A Report on the Modelling of the Dispersion and Deposition of Ammonia from the Proposed Poultry Houses at Ystym Colwyn Farm, Meifod, Welshpool, Powys

Prepared by Steve Smith

AS Modelling & Data Ltd.

Email: stevesmith@asmodata.co.uk

Telephone: 01952 462500

12th August 2016

1. Introduction

AS Modelling & Data Ltd. has been instructed by John Ward, on behalf of Ystym Colwyn Farms Ltd. to use computer modelling to assess the impact of ammonia emissions from the proposed broiler rearing unit at Ystym Colwyn Farm, Meifod, Welshpool, Powys. SY22 6XT.

Ammonia emission rates from the proposed poultry houses have been assessed and quantified based upon the Environment Agency's standard ammonia emission factors. The ammonia emission rates have then been used as inputs to an atmospheric dispersion and deposition model which calculates ammonia exposure levels and nitrogen and acid deposition rates in the surrounding area.

This report is arranged in the following manner:

- Section 2 provides relevant details of the farm and potentially sensitive receptors in the area.

- Section 3 provides some general information on ammonia; details of the method used to estimate ammonia emissions, relevant guidelines and legislation on exposure limits and where relevant, details of likely background levels of ammonia.

- Section 4 provides some information about ADMS, the dispersion model used for this study and details the modelling procedure.

- Section 5 contains the results of the modelling.

- Section 6 provides a discussion of the results and conclusions.

2. Background Details

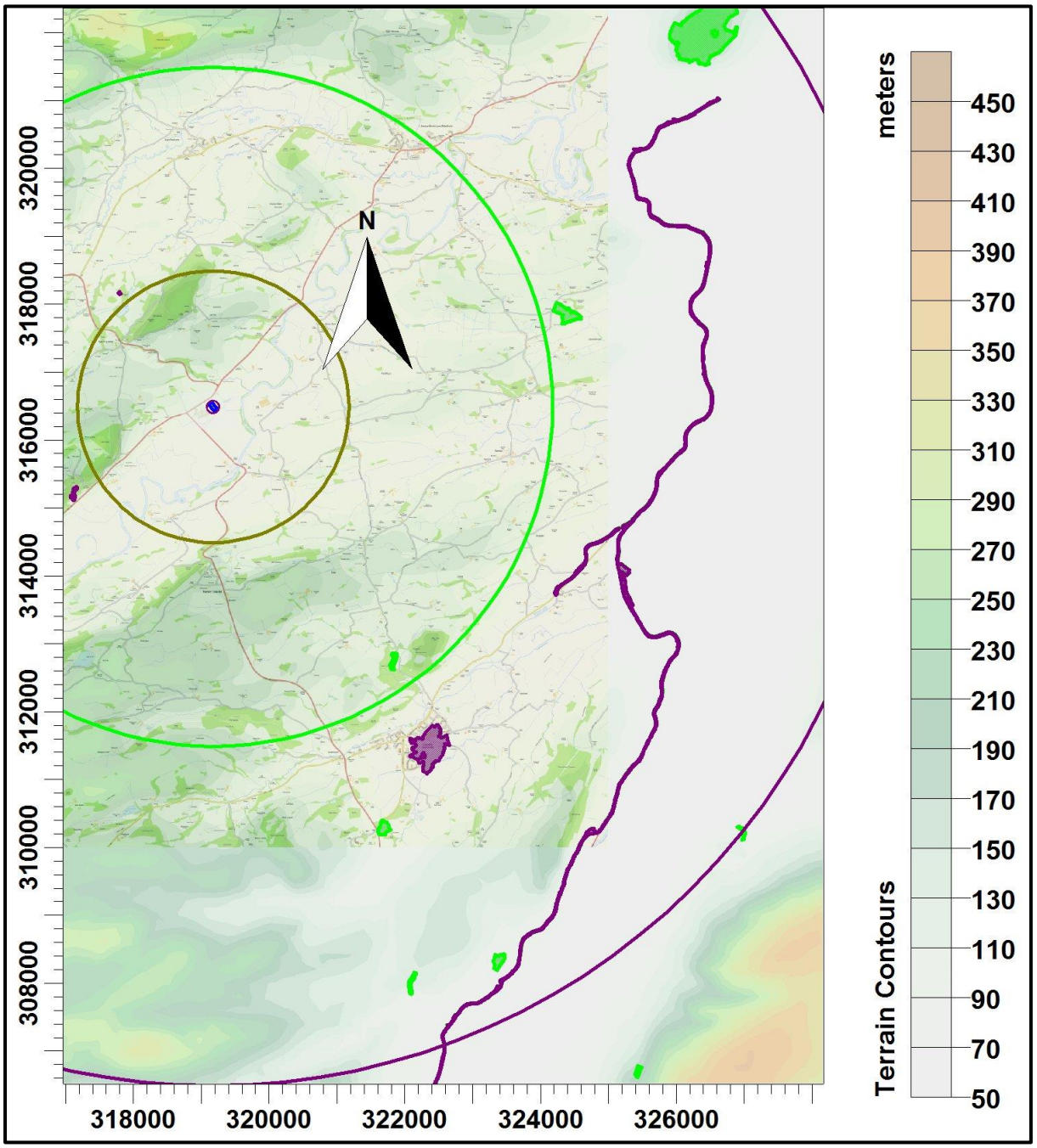
The site of the proposed broiler chicken rearing houses is in an isolated rural area approximately 4.7 km to the north-east of the village of Meifod in Powys. The surrounding land is used primarily for arable and livestock farming, although there are some areas of semi natural woodland and grassland. The site is at an altitude of around 100 m in the River Vyrnwy Valley with the ground rising towards hills to the north-west and falling gently towards the River Vyrnwy to the south-east.

It is proposed that two broiler chicken rearing houses be constructed on what is currently improved grassland. The houses would provide accommodation for up to 100,000 broiler chickens and would be ventilated by uncapped high speed ridge mounted fans, each with a short chimney. The chickens would be reared from day old chicks to up to around 38 days old and there would be approximately 7.5 crops per year.

There are several areas of Ancient Woodland (AW) within 2 km of the site of the proposed poultry houses at Ystyn Colwyn; parts of one of the AWs, namely Ceunant Mawr, would be within 300 m of the site of the proposed poultry houses. There are three Sites of Special Scientific Interest (SSSI) within 5 km, namely Gwern-y-Brain Dingle SSSI, Bryngwyn Hall Stables and Coach House SSSI and Allt y Main Mine SSSI. Bryngwyn Hall Stables and Coach House SSSI and Allt y Main Mine SSSI are also designated as parts of the Tanat and Vyrnwy Bat Sites Special Area of Conservation (SAC). There are other parts of the Tanat and Vyrnwy Bat Sites SAC within 10 km of the site and there are also two other SACs within 10 km, namely the Granllyn SAC and the Mongomery Canal SAC. Note that the sites that are part of the Vyrnwy Bat Sites SAC are included as potential receptors in this report; however, because they are designated for mammalian features, they are unlikely to be adversely affected by ammonia emissions from the proposed poultry houses. There are no Special Areas of Conservation (SACs), Special Protection Areas (SPAs), or Ramsar sites within 10 km of the site.

