Ammonia Impact Assessment – Poultry Farm at Gorteen, Broader, Co. Limerick

Prepared for:

Ceres Consulting Ltd

August 2025

Final

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Document Control

Deliverable #:	DK24014-2
Title:	Ammonia Impact Assessment – Poultry Farm at Gorteen, Broader, Co. Limerick
Version:	1.0 Final
Client:	Ceres Consulting Ltd
Document reference:	DK24014-2 Limerick Breeder Rearer AIA Report.docx
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Reviewed by:	Simon Welchman
Approved by:	 Simon Welchman 19/08/2025

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Glossary

Term	Definition
g/s	gram per second
kg	kilogram
kg/m³	Kilogram per cubic meter
km	kilometre
km/hr	kilometre per hour
m	metre
m/s	metres per second
m^2	square metres
m^3	cubic metres
m^3/s	cubic metres per second
m^3/hr	cubic metres per hour
mg	milligram
Z_0	roughness length
$\mu g/m^3$	micrograms per cubic meter
Abbreviations	**Definition**
AG4	Air Guidance 4
AIA	Ammonia Impact Assessment
BAT	Best available techniques
EPA	Environmental Protection Agency
EF	Emission factor
EU	European Union
IEL	Industrial Emissions Licence

1. INTRODUCTION

Katestone Environmental Pty Ltd (Katestone) was commissioned by Ceres Consulting Ltd (Ceres Consulting) to complete an ammonia impact assessment (AIA) for a poultry breeding operation located at Gorteen, Broadford, Co. Limerick (site).

The site is owned and operated by Enfield Broiler Breeders Limited (Enfield Broiler Breeders). There are currently eight (8) poultry housing units that hold 39,999 egg laying hens at the site. Enfield Broiler Breeders proposes to increase stocking numbers at the site to 61,800 hens. The proposed increase in bird numbers will be housed in the existing housing units at the site. No additional buildings or floorspace will be required to facilitate the additional bird numbers.

The proposed increase in bird numbers will result in the site exceeding the Industrial Emissions License (IEL) threshold for bird numbers. An IEL will, therefore, be required for the site.

In July 2024, Enfield Broiler Breeders submitted a licence application to EPA. Ceres Consulting managed the licence application. The licence register number for the application is P1214-01. On 11 December 2024, EPA issued a request for further information (RFI) under section Regulation 10(2)(b)(ii) of the *EPA (Industrial Emissions) (Licensing) Regulations 2013*. The RFI included the following item:

> 10. Appropriate Assessment
>
> *A screening for Appropriate Assessment was undertaken on 13 August 2024 and the Agency determined that an Appropriate Assessment of the proposed activity is required. You are thereby required to submit a Natura Impact Statement (NIS), as defined in Regulation 2(1) of the European Communities (Birds and Natural Habitats) Regulations 2011 as amended.*
>
> *The NIS should be prepared in accordance with the EPA Licence Application*
>
> *Instruction Note 1 (IN1) "Assessment of the impact of ammonia and nitrogen on Natura 2000 sites from Intensive Agriculture Installations".*
>
> *You are furthermore advised to refer to the document 'Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities', issued in 2009 by the Department of the Environment, Heritage and Local Government, and revised in 2010. This document is available on the National Parks & Wildlife Survive website at:*
>
> *http://www.npws.ie/sites/default/files/publications/pdf/NPWS_2009_AA_Guidance.pdf.*

This ammonia impact assessment will form part of the supporting documentation for the response to RFI and, subsequently, the licence application. The assessment has been conducted in accordance with the RFI requirements and, in particular, *Licence Application Instruction Note 1 (IN1) Assessment of the Impact of Ammonia and Nitrogen on Natura 2000 Sites from Intensive Agriculture Installations* (Version 2.0) (EPA, 2023), which is referred to here as EPA's Ammonia Assessment Guidance.

Nitrogen deposition results from the settlement of nitrogenous compounds from the air onto land surfaces. Emissions of ammonia from the Facility were considered in this assessment.

This ammonia impact assessment was undertaken using dispersion modelling techniques. The dispersion modelling has been completed in accordance with the requirements of EPA's Air Dispersion Modelling Guidance Note (AG4).

2. PROPOSED OPERATIONS AT THE FACILITY

This section presents an overview of the Facility as it will operate after the completion of the increase in stocking numbers from 39,999 to 61,800 hens. The Facility is located in a rural area of Co. Limerick, approximately 8 km south of Newcastle West.

Current operations involve:

- The rearing of 39,999 hens in eight (8) housing units for the production of eggs
- Removal of soiled litter from the site at the end of each lay cycle by a licenced provider.

The proposed operations involve:

- The housing of 61,800 hens in the eight (8) housing units for the production of eggs
- Removal of soiled litter from the site at the end of each lay cycle by a licenced provider.

No additional buildings or floorspace will be required to facilitate the additional bird numbers.

The site layout of the existing operations is presented in Figure 1.The layout of the Facility is presented in Figure 1.

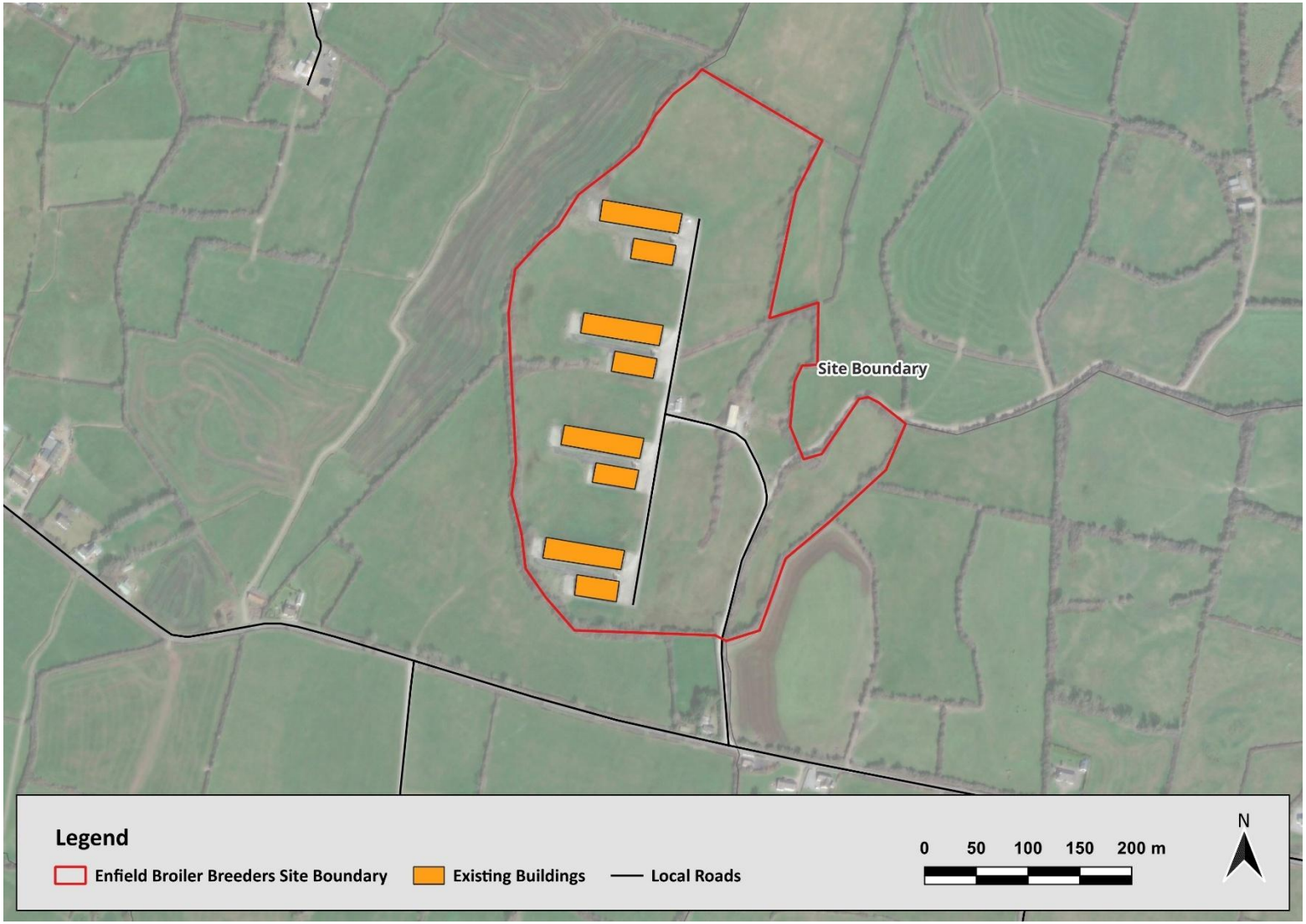

Figure 1 **Layout of the Facility**

3. REGULATORY FRAMEWORK AND ASSESSMENT CRITERIA

3.1 *Environmental Protection Agency Acts 1992 and 2003*

The *Environmental Protection Agency Act 1992 (EPA Act)* and Part 2 of the *Protection of the Environment Act 2003* are collectively referred to as the *Environmental Protection Agency Acts 1992 and 2003*. These Acts provide for the management of air emissions from activities (meaning any process, development or operation) that are listed in the First Schedule of the Acts.

Section 4 (2) of the *Environmental Protection Agency Acts 1992 and 2003* defines Air Pollution as follows:

> *"…the direct or indirect introduction to an environmental medium, as a result of human activity, of substances, heat or noise which may be harmful to human health or the quality of the environment, result in damage to material property, or impair or interfere with amenities and other legitimate uses of the environment, and includes –*
>
> *(a) 'air pollution' for the purposes of the Air Pollution Act 1987,*
>
> *(b) ……..*
>
> *(c) ……."*

The *Air Pollution Act 1987* (AP Act) provides for the control of air pollution and other matters connected with air pollution. Under the AP Act 'pollutant' means any substance that is specified in the First Schedule or any other substance (including a substance which gives rise to odour) or energy which, when emitted into the atmosphere either by itself or in combination with any other substance, may cause air pollution.

Section 4 of the AP Act defines air pollution as follows:

> *"Air pollution" in this Act means a condition of the atmosphere in which a pollutant is present in such a quantity as to be liable to —*
>
> (1) *be injurious to public health, or*
>
> *(ii) have a deleterious effect on flora or fauna or damage property, or*
>
> *(iii) impair or interfere with amenities or with the environment."*

Section 24 of the AP Act details the obligations of the occupier of a premises in respect to preventing emissions, nuisance and what constitutes defences against prosecution:

(1) The occupier of any premises, other than a private dwelling, shall use the best practicable means to limit and, if possible, to prevent an emission from such premises.

