LIVESTOCK INSTALLATIONS AND AMMONIA

19

ADVICE FOR PLANNING OFFICERS AND APPLICANTS SEEKING PLANNING PERMISSION FOR LIVESTOCK INSTALLATIONS WHICH MAY IMPACT ON NATURAL HERITAGE

ISSUE 02 **JUNE 2017**

Introduction

There is a widespread problem with nitrogen deposition from ammonia resulting in the loss of biodiversity. The most recent Article 17 reporting to Europe has indicated that this is resulting in unfavourable conservation status of some sensitive habitats (JNCC, 2013). Some forms of agricultural production produce ammonia outputs during the process/their lifetime which contributes to our general air quality. Unfortunately there are some plant species that are highly sensitive to this pollutant which results in the loss of biodiversity for some habitats. Livestock housing adds to this widespread issue but can have significant local impacts to semi-natural habitats near the proposal. This standing advice should be applied for all livestock installation proposals as it will aid identification of those that have the potential to impact on designated sites and priority habitats.

Application Types

The types of development that most commonly give rise to potentially significant air pollution impacts on designated sites and priority habitats include poultry houses, pig units and cattle-sheds. Anaerobic Digester plants where feed materials are stored have similar effects and the Anaerobic Digestion standing advice should be considered for those cases.

Legislation

The Habitats Directive (92/43/EEC), transposed by the Conservation (Natural Habitats, etc) Regulations (Northern Ireland) 1995, requires that every public body to consider the implications of a proposal, such as livestock installations on European designated sites and make an appropriate assessment where there are any likely significant effects.

The Wildlife and Natural Environment Act (Northern Ireland) 2011 (known as the WANE Act) introduced a biodiversity duty on public bodies in Northern Ireland. It states that it is the duty of every public body, in exercising any functions, to further the conservation of biodiversity so far as is consistent with the proper exercise of those functions.

Planning Policy

Planning Policy Statement 2, Natural Heritage (Policies NH1, NH2, NH3 and NH5) and the Strategic Planning Policy Statement apply to all cases that have the potential to impact on designated sites, protected species and priority habitats.

Ammonia and Nitrogen Deposition

The most damaging pollutant from livestock units is the ammonia gas that arises from the decomposition of animal waste. Ammonia is a colourless gas that has a characteristic pungent smell.

Ammonia gas emitted from agricultural installations is short lived (hrs to days) and can be deposited locally as ammonia gas which may be termed dry deposition. The amount of this

gas declines quickly with distance from a source. This type of deposition is normally only an issue for designated sites and priority habitats when a proposal is located within a few kilometres.

However some of the ammonia gas dissolves in the moist air which may stay airborne for several weeks and be carried further before being washed out in what is termed wet deposition.

In addition to impacts on vegetation, ammonia deposition has the potential to decrease soil pH (e.g. acidification) which also impacts on habitats and species.

The amount of ammonia emitted from a livestock unit depends mainly on the number of animals, but also on how the manure is managed, the ventilation system and the deployment of ammonia stripping devices. The spread of ammonia towards a designated site or priority habitat will depend on the type of housing ventilation used, prevailing wind direction, wind speed and nature of the surrounding land between the development and the site or habitat. It is for this reason that detailed modelling is sometimes requested for applications. Some of the ammonia gas will be absorbed by intervening vegetation particularly trees and shrubs. The planting of trees (shelter belts) around livestock units can therefore help reduce the spread of ammonia. The benefit of this however has not been adequately quantified and is therefore not included in models.

Physiological Effects on Vegetation

The toxic effects of ammonia gas can result in the damage and death of plants. Some species are very sensitive to high ammonia levels. Lichens and mosses (lower plants) are the most sensitive, but there is also evidence of a damaging effect on some trees and shrubs (higher plants).

- Direct damage to sensitive species by ammonia gas can include:
- leaf discolouration, bleaching observed in *Sphagnum* moss species at high concentration (1 µg Ammonia per m-3);
- increase in algal growth over *Sphagnum* mosses; and
- suppression of root uptake of cations (positive ions) such as calcium, magnesium and potassium leading to nutrient imbalances.

The concentration of nitrogen in foliage increases with increasing levels of nitrogen deposited from the atmosphere onto soils and vegetation and can show the following;

- may increase plant sensitivity to stress (frost, drought and insect damage);
- has contributed to changes in the mix of plant species growing in a range of semi-natural habitats (e.g. heathland moorland and bogs) in many parts of UK through loss of sensitive species;
- bramble, holly and ivy appear to be insensitive to high ammonia concentrations so these species can become dominant; and
- there may be epiphyte absence and layer of algal slime on trees indicating extreme eutrophication and damage to lichens and bryophytes.