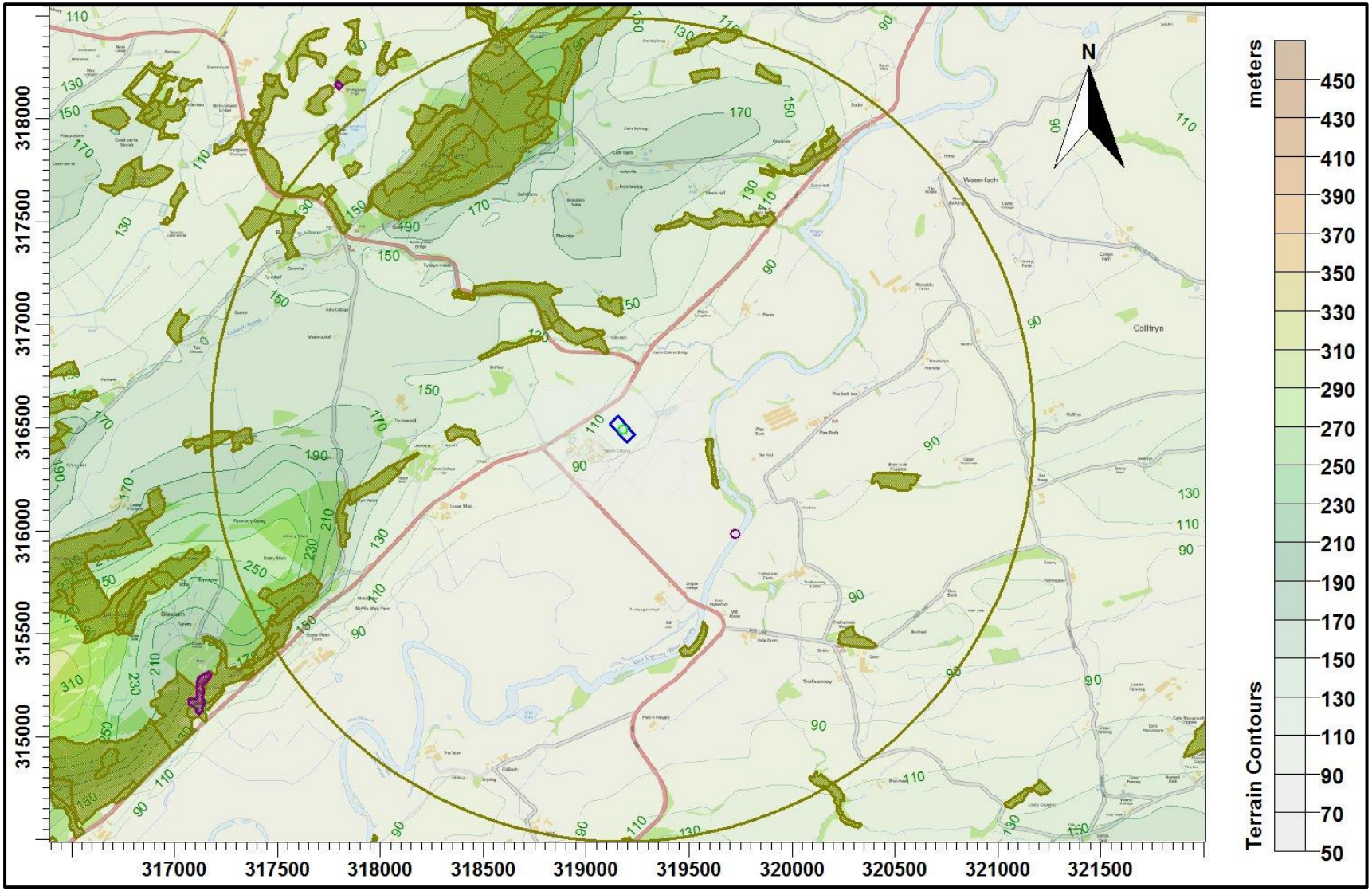
Maps of the surrounding area showing the positions of the poultry unit, the AWs, the SSSIs and the SACs are provided in Figures 1a and 1b. In these figures, the AWs are shaded in olive, the SSSIs are shade in green, the SACs are shade purple and the site of the proposed poultry houses is outlined in blue.

Figure 1a. The area surrounding Ystyn Colwyn – concentric circles radii 2 km (olive) , 5 km (green) and 10 km purple



© Crown copyright and database rights. 2016.

Figure 1b. The area surrounding Ystyn Colwyn – a closer view



© Crown copyright and database rights. 2016.

3. Ammonia, Background Levels, Critical Levels & Loads & Emission Rates

3.1 Ammonia concentration and nitrogen and acid deposition

When assessing potential impact on ecological receptors, ammonia concentration is usually expressed in terms of micrograms of ammonia per metre cubed of air (µg-NH_3/m^3) as an annual mean. Ammonia in the air may exert direct effects on the vegetation, or indirectly affect the ecosystem through deposition which causes both hyper-eutrophication (excess nitrogen enrichment) and acidification of soils. Nitrogen deposition, specifically in this case the nitrogen load due to ammonia deposition/absorption is usually expressed in kilograms of nitrogen per hectare per year (kg-N/ha/y). Acid deposition is expressed in terms of kilograms equivalent (of H^+ ions) per hectare per year (keq/ha/y).

3.2 Background ammonia levels and nitrogen and acid deposition

The background ammonia concentration (annual mean) in the area around Ystyn Colwyn and the wildlife sites is 1.69µg-NH_3/m^3. The background nitrogen deposition rate to woodland is 28.42 kg-N/ha/y and to short vegetation is 17.92 kg-N/ha/y. The background acid deposition rate to woodland is 2.20 keq/ha/y and to short vegetation is 1.44 keq/ha/y. The source of these background figures is the Air Pollution Information System (APIS, 2016).

3.3 Critical Levels & Critical Loads

Critical Levels and Critical Loads are a benchmark for assessing the risk of air pollution impacts to ecosystems. It is important to distinguish between a Critical Level and a Critical Load. The Critical Level is the gaseous concentration of a pollutant in the air, whereas the Critical Load relates to the quantity of pollutant deposited from air to the ground.

Critical Levels are defined as, "concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as human beings, plants, ecosystems or materials, may occur according to present knowledge". (UNECE)

Critical Loads are 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". (UNECE)

For ammonia concentration in air, the Critical Level for higher plants is 3.0 µg-NH_3/m^3 as an annual mean. For sites where there are sensitive lichens and bryophytes present, or where lichens and bryophytes are an integral part of the ecosystem, the Critical Level is 1.0 µg-NH_3/m^3 as an annual mean.

Critical Loads for nutrient nitrogen are set under the Convention on Long-Range Transboundary Air Pollution. They are based on empirical evidence, mainly observations from experiments and gradient studies. Critical Loads are given as ranges (e.g. 10-20 kg-N/ha/y); these ranges reflect variation in ecosystem response across Europe. The Critical Levels and Critical Loads at the wildlife sites assumed in this study are provided in Table 1. N.B. Where the Critical Level of 1.0 µg-NH_3/m^3 is assumed, it is usually unnecessary to consider the Critical Load as the Critical Level provides the stricter test. Normally the Critical Load for nitrogen deposition provides a stricter test than the Critical Load for acid deposition.

Table 1. Critical Levels and Critical Loads at the wildlife sites

Site	Critical Level (µg-NH_3/m^3)	Critical Load - Nitrogen Deposition (kg-N/ha/y)	Critical Load - Acid Deposition (keq/ha/y)
AWs	1.0 [1]	10 [2]	-
Tanat and Vyrnwy Bat Sites SSSIs/SACs	-	-	-
Other SSSIs & SACs	1.0 [1]	10 [2]	-

1. A precautionary figure, used where details of the site are unavailable, or citations indicate that sensitive lichens and bryophytes may be present.
2. The lower bound of the range of Critical Loads for broad-leaved woodlands obtained from APIS.

3.4 Guidance on the Significance of Ammonia Emissions

The following are obtained from the Environment Agency's horizontal guidance, H1 Environmental Risks Assessment, H1 Annex B - Intensive Farming.

"An emission is insignificant where Process Contribution (PC) is <4% of Critical Levels for SACs, SPAs and Ramsars, <20% for SSSIs, and <50% for local and national nature reserves (LNRs & NNRs), ancient woodland and local wildlife sites." And "Where modelling predicts a process contribution >20% of the Critical Level/Load at a SAC, SPA or Ramsar, >50% at a SSSI or >100% at a NNR, LNR, ancient woodland or local wildlife site, your proposal may not be considered acceptable. In such cases, your assessment should include proposals to reduce ammonia emissions."

This document was withdrawn February 1st 2016 and replaced with a web-page titled "Intensive farming risk assessment for your environmental permit", which contains essentially the same criteria. It is assumed that the upper threshold and lower threshold on the web-page refers to the levels that were previously referred to as levels of insignificance and acceptability in Annex B– Intensive Farming. It is understood that Natural Resources Wales currently apply the Environment Agency's criteria for permitting in Wales.

Within the range between the lower and upper thresholds; 4% to 20% for SACs, SPAs and Ramsars; 20% to 50% for SSSIs and 100% to 100% for other non-statutory wildlife sites, whether or not the impact is deemed acceptable is at the discretion of the Environment Agency. In making their decision, the Environment Agency will consider whether other farming installations might act in combination with the farm and the sensitivities of the wildlife sites. N.B. In the case of LWSs and AWs, the Environment Agency do not usually consider other farms that may act in combination and

therefore a PC of up to 100% of Critical Level or Critical Load is usually deemed acceptable for permitting purposes and therefore the upper and lower thresholds are the same (100%).

