Report

An Ammonia Concentration Study for an Increase in the Number of Free Range Birds at Dolobran Hall, Pontrobert, Powys (Updated)

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Version History

VERSION	DATE	AMENDMENTS
Draft 1	24 September 2016	Initial Report. Approved and Amended for Client
Client Draft	27 September 2016	Client Report
Draft 2	13 December 2016	Amended following consultation comments from NRW and approved for Client issue
Client Draft 2	16 December 2016	Client Report
Client Issue	30 May 2017	Amended to take into account NRW's new GN20 guidance and detailed modelling added.

Contents

Executive Summary

RSK ADAS Ltd was commissioned by Roger Parry & Partners LLP on behalf of J.M. Evans & Partners to conduct a screening modelling study to assess the potential impact of atmospheric ammonia emissions associated with an increase in the number of free range birds at Dolobran Hall, Pontrobert, Meiford, Powys.

The current proposal is to increase the number of birds to 64,000 which would require the erection of an additional poultry building and a larger ranging area. The scope of the assessment therefore was to undertake an ammonia screening modelling run in order to ascertain whether ammonia impacts would still be acceptable.

Ammonia emissions associated with the increase in the number of free range birds at Dolobran Hall were therefore assessed and quantified using Environment Agency standardised ammonia emission figures. These emission rates have been used in atmospheric dispersion modelling in order to predict process contributions to atmospheric ammonia concentrations at nearby nature conservation sites.

Main Findings

The results of the screening modelling run show that predicted process contributions to atmospheric ammonia concentrations are above the lower threshold of 1% but below the upper threshold of 8% of the relevant Critical Level for 9 discrete receptor points representing the closest areas of the Sites of Special Scientific Interest (SSSIs). Preliminary results of predicted nitrogen deposition rates also show exceedance of the lower threshold of 1% at 11 discrete receptor points representing the SSSIs. A slight exceedance of the upper threshold of 8% is also predicted at one discrete receptor point representing a SSSI. The predicted process contributions are below 100% of the relevant Critical Level and Critical Load for all of the ancient woodlands and Local Wildlife Sites. Additional detailed modelling was carried out in the light of these findings.

The results of the detailed model run, using the spatially varying deposition field, show that predicted process contributions to atmospheric ammonia concentrations are above the lower threshold of 1% but below the upper threshold of 8% of the relevant Critical Level and Critical Load for 6 discrete receptor points representing the closest parts of the SSSIs. At all other discrete receptor points predicted exposures are below the relevant lower threshold.

The predicted process contributions do not cause exceedances of the Critical Levels or Critical Loads apart from where the background levels already exceed the Critical Level and Critical Loads.

1 Introduction

1.1 Background

This Ammonia Impact Assessment has been prepared by RSK ADAS Ltd under instruction from Roger Parry & Partners LLP, on behalf of J.M. Evans and Partners, to assess the impact of ammonia emissions for an expansion to poultry operations at Dolobran Hall, Pontrobert, Meiford, Powys.

RSK ADAS Ltd originally carried out an ammonia concentration and deposition study in December 2010 for 32,000 free range birds. The assessment was based on one poultry building measuring 85.5m long by 30.45m wide, 3.35m high to the eaves and 7.43m high to the ridge. Ventilation was through high speed extract fans mounted on the roof, and the assessment was based on a release height of 7.43m, diameter of 0.8m and an emission velocity of 7.0m/s. The assessment was also based on twice weekly removal of manure via a belt system. The assessment included a ranging area of 13,712m^2.

The current proposal is to increase the number of birds to 64,000 which would require the erection of an additional poultry building with the same dimensions as the existing building and the birds would be free to roam over a larger ranging area than the existing one at approximately 174,319m^2. The scope of this assessment therefore was to undertake an ammonia screening modelling run without deposition in order to ascertain whether ammonia impacts would still be acceptable.

Ammonia emissions associated with the increase in the number of free range birds at Dolobran Hall have therefore been assessed and quantified using Environment Agency standardised ammonia emission figures. These emission rates have been used in atmospheric dispersion modelling in order to predict process contributions to atmospheric ammonia concentrations.

1.2 Site Location

Dolobran Hall Poultry Farm is located in a rural setting, at an altitude of approximately 120m. The surrounding land is hilly and used primarily for arable and livestock farming with wooded areas on the surrounding mountains. The nearest village is Pontrobert approximately 1.5km to the west of Dolobran Hall Poultry Farm (see Figure 1).

1.3 Existing Poultry Unit and Proposed Development

Dolobran Hall currently has one established poultry building, providing accommodation for up to 32,000 laying hens. The building is subdivided into 4 ‘communities’ internally, and each contains different areas for the birds including nest-boxes and slatted floors for the scratching area. The building also contains feeding areas and drinkers. These areas are utilised by the birds whilst within the building.

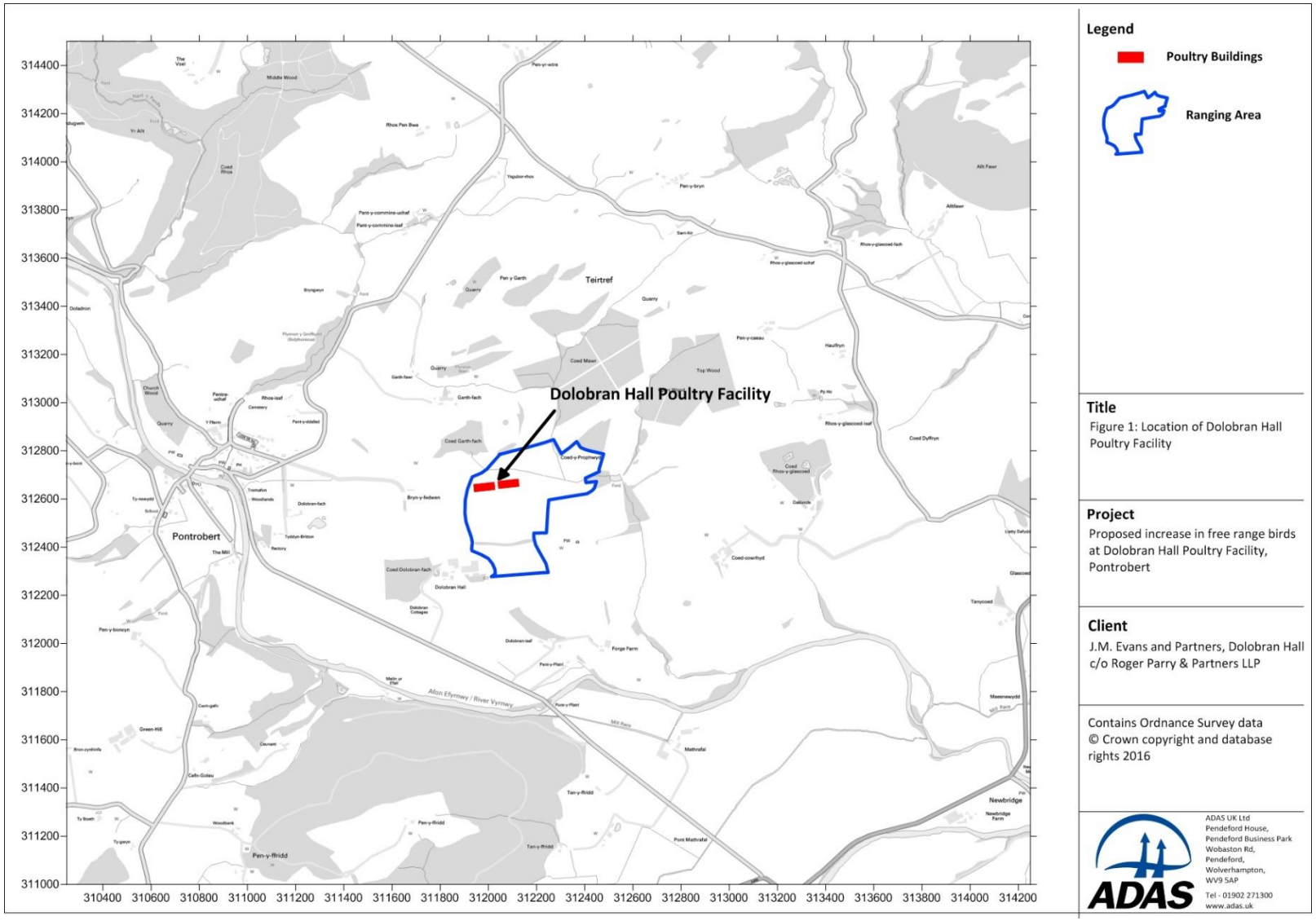
The laying cycle is normally 58 to 60 weeks; the birds are delivered at the beginning of this cycle and removed from the site at the end of the cycle. The birds are free range and have the opportunity to exit the building and range the outside area every day.

The existing poultry building is ventilated by high speed fans mounted on the roof. Each fan has a short chimney and air flow is unobstructed by any caps or baffles. Manure is removed by a belt system and taken from the site for disposal twice weekly.

There are currently proposals to erect an additional poultry building immediately to the west of the existing shed, which would provide accommodation for an additional 32,000 laying hens. This would increase the total flock size to 64,000 laying hens. The proposed new building would have the same dimensions as the existing building, with ventilation again being provided by high speed fans mounted on the roof, at the same height, diameter and emission velocity as the existing shed. Manure from the proposed new shed will also be removed twice weekly via a belt system. However, the birds will be allowed to roam over a larger ranging area compared to existing operations.

Currently the Dolobran Hall poultry facility does not have an Environmental Permit as the number of birds falls below the Environmental Permit threshold of 40,000 poultry places. However, following the increase of the number of birds to 64,000, the poultry farm will exceed the 40,000 place threshold and will be required to apply for a Part B3.5 new bespoke intensive farming installation permit for rearing poultry in line with the Environmental Permitting (England and Wales) Regulations 2010 (as amended) (**Ref 1**).

Figure 1. Location of the Dolobran Hall Poultry Facility



2 Background to Ammonia and Nitrogen Deposition

2.1 Airborne Ammonia Emissions and Nutrient Nitrogen Deposition

Ammonia is produced by the breakdown of urea in animal manures or uric acid in poultry litter. Ammonia which escapes as gas to the atmosphere from animal housing and/or associated manure storage can lead to significant environmental damage (**Ref 2**).