Ecosystem Effects

The habitats that are most susceptible to the effects of ammonia are bogs, heathlands, woodlands and low nutrient grasslands (see Appendix 1 for more details). However the

impacts from a specific proposal on a habitat are highly dependent on the distance from the habitat, as well as wind speed and wind direction. Standing water can also be affected, where eutrophication can lead to algal blooms that block out light to other aquatic plants and deoxygenate the water.

Sources of information

Spatial information

- **NIEA Protected Sites**
    - Designated sites
        - Special Areas of Conservation (SACs)
        - Special Protection Areas (SPAs)
        - RAMSaR sites
        - Areas of Special Scientific Interest (ASSIs)
- **NIEA Biodiversity Hazard Mappings** showing areas likely to be of significance for priority habitats containing
    - Local Wildlife sites
    - Mapped priority habitats
    - Some sensitive birds sites (often displayed as 1km² area grids)

Critical Level

Critical levels (Cle) 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" (APIS, 2017 cited at* UNECE, 2003*).* The concentration in air is expressed in microgrammes per cubic metre (µg/m^3) e.g. 1 µg/m^3 for lichens. The exceedance of a critical level is defined as the atmospheric concentration of the pollutant above the critical level. See Table 1 for critical level for specific habitats.

Table 1: critical levels for habitats of concern – data source www.apis.ac.uk

Habitat Type	Critical Level For Ammonia µg/m^3
Bogs	1
Coniferous Woodland	3
Broadleaved , Mixed and Yew Woodland with priority lichens and bryophytes	1
Broadleaved , Mixed and Yew Woodland	3
Calcareous Grassland (Lichens and bryophytes)	1
Calcareous Grassland (Higher Plants)	3

Air Pollution Background Data

Ammonia levels have been reducing in the United Kingdom except in Northern Ireland.

Monitoring in Northern Ireland has shown that atmospheric ammonia is increasing across NI. Monitoring of European habitats has found that most habitats are at risk from high ammonia levels which will affect the vegetation of the habitat and its conservation status (JNCC, 2013).

Models

Although dispersion modelling software can have uncertainties associated with them, they are used to help predict the impacts of gases or particulates on receptors. Historical weather data from Aldergrove is used to inform the dispersion model. The results of the modelling can be used to support judgements on whether a planning application is likely to impact on receptors such as habitats and species. More details are given in Appendix 2.

Mitigation

There may be some opportunity within an application to provide mitigation which could reduce the impacts from ammonia and should be detailed on all plans with an application and incorporated where possible into the modelling.

These could include fans, chimneys stacks, shelter belts, bio-filters and air scrubbers.

Current Position

As most of the designated sites and priority habitats in Northern Ireland have reached or exceeded their critical level of ammonia, NIEA have adopted a working position for the assessment of applications in relation to facilities that produce ammonia.

It is the current working position of NIEA to only accept applications that produce up to 10 % of the CLe for all designated sites that could be impacted. This includes potential cumulative and in combination impacts with other applications and installations that could also produce ammonia pollution.

Outside designated sites the current position is to allow for up to 50% of the CLe for a priority habitat.

Please note that this position is under review and these levels may reduce.

Procedure for Applications

Screening

All applications which emit ammonia must be screened for their potential to impact on designated sites or priority habitat. This is achieved by undertaking a spatial check for designated sites and priority habitats near the proposal.

Planning Officers must check to see if there are designated sites within 7.5km of the

proposal. See NIEA website for a map of all designated sites. These sites have the potential to be impacted upon by the proposal.

All priority habitats that could be impacted within 2km must also be considered. NIEA provides a Northern Ireland Biodiversity Hazard Map which identifies a significant proportion of potential habitat for Northern Ireland. See appendix 1 for priority habitat types that can be significantly impacted by ammonia deposition.

In order to adequately assess an application it is important that there is sufficient information on which to base a decision. The following is required for a complete application.

A SCAIL (Simple Calculation of Atmospheric Impact Limits) check of designated sites within 7.5km and priority habitats within 2km must be undertaken for each application.

If the SCAIL is 1% or over of the CLe for designated sites, or 10% or over for priority habitat then there is the potential for significant effects and the application may require more detailed air quality modelling. A detailed air impact assessment (modelling) is always required where the designated site or priority habitat has reached its capacity regarding permitted input or that the initial SCAIL screening has exceeded permitted input.

