A Report on the Modelling of the Dispersion and Deposition of Ammonia from the Existing and Proposed Pig Rearing Houses at Crockway Farm Pig Unit, near Maiden Newton in Dorset

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1. Introduction

AS Modelling & Data Ltd. has been instructed by Harry Edwards of The Farm Consultancy Group, on behalf of Crockway Farms Limited, to use computer modelling to assess the impact of ammonia emissions from the existing and proposed pig rearing houses at the Crockway Farm Pig Unit, near Maiden Newton, Dorchester in Dorset. DT2 0BY.

Ammonia emission rates from the existing and proposed piggeries have been assessed and quantified based upon the Environment Agency's standard ammonia emission factors and figures obtained from the UK Ammonia Emissions Inventory (UKAIE). 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 piggery at Crockway Farm is in a rural area approximately 1.5 km to the south-east of the village of Maiden Newton in Dorset. The surrounding land is used primarily for arable farming although there is grazing land and some semi-natural woodlands and grasslands nearby. The site is at an elevation of around 140 m in the River Frome valley, with the land rising towards downs to the north and falling towards the River Frome immediately to the south.

Crockway Farm Pig Unit comprises of a 'top yard' and 'bottom yard' each with several pig houses of varying age and design; these houses currently provide accommodation for up to 17,318 pigs, with 7,550 pigs (growers <30 kg, production pigs > 30 kg and gilts > 30 kg) at the top yard and up to 9,768 pigs (farrowers, weaners, dry sows and production pigs > 30 kg) at the bottom yard.

It is proposed that three new cabins be constructed at the bottom yard of Crockway Farm Pig Unit in addition to changes in numbers of pigs in the existing buildings. Under the proposal, the buildings on the top yard would house up to 9,500 pigs (growers <30 kg, weaners 6-15 kg and gilts > 30 kg) and the bottom yard would house up to 4,856 pigs (farrowers, dry sows and gilts > 30 kg) There would therefore be up to 14,356 pigs at Crockway Farm under the proposed scenario.

Breakdowns of pig weights and numbers, housing types and ventilation details, for both the baseline and proposed scenarios are provided in Section 3 of this report.

In the area surrounding Crockway Farm piggery there are several areas designated as Ancient Woodlands (AWs), or other non-statutory Local Wildlife Sites (LWSs), within 2 km. There are also sixteen Sites of Special Scientific Interest (SSSIs) within 10 km, three of which also share an international designation as a Special Area of Conservation (SAC); there is also one other SAC within 10 km. Further details of the SSSIs and SACs are provided below:

- **Hogg Cliff SSSI/Cerne & Sydling Downs SAC** - Approximately 350 m to the north at closest point. Grassland and scrub site with small amount of woodland, noted for abundant and diverse fungi including a number of uncommon species.
- **Langford Meadow SSSI** - Approximately 1.8 km to the south-east. Disused water meadow.
- **Sydling Valley Downs SSSI** - Approximately 3.5 km to the north-east. Chalk grassland with areas of ancient woodland dominated by Ash, Oak and Maple.
- **West Dorset Alder Woods SAC** – Approximately 5.2 km to the west. Mixed woodland with grassland and scrub habitats and a series of ponds.
- **Batcombe Down SSSI** - Approximately 7.1 km to the north. Dorset Chalk escarpment, scrubby acid grassland.
- **Melbury Park SSSI** - Approximately 9.3 km to the north-north-west. Parkland with many exotic and ornamental trees and large areas of semi-natural woodland. One of the richest localities for epiphytic lichens in Europe including *Lobarion pulmonariae, Agonimia octospora* and *Sticta limbata*.
- **Rampisham Down SSSI** - Approximately 7.5 km to the north-west. Lowland acid grassland and heathland.
- **Toller Porcorum SSSI** - Approximately 6.0 km to the north-west-west. Grassland site with rare or absent species elsewhere in Dorset and small areas of woodland of Pedunculate Oak and Ash.
- **Haydon and Askerswell Downs SSSI** - Approximately 6.5 km to the south-west-west. Extensive area of steep chalk slopes of well grazed grassland.

- **Eggardon Hill & Luccas Farm SSSI** - Approximately 6.8 km to the west. Grassland site on chalk escarpment with wooded areas dominated by ash, pedunculate oak and field maple.
- **Drakenorth SSSI** - Approximately 8.6 km to the west. Grassland site within Dorset Area of Outstanding Natural Beauty with several stream in deeply incised wooded ravines.
- **Mapperton and Poorton Vales SSSI** - Approximately 10.0 km to the west. Steep sided valleys with wet woodland, fn and marshy grassland habitats.
- **Pitcombe Down SSSI** - Approximately 6.7 km to the south-south-west. Chalk downland noted for the uncommon butterfly species Small Blue and Adonis Blue.
- **Valley of Stones SSSI** - Approximately 7.5 km to the south-south-west. Grassland on valley slopes supporting a rich flora of lichens, mosses and liverworts including nationally scarce species.
- **Blackdown (Hardy Monument) SSSI** - Approximately 8.2 km to the south. Important geological site within Dorset Area of Outstanding Natural Beauty with abundant epiphytic mosses and lichens.
- **River Frome SSSI** - Approximately 9.8 km to the south-east. Chalk stream supporting typical aquatic flora and bank species.
- **Court Farm, Sydling SSSI** - Approximately 9.4 km to the north and north-north-west. Unimproved grassland abundant in flowering herbs.

Maps of the surrounding area showing the positions of the pig houses, the AWs, the LWSs, the SSSIs and the SACs are provided in Figures 1a and 1b. In the figures, the AWs and LWSs are shaded in olive, the SSSIs are shaded in green, the SACs are shaded in purple and the site of the pig units at Crockway Farm are outlined in blue.

Figure 1a. The area surrounding Crockway Farm – concentric circles radii 2.35 km (olive), 5.35 km (green) and 10.35 km (purple)

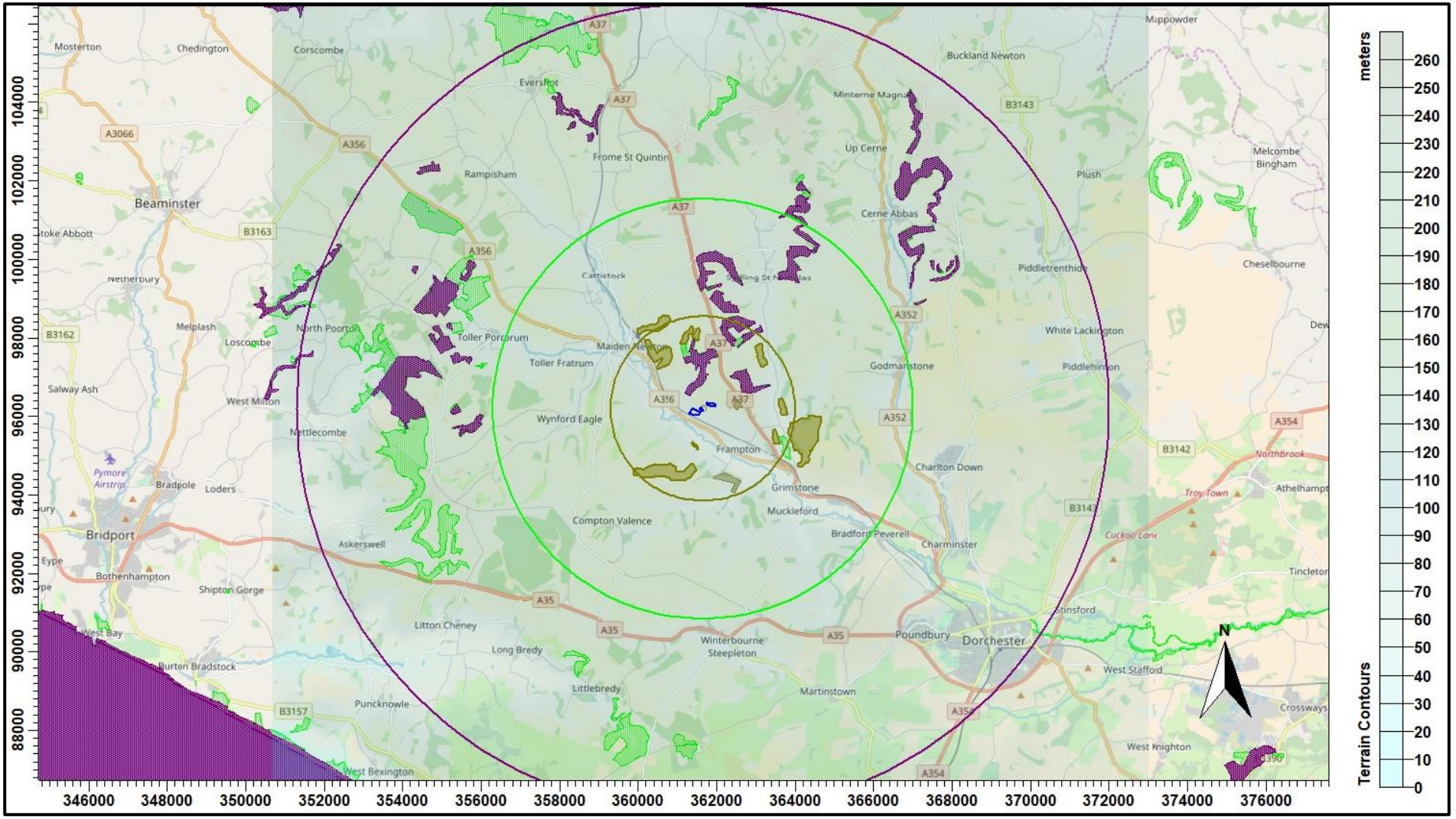
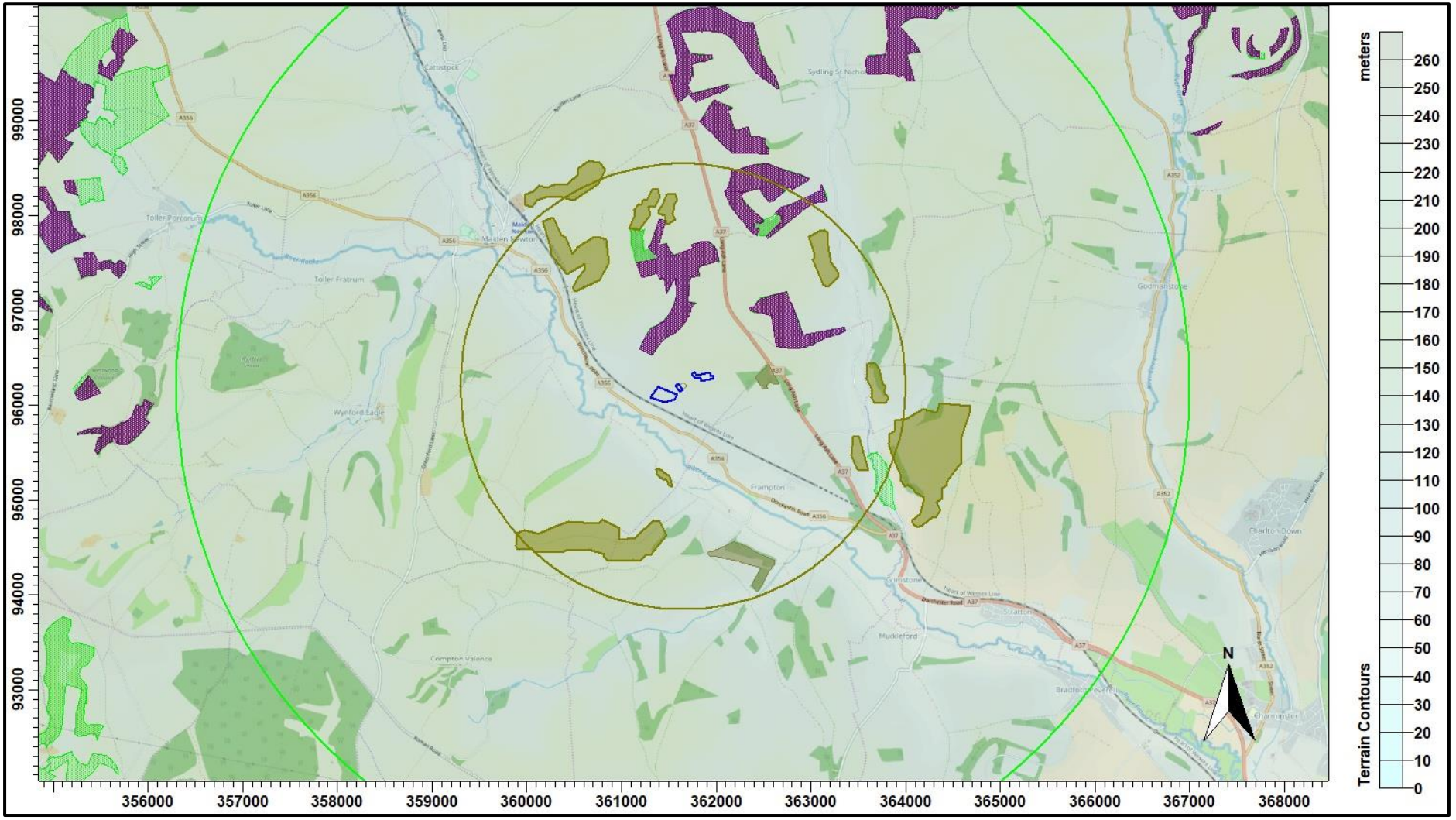


