**EAST DORSET DISTRICT COUNCIL**

**TOWN AND COUNTRY PLANNING ACT 1990**

**APPEAL UNDER SECTION 78**

Appeal by Mr M E Gardner against the decision of East Dorset District Council to refuse planning permission to provide temporary accommodation for an essential agricultural worker at The Barn, Earles Road, Three Legged Cross, Wimborne, Dorset.

**LOCAL PLANNING AUTHORITY REFERENCE: 3/01/0475**

**PLANNING INSPECTORATE PLANNING REFERENCE: APP/U1240/A/03/112225**

# Proof of evidence and Summary of Dr Mark Alexander Sutton

**BSc, ARCS, PhD**

**(Centre for Ecology and Hydrology, Edinburgh Research Station)**

**On behalf of East Dorset District Council and English Nature.**

**January 2004**

**EXECUTIVE SUMMARY**

S1. I am Mark Alexander Sutton, the leader of the Atmospheric Sciences Section of the Centre for Ecology and Hydrology, which is a component body of the UK Natural Environment Research Council. My research speciality is in the emission, dispersion, deposition and environmental impacts of atmospheric ammonia. I have written over 70 peer review papers and a further 90 book chapters, most of which are on this topic. I provide advice concerning ammonia to a wide range of organizations including DEFRA (both air quality and farming divisions), JNCC, English Nature, Environment Agency etc. My team is a nationally and internationally recognized leader in this field.

S2. I have been involved with the planning application for a poultry farm at Holt and West Moors SSSI since October 2002. I was contacted by Dr. Clare Whitfield, the JNCC Air Pollution Adviser and Network Officer to provide advice on the likely impacts of the proposed farm on the SSSI, which is part of the Dorset Heaths cSAC, Dorset Heatlands SPA and Dorset Heatlands Ramsar site. I since contributed information to the Rule 6 statement. In January 2004 I visited the SSSI adjacent to the proposed Application Site.

S3. Ammonia ($NH_3$) is a reactive nitrogen compound that is emitted to the atmosphere from agricultural activities. In particular, poultry farming leads to the production of large quantities of uric acid in excreta, which decomposes to release ammonia to the atmosphere.

S4. The proposed development includes 1200 barn housed hens and 1000 free range hens. Ammonia emissions from laying hens are larger than from broilers, due to the larger body mass, being around 0.2 kg N per bird per year. There is uncertainty regarding the emissions from free range hens, as some factors would tend to encourage smaller emissions (an absolute minimum number would be 0.1 kg N per bird per year). However, potentially higher moisture content of the excreta from free-range poultry could, conversely, increase emissions and in the present assessment it is therefore considered safest to assume that the emission rates from free-range and barn layers are the same.

S5. Environmental impacts of ammonia may occur either from the increased concentration in air (ug /m3) or from the increase in nitrogen deposition (kg N /hectare /year). Effects may be gauged by comparison of modelled values with against the critical level for ammonia concentrations or the critical load for nitrogen deposition. Although values are available for both critical levels and critical loads, the current evidence suggests that the critical level is too high (i.e. not sufficiently precautionary). Therefore, assessment should focus at present the extent of deposition and critical loads exceedance.

S6. Critical loads for the heathland habitats of most concern at Holt and West Moors heaths SSSI (being part of the cSAC, SPA and Ramsar Site) are in the range 10-20 kg N /hectare /year (dry heath and Calluna dominated wet heath) and 10-25 kg N /hectare /year (for *Erica tetralix* dominated wet heath).

S7. Background deposition at the SSSI is around 20-23 kg N /hectare /year, as estimated by national models. No local site-based estimate of background deposition is available, so that the national model estimate provides the current best estimate.

S8. Based on the background deposition, the critical loads for the sites are therefore already to some extent exceeded. Using the critical load for dry

heathland, the extent of exceedance is 6 (range 0-13) kg N /hectare /year. Any additional development therefore needs to be seen in the context of providing an additional specific threat to the existing general problem of excess atmospheric nitrogen deposition. It should be noted that the critical load represents a simple tool for environmental assessment, and it must be recognized that increasing the extent of exceedance increases the risk and extent of likely environmental impact. (Hence there is a good argument for reducing deposition even at rates above the critical load).

S9. The relevant effects of additional nitrogen deposition above the critical load include break down of the heather canopy (Calluna and Erica species), with an increase in grass species and a loss of lichens and mosses. The experimental basis for these changes is very strong.

S10. There is less information available on the effects of N deposition on rare plants, since by definition this is more difficult to study. However, it is expected that effects on rare species will parallel the changes in other parts of the habitats.

S11. The effects of the proposed development via ammonia deposition on the SSSI (and simultaneously the cSAC, SPA and Ramsar sites) can best be described by defining two main and two subzones, immediately to the north and south of the proposed Application Site:

- Zone 1: Area bounded by a dashed pink line to the north east of the Application Site (Marked Lower Common North).
    - Zone 1a: Belt of trees around the path to the north of the Application Site, running in the direction NW to SE, approximately 10 m wide. The boundary of the SSSI appears to run through this band of trees.
    - Zone 1b: Heathland with scattered trees in Lower Common North, which includes both dry heathland and wet heathland habitats.
- Zone 2: Area bounded by a dashed pink line to the south west of the Application Sites (Marked Lower Common South).
    - Zone 2a: Belt of trees running NW to SE, south of the Application Site, approximately 50 m wide.
    - Zone 2b: Heathland with scattered trees in Lower Common South, which includes both dry and wet heathland habitats.