3.5 Quantification of Ammonia Emissions

Ammonia emission rates from poultry houses depend on many factors and are likely to be highly variable. However, the benchmarks for assessing impacts of ammonia and nitrogen deposition are framed in terms of an annual mean ammonia concentration and annual nitrogen deposition rates. To obtain relatively robust figures for these statistics, it is not necessary to model short term temporal variations and a steady continuous emission rate can be assumed. In fact, modelling short term temporal variations might introduce rather more uncertainty than modelling continuous emissions.

The Environment Agency provided an Intensive farming guidance note which lists standard ammonia emission factors for a variety of livestock, including broiler chickens and other sources, such as poultry manure. The emission factor for broiler chickens is 0.034 kg-NH_3/bird place/y; this figure is used as the basis of the calculation of the emissions from the proposed poultry unit.

It should be noted that the proposed poultry houses would be heated using an indirect heating system. Indirect heating leads to lower humidity within the houses and consequently lower litter moisture content and lower ammonia emissions than houses heated using direct heating (on which the Environment Agency's standard ammonia emission factor is based). Ongoing studies suggest that emissions may be more than 40% lower than the Environment Agency's standard ammonia emission factor.

Details of the poultry numbers and types and emission factors used and calculated baseline ammonia emission rates are provided in Table 2.

Table 2. Details of poultry numbers and baseline ammonia emission rates

Source	Animal numbers/ Tonnes	Type or weight	Emission factor (kg-NH_3/place/y)	Emission rate (g-NH_3/s)
Proposed Housing	100,000	Broiler Chickens	0.034	0.107739

4. The Atmospheric Dispersion Modelling System (ADMS) and model parameters

The Atmospheric Dispersion Modelling System (ADMS) ADMS 5 is a new generation Gaussian plume air dispersion model, which means that the atmospheric boundary layer properties are characterised by two parameters; the boundary layer depth and the Monin-Obukhov length rather than in terms of the single parameter Pasquill-Gifford class.

Dispersion under convective meteorological conditions uses a skewed Gaussian concentration distribution (shown by validation studies to be a better representation than a symmetrical Gaussian expression).

ADMS has a number of model options including: dry and wet deposition; NO_x chemistry; impacts of hills; variable roughness; buildings and coastlines; puffs; fluctuations; odours; radioactivity decay (and γ-ray dose); condensed plume visibility; time varying sources and inclusion of background concentrations.

ADMS has an in-built meteorological pre-processor that allows flexible input of meteorological data both standard and more specialist. Hourly sequential and statistical data can be processed and all input and output meteorological variables are written to a file after processing.

The user defines the pollutant, the averaging time (which may be an annual average or a shorter period), which percentiles and exceedance values to calculate, whether a rolling average is required or not and the output units. The output options are designed to be flexible to cater for the variety of air quality limits which can vary from country to country and are subject to revision.

4.1 Meteorological data

Computer modelling of dispersion requires hourly sequential meteorological data and to provide robust statistics the record should be of a suitable length; preferably four years or longer.

The meteorological data used in this study is obtained from assimilation and short term forecast fields of the Numerical Weather Prediction (NWP) system known as the Global Forecast System (GFS). Traditional observational meteorological datasets from Lake Vyrnwy, RAF Sawbury and Hawarden have also been considered.

The GFS is a spectral model and data are archived at a horizontal resolution of 0.25 degrees, which is approximately 25 km over the UK (formerly 0.5 degrees, or approximately 50 km). The GFS resolution adequately captures major topographical features and the broad-scale characteristics of the weather over the UK. Smaller scale topological features may be included in the dispersion modelling by using the flow field module of ADMS (FLOWSTAR). The use of NWP data has advantages over traditional meteorological records because:

- Calm periods in traditional records may be over represented, this is because the instrumentation used may not record wind speed below approximately 0.5 m/s and start up wind speeds may be greater than 1.0 m/s. In NWP data, the wind speed is continuous down to 0.0 m/s, allowing the calms module of ADMS to function correctly.

- Traditional records may include very local deviations from the broad-scale wind flow that would not necessarily be representative of the site being modelled; these deviations are difficult to identify and remove from a meteorological record. Conversely, local effects at the site being modelled are relatively easy to impose on the broad-scale flow and provided horizontal resolution is not too great, the meteorological records from NWP data may be expected to represent well the broad-scale flow.

- Information on the state of the atmosphere above ground level which would otherwise be estimated by the meteorological pre-processor may be included explicitly.

A wind rose showing the distribution of wind speeds and directions in the GFS derived data is shown in Figure 2a.

Wind speeds are modified by the treatment of roughness lengths (see Section 4.7) and where terrain data is included in the modelling, wind speeds and directions will be modified. The terrain and roughness length modified wind rose for Ystym Colwyn is shown in Figure 2b. Note that elsewhere in the modelling domain, modified wind roses may differ markedly and that the resolution of the wind field in terrain runs is approximately 600 m.

Ystym Colwyn is approximately central to the meteorological recording stations at Lake Vyrnwy, RAF Shawbury and Hawarden. However, neither Lake Vyrnwy, RAF Shawbury and Hawarden has an aspect that in any way could be considered similar to Ystym Colwyn. Therefore, it should be noted that the frequency of winds from a particular direction in the Lake Vyrnwy, RAF Shawbury and Hawarden data may be either high or low in comparison to what might occur at Ystym Colwyn, which means mean concentrations downwind may be either over or under predicted. Additionally, periods of light winds and calms cannot be properly modelled, which with low level and ground level sources means that, in general, predictions may be somewhat lower than would be obtained if calm conditions were considered. Therefore, it is the opinion of AS Modelling & Data Ltd. that the results obtained using the GFS data, particularly when modified by using FLOWSTAR, should be given considerably more weight when interpreting the results of the modelling.

The wind roses for Lake Vyrnwy, RAF Shawbury and Hawarden are provided in Figures 2c, 2d and 2e and should serve to demonstrate how different the wind regime from relatively close observing sites in complex terrain can be and how unlikely it is that a remote observational dataset could in any way be representative of the wind regime around Ystym Colwyn.