Exposure to high concentrations of ammonia can lead to direct damage to woodlands, for example, leaf scorching and loss. Severe damage has been found in woodland edges adjacent to fields with high slurry applications in the Netherlands and Belgium (**Ref 3 & Ref 4**) and damage to trees has been reported in the immediate vicinity of farms in the United Kingdom (**Ref 5 & Ref 6**). There may also be changes in plant morphology, physiology and biochemistry which can increase growth and also increase sensitivity to other environmental factors such as wind, frost, drought and pests.

Excessive nitrogen deposition can lead to acidification and eutrophication of soils. In addition, species richness can be compromised, especially for slow growing species which suffer from increased competition from invasive species.

2.2 Critical Loads and Levels

Critical Loads and Levels are generally defined as: "*a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge*" (**Ref 7**). It is important to distinguish between a Critical Load and a Critical Level. The Critical Load relates to the quantity of pollutant deposited from air to the ground, whereas the Critical Level refers to the gaseous concentration of a pollutant in the air.

A critical load is defined by the United Nations Economic Commission for Europe (UNECE) (**Ref 8**) as:

> *"A quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge"*

A critical level is defined as:

> *"Concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as human beings, plants, ecosystems, may occur according to present knowledge."*

When pollutant loads (or concentrations) exceed the critical load or level it is considered that there is a risk of harmful effects. The excess over the critical load or level is termed the exceedance. A larger exceedance is often considered to represent a greater risk of damage.

2.3 Guidance on the Significance of Ammonia Emissions

Guidance on the significance of ammonia emissions from farming installations can be found in the Environment Agency's Environmental Management Guidance, Intensive Farming Risk Assessment for your Environmental Permit (2016) (**Ref 9**) with respect to Local and National Nature Reserves (LNRs and NNRs), Ancient Woodland (AW) and Local Wildlife Sites (LWSs). Upper significance thresholds are set at 100% for LNRs, NNRs, AW and LWSs.

In March 2017, Natural Resources Wales (NRW) (Regulation and Permitting Department, EPP) published Guidance Note 20 (GN 20), "Assessing the impact of ammonia and nitrogen on designated sites from new and expanding intensive livestock units when applying for an Environmental Permit or Planning Permission" (**Ref 10**). This guidance note has updated the approach NRW take to assessing the impact of ammonia emissions and in particular has changed the thresholds of insignificance and the upper threshold process contributions for European designated sites, such as Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar sites as well as Sites of Special Scientific Interest (SSSIs). In GN 20 the threshold of insignificant percentage of the designated site Critical Level or Load is given as 1%; while the upper threshold percentage of the designated site Critical Level or Load is given as 8%.

3 Sources of Ammonia at Dolobran Hall

The Environment Agency's Intensive Farming Guidance Note (**Ref 11**) provides standardised ammonia emission figures for a variety of poultry housing types and other sources. The figure given for barn and free range birds in an aviary system with manure removal twice a week by manure belt is 0.08 kg NH_3/animal place/ year.

To provide a worst case assessment of ammonia impact, empty periods have not been taken into account in the calculation of gross ammonia emissions for the proposed expansion of the poultry farm. Therefore the overall ammonia emission rate for 64,000 laying hens is calculated to be 0.1622 g/s.

A summary of bird numbers per house and associated ammonia emissions is provided in Table 1 below.

Guidance on modelling the concentration and deposition of ammonia emitted from intensive farming for free-range animals published by the Environment Agency, states that the appropriate emission factor will need to be apportioned between the free-range area and any buildings in proportion to the time the animals spend in each location (**Ref 12**). The Environment Agency guidance assumes that 20% of droppings will occur outside the buildings. It also states that typically, birds remain close to the buildings and it would generally be inappropriate to assume that they roam over the whole area available to them. In cases where large ranging areas are present, the guidance recommends a conservative modelling assumption whereby it should be assumed that 100% of the emissions arise from the buildings. In the case of this assessment, 100% of the emissions have been assumed to be coming from the two poultry buildings.

Table 1. Sources of Ammonia and Emission Rates for Poultry Buildings

Source	Shed No.	Bird Nos.	Emission Factor (kg NH_3/pl/yr)	Gross Emission (g/s)
Poultry Buildings	1 (Existing)	32,000	0.08	0.0811
	2 (Proposed)	32,000	0.08	0.0811
Total		**64,000**		**0.1622**

4 Ecological Receptors

4.1 Receptors Considered

As required by the Environment Agency guidance (**Ref 13**) and NRW guidance (Ref 10) a desktop study was undertaken to identify SACs, SPAs and Ramsar Sites within 5km of the site, SSSIs within 5km of the site and LWSs, AWs, LWSs and NNRs within 2km of the site.

The study was completed using the Multi-Agency Geographic Information for the Countryside (MAGIC) web-based interactive mapping service (**Ref 14**), which draws together information on key environmental schemes and designations for any statutory designations although it should be noted that not all locally designated sites appear on MAGIC.

There are 13 SSSIs within 5km, and 24 AWs and 2 LWSs within 2km of the Dolobran Hall poultry facility. The location of these designated conservation sites in relation to the poultry farm are shown in Figure 2 and Figure 3 below.

It is worth noting here that the AW sites do not have a specific name given to them.

Figure 2. Ecological Designations SSSIs

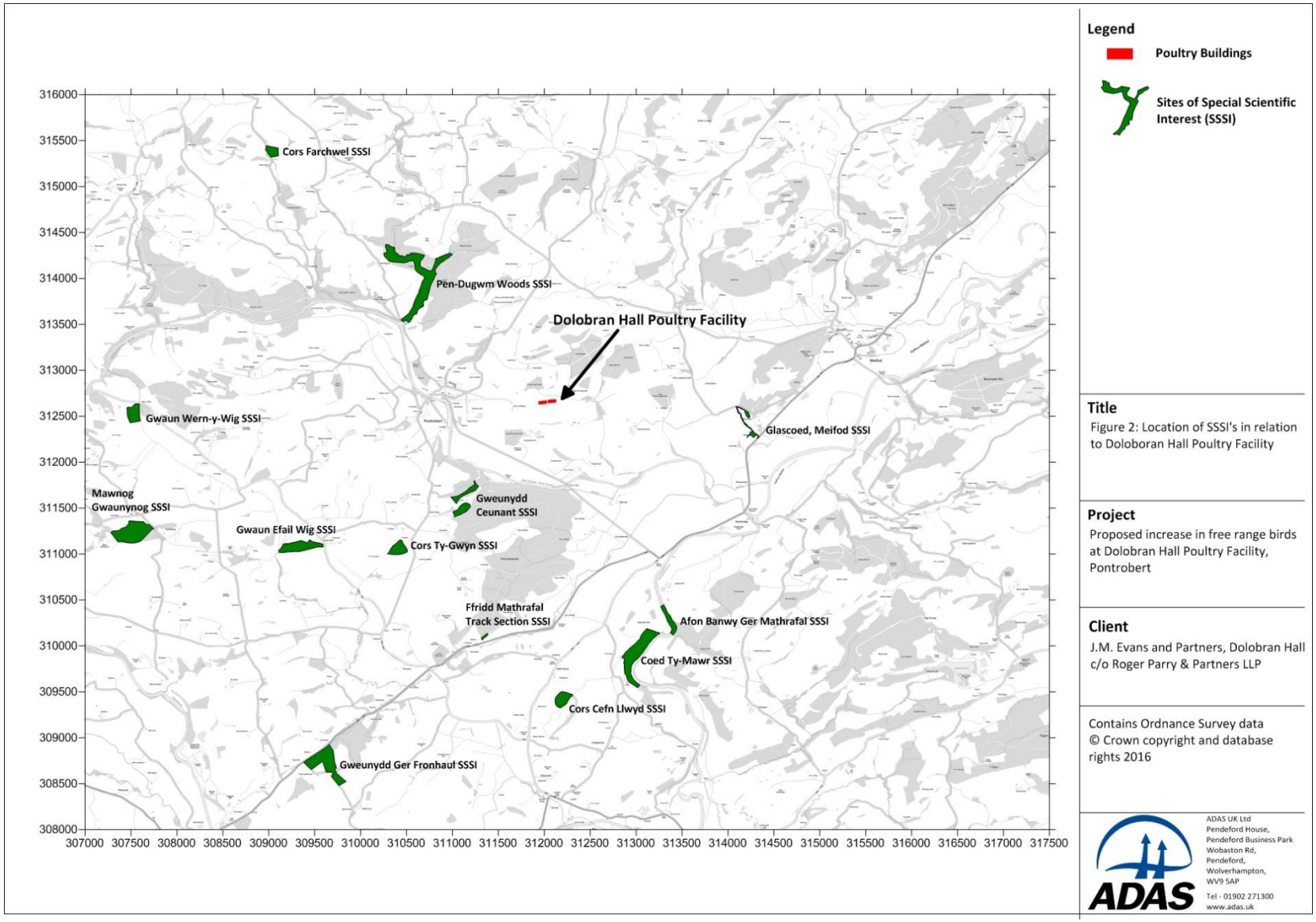
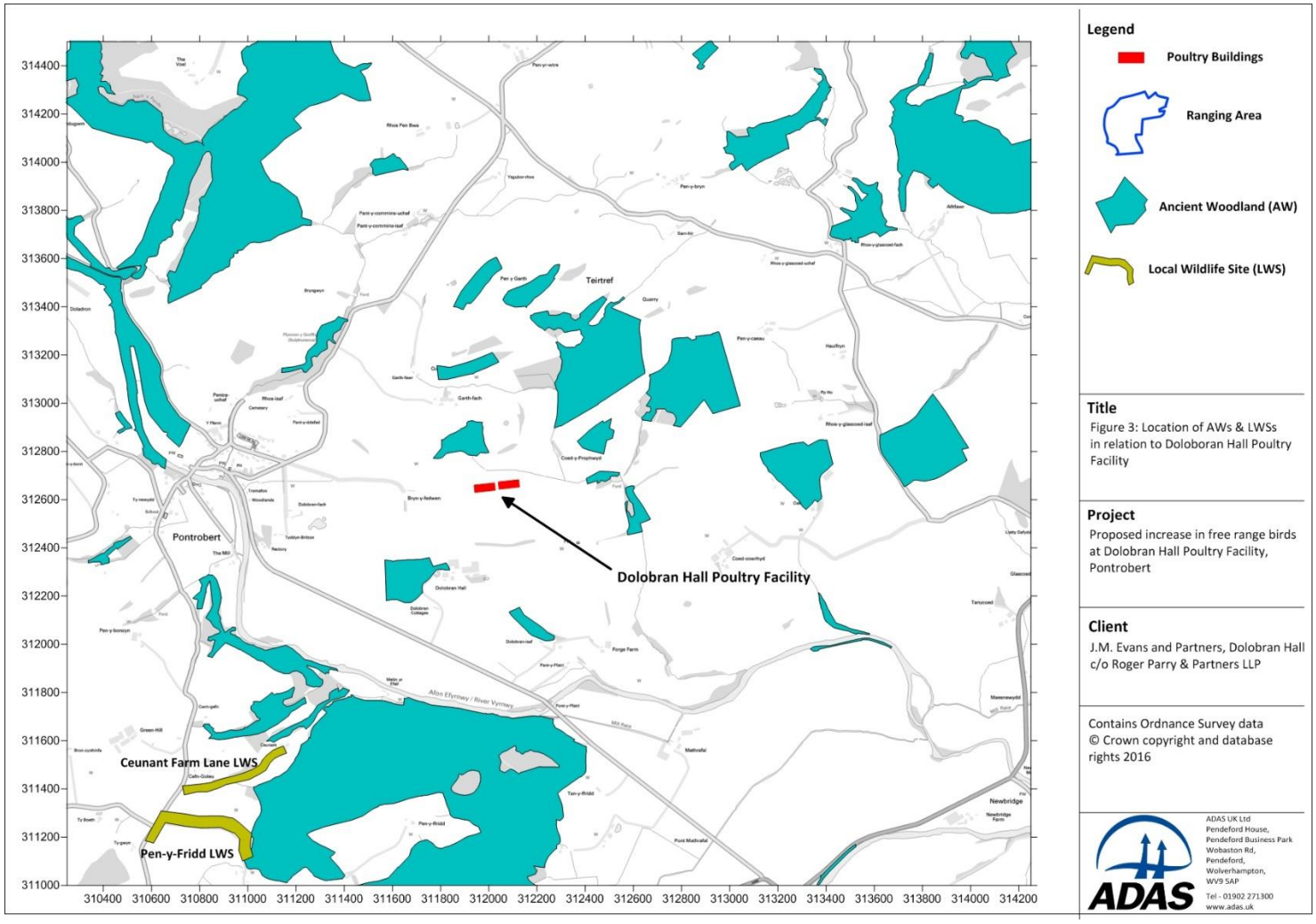