S12. I have used two complementary methods to assess the impact of the proposed development on the SSSI (including the cSAC, SPA and Ramsar sites):

a) expert judgement of the distance scales of impact, making a distinction between distances for "possible significant effects" and for "probable significant effects". The first asks the question: "at what distance can I be confident that there would be no significant effect? The second asks the question: " within what distance do I on balance expect to observe significant effects?" While the first provides the relevant legal test, the second is used to help provide confidence in the conclusions.

b) Application of a model screening tool, called SCAIL (Simple Calculation of Ammonia Impact Limits), that we have been developing at CEH. This model provides a simple approach to estimate the additional N deposition at

particular distances from a development, allowing comparison with critical loads.

S1. A third approach is possible, being the application of detailed atmospheric scale dispersion models. Such an assessment is normally carried out by applicants, but has not been provided in the present case. However, I consider that the cost and additional information from such an assessment do not merit its use by me in the present instance. This is because, as will be seen below, the conclusions from the first two assessment methods are so clear, that this would be money spent that would not alter key findings.

S2. Based on my expert judgement, I estimate that there would be both 'possible' and 'probable' adverse effects of the development on the SSSI, cSAC, SPA and Ramsar sites:

a) Zone 1a: A probable adverse effect would occur throughout this narrow zone, with changes in the ground flora and in epiphytic lichens.

b) Zone 1b: A probable adverse effect would occur for the first 50 m of the heathland, while a possible adverse effect would apply for the first 300 m. The effects would consist of an alteration to the heather canopy, with an increase in grasses, coupled with a reduction in lichen and moss cover.

c) Zone 2a: A probable adverse effect would occur for the first 30 m of this zone, with a possible significant effect for the full width of the woodland.

d) Zone 2b: Due to the screening effect of the woodland, I would not anticipate a probable adverse effect of the development via ammonia deposition. I estimate possible adverse effects would occur up to 150 m on the heathland in this direction.

S1. These distances are approximate and serve as indicative values. The overall conclusion is that the proposed development is not consistent with maintenance of the UK and international designated habitats. For large areas (up to 300 m into the SSSI and cSAC etc) I cannot be confident that there would be no effect, and for smaller distances (50 m into the SSSI and cSAC etc) I would expect to see visible signs of change within a few years of operation if the development went ahead.

S2. Although the development is only a small farm, what is of concern is that the Application Site is immediately adjacent to a sensitive designated habitat.

S3. Using the SCAIL approach for a farm of this size, the deposition 50 and 100 m down wind of a point source farm would be 13.5 and 7.7 kg N /hectare /year, respectively. Although the details of local conditions cannot be treated in such a model, it indicates broadly that the proposed farm would add around 5-15 kg N /hectare/year to the designated heathland immediately downwind of the farm. This represents a significant addition to the background critical load exceedance already estimated for this site, indicating the likelihood for significant adverse ecological effects.

S4. It is difficult to specify realistic mitigation options to reduce ammonia emissions further than those calculated here. In particular, the export of manure off site cannot be considered an additional mitigation option, since this is already assumed in the calculations and estimates used here. Planting of trees can in some instances play a role to recapture and disperse the emissions. In the present site however, there is not sufficient space available, while the benefits would not be likely to be sufficient to fully protect the

SSSI. The simplest option in such circumstances is usually to locate the proposed farm on another site, more distant from a sensitive habitat.

S5. The trees to the south of the Application Site (Zone 2a) will already play a useful role to shelter Zone 2b from existing ammonia emissions. I note that it is part of the conservation objectives to restore this to heathland. Should the development go ahead, I would advise against this, as the woodland would be necessary to help protect Zone 2b from ammonia emissions. Hence if the proposed development of the site went ahead, this would restrict the potential for restoring this area to heathland. Similarly, if free range poultry farming were conducted on the Application Site, this would make it extremely difficult to restore this land to heathland as part of possible future restoration plans.

S6. Assuming regulation 48 of the Habitats Regulations to be applicable, my conclusions in respect of the implication of the poultry unit for each of the international sites are:

- It is likely to have a significant effect
- It cannot be ascertained not to have an adverse effect on the integrity of the site, and
- It is more probable than not to have an adverse effect on the integrity of the site in respect of the first 50 metre width of heathland to the immediate north of the development site.

## 1 INTRODUCTION

1.1 My name is Mark Alexander Sutton and I lead the Atmospheric Sciences Section of the Centre for Ecology and Hydrology (CEH). CEH is a component of the Natural Environment Research Council (NERC), the UK government organization dealing with research into the natural environment. The Atmospheric Sciences Section that I lead includes around 30 scientists and a further 20 PhD students.

1.2 My original training was in Botany, in which I hold a BSc and ARCS from Imperial College, London. Subsequently, I carried out my PhD (1990) on the topic of the land surface - atmosphere exchange of ammonia. Since 1992 I have been employed at the Institute of Terrestrial Ecology, which has since been incorporated into CEH.

1.3 The processes controlling the emission, dispersion, deposition and environmental impacts of atmospheric ammonia remain my primary research interest. Within the Atmospheric Sciences Section, I lead a team on ammonia consisting of 11 staff members and 6 PhD students. I have Published around 70 peer review papers, around ¾ of which are on the topic of ammonia, plus a further 90 chapters in books.

1.4 My group is a nationally and internationally recognized leader in the field of ammonia emission, dispersion, deposition and environmental impacts. As an indication of the national recognition of my work, in the recently published summary of the ammonia problem by DEFRA [Ref. 1], I led or co-authored 7 out of the 11 chapters.