Before undertaking any further assessment the applicant should be made aware that the general area is exceeding the critical level for a number of airborne pollutants including those which can result in nitrogen deposition. NIEA has a commitment to the EU Strategy: 'Our life insurance, our natural capital: an EU biodiversity strategy to 2020', to ensure that all designated sites are in favourable status by 2020. The existing high ammonia levels could hinder progress towards achieving this. NIEA advise that all applications which result in nitrogen deposition are considered in respect of this commitment. The applicant may therefore wish to fully consider the additional expense of the information required to further this application if additional modelling is requested**.**

NIEA should then be consulted with the air quality modelling to provide further advice on environmental effects.

The following survey that may also be required where there is permanent storage of materials on site or the unit is naturally ventillated:

- smooth newt - if a pond is within 250m of the proposal due to potential for acidification of the waterbody.

References

APIS, 2017. *Critical Loads and Critical Levels - a guide to the data provided in APIS*. (Online) Available at: http://www.apis.ac.uk/overview/issues/overview_Cloadslevels.htm#_Toc279788056 (Accessed 23 May 2017).

JNCC. 3rd UK Habitats Directive Reporting 2013. Joint Nature Conservation Committee

UNECE (2003): Empirical Critical Loads for Nitrogen - Expert Workshop, Berne 2002, Eds. Acherman and Bobbink. Environmental Documentation No. 164, SAEFL

Process to consider for applications when dealing with livestock units for non-EIA development

Is the proposal within 7.5KM of a designated site or 2KM of a priority habitat (check NI Biodiversity Hazard Map)?

No → Record no potential to impact on designated sites or known priority habitats

Yes ↓

Undertake SCAIL screening check of proposal; see appendix 2 for list of all information required for this process.

If SCAIL is 1% or over of the CLe for a designated site, or 10% or over of the CLe for a priority habitat request detailed modelling of the proposal where the background CLe for the habitat is already exceeded as the proposal has potential for significant effects

→ Send to internal Shared Environmental Service for Habitats Regulations Assessment to confirm if modelling is required

Has modelling been received?

No → Proposal could be contrary to policy due to lack of information and potential to cause harm to a designated site and/or priority habitat

Yes ↓

Consult NIEA with SCAIL assessment and modelling report to provide advice as development has the potential to impact on a designated site and/or priority habitat

Appendix 1

Greater detail on habitat effects - source www.apis.ac.uk.

BOGS and HEATHLANDS – effects and implications

- Ammonia exposure will predispose sensitive plants to stress much faster than wet N deposition ie. at lower N loads.
- Effects will vary depending on the exposure concentrations, the length of time of exposure and whether phosphorus and Potassium (PK) deposition has also been increased, e.g. dust from point sources.
- Direct damage to sensitive species, e.g. bleaching and leaf discoloration, observed in *Sphagnum* species and lichen *Cladonia portentosa* at high >20 µg m^{-3} concentrations. Bleaching is a particularly likely consequence of NH_3 exposure. Breakdown of *Sphagnum* hummocks and increase in bare peat which can increase the likelihood *of ero*sion and surface oxi*dation.*
- Increase in algal growth over *Sphagnum* especially where PK also enriched.
- Reduced ability of stomata to close under drought *conditio*ns, leading to plant water stress (Van Hove et al. 1991, Erisman and Draaijers 1995) highly visible as greatly increased amount of grey foliage in *Calluna* a consequence of winter desiccation (Sheppard et al 2008; 2011).
- Changes in the composition of ground-flora, bryophyte and lichen communities.
- There may also be subtle changes in plant morphology, physiology and biochemistry which not only increases growth, but also increases sensitivity to environmental factors such as wind, frost, drought and pests (e.g. increased tissue N concentrations can predispose plants to insect attack).

