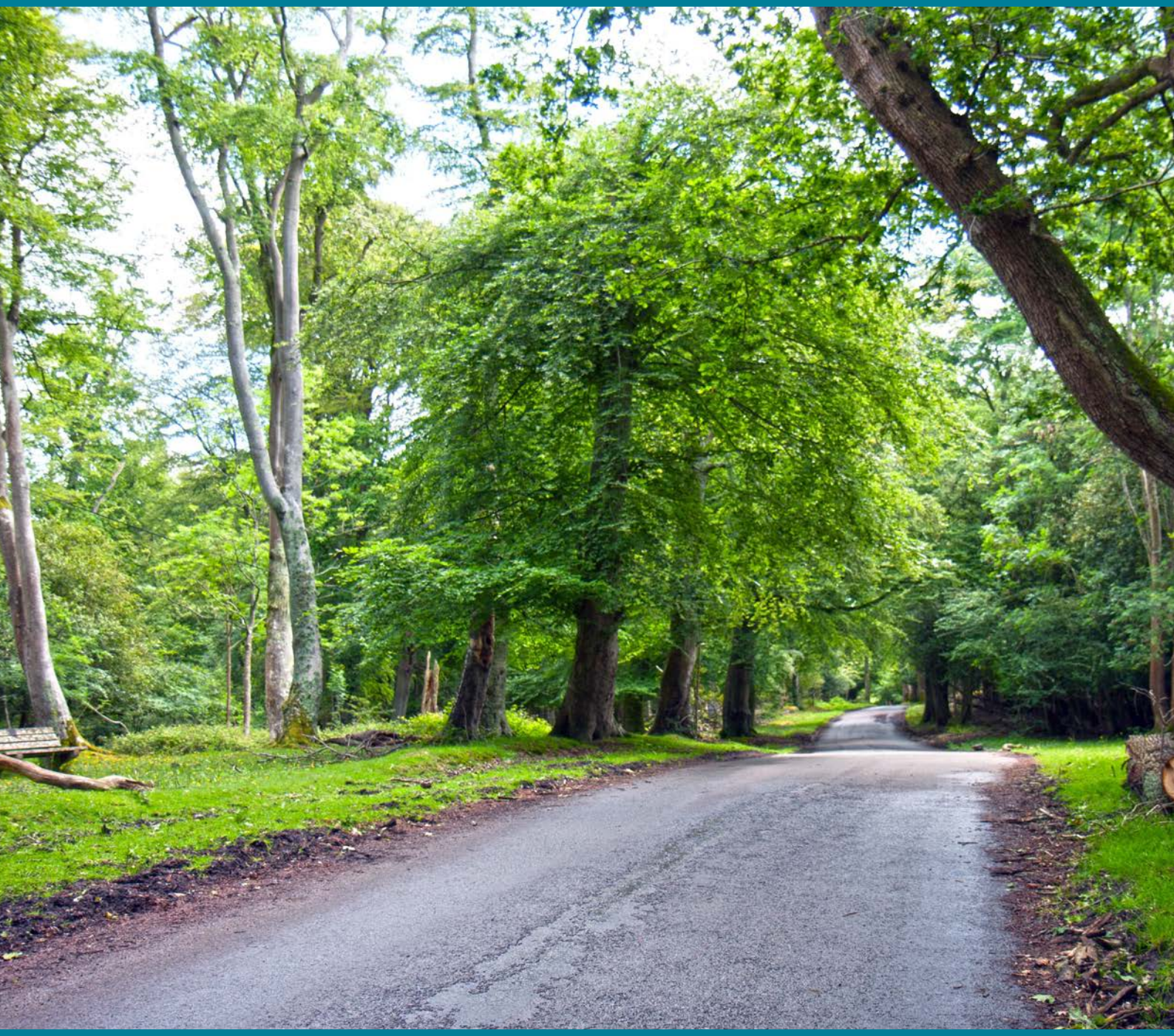
Institute of Air Quality Management

A guide to the assessment of air quality impacts on designated nature conservation sites

Version 1.1

May 2020



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Members of the IAQM Working Group
Dr Claire Holman CSci, CEnv, FIAQM, FIEnvSc, Brook Cottage Consultants (Chair)
Roger Barrowcliffe CSci, CMet, FRMetS, MIAQM, MIEnvSc, Clear Air Thinking
Graham Harker, BSc (Eng), CEng, MIMechE, MIEnvSc, MIAQM, Ramboll
Carl Hawkings, BSc, MIAQM, MIEnvSc, ADM Ltd
Sarah Horrocks BSc, MSc, CEnv, CSci, MIEnvSc, MIAQM, Atkins
Fiona Prismall MSc, BSc, CEnv, MIEnvSc, MIAQM, RPS Planning & Development

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Contact: IAQM
c/o Institution of Environmental Sciences
1st Floor, 6-8 Great Eastern Street, London
EC2A 3NT

Telephone: +44 (0)20 3862 7484

Email: info@iaqm.co.uk

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Institute of Air Quality Management: IAQM aims to be the authoritative voice for air quality by maintaining, enhancing and promoting the highest standards of working practices in the field and for the professional development of those who undertake this work. Membership of IAQM is mainly drawn from practising air quality specialists working within the fields of air quality science, air quality assessment and air quality management.

Record of substantive amendments

v1.1. May 2020

Original location	Revised location	Amendment made
Thoughout	---	Reference to Highways Agency Design Manual for Roads and Bridges (DMRB) updated to reflect new guidance published in November 2019.
1.2.1	---	*Deleted text:* The need to take account of complex new case law relating to European sites, coupled with the voluntary nature of producing this guidance has meant that the final joint document has been unavoidably delayed.
1.2.2	1.2.2	*Replacement paragraph as follows*: There were a number of unavoidable delays in producing the document and IAQM made the decision to publish the air quality sections as a standalone document in 2019.
---	1.2.4	*Additional paragraph*: CIEEM intend to publish the ecological sections in 2020. Both documents should be considered together.
Box 3.1	Box 3.1	*Footnote added:* The relevant section of the DMRB has been replaced by LA 105 Air Quality (see reference 23).
3.12	---	*Deleted text:* The 2019 Clean Air Strategy includes a commitment that the EU Withdrawal Bill will ensure existing EU environmental law continues to have effect in law after the UK leaves the EU. Therefore, the above rulings of the CJEU are likely to remain relevant for the foreseeable future.
5.3.14	5.3.2	*Paragraphs 5.3.2 and 5.3.14 merged.* *Paragraph 5.3.2 amended as follows:* The locations and boundaries of international and national designated sites can be found online, e.g. on the MAGIC website or similar online resources from the relevant SNCO. If local sites are to be assessed, details can be obtained by consulting the Environment Agency or local biodiversity records office who may charge a nominal fee for this service. Sufficient time should be allowed to obtain this data.
---	5.4.1.3	*Reference added:* iaqm.co.uk/text/position_statements/screening_tools_interim.pdf.
---	5.4.1.10	*Additional text added:* Although this may be offset to some extent if NH_3 emissions per vehicle km increase in the future.
---	5.4.1.11	*New footnote:* An updated version of the spreadsheet is available from the Overseeing Organisations (e.g. Highways England) for use on their road schemes.
---	5.4.1.17	*Reference added:* laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf.
5.4.1.21	---	*Deleted text:* It should be noted that the current DMRB guidance only provides a deposition velocity for NO_2 only and that it is different from the AQTAG NO_2 deposition velocity. IAQM recommends that the AQTAG value is used in preference to the DMRB value. It should also be noted that the deposition velocity for NO is extremely small and assuming that all NO_x is in the form of NO_2 is therefore highly conservative.
5.4.2.5	---	*Reference removed:* Development of the CURED V3A Emissions Model, Air Quality Consultants.
5.4.2.9	---	*Deleted paragraph:* The 2007 DMRB guidance for ecological assessment suggests reducing the background deposition rates by 2% each year. This approach is now considered to be inappropriate as it is not supported by monitoring data.
5.5.4.1	5.5.4.1	*Replacement paragraph as follows:* There is evidence that ammonia emissions from road vehicles may contribute more than half the local traffic related increment to nitrogen deposition.
5.5.4.2	5.5.4.2	*Replacement paragraph as follows:* The DMRB methodology only requires the assessment of NO_x emissions and nitrogen deposition. It does not consider NH_3 or its contribution to nitrogen deposition. As road transport is a source of ammonia, albeit a small source compared to agriculture at a national level, consideration should be given to including it and its contribution to local nitrogen deposition.

Original location	Revised location	Amendment made
5.5.4.3	---	*Deleted paragraph:* Where internationally important sites are involved this should be discussed with the project ecologist (or the HRA co-ordinator) to ensure that the potential for 'in-combination' effects is treated appropriately.
5.5.4.4	---	*Deleted paragraph:* If a formal assessment of 'in-combination' impacts is required, it must take place before applying the 1% criterion. Within this context, it may be possible to screen for effects of nitrogen deposition without specifically calculating the nitrogen deposition rate and identifying relevant critical loads and baseline concentrations at all sensitive sites. This assumes a linear relationship between concentration and deposition of NO_x (through the application of simple conversion factors to calculate deposition from concentration – there may be cases when a more complex relationship is applied) means that where the change in NO_x concentrations is less than 0.4 µg/m3, it is unlikely that it would exceed 1% of the most stringent critical loads for nitrogen and acid deposition for a sensitive habitat. This, however, may not be true for all habitats[66], and depends on the deposition velocity used.

1. Introduction

1.1 Purpose

1.1.1 This document has been produced by the Institute of Air Quality Management (IAQM) to assist its members in the assessment of the air quality impacts of development on designated nature conservation sites. It may also be useful for ecologists, who use the results of air quality assessments (AQAs) to evaluate the effects of air pollution on habitats and species, by increasing their understanding of the information provided by air quality specialists. This subsequent stage of the overall process, i.e. the assessment of the *effects* that air quality impacts may have on habitats and species, is generally outside the expertise of IAQM members and no specific detail on this stage is provided in this guidance.

1.1.2 This document focuses on air quality assessments in support of Habitats Regulations Assessments (HRA)[1], but it will also be useful when assessing the air quality impact on national or local designated nature conservation sites.

1.2 Producing this guidance

1.2.1 The IAQM and the Chartered Institute of Ecology and Environmental Management (CIEEM) originally intended to produce a joint document on the assessment of the ecological effects of air pollution. The members of both organisations, some regulatory bodies and nature conservation agencies were consulted on a draft document in October 2017.

1.2.2 There were a number of unavoidable delays in producing the document and IAQM made the decision to publish the air quality sections as a standalone document in 2019.

1.2.3 A second round of consultation of IAQM members was undertaken for the draft of this document in Spring 2019. The comments received from both consultations have been taken into account in the production of the final document.