Figure 1b. The area surrounding Crockway Farm – a closer view



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 ($\mu g\text{-}NH_3/m^3$) 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 source of the background figures is the Air Pollution Information System (APIS, January 2024). It should be noted that the 1 km APIS database background levels are extrapolated from 5 km modelled data. Ammonia levels may vary markedly over relatively short distances and the APIS website itself notes that, the background values should be used only to assist the user in obtaining a broad indication of the likely pollutant impact at a specific location and cannot be considered representative of any particular location within the 5 km grid square; extrapolation to a 1 km grid does not alter this.

The background ammonia concentration (annual mean) in the area around Crockway Farm and the wildlife sites is 1.7 $\mu g\text{-}NH_3/m^3$. The background nitrogen deposition rate to woodland is 27.45 kg-N/ha/y and to short vegetation is 16.89 kg-N/ha/y. The background acid deposition rate to woodland is 1.96 keq/ha/y and to short vegetation is 1.19 keq/ha/y.

The APIS background figures are subject to revision and appear to change fairly frequently, the latest figures can be obtained at https://www.apis.ac.uk/search-location.

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. 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. However, it may be necessary to consider nitrogen deposition should a Critical Load of 5.0 kg-N/ha/y be appropriate. 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)
AW/LWS	1.0 [1]	-	-
Hog Cliff SSSI	1.0 [1]	15.0 [2]	1.930 [2]
Batcombe Down SSSI; Haydon and Askerswell Downs SSSI; Pitcombe Down SSSI	1.0 [1]	15.0 [4]	-
Eggardon Hill & Luccas Farm SSSI, Drakenorth SSSI, Mapperton and Poorton Vales SSSI, Court Farm Sydling SSSI and Sydling Valley Downs SSSI, West Dorset Alder Woods SAC.	1.0 [3]	10.0 [4]	-
Cerne & Sydling Downs SAC	3.0 [5]	15.0 [5]	-
Rampisham Down SSSI, Toller Porcorum SSSI, Blackdown (Hardy Monument) SSSI, River Frome SSSI	1.0 [3]	5.0 [4]	-
Melbury Park SSSI	1.0 [3]	-	-
Langford Meadow SSSI	3.0 [3]	15.0 [4]	-

1. A precautionary figure used where no details of the ecology of the site are available, or the citation for the site contains reference to sensitive lichens and/or bryophytes.
2. Based on Environment Agency pre-application report.
3. Based upon the citation for the site and information from APIS (January 2024).
4. The lower bound of the range of Critical Loads for the site/species, obtained from APIS (January 2024).
5. Critical Level for SAC confirmed by Natural England during last permit variation.

3.4 Guidance on the significance of ammonia emissions

3.4.1 Environment Agency Criteria

The Environment Agency web-page titled "Intensive farming risk assessment for your environmental permit", contains a set of criteria, with thresholds defined by percentages of the Critical Level or Critical Load, for: internationally designated wildlife sites (Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and Ramsar sites); Sites of Special Scientific Interest (SSSIs) and other non-statutory wildlife sites. The lower and upper thresholds are: 4% and 20% for SACs, SPAs and Ramsar sites; 20% and 50% for SSSIs and 100% and 100% for non-statutory wildlife sites.

If the predicted process contributions to Critical Level or Critical Load are below the lower threshold percentage, the impact is usually deemed acceptable.

If the predicted process contributions to Critical Level or Critical Load are in the range between the lower and upper thresholds; 4% to 20% for SACs, SPAs and Ramsar sites; 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. 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%).

3.4.2 Natural England advisory criteria

Natural England are a statutory consultee at planning and usually advise that, if predicted process contributions exceed 1% (or lower in some circumstances) of Critical Level or Critical Load at a SSSI, SAC, SPA or Ramsar site, then the local authority should consider whether other farming installations[1] might act in-combination or cumulatively with the farm and the sensitivities of the wildlife sites.

1. The process contribution from most farming installations is already included in the background ammonia concentrations and nitrogen and acid deposition rates. Therefore, it is normally only necessary to consider new installations and installations with extant planning permission and proposed developments when understanding the additional impact of a proposal upon nearby ecologies. However, established farms in close proximity may need to be considered given the background concentrations are derived from an average for a 5 km by 5 km grid.

3.4.3 Environment Agency and Natural England May 2022 Air Quality Risk Assessment Interim Guidance

Although it seems important to include a reference to this document, it appears to be primarily a discussion document about internal Environment Agency screening models and the SCAIL model and AS Modelling & Data Ltd. have been unable to draw any conclusions from the document as to what thresholds may or may not apply, nor in what circumstances the threshold may or may not apply.

3.4.4 Joint Nature Conservancy Committee - Guidance on Decision-making Thresholds for Air Pollution

In December 2021, the Joint Nature Conservancy Committee (JNCC) published a report titled, "Guidance on Decision-making Thresholds for Air Pollution". This report provides decision-making criteria to inform the assessment of air quality impacts on designated conservation sites. The criteria are intended to be applied to individual sources to identify those for which a decision can be taken without the need for further assessment effort. The Decision-making thresholds (DMT) for on-site emission sources provided in the JNCC report are reproduced below:

- For lichens and bryophytes - 0.08%, 0.20%, 0.34% and 0.75% of the Critical Level for high, medium, low and very low development density areas, respectively.
- For higher plants - 0.08%, 0.20%, 0.34% and 0.75% of the Critical Level for high, medium, low and very low development density areas, respectively.

- For nitrogen deposition to woodland (Critical Load 10 kg-N/ha/y) - 0.13%, 0.34%, 0.57% and 1.30% of the Critical Level for high, medium, low and very low development density areas, respectively.
- For nitrogen deposition to grassland (Critical Load 10 kg-N/ha/y) 0.09%, 0.24%, 0.40% and 0.88% of the Critical Level for high, medium, low and very low development density areas, respectively.

Note that 'development density' is defined as, the assumed number of additional new sources below the DMT within 5 km of the proposed development over 13 years: very low density being 1 development; low 5 developments; medium 10 developments and high 30 developments.

Subject to some exceptions, where the process contribution from an on-site source is below the DMT, no further assessment is required. Where the process contribution exceeds the DMT there are two possible outcomes:

- Where site-relevant thresholds have been derived these can be applied to see if it is possible to avoid further assessment effort on the basis of site specific circumstances.
- If site-relevant thresholds have not yet been derived, further assessment in combination with other plans and projects is required.

3.6 Quantification of ammonia emissions

Ammonia emission rates from piggeries 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 provides an Intensive Farming Guidance note which lists standard ammonia emission factors for a variety of livestock, including for pigs and manure storage. The emission factors for the baseline and proposed scenarios are based on Environment Agency figures and figures obtained from the UK Ammonia Emissions Inventory (UKAIE). Emission factors for pigs are reduced by 20% for lower protein diet use.

Details of the pig numbers and types, emission factors used and calculated ammonia emission rates are provided in Tables 2a (baseline scenario) and 2b (proposed scenario).

Table 2a. Details of pig numbers and ammonia emission rates for the baseline scenario

ADMS ID	Pig type/weight (kg)	Housing type	Ventilation type	Animal numbers	Emission factor (kg-NH_3/animal-place/y)	Ammonia emission rate (g-NH_3/s)
B1TO6	Farrowers	FSF	High Speed	442	3.504	0.049077
B7	Farrowers	FSF	High Speed	74	3.504	0.008217
B8TO11	Weaners	FSF	High Speed	5,040	0.176	0.028109
B12	Weaners	FSF	High Speed	1,260	0.176	0.007027
B13	Farrowers	FSF	High Speed	132	3.504	0.014657
B14	Dry sows	PSF	High Speed	430	1.808	0.024636
B15	Dry sows	PSF	High Speed	530	1.808	0.030365
B16	Dry sows	PSF	High Speed	390	1.808	0.022344
B17TO18	Dry sows	PSF/FSF	High Speed	1,100	1.808	0.063021
B19	Production Pigs 30 kg +	PSF	High Speed	250	2.0	0.015844
PRB20	Farrowers	FSF	High Speed	120	3.504	0.013324
T1TO2	Growers <30 kg	FSF	High Speed	2,100	0.952	0.063351
T3TO4	Growers <30 kg	FSF	High Speed	2,100	0.952	0.063351
T5	Growers <30 kg	FSF	High Speed	1,050	0.952	0.031675
T6	Production Pigs 30 kg +	FSF	High Speed	800	2.0	0.050701
T7	Production Pigs 30 kg +	FSF	High Speed	300	2.0	0.019013
T8TO9	Gilts 30 kg +	FSF	High Speed	1,200	2.0	0.076051
ADMS ID				Area (m^2)	Emission factor (kg-NH_3/m^2/y)	Ammonia emission rate (g-NH_3/s)
SLURRY_LAGOON	UNCOVERED			2,157	0.56	0.038284
SLURRY_STORE	FLOATING COVER			286	0.7	0.006352

Table 2b. Details of pig numbers and ammonia emission rates for the proposed scenario

ADMS ID	Pig type/weight (kg)	Housing type	Ventilation type	Animal numbers	Emission factor (kg-NH_3/animal-place/y)	Ammonia emission rate (g-NH_3/s)
B1TO6	Farrowers	FSF	High Speed	442	3.504	0.049077
B7	Farrowers	FSF	High Speed	74	3.504	0.008217
B8TO11	Farrowers	FSF	High Speed	200	3.504	0.022207
B12	Farrowers	FSF	High Speed	40	3.504	0.004441
B13	Farrowers	FSF	High Speed	132	3.504	0.014657
B14	Dry sows	PSF	High Speed	850	1.808	0.055860
B15	Dry sows	PSF	High Speed	470	1.808	0.034089
B16	Dry sows	PSF	High Speed	710	1.808	0.047839
B17TO18	Dry sows	PSF/FSF	High Speed	1,040	1.808	0.066745
B19	Gilts 30 kg +	PSF	High Speed	250	2.01	0.015923
PRB20	Farrowers	FSF	High Speed	100	3.504	0.011104
CABIN1	Farrowers	FSF	High Speed	16	3.504	0.001777
CABIN2	Farrowers	FSF	High Speed	16	3.504	0.001777
CABIN3	Farrowers	FSF	High Speed	16	3.504	0.001777
T1TO2	Growers <30 kg	FSF	High Speed	2,000	0.952	0.060334
T3TO4	Growers <30 kg	FSF	High Speed	2,000	0.952	0.060334
T5	Weaners 6-15 kg	FSF	High Speed	2,000	0.532	0.033716
T6	Weaners 6-15 kg	FSF	High Speed	2,000	0.532	0.033716
T7	Gilts 30 kg +	FSF	High Speed	250	2.01	0.015923
T8TO9	Gilts 30 kg +	FSF	High Speed	1,250	2.01	0.079616
ADMS ID				Area (m^2)	Emission factor (kg-NH_3/m^2/y)	Ammonia emission rate (g-NH_3/s)
SLURRY_TANK1	RIGID COVER			1,069	0.28	0.009486
SLURRY_TANK2	RIGID COVER			1,041	0.28	0.009234
SLURRY_STORE	FLOATING COVER			286	0.7	0.006352

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)[1].