Figure 2a. The wind rose. GFS derived data for 52.740 N, 3.198 W, 2012 – 2015

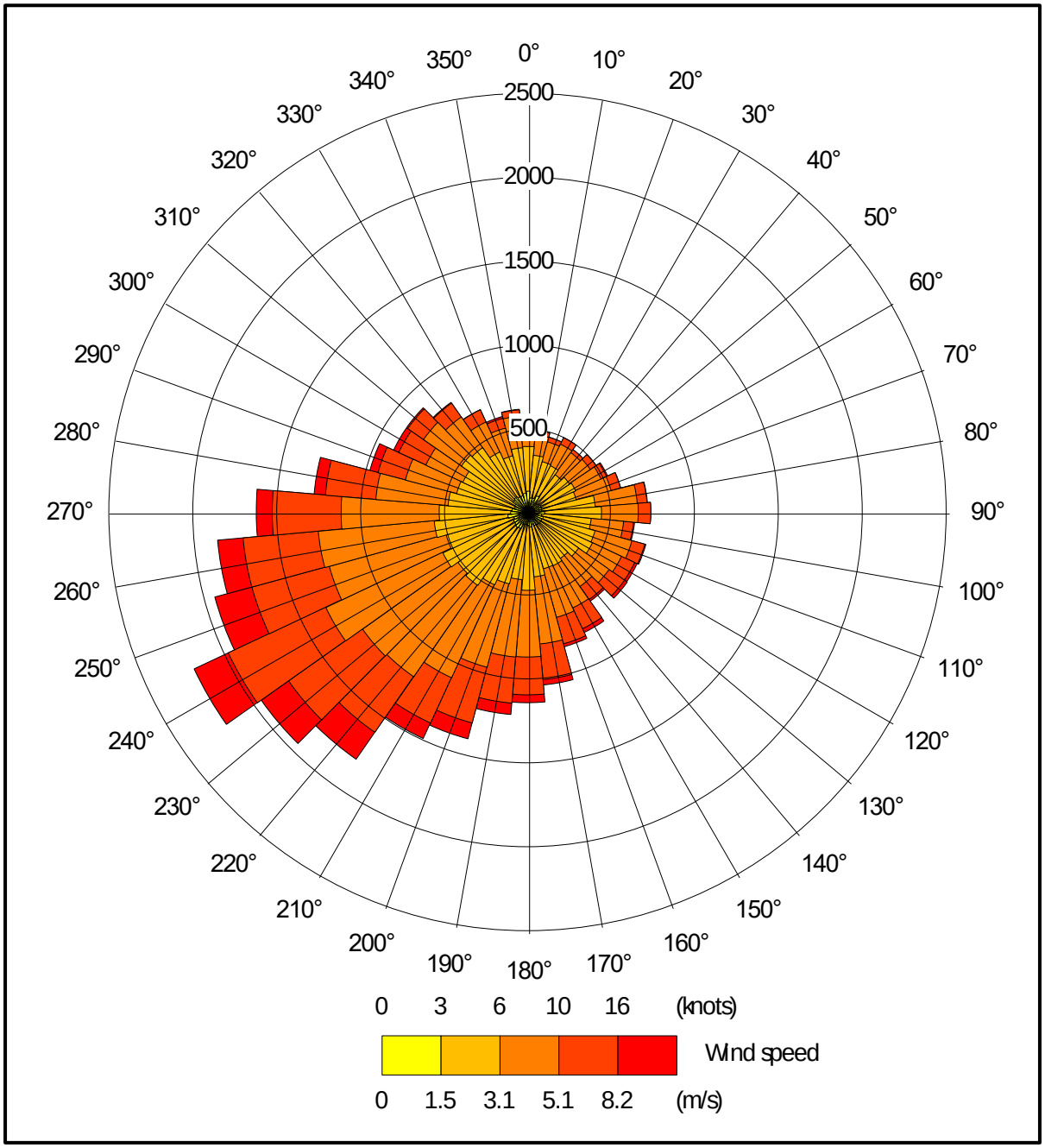


Figure 2b. The wind rose. FLOWSTAR derived data for 52.740 N, 3.198 W, 2012 – 2015

