion potentially passing through the wind farm corresponds to the population sizes of the studied Rockabill and Coquet Island SPAs.

Table 2.5: The proportion of population potentially passing through the windfarm

SPA Population	Biogeographic population	Proportion of population in UK
Rockabill SPA	3552 *	1
Coquet Island SPA	236 **	1

*Source: * Coughlan et al., 2024; ** Burnell et al., 2023; Harris et al., 2024*

2.1.2.6. Proportion of flight activity at Potential Collision Risk Height (PCH)

For the migration collision risk modelling, the proportion of flights expected to be at collision height is assumed to be 10%. Thus, a Potential Collision Risk Height (PCH) of 0.1 was used for the Roseate tern under both design options A and B.

3. Results

The Table 3.1 below presents the seasonal migration collision estimates for the Roseate tern, including standard deviations. The values assume a single passage within a season.

Table 3.1: Predicted collision rates for Design Options A and B for the Roseate tern

Design option	SPA population	Collisions in each migratory period (±SD)		Annual collisions (±SD)	Percentage of population impacted annually (median)
		Pre-breeding	Post-breeding		
A	Rockabill	0.216 (± 0.022)	0.227 (± 0.023)	0.443 (± 0.032)	0.012%
	Coquet Island	0.014 (± 0.001)	0.015 (± 0.002)	0.029 (± 0.002)	0.012%
B	Rockabill	0.19 (± 0.026)	0.199 (± 0.027)	0.389 (± 0.037)	0.011%
	Coquet Island	0.013 (± 0.002)	0.013 (± 0.002)	0.026 (± 0.003)	0.011%

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