Prior to April 2019 the GFS was a spectral model, post April 2019 the physics are discrete. The physics/dynamics model has a resolution or had an equivalent resolution of approximately 7 km over the UK; terrain is understood to be resolved at a resolution of approximately 2 km, with sub-7 km terrain effects parameterised. Site specific data may be extrapolated from nearby archive grid points or a most representative grid point chosen. 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[2]). The use of NWP data has advantages over traditional meteorological records because:

- Calm periods in traditional records may be over represented 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 and wind directions are modified during the modelling by the treatment of roughness lengths (see Section 4.7) and because terrain data is included in the modelling. The terrain and roughness length modified wind rose for the location of the farm is shown in Figure 2b; it should be noted that elsewhere in the modelling domain the modified wind roses may differ more markedly, reflecting the local flow in that part of the domain. N.B. The resolution of FLOWSTAR is 64 x 64 grid points; therefore, the effective resolution of the wind field is approximately 340 m. Please also note that FLOWSTAR is used to obtain a local flow field, not to explicitly model dispersion in complex terrain as defined in the ADMS User Guide; therefore, the ADMS default value for minimum turbulence length has been amended.

Figure 2a. The wind rose. GFS derived data, for 50.764 N, 2.544 W, 2020 – 2024

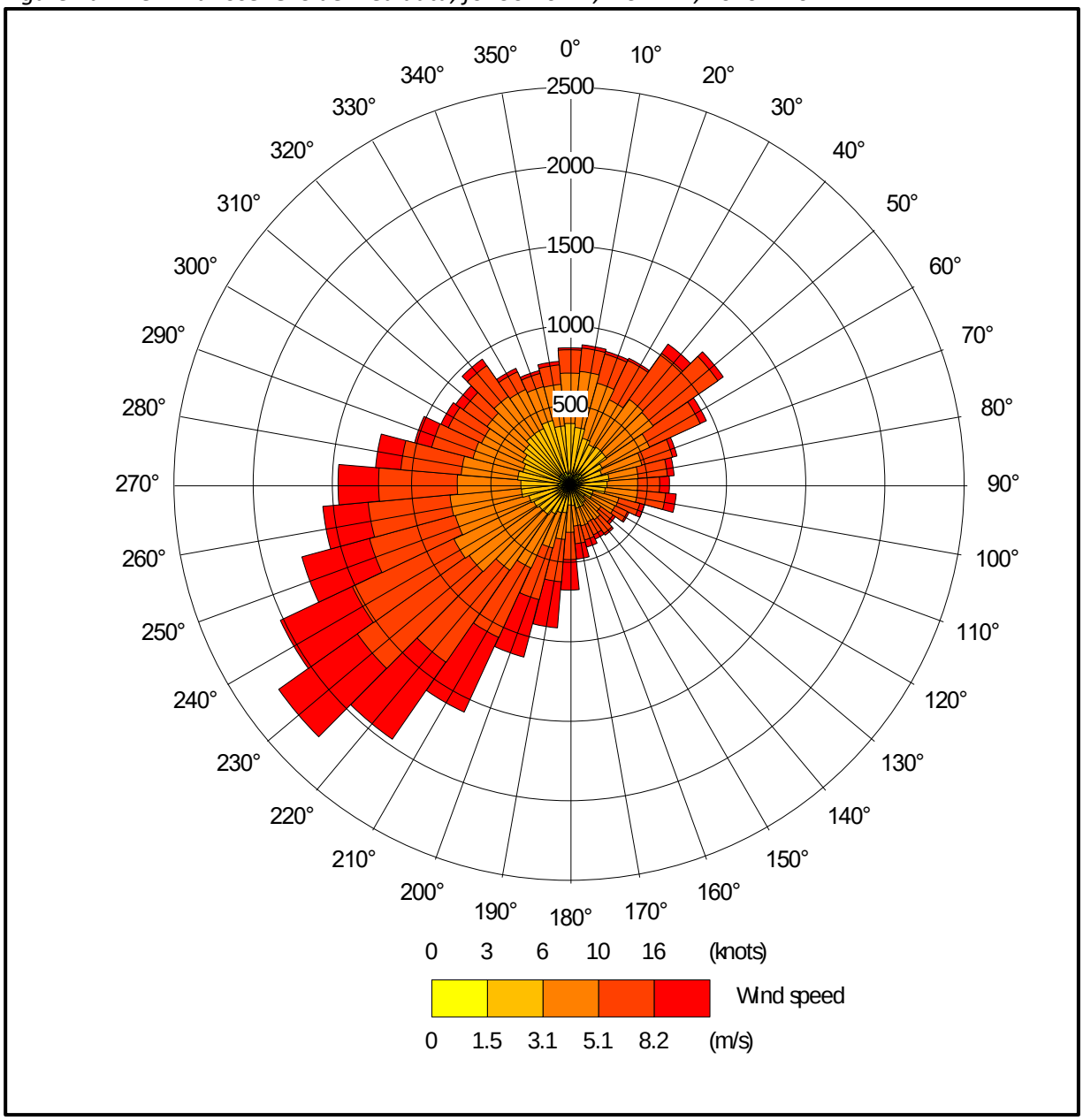
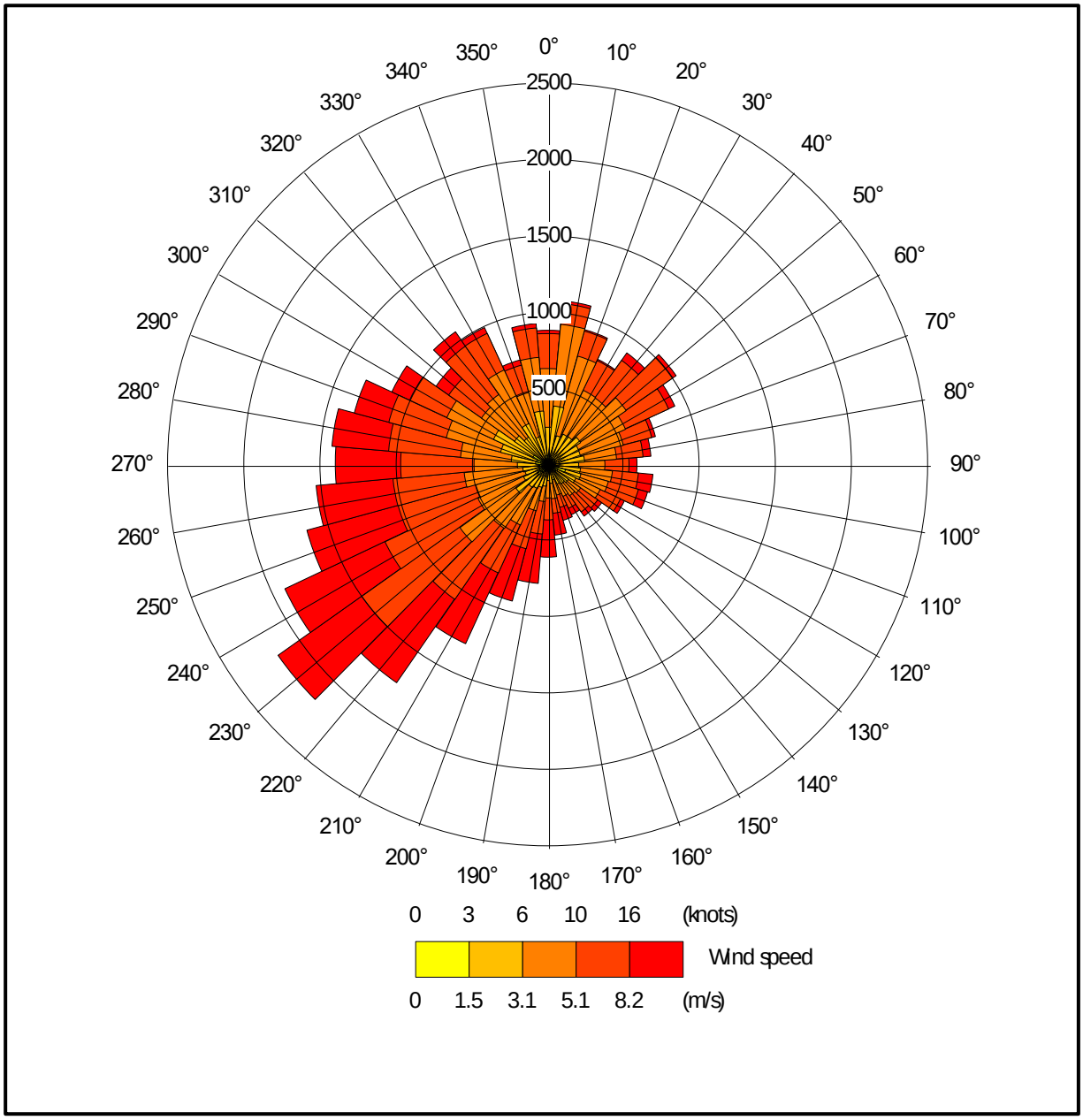


Figure 2b. The wind rose derived from FLOWSTAR output for NGR 361600, 96200



4.2 Emission sources

Emissions from the high speed ridge fans that would be used to ventilate the existing and proposed pig houses are represented by three point sources per building within ADMS. Details of the point source parameters are provided in Tables 3a and 3b.

Table 3a. Point source parameters – baseline scenario

Source ID	Height (m)	Diameter (m)	Efflux velocity (m/s)	Emission temperature (˚C)	Emission rate per source (g-NH_3/s)
B1TO6_	7.6	0.8	11.0	21.0	0.016359
B7_	6.4	0.8	11.0	21.0	0.002739
B8TO11_	5.9	0.8	11.0	21.0	0.009370
B12_	5.9	0.8	11.0	21.0	0.002342
B13_	7.4	0.8	11.0	21.0	0.004886
B14_	8.1	0.8	11.0	21.0	0.008212
B15_	8.1	0.8	11.0	21.0	0.010122
B16_	8.1	0.8	11.0	21.0	0.007448
B17TO18_	7.6	0.8	11.0	21.0	0.021007
B19_	7.6	0.8	11.0	21.0	0.005281
PRB20_	8.9	0.8	11.0	21.0	0.004441
T1TO2_	10.6	0.8	11.0	21.0	0.021117
T3TO4_	9.9	0.8	11.0	21.0	0.021117
T5_	8.9	0.8	11.0	21.0	0.010558
T6_	8.9	0.8	11.0	21.0	0.016900
T7_	7.4	0.8	11.0	21.0	0.006338
T8TO9_	10.6	0.8	11.0	21.0	0.025350

Table 3b. Point source parameters – proposed scenario

Source ID	Height (m)	Diameter (m)	Efflux velocity (m/s)	Emission temperature (˚C)	Emission rate per source (g-NH_3/s)
B1TO6_	7.6	0.8	11.0	21.0	0.016359
B7_	6.4	0.8	11.0	21.0	0.002739
B8TO11_	5.9	0.8	11.0	21.0	0.007402
B12_	5.9	0.8	11.0	21.0	0.001480
B13_	7.4	0.8	11.0	21.0	0.004886
B14_	8.1	0.8	11.0	21.0	0.016233
B15_	8.1	0.8	11.0	21.0	0.008976
B16_	8.1	0.8	11.0	21.0	0.013559
B17TO18_	7.6	0.8	11.0	21.0	0.019861
B19_	8.9	0.8	11.0	21.0	0.005308
PRB20_	8.9	0.8	11.0	21.0	0.003701
T1TO2_	10.6	0.8	11.0	21.0	0.020111
T3TO4_	9.9	0.8	11.0	21.0	0.020111
T5_	8.9	0.8	11.0	21.0	0.011239
T6_	8.9	0.8	11.0	21.0	0.011239
T7_	7.4	0.8	11.0	21.0	0.005308
T8TO9_	10.6	0.8	11.0	21.0	0.026539
CAB1_	7.9	0.8	11.0	21.0	0.0017766
CAB2_	7.9	0.8	11.0	21.0	0.0017766
CAB3_	7.9	0.8	11.0	21.0	0.0017766

Emissions from the slurry lagoon and stores in the baseline and proposed scenarios are represented by area sources within ADMS. Details of the area source parameters for the baseline scenario are given in Table 3c and for the proposed scenario in Table 3d.