1.5 The scope of my work includes a) conducting novel experimental research into ammonia emission, dispersion and deposition processes, and the effect of ammonia on natural habitats, b) leading the development and implementation of atmospheric ammonia monitoring activities in the UK, primarily for DEFRA [Ref 2.], c) developing mathematical models of ammonia exchange processes at plot, landscape and national scales [Ref. 1], d) advising government on the development of strategies and policies to mitigate the effects of atmospheric ammonia and e) advising the devolved agencies for pollution and conservation issues (Environment Agency, English Nature, etc) in local case-work on impacts of ammonia on the natural environment.

1.6 My involvement in the assessment of risks to Holt and West Moors Heaths SSSI (subsequently referred to as the SSSI) from the proposed development at the Barn, Earles Road, Three Legged Cross, Dorset (subsequently referred to as the Application Site) started in October 2002, when I provided preliminary advice to English Nature on the likely impacts.

1.7 I subsequently read and contributed to the Draft Rule 6 statement of English Nature, with which I agree. My contribution to this statement consisted of checking and editing Section 3.4.

1.8 I visited the SSSI in January 2004 and have observed the spatial relationships between the Application Site and the adjacent parts of the SSSI.

## 2 SCOPE OF EVIDENCE

2.1 Section 3 of my proof contains a general summary of the sources of ammonia emissions to the atmosphere and the impacts of ammonia on heathland and woodland habitats.

2.2 Section 4 relates to the nature of the risks of increased ammonia deposition to Holt and West Moors Heaths SSSI that are specifically relevant to the proposed development.

2.3 Section 5 relates to the existing status of the parts of Holt and West Moors SSSI that are relevant in relation to the proposed development.

2.4 Section 6 covers the possible and likely impacts of the proposed development on Holt and West Moors SSSI as a result of increased ammonia deposition

2.5 Section 7 discusses the differences in ammonia emission rates between poultry systems and the possibility for mitigation measures to minimize impacts on Holt and West Moors SSSI.

2.6 Section 8 discusses the concerns of ammonia deposition to Holt and West Moors SSSI in relation to meeting conservation objectives of the site.

2.7 Section 9. Discusses the concerns of ammonia deposition to Dorset Heath candidate Special Area of Conservation ("the cSAC"), the Dorset Heathland Special Protection Area ("the SPA") and the Dorset Heathlands Ramsar Site ("the Ramsar Site").

## 3 SUMMARY OF SOURCES AND ENVIRONMENTAL IMPACTS OF AMMONIA

3.1 Ammonia ($NH_3$) is a reactive nitrogen compound that is emitted to the atmosphere from a wide range of anthropogenic sources. The main source is volatilisation from excreta (urine and dung) of agricultural livestock; in particular, urea (from animals) and uric acid (from poultry) decompose in the presence of water to release ammonia, which being volatile is released to the atmosphere. Other minor sources include wild animals, vehicles, sewage treatment etc.

3.2 An overview of the different contributors to ammonia emission in the UK is provided in "Ammonia in the UK" [Ref. 1, pages 33 and 86]. Ammonia emissions to the atmosphere from poultry farming in the UK amount to 45,000 tonnes of $NH_3$ per year, or 14% of the UK total.

3.3 Emissions of ammonia occur at different stages of manure management, with the largest component emissions from poultry resulting from housing (23,6000 tonnes) and land spreading of the manures (20,100 tonnes). A smaller fraction of the total UK ammonia emission from poultry arises during the time that birds spend outside (1,500 tonnes) and from manure storage (300 tonnes). The manure storage value is smaller than the others since in many cases manure is stored within house. Outdoor emissions are small, since only a few birds spend time out doors and those that do, still spend the largest proportion of their time in the bird house. As a result, most excreta from poultry is deposited indoors.

3.4 Ammonia emissions from laying birds are larger per bird than those of broilers (table birds). This is because a laying bird is of larger average weight than a

broiler, and therefore excretes more nitrogen. Per livestock unit (i.e. normalized per kg of bird) the emission rates are similar, ranging from 2.9 to 6.9 g $NH_3$ /livestock unit/ hour [Ref. 1, page 59]. Expressed per bird, emissions from layers are around 2 times that from broilers, with emissions from broilers equating to around 0.1 kg ammonia nitrogen /bird /year and the emissions from layers equating to around 0.2 kg ammonia nitrogen /bird / year [Ref. 3].

3.5 Once ammonia is emitted to the atmosphere it is rapidly dispersed away from the source, so that the highest concentrations in the atmosphere occur in the immediate vicinity of the emissions. The decrease in concentrations with distance from source is approximately exponential; that is to say that concentrations decrease very rapidly near the source, but at greater distances decrease more slowly with distance. As a consequence of this distribution, for a very large ammonia emission source with 400,000 broilers, even at more than 1 km from source there may be a perceptible increase in ammonia concentrations [Ref 4.]. For a more typical poultry unit with 50,000 broilers, the enhanced concentrations may last for 200-500 m. Smaller distance scales apply for smaller sources. The 'footprint' of increased ammonia concentrations can be assessed at a site level available atmospheric dispersion models.