1.2.4. CIEEM intend to publish the ecological sections in 2020. Both documents should be considered together.

1.2.5 It is recognised that there may be useful learning points and amendments to be made to this guidance once it has been applied in practice. IAQM, therefore, welcomes comments and feedback on the guidance and will endeavour to produce, if necessary, a revised version at an appropriate time.

1.2.6 The publication of this document replaces the IAQM

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Position Statement on 'Use of a Criterion for the Determination of an Insignificant Effect of Air Quality Impacts on Sensitive Habitats' issued in January 2016.

1.2.7 A glossary of terms is provided in **Appendix A**.

1.3 Sites covered by this guidance

1.3.1 This IAQM guidance is applicable to the assessment of European, national and local designated sites where such assessments are required by the decision maker. This guidance, therefore, applies to the assessment of Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) (known as European sites) and Ramsar sites[2] which are covered by the Habitats Regulations. It also applies to Sites of Special Scientific Interest (SSSIs), Areas of Special Scientific Interest (ASSIs), National Nature Reserves (NNRs), local nature reserves (LNRs), local wildlife sites (LWSs) and areas of ancient woodland (AW)[3]. All these sites may require assessment depending on the type of project and/or the regulatory system under which the application is made. In this document, these are referred to as 'designated sites'.

1.3.2 The Habitats Regulations[4], which transpose the Habitats Directive[5] into legislation in the UK[6], require that a development proposal, or a project or plan, will not cause a likely significant effect or, where likely significant effects cannot be discounted, no adverse effect on the integrity of European sites[7]. Proving the absence of significant effects is more difficult than proving that a significant effect will occur. The air quality practitioner has an important role to play in ensuring the right information is provided to the ecologist to allow them to make that judgement.

1.3.3 Different requirements apply to national and local designated sites. In England, for example, the National Planning Policy Framework (NPPF)[8] states that planning permission should be refused if significant harm to biodiversity cannot be avoided, mitigated or, as a last resort, compensated[8]. The same basic assessment methodology can be used although the final determination of the significance of effect may be different.

1.4 The Habitats Regulations

1.4.1 The European Commission (EC) provides guidance on managing internationally designated nature conservation sites[9]. The flow chart in **Appendix B**, reproduced from this EC guidance, illustrates the stages of the assessment process. It should be noted that the process is iterative, i.e. it is possible to return to earlier stages during the assessment of a project or plan. Air quality assessment may be required at any stage.

1.4.2 The requirement to produce an HRA is driven in England and Wales by the Conservation of Habitats and Species Regulations 2017 (as amended), which states that: 'A competent authority, before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which

- Is likely to have a significant effect on a European site or a European offshore marine site (either alone or in-combination with other plans or projects); and

- Is not directly connected with or necessary for the management of that site, must make an appropriate assessment of the implications for that site in view of that site's conservation objectives.'

1.4.3 Similar requirements apply in Scotland and Northern Ireland.

1.4.4 The contents of an appropriate assessment are not defined in the legislation, and there is no current Government guidance providing clarification. The competent authority[10] varies depending on the type of the project or plan, but for planning applications is primarily the local planning authority. For appeals, for example, in England, the planning inspector or the Secretary of State can also be the competent authority. For environmental permits the UK competent authorities include the Environment Agency in England (EA), Scottish Environmental Protection Agency (SEPA) in Scotland, Industrial Pollution and Radiochemical Inspectorate (IPRI) in Northern Ireland, Natural Resources Wales (NRW) in Wales, and local authorities. It should be noted that the regulators of industrial installations in the devolved authorities generally, but not exclusively, rely on EA advice[11].

1.4.5 Typically, consultants working for the applicant produce an HRA, which is used by the competent authority to inform the 'appropriate assessment'. The role of the air quality specialist is to assess the potential impacts so as to either demonstrate that a project or plan will not have a likely significant effect (alone or in-combination) or, if this is not possible, to provide an ecologist with an estimate of the air quality impacts. If there is a need for an HRA covering the air quality impacts, the ecologist should produce it in liaison with the air quality specialist.

1.4.6 Where the appropriate assessment concludes that the project or plan will not result in an adverse effect on the integrity of the European site(s) being considered, consent may be granted. If adverse effects on the integrity of the European site(s) cannot be ruled out, consent cannot be granted without further work. This may include the identification of further measures to address the predicted adverse effect(s).

1.4.7 Where no further measures are available, and the project or plan is needed for 'imperative reasons of overriding public

interest' (IROPI), the competent authority may authorise the project or plan despite the potential for adverse effects provided there are no reasonable alternatives to achieving the objectives of the plan or project which would have less effect on European sites. Under these circumstances, consent can only be granted if suitable compensatory measures are identified.

1.5 Scope of this document

1.5.1 This IAQM guidance document is not intended to be a primer on how to model air quality impacts[12] but instead is intended to provide practical guidance for those air quality specialists who undertake air quality impact assessments and are already familiar with modelling techniques. It also aims to encourage greater communication and co-operation between air quality and ecological specialists.

1.5.2 The planning and environmental permitting systems are somewhat different in the various devolved administrations. In addition, these two regulatory systems have different requirements in terms of the types of designated site that require assessment.

1.5.3 The air quality specialists undertaking assessments are required to make professional judgements. This is due to the diverse range of projects and the wide range of factors that influence the approach taken, which means it is not possible to be entirely prescriptive. IAQM advice is that the assessments of impacts should be undertaken by, or under the close supervision of, an experienced air quality practitioner. Where possible the name of the assessors and/or supervisors should be included in the assessment with a brief summary of their relevant qualifications, experience and role in the assessment.

Box 1.1 Key Issues for the Air Quality Assessment

1. Impacts vs. effects

- The air quality practitioner calculates the air quality impacts.
- The ecologist identifies the ecological effects.

2. IAQM document scope

- This document is concerned with determining whether there will be a 'likely significant effect' on a habitat, and where this cannot be screened out, providing the ecologist with detailed information on the air quality impacts.
- It is the job of the ecologist to determine whether in reality there will be a 'significant effect', or, for European sites, an 'adverse effect on the integrity of the site'.

3. Consultation

- Always consult the regulator on the:
  - assessment approach;
  - pollutants to be included;
  - designated sites to be considered; and
  - the list of projects and plans to be included in the in-combination or cumulative impact assessment.

4. Collaboration

- Work closely with the project ecologist throughout the air quality assessment.
- If there is no project ecologist, as is the case for many environmental permit applications, it may be necessary in some circumstances to recommend to the client that one is appointed.

5. Professional judgement

- There are too many different types of plans and projects and regulatory regimes in the UK to be prescriptive on how to undertake air quality assessments.
- Professional judgement of an experienced air quality practitioner is essential.
- Demonstration of experience of undertaking similar assessments should be provided in the assessment report or other appropriate document.

6. Proportionate

- The scope and detail of assessment should be proportionate to the risk.

7. Precautionary principle

- The assessment should be precautionary, but not so precautionary as to produce results that are unrealistic.

8. Guidance changes with time

- Always check for the most recent guidance from the relevant regulator.

The key issues to be considered when undertaking an air quality assessment of ecological impacts with reference to this practical guidance are set out in **Box 1.1**.

1.5.4 In this document, current guidance from other bodies is referred to, recognising that it may be revised in the future as the regulatory position and case law evolves. If that happens, this document will be amended accordingly.

1.5.5 Throughout this document the term 'regulator' is used to describe the decision maker in both the planning and environmental permitting regimes; where the assessment includes a European Site, the 'regulator' is also the competent authority.

1.6 Other IAQM guidance

1.6.1 Impacts associated with dust soiling, e.g. from construction projects and minerals sites are not within the scope of this guide. Such impacts may be included in a subsequent edition. A methodology for the qualitative risk assessment of construction dust on ecological sites is available from IAQM[13]. IAQM also produces guidance for the assessment of impacts of mineral sites for planning applications[14].

1.6.2 Existing guidance on planning and air quality has been produced by Environmental Protection UK (EPUK) and IAQM[15]. This guidance applies in the context of human receptors only and specifically excludes consideration of ecological sites and so does not conflict in any way with this document. These guidance documents are complementary to this document and it is not anticipated that there will be any substantial overlap of application, as they serve different purposes.

1.7 Ecological impact assessment guidance

1.7.1 For many developments that could give rise to air quality impacts on designated sites, there will be a need to incorporate the assessment of these impacts into a wider ecological impact assessment (EcIA). CIEEM defines EcIA as '*...a process of identifying, quantifying and evaluating the potential effects of development-related or other proposed actions on habitats, species and ecosystems*'[16].

1.7.2 CIEEM has produced guidelines for implementing the EcIA process in the UK. The various stages of the EcIA process as recommended by CIEEM will interact with the various stages of an air quality assessment on designated sites. For detailed information on the EcIA process, the reader is referred to the CIEEM Guidelines. A summary of how the two processes may interact is provided in **Appendix C**.


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[1] Also known as a Habitats Directive Article 6 Assessment.
[2] These sites are designated under The Convention on Wetlands, known as the Ramsar Convention.
[3] Throughout this guidance, areas of ancient woodland are included within the definition of 'designated sites'. Environment Agency guidance states that ancient woodland within 2 km of a new emitting installation should be included in detailed assessments for environmental permit applications. (www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit). 'Ancient woodland' is in many cases included on countrywide Ancient Woodland Inventories; these are coordinated by the relevant country Statutory Nature Conservation Organisation (SNCO) and / or government forestry department. Ancient woodland can also occur in areas not included in the inventory.
[4] The Conservation of Habitats and Species Regulations 2010 (as amended); in Scotland, by The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) and in Northern Ireland, by The Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995.
[5] The Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.
[6] Readers need to check the status of elements of the Regulations in devolved administrations.
[7] The definition of site integrity covers the distribution, structure, function and abundance; 'typical species'; whether a species is a 'viable component of its natural habitat'; and a sufficiently large habitat to maintain populations on a long-term basis. www.clientearth.org/reports/natura-2000-site-integrity-briefing.pdf.
[8] MHVLG, 2019, National Planning Policy Framework 2019, www.gov.uk/government/publications/national-planning-policy-framework--2.
[9] European Commission, 2018, Commission Notice "Managing Natura 2000 Sites -The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC", Brussels 21.11.18, C(2018) 7621 final. ec.europa.eu/environment/nature/natura2000/management/guidance_en.htm.
[10] '*Competent authorities*' are defined by the Habitats Regulations, and include local planning authorities, government departments and statutory undertakers.
[11] For example, NRW had its own guidance on 'Assessing the impact of ammonia and nitrogen on designated sites from new and expanding intensive livestock' (Guidance Note 020) cdn.naturalresources.wales/media/684017/guidance-note-20-assessing-the-impact-of-ammonia-and-nitrogen-on-designated-sites-from-new-and-expanding-intensive-livestock-units.pdf.
[12] See for example, Defra, 2016, Local Air Quality Management Technical Guidance TG.16 laqm.defra.gov.uk/technical-guidance/
[13] iaqm.co.uk/text/guidance/construction-dust-2014.pdf.
[14] www.iaqm.co.uk/text/guidance/mineralsguidance_2016.pdf.
[15] www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf.
[16] CIEEM, 2018, *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal*. Chartered Institute of Ecology and Environmental Management, Winchester.