Table 3c. Area source parameters – baseline scenario

Source ID	Area (m^2)	Base height (m)	Emission temperature (°C)	Emission rate ($g\text{-}NH_3/s$)
SLURRY LAGOON	2,157.4	0.0	Ambient	0.038284
SLURRY STORE	286.4	0.0	Ambient	0.006352

Table 3d. Area source parameters – baseline scenario

Source ID	Area (m^2)	Base height (m)	Emission temperature (°C)	Emission rate ($g\text{-}NH_3/s$)
SLURRY STORE	286.4	0.0	Ambient	0.006352
SLURRY TANK1	1,069.1	0.0	Ambient	0.009486
SLURRY TANK2	1,040.7	0.0	Ambient	0.009234

The positions of the sources may be seen in Figures 3a (baseline scenario) and Table 3b (proposed scenario).

4.3 Modelled buildings

The structure of the farm buildings may affect the plumes from the point sources. Therefore, the buildings are modelled within ADMS. The positions of the modelled buildings in the baseline and proposed scenarios may be seen in Figures 3a and 3b (marked by grey rectangles).

4.4 Discrete receptors

Seventy-six discrete receptors have been defined at the nearby wildlife sites. These receptors are defined at ground level within ADMS. The positions of the discrete receptors may be seen in Figures 4a and 4b (marked by enumerated pink rectangles).

4.5 Cartesian grid

To produce the contour plots presented in Section 5 of this report and to define the spatially varying deposition velocity field, two regular Cartesian grids have been defined within ADMS. The individual grid receptors are defined at ground level within ADMS.

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 22.0 km x 22.0 domain has been resampled at 100 m horizontal resolution for use within ADMS. N.B. The resolution of FLOWSTAR is 64 x 64 grid points; therefore, the effective resolution of the wind field is approximately 340 m.

4.7 Surface Roughness Length

In this case, a spatially varying roughness length file has been defined, this is based upon the Defra Living Landscapes land use database. The GFS meteorological data is assumed to have a roughness length of 0.145 m (arithmetic average of the spatially varying roughness over the modelling domain). The sample of the central area of the spatially varying roughness length field is shown in Figure 5.

Figure 3a. The positions of the modelled building and sources – baseline scenario

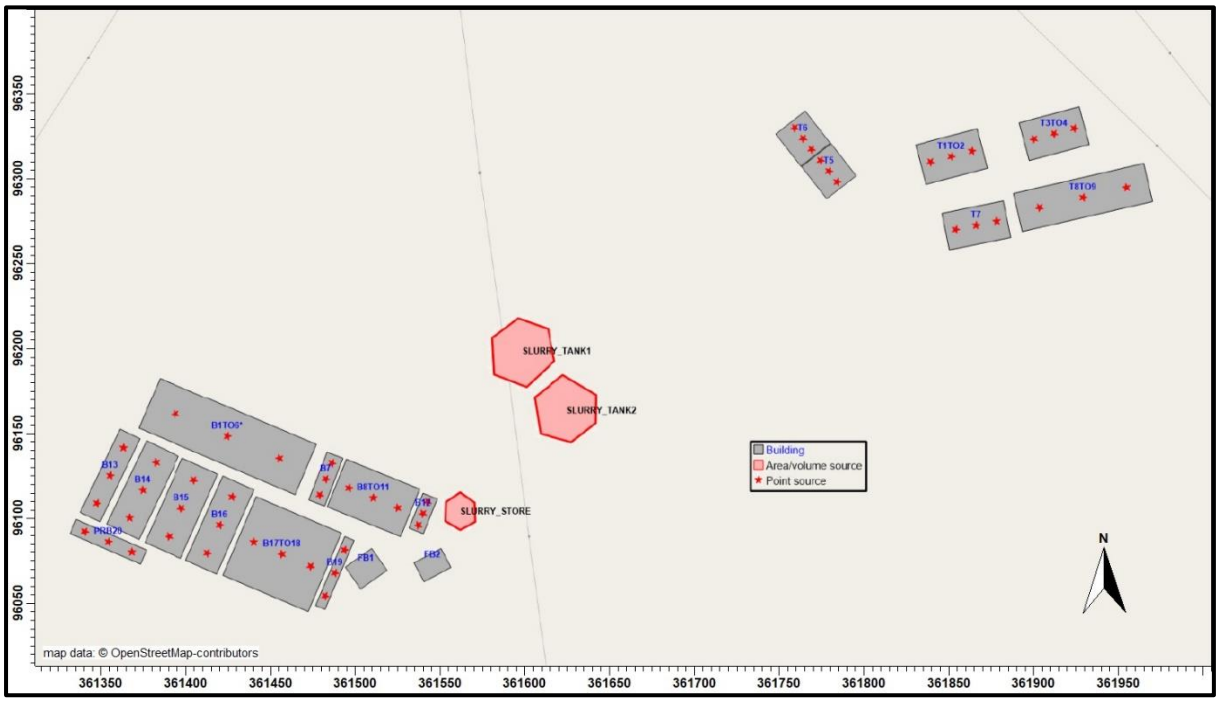


Figure 3b. The positions of the modelled building and sources – proposed scenario