(2) The occupier of any premises shall not cause or permit an emission from such premises in such a quantity, or in such a manner, as to be a nuisance.

(3) In any prosecution for a contravention of this section, it shall be a good defence to establish that—

(a) the best practicable means have been used to prevent or limit the emission concerned, or

(b) the emission concerned was in accordance with a licence under this Act, or

(c) the emission concerned was in accordance with an emission limit value, or

(d) the emission concerned was in accordance with a special control area order in operation in relation to the area concerned, or

in the case of an emission of smoke, the emission concerned was in accordance with regulations under section 25, or

(f) the emission did not cause air pollution.

Section 75 (1) of the *Environmental Protection Agency Acts 1992 and 2003* requires the EPA to publish reasonable and desirable quality objectives to protect the environment, namely:

"The Agency shall, in relation to any environmental medium and without prejudice to its functions under section 103, specify and publish quality objectives which the Agency considers reasonable and desirable for the purposes of environmental protection."

3.2 Birds Directive and Habitats Directive

Concerned with the decline of wild bird species, EU Member States unanimously adopted the Birds Directive (79/409/EEC) in April 1979 that aims to conserve species of wild birds and the habitats that are crucial for their conservation. The Birds Directive was amended in 2009 (2009/147/EC).

The Habitats Directive (92/43/EEC) aims to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements. It forms the cornerstone of Europe's nature conservation policy with the Birds Directive and establishes the EU wide Natura 2000 ecological network of protected areas.

The Habitats Directive requires EU Member States to take measures to maintain or restore natural habitats and wildlife species at a favourable conservation status. Sites designated under the Birds Directive and the Habitats Directive form the Natura 2000 network. Maintaining or restoring the Natura 2000 network is an obligation that must be considered concurrently with requirements for increased food production and economic growth targets set for agricultural sectors in EU Member States.

The main aim of the Habitats Directive is to contribute towards the conservation of biodiversity by requiring EU Member States to take measures to maintain or restore natural habitats and wild species listed on the Annexes to the Directive at a favourable conservation status. These annexes list habitats (Annex I) and species (Annexes II, IV and V) that are considered threatened in the EU territory. The listed habitats and species represent a considerable proportion of biodiversity in Ireland and the Habitats Directive itself is one of the most important pieces of legislation governing the conservation of biodiversity in Europe.

The protection and conservation duties of EU Member States for Natura 2000 sites are specified in Article 6 of the Habitats Directive and are summarised below:

- Article 6(1): establish necessary conservation measures, management plans and appropriate statutory, administrative or contractual measures which correspond to the ecological requirements of the natural habitats and species present at the sites
- Article 6(2): take appropriate steps to avoid deterioration of Natura 2000 sites
- Article 6(3) and 6(4): assess the impact of new plans and projects and only agree to the plan or project if it will not adversely affect the integrity of the site unless the plan or project is imperative for reasons of overriding public interest.

The European Communities (Birds and Natural Habitats) Regulations 2011 to 2015, as amended (Birds and Natural Habitats Regulations) give effect to the Habitats Directive in Irish law. The regulations require, inter alia, that a public authority carry out screening for Appropriate Assessment of a plan or project for which an application for consent is received, to assess, in view of best scientific knowledge and in view of the conservation objectives of the site, if that plan or project, individually or in combination with other plans or projects is likely to have a significant effect on the European site. Where it is determined that an Appropriate Assessment is required, the Birds and Natural Habitats Regulations require that the assessment carried out by a public authority include a determination

pursuant to Article 6(3) of the Habitats Directive as to whether or not the plan or project would adversely affect the integrity of a European site.

3.3 Ammonia impact assessment – Guidance

In May 2021, due to a high volume of intensive agriculture applications/reviews and licenses, EPA published ammonia and nitrogen assessment guidance for the intensive agricultural sector entitled *Licence Application Instruction Note 1 (IN1) Assessment of the impact of ammonia and nitrogen on Natura 2000 sites from intensive agricultural installations* (EPA, 2021). This guidance was updated in March 2023 (EPA, 2023, referred to here as EPA's Ammonia Assessment Guidance). It describes how applicants should assess, the impact of air emissions, as part of a licence application for the following activities listed under the First Schedule of the Environmental Protection Agency Acts 1992 as amended:

- Class 6.1 (the rearing of poultry in an installation, where the capacity exceeds 40,000 places)
- Class 6.2 (the rearing of pigs in an installation where the capacity exceeds – (a) 750 places for sows, or. (b) 2,000 places for production pigs).

EPA's Ammonia Assessment Guidance. describes a six-step process for the assessment of emissions of ammonia to the atmosphere from intensive agricultural installations (IAIs). Step 1 needs to be completed for all applications to inform the additional steps that need to be completed.

Compliance with the criteria defined in the subsequent steps means that no further steps need to be undertaken and the compliant results can be presented to EPA for review as part of the approvals process.

Katestone followed the step-wise approach described in EPA's Ammonia Assessment Guidance in this assessment. The graphical summary format of the step-wise approach is reproduced here in Figure 2. The methodology adopted to complete this assessment is described in Section 5.

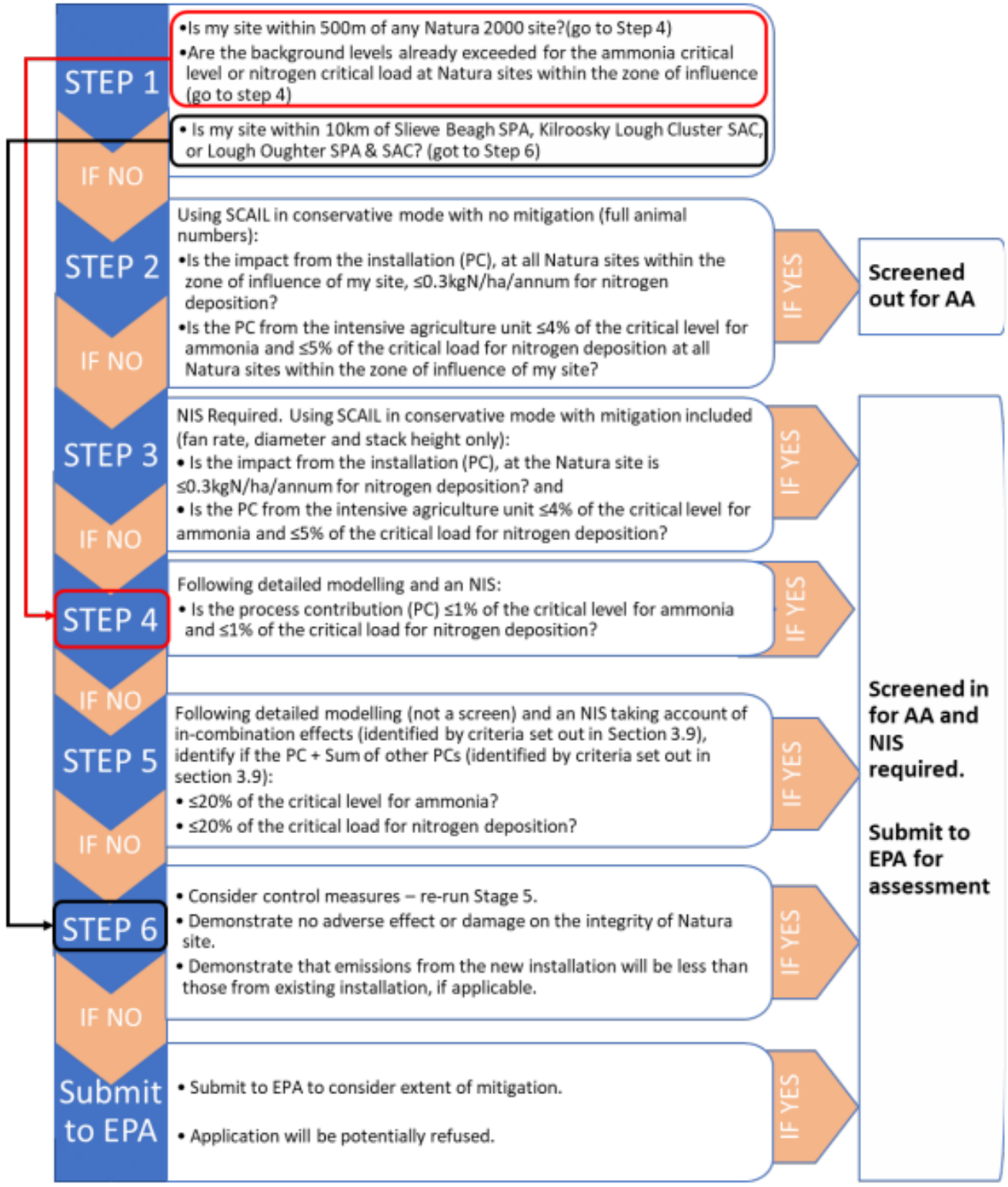

Figure 2 **The steps involved in the assessment process described in EPA's Ammonia Assessment Guidance (reproduced from EPA, 2023)**

3.4 Assessment Criteria for ammonia and nitrogen deposition

The compliance criteria adopted in the assessment are based on critical limits. A critical limit, in its simplest form, is a threshold set to indicate when impacts on the terrestrial environment are likely to occur from air pollutants. These can be used as part of the regulatory process for the assessment of impacts of air quality on terrestrial ecology (Kelleghan *et al.*, 2022). The EPA's Ammonia Assessment Guidance adopts criteria based on critical limits including:

- Critical levels for ammonia
- Empirical critical loads for nitrogen deposition.

Both critical levels and loads are international guidelines used to protect habitats, primarily across Europe. Critical levels here refer specifically to the threshold for impacts that can occur directly from atmospheric ammonia, allowing for an acute measurement of direct effects. Critical levels are defined as "the concentration in the atmosphere above which direct adverse effects on receptors, such as plants, ecosystems or materials, may occur according to present knowledge" (Posthumus, 1988; Kelleghan *et al.*, 2022).

Empirical critical loads are based on total nitrogen deposition. A critical load is defined as a deposition rate below which significant harmful effects do not occur "according to present knowledge" (Posthumus, 1988).

The critical level for ammonia and the critical load for nitrogen deposition for each of the species and habitat are presented in Section 4.3 for the modelled discrete receptors.