2. Background

2.1 The broad effects of air pollution on habitats are now reasonably well understood, after several decades of research. Although the threat from acid deposition in the UK has diminished considerably in recent years, with the dramatic reduction in emissions of sulphur dioxide (SO_2), there is still a legacy effect in some habitats from the accumulated deposition since the Industrial Revolution. The effects of other pollutants are also apparent at many of the designated sites, especially from the deposition of nitrogen (N), and this problem is likely to persist for some time at the national and international level.

2.2 To provide clarity, IAQM uses the term 'impact' where discussing changes in concentration or deposition and the term 'effect' when discussing the ecological changes due to the air pollution impact.

2.3 To quantify and describe the effects on a designated site that might result from introducing a new source of airborne pollution, there needs to be an understanding of the atmospheric processes that define the scale of the impact following the release of a pollutant and the consequences of this impact for the habitat.

2.4 A useful summary of knowledge on this subject is provided by a consortium of environmental and conservation agencies on the Air Pollution and Information System (APIS) website[17], as hosted by the Centre for Ecology and Hydrology. This site provides a key database of information pertaining to air pollution effects at designated sites.

2.5 This IAQM document assumes that many users will be well acquainted with the subject of air pollution. For those who require an introduction to the concepts and terminology, a very brief summary is provided below, supported by further information found in **Appendix D**.

2.6 There are two categories of pollutants that are typically the subject of AQAs for designated sites. These are pollutants that have an effect on vegetation/habitats in a gaseous form and those which have an impact through deposition.

2.7 For some important gaseous pollutants, critical levels below which significant harmful effects are not thought to occur[18] have been adopted by, amongst others, the European Union and the United Nations Economic Commission for Europe (UNECE) and are used as regulatory standards. These are summarised in **Table 2.1.** Their origin and use are explained in further detail within **Appendix D**.

2.8 Some other pollutants, for example, heavy metals and hydrogen chloride, are emitted by industrial processes and these pollutants may also need to be assessed. It is recommended that, prior to the assessment of industrial emissions, the scope of any assessment is discussed with the regulator.

2.9 Another gaseous pollutant that has important effects on vegetation is ozone. This is a secondary pollutant, formed in the atmosphere from emissions of nitrogen oxides (NO_x) and volatile/semi-volatile organic compounds. Its production

Table 2.1 Critical levels

Pollutant	Averaging Period	Critical Level
Oxides of nitrogen (NO_x)	24 hours	75/200 µg/m³*
	Annual	30 µg/m³
Sulphur dioxide (SO_2)	Annual	10 µg/m³ (for lichens and bryophytes)
	Annual	20 µg/m³
Ammonia (NH_3)	Annual	1 µg/m³ (for lichens and bryophytes)
	Annual	3 µg/m³
Hydrogen fluoride (HF)	24 Hours	5 µg/m³
	Weekly	0.5 µg/m³

* The critical level is generally considered to be 75 µg/m³; but this only applies where there are high concentrations of SO_2 and ozone, which is not generally the current situation in the UK. See **paragraph D.4.11** in **Appendix D**.[19]

through photochemical reactions occurs at a considerable distance from the release point and is not amenable to the assessment methods set out in this document. Consequently, no guidance on its assessment is provided.

2.10 For the deposition of air pollutants critical loads, given as a range, for different habitats have been provided by UNECE (see the APIS[20]). APIS provides critical loads for nitrogen deposition (leading to eutrophication) and acid deposition (leading to acidification).

2.11 Critical loads for nitrogen deposition are in units of kilogrammes of nitrogen per hectare per year (kg N/ha/year) and vary with habitat sensitivity.

2.12 Nitrogen and sulphur deposition both contribute to acid deposition, as do some other compounds such as hydrogen chloride. APIS provides a Critical Load Function that defines the contributions from sulphur and nitrogen deposition that will not cause harmful effects. Critical loads for acidification are in units of kilograms of H^+ ion equivalents per hectare per year (keq/ha/year).

[17] www.apis.ac.uk.
[18] There is some more recent evidence that damage can occur at lower levels.
[19] Values taken from www.apis.ac.uk/critical-loads-and-critical-levels-guide-data-provided-apis#_Toc279788051.
[20] Available at www.apis.ac.uk.

3. Case Law

3.1 Several recent judgements in the European and national courts affect the way assessments of the impacts of developments and local plans on designated sites are undertaken. Four are discussed below. A more comprehensive review of case law is provided by the European Commission.[21]

3.2 Natural England's guidance[22] summarises Habitats Directive case law on the meaning of 'likely significant effect' as follows:

- An effect is likely if it *'cannot be excluded on the basis of objective information'*
- An effect is significant if it *'is likely to undermine the conservation objectives'*
- In undertaking a screening assessment for likely significant effects *'it is not that significant effects are probable, a risk is sufficient'....* but there must be credible evidence that there is *'a real, rather than a hypothetical, risk'*.

3.3 The implication of the Wealden Judgement, summarised in **Box 3.1**, means that it is no longer appropriate to scope out the need for a detailed assessment of an individual project or plan using, for example, the 1000 annual average daily traffic (AADT) increase in the Design Manual For Roads and Bridges (DMRB)[23] or the 1% of the critical level or load used by Defra/Environment Agency[24] without first considering the in-combination impact with other projects and plans. This position has been adopted by Natural England in its internal guidance for competent authorities assessing road traffic emissions under the Habitats Directive[25].

3.4 In 2016, the European Commission challenged a 2008 decision by the Federal Republic of Germany to authorise the construction of a coal-fired power station at Moorburg, near Hamburg.[26] The Court of Justice of the European Union (CJEU) ruled that even though the power station was a considerable distance from the Natural 2000 site, there was still a requirement to assess whether there would be was a likely significant effect on the site. The assessment undertaken showed that the power plant drawing cooling water from the river Elbe would result in a high risk for migratory species of fish. As the Court has previously held, competent authorities may authorise an activity only if they have made certain that it will not adversely affect the integrity of the protected site. There should be no reasonable scientific doubt as to the absence of such adverse effects. In this case, the Court ruled that the impact assessment did not contain sufficient definitive data regarding the effectiveness of the proposed mitigation measure. Although this case was not air quality-related, the ruling suggests there must be definite evidence of the efficacy of any mitigation measures proposed.

3.5 This case also concerned the failure of the impact assessment to take account of the cumulative impacts of a pumped-storage power plant and a potential hydroelectric plant on the fish stocks. When assessing cumulative effects, the Habitats Directive requires the assessment to take into account all other projects and plans which, in-combination with the project or plan for which an authorisation is sought, are likely to have a significant effect on a protected site even where those projects/plans precede the date of transposition of the directive.

3.6 In 'People Over Wind', the Irish High Court referred the following question to the CJEU for a preliminary ruling: *"Whether, or in what circumstances, mitigation measures can be considered when carrying out screening for appropriate assessment under Article 6(3) of the Habitats Directive?"*[27]

3.7 In reaching its decision, the Court noted the importance of the precautionary principle to the interpretation of Article 6(3) of the Habitats Directive. The Court judgment, made in 2017, was that it is more appropriate to consider mitigation at the assessment stage than the screening stage. What is unclear is where the boundary lies between what is an integral part of a proposed development and what is a mitigation measure.

3.8 The fourth recent case relevant to air quality assessments was on nitrogen emissions from farms in the Netherlands. In 2018 the CJEU ruled[28] that a reduction in emissions can only be taken into account in an appropriate assessment if the expected benefits are certain at the time of the assessment.

3.9 Previous case law on the interpretation of the Habitats Directive has clarified that 'certain' does not mean absolute certainty but *'where no reasonable scientific doubt remains'*[29] (emphasis added). In the Netherlands case, the CJEU recognised that the measures with which they were concerned had *"not yet been taken or have not yielded any results, so that their effects are still uncertain"*. It is in that context that the CJEU stated *"The appropriate assessment of the implications of a plan or project for the sites concerned is not to take into account the future benefits of such 'measures' if those benefits are uncertain, inter alia because the procedures needed to accomplish them have not yet been carried out or because the level of scientific knowledge does not allow them to be identified or quantified with certainty"*.

3.10 A summary of the ruling in the context of air quality assessments is provided in **Box 3.2**.

3.11 Also, of note is that the Court ruled that the grazing of cattle and the application of fertiliser may be classified as a 'project' under the Habitats Directive, and therefore require an appropriate assessment if it is likely to cause a significant effect on the designated site. The grazing of cattle and application of fertiliser is often a long-established activity, predating the Habitats Directive. The judgement suggests that a change in location, the rate of application, or spreading technique may be sufficient to trigger an assessment. This may mean that more assessments will be required for agricultural developments.

Box 3.1 The Wealden Judgement

Judgment in Wealden District Council v Secretary of State for Communities and Local Government, Lewes District Council and South Downs National Park Authority) [2017] EWHC 351 (Admin)

DATE: 21 March 2017

Wealden District Council challenged a part of the Lewes Joint Core Strategy (JCS) prepared jointly by Lewes District Council (LDC) and the South Downs National Park Authority (SDNPA). The case concerned the approach to in-combination assessments pursuant to the Habitats Regulations.

The principal issue was whether LDC and the SDNPA had acted unlawfully in concluding, on advice from Natural England, that the JCS would not be likely to have a significant effect on the Ashdown Forest Special Area of Conservation (SAC), in-combination with the Wealden Core Strategy. An in-combination assessment of the impact of vehicle emissions on nitrogen deposition on the heathland within the SAC had not been undertaken using advice from the then Highways Agency, in the Design Manual for Roads and Bridges (DMRB)[30]. This states that where annual average daily traffic movements (AADT) resulting from development did not exceed 1000 on affected roads, environmental effects could be regarded as neutral and "scoped" out of any further assessment.

Wealden District Council argued that, whereas its Core Strategy had been prepared on the basis that it would generate 950 AADT on part of the A26 road next to the SAC, the effect of the JCS would be to increase the AADT beyond the 1000 threshold and, on a proper interpretation of the DMRB guidance, this required an in-combination assessment of the effects of both the Wealden Core Strategy and the JCS which had not been carried out in the Habitats Regulations Assessment (HRA) associated with the preparation of the JCS. LDC and the SDNPA argued that no in-combination assessment was required, because the JCS on its own involved the generation of traffic below the threshold and, in applying the guidance, no further in-combination assessment was required.