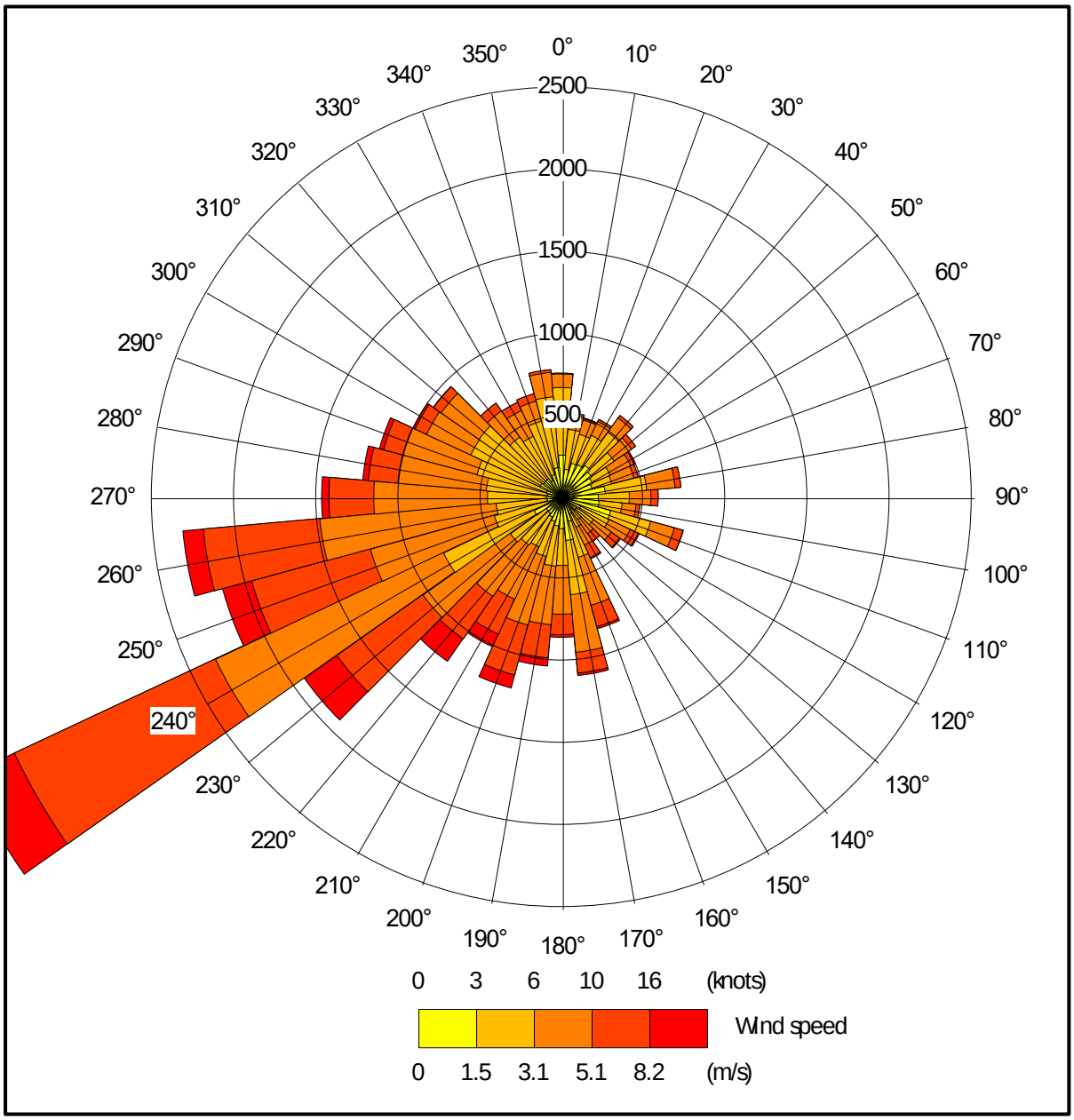


Figure 2c. The wind rose. Lake Vyrnwy data 2012 – 2015

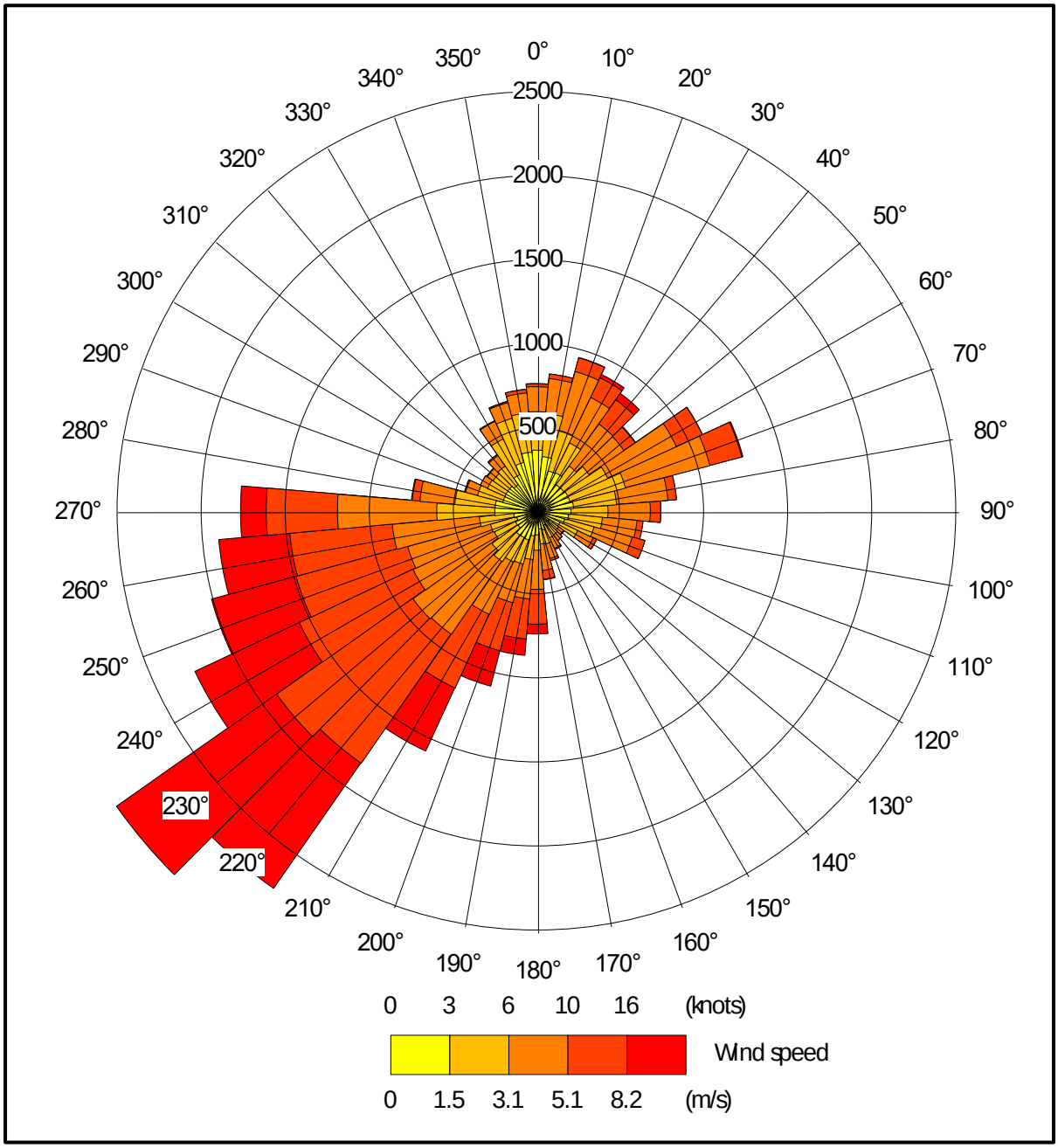


Figure 2d. The wind rose. RAF Shawbury data 2012 – 2015

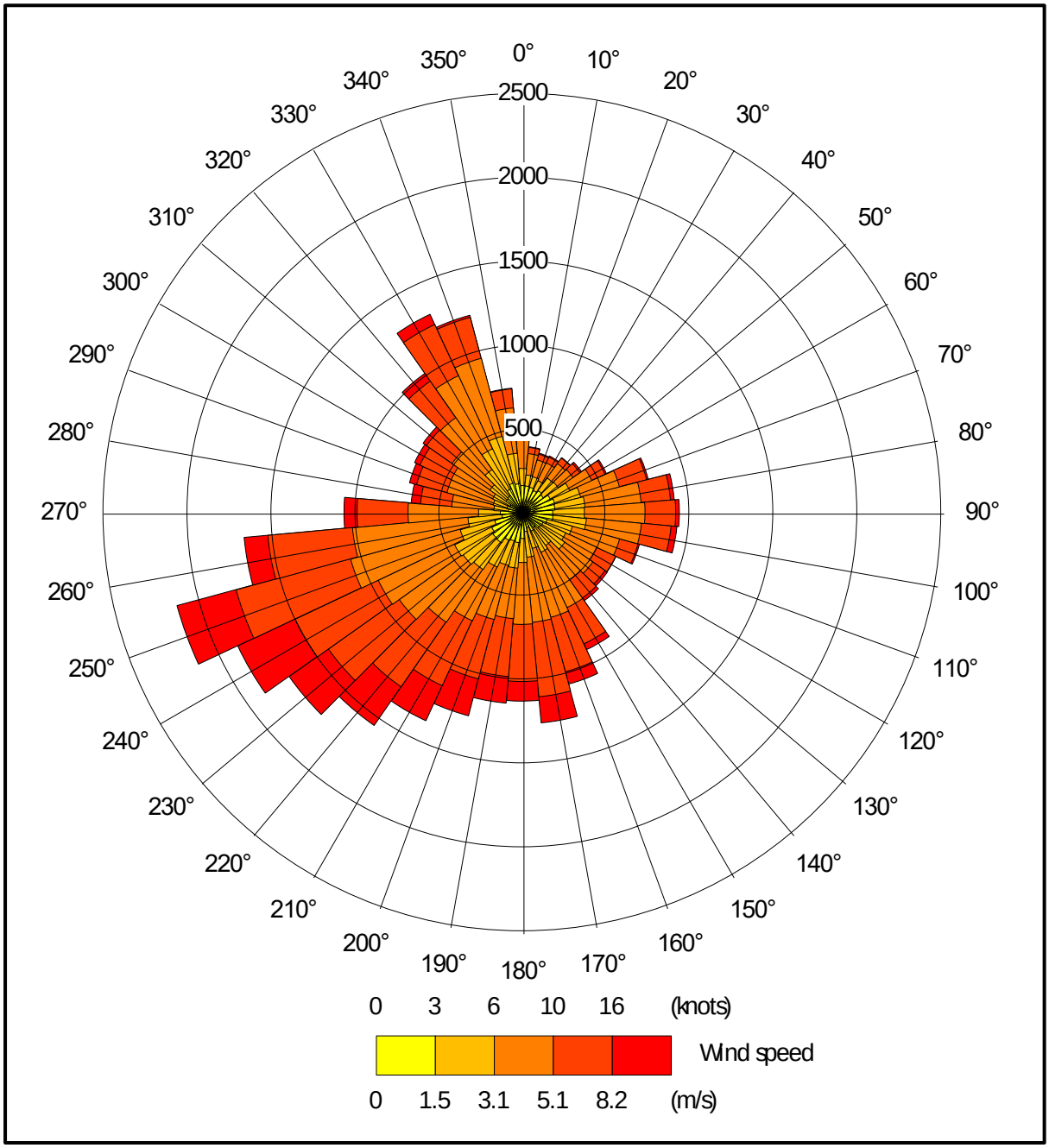
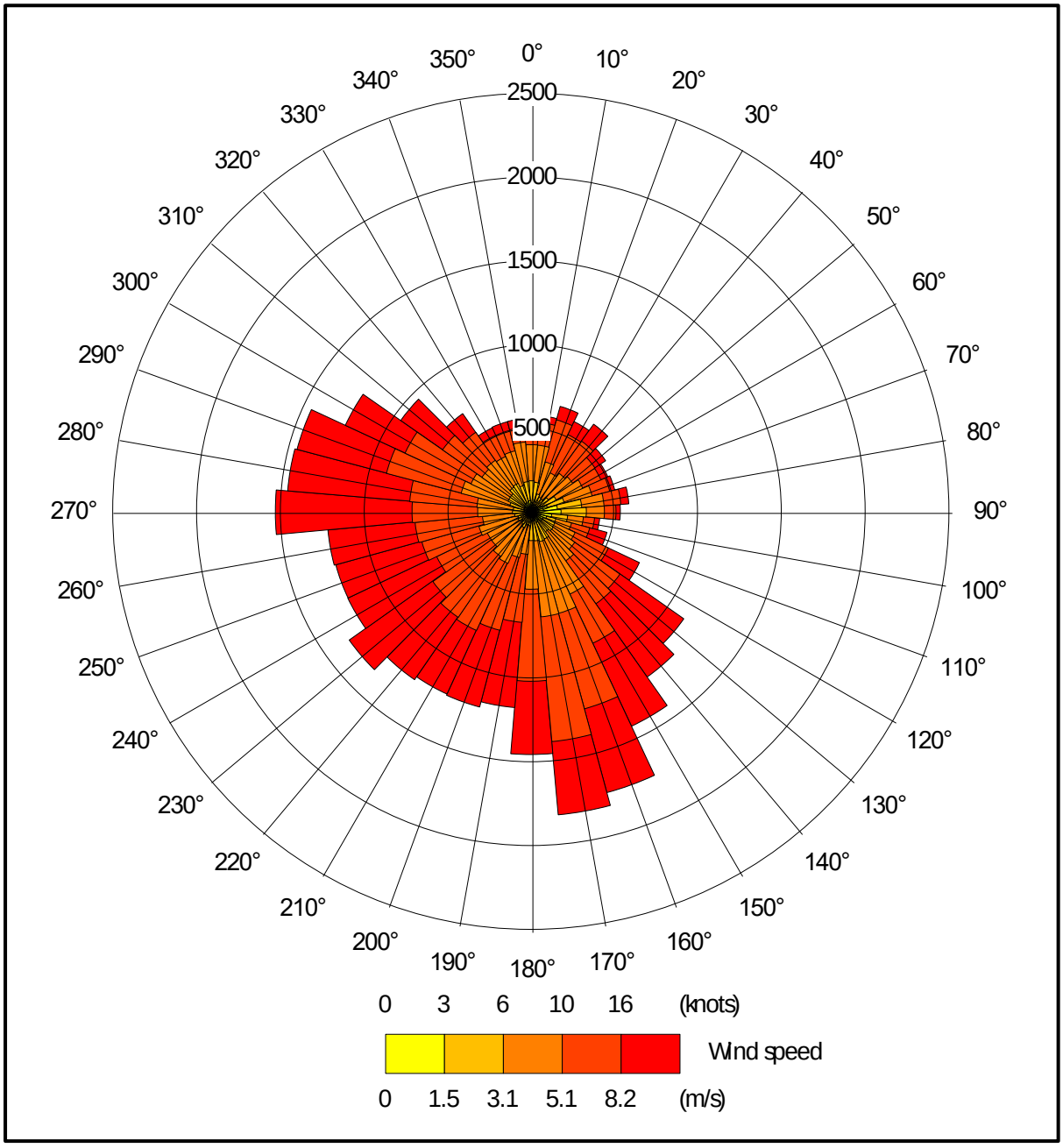