4. EXISTING ENVIRONMENT

This section presents information on the existing environment in the vicinity of the site, within the dispersion modelling domain and within the meteorological modelling domain. The meteorological modelling domain has been generated using geophysical data (terrain and land use) and meteorological data.

The extents of the dispersion modelling domain were determined based on the locations of the nearest ecological receptors in all directions from the site.

4.1 Local terrain and land-use

The poultry farm is located in an expansive area of relatively flat rolling rural terrain that is part of the River Deel Valley. The River Deel Valley is bordered by elevated terrain of the Mullaghareirk Mountains, the eastern facing slopes of which form a crescent shape that borders the River Dell Valley starting northwest of Newcastle West, initially extending south before curving around to the east towards Dromcolliher. The Mullaghareirk Mountains rise to an elevation of 420 m approximately 6 km southwest of the site. The terrain to the east of the site is primarily flat with small, isolated areas of higher terrain.

The site is in a remote rural location surrounded by predominately agricultural land with sparsely located residences. The Mullaghareirk Mountains contain extensive areas of forest and bog land that extend to the south and west, starting approximately 3 km from the site.

The terrain of the modelling domain is presented as:

- A 2-dimenstional surface plot in in Figure 3
- A 3-dimenstional surface plot in in Figure 4.

The mountains and hills of the modelling domain will affect synoptic scale wind patterns in the area by:

- Blocking wind coming from certain directions
- Channelling winds along the valleys created by the hills and mountains
- Creating very specific local air flows under low windspeed conditions due to katabatic and anabatic air flows created by the slopes of the complex terrain.

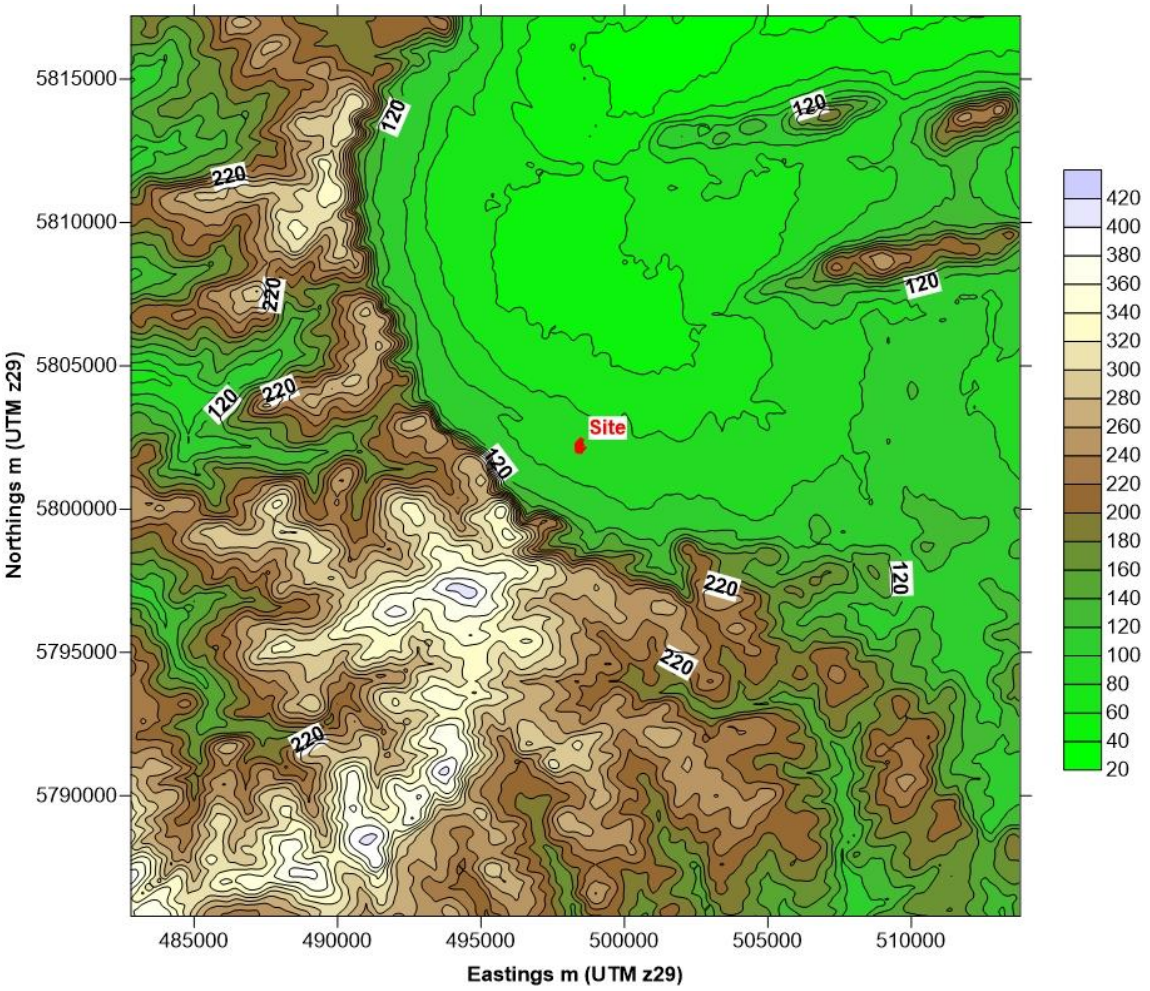

Figure 3 **2-dimensional terrain of the modelled domain**

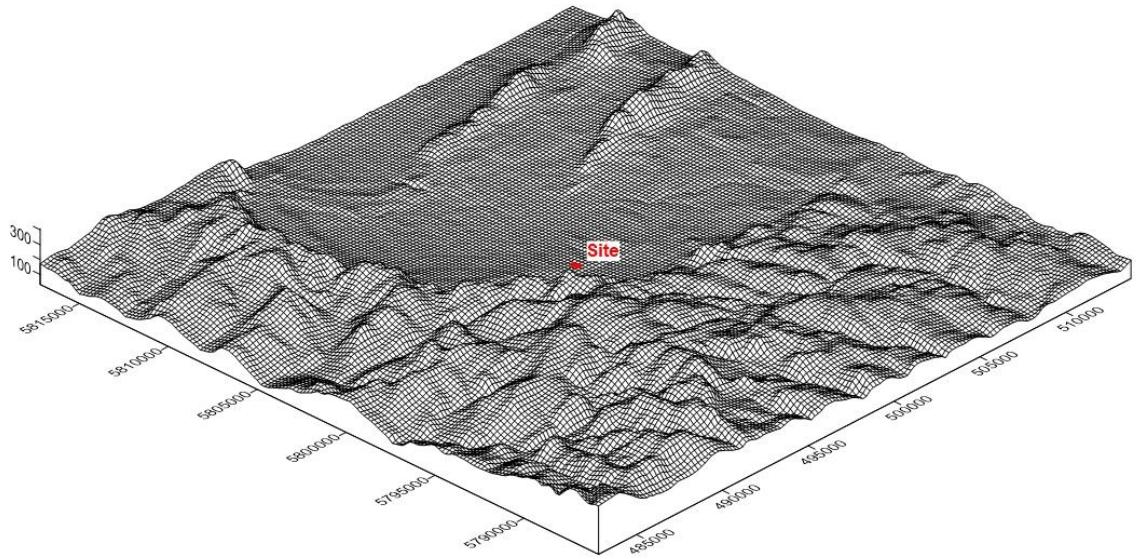

Figure 4 **3-dimensional terrain of the modelled domain**

4.2 Meteorology

Wind speed and wind direction are important parameters for the transport and dispersion of air pollutants from a source. The winds in the vicinity of the Site have been characterised using a three-dimensional meteorological model called CALMET. The 1-hour average wind speed for the modelling period is 4.01 m/s. A wind rose representing the annual distribution of 1-hour average winds is presented in Figure 5.

The prevailing wind direction in Ireland is between south and west. It is clear from Figure 5 that westerly winds occur more frequently than southwesterlies throughout the year at this site. Both daytime and nighttime winds are heavily influenced by the prevailing westerly wind observed at the site. It is clear that wind speed on average rises steadily through the early hours of morning before peaking in the afternoon before dropping again overnight (Figure 6)

The seasonal distribution of wind speed and wind direction is presented in Figure 7. The strongest winds at the site occur most frequently from the west during the winter months. The greatest proportion of light winds occur during summer. The overarching westerly and southerly winds persist through all seasons. A higher proportion of southeasterly winds occurs during the spring months.

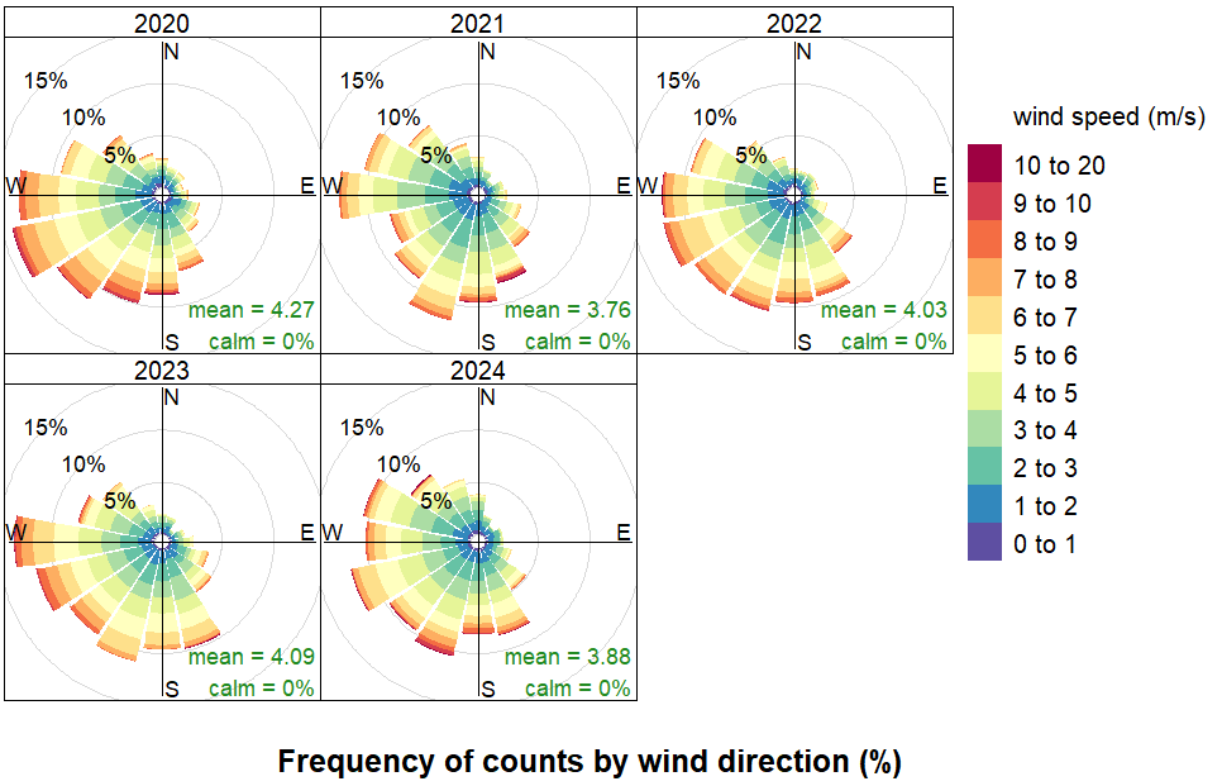

Figure 5 **Annual wind distribution predicted at the Site using CALMET for 2020 to 2024**