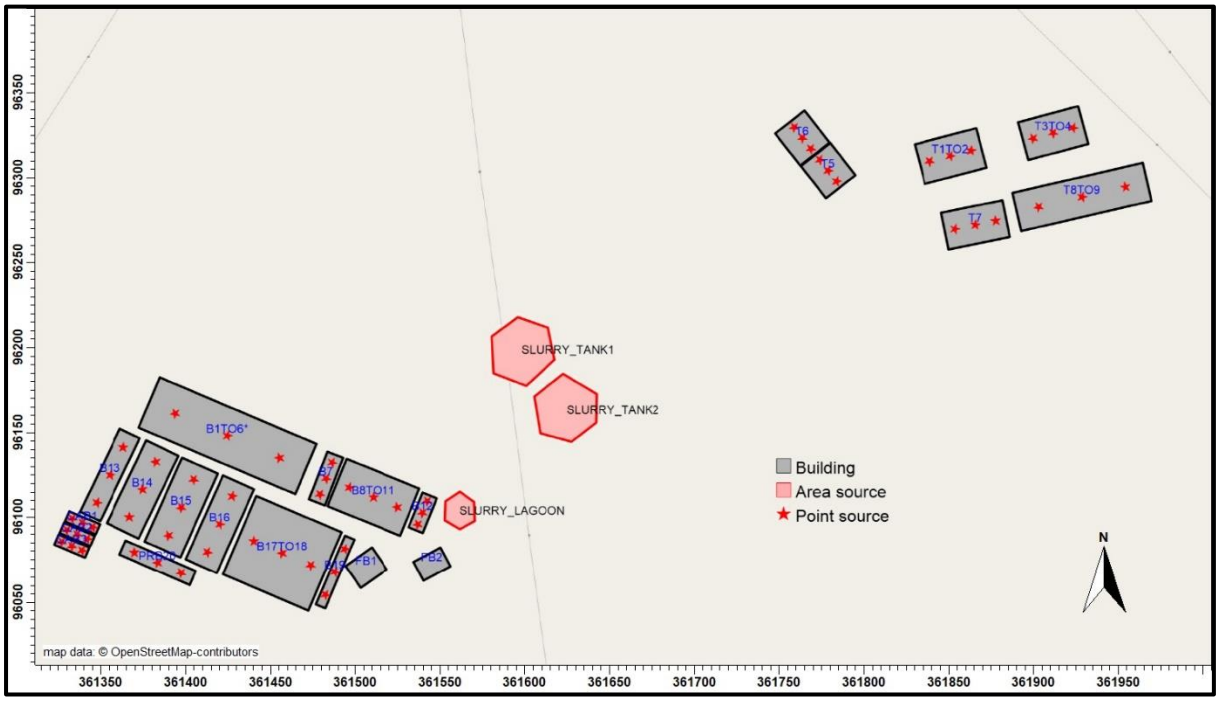


Figure 4a. The discrete receptors – a broad scale view

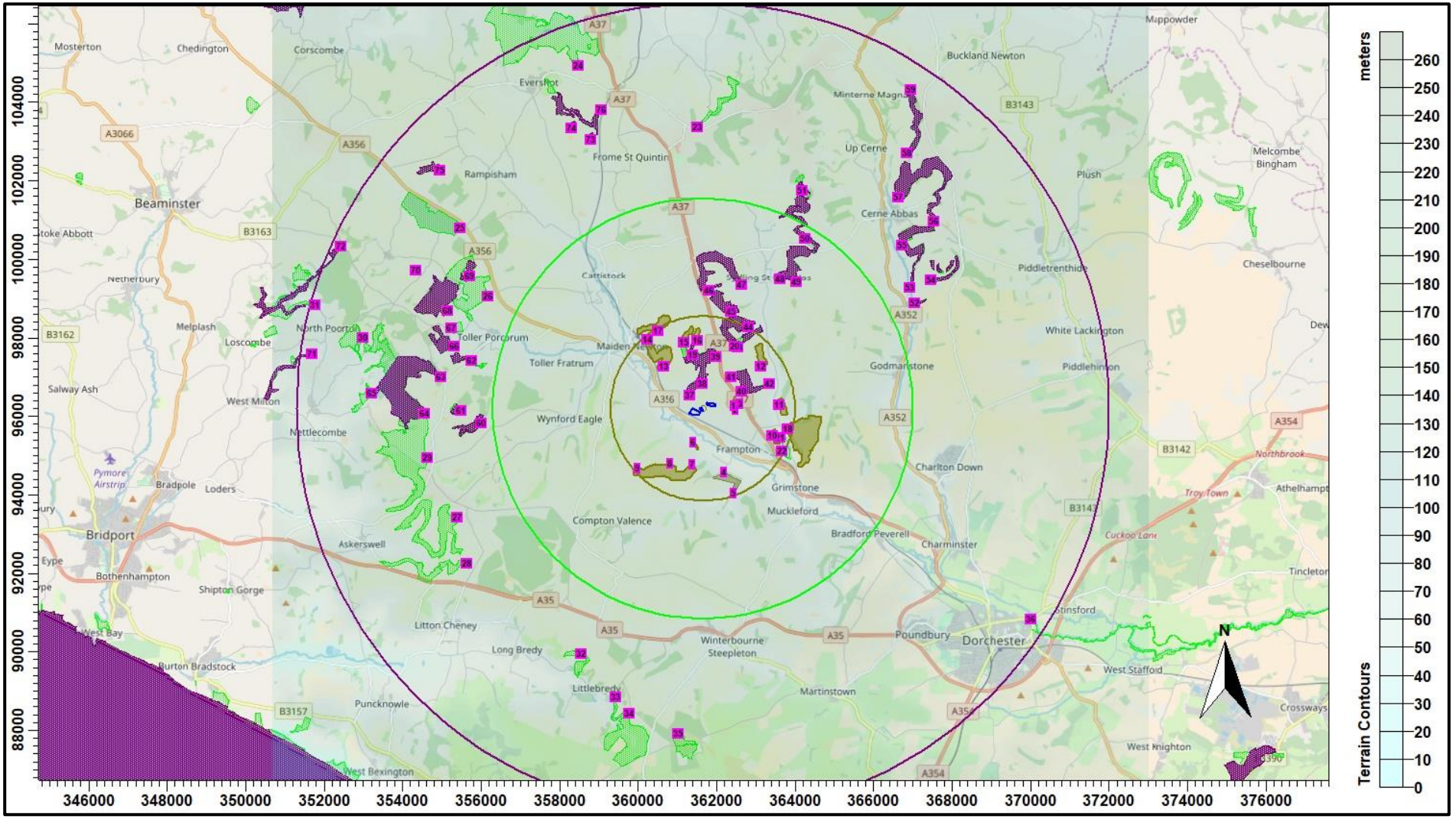


Figure 4b. The discrete receptors – a closer view

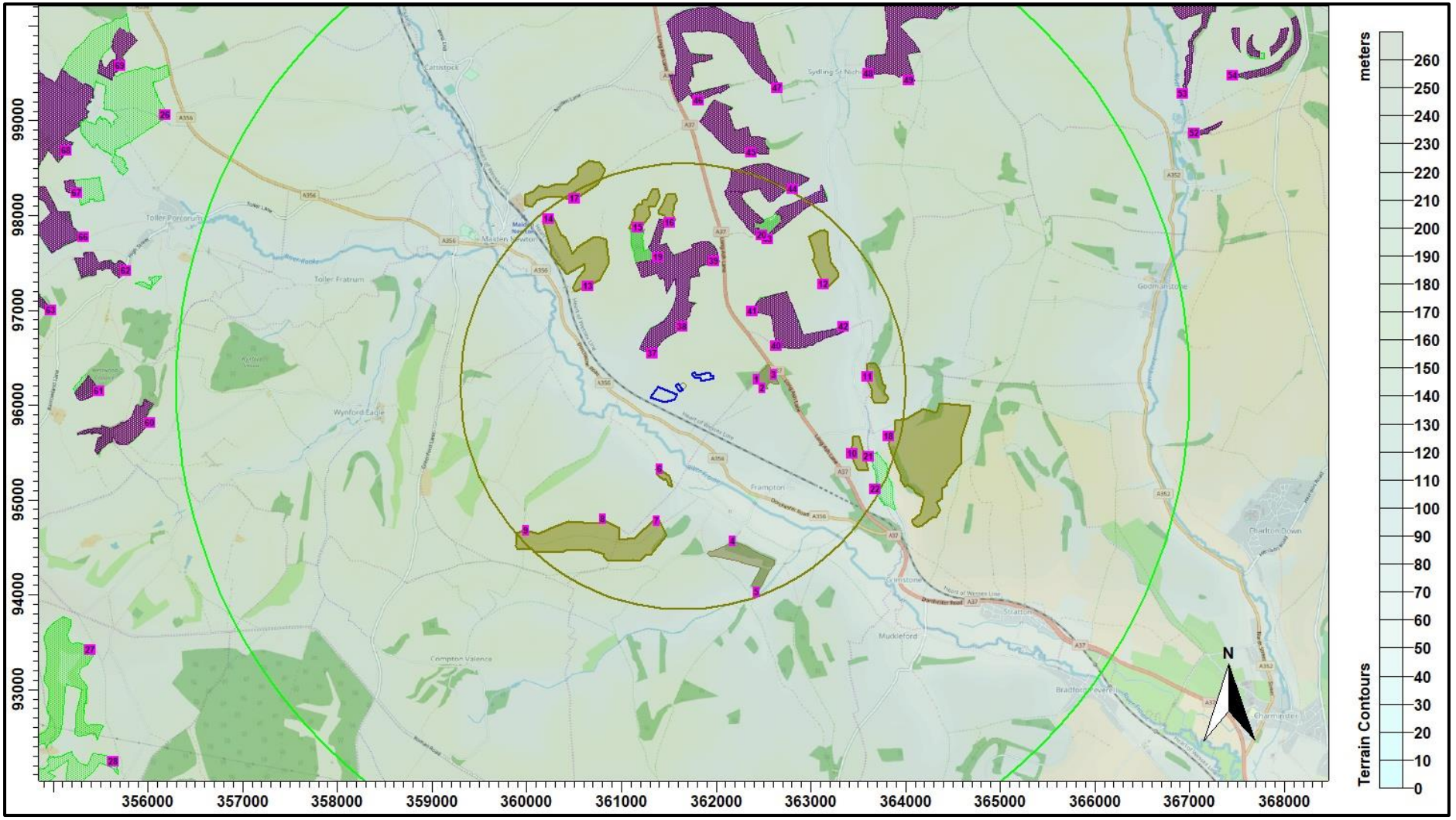
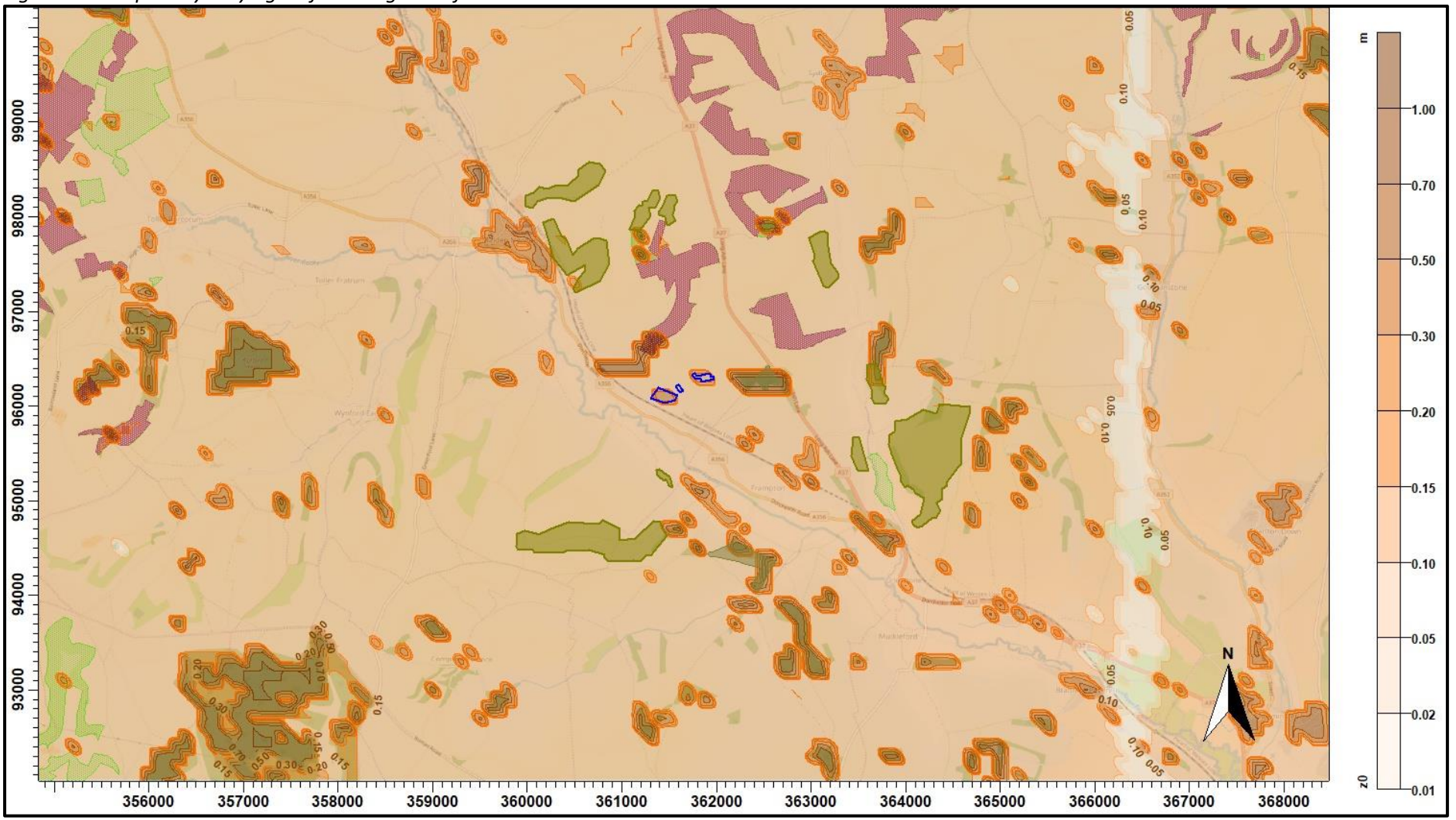


Figure 5. The spatially varying surface roughness field



4.8 Deposition

The method used to model deposition of ammonia and consequent plume depletion is based primarily upon Frederik Schrader and Christian Brümmer. Land Use Specific Ammonia Deposition Velocities: A Review of Recent Studies (2004-2013). AS Modelling & Data Ltd. has restricted deposition over arable farmland and heavily grazed and fertilised pasture; this is to compensate for possible saturation effects due to fertilizer application and to allow for periods when fields are clear of crops (Sutton), the deposition is also restricted over areas with little or no vegetation and the deposition velocity is set to 0.002 m/s where grid points are over the housing and 0.010 m/s to 0.015 m/s over heavily grazed grassland. Where deposition over water surfaces is calculated, a deposition velocity of 0.005 m/s is used. Land use data used to derive deposition velocity is based upon the Defra Living Landscapes land use database.

In summary, the method is as follows:

- A preliminary run of the model without deposition is used to provide an ammonia concentration field.
- The preliminary ammonia concentration field, along with land usage, has been used to define a deposition velocity field. The deposition velocities used are provided in Table 4.

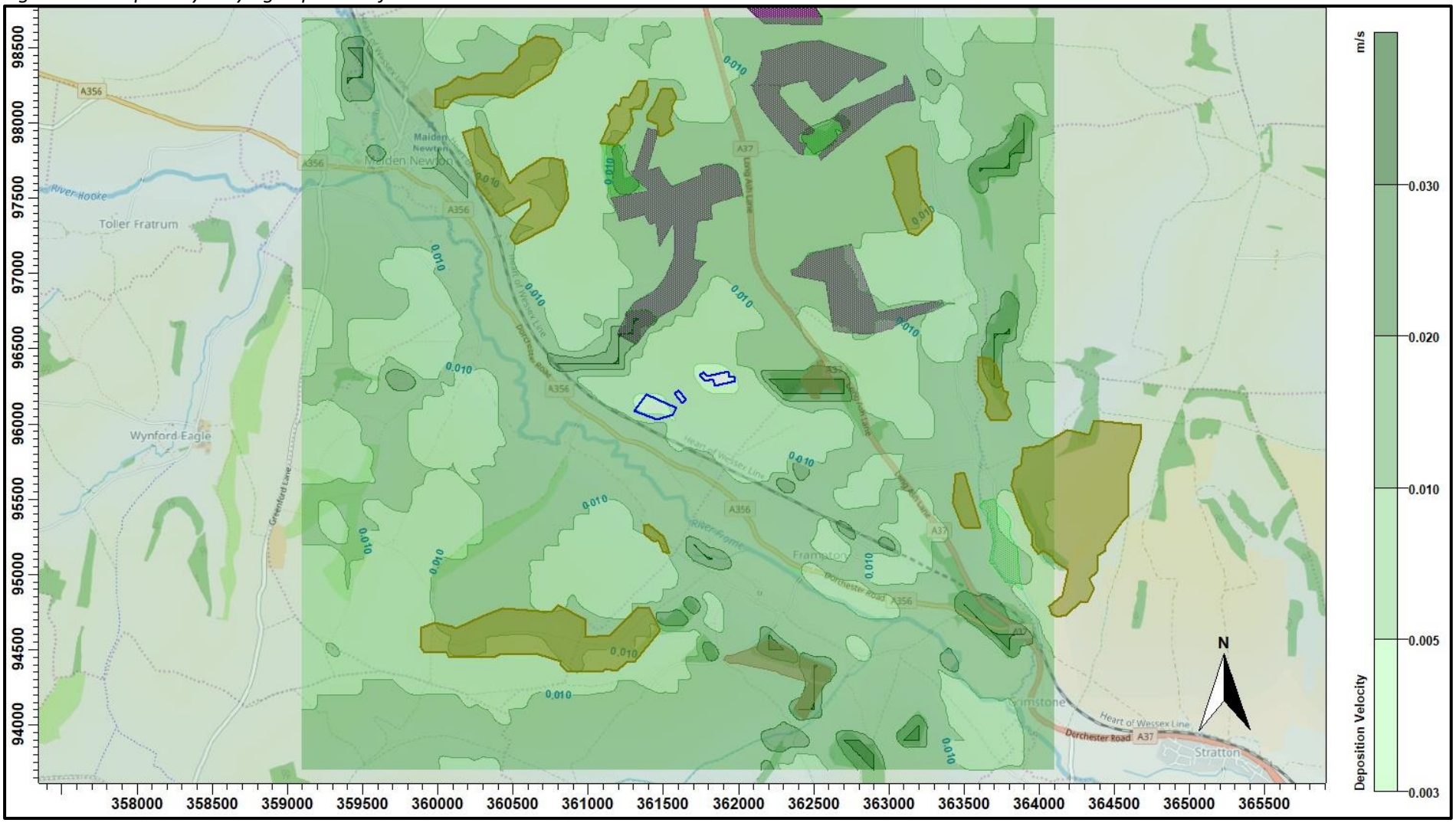
Table 4. Deposition velocities

NH_3 concentration (PC + background) ($\mu g/m^3$)	< 10	10 - 20	20 - 30	30 - 80	> 80
Deposition velocity - woodland (m/s)	0.03	0.015	0.01	0.005	0.003
Deposition velocity - short vegetation (m/s)	0.02 (0.010 0.015 over heavily grazed grassland)	0.015	0.01	0.005	0.003
Deposition velocity - arable farmland/rye grass (m/s)	0.005	0.005	0.005	0.005	0.003

- The model is then rerun with the spatially varying deposition module.