The Secretary of State also referred to separate guidance relied upon by Natural England and prepared by the Air Quality Technical Advisory Group (AQTAG), to the effect that the 1000 AADT threshold equated to a 1% change in critical loads/levels which, if not exceeded, allowed the decision-maker to conclude that there was no likely significant effect. The advice also stated that experience of permitting allowed the Group to be *"confident that it was unlikely that a substantial number of plans or projects will occur in the same area at the same time, such that their in-combination impact would give rise to concern at the appropriate assessment stage. If such a situation were to arise then the assessment could be determined on a case-specific basis"*. Wealden District Council argued that this confirmed the unlawfulness of the approach taken in the HRA.

The judge found that, on a proper interpretation of the DMRB, at least in principle, in-combination effects are potentially relevant at the initial "scoping" stage as well as the subsequent stage requiring further assessment. It was also concluded that advice from Natural England to LDC and SDNPA on the approach to be taken to the HRA, which relied on the AQTAG guidance, was *"plainly erroneous"*:

It was therefore held that the HRA was *'contaminated'* by Natural England's advice, because LDC and the SDNPA should have undertaken further inquiry of Natural England in circumstances where no explanation had been given for not aggregating the two amounts; and because Natural England's error directly affected the decision-making process. The judge also directed Natural England to reconsider its advice in the light of this judgment and that the DMRB should be re-examined, and clarified, to reflect the concerns indicated.

Box 3.2 The Netherlands Air Quality Judgement

Judgment of the Court (Second Chamber)

DATE: 7 November 2018

Coöperatie Mobilisation for the Environment UA and Vereniging Leefmilieu v College van gedeputeerde staten van Limburg and College van gedeputeerde staten van Gelderland. Requests for a preliminary ruling from the Raad van State Joined Cases C-293/17 and C-294/17

These two cases challenged the Netherlands approach to the assessment and permitting of ammonia emissions from beef, dairy, pig and poultry farms. The Netherlands Government has adopted a strategic approach to regulating nitrogen deposition, known as the Programma Aanpak Stikstof or PAS. This aims to conserve or where necessary to restore the Natura 2000 sites to favourable conservation status whilst also allowing economic growth. The premise of PAS is that nitrogen deposition will reduce, and that half of that reduction can be offset by the emissions from new economic activity.

The national court referred a number of questions to the CJEU. These include whether an appropriate assessment may take into account the existence of conservation measures, preventative measures, measures specifically adopted for a programme or autonomous measures (i.e. those that are not part of the programme; in this case the PAS).

Of most relevance to the way air quality assessments are undertaken in the UK is the following question *"May the positive effects of the autonomous decrease in the nitrogen deposition … be taken into account in the appropriate assessment…, is it important that the autonomous decrease in the nitrogen deposition be monitored and, if it transpires that the decrease is less favourable than had been assumed in the appropriate assessment, that adjustments, if required, be made?"* The judgement states that according to previous case law *"…it is only when it is sufficiently certain that a measure will make an effective contribution to avoiding harm to the integrity of the site concerned, by guaranteeing beyond all reasonable doubt that the plan or project at issue will not adversely affect the integrity of that site, that such a measure may be taken into consideration in the 'appropriate assessment' within the meaning of Article 6(3) of the Habitats Directive"*.

The court concluded that an appropriate assessment may not take into account the existence of conservation measures, preventive measures, measures specifically adopted for a programme such as that at issue in the main proceedings (the PAS) or autonomous' measures (i.e. measures not part of that programme), if the expected benefits of those measures are not certain at the time of that assessment.

The CJEU also considered whether a threshold can be used to exclude projects from authorisation if the court is satisfied that the appropriate assessment carried out in advance meets the criterion that there is no reasonable scientific doubt as to the lack of adverse effect on the integrity of the sites concerned. The CJEU concludes that, under these circumstances, thresholds can be used. It should be noted that the PAS threshold (1 mol N/ha/yr which is equivalent to 0.014 kg N/ha/yr) is lower than 1% of the critical load (1 mol N/ha/yr is 0.28% where the critical load is 5 kg N/ha/yr). It must be ascertained, however, that, even below the threshold values, there is no risk of significant effects being produced which may adversely affect the integrity of the sites concerned.

An appropriate assessment must contain complete, precise and definitive findings and conclusions capable of removing all reasonable scientific doubt as to the effects of the plans or the projects proposed on the protected site concerned.

[21] European Commission, 2018, Commission Notice, Managing Natura 2000 sites - The provisions of article 6 of the Habitats Directive' 92/43/EEC Brussels 21.11.2018, C(2018) 7621 final.
[22] Natural England, 2018, Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations.
[23] Highways Agency, 2019, Design Manual for Roads and Bridges, Sustainability & Environment Appraisal, LA 105 Air Quality.
[24] www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit.
[25] Natural England, 2018, Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations.

[26] C-142/16 Judgement of the Court 26 April 2017, Action under Article 258 TFEU. For failure to fulfil obligations, brought on 9 March 2016, European Commission v Federal Republic of Germany curia.europa.eu/juris/document/document.jsf?text=&docid=190143&pageIndex=0&doclang=en&mode=lst&dir=&occ=first&part=1&cid=11885397.
[27] C-323/17 Judgement of the Court 12 April 2018, Request for a preliminary ruling under Article 247 TFEU from the High Court (Ireland), made by decision on 10 May 2017, received at the Court on 30 May 2017, in the proceedings of People Over Wind and Peter Sweetman v Coillte Teoranta, curia.europa.eu/juris/document/document.jsf?text=&docid=200970&pageIndex=0&doclang=en&mode=req&dir=&occ=first&part=1&cid=619449.
[28] C-293/17 andC-294/17 Judgment of the Court (Second Chamber) of 7 November 2018 in Coöperatie Mobilisation for the Environment UA and Vereniging Leefmilieu v College van gedeputeerde staten van Limburg and College van gedeputeerde staten van Gelderland. Requests for a preliminary ruling from the Raad van State curia.europa.eu/juris/liste.jsf?language=en&num=C-293/17.
[29] Case C-239/04 Commission v Portugal, 2006, ECR I-10183, para. 24; Holohan *et al* vs. An Bord Pleanála (C-461/17), para. 33.
[30] The relevant section of the DMRB has been replaced by LA 105 Air Quality (see reference 23).

4. Assessment outline

4.1 Introduction

4.1.1 The principal purpose of this document is to set out a procedure for air quality specialists to follow when evaluating the impacts of airborne pollution at designated sites. Whilst an air quality specialist may be able to conclude that there are no likely significant effects using established thresholds, they will not generally be able to assess the effects of the air pollution on the integrity of the designated site. This is the job of an ecologist. This chapter provides an overview of the complete assessment process and, where applicable, the basis for reaching a conclusion that there is no likely significant effect because the air quality impact is too small.

4.1.2 The procedure assumes that the assessment will be collaborative between air quality and ecology specialists since this represents the ideal combination of expertise. Collaboration between the two can be valuable at various stages of the assessment and it is important that the most appropriate specialist undertakes certain tasks. Collaboration can also help to minimise duplication of effort to ensure assessments are undertaken efficiently. The outline stages of an ideal assessment are set out in **Table 4.1**.

4.1.3 It should be noted, however, that ecologists are not engaged on all projects for which an air quality assessment is undertaken. This is a decision for the promoter of the proposed project or plan.

Table 4.1 Outline of assessment stages

Stage	Who	What	Planning/permitting output (all sites)	HRA output (European sites only)	Guidance in this document/ elsewhere
Scoping	Air quality specialist & ecologist	Initial evaluation of potential receptors, consultation with competent authority/ stakeholders	Study area, relevant receptors, pollutants	n/a	Chapter 4 and 5
Quantification & Screening					
Simple assessment	Air quality specialist	Calculate/estimate PC and compare with screening thresholds (1%, 1000 AADT)	Identify if insignificant OR if further assessment required (e.g. detailed modelling)	Screening Identification of likely significant effects (project alone & in-combination)	Chapter 5
	Ecologist		Assessment of significance of effects (inter & intra project)		
Detailed assessment	Air quality specialist	Calculate PC & PEC and compare against critical levels/loads at relevant receptors	Identification of impacts (project alone & cumulative impacts)	Identification of adverse effects on integrity (project alone & in-combination)	
	Ecologist		Assessment of significance of the project alone and cumulative effect (i.e. inter and intra project effects)		
Mitigation & monitoring	Air quality specialist & ecologist	The application of measures to address air quality impacts and associated ecological effects following a mitigation hierarchy, and the use of monitoring		Apply mitigation hierarchy. Identify imperative reasons of overriding public interest (IROPI)	IAQM position statement sets out the basic hierarchical principles for identifying mitigation measures[31]

4.1.4 A more complete description of the air quality assessment procedure follows in **Chapter 5**.

4.2 Scoping

4.2.1 Both the ecology and the air quality specialists should consult with each other and the relevant decision-makers and/or stakeholders prior to commencing their assessments. The results of those consultations should be shared between the specialists to allow the scope of the assessment to be defined. It may be appropriate at this stage to scope out the requirement for an air quality assessment of effects on habitats, because of the absence of relevant pollutants, and/or the lack of proximity of sensitive sites or species.

4.2.2 A summary of the key elements to be considered during the project initiation and evaluation (i.e. scoping) is given in **Box 4.1**.

4.3 Quantification of air quality impacts

4.3.1 **Box 4.2** sets out the key elements of the air quality assessment.

4.4 The ecological assessment

4.4.1 In those cases where effects (alone and in-combination) cannot be definitively described as insignificant on the basis of the air quality assessment alone (see **Section 5**), the ecologist will review the information provided by the air quality specialist and consider the likely significance of the effects.

4.4.2 For European sites the next formal stage is the completion of an HRA. This is largely undertaken by an ecologist.

4.4.3 It is the ecologist's responsibility (where included in the project team) to report the ecological assessment and the conclusions of the assessment. The air quality specialist would normally separately describe their assessment methodology, assumptions, and the impacts on air quality and deposition.

4.4.4 It is important that the ecologist provides the draft ecological assessment report to the air quality specialist to ensure that there has been no misinterpretation of the information.

4.4.5 If the ecologist identifies a significant effect or, for European Sites, adverse effect on the integrity of the site, mitigation and emission control measures need to be explored. These measures may include the need for changes to the project to avoid or reduce the air quality impact and this should be discussed with the air quality specialist, who may need to liaise with other members of the project team, such as the transport consultant or the process engineer designing the installation.