3.6 Environmental impacts of ammonia occur in two ways, via wet and dry deposition. Dry deposition is the direct removal of ammonia to the surface by absorption or adsorption of the gas. Wet deposition is the scavenging of ammonia or particulate ammonium (resulting from ammonia emissions) in to cloud and rain droplets, providing inputs of ammonium via precipitation. Dry deposition tends to be a local near-source effect, while wet deposition although not significantly enhanced near sources, may be increased many 1000s of km from source, due to a very wide dispersal of ammonia and ammonium in the atmosphere. It is the dry deposition route that is of prime concern for natural habitats in the immediate vicinity of activities that emit ammonia.

3.7 While dry deposition provides the route by which ammonia is transferred to the surface, environmental impacts may be the result of either the long term average deposition of nitrogen (expressed in kg nitrogen /ha /yr) or the concentration exposure to ammonia (expressed in ug /$m^3$). Appropriate thresholds or limits have been defined for each of these, called critical loads and critical levels, respectively.

3.8 The critical load is defined as "the amount of pollutant deposited below which significant harmful effects on specified elements of the environment do not occur, according to present knowledge" [Ref 1, page 27]. The critical level is defined as "the concentration of a pollutant in the atmosphere, below which vegetation is unlikely to be damaged according to present knowledge" [Ref 1, page 27].

3.9 Critical loads for nitrogen deposition have been defined by a number of different methods of different complexity, including empirical estimates, steady state models and dynamic models. The empirical estimates have recently been reviewed under the Convention on Long Range Transboundary Air Pollution (CLRTAP) of the United Nations Economic Commission for Europe (UN-ECE) at the "Bern Workshop" and are based on a broad range of information from experimental studies and field observations. The recently published UNECE estimates represent the international scientific consensus. Relevant critical load values include:

- Calluna dominated wet heath: 10-20 kg N /hectare /year
- Erica tetralix dominated wet heath: 10-25 kg N /hectare /year
- Dry heath: 10-20 kg N /hectare /year

The ranges for each habitat represent the range of best estimates recognizing variation in environmental conditions between locations. Indicators of exceedance include decreased heather dominance, transitions from heather to grassland and declines in lichen and moss communities [Ref 5. page 38].

3.10 Critical levels for ammonia were most recently defined in the "Egham Workshop" of the UNECE in 1992, the results of which were subsequently summarized by the UK Critical Loads Advisory Group (CLAG) [Ref 6]. The critical level for ammonia is set on the period of exposure above a threshold concentration:

- 1 day exposure: 270 ug /m3
- 1 month exposure: 23 ug /m3
- 1 year exposure 8 ug /m3.

3.11 It should be noted that the critical level values for ammonia are now considered by many scientists to be out-of-date and not sufficiently precautionary. In particular, it can be shown that exceedance of the critical loads occurs at much lower concentrations than the critical levels. (i.e. ammonia concentrations of >1-2 ug /m3 are sufficient in most cases to lead to exceedance of the critical load) [Ref 7]. This indicates that the issue of most concern from ammonia is the indirect impact of nitrogen from ammonia deposition, rather than the direct toxic effect of ammonia concentrations. However, recent results from a Joint Nature Conservation Committee (JNCC), Countryside Council for Wales and English Nature jointly funded study have shown direct effects of ammonia concentrations on lichens at concentrations <2 ug /m3 [Ref 8].

3.12 Given the recognition that the current critical levels are probably too high, assessment of the environmental impacts of ammonia should at present focus on the extent of critical loads rather than critical levels exceedance.

## 4 NATURE OF THE RISKS OF INCREASED AMMONIA DEPOSITION TO THE SSSI

4.1 The parts of Holt and West Moors SSSI of concern for the present planning enquiry (i.e. those parts adjacent to the Application Site) have been designated to protect heathland habitats. The SSSI Citation [Ref 9] notes the presence of dry heathland dominated by Heather (*Calluna vulgaris*), with Dwarf Gorse (*Ulex minor*) and Bell Heather (*Erica cinerea*), as well as of wet heathland with Cross-leaved Heath (*Erica tetralix*) and Purple Moor-grass (*Molinea caerulea*).

4.2 These wet and dry heathland habitats are well known to be sensitive to atmospheric nitrogen deposition, particularly in the form of ammonia, as reflected by the setting of critical loads (3.9).

4.3 The proposed development, if it went ahead, would lead to significant ammonia emissions to the atmosphere, thereby increasing ammonia concentrations in the atmosphere and nitrogen deposition from the atmosphere in the near vicinity. The extra nitrogen arising from the Application Site, added to the SSSI via the atmosphere, would alter nutrient cycling and competition between the different

species present, as well as increase the chance of invasion by species not presently occurring.

4.4 Particular changes that would be expected would be the reduction in cover by the three main heather species (*Calluna vulgaris*, *Erica cinerea* and *Erica tetralix*), at the expense of increasing cover by rough grasses, *Deschampsia flexuosa* (in drier areas) and *Molinea caerulea* (in wetter areas). Such changes have also been shown to lead to losses of lower plants (lichens and mosses), which are an integral part of such heathland habitats. A detailed review of the effect on dry heathlands has been provided by Bobbink et al. 2003 [Ref 10, page 82-96], which illustrates the wealth of experimental evidence available.

4.5 It is important to note that increased atmospheric nitrogen deposition can interact strongly with normal management practice of heathlands. Where sites are unmanaged, the lower end of the critical load range is appropriate [Ref 5, page 35]. In addition, available data show that fire management may have an effect on the responses to nitrogen deposition. While fire is an essential part of lowland heathland management (and may also occur due to third parties or accidents), it has been shown experimentally that the effects of nitrogen deposition on a heather canopy may initially be hard to detect, but become much more obvious following a fire event, where grasses re-grow preferentially at the expense of the former heather canopy [Ref 11]. This shows that the effects of nitrogen on the habitat may to some extent remain latent until they are revealed several years later by interaction with management events.