Figure 3. Ecological Designations AWs and LWSs



4.2 Background Levels of Ammonia

Background ammonia concentrations at each ecological receptor location were obtained from the UK Air Pollution Information System (APIS) website (**Ref 15**) using the 'search by location' function and are summarised in Table 2. The background ammonia concentration near to Dolobran Hall is 1.43 micrograms per cubic metre of air (µg/m^3).

5 Ecology of the Conservation Sites and Critical Levels and Loads.

Critical Levels and Critical Loads have been designated within the UK based on the sensitivity and qualifying features of the receiving habitat. A review of the APIS website, together with any additional site specific citation information issued by the NRW, where available, was undertaken for each SSSI in order to identify the most suitable habitat description and associated Critical Level/Load for the area of each designation considered within the assessment. At sites where lichens, bryophytes or rare sphagnum mosses are present the lower Critical Level of 1.0 µg/m^3 has automatically been applied. For all other sites a Critical Level 3.0 µg/m^3 has been applied. The Critical Load range for woodland, obtained from APIS, is 10 kg-N/ha/yr to 15 kg-N/ha/yr and for meadows/grasslands 10 kg-N/ha/yr to 20 kg-N/ha/yr. Whereas for the sites where sphagnum mosses, lichens or bryophytes are present a Critical Load of 5 kg-N/ha/yr has been applied.

The habitat types within each designation are listed in accordance with the UK Biodiversity Action Plan (BAP) criteria, which are then split further by the European Nature Information System (EUNIS) habitat type. These were reviewed, along with the habitat maps available through MAGIC, to define the relevant classification at each of the receptor locations. It should be noted that separate habitat types are often listed for European and National designations, although the geographical areas covered are the same. When this was the case the most suitable classification for the area of interest was selected based on the site descriptions given in the citation documents. The relevant Critical Levels and Loads are presented in Table 2.

Table 2. Critical Levels/Loads and Background Ammonia Concentrations for the Designated Sites

Site Name	Designation Type	Habitat / Reason for Designation	Background Ammonia Conc. (µg/m^3)	Ammonia Critical Level (µg/m^3)	Nutrient Nitrogen Critical Load (kg N/ha/yr)
Gweunydd Ceunant	SSSI	Dry Neutral Grassland: Low and medium altitude hay meadows (supports largest known population of rare greater butterfly-orchid, also locally uncommon adder's-tongue and smooth brome)	1.43	3.0	10
Cors Ty-Gwyn	SSSI	Raised and blanket bogs (Basin Mire where natural succession progressed to woodland stage (mainly birch and	1.43	1.0	10

Site Name	Designation Type	Habitat / Reason for Designation	Background Ammonia Conc. ($\mu g/m^3$)	Ammonia Critical Level ($\mu g/m^3$)	Nutrient Nitrogen Critical Load (kg N/ha/yr)
		willow) but extremely wet, supporting swamp vegetation including sphagnum mosses)			
Gwaun Efail Wig	SSSI	Mixed dry and wet grassland (includes Moist and wet oligotrophic grasslands: *Molinia caerulea* meadows, Heath (*Juncus*) meadows & humid (*Nardus Stricta*) swards)	1.43	1.0	5
Pen-Dugwm Woods	SSSI	Broadleaved Deciduous Woodland (Mixed, but dominant species is Oak)	1.43	1.0	10
Cors Farchwel	SSSI	Valley mires, poor fens and transition mires	0.91	1.0	10
Glascoed, Meifod	SSSI	Designated as it supports a major maternity roost of the Lesser Horseshoe Bat (*Rhinolophus hipposideros*). The site includes patches of woodlands, scrub and hedge lines that assist the bats dispersal.	1.43	3.0	10
Afon Banwy Ger Mathrafal	SSSI	Silurian Graptolite Fauna's (Fossils) (Riparian Broadleaved Woodland)	1.5	3.0	10
Coed Ty-Mawr	SSSI	Mixed Broadleaved Deciduous Woodland, with predominant tree species being Sessile Oak, but also significant stands of Wych Elm, Ash, Rowan and Holly.	1.5	3.0	15
Cors Cefn Llwyd	SSSI	Broadleaved Deciduous Woodland (Wet Carr Woodland with Alder & Grey Willow)	1.5	3.0	10
Ffridd Mathrafal Track Section	SSSI	Marine Fauna's (Fossils) (Forest Track) (Broadleaved Woodland)	1.5	3.0	10
Gweunydd Ger Fronhaul	SSSI	Non-Mediterranean dry acid and neutral closed grassland	1.29	3.0	20

Site Name	Designation Type	Habitat / Reason for Designation	Background Ammonia Conc. (µg/m³)	Ammonia Critical Level (µg/m³)	Nutrient Nitrogen Critical Load (kg N/ha/yr)
Mawnog Gwaunynog	SSSI	Broadleaved Deciduous Woodland (Carr Woodland with Birch, Alder & Grey Willow plus abundant fallen timber clothed in lichens and bryphytes. Also some sessile oak and sedge communities)	1.26	1.0	10
Gwaun Wern-y-Wig	SSSI	Moist and wet oligotrophic grasslands: *Molinia caerulea* meadows	1.26	3.0	10
Unnamed	AW	Plantation on Ancient Woodland (Coniferous Woodland)	1.43	3.0	10
Unnamed	AW	Plantation on Ancient Woodland (Coniferous Woodland)	1.43	3.0	10
Unnamed	AW	Plantation on Ancient Woodland (Coniferous Woodland)	1.43	3.0	10
Unnamed	AW	Plantation on Ancient Woodland (Coniferous Woodland)	1.43	3.0	10
Unnamed	AW	Plantation on Ancient Woodland (Coniferous Woodland)	1.43	3.0	10
Unnamed	AW	Plantation on Ancient Woodland (Coniferous Woodland)	1.43	3.0	10
Unnamed	AW	Ancient Semi Natural Woodland (Broadleaf Deciduous Woodland)	1.43	3.0	10
Unnamed	AW	Plantation on Ancient Woodland (Coniferous Woodland)	1.43	3.0	10
Unnamed	AW	Ancient Semi Natural Woodland (Broadleaf Deciduous Woodland)	1.43	3.0	10
Unnamed	AW	Restored Ancient Woodland (Broadleaf Deciduous Woodland)	1.43	3.0	10

Site Name	Designation Type	Habitat / Reason for Designation	Background Ammonia Conc. (µg/m³)	Ammonia Critical Level (µg/m³)	Nutrient Nitrogen Critical Load (kg N/ha/yr)
Unnamed	AW	Plantation on Ancient Woodland (Coniferous Woodland)	1.43	3.0	10
Unnamed	AW	Ancient Semi Natural Woodland (Broadleaf Deciduous Woodland)	1.43	3.0	10
Unnamed	AW	Ancient Semi Natural Woodland (Broadleaf Deciduous Woodland)	1.43	3.0	10
Unnamed	AW	Ancient Semi Natural Woodland (Broadleaf Deciduous Woodland)	1.43	3.0	10
Unnamed	AW	Ancient Semi Natural Woodland (Broadleaf Deciduous Woodland)	1.43	3.0	10
Unnamed	AW	Ancient Semi Natural Woodland (Broadleaf Deciduous Woodland)	1.43	3.0	10
Unnamed	AW	Ancient Semi Natural Woodland (Broadleaf Deciduous Woodland)	1.43	3.0	10
Unnamed	AW	Ancient Woodland Site of Unknown Category (Young Conifer Plantation)	1.43	3.0	10
Unnamed	AW	Plantation on Ancient Woodland (Coniferous Woodland)	1.43	3.0	10
Unnamed	AW	Ancient Semi Natural Woodland (Broadleaf Deciduous Woodland)	1.43	3.0	10
Unnamed	AW	Restored Ancient Woodland (Broadleaf Deciduous Woodland)	1.43	3.0	10
Unnamed	AW	Restored Ancient Woodland (Broadleaf Deciduous Woodland)	1.43	3.0	10
Unnamed	AW	Ancient Semi Natural Woodland (Broadleaf Deciduous Woodland)	1.43	3.0	10

Site Name	Designation Type	Habitat / Reason for Designation	Background Ammonia Conc. (µg/m^3)	Ammonia Critical Level (µg/m^3)	Nutrient Nitrogen Critical Load (kg N/ha/yr)
Unnamed	AW	Ancient Semi Natural Woodland (Broadleaf Deciduous Woodland)	1.43	3.0	10
Unnamed	AW	Ancient Woodland Site of Unknown Category (Young Conifer Plantation)	1.43	3.0	10
Unnamed	AW	Ancient Semi Natural Woodland (Broadleaf Deciduous Woodland)	1.43	3.0	10
Unnamed	AW	Plantation on Ancient Woodland (Coniferous Woodland)	1.43	3.0	10
Ceunant Farm Lane	LWS	Road Verge Nature Reserves - Early Purple Orchid	1.43	1.0	5
Pen-y-Fridd	LWS	Road Verge Nature Reserves - Early Purple Orchid	1.43	1.0	5

6 Dispersion Modelling Methodology

6.1 Model Description

Dispersion modelling was undertaken using ADMS 5.2 (v5.2.2.0), which has been developed by Cambridge Environmental Research Consultants (CERC) Ltd. ADMS 5 is a steady-state atmospheric dispersion model that is based on modern atmospheric physics. It is a new generation model utilising boundary layer height and Monin-Obukhov length to describe the atmospheric boundary layer and a skewed Gaussian concentration distribution to calculate dispersion under convective conditions.