Box 4.1 Initial evaluation (Scoping)

Considerations

Pollutants: Are there any that may cause adverse effects on vegetation or habitats?

Study area: Has the relevant regulator specified any screening distances from air pollution sources?

Has the ecologist identified any other designated sites that might be affected by the change in emissions?

Actions

Identify designated sites.

- Scope out any sites with habitats/species not sensitive to air pollution.
- Provide mapping showing the sites to be assessed.

Box 4.2 Key elements of the air quality assessment (Quantification and Screening)

Considerations

Agreement between the air quality and ecology specialists on appropriate critical loads.

Agreement on the locations where estimates of pollutant concentrations and deposition rates are required.

Agreement with the regulator on the 'in-combination' effects that need to be accounted for.

Are the estimated impacts sufficiently small that their effects could be described as insignificant?

Outputs

- A list of sites and/or pollutants that have been screened out and require no further assessment;
- A list of sites and/or pollutants that require further assessment to determine whether, or not, there may be a likely significant effect at the relevant site(s);
- The grid references or areas of the modelled impacts;
- The basis for emissions calculations, and whether it takes into account the operational characteristics e.g. batch processes do not operate continuously;
- A list of the emission sources considered in the in-combination assessment and why they were included or excluded;
- Existing concentrations and deposition rates (except in some cases for permitting);
- The change due to the project, or the 'future baseline with project', and 'future baseline without project' concentrations and deposition rates;
- The change in the case of European sites should be quantified for the project without taking into account mitigation;
- A description of the assumptions used in the assessment e.g. hours of operation, assessment year, location of ecological habitats of concern, and future year conditions. The degree of conservatism and whether there are known uncertainties in the input data. A summary of the habitat categories selected, the critical levels and loads applied and existing concentrations and rates of deposition at each site;
- Tabulated results for the project or plan alone and, in-combination with other projects and plans showing for all pollutants the totals and changes in concentrations and deposition rates at the key locations of interest, and contributions as a percentage of the air quality criteria (critical levels and loads);
- If they are likely to be useful in the interpretation (notably, when assessing impacts of point sources) concentration contours (isopleths) overlaid in a clear manner over an Ordnance Survey (or equivalent) base map.

* Mitigation is generally considered to be any additional measure to reduce or remove emissions, or diminish their impacts, above and beyond those that would be expected to be present as part of a proposal or project design. See also **paragraph 3.7**.

[31] iaqm.co.uk/text/position_statements/mitigation_of_development.pdf.

5. The assessment of air quality impacts

5.1 Introduction

5.1.1 There is a range of existing statutory and non-statutory guidance and supporting tools provided by *inter alia* the Environment Agency (EA), Natural Resources Wales (NRW), Scottish Environmental Protection Agency (SEPA), Highways England, Defra, Natural England and the Air Pollution Information Service (APIS) on how to estimate the impact of a project or plan on ambient concentrations and pollutant deposition. It is not the intention of this chapter to reproduce this guidance, nor to describe how to model concentrations or deposition of air pollutants. This chapter aims to supplement existing guidance with further explanation of the air quality assessment process.

5.1.2 Most of the existing published guidance predates the Wealden Judgement and CJEU rulings described in **Chapter 3**. The exception is guidance for road traffic produced by Natural England in 2018 to address specifically the issues raised in the Wealden judgement[32].

5.1.3 The approaches to air quality assessment differ according to whether the project or plan comprises transport sources, industrial sources[33] or agricultural sources. A single project may include a mixture of these source types and therefore more than one guidance document may be applicable.

5.1.4 There are three stages of the air quality assessment which can be summarised as:

i. Scoping;
ii. Quantification; and
iii. Screening.

5.1.5 This chapter describes the air quality assessment process. Where an assessment concludes that there is a significant effect, or for European sites, a significant effect on the integrity of the site, there may also be an need for air quality mitigation measures to be investigated.

5.2 In-combination impacts

5.2.1 The Habitats Regulations place a duty on competent authorities to assess the effect of new projects and plans both alone and in-combination with other projects and plans, i.e. the effects of the plan or project being assessed must also be considered together with the effects of other relevant projects and plans. This is because a series of individually modest impacts may, in-combination, produce a significant effect on a habitat/species.

5.2.2 For development requiring Environmental Impact Assessment (EIA) under the EIA Regulations[34], there is a requirement to consider the cumulative effects of the development with other relevant developments. This is known as the inter cumulative impacts.

5.2.3 In EIA, cumulative effects can also apply to the combined effects of different impacts, e.g. an increase in air pollution and an increase in noise pollution. This is known as the intra cumulative impacts.

5.2.4 There is, therefore, an overlap between the meaning of 'in-combination effects' and 'cumulative effects' but they are not the same in all cases. In this IAQM document, the term 'in-combination' impact is used to refer to the cumulative air quality impacts of the project or plan being authorised with other relevant projects and plans that are in the public domain[35].

5.2.5 It should, however, be noted that where the impacts are due to road traffic emissions, the cumulative impact may not be explicitly identified (see **paragraph 5.4.1.19**).

5.2.6 Relevant projects and plans to be considered include those that may have been approved but are, as yet, incomplete (e.g. a committed development), the subject of an outstanding appeal, or ongoing review. The air quality specialist and ecologist should liaise with each other and the regulator to agree the list of relevant projects and plans. This information may also reside with other specialists in the wider assessment team, such as transport or planning. Ultimately, for European sites, a decision on the inclusion of other projects or plans is the responsibility of the competent authority.

5.2.7 It is important that the assessor considers the potential for in-combination impacts of plans and projects resulting from all relevant sources of emissions where there could be an overlap of air quality impacts.

5.2.8 Road transport emissions near to designated sites are often the result of many projects and plans located some distance from the site. It is normal in an air quality assessment to include traffic growth estimates using the Department of Transport's TEMPRO[36] growth factors or from a strategic transport model that explicitly includes traffic from other projects and/or plans.

5.2.9 It is, however, rare for a proposed new or enlarged industrial installation to be located close to other proposed new or enlarged industrial facilities and the risk of the

plumes overlapping and giving rise to a significant effect on a designated site is generally low. Should these circumstances arise, the dispersion modelling can be extended to account for multiple sources, should the emission data be available. There is a higher likelihood that there will be a cluster of overlapping intensive agricultural emission sources close to designated sites and these need to be considered in assessments[37].

5.2.10 Regarding the permitting of industrial sources, the Air Quality Technical Advice Group (AQTAG) states that "*Experience of permitting allows us to be confident that it is unlikely that a substantial number of plans or projects will occur in the same area at the same time, such that their in-combination impact would give rise to concern at the appropriate assessment stage. If such a situation was to arise then the assessment could be determined on a case-specific basis*"[37].

5.2.11 The impacts from different pollutants also need to be considered, such as the impact on deposition of nitrogen derived from NO_x and NH_3. For example, the NH_3 contribution from agricultural activities may need to be considered together with NO_x and NH_3 emissions from road transport.

5.2.12 Where the impact of an isolated project meets the regulator's screening threshold (see later in this chapter) on its own and there will not be an in-combination effect with other projects or plans, the screening criterion can be used for the project alone. Defining an 'isolated source' precisely is not possible, and it is a matter for an experienced air quality specialist to use their professional judgement in consultation with the regulator. If there is any doubt, it should be assumed that there may be an in-combination effect.

5.2.13 Further advice on in-combination assessments is provided in the European Commission's 2018 guidance[38].

5.3 Stage 1. Scoping

5.3.1 The first stage in any assessment is to consult with the relevant regulator and stakeholders to ensure that the scope and approach to the assessment meet their requirements. Depending on the type of project, the stakeholders may include the relevant Statutory Nature Conservation Organisation (SNCO) (e.g. Natural England), environmental agencies and other potentially affected public and private bodies and special interest groups. The objective of this stage is to identify the *scope* of the assessment, in terms of the relevant habitats to be included, and to *screen* out any emission sources on the grounds that they are too small or too far away from a habitat to have a meaningful effect.

5.3.2 The locations and boundaries of international and national designated sites can be found online, e.g. on the MAGIC website or similar online resources from the relevant SNCO. If local sites are to be assessed, details can be obtained by consulting the Environment Agency or local biodiversity records office who may charge a nominal fee for this service. Sufficient time should be allowed to obtain this data.

5.3.3 For individual planning applications for conventional residential or mixed-use development where European sites are a consideration, the assessor should first investigate whether the air quality issues have already been fully explored for the Local Plan HRA. If this has been done, then it would be appropriate and in line with government guidance[39] to defer to that over-arching Local Plan assessment. This should be a suitable approach for windfall development[40] as well as actual allocations, as Local Plans all make an allowance for a specified quantum of windfall development in particular locations and this should be included in the strategic Local Plan air quality assessment and HRA.

5.3.4 Similarly, if a given local authority believes that Neighbourhood Plans will be coming forward in their authority boundary, they should consider including any sites allocated in those plans in their air quality modelling. This would also avoid problems for the planning application or Neighbourhood Plan that might otherwise result from the Wealden judgment (see **Box 3.1**). Deferring 'upwards' to the Local Plan also addresses the undesirable situation of having multiple traffic and air quality models for a single local authority area and the potential inconsistencies that can be introduced in such circumstances.

5.3.5 For projects requiring assessment, the air quality specialist, assisted by the ecologist, should identify the designated sites likely to be affected by the source of emissions to air that require assessment, taking into account distance criteria in the relevant guidance documents, where these exist, relevant to the scale and type of development being assessed. These criteria are described below.

5.3.6 The Design Manual for Roads and Bridges (DMRB)[41] describes the approach for the assessment of the impact of emissions from schemes on the strategic road network. A quantitative air quality assessment is required if European Sites are within 200 m of affected roads. Within this context, the distance of the affected road from the designated site is an important consideration. Air pollution levels fall sharply within the first few tens of metres from a road before reducing more slowly with distance. The air quality impact of a given change in traffic on a designated site where the relevant habitat/species is 100 m from a road will be very different to one that abuts the road.

5.3.7 For strategic planning, where substantial changes in traffic

volumes are being considered, there is the potential for wider-scale impacts, which can potentially affect the future background concentrations, as well concentrations within 200m of individual roads within the affected network. In these circumstances, the modelling may need to encompass a large road network.

5.3.8 Natural England[42] advises that the next step is to identify the spatial distribution of qualifying features within a designated site. If there are no qualifying features sensitive to air pollution within 200 m of a road, then no further assessment is required. For example, a chalk river will not typically be sensitive to acid deposition because of its natural buffering capacity. In these circumstances, a screening conclusion of no likely significant effect on the site can be reached with regard to air quality without undertaking any modelling.