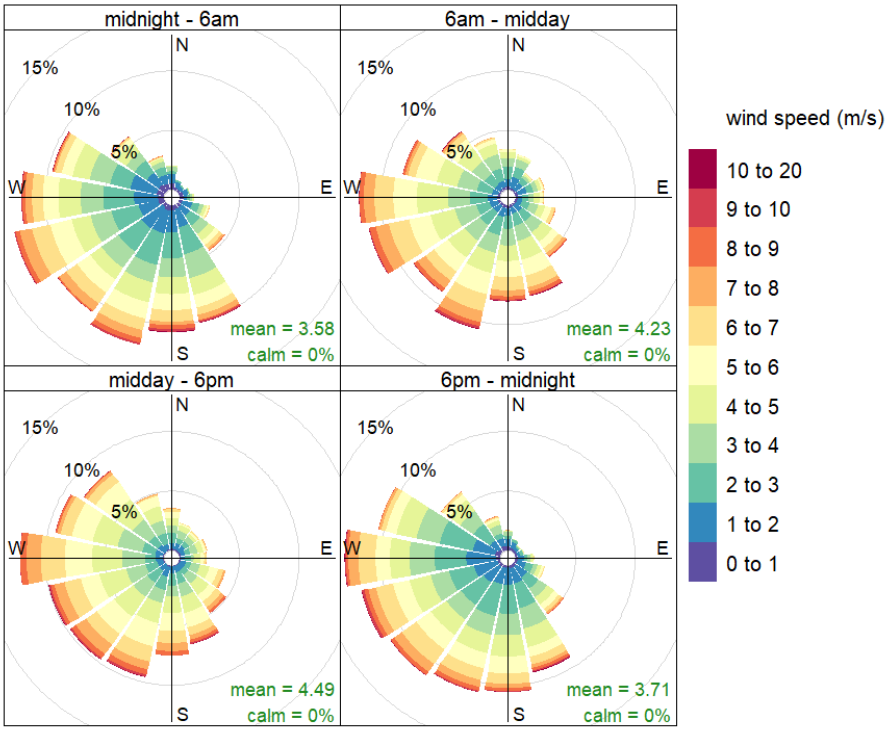

Figure 6 **Diurnal wind distribution predicted at the Site using CALMET**

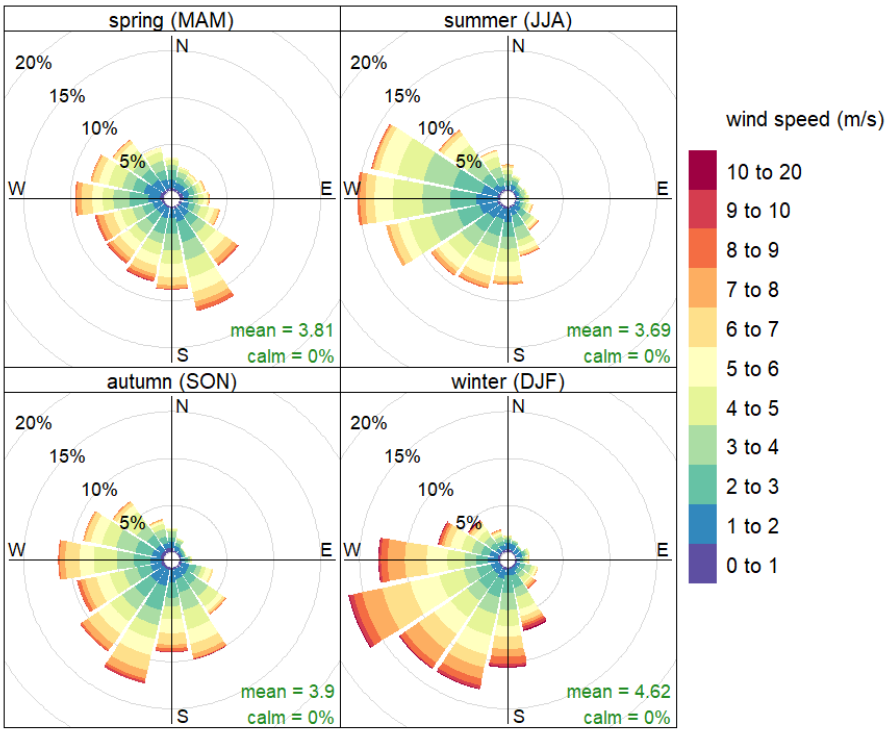

Figure 7 **Seasonal wind distribution predicted at the Site using CALMET**

4.3 Sensitive receptors

The sensitive receptors that are nearest to the site are presented in Figure 8. The sensitive receptors included in the dispersion modelling assessment are at Natura 2000 sites in the vicinity of the poultry farm. The Natura 2000 sites within 15 km, which are indicated by a red dashed circle in Figure 8, have been considered in this assessment. The Natura 2000 sites within 15 km of the poultry farm that have been considered in this assessment include:

- Blackwater River (Cork/Waterford) SAC (002170)
- Lower River Shannon SAC (002165)
- Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA (004161).

Several tributaries of the Blackwater River (Cork/Waterford) SAC and the Lower River Shannon SAC are within 15 km of the poultry farm. A significant portion of the Stack's to Mullaghareirk Mountains SPA, West Limerick Hills and Mount Eagle SPA is located within 15 km of the poultry farm.

These Natura 2000 sites contain a range of ammonia and nitrogen sensitive species and habitats that are listed as conservation interests, some of which are within 15 km of the site including:

- The Blackwater River (Cork/Waterford) SAC:
    - Perennial vegetation of stony banks [1220]
    - Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation [3260]
    - Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0]
    - Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0]
    - Trichomanes speciosum (Killarney Fern) [1421].
- The Lower Shannon SAC:
    - Perennial vegetation of stony banks [1220]
    - Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation [3260]
    - Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae) [6410]
    - Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0].

SPAs focus on the protection of areas that bird species typically use as nesting, breeding or over wintering sites. The protection of SPA habitats from projects that are likely to have significant adverse impacts is crucial to maintaining or restore the protected species of birds to a favourable conservation status.

A review of the conservation objectives published by NPWS for the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA indicate that the species listed as conservation objectives is the Hen Harrier (*Circus cyaneus)* (A082).

NPWS conservation objectives highlight the extent and condition of heath and bog and associated habitats as important nesting and foraging resources for the breeding population of Hen Harrier. As a result, heath and bog habitats within the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA have been considered in this assessment.

The critical level for ammonia and the critical load for nitrogen deposition for each of the species and habitat considered in this assessment is presented in Table 1.

Table 1 The critical level for ammonia and the critical load for nitrogen deposition for each of the species and habitat within 15 km of the poultry farm

Habitat or Species	Critical Level	Critical Load
	µg/m³	kg/ha/year
Perennial vegetation of stony banks [1220]	1	10
Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation [3260]	1	10
Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0]	1	10
Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0]	1	15.3
Trichomanes speciosum (Killarney Fern) [1421]	1	10
Molinia meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae) [6410]	1	15
Blanket bogs (* if active bog) [7130]	1	5

Fifty-three sensitive receptor locations were included in the dispersion modelling assessment. The locations were chosen to represent places within each Natura 2000 site where:

- A qualifying habitat or species that are sensitive to ammonia and nitrogen deposition have been mapped
- Potential impacts from the Facility are likely to be greatest (i.e. at locations on the natura 2000 site closest to the Facility).

A review of National Parks and Wildlife Service surveys of the habitats and species of the Natura 2000 sites indicates that only the following habitats of interest are present within sites within 15 km of the poultry farm:

- Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0]
- Blanket bogs (* if active bog) [7130].

The Blackwater River (Cork/Waterford) SAC flows to the southeast of the site. The closest point of the Blackwater River is located 6.2 km from the site boundary. A review of the conservation objectives published by NPWS for the stretch of the Blackwater River within 15 km of the site indicates that there are no ammonia and nitrogen sensitive species or habitats within 15 km of the poultry farm.

The Lower River Shannon SAC flows to the west of the site. The closest point of the Lower River Shannon is located 4.6 km from the site boundary. A review of the conservation objectives published by NPWS for the stretch of the Lower River Shannon within 15 km of the site indicates that there are two areas of old sessile oak woods with Ilex and Blechnum in the British Isles [91A0] with the closest located 7.0 km west of the site boundary. There are no other ammonia and nitrogen sensitive species or habitats identified along the stretch of the Lower River Shannon within 15 km of the poultry farm.

The Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA is located along the eastern side of the site extending from the south to the north. NPWS databases were reviewed to determine the extent of habitats on the Mullaghareirk Mountains within 15 km of the site that are:

- Important nesting and foraging resources for the breeding population of Hen Harrier
- Sensitive to airborne ammonia and nitrogen deposition.

This review indicates that there are several Active Blanket bogs [7130] with the closest 4 km southeast of the site boundary. In addition, NPWS database indicates an area of Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0] is located 14.7 km northwest of the site boundary. No other ammonia and nitrogen sensitive species or habitats were identified in the area of the Mullaghareirk Mountains within 15 km of the site.

The sensitive receptor locations included in the dispersion modelling assessment are at points on Natura 2000 sites including:

- Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA (004161) – N2K_R1 to N2K_R22 and N2K_37 to N2K_53
- Blackwater River (Cork/Waterford) SAC (002170) – N2K_R23 to N2K_R29
- Lower River Shannon SAC (002165) – N2K_R30 to N2K_R36.

The sensitive receptors represent locations across the extents of all Natura 2000 sites within 15 km of the poultry farm and are presented graphically in a map in Figure 8.