Figure 2e. The wind rose. Hawarden data 2012 – 2015



4.2 Emission sources

Emissions from the chimneys of uncapped high speed ridge fans on the proposed poultry houses are represented by three point sources per house within ADMS (PR1 a, b & c and PR2 a, b & c).

Details of the point source parameters are shown in Table 3 and the positions of the point sources may be seen in Figure 3.

Table 3. Point source parameters

Source ID	Height (m)	Diameter (m)	Efflux velocity (m/s)	Emission temperature (˚C)	Baseline emission rate per source (g-NH_3/s)
PR1 a, b & c and PR2 a, b & c	5.5	0.8	10.0	22.0	0.017957

4.3 Modelled buildings

The structure of the poultry houses and other farm buildings may affect the plumes from the point sources. Therefore, the buildings are modelled within ADMS. The positions of the modelled buildings may be seen in Figure 3, where they are marked by grey rectangles.

4.4 Discrete receptors

Forty-seven discrete receptors have been defined: thirty-two at the AWs (1 to 32); one at Gwern-y-Brain Dingle SSSI (33); ten at Granllyn SAC and the Mongomery Canal SAC (34 to 43) and four at the Tanet and Vyrnwy Bat Sites SAC (44 to 47). These receptors are defined at ground level within ADMS. The positions of the discrete receptors may be seen in Figures 4a and 4b, where they are marked by enumerated pink rectangles.

4.5 Cartesian grid

Not used.

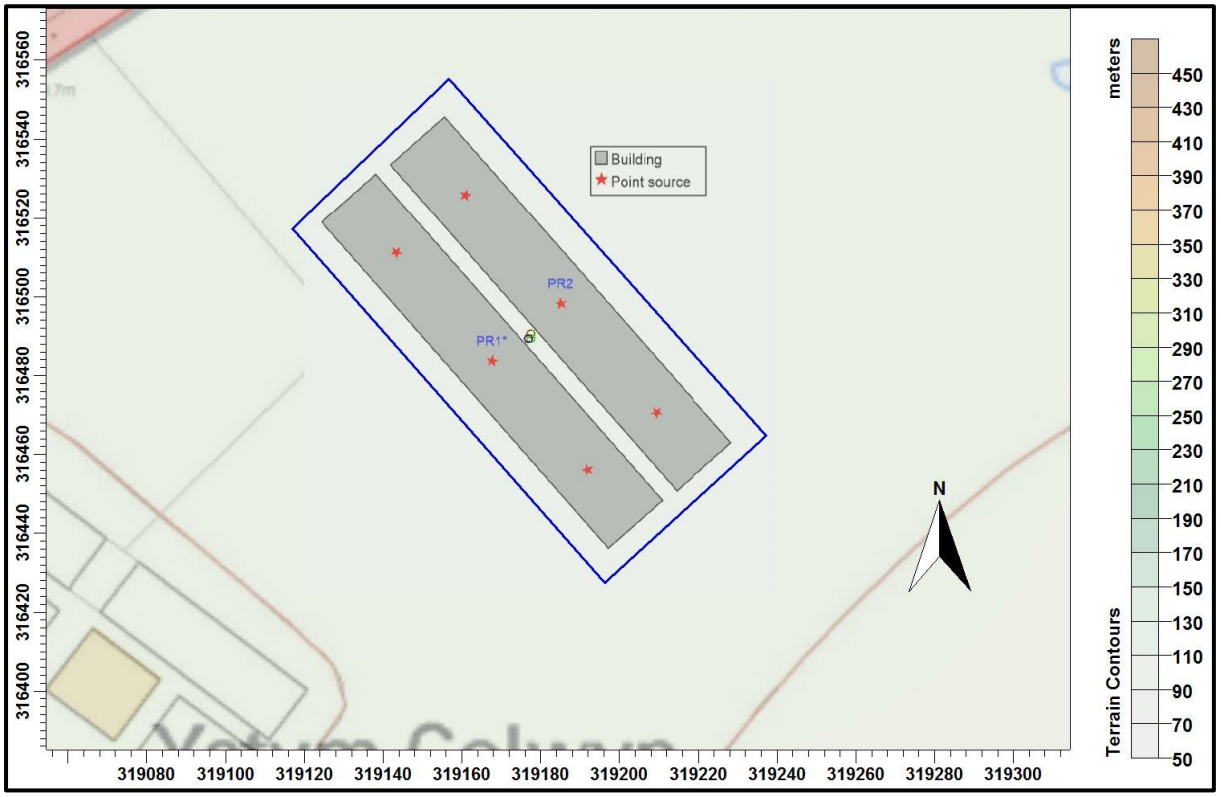
4.6 Terrain data

Terrain has been considered in the modelling. The terrain data are based upon the Ordnance Survey 50 m Digital Elevation Model. A 20.0 km x 20.0 km domain has been resampled at 100 m horizontal resolution for use within ADMS for use in the preliminary. N.B. The resolution of FLOWSTAR is 32 x 32 grid points; therefore, the effective resolution of the wind field is approximately 600 m.

4.7 Roughness Length

A fixed surface roughness length of 0.25 m has been applied over the entire modelling domain. As a precautionary measure, the GFS meteorological data is assumed to have a roughness length of 0.225 m. The effect of the difference in roughness length is precautionary as it increases the frequency of low wind speeds and the stability and therefore increases predicted ground level concentrations.