A contour plot of the spatially varying deposition field is provided in Figure 6.

Figure 6. The spatially varying deposition field



5. Details of the Model Runs and Results

5.1 Preliminary modelling and model sensitivity tests

Not conducted. General sensitivities have been tested in previous modelling studies of this site.

5.2 Detailed deposition modelling

Detailed modelling has been carried out over a high resolution (100 m) domain that extends 5.0 km by 5.0 km around the site. The primary purpose is to determine the magnitude of deposition of ammonia and consequent plume depletion close to the sources where it is of the greatest importance. Outside of this domain, a fixed deposition velocity of 0.005 m/s is assumed (with appropriate deposition velocities applied post-modelling at the discrete receptors).

The predicted maximum annual mean ground level ammonia concentrations, nitrogen deposition and acid deposition rates at the discrete receptors are shown in Table 5. In the Table, predicted ammonia concentrations and deposition rates that are in excess of the Environment Agency's upper threshold (20% of relevant Critical Level or Load for a SSSI and 4% of relevant Critical Level or Load for an internationally designated site) are coloured red. Concentrations or deposition rates in the range between the Environment Agency's lower and upper thresholds (20% and 50% for a SSSI and 4% and 20% for an internationally designated site) are coloured blue. Additionally, process contributions which exceed 1% of the relevant Critical Level or Critical Load at a statutory site are highlighted with bold text.

Contour plots of the predicted maximum annual mean ammonia concentration and the maximum annual nitrogen deposition rate are shown in Figures 7a and Figure 7b (baseline scenario) and Figures 8a and 8b (proposed scenario).

Table 6. Predicted maximum annual mean ammonia concentrations and nitrogen deposition rates

Receptor number	X(m)	Y(m)	Designation	Site Parameters			Maximum annual ammonia concentration		Maximum annual nitrogen deposition rate		Maximum annual ammonia concentration		Maximum annual nitrogen deposition rate	
							Baseline Scenario				Proposed Scenario			
				Deposition Velocity	Critical Level ($\mu g/m^3$)	Critical Load (kg/ha)	Process Contribution ($\mu g/m^3$)	%age of Critical Level	Process Contribution (kg/ha)	%age of Critical Load	Process Contribution ($\mu g/m^3$)	%age of Critical Level	Process Contribution (kg/ha)	%age of Critical Load
1	362428	96274	Baby Hyde Crook AW	0.03	1.0	10.0	0.532	53.2	4.15	41.5	0.495	49.5	3.86	38.6
2	362488	96174	Baby Hyde Crook AW	0.03	1.0	10.0	0.414	41.4	3.23	32.3	0.387	38.7	3.02	30.2
3	362607	96317	Baby Hyde Crook AW	0.03	1.0	10.0	0.379	37.9	2.95	29.5	0.356	35.6	2.77	27.7
4	362175	94562	Metland's Wood AW	0.03	1.0	10.0	0.088	8.8	0.68	6.8	0.083	8.3	0.65	6.5
5	362425	94028	Metland's Wood AW	0.03	1.0	10.0	0.056	5.6	0.44	4.4	0.053	5.3	0.42	4.2
6	361402	95327	Unnamed LWS	0.03	1.0	10.0	0.273	27.3	2.13	21.3	0.271	27.1	2.11	21.1
7	361368	94780	Southover Bottom LWS	0.03	1.0	10.0	0.126	12.6	0.98	9.8	0.124	12.4	0.96	9.6
8	360807	94794	Southover Bottom LWS	0.03	1.0	10.0	0.079	7.9	0.61	6.1	0.079	7.9	0.61	6.1
9	359986	94677	Southover Bottom LWS	0.03	1.0	10.0	0.045	4.5	0.35	3.5	0.044	4.4	0.34	3.4
10	363433	95491	Watercress Beds (disused) LWS	0.03	1.0	10.0	0.107	10.7	0.83	8.3	0.104	10.4	0.81	8.1
11	363598	96298	Watercress Beds LWS	0.03	1.0	10.0	0.126	12.6	0.98	9.8	0.122	12.2	0.95	9.5
12	363132	97276	Unnamed LWS	0.03	1.0	10.0	0.180	18.0	1.40	14.0	0.172	17.2	1.34	13.4
13	360650	97256	Langcombe Bottom LWS	0.03	1.0	10.0	0.063	6.3	0.49	4.9	0.062	6.2	0.48	4.8
14	360232	97960	Unnamed LWS	0.03	1.0	10.0	0.033	3.3	0.26	2.6	0.032	3.2	0.25	2.5
15	361176	97871	Unnamed LWS	0.03	1.0	10.0	0.043	4.3	0.33	3.3	0.041	4.1	0.32	3.2
16	361511	97926	Unnamed LWS	0.03	1.0	10.0	0.042	4.2	0.33	3.3	0.041	4.1	0.32	3.2
17	360506	98179	Unnamed LWS	0.03	1.0	10.0	0.032	3.2	0.25	2.5	0.030	3.0	0.24	2.4
18	363823	95669	Grimstone Down LWS	0.03	1.0	10.0	0.090	9.0	0.70	7.0	0.086	8.6	0.67	6.7
19	361382	97555	Hog Cliff SSSI	0.03	1.0	15.0	0.065	**6.5**	0.50	**3.4**	0.062	**6.2**	0.49	**3.2**
20	362478	97789	Hog Cliff SSSI	0.03	1.0	15.0	0.091	**9.1**	0.71	**4.7**	0.089	**8.9**	0.69	**4.6**
21	363609	95461	Langford Meadow SSSI	0.03	3.0	15.0	0.098	**3.3**	0.76	**5.1**	0.095	**3.2**	0.74	**4.9**
22	363676	95114	Langford Meadow SSSI	0.03	3.0	15.0	0.069	**2.3**	0.54	**3.6**	0.068	**2.3**	0.53	**3.5**
23	361516	103355	Batcombe Down SSSI	0.03	1.0	15.0	0.004	0.4	0.03	0.2	0.004	0.4	0.03	0.2
24	358465	104924	Melbury Park SSI	0.03	1.0	-	0.003	0.3	0.03	-	0.003	0.3	0.03	-

25	355458	100784	Rampisham Down SSSI	0.03	1.0	5.0	0.008	0.8	0.07	1.3	0.009	0.9	0.07	1.3
26	356178	99063	Toller Porcorum SSSI	0.03	1.0	5.0	0.011	1.1	0.08	1.6	0.011	1.1	0.08	1.7
27	355393	93419	Haydon and Askerswell Downs SSSI	0.03	1.0	15.0	0.008	0.8	0.06	0.4	0.008	0.8	0.06	0.4
28	355633	92242	Haydon and Askerswell Downs SSSI	0.03	1.0	15.0	0.008	0.8	0.06	0.4	0.008	0.8	0.06	0.4
29	354630	94944	Eggardon Hill & Luccas Farm SSSI	0.03	1.0	10.0	0.007	0.7	0.05	0.5	0.007	0.7	0.05	0.5
30	352996	97995	Drakenorth SSSI	0.03	1.0	10.0	0.006	0.6	0.04	0.4	0.005	0.5	0.04	0.4
31	351776	98845	Mapperton and Poorton Vales SSSI	0.03	1.0	10.0	0.004	0.4	0.03	0.3	0.004	0.4	0.03	0.3
32	358553	89954	Pitcombe Down SSSI	0.03	1.0	15.0	0.009	0.9	0.07	0.5	0.009	0.9	0.07	0.5
33	359424	88843	Valley of Stones SSSI	0.03	3.0	10.0	0.008	0.3	0.06	0.6	0.008	0.3	0.06	0.6
34	359773	88429	Valley of Stones SSSI	0.03	3.0	10.0	0.008	0.3	0.06	0.6	0.008	0.3	0.06	0.6
35	361015	87906	Blackdown (Hardy Monumnent) SSSI	0.03	1.0	5.0	0.008	0.8	0.06	1.2	0.008	0.8	0.06	1.2
36	370014	90826	River Frome SSSI	0.03	1.0	5.0	0.008	0.8	0.06	1.3	0.008	0.8	0.06	1.3
37	361324	96539	Hog Cliff SSSI	0.03	1.0	15.0	0.422	42.2	3.29	21.9	0.407	40.7	3.17	21.1
38	361639	96832	Hog Cliff SSSI	0.03	1.0	15.0	0.327	32.7	2.55	17.0	0.315	31.5	2.45	16.3
39	361974	97512	Hog Cliff SSSI	0.03	1.0	15.0	0.088	8.8	0.68	4.6	0.085	8.5	0.67	4.4
40	362629	96624	Hog Cliff SSSI	0.03	1.0	15.0	0.428	42.8	3.34	22.2	0.402	40.2	3.13	20.9
41	362378	96994	Hog Cliff SSSI	0.03	1.0	15.0	0.377	37.7	2.94	19.6	0.361	36.1	2.81	18.7
42	363343	96828	Hog Cliff SSSI	0.03	1.0	15.0	0.164	16.4	1.28	8.5	0.157	15.7	1.22	8.1
43	362544	97755	Hog Cliff SSSI	0.03	1.0	15.0	0.098	9.8	0.76	5.1	0.095	9.5	0.74	4.9
44	362803	98273	Court Farm, Sydling SSSI	0.03	1.0	10.0	0.070	7.0	0.55	5.5	0.069	6.9	0.53	5.3
45	362366	98660	Court Farm, Sydling SSSI	0.03	1.0	10.0	0.037	3.7	0.29	2.9	0.037	3.7	0.29	2.9
46	361808	99208	Court Farm, Sydling SSSI	0.03	1.0	10.0	0.022	2.2	0.17	1.7	0.022	2.2	0.17	1.7
47	362644	99343	Court Farm, Sydling SSSI	0.03	1.0	10.0	0.031	3.1	0.24	2.4	0.031	3.1	0.24	2.4
48	363609	99496	Sydling Valley Downs SSSI	0.03	1.0	10.0	0.031	3.1	0.24	2.4	0.031	3.1	0.24	2.4
49	364039	99426	Sydling Valley Downs SSSI	0.03	1.0	10.0	0.029	2.9	0.22	2.2	0.028	2.8	0.22	2.2
50	364248	100521	Sydling Valley Downs SSSI	0.03	1.0	10.0	0.017	1.7	0.14	1.4	0.017	1.7	0.13	1.3
37	361324	96539	Cerne & Sydling Downs SAC	0.02	3.0	15.0	0.422	14.1	2.19	14.6	0.407	13.6	2.11	14.1
38	361639	96832	Cerne & Sydling Downs SAC	0.02	3.0	15.0	0.327	10.9	1.70	11.3	0.315	10.5	1.63	10.9
39	361974	97512	Cerne & Sydling Downs SAC	0.02	3.0	15.0	0.088	2.9	0.46	3.0	0.085	2.8	0.44	3.0
40	362629	96624	Cerne & Sydling Downs SAC	0.02	3.0	15.0	0.428	14.3	2.22	14.8	0.402	13.4	2.09	13.9
41	362378	96994	Cerne & Sydling Downs SAC	0.02	3.0	15.0	0.377	12.6	1.96	13.1	0.361	12.0	1.87	12.5
42	363343	96828	Cerne & Sydling Downs SAC	0.02	3.0	15.0	0.164	5.5	0.85	5.7	0.157	5.2	0.81	5.4
43	362544	97755	Cerne & Sydling Downs SAC	0.02	3.0	15.0	0.098	3.3	0.51	3.4	0.095	3.2	0.49	3.3
44	362803	98273	Cerne & Sydling Downs SAC	0.02	3.0	15.0	0.070	2.3	0.36	2.4	0.069	2.3	0.36	2.4