5.3.9 In some cases, a road surface and its adjacent verges may be included within a designated site's boundary. This does not necessarily mean that they will be of nature conservation interest and form part of a qualifying feature. This inclusion might simply be for convenience, e.g. for defining a boundary. These areas will, therefore, be of no special nature conservation interest. Conversely, at some sites, roadside verges may have been deliberately included within a site boundary and be an integral part of a designated site. It is important that the air quality specialist works with the project ecologist to make these decisions.

5.3.10 If a project/plan has not been screened out using the criteria outlined above, the next step is to consider the risk of the road traffic emissions using either the annual average daily traffic flow (AADT) or the predicted air quality impacts.

5.3.11 The DMRB provides a series of traffic screening criteria. These include the change in AADT flows on a given road of 1000 vehicles or 200 heavy duty vehicles (HDVs). These thresholds have been widely used to screen out the need for quantitative assessment of projects/plans in the absence of any other thresholds recognised as being applicable in this context.

5.3.12 The 2017 Wealden judgment[43] (see **Box 3.1**) has clarified that, if the DMRB screening criteria are used, they should be used to screen in-combination impacts as well as the project/plan alone.

5.3.13 The Defra/Environment Agency's *Air emissions risk assessment for your environmental permit* (which applies to industrial emission sources) currently identifies distances of 2 km for local and nationally important sites and areas of ancient woodland, and 5, 10 or 15 km depending on the emission source for European Sites. Smaller industrial facilities or waste sites may not require such a large study area. Different distances apply for agricultural emissions. The air quality specialist should check first with the relevant regulator/SNCO what distances apply as they can vary. Different regulators throughout the United Kingdom have different criteria in some cases, most notably for ammonia emissions from livestock.

5.3.14 It is important that the air quality specialist and the ecologist discuss the types of habitat located within the distance criteria. It may be that a site is screened-in, but the relevant habitat feature/species is not present in the study area (e.g. based on APIS or site survey data) nor needs to be present for the site to achieve its conservation objectives. In this circumstance, a conclusion of no likely significant effect on the site can be reached with regard to air quality without undertaking any modelling.

5.4 Stage 2. Quantification

5.4.1 Approach and methods

5.4.1.1 Once all the required information on the project/plan and the projects/plans for the in-combination assessment, has been gathered, concentrations and deposition rates will be calculated.

5.4.1.2 The change in pollutant concentrations due to an industrial or agricultural source is often determined simply by modelling the dispersion of the emissions. This is known as the process contribution (PC)[44]. The in-combination[45] impacts would then be assessed by adding the PCs from the other relevant projects and plans.

5.4.1.3 The PCs may be calculated by a variety of methods, depending on the circumstances and scale of the project. For a simple approach, for instance, at a screening stage, a spreadsheet tool such as the Environment Agency's risk assessment tool[46] or the Simple Calculation of Atmospheric Impact Limits (SCAIL)[47] may be used. However, these models have limitations[48]. In reality, detailed dispersion modelling is used in most cases.

5.4.1.4 To determine the concentration/deposition rates, the PC is added to the baseline concentration/deposition rates. These may be taken from measurement data or other appropriate sources such as Defra or APIS background maps. The concentration/deposition rate is known as the predicted environmental concentration (PEC).

5.4.1.5 Case law (see the Moorburg case in **Chapter 4**) suggests that it may no longer be sufficient to rely solely on the background data provided by Defra and APIS in all assessments, as these provide 'average' data and are typically based on emissions data for a time period which does not encompass newly operating facilities. Some assessments may need to include the impact of existing sources explicitly or those that

have recently started operating. For this reason, the term 'baseline' is used instead of 'background' in this document.

5.4.1.6 It may also be worthwhile investigating whether operators of existing facilities or local authorities are required, or intend, to make improvements that will change air emissions and consequently future baseline concentrations.

5.4.1.7 Measurements of pollutant concentrations are made by local authorities and Defra and are available online or on request. The choice of data source will often depend on the location of the study area, i.e. whether urban or rural, which dictates the amount of monitoring data available. Site-specific monitoring (e.g. using diffusion tubes) is sometimes undertaken to determine baseline concentrations, to obtain the most up to date information or where appropriate baseline data are not available.

5.4.1.8 The APIS website holds a database of three-year average pollutant concentrations and deposition rates. These are available for five by five kilometre grid squares covering the whole of the UK. CEH also maintains another database of results from its Concentration Based Estimated (CBED) model[49]. This provides deposition rates for nitrogen and sulphur for three year averages at 5 km^2 resolution for two surface types (forest and moorland).

5.4.1.9 As noted earlier, care should be taken to ensure all relevant emission sources are included in the baseline concentration selected for each receptor location. For example, it is important that, where a sensitive receptor is close to a busy road, the contribution from traffic emissions on that road is explicitly included in the estimation of the PEC.

5.4.1.10 For projects/plans that generate road traffic, the dispersion modelling will estimate the PEC "without the project/plan" (i.e. the future baseline) and PEC concentrations "with the project/plan". The PC is derived by subtracting one from the other. This future baseline typically takes account of the traffic from other projects/plans. To calculate the in-combination PC another scenario will need to be modelled. This may use the baseline traffic data with future emission factors to provide an alternative future baseline PEC. Subtracting this from the project/plan PEC described in the last paragraph will provide the in-combination impact. This approach enables the future decline in road traffic NO_x emissions per vehicle km to be taken into account, although this may be offset to some extent if NH_3 emissions per vehicle km increase in the future.

5.4.1.11 The road traffic PC could be calculated using the publicly available version of the 2007 DMRB spreadsheet model; this, however, dates back over a decade and uses out of date emission factors and fleet composition[50]. The IAQM recommends that the latest version of the Emission Factor Toolkit (EFT) and dispersion modelling is used.

5.4.1.12 When modelling the dispersion of emissions, it is good practice to assess several points within each designated site, both along the site boundary and within the site itself (for point emission

sources, this may be a grid of receptors, or for a road, a transect) to identify the maximum impact (i.e. the PC) at the site, as well as the range that may be experienced across the entire area[51].

5.4.1.13 Concentrations should not, however, be predicted too close to the roadway, since such predictions can be unreliable and may not represent areas of relevance to the assessment. It is recommended, for example, that predictions are not made closer than 2 m from the edge of a road.

5.4.1.14 The maximum PC within, or on, the boundary of the designated site should be used to provide a robust assessment (where that coincides with the presence of a habitat or species of concern).

5.4.1.15 Consideration should also be given to the distribution of habitat features of interest within the site. A single receptor point may be adequate if the site area is small and is situated a relatively large distance from the source, as there is less potential for variation in concentrations and deposition rates across the site. The air quality specialist should consult the appropriate guidance for determining the approach to selecting receptor points and grids[52].

5.4.1.16 The surface roughness in the wider area will affect the modelled ground level concentration of pollutant. A suitable value (or values) should be used, in line with model guidance.

5.4.1.17 Multiple years of representative meteorological data (typically three to five consecutive years, depending on the type of assessment) should be used in the dispersion modelling of point sources; for road schemes, one year is normally sufficient (according to LAQM TG16)[53].

5.4.1.18 For road transport sources, individual receptors along a transect, or along a series of transects at suitable intervals, perpendicular to the road up to 200 m are generally used[54]. As NO_x emissions from road traffic and other sources are forecast to decrease in the future, it is appropriate to estimate future air quality (see below). For a project, this usually is the year when it will be first operational. For large projects, several future years may be used, with and without the project, to provide information on the impacts during phases of development. For land use plans, the end year of the plan period is normally used as this is when the development set out in the plan may have been fully built out. This may, however, miss the potential for significant effects as there is a balance between traffic growth and declining emissions per kilometre from vehicles. Modelling one or more intermediate years should be considered.

5.4.1.19 Transport consultants often do not provide separate data to enable the impact of the other projects or plans to be explicitly estimated; however, a decision maker may require this to be assessed so they can review the impact of the project/plan alone and in-combination with other projects/plans. It is therefore important for the air quality specialist to consult with the decision maker and transport consultant at the earliest opportunity. (Also see **paragraph 5.4.1.10**).

5.4.1.20 The changes in deposition rates (i.e. PC) resulting from the project or plan for the pollutants of interest are typically derived from the product of the atmospheric concentration and the deposition velocity[55] (taking into account the units). The best available estimate of the deposition velocity available should be used for this calculation. The deposition velocity depends on the vegetation type (this can be general, for example, forest or heathland) at the location of interest. This information on vegetation type can be informed by the ecologist.

5.4.1.21 The most commonly used values are shown in **Table 5.1**, taken from AQTAG guidance[56]. An air quality specialist may choose to derive their own deposition velocities based on a

Table 5.1 Deposition velocities (after AQTAG)

Pollutant	Habitat	Deposition velocity (m/s)
NO_2	Grassland	0.0015
	Forest	0.003
SO_2	Grassland	0.012
	Forest	0.024
NH_3	Grassland	0.020
	Forest	0.030
HCl	Grassland	0.025
	Forest	0.060

review of published data. The source of the deposition velocity and justification for its use should be provided.

5.4.1.22 The Environment Agency's *"Guidance on modelling the concentration and deposition of ammonia emitted from intensive farming"*, where relevant, should be referred to when calculating deposition of ammonia from intensive farming[57].

5.4.2 Future concentrations and deposition rates

5.4.2.1 Natural England guidance[58] signposts the APIS website which provides information on deposition trends drawn from the results of national modelling over a number of years. APIS is updated annually, though background trends are a 3-year average to account for weather variation. The trend data for these 3-year averages are provided for maximum and minimum deposition (nutrient nitrogen and acid).

5.4.2.2 The APIS website also provides background concentrations data, but the higher spatial resolution background data available from Defra for certain pollutants should be used when possible. Note that it may be necessary to forecast future concentrations taking into account sources of emissions not directly relevant to the project/plan under consideration, such as road traffic for industrial projects.

5.4.2.3 The air quality specialist may choose to assume no change in future baseline concentrations or deposition rates, where there is no evidence to indicate that they may decrease in value. This may be appropriate if, for example, the project/plan under consideration is likely to be completed within a relatively short period of time (one or two years in the future). If there is a long lead-in period (due to construction and/or commissioning periods), it may be more appropriate to reduce future baseline concentrations/deposition rates to allow for anticipated improvements in national emissions. (There is an IAQM Position Statement on the uncertainties in the estimation of future road traffic emissions).

5.4.2.4 The judgement in the Netherlands cases concludes that 'autonomous measures' (see **Box 3.2**) can only be taken into account if it is sufficiently certain that the measure will deliver as anticipated. There is clear evidence that UK NO_x emissions, including those from road traffic, are declining and will continue to do so in the future. NO_2 concentrations are also declining.