Figure 3. The positions of modelled buildings & sources

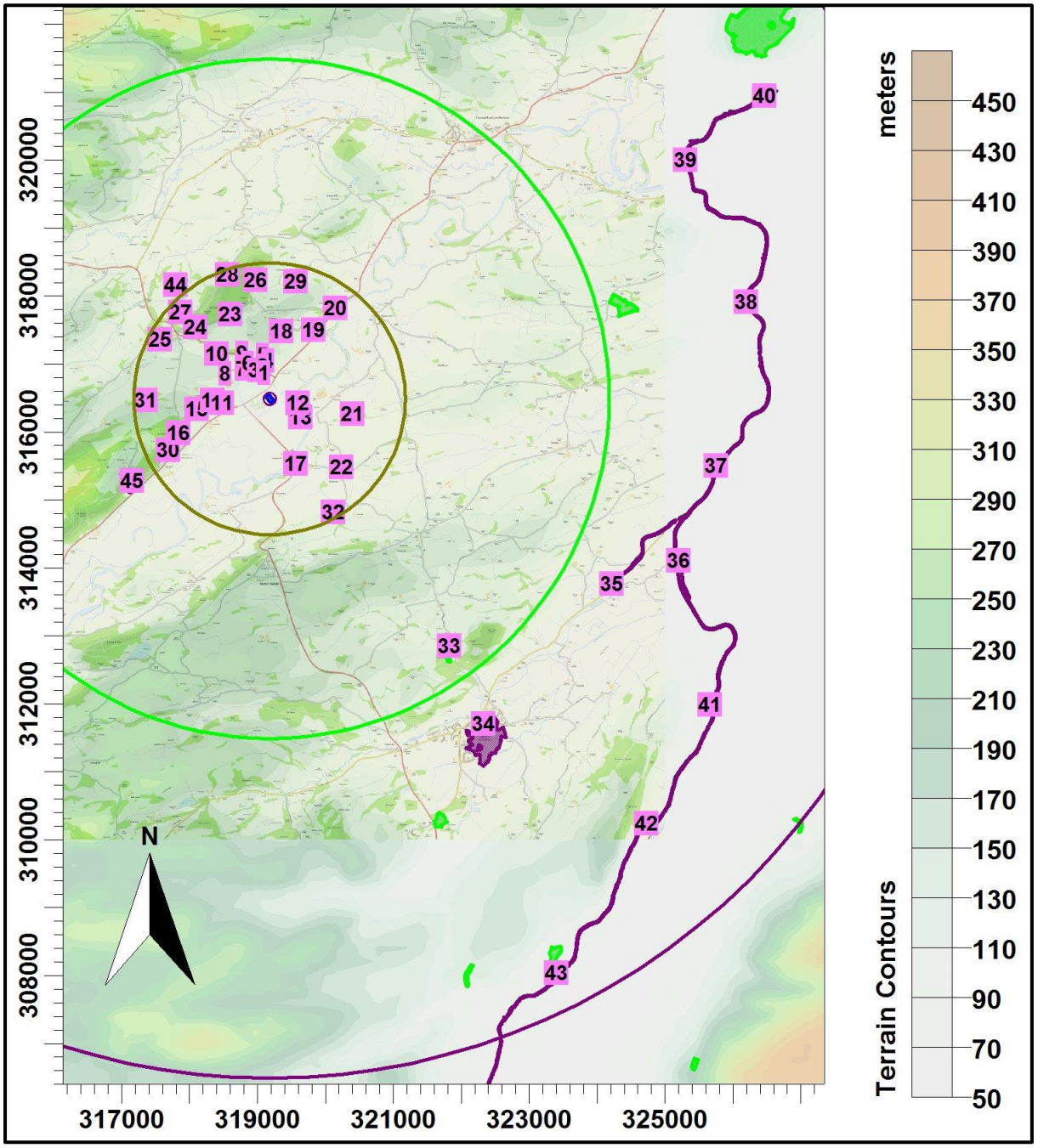


© Crown copyright and database rights. 2016.

4.8 Deposition

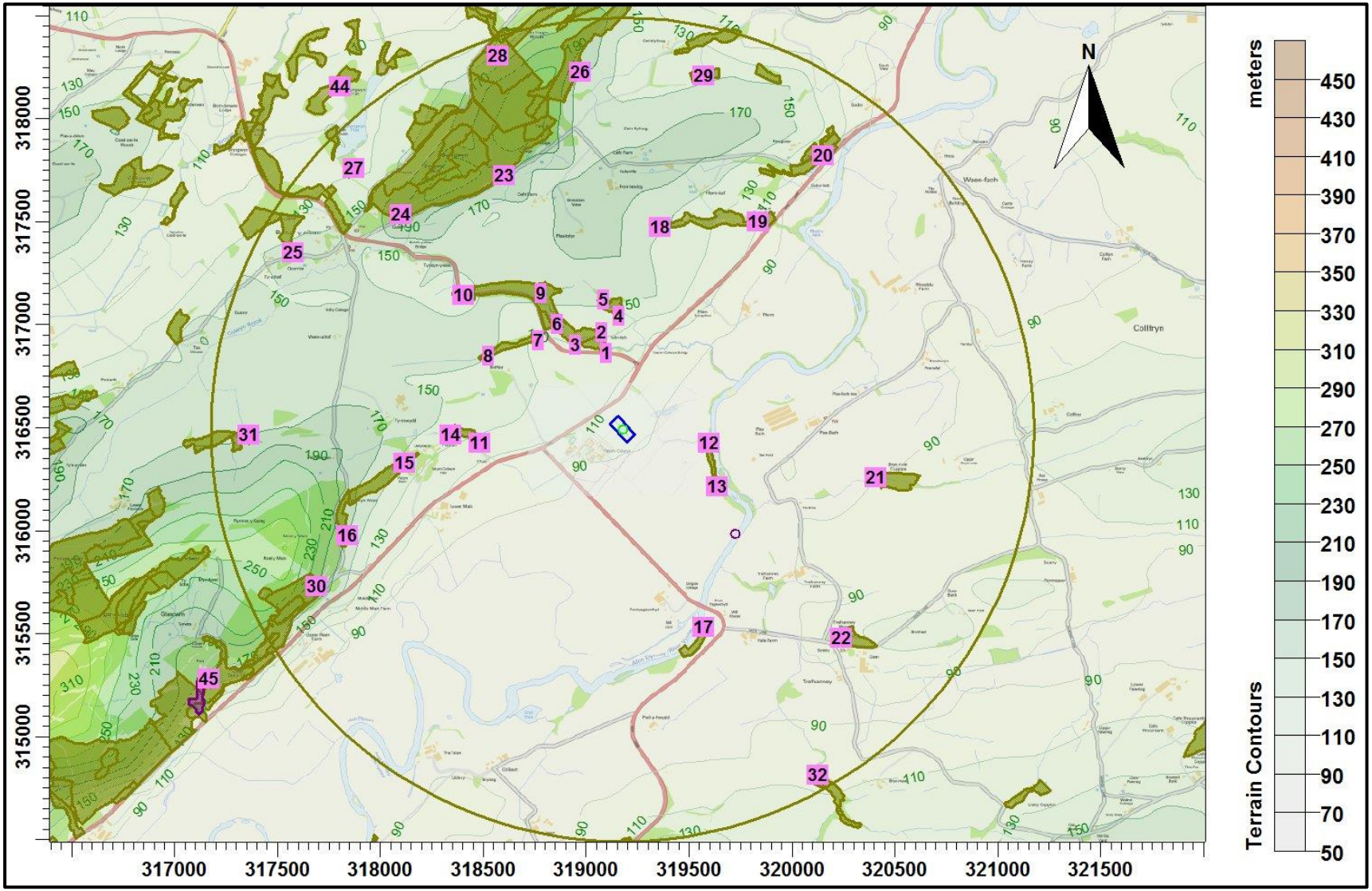
The method used to model deposition of ammonia and consequent plume depletion is based on a document titled "Guidance on modelling the concentration and deposition of ammonia emitted from intensive farming" from the Environment Agency's Air Quality Modelling and Assessment Unit, 22 November 2010. In this case it proves unnecessary to model deposition of ammonia explicitly and where deposition figures are quoted, these are obtained by multiplying the predicted ammonia concentration by an appropriate deposition velocity and a factor of 259.7 to convert units. Please note that, because deposition of ammonia and the consequent plume depletion are not accounted for, this is a precautionary approach. Therefore, predicted ammonia concentrations (and nitrogen and acid deposition rates) are always higher than if deposition were modelled explicitly, particularly where there is some distance between the source and a receptor.

Figure 4a. The discrete receptors – concentric circles radii 2 km (olive) and, 5 km (green)



© Crown copyright and database rights. 2016.

Figure 4b. The discrete receptors and the regular Cartesian grid – a closer view



© Crown copyright and database rights. 2016.

.

5. Details of the Model Runs and Results

5.1 Preliminary modelling

ADMS was run a total of twelve times, once for each year of the meteorological record in six modes:

- In basic mode without calms, or terrain – GFS data.
- With calms and without terrain – GFS data.
- Without calms and with terrain – GFS data.
- In basic mode without calms, or terrain – Lake Vyrnwy data.
- In basic mode without calms, or terrain – RAF Shawbury data.
- In basic mode without calms, or terrain – Hawarden data.

For each mode, statistics for the maximum annual mean ammonia concentration at each receptor were compiled.

Details of the predicted annual mean ammonia concentrations at each receptor are provided in Table 5. In the Table, predicted ammonia concentrations that are in excess of the Environment Agency's upper threshold (20% of Critical Level or Load for a SAC, 50% of Critical Level or Load for a SSSI and 100% of Critical Level or Load for an AW) are coloured red. Concentrations in the range between the Environment Agency's upper threshold and lower threshold (4% to 20% for a SAC, 20% to 50% for a SSSI and 50% [1] to 100% for an AW) are coloured blue. For convenience, cells referring to AWS/LWS are shaded olive, cells referring to SSSIs are shaded green and cells referring to the SACs are shaded purple. A table showing equivalent ammonia concentrations is shown in Table 4 below.