45	362366	98660	Cerne & Sydling Downs SAC	0.02	3.0	15.0	0.037	**1.2**	0.19	**1.3**	0.037	**1.2**	0.19	**1.3**
46	361808	99208	Cerne & Sydling Downs SAC	0.03	3.0	15.0	0.022	0.7	0.17	**1.1**	0.022	0.7	0.17	**1.1**
47	362644	99343	Cerne & Sydling Downs SAC	0.02	3.0	15.0	0.031	**1.0**	0.16	**1.1**	0.031	**1.0**	0.16	**1.1**
48	363609	99496	Cerne & Sydling Downs SAC	0.02	3.0	15.0	0.031	**1.0**	0.16	**1.1**	0.031	**1.0**	0.16	**1.1**
49	364039	99426	Cerne & Sydling Downs SAC	0.03	3.0	15.0	0.029	1.0	0.22	**1.5**	0.028	0.9	0.22	**1.5**
50	364248	100521	Cerne & Sydling Downs SAC	0.03	3.0	15.0	0.017	0.6	0.14	0.9	0.017	0.6	0.13	0.9
51	364186	101757	Cerne & Sydling Downs SAC	0.03	3.0	15.0	0.011	0.4	0.08	0.6	0.011	0.4	0.08	0.6
52	367043	98871	Cerne & Sydling Downs SAC	0.03	3.0	15.0	0.020	0.7	0.16	**1.0**	0.020	0.7	0.15	**1.0**
53	366930	99282	Cerne & Sydling Downs SAC	0.03	3.0	15.0	0.020	0.7	0.16	**1.1**	0.020	0.7	0.15	**1.0**
54	367454	99478	Cerne & Sydling Downs SAC	0.03	3.0	15.0	0.016	0.5	0.12	0.8	0.015	0.5	0.12	0.8
55	366734	100342	Cerne & Sydling Downs SAC	0.03	3.0	15.0	0.019	0.6	0.15	1.0	0.019	0.6	0.15	1.0
56	367526	100959	Cerne & Sydling Downs SAC	0.03	3.0	15.0	0.014	0.5	0.11	0.7	0.014	0.5	0.11	0.7
57	366631	101577	Cerne & Sydling Downs SAC	0.03	3.0	15.0	0.014	0.5	0.11	0.7	0.014	0.5	0.11	0.7
58	366847	102708	Cerne & Sydling Downs SAC	0.03	3.0	15.0	0.009	0.3	0.07	0.5	0.009	0.3	0.07	0.5
59	366940	104320	Cerne & Sydling Downs SAC	0.03	3.0	15.0	0.006	0.2	0.05	0.3	0.006	0.2	0.05	0.3
60	356014	95811	West Dorset Alder Woods SAC	0.03	1.0	10.0	0.009	0.9	0.07	0.7	0.009	0.9	0.07	0.7
61	355479	96146	West Dorset Alder Woods SAC	0.03	1.0	10.0	0.008	0.8	0.07	0.7	0.008	0.8	0.07	0.7
62	355761	97417	West Dorset Alder Woods SAC	0.03	1.0	10.0	0.009	0.9	0.07	0.7	0.009	0.9	0.07	0.7
63	354973	97000	West Dorset Alder Woods SAC	0.03	1.0	10.0	0.008	0.8	0.06	0.6	0.008	0.8	0.06	0.6
64	354557	96056	West Dorset Alder Woods SAC	0.03	1.0	10.0	0.007	0.7	0.06	0.6	0.007	0.7	0.05	0.5
65	353204	96569	West Dorset Alder Woods SAC	0.03	1.0	10.0	0.006	0.6	0.05	0.5	0.006	0.6	0.05	0.5
66	355315	97773	West Dorset Alder Woods SAC	0.03	1.0	10.0	0.008	0.8	0.06	0.6	0.008	0.8	0.06	0.6
67	355248	98234	West Dorset Alder Woods SAC	0.03	1.0	10.0	0.008	0.8	0.06	0.6	0.008	0.8	0.06	0.6
68	355137	98680	West Dorset Alder Woods SAC	0.03	1.0	10.0	0.007	0.7	0.06	0.6	0.007	0.7	0.06	0.6
69	355702	99572	West Dorset Alder Woods SAC	0.03	1.0	10.0	0.009	0.9	0.07	0.7	0.010	1.0	0.08	0.8
70	354349	99713	West Dorset Alder Woods SAC	0.03	1.0	10.0	0.007	0.7	0.05	0.5	0.007	0.7	0.05	0.5
71	351700	97596	West Dorset Alder Woods SAC	0.03	1.0	10.0	0.005	0.5	0.04	0.4	0.005	0.5	0.04	0.4
72	352426	100332	West Dorset Alder Woods SAC	0.03	1.0	10.0	0.004	0.4	0.03	0.3	0.004	0.4	0.03	0.3
73	358804	103036	West Dorset Alder Woods SAC	0.03	1.0	10.0	0.004	0.4	0.03	0.3	0.004	0.4	0.03	0.3
74	358310	103343	West Dorset Alder Woods SAC	0.03	1.0	10.0	0.004	0.4	0.03	0.3	0.004	0.4	0.03	0.3
75	354937	102271	West Dorset Alder Woods SAC	0.03	1.0	10.0	0.006	0.6	0.05	0.5	0.006	0.6	0.05	0.5
76	359052	103794	West Dorset Alder Woods SAC	0.03	1.0	10.0	0.004	0.4	0.03	0.3	0.004	0.4	0.03	0.3