4.6 The trees Birch (*Betula pubescens*), Pine (*Pinus sylvestris*) and Sallow (*Salix cinerea*) are also noted as a feature in the citation. While not rare, these form an important part of the mosaic of heathland, particularly at the borders, and represent an important habitat for animal species. The evidence for direct impacts of ammonia on these trees is rather variable (e.g. evidence of chemical changes, but less evidence of tree decline). More important, however, is the clear evidence of changes in both the ground flora under such tree canopies and of changes in the epiphytic (bark growing) lichen flora. Increased deposition of nitrogen as ammonia has been well documented to lead to a loss of herb and moss species and an increase in rough grasses in the ground flora. In the case of epiphytic lichens, those species favouring clean acid bark conditions ('Acidophytes') tend to be replaced by those favouring alkaline, nutrient enriched bark ('Nitrophytes') (See Ref 8).

## 5 EXISTING STATUS OF THE SSSI IN RELATION TO AMMONIA AND THE PROPOSED DEVELOPMENT

5.1 The parts of the Holt and West Moors SSSI in the vicinity of the Application Site represent heathland and woodland, under a range of management conditions. On the basis of having spoken with the English Nature local officer Nick Squirrell and having visited the site myself, the areas of the SSSI around the Application Site can be loosely be considered in 2 zones, each consisting of two broad sub-zones. These can best be considered by reference to the aerial photograph of the site. [Ref 11].

- Zone 1: Area bounded by a dashed pink line to the north east of the Application Site (Marked Lower Common North).

- Zone 1a: Belt of trees around the path to the north of the Application Site, running in the direction NW to SE, approximately 10 m wide. The boundary of the SSSI appears to run through this band of trees.
- Zone 1b: Heathland with scattered trees in Lower Common North, which includes both dry heathland and wet heathland habitats.

▪ Zone 2: Area bounded by a dashed pink line to the south west of the Application Sites (Marked Lower Common South).

- Zone 2a: Belt of trees running NW to SE, south of the Application Site, approximately 50 m wide.
- Zone 2b: Heathland with scattered trees in Lower Common South, which includes both dry and wet heathland habitats.

5.2 I am informed by Nick Squirrell that the area which I refer to as Zone 1 is subject to some uncertainty of ownership, and as a result it is not under active heathland management. By contrast, Zone 2, is under clear ownership and active management. In visiting the site, I noted in Zone 2b indications of tree removal, as well as areas with a younger heather canopy (indicating burning in recent years), which are consistent with this information from Mr Squirrell.

5.3 In considering the effect of ammonia deposition from a future development it is important to assess the existing 'background' atmospheric input. No site-based measurements of atmospheric ammonia concentrations have been made, and therefore the best estimate is provided by national models [Ref 1, page 18]. The National Expert Group on Transboundary Air Pollution (NEGTAP) estimates an atmospheric deposition at this site (relevant for the 5 km x 5 km grid in which the site lies) to be around 20-23 kg N /ha/year for the heathland habitat. These values have been calculated by my group at CEH Edinburgh and represent the nationally agreed best estimates (They are also the values we provide in the UK Air Pollution Information System (APIS) of the conservation and pollution agencies [Ref 12]). It is important to note that the values include significant uncertainties at a site level, and the actual deposition may be either larger or smaller, depending on the spatial relationships between sources and sinks that cannot be resolved by 5 km resolution modelling.

5.4 While it is accepted that there are uncertainties in the NEGTAP estimate of nitrogen deposition, it should be noted that the estimated value is already larger than the critical load range for dry heath (10 – 20 kg N /ha/yr), and at the upper end of the critical load range for wet heath (10 – 25 kg N /ha /yr). Therefore, even in the absence of further development, the site is already at risk of the effects of atmospheric nitrogen deposition. The proposed development needs to be considered as an additional risk to this background.

5.5 A recent botanical survey of the site has been conducted by Bryan Edwards of the Dorset Environmental Records Centre (January 2004) [Ref 13]. This describes in more detail the distribution of the different types of heathland and woodland on the site. In particular, analysis of the epiphytic (bark living) lichen species shows that both species that prefer clean acid bark and species that prefer nitrogen enriched bark are present (page 4-5 of Ref 13). This indicates that the site is currently exposed to a moderately high level of atmospheric ammonia or nitrogen, which is consistent with the estimate of background nitrogen deposition.

## 6 SCALE OF POSSIBLE AND PROBABLE IMPACTS OF THE PROPOSED DEVELOPMENT ON THE SSSI THROUGH AMMONIA

6.1 The proposed development envisages, within three years, around 1200 laying poultry in the barn at the south edge of the Application Site, and a further 1000 free range laying birds located in 10 movable arks across the Application Site. Under this plan the barn could be considered as a fixed location point source of ammonia, while the free range birds could be (over time) considered as an area source across the whole of the Application Site.

6.2 Under normal circumstances in such applications I am asked to comment on a numerical modelling assessment conducted by the applicant or their agents that assesses the scale of ammonia deposition and its effects. Although it is the responsibility of the applicant to provide appropriate information to demonstrate that there will be no significant effects, this application is unusual in that no such assessment appears to have been made. In the absence of such an assessment, I have several possible tools to make my assessment of the possible and probable impacts:

a) expert judgement, based on the analysis of many similar cases of the impacts of poultry farms on nearby semi-natural ecosystems

b) use of an empirical model screening tool, that we have developed in my team to enable a quick and cost effective quantitative assessment (SCAIL: Simple Calculation of Ammonia Impact Limits)

c) use of a range of detailed local scale atmospheric dispersion models. Given the resources and financial costs required for c) and that the onus is on the developer to show that the development would have no significant effect (rather than the Statutory Authority to show an effect), I here apply a simple assessment using a) and b).