1. The pre-February 2016 value is retained.

Table 4. Equivalent ammonia concentrations

Deposition Velocity (m/s)	Concentration equivalent to X % of Critical Load of 10 kg/ha (µg/m^3)			
	100%	50%	20%	4%
0.03	1.284	0.642	0.257	0.051
0.02	1.925	0.963	0.385	0.077

Table 5. Predicted maximum annual mean ammonia concentration rate at the discrete receptors

Receptor number	X(m)	Y(m)	Name	Maximum annual mean ammonia concentration - ($\mu g/m^3$)					
				GFS No Calms	GFS Calms	GFS Terrain	Lake Vyrnwy	Shawbury	Hawarden
1	319093	316867	Ceunant Mawr AW	0.275	0.271	0.286	0.117	0.308	0.283
2	319070	316971	Ceunant Mawr AW	0.188	0.185	0.192	0.078	0.195	0.191
3	318944	316909	Ceunant Mawr AW	0.149	0.147	0.144	0.054	0.172	0.172
4	319155	317048	Unnamed AW	0.180	0.177	0.144	0.082	0.154	0.141
5	319079	317128	Unnamed AW	0.132	0.130	0.119	0.056	0.120	0.123
6	318856	317006	Ceunant Mawr AW	0.103	0.102	0.089	0.036	0.110	0.117
7	318763	316929	Unnamed AW	0.105	0.104	0.074	0.033	0.097	0.108
8	318519	316856	Unnamed AW	0.084	0.083	0.081	0.044	0.061	0.056
9	318774	317157	Ceunant Mawr AW	0.073	0.072	0.063	0.026	0.076	0.080
10	318395	317148	Ceunant Mawr AW	0.054	0.054	0.038	0.018	0.040	0.042
11	318475	316431	Unnamed AW	0.098	0.097	0.076	0.082	0.095	0.090
12	319588	316431	Unnamed AW	0.308	0.302	0.303	0.233	0.181	0.200
13	319628	316220	Unnamed AW	0.148	0.146	0.129	0.079	0.106	0.115
14	318333	316471	Unnamed AW	0.078	0.077	0.055	0.059	0.076	0.071
15	318109	316333	Unnamed AW	0.051	0.050	0.034	0.052	0.052	0.050
16	317832	315984	Moel y Main AW	0.024	0.024	0.013	0.048	0.029	0.031
17	319564	315537	Unnamed AW	0.046	0.046	0.040	0.070	0.067	0.069
18	319352	317480	Unnamed AW	0.080	0.079	0.048	0.041	0.058	0.054
19	319828	317504	Unnamed AW	0.069	0.068	0.051	0.056	0.055	0.050
20	320145	317827	Unnamed AW	0.046	0.045	0.041	0.040	0.039	0.035
21	320397	316265	Bryn Over Coppice AW	0.061	0.060	0.055	0.050	0.028	0.033
22	320233	315485	Trefnanney Wood AW	0.042	0.041	0.037	0.030	0.029	0.027
23	318595	317733	Bryngwyn Wood AW	0.035	0.035	0.035	0.013	0.035	0.035
24	318090	317539	Bryngwyn Wood AW	0.032	0.031	0.019	0.010	0.023	0.026
25	317568	317357	Unnamed AW	0.031	0.030	0.029	0.016	0.019	0.017

Table 5. (continued)

Receptor number	X(m)	Y(m)	Name	Maximum annual mean ammonia concentration - ($\mu g/m^3$)					
				GFS No Calms	GFS Calms	GFS Terrain	Lake Vyrnwy	Shawbury	Hawarden
26	318965	318232	Bryngwyn Wood AW	0.034	0.034	0.027	0.014	0.026	0.026
27	317861	317768	Bryngwyn Wood AW	0.025	0.025	0.017	0.008	0.018	0.020
28	318560	318314	Bryngwyn Wood AW	0.025	0.025	0.030	0.010	0.021	0.023
29	319564	318214	Unnamed AW	0.035	0.035	0.021	0.020	0.029	0.025
30	317679	315737	Moel y Main AW	0.019	0.019	0.010	0.041	0.022	0.024
31	317351	316471	Unnamed AW	0.030	0.030	0.015	0.025	0.027	0.027
32	320115	314821	Unnamed AW	0.027	0.026	0.013	0.037	0.030	0.030
33	321821	312856	Gwern-y-Brain Dingle	0.012	0.012	0.004	0.012	0.009	0.009
34	322323	311707	Granllyn	0.009	0.009	0.003	0.011	0.007	0.007
35	324212	313768	Montgomery Canal	0.008	0.008	0.010	0.008	0.004	0.004
36	325196	314105	Montgomery Canal	0.007	0.007	0.009	0.008	0.003	0.003
37	325751	315500	Montgomery Canal	0.007	0.007	0.008	0.010	0.003	0.003
38	326195	317910	Montgomery Canal	0.007	0.007	0.007	0.009	0.006	0.006
39	325301	320008	Montgomery Canal	0.007	0.007	0.017	0.007	0.008	0.007
40	326459	320952	Montgomery Canal	0.005	0.005	0.012	0.005	0.006	0.006
41	325661	311987	Montgomery Canal	0.005	0.005	0.009	0.006	0.003	0.003
42	324727	310244	Montgomery Canal	0.006	0.006	0.004	0.006	0.004	0.004
43	323403	308044	Montgomery Canal	0.004	0.004	0.002	0.008	0.005	0.005
44	317795	318161	Bryngwyn Hall & Stables	0.020	0.020	0.015	0.006	0.015	0.017
45	317156	315286	Allt y Main Mine	0.012	0.012	0.006	0.026	0.014	0.015
46	318747	323220	Tanet & Vyrnwy	0.006	0.006	0.002	0.003	0.005	0.004
47	316365	323610	Tanet & Vyrnwy	0.005	0.005	0.002	0.002	0.004	0.004

6. Summary and Conclusions

AS Modelling & Data Ltd. has been instructed by John Ward, on behalf of Ystym Colwyn Farms, to use computer modelling to assess the impact of ammonia emissions from the proposed broiler rearing unit at Ystym Colwyn Farm, Meifod, Welshpool, Powys. SY22 6XT.

Ammonia emission rates from the proposed poultry houses have been assessed and quantified based upon the Environment Agency's standard ammonia emission factors. The ammonia emission rates have then been used as inputs to an atmospheric dispersion and deposition model which calculates ammonia exposure levels and nitrogen and acid deposition rates in the surrounding area.

Using the Environment Agency's standard ammonia emission factors, at all receptors considered, the process contribution to both maximum annual mean ammonia concentration and the nitrogen deposition rate is predicted to be below the Environment Agency's lower threshold percentage of the Critical Level and Critical Load for the designation of the site.

It should be noted that the use of indirect heating at the proposed poultry unit would likely lead to significantly lower ammonia emission rates than the Environment Agency's standard emission rate, which was used for the modelling.

7. References

Cambridge Environmental Research Consultants (CERC) (website).
http://www.cerc.co.uk/environmental-software/ADMS-model.html

Environment Agency H1 Risk Assessment (website).
https://www.gov.uk/government/collections/horizontal-guidance-environmental-permitting

M. A. Sutton *et al*. Measurement and modelling of ammonia exchange over arable croplands.
https://enviro.doe.gov.my/lib/digital/1386301476-1-s2.0-S0166111606802748-main.pdf

Misselbrook. *et al*. Inventory of Ammonia Emissions from UK Agriculture 2011
http://uk-air.defra.gov.uk/assets/documents/reports/cat07/1211291427_nh3inv2011_261112_FINAL_corrected.pdf

Colin Powlesland, 2009. Revision of Emission Factor for Broilers
http://webarchive.nationalarchives.gov.uk/20140328084622/http://www.environment-agency.gov.uk/static/documents/Business/Revision_of_Emission_Factor_for_Broilers_160209_bpc_2.pdf

United Nations Economic Commission for Europe (UNECE) (website).
http://www.unece.org/env/lrtap/WorkingGroups/wge/definitions.htm

UK Air Pollution Information System (APIS) (website).
http://www.apis.ac.uk/