Figure 7a. Maximum annual ammonia concentration – baseline scenario

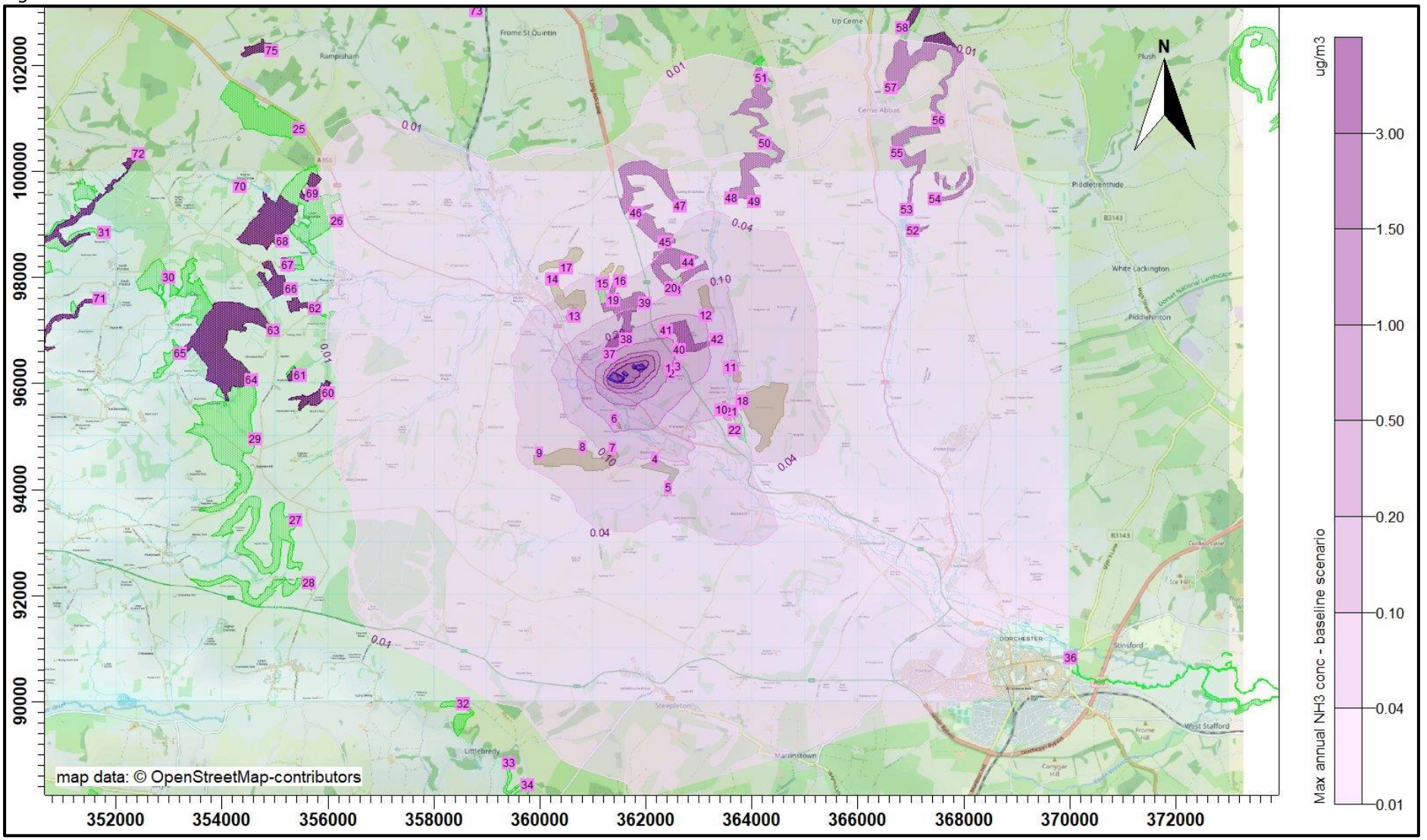


Figure 7b. Maximum annual nitrogen deposition rates – baseline scenario

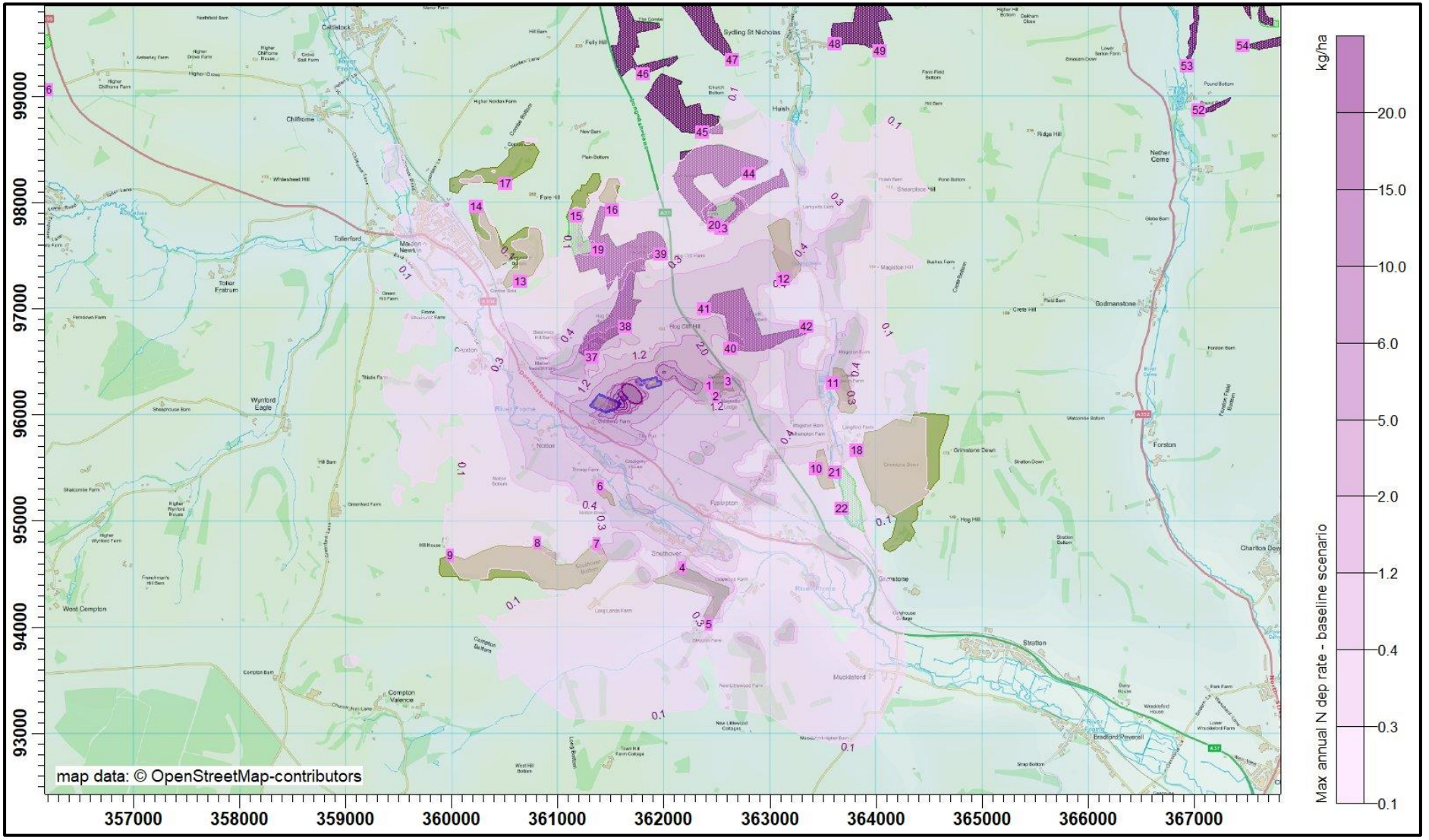


Figure 8a. Maximum annual ammonia concentration – proposed scenario

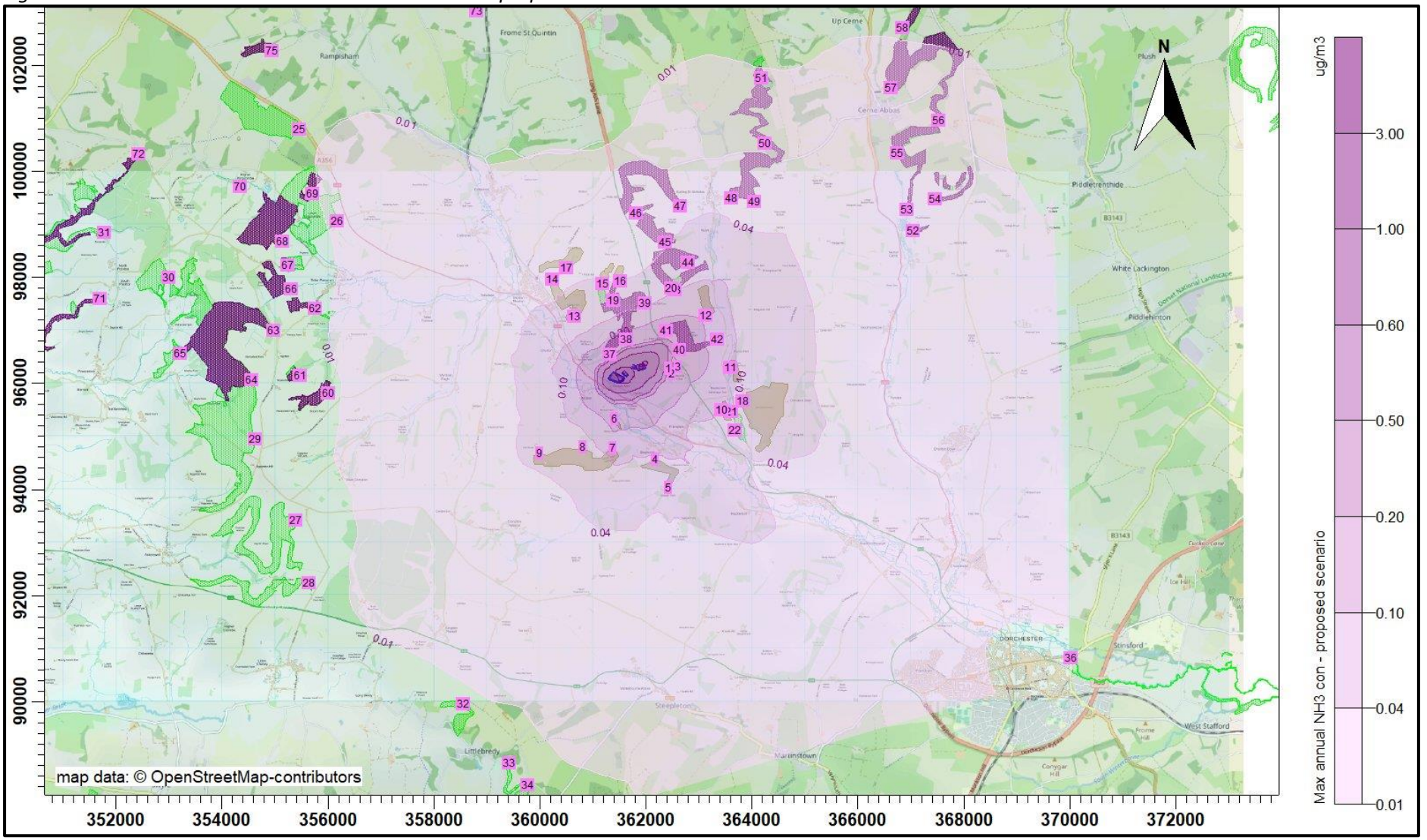
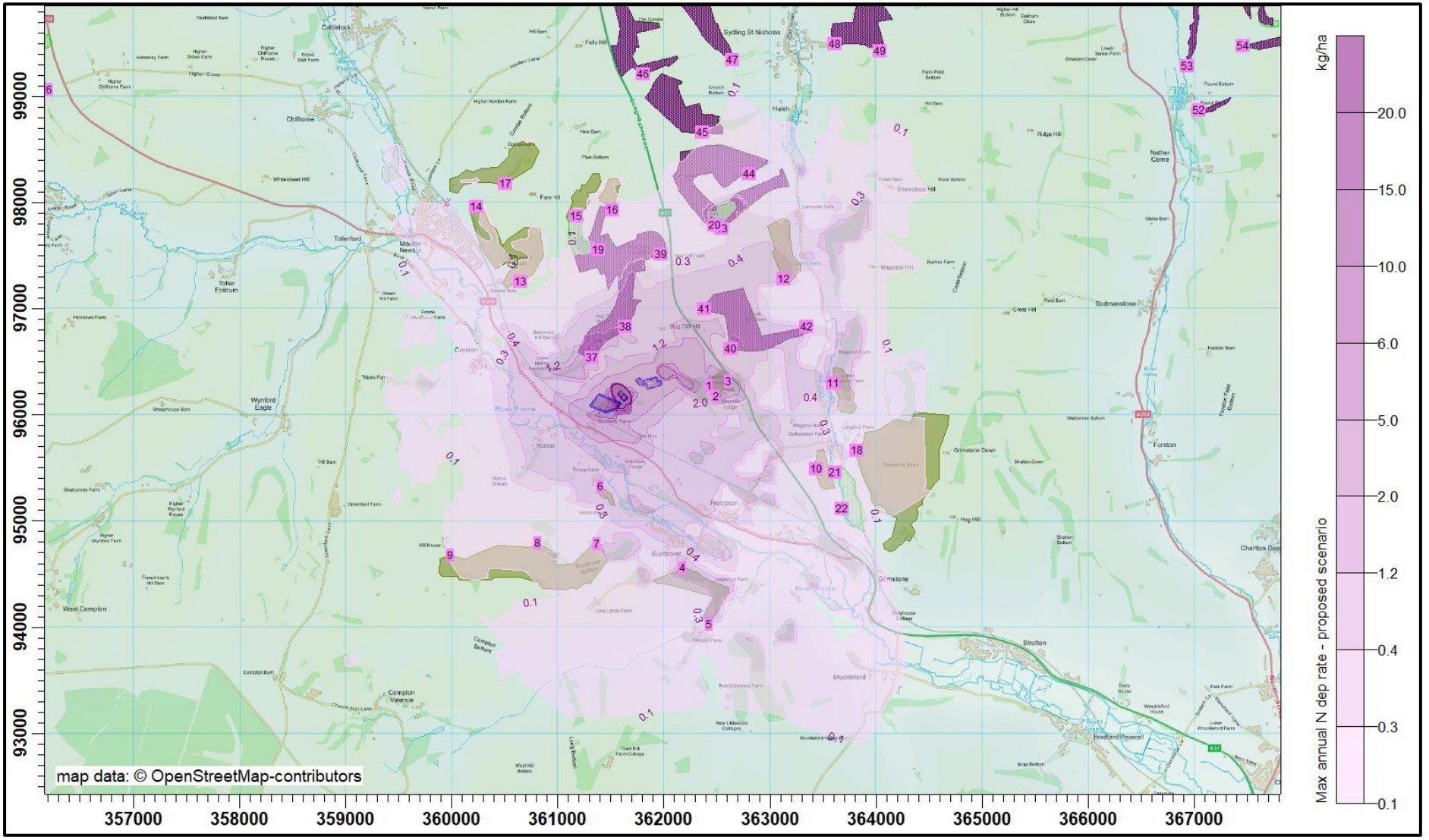


Figure 8b. Maximum annual nitrogen deposition rates – proposed scenario



6. Summary and Conclusions

AS Modelling & Data Ltd. has been instructed by Harry Edwards of The Farm Consultancy Group, on behalf of Crockway Farms Limited, to use computer modelling to assess the impact of ammonia emissions from the existing and proposed pig rearing houses at the Crockway Farm Pig Unit, near Maiden Newton, Dorchester in Dorset. DT2 0BY.

Ammonia emission rates from the existing and proposed piggeries have been assessed and quantified based upon the Environment Agency's standard ammonia emission factors and figures obtained from the UK Ammonia Emissions Inventory (UKAIE). 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.

The modelling predicts that:

- At all the non-statutory wildlife sites, the process contribution to maximum annual ammonia concentration and the nitrogen and acid deposition rates would be below the Environment Agency's lower threshold percentage of 100% of the precautionary Critical Level of 1.0 µg-NH_3/m^3 in both the existing baseline and proposed scenarios.

- In both the existing baseline and proposed scenarios there are exceedances of the Environment Agency lower threshold percentages of 20% (for a SSSI) at closer parts of Hog Cliff SSSI, of the Critical Level of 1.0 µg-NH_3/m^3 and the Critical Load of 15.0 kg-N/ha/y. In the proposed scenario these exceedances would be reduced at all receptors considered.

- At Cerne & Sydling Downs SAC there are currently exceedances of the Environment Agency lower threshold percentage of 4% (for a SAC) of the Critical Level of 3.0 µg-NH_3/m^3 and the Critical Load of 15.0 kg-N/ha/y. Annual ammonia concentrations and nitrogen deposition rates would be reduced at all receptors considered in the proposed scenario.

- Ammonia concentrations and nitrogen deposition rates at West Dorset Alder Woods SAC are below 1% of the Critical Level of 1.0 µg-NH_3/m^3 and the Critical Load of 10.0 kg-N/ha/y in both the existing baseline and proposed scenarios. Additionally, at all receptors considered ammonia concentrations would be reduced in the proposed scenario.

- At all other SSSIs considered, the process contribution to the annual ammonia concentration and the nitrogen deposition rates would be below the Environment Agency lower threshold percentage of 20% (for a SSSI) of the relevant Critical Level and Critical Load for the sites. There are currently exceedances of 1% Langford Meadow SSSI, Rampisham Down SSSI, Toller Porcorum SSSI, Blackdown (Hardy Monument) SSSI, River Frome SSSI, Court Farm Sydling SSSI and Sydling Valley Downs SSSI, however the magnitude and extent of these exceedances are all reduced in the proposed scenario.

7. References

Cambridge Environmental Research Consultants (CERC) (website).

Environment Agency H1 Risk Assessment (website).

Steven R Hanna, & Biswanath Chowdhury. Minimum turbulence assumptions and u* and L estimation for dispersion models during low-wind stable conditions.

M. A. Sutton *et al*. Measurement and modelling of ammonia exchange over arable croplands.

Frederik Schrader and Christian Brümmer. Land Use Specific Ammonia Deposition Velocities: a Review of Recent Studies (2004-2013).

United Nations Economic Commission for Europe (UNECE) (website).

UK Air Pollution Information System (APIS) (website).