The model utilises hourly meteorological data to define conditions for plume rise, transport and diffusion. It estimates the concentration for each source and receptor combination for each hour of input meteorology, and calculates user-selected long-term and short-term averages.

ADMS 5 has been chosen because it is "fitted for the purpose of the modelling procedure" as defined by the guidelines published by the Royal Meteorological Society (**Ref 16 & Ref 17**). The group that leads the development of ADMS 5 is CERC, but the UK Met Office and others have made significant contributions. The model has been extensively validated against site measurements. Details of these validation studies and information on the development of ADMS are available on the CERC website.

6.2 Model Parameters

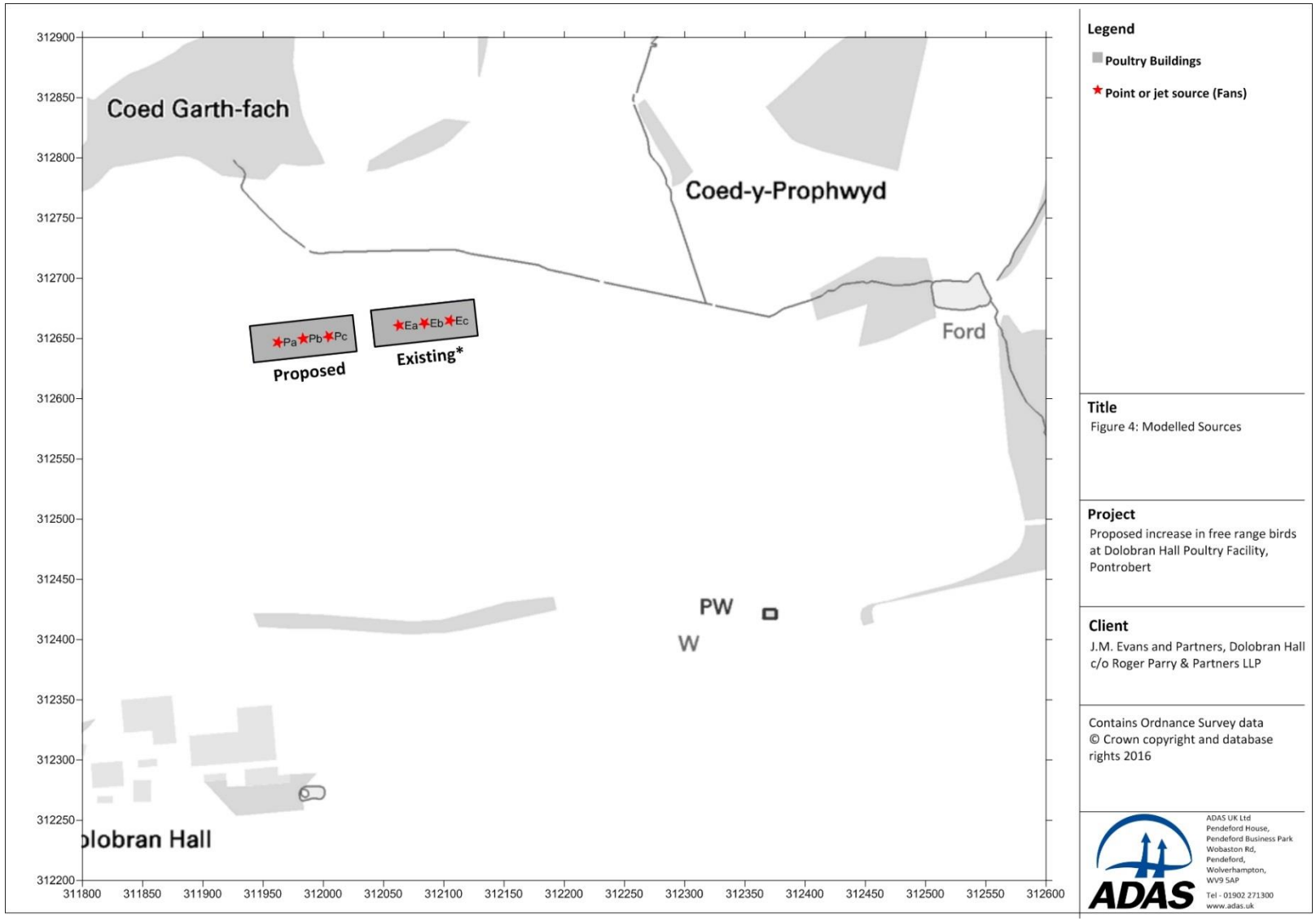
The existing poultry building at the Dolobran Hall poultry facility is ventilated using high velocity ridge mounted fans. It is understood that the proposed additional building will also be mechanically ventilated using the same high velocity ridge fan system. As such ammonia emissions from the buildings have been represented by three point sources per building within ADMS. The ammonia emission rate per point source (i.e. fan) is 2.7041 x 10^{-2} g/s. As per the recommendations in the Environment Agency Guidance outlined in Section 3, this is taken to be 100% of ammonia emissions from the poultry facility.

Table 3 below provides further information on the emission parameters used in the modelling, which are based on information provided by the Applicant. The positions of the modelled sources are shown in Figure 4.

Table 3. Modelled Source Parameters – Poultry Buildings

Source ID	Fans per Shed	Source Height (m)	Source Diameter (m)	Efflux Velocity (m/s)	Temp (°C)	Emission Rate (per fan) (g-NH_3/s)
(Existing Shed) E_a, E_b, E_c	3	7.43	0.8	7	22	0.027041
(Proposed Shed) P_a, P_b, P_c,	3	7.43	0.8	7	22	0.027041

Figure 4. Modelled Sources

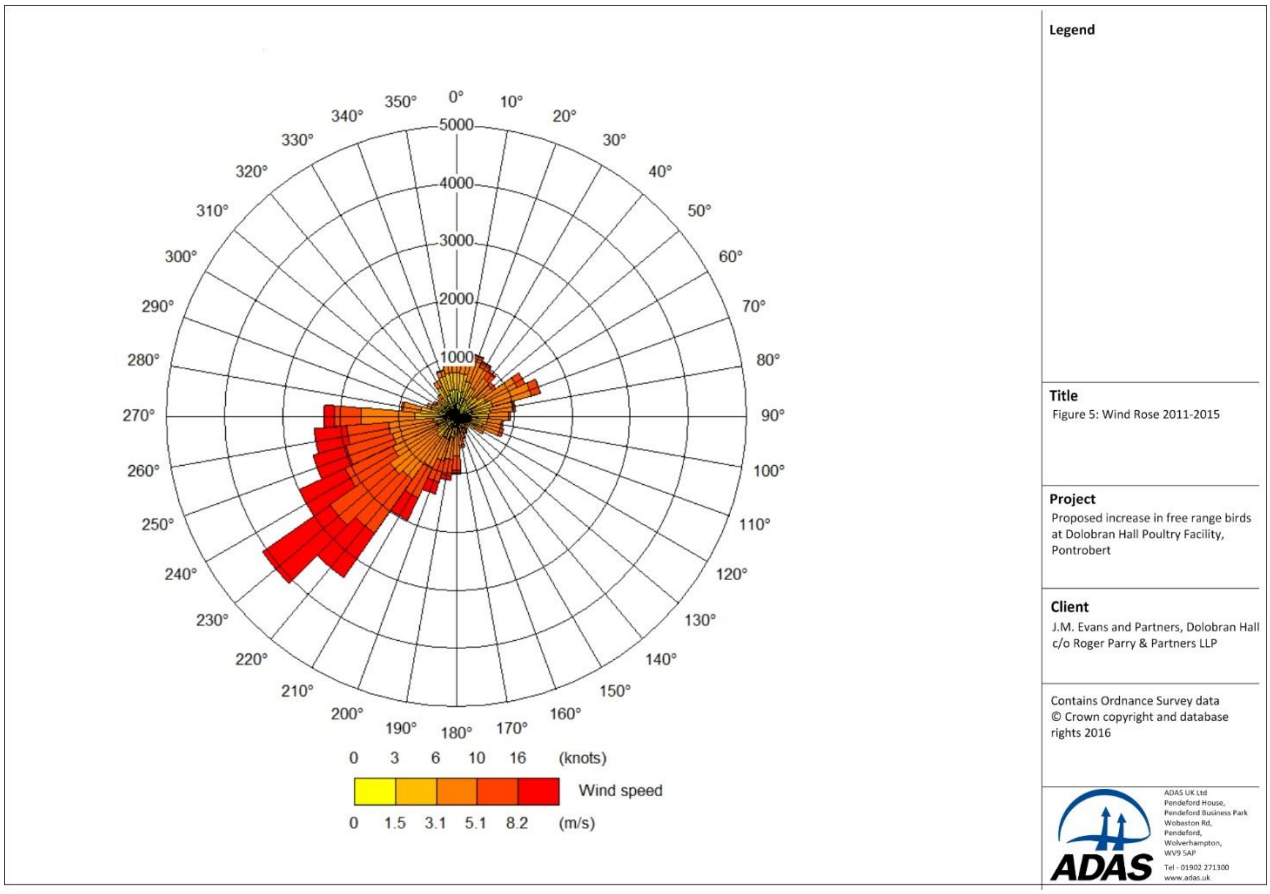


6.3 Meteorology

The closest meteorological station to Dolobran Hall Poultry Farm that regularly records all the weather elements required for dispersion modelling to a suitable standard is at Lake Vrynwy, which is approximately 12 km to the north-west of the poultry farm. Meteorological data used in this assessment was taken from Lake Vrynwy meteorological station over the period 1st January 2011 to 31st December 2015 (inclusive).