The sensitive receptors are presented in tabular format in Table 2, which includes for each location:

- The conservation objectives of the habitats or species identified at that point
- The critical level for ammonia adopted in the modelling assessment
- The critical load for nitrogen deposition adopted in the modelling assessment.

Table 2 **Sensitive receptor locations included in the dispersion modelling assessment, the conservation interest at each location, the critical level for ammonia adopted in the modelling assessment and the critical load for nitrogen deposition at each location**

Receptor	Species or Habitat							Relevant Criteria	
	Perennial vegetation of stony banks [1220]	Water courses of plain to montane levels (3260)	Old sessile oak woods with Ilex and Blechnum [91A0]	Alluvial forests with Alnus glutinosa and Fraxinus excelsior [91E0]	Trichomanes speciosum (Killarney Fern) [1421]	Molinia meadows on calcareous, peaty or clayey-silt-laden soils [6410]	Blanket bogs (* if active bog) [7130]	Ammonia Concentration	Nitrogen Deposition
Cle (µg/m³)	1	1	1	1	1	1	1	µg/m³	kg/ha/yr
Clo (kg/ha/yr)	10	10	10	15.3	10	15	5		
N2K_R1								3	30
N2K_R2								3	30
N2K_R3								3	30
N2K_R4								3	30
N2K_R5								3	30
N2K_R6								3	30
N2K_R7								3	30
N2K_R8								3	30
N2K_R9								3	30
N2K_R10								3	30
N2K_R11								3	30
N2K_R12								3	30
N2K_R13								3	30
N2K_R14								3	30
N2K_R15								3	30

Receptor	Species or Habitat							Relevant Criteria	
	Perennial vegetation of stony banks [1220]	Water courses of plain to montane levels (3260)	Old sessile oak woods with Ilex and Blechnum [91A0]	Alluvial forests with Alnus glutinosa and Fraxinus excelsior [91E0]	Trichomanes speciosum (Killarney Fern) [1421]	Molinia meadows on calcareous, peaty or clayey-silt-laden soils [6410]	Blanket bogs (* if active bog) [7130]	Ammonia Concentration	Nitrogen Deposition
N2K_R16								3	30
N2K_R17								3	30
N2K_R18								3	30
N2K_R19								3	30
N2K_R20								3	30
N2K_R21								3	30
N2K_R22								3	30
N2K_R23								3	30
N2K_R24								3	30
N2K_R25								3	30
N2K_R26								3	30
N2K_R27								3	30
N2K_R28								3	30
N2K_R29								3	30
N2K_R30								3	30
N2K_R31								3	30
N2K_R32								3	30
N2K_R33								3	30
N2K_R34			✓					1	10
N2K_R35			✓					1	10

Receptor	Species or Habitat							Relevant Criteria	
	Perennial vegetation of stony banks [1220]	Water courses of plain to montane levels (3260)	Old sessile oak woods with Ilex and Blechnum [91A0]	Alluvial forests with Alnus glutinosa and Fraxinus excelsior [91E0]	Trichomanes speciosum (Killarney Fern) [1421]	Molinia meadows on calcareous, peaty or clayey-silt-laden soils [6410]	Blanket bogs (* if active bog) [7130]	Ammonia Concentration	Nitrogen Deposition
N2K_R36			✓					1	10
N2K_R37							✓	1	5
N2K_R38							✓	1	5
N2K_R39							✓	1	5
N2K_R40							✓	1	5
N2K_R41							✓	1	5
N2K_R42							✓	1	5
N2K_R43			✓					1	10
N2K_R44							✓	1	5
N2K_R45							✓	1	5
N2K_R46							✓	1	5
N2K_R47							✓	1	5
N2K_R48							✓	1	5
N2K_R49							✓	1	5
N2K_R50							✓	1	5
N2K_R51							✓	1	5
N2K_R52							✓	1	5
N2K_R53							✓	1	5

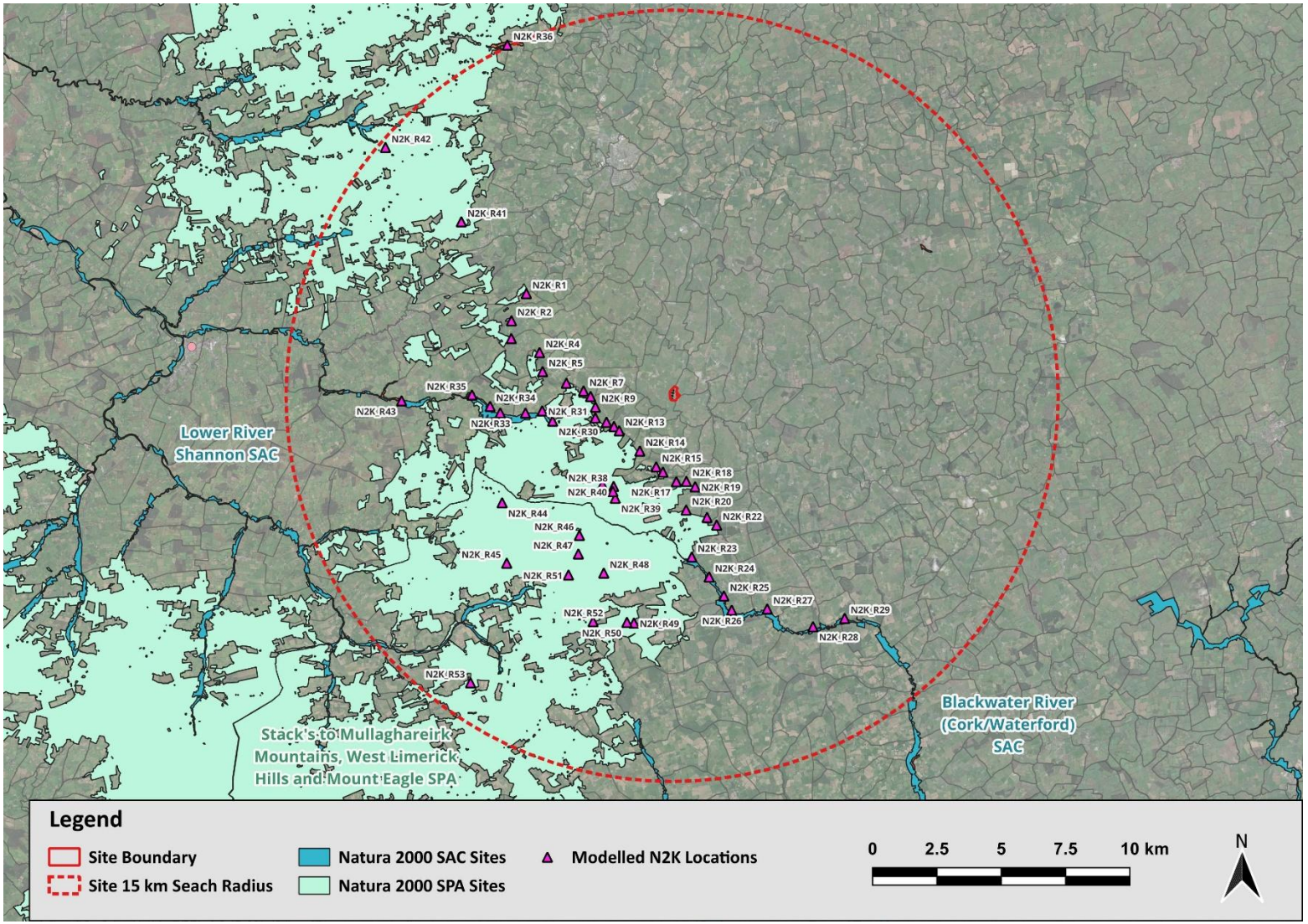

Figure 8 **The sensitive receptors included in the dispersion modelling assessment to represent locations on Natura 2000 sites**

4.4 Background concentrations of ammonia and nitrogen deposition

The background ammonia concentration and nitrogen deposition flux rates at each modelled sensitive receptor were obtained from the Simple Calculation of Atmospheric Impacts Limits (SCAIL) online tool as recommended in EPA's Ammonia Assessment Guidance. The background concentrations of ammonia and nitrogen deposition levels adopted in the assessment are presented in Table 3.

Background ammonia concentration and nitrogen deposition flux rates adopted in the assessment were included in the assessment methodology defined in EPA's Ammonia Assessment Guidance.

Table 3 The background concentrations of ammonia and nitrogen deposition levels adopted in the assessment (based on SCAIL)

Receptor	SCAIL Background	
	Concentration of ammonia (µg/m³)	Nitrogen Deposition Flux (kg/ha/yr)
N2K_R1	2.39	6.72
N2K_R2	2.39	6.72
N2K_R3	2.39	6.72
N2K_R4	1.97	6.40
N2K_R5	2.16	6.73
N2K_R6	1.85	6.45
N2K_R7	1.85	6.45
N2K_R8	1.85	6.45
N2K_R9	2.07	6.64
N2K_R10	2.07	6.64
N2K_R11	2.26	6.78
N2K_R12	1.88	6.51
N2K_R13	1.96	6.75
N2K_R14	1.74	6.54
N2K_R15	1.94	6.77
N2K_R16	1.94	6.77
N2K_R17	1.94	6.77
N2K_R18	2.14	6.99
N2K_R19	2.14	6.99
N2K_R20	2.24	7.11
N2K_R21	2.24	7.11
N2K_R22	2.22	7.16
N2K_R23	2.59	7.32
N2K_R24	2.59	7.32
N2K_R25	2.55	7.29
N2K_R26	2.49	7.32
N2K_R27	2.49	7.32
N2K_R28	2.85	7.72
N2K_R29	2.62	7.51

Receptor	SCAIL Background	
	Concentration of ammonia (µg/m³)	Nitrogen Deposition Flux (kg/ha/yr)
N2K_R30	2.49	6.85
N2K_R31	2.07	6.38
N2K_R32	2.07	6.38
N2K_R33	2.39	6.72
N2K_R34	2.62	7.51
N2K_R35	2.91	7.65
N2K_R36	2.00	6.09
N2K_R37	2.06	6.49
N2K_R38	2.00	6.19
N2K_R39	1.77	6.01
N2K_R40	1.77	6.01
N2K_R41	2.00	6.19
N2K_R42	1.46	5.09
N2K_R43	1.83	5.73
N2K_R44	1.43	5.51
N2K_R45	1.29	5.70
N2K_R46	1.24	5.96
N2K_R47	1.28	5.88
N2K_R48	1.35	5.97
N2K_R49	1.57	6.46
N2K_R50	1.57	6.46
N2K_R51	1.33	5.84
N2K_R52	1.48	6.45
N2K_R53	1.28	5.68

5. ASSESSMENT

5.1 Methodology

The following section describes the dispersion modelling methodology that was adopted to determine concentrations of ammonia and deposition rates of nitrogen from the poultry farm in combination with background levels at ecologically sensitive locations near the Site. The methodology is based on a dispersion modelling study incorporating source characteristics and operational activity data of the poultry farm with meteorological data that is representative of the Site and surrounding region. The dispersion modelling assessment has been prepared in accordance with industry standards, regulatory requirements and best practice approaches.