BROADLEAVED, MIXED and YEW WOODLAND – effects and implications

- Direct damage to foliage, e.g. leaf discolouration, premature senescence and loss.
- Increased sensitivity to drought and spring frost and increased risk of pest and pathogens attack
- Reduced ability of stomata to close under drought conditions, leading to plant water stress (Van Hove et al. 1991, Erisman and Draaijers1995).
- Loss of mycorrhiza and fruit bodies.
- Changes in the composition of ground flora, bryophyte and lichen communities. Changes in the understorey, increase in grasses and ruderal species.
- Nitrification will be stimulated, increasing soil acidity.
- Effects likely to be exacerbated if leaf area, canopy increases

CONIFEROUS WOODLAND – effects and implications

- Direct damage to spruce and pine tree foliage, for example, leaf discolouration, premature senescence and loss.
- Increased sensitivity to drought and frost and increased risk of pest and pathogens attack
- Reduced ability of stomata to close under drought conditions, leading to plant water stress (Van Hove et al. 1991, Erisman and Draaijers1995).
- Loss of mycorrhiza and fruit bodies.
- Increased rates of litter loss

- Changes in the composition of ground flora, bryophyte and lichen communities. Changes in the under storey, increase in grasses and ruderal species.
- Nitrification will be stimulated, increasing soil acidity.

CALCAREOUS GRASSLAND – effects and implications

- Reduced species richness and diversity
- Change in species composition
- Loss of rare or endangered species.
- Loss of characteristic calcicolous mosses and lichens at risk from shading and N accumulation, if over storey species are stimulated.
- Increased risk of drought effects.

References

Erisman, J.W.; Draaijers, G.P.J. 1995 Studies in Environmental Science 63 Amsterdam: Elsevier

Hove, L.W.A.; Vankooten, O.; Vanwijk, K.J.; Vredenberg, W.J.; Adema, E.H.; Pieters, G.A. 1991 Physiological-effects of long-term exposure to low concentrations of SO2 and NH3 on poplar leaves Physiologia Plantarum 82 32-40

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Sheppard, L.J.; Leith, I.D.; Crossley, A.; Dijk, N.; Fowler, D.; Sutton, M.A.; Woods, C. 2008 Stress responses of Calluna vulgaris to reduced and oxidised N applied under 'real world conditions' Environmental Pollution 154 404-413

Sheppard, L.J.; Leith, I.D.; Mizunuma, T.; Cape, J.N.; Crossley, A.; S., L.; Sutton, M.A.; Fowler, D.; Dijk, N. 2011 Dry deposition of ammonia gas drives species change faster than wet deposition of ammonium ions: evidence from a long-term field manipulation Global Change Biology 17 (12) 3589-3607

Appendix 2 – modelling details

Initial Model Used for Screening

SCAIL (http://www.scail.ceh.ac.uk/) - Simple Calculation of Atmospheric Impact Limits is a simple online screening tool that can be used to estimate the effect of an agricultural emission (e.g. poultry shed) on a habitat (e.g. ASSI). This estimate may then be used to determine the exceedance or non-exceedance of the habitat's impact limit and will help users in deciding whether more detailed modelling or site specific investigation is required.

Information Required

Information	**Detail**
Source Location	Easting and Northing
Source Type	Housing, litter/manure storage, land spreading
Ventilation Type	Naturally ventilated or force ventilated
Building Height	Metres
Livestock Number	Number of animals
Housing Floor Area	Square metres
Type	Broilers, layers etc
Fan Location	Roof or side of building
Number Of Fans	Number
Fan Diameter	Metres
Fan Flowrate	M^3/s
Designated Site Details	Detail
Search Radius	Kilometres
User Specified Site	Detail
Site Name	Name of site
Site Location	Easting and Northing
Habitat Within Site	Acid grassland, bog etc

Use the APIS website (Air pollution Information System)(http://www.apis.ac.uk/)) to identify the Critical Level of each sensitive species/habitat: It is important to distinguish between a critical load and a critical level. The **critical load** relates to the quantity of pollutant **deposited** from air to the ground, whereas the **critical level** is the gaseous **concentration** of a pollutant in the air. (For more detail on Critical Loads/Levels go to: http://www.apis.ac.uk/overview/issues/overview_Cloadslevels.htm#_Toc279788050)

More detailed dispersion modelling could be provided by the following models:

ADMS

ADMS is a dispersion model used to model the air quality impact of existing and proposed industrial installations. It has been developed by Cambridge Environmental Research Consultants (CERC) in collaboration with government bodies. The model predicts wet and dry deposition using meteorological data and typography. It covers dispersion from point, area, volume and line sources with a straight-line plume trajectory from source to receptor or grid point. Concentrations are modelled on an hour by hour basis using an appropriate regional meteorological data set. This modelling software is the industry standard in the United Kingdom.

AERMOD

AERMOD is another dispersion modelling software package which was produced by American Meteorological Society/United States Environmental Protection Agency. It is a steady-state plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain.

NIEA (2015) 'Guidance for Operators on producing an Air Dispersion Modelling Report for a PPC Farming Application' will provide more detail on the type of information required when published.

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