6.3 In not conducting a detailed modelling assessment c), I note in passing that in many cases such an assessment is not actually necessary in order to determine whether there would be a likely effect, and would therefore represent a waste of resources. It was for this reason that we have been developing the SCAIL approach, as a means to save both applicants and statutory authorities significant resources. For example, detailed model analyses might be avoided in situations where the impact is trivial (e.g. effect of 2000 layers on a SSSI that is 20 km distant), or where the impact is massive (e.g. effect of 1 million layers on an SSSI that is 100 m distant).

### *6.4 Assessment based on expert judgement*

6.4.1 It is convenient for me to consider two assessments of significant environmental impact on the SSSI, “possible” effect and “probable” effect. I consider the implications of my assessments, in the context of the international designations and the Conservation (Natural Habitats &c.) Regulations 1994 (“the Habitats Regulations”) in Section 9 below.

6.4.2 In the case of “possible significant effect”, I am concerned to say whether the development could in reasonable possibility lead to a significant effect on the SSSI.

6.4.3 In the case of "probable significant effect", I am concerned to say whether the development, in balance of probabilities, would have an environmental impact on the SSSI.

6.4.4 In visiting the site, I noted the location of the barn as being immediately adjacent to the Zone 2a of the SSSI. Conversely, this barn is around 110 m from Zone 1a of the SSSI. Although most winds come from the south and west, this difference in distance would make Zone 2a the most likely part of the SSSI to be vulnerable to ammonia emitted from the barn.

6.4.5 I also noted that with the proposal for 1000 birds in movable arks across the Application Site, emissions could take place anywhere up to the north east boundary. In this case the Zone 1a would be immediately (0 m) downwind of the source, while Zone 1b would be 10 m downwind of the source, in the direction of the prevailing wind.

6.4.6 Noting that it is proposed for the site to contain overall, 2200 laying birds, and that layers emit approximately two times as much ammonia per bird as broilers, it can be estimated that the annual emission of ammonia to the site would be around 440 kg nitrogen / year or around 530 kg ammonia /year. (This difference reflects the atomic mass of nitrogen, 14 and molecular weight of ammonia, 17).

6.4.7 Having visited the site, and using this information on the nature of the source and sensitivity of the nearby habitats, based on my 'expert judgement', I would estimate that there would be both 'possible' and 'probable' significant effects on the SSSI. This would include effects on both the woodland and heathland elements of the SSSI.

a) Zone 1a (woodland boundary to north of the Application Site): In this case a probable significant effect would occur throughout this narrow 10 m wide zone. This would consist of changes in the ground flora and changes in epiphytic lichens.

b) Zone 1b (heathland to the immediate north of the Application Site): In this zone I estimate that a probable significant effect would occur for the first 50 m of the heathland, while a possible significant effect would apply for the first 300 m. The effects would consist of an alteration to the heather canopy, with an increase in grasses (particularly following burning events), coupled with a reduction in lichen and moss cover. Other herbs occurring in this distance may also be affected.

c) Zone 2a (Woodland to the south of the Application Site): In this case a probable significant effect would occur for the first 30 m of this zone, in the area immediately to the southwest of the barn. In this direction a possible significant effect would be expected for the full width of the woodland. The changes occurring would include loss of ground flora species (including *Sphagnum denticulatum*) as well as of epiphytic bryophytes and lichens.

d) Zone 2b (Heathland to the south of the Application Site): In this case, due to the screening effect of the woodland (but see Section 8), I would not anticipate a probable significant effect of the development via ammonia deposition. Given the presence of the woodland, I estimate possible significant effects to occur up to 150 m on the heathland in this direction. The effects would be as for Zone 1b.

6.4.8 In making these expert judgement assessments, it should be noted that the distances given are approximate and serve as indicative values. The overall message is that the proposed development is not consistent with maintenance of the habitats designated in the SSSI citation. For large areas (up to 300 m into the SSSI) I cannot be confident that there would be no effect, and for smaller distances (50 m into the SSSI) I would expect to see visible signs of change within a few years of operation if the development went ahead.

6.4.9 It is important to recognize that the development proposed is a very small poultry farm. In many instances such a development would not pose a threat to local conservation interests. What is of concern in the present case is that the Application Site is located immediately adjacent to a sensitive SSSI.

### *6.5 Indicative assessment based using the SCAIL model*

6.5.1 SCAIL is a screening tool that CEH have been developing for the Environment Agency, to provide a simplified assessment of the local impacts of farm ammonia sources [Ref 14]. As a screening tool, the objective is not to provide a definitive best model estimate, but to identify the need for further more detailed modelling assessments.

6.5.2 A key feature of the proposed development is that the distance scales are very small. Under these conditions, all atmospheric dispersion models, including SCAIL are rather uncertain. This is because local land structures and topography become important, for example turbulence around individual buildings or air flow around stands of trees. Similarly, SCAIL does not include specific estimates for free range laying hens (see Section 7), and therefore estimates are available only for layers (perches or deep litter) or for broilers, while the emissions are treated as a point source rather than an area source.