5.4.2.5 What is not certain is the exact rate of reduction of NO_x emissions and therefore it is important that a conservative estimate is used for the modelling. There are reasons to believe that Defra's current Emission Factor Toolkit (version 9.0) may overestimate emissions over the longer term. This is because the assumptions in the fleet turnover model that is used in EFT do not reflect recent developments in either national policy nor in purchasing trends relating to diesel and non-conventional cars[59].

5.4.2.6 The Netherlands case also clarifies that a mechanism must be in place to ensure that the expected reductions take place. In the UK, the Government has published a Clean Air Strategy, which sets out the mechanisms by which the target of a 73% reduction in NO_x emissions will take place by 2030 (relative to a 2005 baseline). This will ensure compliance with the National Ceilings Emission Directive. The strategy also includes a target for the reduction of deposition of reactive forms of nitrogen in England's protected priority sensitive habitats.

5.4.2.7 There is more uncertainty regarding ammonia emissions, but the government is legally committed, under the 2016 National Emissions Ceiling Directive to reduce these emissions, along with SO_2 and NO_x emissions. The UK has a good track record on meeting its international emission reduction obligations. Any assumption should be clearly explained, with justification given.

5.4.2.8 It should be recognised that there is a non-linear relationship between emissions, concentrations and deposition and these relationships may change in the future because of changes in atmospheric chemistry.

5.4.2.9 Whichever approach is adopted, it is advisable to gain agreement in advance from the regulator and explain to the ecologist the basis of assessment, so they can use the information in their judgement of significance, particularly where precautionary assumptions have been applied.

5.5 Stage 3. Screening

5.5.1 Introduction

5.5.1.1 A database of site-specific critical loads for nitrogen and acid deposition rates is available on the APIS website[60]. Unless the lowest value for a high-level screening assessment is adopted, the selection of critical loads requires knowledge of the habitat type, site interest features, and specialist knowledge, such as whether the environment is nitrogen or phosphorous limited, or whether grassland is acidic or calcareous. It also requires knowledge as to the relative reliability of the critical load in question as some are supported by firmer evidence than others. This is identified on the APIS website.

5.5.1.2 In many circumstances, the air quality specialist will suggest the assessment criteria, although this may be modified by an ecologist in the light of knowledge of the habitat in question. It should be noted that ecologists are not appointed for the assessment of all developments and the air quality specialist may need to use professional judgment.

5.5.1.3 APIS does not cover all habitat types. In these cases, for an assessment to be undertaken advice from a suitably qualified ecologist is required.

5.5.1.4 For each site, and for each habitat within each site, the air quality specialist should calculate the PC as a percentage of the relevant critical level/load both alone and in-combination with other plans and projects.

5.5.1.5 The calculated maximum PC as a percentage of the relevant critical load/level is used to determine whether the impacts will have an insignificant effect or, conversely, may be large enough to warrant further evaluation by an ecologist.

5.5.1.6 In the case of Environment Agency permitting, an increment of 1% (or less)[61] of the relevant long term critical level or critical load alone is considered inconsequential. A change of such magnitude, i.e. two orders below the criterion for harm to occur, is challenging to measure (even by the most precise air quality instrument)[62] and difficult to distinguish from natural fluctuations in measured data (due to other variables such as variations in emissions and weather). For this reason, and others, it has been used as a precautionary screening criterion.

5.5.1.7 The 1% threshold has become widely used throughout the air quality assessment profession to define a reasonable quantum of long term pollution which is not likely to be discernible from fluctuations in background/measurements[63]. For example, for many habitats, 1% of the critical load for nitrogen deposition equates to a very small change of less than 0.1 kgN/ha/yr, well within the expected normal variation in deposition. Its use has not been challenged by the courts, but it should be used in the context of an in-combination assessment.

5.5.1.8 Crucially, the 1% screening criterion is not a threshold of harm and exceeding this threshold does not, of itself, imply damage to a habitat.

5.5.1.9 For all types of project/plan, if the air quality specialist identifies that the impact is sufficiently large (alone and/or in-combination) that it cannot be screened out and therefore it could have a potential significant effect, the information should be passed to the ecologist to use their expertise to determine whether or not there is, in fact, a likely significant effect of the project or plan on the habitat, and, if so, whether for European Sites it is possible to ascertain that there will be no adverse effect on the integrity of the site and for other types of designated sites, no likelihood of damage.

5.5.1.10 If the ecologist concludes, however, that an adverse effect on site integrity cannot be ruled out, the air quality specialist may be required to undertake an assessment of the impact of mitigation measures including providing advice on emission control measures that could be employed to prevent avoid, minimise or reduce impacts. The air quality specialist should provide evidence on the efficacy of any recommended mitigation measures.

5.5.2 Industrial point sources

5.5.2.1 The Environment Agency's risk assessment guidance[64] includes a series of criteria to define when impacts can, in their view, be screened out for an individual installation for the purposes of permitting. It should be noted these criteria are intended to be applied to simple and cautious calculation methods (e.g. the risk assessment tool). They are, however, commonly applied to all assessments, both those that have used a dispersion model to estimate the PC and point sources not regulated by the Environment Agency or equivalent organisation. For Ramsar, European and national designated sites, the guidance advises that to screen out the need for further assessment, a PC for any substance emitted from an industrial source[65] must meet both of the following criteria:

- the short-term PC is less than 10% of the short-term environmental standard[66]; and
- the long-term PC is less than 1% of the long-term environmental standard.

5.5.2.2 For local wildlife sites and ancient woodlands, the Environment Agency uses less stringent criteria in its permitting decisions. Environment Agency policy for its permitting process is that if either the short-term or long-term PC is less than 100% of the critical level or load, they do not require further assessment to support a permit application. In ecological impact assessments of projects and plans, it is, however, normal practice to treat such sites in the same manner as SSSIs and European Sites, although the determination of the significance of an effect may be different. It is difficult to understand how the Environment Agency's approach can provide adequate protection.

5.5.2.3 In March 2015, AQTAG clarified to the Planning Inspectorate that *'For installations other than intensive pig and poultry farms, AQTAG is confident that a process contribution (PC, as predicted by H1 or a detailed dispersion model) < 1% of the relevant critical level or load (CL) can be considered inconsequential and does not need to be included in an in-combination assessment'*[67].

5.5.2.4 AQTAG has also drawn a clear distinction between *'projects and plans considered to be inconsequential and never likely to have an in-combination effect (and so not included in any assessment of likely significant effect in-combination with a new plan or project)'* and those concluded to have *'no likely significant effect'* (insignificant alone but which may need to be considered in the assessment of any other new plans or projects)[67].

5.5.2.5 These recommendations made by AQTAG were made prior to the most recent court rulings. This advice may change in the future and alter the circumstances in which the screening criteria can be used with confidence. This is why it is important to consult with the relevant regulator.

5.5.2.6 In the IAQM's opinion, the 1% and 10% screening criteria should not be used rigidly and, not to a numerical precision greater than the expression of the criteria themselves. Whilst it is straightforward to generate model results for the PC to any level of precision required, the accuracy of the result is much less certain and it is unwise to place too much emphasis on whether the PC is 0.9% or 1.1%, for example. In practice, because the magnitude of impacts attributable to new sources is often around 1% of the criterion, a regulator may require the results to be presented at greater resolution, i.e. having one (or more) decimal places. The distinction here is between the presentation of the model results and the weight given to fine differences around the criterion itself in making a judgement.

5.5.2.7 It is important to remember that a change of more than 1% does not necessarily indicate that a significant effect (or adverse effect on integrity) will occur; it simply means that the change in concentration or deposition rate cannot in itself be described as numerically inconsequential or imperceptible and therefore requires further consideration.

5.5.3 Predicted Environmental Concentration (PEC)

5.5.3.1 The PEC (which applies to both annual mean concentrations and deposition rates) should be calculated with the project or plan alone and in-combination with other projects and plans to identify whether the critical levels or critical loads will be exceeded. This information should be passed on to the ecologist if the PC exceeds 1% of the critical level/load either alone or in-combination.

5.5.3.2 The Environment Agency risk assessment guidance states that if the PEC is less than 70% of the long-term criterion it can be deemed to be insignificant, regardless of the PC. For some pollutants (nitrogen deposition, in particular) background values


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are high over much of the UK and it is unlikely there will be many occasions where the PEC is less than 70%. Also, this was intended to be a trigger for detailed dispersion modelling. It is not intended to be a damage threshold.

5.5.4 Traffic impacts

5.5.4.1 There is evidence that ammonia emissions from road vehicles may contribute more than half the local traffic related increment to nitrogen deposition[68].

5.5.4.2 The DMRB methodology[69] only requires the assessment of NO_x emissions and nitrogen deposition. It does not consider NH_3 or its contribution to nitrogen deposition. As road transport is a source of ammonia, albeit a small source compared to agriculture at a national level, consideration should be given to including it and its contribution to local nitrogen deposition.

[32] Natural England, 2018, Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations.
[33] Including residential and commercial large boilers, combined heat and power plants, and data centres which may not typically be considered to be industrial sources of emissions.
[34] The Town and Country Planning (Environmental Impact Assessment) Regulations 2017.
[35] Sufficient data to quantify the impacts is only likely to be available for projects where planning permission (or other regulatory consent) has been applied for or granted but not yet implemented. For proposed plans data is only likely to be available in the public domain for those that are published for consultation.
[36] Trip End Model Presentation Program (TEMPRO) www.gov.uk/government/publications/tempro-downloads.
[37] Air Quality Technical Advisory Group, AQTAG21, 'Likely significant effect' – use of 1% and 4% long-term thresholds and 10% short -term threshold, Updated version approved 2 October 2015.
[38] Natural England, 2018, Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations.
[39] In July 2012, Defra issued guidance on 'Competent Authority Co-Ordination under the Habitats Regulations', which recommends that '*Competent authorities should adopt the reasoning, conclusion or assessment of another competent authority, if they can*' and goes on to state that where another competent authority is a specialist in the issues under consideration, robustness of the previous HRA *'can be assumed ... if the reasoning, conclusion or assessment was undertaken or made by a competent authority with the necessary technical expertise*'. www.gov.uk/government/publications/guidance-on-competent-authority-coordination-under-the-habitats-regulations.
[40] Development that does not have a specific allocation, usually because local authorities do not allocate development sites below a certain size.
[41] Highways Agency, 2019, Design Manual for Roads and Bridges, Sustainability & Environment Appraisal, LA 105 Air Quality.
[42] Natural England, 2018, Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations.
[43] Wealden District Council vs Secretary of State for Communities and Local Government. Lewes District Council and South Downs National Park Authority and Natural England. [2017] EWHC 351 (Admin) (See Box 3.1).
[44] HRA requires the in-combination effects to be assessed; Environmental Impact Assessment requires the cumulative impacts to be assessed. For assessing air quality impacts these terms may be different.
[45] Process contribution (PC) is a term used in the Environment Agency to define the contribution to ambient concentrations and deposition rates due to the emissions from the process being permitted. In this guidance the term is also applied to the contribution from any source such including road traffic, and commercial boilers.
[46] Formerly called the H1 screening tool, available at www.gov.uk/government/collections/risk-assessments-for-specific-activities-environmental-permits#H1-software-tool.
[47] A suite of screening tools for assessing the impact from agricultural and combustion sources on semi-natural areas. Produced by CEH, available at www.scail.ceh.ac.uk.
[48] iaqm.co.uk/text/position_statements/screening_tools_interim.pdf.
[49] www.pollutantdeposition.ceh.ac.uk/data.
[50] An updated version of the spreadsheet is available from the Overseeing Organisations (e.g. Highways England) for use on their road schemes.
[51] For some sources, notably tall point sources, it is not always the case that the highest modelled concentrations will occur on the site boundary closest to source.
[52] admlc.files.wordpress.com/2015/08/dispersion-model-guidelines-v1-5.pdf.
[53] laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf.