All meteorological data used in the assessment was provided by ADM Ltd, a leading supplier of UK and international meteorological data. Reference should be made to Figure 5 for a wind rose of the utilised meteorological data.

Figure 5. Wind Rose Derived from Data from Lake Vrynwy (2011 - 2015)



6.4 Buildings

The dispersion of substances released from elevated point sources can be influenced by the presence of buildings close to the emission point. Structures can interrupt the wind flows and cause significantly higher ground-level concentrations close to the source than would arise in the absence of the buildings. Therefore, both the existing and proposed poultry houses have been modelled as rectangular blocks within ADMS. The position of the modelled buildings can be seen in Figure 4, where they are marked by grey rectangles.

6.5 Terrain and Surface Roughness Length

The land around the Dolobran Hall poultry facility and the designated conservation sites is hilly, with some significant topographical features including slopes that are greater than 1:10. This in turn will affect wind flow and dispersion of ammonia. Terrain data has therefore been utilised within ADMS. This data is based on Ordnance Survey Land-Form PANORAMA.

A roughness length (z_0) of 0.2m was used in the dispersion modelling study. This value of z_0 is considered appropriate for the morphology of the assessment area and is suggested within ADMS 5.1 as being suitable for 'agricultural land min'. A roughness length (z_0) of 0.2m was also considered appropriate for the morphology of the meteorological station.

6.6 Discrete Receptor Points

Forty Seven discrete receptor points have been defined within the model for initial screening to represent the closest boundaries of the identified designated sites. These discrete receptors are taken to be at ground level and their locations are shown in Figure 6 and Figure 7, where they are marked by black stars.

6.7 Assessment Extents

A 5km by 5km regular Cartesian grid at 200 m resolution around the Dolobran Hall poultry facility, has been used in the screening and detailed modelling run. This grid was also used to define the spatially varying deposition field and to produce the contour map presented in Section 7 of this report. Receptors in the Cartesian grid are taken to be at ground level. The grid location is shown in Figure 8, where it is marked by grey lines bounded by a grey square.

6.8 Deposition Parameters

The methods used to model deposition of ammonia and consequent plume depletion are based on Environment Agency guidance from the draft document entitled 'Guidance on modelling the concentration and deposition of ammonia emitted from intensive farming' (**Ref 12**):

1. Annual mean ammonia concentration in each of the five separate years of the meteorological record was calculated using ADMS without deposition. As deposition results in depletion of ammonia in the plume, this tends to overestimate the concentration in air.
2. Based on the maxima of the annual concentrations obtained in step one, values for deposition velocity suggested by the Environment Agency (see Table 4) and land usage around the farm, a spatially varying deposition field was defined for the detailed modelling. This is shown in Figure 9.
3. ADMS was re-run for the years when the greatest exposures are predicted using the spatially varying deposition field obtained in step two.

Table 4. Environment Agency Recommended Ammonia Dry Deposition Velocity at Different Long Term Average Concentrations to be used in an Impact Assessment

NH_3 Concentration (Farm(s) Contribution + Background) ($\mu g/m^3$)	< 10	10 - 20	20 – 30	30 – 80	> 80
Deposition velocity (m/s)	0.02 - 0.03*	0.015	0.01	0.005	0.003

*0.02 m/s for short vegetation, and 0.03 m/s for tall vegetation.

A further restriction to deposition velocity of 0.005 m/s has been applied where there is fertilised arable cropland. This is to account for possible restricted deposition over crops and open ground. It is a precautionary approach which can only result in higher predictions of ammonia concentration and deposition at sensitive sites.

For modelling purposes, deposition velocity is temporally fixed. However, in reality it will vary seasonally and diurnally and it is also dependent on meteorological conditions and the state of vegetation. Model sensitivity to such effects is currently unknown. Nevertheless, higher rates of deposition and plume depletion in summer probably compensate for lower rates in winter.

Deposition rates were calculated using the conversion factors provided within the Environment Agency guidance. Predicted ammonia concentrations were multiplied by the deposition velocity and conversion factor to calculate the dry deposition flux.

The spatially varying deposition field has been restricted to the area surrounding Dolobran Hall poultry farm and the nearest nature conservation sites. A contour map of the deposition velocity field is shown in Figure 9. The contouring software “smoothes” any abrupt changes in deposition velocity at woodland/field boundaries.

Figure 6. Modelled Discrete Receptor Points (SSSIs)

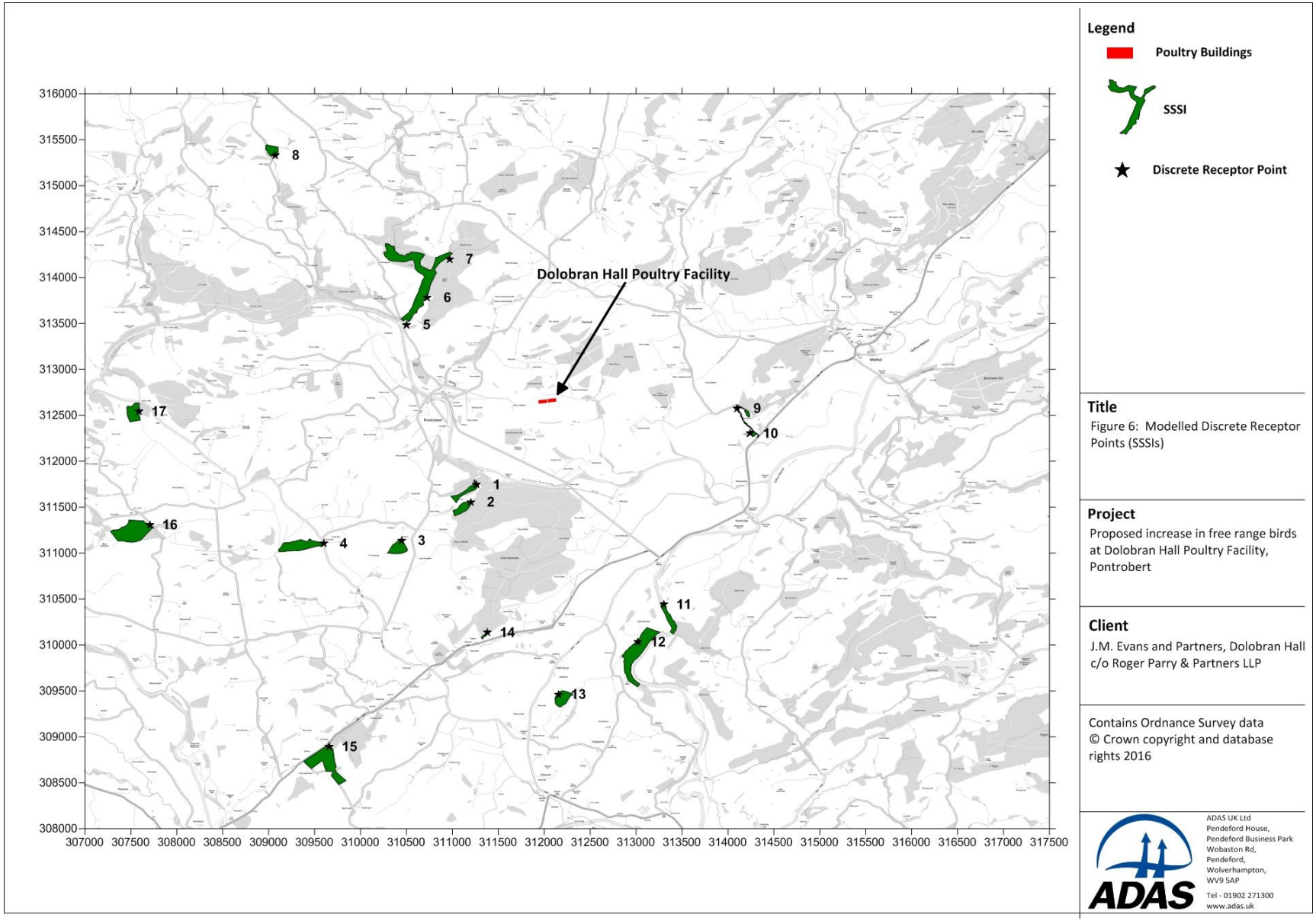


Figure 7. Modelled Discrete Receptor Points (AWs & LWSs)