6.5.3 Based on modelling the deposition of ammonia to the north east of the farm (in the direction of the prevailing wind), with 2200 laying hens the expected contribution of the proposed farm would be 13.5 kg N /hectare /year at 50 m down wind and 7.7 kg N /hectare /year at 100 m downwind.

6.5.4 Although the small scale differences in source location (barn vs free range birds) make exact location comparisons complex when using such as simple tool, the broad indication is of deposition to Zone 1b of around 5-15 kg N /hectare /year.

6.5.5 These SCAIL estimates are for heathland vegetation, and larger values would be calculated for woodland vegetation.

6.5.6 Based on an existing background deposition of 20-23 kg N /hectare /year (from mapped estimates), a critical load for dry heathland of 10-20 kg N /hectare /year and the additional estimated deposition from the proposed development to Zone 1b of around 5-15 kg N /hectare /year, it is clear that the proposed development would make a significant contribution to critical load exceedance. While it is important to recognize the uncertainties, the use of mid range values is useful to indicate the contribution in broad terms. The existing critical load exceedance of the site is around 6.5 (0 – 13) kg N /hectare/ yr and this would be increased to 11.5 (5-28) kg N /hectare /year, at the leading edge of Zone 1b should the development be permitted. The magnitude of the additional deposition is such that significant ecological effects on the SSSI are both possible and probable.

## 7 AMMONIA EMISSIONS IN RELATION TO POULTRY SYSTEMS AND POSSIBLE MITIGATION OPTIONS

7.1 It is noted in Section 6.6.2 that the SCAIL model used standard emission factors as applied by the Environment Agency for laying poultry. While this is the appropriate value for the 1200 birds proposed for the barn, there is a lack of experimental data on emissions from free range poultry.

7.2 In the letter of Clare Whifield to Nick Squirrell (22 October 2002), it was noted that CEH considered that emissions from free range hens could be lower than that for housed birds. This tendency could occur because the excretion that occurs outside (around 10%) would have a lower emission potential than excretion indoors. This would mean that emissions from free range hens were around 90% those of barn birds, which is only a small difference. However, another important factor is the extent to which litter is kept dry. The environment of a small movable ark for free range birds is not easily controllable, and it is possible that greater moisture ingress could also increase emissions compared with barn birds. On balance, therefore, in the present assessment the same emission values for free range birds are used here as for barn housed birds.

7.3 It is important to note that the assumption in 7.2 above makes no difference to the interpretation of the SCAIL assessment, since the contribution of the birds would still be significant even if the smaller emission factor of broilers were used.

7.4 is difficult to specify realistic mitigation options that could be used with the present development that would avoid significant effects to the adjacent SSSI. It is noted that in the proposed development, accumulated manure would be removed from the site. This cannot be considered an abatement measure compared with this assessment, since the values used already exclude emissions from land spreading of poultry manure.

7.5 Secondary spatial policies might be considered that do not reduce the emissions of ammonia, but do reduce the deposition and impact on the sensitive features of the SSSI. The first option here is the planting of woodland or use of existing woodland around the poultry farm. At the present site, there is not sufficient distance to plant the amounts of woodland that would be necessary, while the scale of benefit would not be sufficient to completely avoid a likely significant effect on the SSSI.

7.6 The best and most simple option for reducing the impacts of proposed poultry farms on specific SSSIs is to locate the farm at a greater distance from the SSSI. For example, with a small farm of the nature proposed (2200 birds) even a move of 1 km from the SSSI would probably be sufficient to avoid significant ecological effects on the SSSI.

## 8 IMPACTS OF AMMONIA DEPOSITION ON THE SSSI IN RELATION TO MEETING THE CONSERVATION OBJECTIVES

8.1 At present the Application Site, and the land immediately to the east of it are used as extensively grazed paddock, it appears mainly for horses, and there will already be a small amount of ammonia emitted from this source.

8.2 Bearing in mind the benefits of trees to capture and disperse ammonia (Section 7), the belts of trees at Zone 1a and 2a will already be performing a useful

function in reducing ammonia deposition to Zone 1b and 2b, respectively. The belt at Zone 2a is the widest and therefore have the larger benefit, while that at 1a is rather narrow and would have a modest benefit. In the context of local ammonia sources, such boundary belts of trees therefore have a useful 'sacrificial' role to play in contributing to the protection of the heathland habitats which they surround.

8.3 I note that the conservation objectives of the SSSI (and cSAC) include the requirement to restore heathland vegetation and to reduce the amount of cover by woodland. In particular, the woodland at Zone 2a is not considered by English Nature to be of particular conservation value compared with the adjacent heathland [Ref 15, and Nick Squirrell, pers. Comm.]. It is therefore considered by English Nature that some of this woodland will in due course be removed to allow restoration to heathland vegetation.

8.4 If the proposed development were to go ahead I would strongly advise against removing the woodland at Zone 2a, since the buffering effect of this woodland to protect Zone 2b would be lost. Such use of the woodland at Zone 2b would therefore prevent English Nature from meeting its conservation objectives in relation to Zone 2a.

8.5 Given the local nature of ammonia impacts, one way to protect designated heathland habitats in mixed landscapes (such as SSSIs and European designated sites) is to extend sympathetic management (eg heathland restoration and extensive grazing) to land outside and adjacent to the designated areas providing a 'buffer zone' to ensure that the distance to ammonia emission sources is maximized and deposition to the centre of protected sites minimized. Existing mechanisms to encourage this approach include the Countryside Stewardship scheme and English Nature's Wildlife Enhancement Scheme. This is consistent with the objectives of English Nature (Nick Squirrell, personal communication) to restore areas of Dorset heathland and to reduce the level of heathland fragmentation.