The assessment methodology has included:

- Derivation of an emissions inventory for onsite sources of ammonia based on their design, capacity and monitoring reports
- Characterisation of regional and local meteorology.
- Generation of a representative meteorological dataset using prognostic meteorological modelling techniques.
- Dispersion modelling using the regulatory dispersion model, CALPUFF, to predict ground-level concentrations of ammonia and nitrogen deposition at sensitive receptor locations.
- Comparison of the predicted ground-level concentrations of air contaminants against the relevant air contaminant assessment criteria for the existing operations compared to the proposed operations in accordance with EPA's Ammonia Assessment Guidance.

5.2 SCAIL-Agriculture

The baseline levels of ammonia and flux rates of nitrogen deposition at the sensitive ecological receptor locations were determined using SCAIL- Agriculture for Step 1 of EPA's Ammonia Assessment Guidance.

SCAIL-Agriculture is a tool for assessing impacts of atmospheric nitrogen from agricultural installations in the UK and Ireland. It is a model underpinned by a detailed air dispersion model, AERMOD (Kelleghan *et al.*, 2022).

SCAIL-Agriculture includes estimates of baseline levels of ammonia and flux rates of nitrogen deposition across Ireland. The SCAIL-Agriculture ambient concentration model (1 x 1 km grid) has been updated to include modelled 2018 emissions by the UKCEH on behalf of the EPA. Similarly, the coarser international 2018 European Monitoring and Evaluation Programme (EMEP) national concentration and deposition models for Ireland have been made available through the AmmoniaN2K website (AmmoniaN2K, 2021). Both these models currently rely on the MapEire emissions model, which utilises cattle and sheep distribution from 2010 and locations of pig and poultry farms from 2015 according to the Irish Wildlife Manual 135 (Kelleghan *et al.*, 2022).

5.3 Meteorological modelling

5.3.1 Overview

The modelling domain includes areas of complex terrain. The meteorological parameters that affect dispersion are likely to vary spatially and temporally across the modelling domain due to the complexity of the terrain.

The closest Met Eireann monitoring location to the site is at Shannon Airport, which is 39 km north of the poultry farm. This monitoring station is at an airport located to the north of the River Shannon that runs east to west. Meteorological data at Shannon Airport is characterised by frequent westerly and south-westerly winds. The meteorological station at Shannon Airport is not likely to be representative of meteorological conditions at the site due to the differences in surrounding terrain characteristics at both sites.

A review by Katestone indicates that there are no other meteorological observation stations on the Met Eireann Network that meet the requirements specified in AG4 to be considered representative of the modelling domain.

Where site specific or representative meteorological data is not available, AG4 provides the following alternatives:

> *Prognostic meteorological data should be considered in locations where there is no comparable representative Met Eireann station particularly in areas of complex terrain or at a land / sea interface.*

and

> *Prognostic meteorological data may be useful in locations where there is no comparable representative Met Eireann station. Locations where prognostic meteorological data may be required include regions of complex terrain and at a land/sea interface in circumstances where the nearest meteorological stations are outside of the modelling domain. As outlined by the USEPA, meteorological data should be spatially representative of the modelling domain and in particular of the pathway from the source to the most impacted receptor.*

Accordingly, prognostic meteorological data was generated for the site due to the complexity of the terrain. The approach adopted to generate representative site-specific data utilised a numerical model to generate a 3-dimensional grid of spatially varying meteorological parameters to represent conditions surrounding the site. The approach is described in Appendix A1.

5.3.2 Meteorology

The prognostic model TAPM (developed in Australia by the Commonwealth Scientific and Industrial Research Organisation [CSIRO], version 4.0.5) and the diagnostic meteorological model CALMET (developed by EarthTec, version 6.5) were used to generate the three-dimensional meteorological dataset for the region.

The CALMET simulation was initialised with the gridded TAPM 3D wind field data from the innermost nest. CALMET treats the prognostic model output as the initial guess field for the CALMET diagnostic model wind fields. The initial guess field is then adjusted for the kinematic effects of terrain, slope flows, blocking effects and 3D divergence minimisation.

The three-dimensional wind field produced by TAPM/CALMET was then used to create a meteorological file suitable for us with the CALPUFF dispersion model.

Details of the model configuration and evaluation are presented in Appendix A.

The TAPM/CALMET approach has been used in jurisdictions like Australia to generate suitable meteorological data for modelling odour impacts for over 15 years. It has been adopted in for the assessment of a number proposed projects in Ireland in the last 5 years. There is significant experience using these approaches in jurisdictions such as Australia. Industry specific guidance on modelling odour dispersion from sources such as intensive poultry farms

and cattle feedlots recommend the use of TAPM/CALMET to generate representative site-specific data. Research in Europe indicates that meteorological data generated using a numerical model provided a better indication of locations where odour nuisance occurred (Feliubadaló et al, 2008). In that study, locations of likely odour nuisance were determined using the German VDI grid assessment approach. The correlation between observed and modelled odour concentrations was significantly better using the TAPM/CALMET approach compared to traditional steady state gaussian models such as AERMOD.

5.4 Development of an emissions inventory

5.4.1 Overview

The derivation of the ammonia emissions inventory adopted for the dispersion modelling assessment is presented in this section. Ammonia emission inventories were derived based on the design and capacity for the housing units at the poultry farm for the proposed operations.

There are no emissions monitoring data available for the poultry farm. Ammonia and other nitrogenous compound emission rates from poultry housing units at poultry farms vary considerably depending on factors such as:

- The ventilation rate, which is heavily influenced by:
    - The target temperature of the birds in the shed, which is influenced by:
        - Type of bird
        - The age of the birds
    - The ambient temperature outside the poultry unit.
- The design of the housing system includes but is not limited to the following:
    - Depth of manure hand litter
    - Frequency of manure removal
    - Ventilation design
    - Surface area of manure in the housing unit.
- The depth of manure in the house, which varies considerably with season.

The ammonia emission inventory derived for the poultry farm for the proposed operations is based on:

- The livestock type and associated housing type / livestock maintenance system
- The number of livestock
- The housing floor area
- Ammonia emission rates derived from published literature.

5.4.2 Proposed Operations

Proposed operations will involve an increase in stocking numbers from 39,999 to 70,000 egg laying hens, which will be housed in the existing housing units. There are no additional houses required for the proposed development.

Each housing unit at the site contains a centralised elevated structure that contains nests, perches and an egg collection belt below the nest. On each side of the elevated structure are solid floor areas.

Hens are brought to the housing unit at the start of the lay cycle which starts when hens are approximately 18 weeks of age. The housing units are freshly cleaned and disinfected before hens are placed. Solid floor areas of

the housing units have fresh litter when hens are placed. The lay cycle lasts until hens are approximately 14 months old at which time they are removed. Subsequently, all soiled litter is removed from the housing unit. The housing unit is then cleaned and disinfected before new hens placed in the housing unit to start of the next lay cycle.

The poultry housing units operate as free-range, deep litter housing systems. Manure accumulates in the litter over the course of the lay cycle.

The ammonia emission rate adopted for the deep litter system at the site was taken from Table 3.50 of the BAT reference document (BREF) (IPCC, 2017) titled 'Intensive Rearing of Poultry or Pigs for housing units described as "Hens on floor, with manure pit" which specifics an ammonia emission rate of 0.29 kg NH_3. $bird^{-1}$. $year^{-1}$. This emission rate is considered appropriate as:

- The ammonia emission rate is dependent on the amount of manure held in a housing unit
- In relation to both deep pit and deep litter, all manure generated in the housing unit remains in the housing unit until the house is cleaned at the end of the lay cycle.

Soiled litter removed from housing units is immediately taken from the site by an external contractor. As a result, the storage of manure onsite external to the housing units has not been considered in the dispersion modelling assessment.

5.5 Dispersion modelling

The assessment was conducted in accordance with recognized techniques for dispersion modelling specified in EPA's Air Dispersion Modelling Guidance Note (AG4). CALPUFF was used to predict ground-level concentrations of ammonia and nitrogen deposition rates across the modelling domain and at sensitive ecological receptor locations on nearby Natura 2000 site due to sources at the poultry farm.

The details of source characterisation utilised for the poultry farm in the modelling assessment are provided in Section 5.8.

5.6 Methods to consider Nitrogen Deposition

Deposition flux rates of nitrogen at sensitive receptors were estimated based on the predicted concentrations of ammonia across the modelled domain and using the following calculation methodology that is described in AG4:

> *The critical loads in ecologically sensitive areas such as SPAs, SACs and NHAs can be determined using the methodology outlined in the UK publication "AQTAG06 – Technical Guidance on Detailed Modelling Approach For An Appropriate Assessment For Emissions To Air" (Environment Agency, 2014)(64) . The approach is based on using the maximum annual average ground level concentration within the ecologically sensitive area and converting this concentration into a deposition flux based on a chemical species specific deposition velocity (m/s) as outlined in Table A3.*

The recommended dry deposition velocities for ammonia in Table A3 of AG4 are:

- 0.02 m/s for grassland
- 0.03 m/s for forest.

Dry deposition flux (µg m^{-2} s^{-1}) is calculated as the product of the ground-level process contribution (µg/m^3) and the deposition velocity (m/s).

The dry deposition velocities adopted in the modelling assessment were assumed as follows for the Blanket Bog Areas (Active) and the Old Sessile Oak Woodlands:

- Blanket Bog Areas (Active) were assumed to be 0.02 based on their low-lying grassland nature

- Old Sessile Oak Woodlands were assumed to be 0.03 based on their forest-like structure

For the remaining modelled locations 0.03 m/s was assumed to obtain a conservative estimation of nitrogen deposition at the remaining modelled locations.

5.7 Sources of Emissions

The poultry housing units included in the dispersion modelling assessment are presented in Table 4, which specifies:

- The housing unit at the poultry farm
- The details of the housing system operation
- The maximum number of laying hens within each housing unit
- The ammonia emission rate per housing unit.

All poultry housing units at the Site will be naturally ventilated and were configured as volume sources in the modelling assessment.