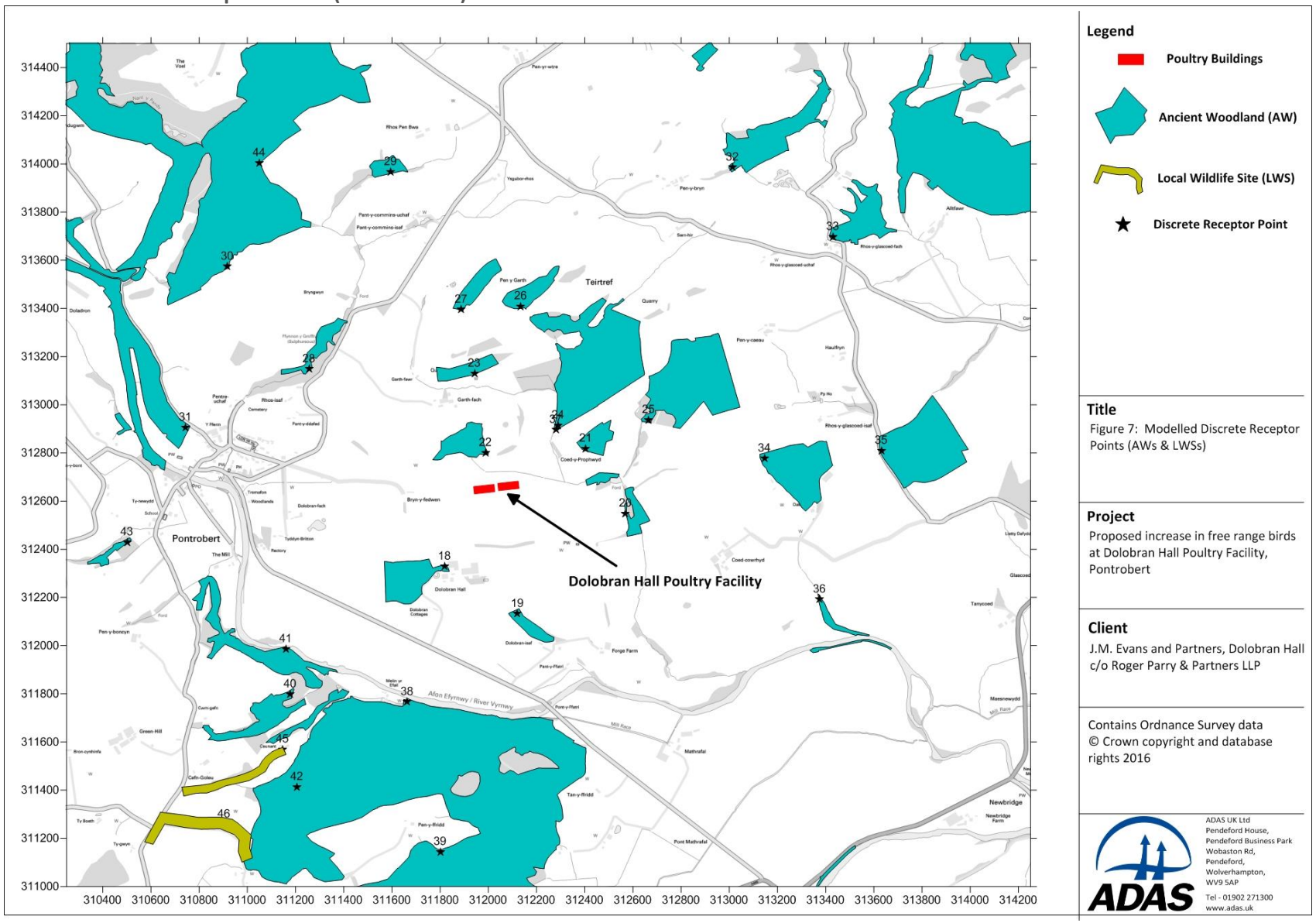
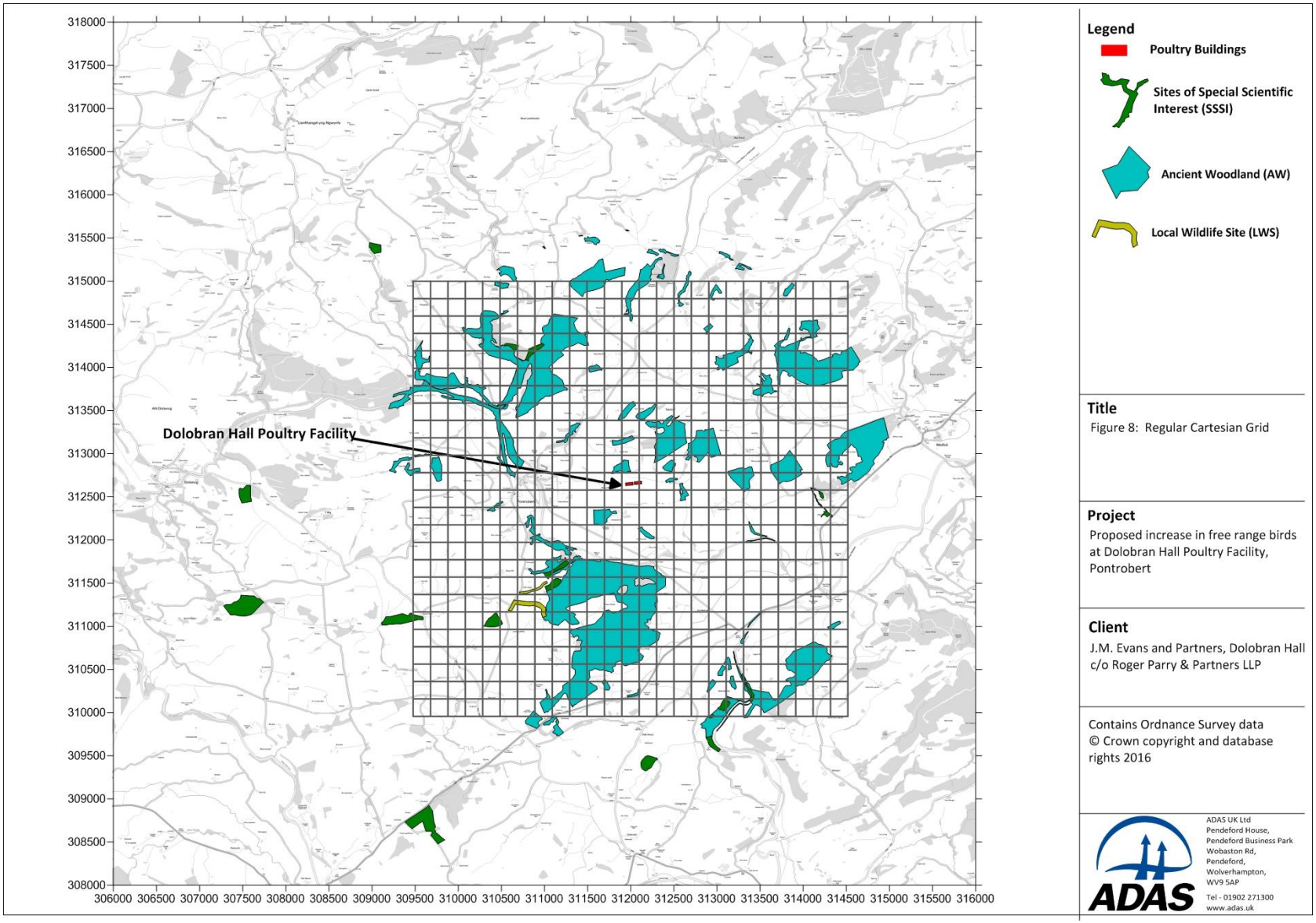


Figure 8. Cartesian Grid



7 Dispersion Modelling Results

Five screening runs, one for each year in the five year meteorological record (2011 to 2015) were performed to assess the impact of ammonia emissions from the Dolobran Hall poultry facility on atmospheric ammonia concentrations at the identified discrete receptor points. The resulting ammonia concentrations have been used to provide an indication of the extent of likely impact.

The maximum annual mean ammonia concentration figures, from this preliminary modelling run were used along with land usage data to define the spatially varying deposition field required in the detailed modelling run. Detailed modelling was then conducted by re-running the model using the deposition and plume depletion module for the years 2011 to 2015.

The results of the screening and detailed model runs are presented below.

7.1 Screening Model Run Results

The predicted 5 year maximum annual mean ammonia concentrations at the discrete receptor points are shown in Table 4. Nutrient nitrogen deposition rates have also been calculated for the receptor points based on the predicted 5 year maximum atmospheric ammonia concentration for each discrete receptor point. The results from the screening modelling are also shown graphically as a contour plot in Figure 9 to show the spatial extent of ammonia concentrations.

The NRW's GN 20 guidance states that if a simple screening run predicts that process contributions to atmospheric ammonia concentrations are less than the lower threshold of the relevant Critical Level then detailed modelling is not required. However if the simple screening predicts ammonia concentrations to be more than the threshold of the relevant Critical Level, then more detailed modelling would be required.

The results of the screening model run show that predicted process contributions to atmospheric ammonia concentrations are above 1% but below 8% of the relevant Critical Level for 9 discrete receptor points representing the SSSIs. The predicted process contributions are below 100% of the relevant Critical Level for AWs and LWSs. For the majority of discrete receptors the maximum annual mean ammonia concentrations were predicted to be in 2011 and 2013. The highest maximum annual mean ammonia concentrations overall were predicted to be 6% of the relevant Critical Level with respect to the SSSIs (Receptor 3) and 39.3% of the relevant Critical Level with respect to the AWs (Receptor 37). For SSSIs the lower significance threshold for SSSIs is 1% of the relevant Critical Level and for AWs and LWSs it is 100% of the relevant Critical Level. In accordance with the criteria set out in the Environment Agency's latest intensive farming risk assessment guidance and NRWs GN20 guidance (2017), the predicted process contributions at the AWs and LWSs should therefore be considered to be insignificant and acceptable for the purposes of permitting. As the predicted process contributions to atmospheric ammonia concentrations are above 1% at 9 discrete receptor points representing the SSSIs, these were carried

forward for detailed modelling including an assessment of process contributions to nutrient nitrogen/acid deposition Critical Loads in accordance with NRW's GN 20 guidance.

The preliminary modelling results also show that predicted process contributions to nutrient nitrogen deposition rates at discrete receptor points above 1% of the relevant Critical Load at 11 discrete receptor points representing the SSSIs. At one of the discrete receptors representing a SSSI, the predicted process contributions to nutrient nitrogen deposition rate is slightly above 8% of the Critical Load. The predicted process contributions to nutrient nitrogen deposition rates are below 100% of the relevant Critical Load for the AWs and LWSs.

In accordance with NRW's GN 20 guidance, the discrete receptors sites representing the SSSIs exceeding 1% of the Critical Load are taken forward for detailed modelling.

Table 4. Predicted Maximum Process Contribution to Annual Mean Ammonia Concentration and Annual Mean Nitrogen Deposition – Screening Run

Rec	X (m)	Y (m)	Site	Maximum Annual Mean Ammonia Concentration (2011 – 2015)			Deposition Velocity (m/s)	Maximum Annual Mean Nitrogen Deposition Rate (2011 – 2015)		
				Cle (µg/m³)	PC (µg/m³)	% Cle		CLo (kg/ha/yr)	N Depo Rate (kg/ha/yr)	% of CLo
1	311263	311743	Gweunydd Ceunant (SSSI)	3	0.1166	3.9	0.02	10	0.61	6.1
2	311199	311555	Gweunydd Ceunant (SSSI)	3	0.0859	2.9	0.02	10	0.45	4.5
3	310447	311136	Cors Ty-Gwyn (SSSI)	1	0.0600	6.0	0.03	5	0.47	9.4
4	309597	311103	Gwaun Efail Wig (SSSI)	1	0.0453	4.5	0.02	10	0.24	2.4
5	310500	313484	Pen-Dugwm Woods (SSSI)	1	0.0192	1.9	0.03	10	0.15	1.5
6	310726	313780	Pen-Dugwm Woods (SSSI)	1	0.0098	1.0	0.03	10	0.08	0.8
7	310968	314199	Pen-Dugwm Woods (SSSI)	1	0.0061	0.6	0.03	10	0.05	0.5
8	309075	315330	Cors Farchwel (SSSI)	1	0.0025	0.2	0.03	10	0.02	0.2
9	314100	312575	Glascoed, Meifod (SSSI)	3	0.0468	1.6	0.03	10	0.36	3.6
10	314245	312303	Glascoed, Meifod (SSSI)	3	0.0341	1.1	0.03	10	0.27	2.7
11	313301	310440	Afon Banwy Ger Mathrafal (SSSI)	3	0.0177	0.6	0.03	10	0.14	1.4
12	313020	310032	Coed Ty-Mawr (SSSI)	3	0.0148	0.5	0.03	15	0.12	0.8
13	312153	309462	Cors Cefn Llwyd (SSSI)	3	0.0156	0.5	0.03	10	0.12	1.2
14	311379	310134	Ffridd Mathrafal Track Section (SSSI)	3	0.0229	0.8	0.03	10	0.18	1.8
15	309661	308893	Gweunydd Ger Fronhaul (SSSI)	3	0.0232	0.8	0.02	20	0.12	0.6
16	307705	311308	Mawnog Gwaunynog (SSSI)	1	0.0146	1.5	0.03	5	0.11	2.3