8.6 It may be noted that the current land use of the Application Site (and the land immediately to the east) is as grazing land. Formerly this would have been heathland, and the land would still be a suitable site for restoration to heathland in the future. Should the proposed development go ahead, the levels of nutrient input from the free range poultry would be so large as to make future restoration of this land to heathland extremely difficult or potentially impossible.

## 9 IMPACTS OF AMMONIA DEPOSITION ON THE INTERNATIONAL SITES

9.1 The designatory documents for the international sites are provided in the statements of English Nature. The whole of Holt and West Moors SSSI is included in the cSAC, the SPA and the Ramsar site. Therefore statutory provisions for the protection these international sites apply in the case of this proposed development.

9.2 The cSAC is recommended for a number of European interest features. Those relevant in the locality of the Application Site are "European Dry Heaths" and "North Atlantic Wet Heaths with *Erica tetralix*". The conservation objectives for these features are to maintain them in favourable condition, and maintain implies restoration if a feature is not currently in favourable condition.

9.3 The SPA is classified for heathland bird species of European importance, and the conservation objectives are to maintain in favourable condition the habitats for the populations of such species, with particular reference to lowland heathland.

9.4 The interest features and conservation objectives of the Ramsar site are subsumed within those of the two European designations, and do not require separate consideration.

9.5 I am informed that both East Dorset District Council, and English Nature, consider that, for the purposes of this application and appeal, the proposed poultry farm forms part of a plan or project subject to regulation 48 of the Habitats Regulations. In this section of my proof I assume this to be the case. My evidence only considers the implications of the poultry operation; it does not consider the use of any building on the site as a dwelling.

9.6 In the light of my evidence so far, especially in Sections 6 to 8 above, I regard it as obvious that the establishment of the proposed poultry unit is likely to have a significant effect on each of the international sites, having regard to their conservation objectives applicable to the heathland close to the site.

9.7 My evidence is relevant to the appropriate assessment of the proposal to establish a poultry unit at the Application Site.

9.8 I am aware that PPG9 (1994) advises that "The integrity of a site is the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified."

9.9 For the reasons explained in Sections 6 to 9 above, it is in my opinion impossible to be confident that the present project, insofar as it includes the poultry unit, will not adversely affect the integrity of each international sites, in relation to their heathland interest features or other interest features that are dependent on this habitat.

9.10 Further, I regard it as more probable than not that the integrity of each international site would be adversely affected by the impact of ammonia deposition within the first 50 metre width of heathland to the immediate north of the Application Site.

## 10 CONCLUSIONS

10.1 The proposed development includes the establishment of a small poultry farm with around 1200 laying hens in a barn and 1000 free range hens. The proposed Application Site is located immediately adjacent to Holt and West Moors SSSI, which is part of the Dorset Heathland cSAC.

10.2 Operation of the proposed poultry farm would necessarily give rise to ammonia emissions that would be dispersed through the atmosphere leading to increased atmospheric nitrogen deposition to the SSSI.

10.3 Based on expert judgement from the available facts, and having visited the SSSI, I cannot be confident that there would be no significant effect of the development on the SSSI, with possible effects up to around 300 m from the Application Site. In addition, I expect probable significant effects of the

proposed development up to 50 m into the SSSI. The changes expected would include a loss of integrity of the heathland canopy, with a decrease in heather species, lichens and mosses and an increase in rough grass species.

10.4 Based on the application of a simple screening model (SCAIL), I estimate that the proposed development would increase N deposition to parts of the heathland of around 5 – 15 kg N /hectare/year, which is in addition to a background deposition of around 20-23 kg N /hectare /year. Given that the 'critical load' for deposition to dry heathland is 10-20 kg N /hectare/year, it is clear that the proposed development would lead to a significant increase in the extent of critical loads exceedance. In practical terms, this means that significant ecological effects would be expected on the SSSI in the long term (20-30 years) should the development go ahead.

10.5 In addition to expert judgement and screening models, it is also possible to apply detailed dispersion models to assess deposition. This activity is normally conducted at the responsibility of the applicant, and I note that this has not been done in the present case. Given the cost of this activity, an the clear conclusions from 9.3 and 9.4, it is my view that such detailed modelling is not necessary in the present case. This would simply be an expensive way to find out what can be determined more simply: namely that that the proposed development would lead to a significant increase in nitrogen deposition to the adjacent SSSI, with consequent ecological effects.

10.6 I am aware of no proven abatement technology that would allow the proposed poultry farming activity at this site to be conducted without threatening the integrity of the SSSI habitats.

10.7 If the development were permitted, it would also hinder the potential future restoration of this SSSI as part of the site conservation objectives to a) reduce the cover of woodland and increase cover of heathland and b) reduce fragmentation of the heathland.

10.8 Assuming regulation 48 of the Habitats Regulations to be applicable, my conclusions in respect of the implication of the poultry unit for each of the international sites are:

- It is likely to have a significant effect
- It cannot be ascertained not to have an adverse effect on the integrity of the site, and
- It is more probable than not to have an adverse effect on the integrity of the site in respect of the first 50 metre width of heathland to the immediate north of the development site.

## 11 REFERENCES

Copies of relevant texts in references are provided in the appendix.


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[15] Conservation objectives for cSAC Dorset Heaths, Component SSSI: Holt and West Moors Heaths.