Table 4 Poultry housing units included in the dispersion modelling assessment

Housing Unit	Type of shed	Number of birds	Ammonia Emission rate (g/s)
House 1	Perchery with deep litter	5150	0.0474
House 2		10300	0.0947
House 3		5150	0.0474
House 4		10300	0.0947
House 5		5150	0.0474
House 6		10300	0.0947
House 7		5150	0.0474
House 8		10300	0.0947

5.8 Source configuration

The building locations, configuration and heights were determined from site plans provided by Ceres Consulting Farms and from satellite imagery. All existing houses have been included in the modelling assessment as volume sources.

Table 5 provides details of the volume sources included in the modelling assessment and relevant modelling parameters including:

- The source coordinates
- The base elevations
- Emission height
- Initial sigma-y
- Initial sigma-z.

Table 5 Source parameters for the volume sources at the poultry farm

Source Number	x-coordinate	y-coordinate	Base Elevation	Emission Height	Sigma-y	Sigma-z
	km	km	m	m	m	m
House 1	498.367	5801.991	94.2	3.0	4.19	2.33
House 2	498.354	5802.024	94.0	3.0	4.19	2.33
House 3	498.385	5802.099	93.2	3.0	4.19	2.33
House 4	498.372	5802.132	93.0	3.0	4.19	2.33
House 5	498.403	5802.207	92.2	3.0	4.19	2.33
House 6	498.391	5802.241	91.9	3.0	4.19	2.33
House 7	498.421	5802.316	90.7	3.0	4.19	2.33
House 8	498.409	5802.349	90.4	3.0	4.19	2.33

6. RESULTS

The results of the assessment are presented in this section. Katestone followed the step-wise approach described in EPA's Ammonia Assessment Guidance in this assessment. The results of each step considered in the modelling assessment are presented in this section.

In summary, the step-wise approach described in EPA's Ammonia Assessment Guidance requires the following steps to be completed:

- Step 1
- Step 4.

6.1 Results of Step 1

Question 2 of Step 1 in the EPA's Ammonia Assessment Guidance asks:

> *Are the background levels already exceeded for the ammonia critical level or nitrogen critical load at Natura Sites within the zone of influence of my site (as reported by SCAIL)?*

The background concentrations of ammonia and the background nitrogen deposition flux as determined using the SCAIL screening tool are presented along with the appropriate critical level for ammonia and critical load for nitrogen deposition fluxes in Table 6.

The results show that the background concentrations of ammonia and the background nitrogen deposition flux exceed the relevant critical level for ammonia and critical load for nitrogen deposition fluxes at a number of the modelled discrete receptor locations.

According to Step 1 of EPA's Ammonia Assessment:

- The approaches using the SCAIL-Agriculture model described in Step 2 and Step 3 of the EPA's Ammonia Assessment Guidance are not applicable.
- A detailed assessment in accordance with Step 4 of EPA's Ammonia Assessment Guidance is, therefore, required to be completed. The results of the Step 4 assessment are presented in Section 6.2.

Table 6 Background concentrations of ammonia and the background nitrogen deposition flux as determined using the SCAIL screening tool are presented along with the appropriate critical level for ammonia and critical load for nitrogen deposition fluxes

Receptor	SCAIL background concentration of ammonia	Critical Level	SCAIL background nitrogen deposition flux	Critical Load
	µg/m³		kg/ha/yr	
N2K_R1	2.39	3.0	6.72	30.0
N2K_R2	2.39	3.0	6.72	30.0
N2K_R3	2.39	3.0	6.72	30.0
N2K_R4	1.97	3.0	6.40	30.0
N2K_R5	2.16	3.0	6.73	30.0
N2K_R6	1.85	3.0	6.45	30.0

Receptor	SCAIL background concentration of ammonia	Critical Level	SCAIL background nitrogen deposition flux	Critical Load
	µg/m³		kg/ha/yr	
N2K_R7	1.85	3.0	6.45	30.0
N2K_R8	1.85	3.0	6.45	30.0
N2K_R9	2.07	3.0	6.64	30.0
N2K_R10	2.07	3.0	6.64	30.0
N2K_R11	2.26	3.0	6.78	30.0
N2K_R12	1.88	3.0	6.51	30.0
N2K_R13	1.96	3.0	6.75	30.0
N2K_R14	1.74	3.0	6.54	30.0
N2K_R15	1.94	3.0	6.77	30.0
N2K_R16	1.94	3.0	6.77	30.0
N2K_R17	1.94	3.0	6.77	30.0
N2K_R18	2.14	3.0	6.99	30.0
N2K_R19	2.14	3.0	6.99	30.0
N2K_R20	2.24	3.0	7.11	30.0
N2K_R21	2.24	3.0	7.11	30.0
N2K_R22	2.22	3.0	7.16	30.0
N2K_R23	2.59	3.0	7.32	30.0
N2K_R24	2.59	3.0	7.32	30.0
N2K_R25	2.55	3.0	7.29	30.0
N2K_R26	2.49	3.0	7.32	30.0
N2K_R27	2.49	3.0	7.32	30.0
N2K_R28	2.85	3.0	7.72	30.0
N2K_R29	2.62	3.0	7.51	30.0
N2K_R30	2.49	3.0	6.85	30.0
N2K_R31	2.07	3.0	6.38	30.0
N2K_R32	2.07	3.0	6.38	30.0
N2K_R33	2.39	3.0	6.72	30.0
N2K_R34	**2.62**	1.0	7.51	10.0
N2K_R35	**2.91**	1.0	7.65	10.0
N2K_R36	**2.00**	1.0	6.09	10.0
N2K_R37	**2.06**	1.0	**6.49**	5.0
N2K_R38	**2.00**	1.0	**6.19**	5.0
N2K_R39	**1.77**	1.0	**6.01**	5.0
N2K_R40	**1.77**	1.0	**6.01**	5.0
N2K_R41	**2.00**	1.0	**6.19**	5.0
N2K_R42	**1.46**	1.0	**5.09**	5.0

Receptor	SCAIL background concentration of ammonia	Critical Level	SCAIL background nitrogen deposition flux	Critical Load
	µg/m³		kg/ha/yr	
N2K_R43	**1.83**	1.0	5.73	10.0
N2K_R44	**1.43**	1.0	**5.51**	5.0
N2K_R45	**1.29**	1.0	**5.70**	5.0
N2K_R46	**1.24**	1.0	**5.96**	5.0
N2K_R47	**1.28**	1.0	**5.88**	5.0
N2K_R48	**1.35**	1.0	**5.97**	5.0
N2K_R49	**1.57**	1.0	**6.46**	5.0
N2K_R50	**1.57**	1.0	**6.46**	5.0
N2K_R51	**1.33**	1.0	**5.84**	5.0
N2K_R52	**1.48**	1.0	**6.45**	5.0
N2K_R53	**1.28**	1.0	**5.68**	5.0
Note: Bold text indicates where SCAIL background exceeds the critical level or critical load.				

6.2 Results of Step 4

Step 4 of EPA's Ammonia Assessment Guidance requires a licensee/applicant to complete a detailed dispersion modelling assessment.

Dispersion modelling has been conducted for five years of meteorological data. The following sections present the highest concentrations across the five-year modelled period as required by EPA dispersion modelling guidance.

The predicted ground-level concentrations of ammonia and annual average flux rate of nitrogen deposition at the nearest ecologically sensitive locations due to the poultry farm are presented in Table 7.

The results in Table 7 are compared against the Step 4 criteria identified in EPA's Ammonia Assessment Guidance, which require the process contribution of the poultry farm (PC) to be:

- ≤1% of the critical level for ammonia at sites of sensitive ecological species or habitats
- ≤1% of the critical load for nitrogen deposition at sites of sensitive ecological species or habitats.

The results presented in Table 7 show that, in relation to the 1% threshold identified in Step 4 of EPA's Ammonia Assessment Guidance, the PC due to the poultry farm:

- as a result of concentrations of ammonia and nitrogen deposition at N2K_R1 to N2K_R37 are above the criteria identified in Step 4 on several occasions. These receptors represent the boundaries of Natura 2000 sites and do not represent sites of sensitive ecological species of habitats.
- as a result of concentrations of ammonia and nitrogen deposition at N2K_R38 to N2K_R58 **comply** with criteria identified in Step 4. These receptors represent sites of sensitive ecological species or habitats, N2K_R38 to N2K_R58.

The concentrations of ammonia and nitrogen deposition levels comply with the criteria identified in Step 4 of EPA's Ammonia Assessment Guidance at the sites of sensitive ecological species or habitats; therefore, no further steps are required.

Table 7 The predicted ground-level concentrations of ammonia and annual average flux rate of nitrogen deposition at the nearest ecologically sensitive locations due to the poultry farm

Receptor	Ammonia			Nitrogen Deposition		
	Concentration	Criteria	% of criteria	Rate	Criteria	% of criteria
	µg/m³	µg/m³		kg/ha/yr	µg/m³	
N2K_R1*	0.02773	3	0.924%	0.262	30	0.87%
N2K_R2*	0.01664	3	0.555%	0.157	30	0.52%
N2K_R3*	0.01948	3	0.649%	0.184	30	0.61%
N2K_R4*	0.03211	3	**1.070%**	0.303	30	**1.01%**
N2K_R5*	0.01748	3	0.583%	0.165	30	0.55%
N2K_R6*	0.02483	3	0.828%	0.234	30	0.78%
N2K_R7*	0.03390	3	**1.130%**	0.320	30	**1.07%**
N2K_R8*	0.03575	3	**1.192%**	0.337	30	**1.12%**
N2K_R9*	0.02819	3	0.940%	0.266	30	0.89%
N2K_R10*	0.01638	3	0.546%	0.155	30	0.52%
N2K_R11*	0.02476	3	0.825%	0.234	30	0.78%
N2K_R12*	0.02699	3	0.900%	0.255	30	0.85%
N2K_R13*	0.02236	3	0.745%	0.211	30	0.70%
N2K_R14*	0.01833	3	0.611%	0.173	30	0.58%
N2K_R15*	0.02053	3	0.684%	0.194	30	0.65%
N2K_R16*	0.02265	3	0.755%	0.214	30	0.71%
N2K_R17*	0.04922	3	**1.641%**	0.464	30	**1.55%**
N2K_R18*	0.08361	3	**2.787%**	0.789	30	**2.63%**
N2K_R19*	0.07150	3	**2.383%**	0.675	30	**2.25%**
N2K_R20*	0.04393	3	**1.464%**	0.414	30	**1.38%**
N2K_R21*	0.03541	3	**1.180%**	0.334	30	**1.11%**
N2K_R22*	0.03405	3	**1.135%**	0.321	30	**1.07%**
N2K_R23*	0.02150	3	0.717%	0.135	30	0.45%
N2K_R24*	0.01911	3	0.637%	0.120	30	0.40%
N2K_R25*	0.01622	3	0.541%	0.102	30	0.34%
N2K_R26*	0.01466	3	0.489%	0.092	30	0.31%
N2K_R27*	0.01524	3	0.508%	0.096	30	0.32%
N2K_R28*	0.01379	3	0.460%	0.087	30	0.29%
N2K_R29*	0.01739	3	0.580%	0.109	30	0.36%
N2K_R30*	0.00709	3	0.236%	0.045	30	0.15%
N2K_R31*	0.01081	3	0.360%	0.068	30	0.23%
N2K_R32*	0.00983	3	0.328%	0.062	30	0.21%
N2K_R33*	0.00885	3	0.295%	0.056	30	0.19%
N2K_R34*	0.00915	1	0.915%	0.086	10	0.86%
N2K_R35*	0.00843	1	0.843%	0.079	10	0.79%