Rec	X (m)	Y (m)	Site	Maximum Annual Mean Ammonia Concentration (2011 – 2015)			Deposition Velocity (m/s)	Maximum Annual Mean Nitrogen Deposition Rate (2011 – 2015)		
				Cle (µg/m³)	PC (µg/m³)	% Cle		CLo (kg/ha/yr)	N Depo Rate (kg/ha/yr)	% of CLo
17	307586	312541	Gwaun Wern-y-Wig (SSSI)	3	0.0146	0.5	0.02	10	0.08	0.8
18	311819	312329	Unnamed (AW)	3	0.5091	17.0	0.03	10	3.97	39.7
19	312121	312132	Unnamed (AW)	3	0.1148	3.8	0.03	10	0.89	8.9
20	312569	312549	Unnamed (AW)	3	0.2649	8.8	0.03	10	2.06	20.6
21	312405	312819	Unnamed (AW)	3	0.8246	27.5	0.03	10	6.42	64.2
22	311988	312800	Unnamed (AW)	3	0.9149	30.5	0.03	10	7.13	71.3
23	311942	313130	Unnamed (AW)	3	0.1149	3.8	0.03	10	0.90	9.0
24	312290	312915	Unnamed (AW)	3	1.0850	36.2	0.03	10	8.45	84.5
25	312666	312938	Unnamed (AW)	3	0.3626	12.1	0.03	10	2.83	28.3
26	312135	313409	Unnamed (AW)	3	0.0835	2.8	0.03	10	0.65	6.5
27	311888	313395	Unnamed (AW)	3	0.0492	1.6	0.03	10	0.38	3.8
28	311256	313148	Unnamed (AW)	3	0.0461	1.5	0.03	10	0.36	3.6
29	311595	313967	Unnamed (AW)	3	0.0108	0.4	0.03	10	0.08	0.8
30	310917	313574	Unnamed (AW)	3	0.0123	0.4	0.03	10	0.10	1.0
31	310743	312906	Unnamed (AW)	3	0.0710	2.4	0.03	10	0.55	5.5
32	313013	313986	Unnamed (AW)	3	0.1098	3.7	0.03	10	0.86	8.6

Rec	X (m)	Y (m)	Site	Maximum Annual Mean Ammonia Concentration (2011 – 2015)			Deposition Velocity (m/s)	Maximum Annual Mean Nitrogen Deposition Rate (2011 – 2015)		
				Cle (µg/m³)	PC (µg/m³)	% Cle		CLo (kg/ha/yr)	N Depo Rate (kg/ha/yr)	% of CLo
33	313430	313697	Unnamed (AW)	3	0.0859	2.9	0.03	10	0.67	6.7
34	313146	312777	Unnamed (AW)	3	0.1246	4.2	0.03	10	0.97	9.7
35	313631	312810	Unnamed (AW)	3	0.0682	2.3	0.03	10	0.53	5.3
36	313375	312192	Unnamed (AW)	3	0.0307	1.0	0.03	10	0.24	2.4
37	312281	312896	Unnamed (AW)	3	1.1780	39.3	0.03	10	9.18	91.8
38	311663	311766	Unnamed (AW)	3	0.0986	3.3	0.03	10	0.77	7.7
39	311801	311144	Unnamed (AW)	3	0.0405	1.4	0.03	10	0.32	3.2
40	311178	311798	Unnamed (AW)	3	0.1238	4.1	0.03	10	0.96	9.6
41	311160	311986	Unnamed (AW)	3	0.1585	5.3	0.03	10	1.23	12.3
42	311206	311414	Unnamed (AW)	3	0.0672	2.2	0.03	10	0.52	5.2
43	310501	312430	Unnamed (AW)	3	0.1006	3.4	0.03	10	0.78	7.8
44	311050	314004	Unnamed (AW)	3	0.0103	0.3	0.03	10	0.08	0.8
45	311146	311569	Ceunant Farm Lane (LWS)	1	0.0890	8.9	0.02	10	0.46	4.6
46	310904	311258	Pen-y-Fridd (LWS)	1	0.0598	6.0	0.02	10	0.31	3.1

*CLe – Critical Level CLo- Critical Load PC – Process Contribution *deposition velocity of 0.02 m/s applied for sites dominated by short vegetation, 0.03 m/s applied for sites dominated by tall vegetation.

7.2 Detailed Modelling, Including Deposition

Detailed modelling has been carried for the discrete receptor points representing the SSSIs which exceeded the threshold set by NRW. One of the discrete receptor points representing an AW has also been included for detailed modelling because it is within 250m from the site.

It is noted that these modelling predictions are based on two precautionary assumptions that a) the birds do not deposit any droppings outside the buildings and b) there are no "empty" periods between stocking cycles.

The predicted maximum annual mean ammonia concentrations and nitrogen deposition rates from the detailed modelling run for all five years in the meteorological record are shown in Table 5. The results from the detailed modelling run are shown graphically as contour plots in Figure 9 and 10. The contour plots are limited to the grid used for the spatially varying deposition field.

The results of the detailed model run show that predicted process contributions to atmospheric ammonia concentrations are above 1% but below 8% of the relevant Critical Level for 6 discrete receptor points representing the SSSIs. The predicted process contributions are below 1% of the relevant Critical Level for all other SSSIs and below 100% for all of the AWs.

The predicted process contributions to nutrient nitrogen deposition rates at discrete receptor points are above 1% but below 8% of the relevant Critical Load at 6 discrete receptor points representing the SSSIs. At all other discrete receptor points they are below the relevant lower threshold.

Where an exceedance of the lower threshold has been predicted, the process contribution has also been considered in the context of the background ammonia concentration and nitrogen deposition at the sensitive receptor. Table 6 provides the predicted environmental concentration, which is the addition of the process contribution with the background levels.

The predicted environmental concentration exceeds the Critical Level at three discrete receptor points because the background levels already exceed the Critical Level. No exceedance are predicted where the background levels do not already exceed the Critical Level. The predicted environmental concentration also exceeds the Critical Loads at seven discrete receptor points because background levels already exceed the Critical Loads.

Table 5. Predicted Maximum Process Contribution to Annual Mean Ammonia Concentration and Annual Mean Nitrogen Deposition – Detailed Modelling Run

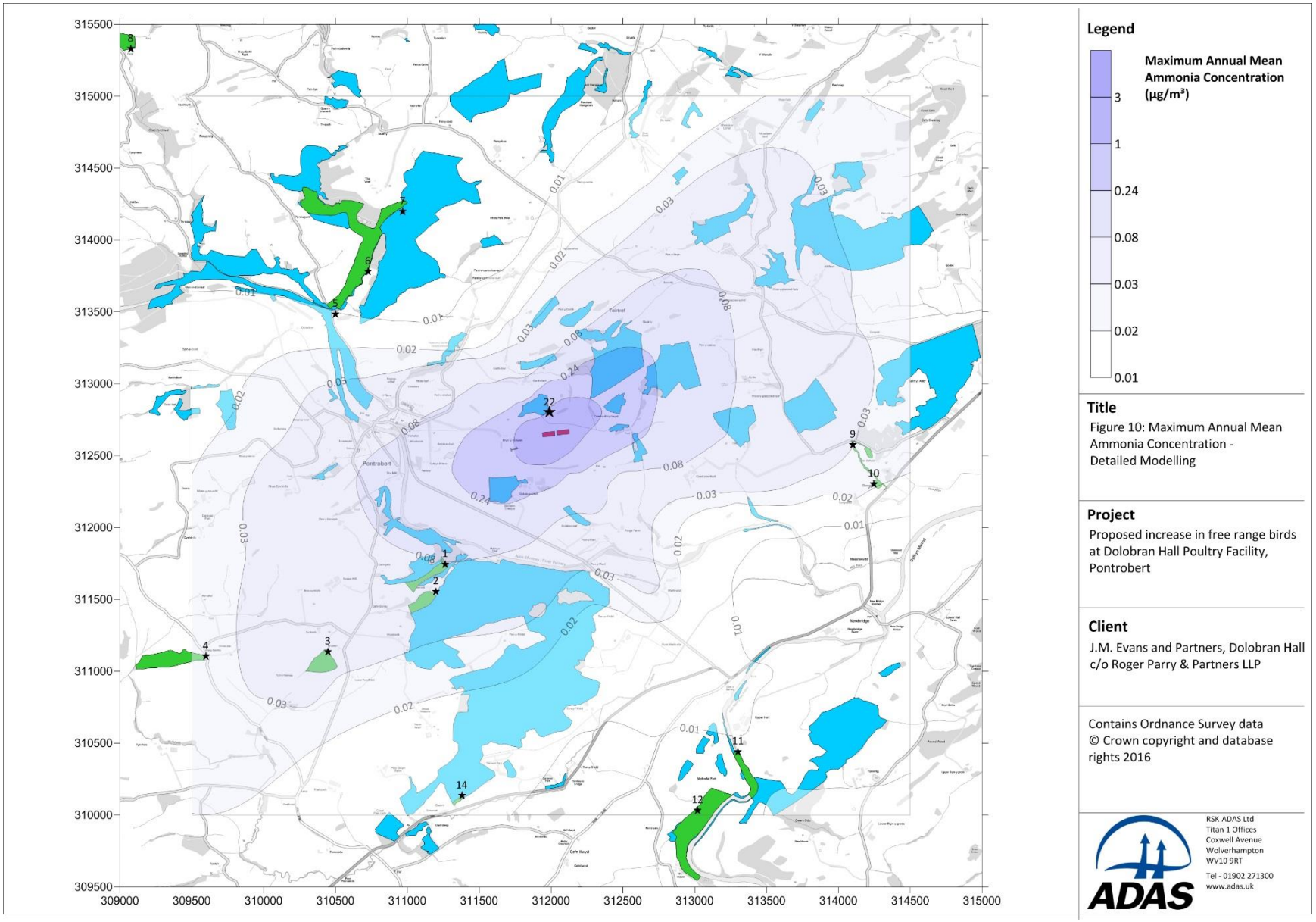
Rec	X (m)	Y (m)	Site	Maximum Annual Mean Ammonia Concentration (2011 – 2015)			Deposition Velocity (m/s)	Maximum Annual Mean Nitrogen Deposition Rate (2011 – 2015)		
				CIe (µg/m³)	PC (µg/m³)	% CIe		CLo (kg/ha/yr)	N Depo Rate (kg/ha/yr)	% of CLo
1	311263	311743	Gweunydd Ceunant (SSSI)	3	0.0799	2.7	0.02	10	0.41	4.1
2	311199	311555	Gweunydd Ceunant (SSSI)	3	0.0569	1.9	0.02	10	0.30	3.0
3	310447	311136	Cors Ty-Gwyn (SSSI)	1	0.0345	3.4	0.03	5	0.27	5.4
4	309597	311103	Gwaun Efail Wig (SSSI)	1	0.0245	2.4	0.02	10	0.13	1.3
5	310500	313484	Pen-Dugwm Woods (SSSI)	1	0.0101	1.0	0.03	10	0.08	0.8
6	310726	313780	Pen-Dugwm Woods (SSSI)	1	0.0052	0.5	0.03	10	0.04	0.4
9	314100	312575	Glascoed, Meifod (SSSI)	3	0.0295	1.0	0.03	10	0.23	2.3
10	314245	312303	Glascoed, Meifod (SSSI)	3	0.0202	0.7	0.03	10	0.16	1.6
11	313301	310440	Afon Banwy Ger Mathrafal (SSSI)	3	0.0098	0.3	0.03	10	0.08	0.8
13	312153	309462	Cors Cefn Llwyd (SSSI)	3	0.0074	0.2	0.03	10	0.06	0.6
14	311379	310134	Ffridd Mathrafal Track Section (SSSI)	3	0.0122	0.4	0.03	10	0.09	0.9
16	307705	311308	Mawnog Gwaunynog (SSSI)	1	0.0061	0.6	0.03	5	0.05	0.9
22	311988	312800	Unnamed (AW)	3	0.7409	24.7	0.03	10	5.77	57.7

*CLe – Critical Level CLo- Critical Load PC – Process Contribution *deposition velocity of 0.02 m/s applied for sites dominated by short vegetation, 0.03 m/s applied for sites dominated by tall vegetation.

Table 6. Predicted Environmental Concentrations – Detailed Modelling Run

Rec	X (m)	Y (m)	Site	Maximum Annual Mean Ammonia Concentration (2011 – 2015)					Maximum Annual Mean Nitrogen Deposition Rate (2011 – 2015)				
				Background (µg/m³)	Cle (µg/m³)	PC (µg/m³)	PEC (µg/m³)	% of Cle	Background (kg N/ha/yr)	CLo (kg/ha/yr)	N Depo Rate (kg/ha/yr)	PEC (kg N/ha/yr)	% of Clo
1	311263	311743	Gweunydd Ceunant (SSSI)	1.43	3	0.0799	1.51	50.3	17.92	10	0.41	18.33	183.4
2	311199	311555	Gweunydd Ceunant (SSSI)	1.43	3	0.0569	1.49	49.6	17.92	10	0.30	18.22	182.6
3	310447	311136	Cors Ty-Gwyn (SSSI)	1.43	1	0.0345	1.46	146.4	17.92	5	0.27	18.19	363.8
4	309597	311103	Gwaun Efail Wig (SSSI)	1.43	1	0.0245	1.45	145.4	19.88	10	0.13	20.01	200.1
5	310500	313484	Pen-Dugwm Woods (SSSI)	1.43	1	0.0101	1.44	144.0	27.3	10	0.08	27.38	273.8
9	314100	312575	Glascoed, Meifod (SSSI)	1.43	3	0.0295	1.46	48.6	27.3	10	0.23	27.53	275.3
10	314245	312303	Glascoed, Meifod (SSSI)	1.43	3	0.0202	1.45	48.3	27.3	10	0.16	27.46	274.6

*CLe – Critical Level CLo- Critical Load PC – Process Contribution PEC - Predicted Environmental Concentration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3
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11
12
14
22
Legend
Maximum Annual Mean Ammonia Concentration (µg/m³)
3
1
0.24
0.08
0.03
0.02
0.01
Title
Figure 10: Maximum Annual Mean Ammonia Concentration - Detailed Modelling
Project
Proposed increase in free range birds at Dolobran Hall Poultry Facility, Pontrobert
Client
J.M. Evans and Partners, Dolobran Hall c/o Roger Parry & Partners LLP
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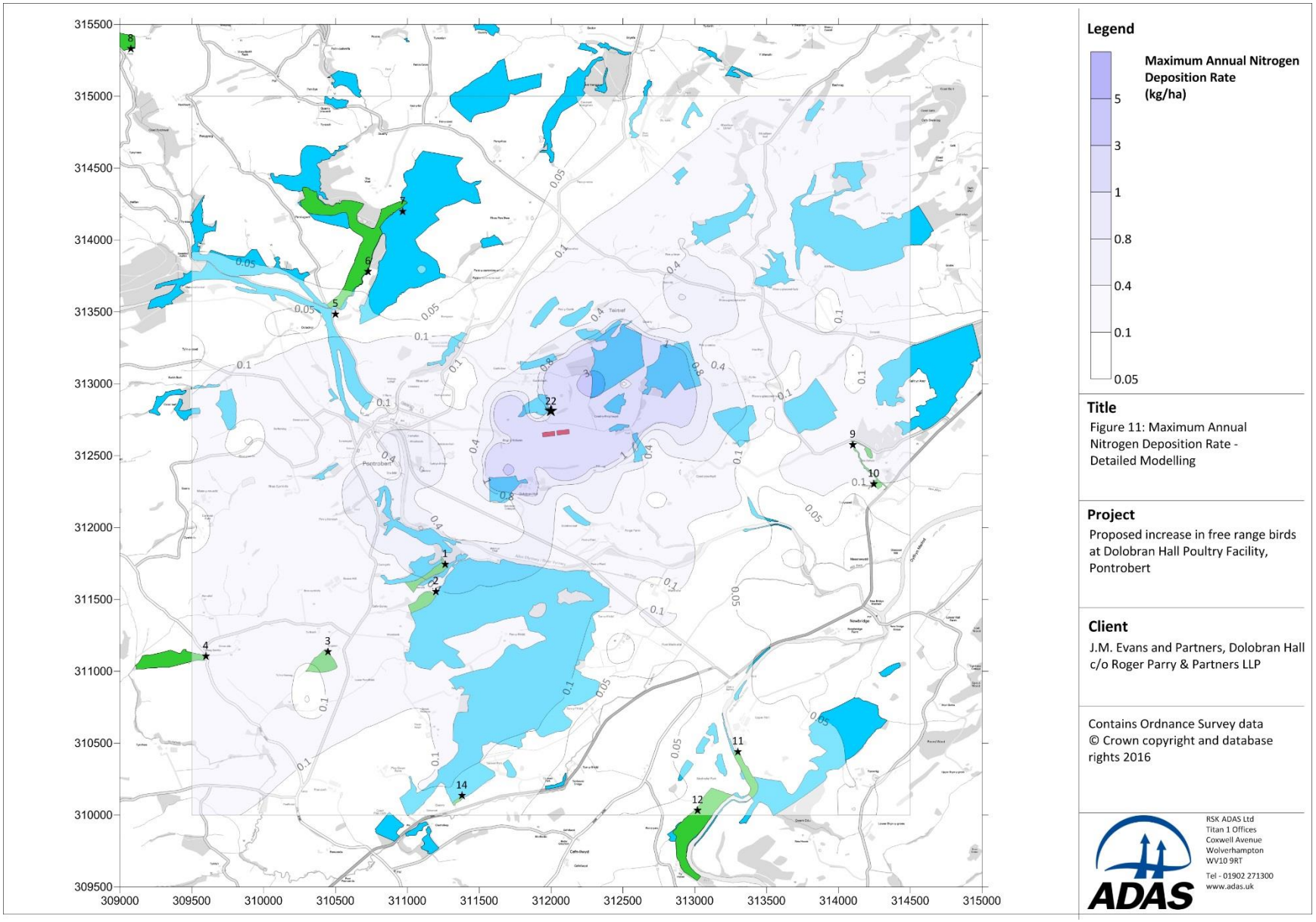
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Maximum Annual Nitrogen Deposition Rate (kg/ha)
5
3
1
0.8
0.4
0.1
0.05
Title
Figure 11: Maximum Annual Nitrogen Deposition Rate - Detailed Modelling
Project
Proposed increase in free range birds at Dolobran Hall Poultry Facility, Pontrobert
Client
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8 Summary and Conclusions

RSK ADAS Ltd was commissioned by Roger Parry & Partners LLP on behalf of J.M Evans and Partners to conduct a screening modelling study to assess the potential impact of atmospheric ammonia emissions associated with an increase in the number of free range birds at Dolobran Hall, Pontrobert, Meiford, Powys.

Ammonia emissions from the proposed expansion of operations have been assessed and quantified using Environment Agency standardised ammonia emission figures. These emission rates have been used in atmospheric dispersion modelling in order to predict process contributions to atmospheric ammonia concentrations at nearby nature conservation sites and estimate nitrogen deposition rates.

The results of the screening modelling run show that predicted process contributions to atmospheric ammonia concentrations are above the lower threshold of 1% but below the upper threshold of 8% of the relevant Critical Level for 9 discrete receptor points representing the closest points of seven SSSIs. Preliminary results of predicted nitrogen deposition rates also show exceedance of the lower threshold of 1% at 11 discrete receptor points representing the SSSIs. A slight exceedance of the upper threshold of 8% was also predicted at one discrete receptor point representing a SSSI. The predicted process contributions are below 100% of the relevant Critical Level and Critical Load for all of the AWs and LWSs.

The results of subsequent detailed model run, using spatially varying deposition fields, show that predicted process contributions to atmospheric ammonia concentrations are above the lower threshold of 1% but below the upper threshold of 8% of the relevant Critical Level and Critical Load for 6 discrete receptor points representing three SSSIs. At all other discrete receptor points they are below the relevant lower threshold.

The predicted process contributions do not cause exceedances of the Critical Levels or Critical Loads apart from where the background levels already exceed the Critical Level and Critical Loads.

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