Receptor	Ammonia			Nitrogen Deposition		
	Concentration	Criteria	% of criteria	Rate	Criteria	% of criteria
	µg/m³	µg/m³		kg/ha/yr	µg/m³	
N2K_R36*	0.00997	1	0.997%	0.094	10	0.94%
N2K_R37*	0.00456	1	0.456%	0.029	5	0.57%
N2K_R38	0.00471	1	0.471%	0.030	5	0.59%
N2K_R39	0.00408	1	0.408%	0.026	5	0.51%
N2K_R40	0.00441	1	0.441%	0.028	5	0.55%
N2K_R41	0.00688	1	0.688%	0.043	5	0.87%
N2K_R42	0.00220	1	0.220%	0.014	5	0.28%
N2K_R43	0.00512	1	0.512%	0.048	10	0.48%
N2K_R44	0.00195	1	0.195%	0.012	5	0.25%
N2K_R45	0.00169	1	0.169%	0.011	5	0.21%
N2K_R46	0.00247	1	0.247%	0.016	5	0.31%
N2K_R47	0.00213	1	0.213%	0.013	5	0.27%
N2K_R48	0.00283	1	0.283%	0.018	5	0.36%
N2K_R49	0.00326	1	0.326%	0.020	5	0.41%
N2K_R50	0.00296	1	0.296%	0.019	5	0.37%
N2K_R51	0.00199	1	0.199%	0.013	5	0.25%
N2K_R52	0.00229	1	0.229%	0.014	5	0.29%
N2K_R53	0.00112	1	0.112%	0.007	5	0.14%

Table Note:
* No sensitive ecological species of habitats identified as part of NPWS mapping at these locations

7. CONCLUSIONS

Katestone Environmental Pty Ltd (Katestone) was commissioned by Ceres Consulting Limited to complete an assessment of the impact of ammonia and nitrogen on Natura 2000 sites for a poultry breeding operation located at Gorteen, Broadford, Co. Limerick (site). The site is owned and operated by Enfield Broiler Breeders.

There is an existing poultry operation at the site, which has a capacity of 39,999 egg laying hens, which is below the poultry stocking threshold and, therefore, does not require an Industrial Emissions Directive (IED) licence.

Enfield Broiler Breeders proposes to:

- Increase bird numbers to 61,800
- Utilise the existing housing units at the site, no additional buildings or floorspace will be required to facilitate the additional bird numbers.

As a consequence of the increase in bird numbers, the stocking numbers at the site will be above the IED licence threshold for poultry.

This assessment is required in response to an RFI issued by EPA on 11 December 2024 requesting an ammonia impact assessment prepared in accordance with *Instruction Note 1 (IN1) "Assessment of the impact of ammonia and nitrogen on Natura 2000 sites from Intensive Agriculture Installations".*

The AIA was conducted in accordance with:

- The stepwise procedure described in EPA's Ammonia Assessment Guidance.
- Recognised techniques for dispersion modelling specified in EPA's Air Dispersion Modelling Guidance Note (AG4). The dispersion model, CALPUFF, was used to predict ground-level concentrations of ammonia and nitrogen deposition flux rates across the model domain due to the poultry farm.

The results of the AIA are as follows:

- The Step 1 assessment indicated that:
    - The approaches using the SCAIL-Agriculture model described in Step 2 and Step 3 of the EPA's Ammonia Assessment Guidance are not applicable
    - A detailed assessment completed in accordance with Step 4 of EPA's Ammonia Assessment Guidance is, therefore, required to be completed.
- The Step 4 assessment shows that, in relation to the 1% threshold identified in Step 4 of EPA's Ammonia Assessment Guidance, the PC due to the proposed development at the poultry farm:
    - Complies with the criteria for ammonia at all sites of sensitive ecological species or habitats modelled on the Blackwater River (Cork/Waterford) SAC, Lower River Shannon SAC and Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA.
    - Complies with the criteria for nitrogen deposition at all sites of sensitive ecological species or habitats modelled on the Blackwater River (Cork/Waterford) SAC, Lower River Shannon SAC and Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA.

The assessment, therefore, indicates that:

- The impacts of the proposed poultry farm in isolation are under EPA limits and, therefore, the proposed increase in bird numbers at the site **complies** with the Step 4 evaluation criteria at all sites of sensitive ecological species or habitats modelled on the Blackwater River (Cork/Waterford) SAC, Lower River Shannon SAC and Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA.

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APPENDIX A MODELLING METHODOLOGY

A1 METEOROLOGICAL MODELLING

A1.1 TAPM

The meteorological model, TAPM (The Air Pollution Model) Version 4.0.5, was developed by the CSIRO and has been validated by the CSIRO, Katestone and others for many locations in Australia, southeast Asia, North America and Ireland. Katestone has used the TAPM model throughout Australia and has performed well for simulating regional winds patterns. Katestone has recently used the TAPM model to generate gridded data over Waterford city and Harbour. The data generated correlated well with observed data at Waterford Airport. TAPM has proven to be a useful model for simulating meteorology in locations where monitoring data is unavailable.

TAPM requires synoptic meteorological information for the region surrounding the project. This information is generated by a global model similar to the large-scale models used to forecast the weather. The data are supplied on a grid resolution of approximately 75 km, and at elevations of 100 metres to five kilometres above the ground. TAPM uses this synoptic information, along with specific details of the location such as surrounding terrain, land-use, soil moisture content and soil type to simulate the meteorology of a region as well as at a specific location.

TAPM resolves local terrain and land-use features that may influence local meteorology and generates a meteorological dataset that is representative of Site-specific geographic conditions. A year of synoptic data must be selected as input for TAPM. TAPM has been modelled for the five most recent years data is available as per AG4.

TAPM was configured as follows:

- 41 x 41 grid point domain with an outer grid resolution of 30 kilometres and nesting grids of 10, 3and 1 kilometre.
- 5 modelled years (1 January 2020 to 31 December 2024)
- Grid centred near the Project Site at latitude 52°22’0 and longitude -9°1’30
- US Geological Survey EROS global terrain height database
- TAPM default land use database, modified to be consistent with aerial imagery in the innermost grid
- 25 vertical grid levels
- No data assimilation.

A1.2 CALMET meteorological modelling

CALMET is an advanced non-steady-state diagnostic 3D meteorological model with micro-meteorological modules for overwater and overland boundary layers. The model is the meteorological pre-processor for the CALPUFF modelling system. CALMET is capable of reading hourly meteorological data as data assimilation from multiple Sites within the modelling domain; it can also be initialised with the gridded three-dimensional prognostic output from other meteorological models such as TAPM. This can improve dispersion model output, particularly over complex terrain as the near surface meteorological conditions are calculated for each grid point.

CALMET (version 6.5.0) was used to simulate meteorological conditions in the region. The CALMET simulation was initialised with the gridded TAPM 3D wind field data from the 1 km grid. CALMET treats the prognostic model output as the initial guess field for the CALMET diagnostic model wind fields. The initial guess field is then adjusted for the kinematic effects of terrain, slope flows, blocking effects and 3D divergence minimisation.

CALMET was configured with twelve vertical levels with heights at 20, 60, 100, 150, 200, 250, 350, 500, 800, 1600, 2600 and 4600 metres at each grid point.

All options and factors were selected in accordance with NSW EPA CALPUFF Guidance released by TRC Environmental in 2011 except where noted below.

Key features of CALMET used to generate the wind fields are as follows:

- Domain area of 156 x 158 grid cells at 200m spacing
- 5 years modelled (1 January 2020 to 31 December 2024)
- Prognostic wind fields input as MM5/3D.dat for “initial guess” field (as generated by TAPM)
- Gridded cloud cover from prognostic relative humidity at all levels
- No extrapolation of surface wind observations to upper layers (not used in no-obs mode)
- Terrain radius of influence set to 2 km
- Maximum search radius of 10 grid cells in averaging process
- Use prognostic relative humidity
- Land use data modified to be consistent with aerial imagery.

All other options set to default.

A2 CALPUFF DISPERSION MODELLING

CALPUFF simulates the dispersion of air pollutants to predict ground-level concentration and deposition rates across a network of receptors spaced at regular intervals, and at identified discrete locations. CALPUFF is a non-steady-state Lagrangian Gaussian puff model containing parameterisations for complex terrain effects, overwater transport, coastal interaction effects, building downwash, wet and dry removal, and simple chemical transformation. CALPUFF employs the 3D meteorological fields generated from the CALMET model by simulating the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal. CALPUFF takes into account the geophysical features of the study area that affects dispersion of pollutants and ground-level concentrations of those pollutants in identified regions of interest. CALPUFF contains algorithms that can resolve near-source effects such as building downwash, transitional plume rise, partial plume penetration, sub-grid scale terrain interactions, as well as the long-range effects of removal, transformation, vertical wind shear, overwater transport and coastal interactions. Emission sources can be characterised as arbitrarily-varying point, area, volume and lines or any combination of those sources within the modelling domain.

Key features of CALPUFF used to simulate dispersion:

- Domain area of 156 x 158 grid cells at 200m spacing, which is a sub-set of the CALMET domain centred on the Site
- 5 years modelled (1 January 2020 to 31 December 2024)
- Gridded 3D hourly-varying meteorological conditions generated by CALMET
- Partial plume path adjustment for terrain modelled
- Dispersion coefficients calculated internally from sigma v and sigma w using micrometeorological variables.

All other options set to default.