[54] A distance of 200 metres is generally used as concentrations from the road source decrease rapidly with distance from the source and beyond this distance the road source contribution is not typically discernible from fluctuations in the background concentration. See DMRB Volume 11.3.1, Appendix C, Figure C.1. The receptor locations along the transect should be chosen so as to capture the salient features of the changes in concentration or deposition rate.
[55] This quantity is correctly described as the 'deposition flux', a term used by the Environment Agency, for example. In this document, the term deposition rate is used instead, on the grounds that we are using deposition flux as a proxy for the quantity of pollutant deposited on the habitat over a defined period of time.
[56] Air Quality Advisory Group, 2014, AQTAG06 Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air.
[57] Defra/Environment Agency, 2018, Intensive farming risk assessment for your environmental permit, www.gov.uk/guidance/intensive-farming-risk-assessment-for-your-environmental-permit.
[58] Natural England, 2018, Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations.
[59] The proportion of new cars that are diesel has fallen from a peak of just over 51% in 2012 to 30% in the third quarter of 2018. Electric and plug in hybrids accounted for 2.5% in the same quarter. EFT v8.021 assumes that there will be zero miles driven on rural roads in 2030 by electric vehicles. www.gov.uk/government/statistical-data-sets/veh02-licensed-cars, Table 253.
[60] www.apis.ac.uk/indicative-critical-load-values.
[61] For intensive farming the Environment Agency environmental permitting guidance use 4%.
[62] The Ambient Air Quality Directive (2008/50/EC) sets data quality standards for monitoring; e.g. for NO_x (including NO_2) automatic monitors the uncertainty requirement is 15%; indicative methods (such as diffusion tubes) is 30%. It should be noted that deposition is not routinely monitored, but calculated from ambient concentrations.
[63] Some readers will be aware that the EPUK/IAQM planning guidance defines a method for describing the severity of impacts. Within this framework, an impact that is 0.5% of an assessment level is defined as negligible and can be regarded as not having a significant effect on air quality. There is no contradiction between this part of the impact descriptor framework in the planning guidance and the choice of 1% as a screening criterion for habitats. The two values serve a different purpose and have different origins.
[64] www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit.
[65] There are different screening criteria for agricultural sources.
[66] The short-term thresholds are only applied to the critical level rather than the critical load (since there are no short-term exposure critical loads) and is only relevant to point source emissions rather than vehicle exhaust emissions.
[67] AQTAG position regarding In-combination guidance and assessment. Correspondence between AQTAG and PINS. March 2015.
[68] Air Quality Consultants, 2020, Ammonia Emissions from Roads for Assessing Impacts on Nitrogen-sensitive Habitats.
[69] Highways Agency, 2013, Interim Advice note 174/13, Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 'Air Quality (HA207/07). Note that IAQM considers that there is a typo in this note and that NO_x concentrations and critical levels should be used (i.e. not NO_2 concentrations and critical levels).

6. Local plans

6.1 It has been increasingly common practice for air quality assessments to be undertaken to support the development of Local Plans for local planning authorities where sensitive internationally important wildlife sites may be affected. This is to enable an HRA to be completed for that Local Plan. Due to the nature of Local Plans, this means that all growth expected across a given district over a long period is assessed collectively.

6.2 The DMRB AADT thresholds were useful to decide whether the air quality assessment for a given Local Plan needed to consider a particular European site. Since the Wealden judgement, the 1000 AADT threshold cannot be applied, at least not rigidly, to growth arising from a single district.

6.3 One of the issues with an assessment of a local plan is how far the air quality assessment needs to 'cast its net'.

6.4 The scale of physical separation between a Local Plan area and European site will clearly be an important factor in making the decision, given that there is a limit to the accuracy of transport modelling at considerable distances (i.e. tens of kilometres) from source, as well as the fact that very small changes in air quality (such as are likely to occur at these distances) are unlikely to be detectable in air quality calculations, or in monitoring data. Distance alone, however, does not automatically mean that the contribution of growth in a given Local Plan area will be imperceptible. This will also be a function of the nature and scale of the development, the presence of strategic routes roads linking the development to the European site and consideration of journey-to-work and trip distribution data.

6.5 It is no longer appropriate for individual local authorities to rely purely on a change in flows of less than 1000 AADT as a reason to dismiss traffic-related air quality impacts in-combination with other local plans, unless there is reason to believe that flows on the road in question would be likely to be dominated by journeys arising from that district (for example, a minor road).

6.6 Since the judge in the Wealden case did not dismiss the use of the 1000 AADT threshold entirely, but only as a threshold to automatically rule out *individual* Local Plans there will be a greater need for local authorities to consider modelling their Local Plan air quality impacts collectively, as a group of authorities around a particular European site, rather than creating separate individual models. This already happens in some parts of the UK, such as within the Partnership for Urban South Hampshire and among Councils to the north and west of Epping Forest SAC.

6.7 The 'alone' assessment should be a comparison of a scenario which includes the background traffic growth (sometimes referred to as a 'do nothing scenario' but not the Local Plan, with a 'with Plan' scenario which adds on the Local Plan traffic.

6.8 Importantly, the air quality calculations should also make reasonable assumptions about expected changes in the baseline NO_2 concentrations over the plan period; given the 15 to 20 year or so timescale of most Local Plans. To assume no improvement over a 15 or 20 year period, would effectively ignore the more stringent legal requirements for vehicle NO_x emission standards to be achieved under real world driving conditions, trends in new vehicle registrations and ongoing government and international initiatives to improve air quality through reductions in emissions. Making a suitable allowance for improvements in baseline air quality can, given the long timescale of most Local Plans, mean that overall air quality at the end of the plan period is very likely to be better than air quality at the start, even allowing for the effects of Local Plan growth on traffic flows. It should be noted that there is no presumption that this improvement can be exploited for allowing unnacceptable air quality impacts, with consequent effects on designated sites.

6.9 For ammonia emissions, it is more difficult to be certain regarding future trends, and it seems reasonable to either assume no change or to assume that emissions will change in line with the requirements of the 2016 National Emissions Ceiling Directive.

6.10 The application of national forecasts to local conditions may need to be justified to ensure the assessment is robust and not subject to challenge.

6.11 Assessing the results of both the 'alone' and 'in-combination' assessments, it is possible to identify the relative contribution of the Local Plan being assessed. This is necessary if the ecologist concludes that there is an adverse effect on the integrity of the designated site to enable the appropriate scale of mitigation measures that may be needed (such as transport management plans, rerouting of heavy duty vehicles,). If, for example, the Local Plan makes little or no difference to the nitrogen deposition when reported to the limits of reliability then little or no action would be specifically required to address the contribution of that Local Plan.

6.12 Additionally, if the ecologist concludes that there is no likely adverse effect on the integrity of the designated site no mitigation would be required. Given the likelihood

that many Local Plan air quality assessments will identify an overall net improvement in air quality over the plan period, the contribution of the individual Local Plan(s) will often be in the form of potential retardation in improvement (i.e. a delay), rather than a deterioration. That is an important distinction in making judgments on adverse effects, although it may still be appropriate (depending on the scale of that delay) to introduce measures to address the plan contribution.

6.13 The preceding discussion is concerned with Local Plans, but the same principle would apply to the traffic impacts of Minerals & Waste Plans where those plans are expected to result in any net increase in vehicle movements within 200 m of sensitive designated sites. Minerals allocations may not result in a net change in vehicle movements due to the nature of minerals sites being worked sequentially (in other words, the 'growth' is in duration of operation rather than scale of activity); similarly, traffic associated with minerals and waste sites may be restricted to certain roads that would not lead them past designated sites. These factors will, therefore, be an important consideration in determining the need for traffic modelling or air quality calculations.

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7. General principles

7.1 There are a number of principles that should be applied when undertaking assessments of the air quality impacts on designated sites, which are set out below.

1. Suitably qualified, experienced and competent assessors should be responsible for the assessment.
2. A precautionary approach is required.
3. The assessment should be appropriate to the risk.
4. The assessment should be undertaken with an ecologist.
5. Always consult with the regulator.

7.2 Suitably qualified, experienced and competent assessors should be responsible for the assessment

7.2.1 All assessments require the use of professional judgement, as it is not possible to provide detailed guidance that covers the individual circumstances of all projects and plans that require assessment. Therefore, all assessments should be undertaken by suitably qualified and competent assessors or under the close supervision of such a person. It is considered useful for the air quality assessment report to include a short biography of each person involved in its production together with their role in the project.

7.3 A precautionary approach is required

7.3.1 Where there is uncertainty in an evaluation of the impact of a project or plan, a precautionary approach is required. This requirement is set out in Article 191 of the Treaty on the Functioning of the European Union. It aims to ensure a higher level of environmental protection than would be the case if this approach was not used. Similar provisions are to be set out in the Environment Bill, and therefore the intention is that the same approach will apply when the UK leaves the EU.

7.3.2 The European Commission guidance[70] on the precautionary principle states its application shall be informed by:

- *"the fullest possible scientific evaluation of the determination, as far as possible, of the degree of scientific uncertainty;*
- *a risk evaluation and an evaluation of the potential consequences of inaction;*
- *the participation of all interested parties in the study of precautionary measures, once the results of the scientific evaluation and/or the risk evaluation are available."*

7.3.3 In addition, the general principles of risk management remain applicable when the precautionary principle is invoked. These are the following five principles:

- *"proportionality between the measures taken and the chosen level of protection;*
- *non-discrimination in the application of the measures;*
- *consistency of the measures with similar measures already taken in similar situations or using similar approaches;*
- *examination of the benefits and costs of action or lack of action;*
- *review of the measures in the light of scientific developments."*

7.3.4 This would suggest that a degree of pragmatism should be used because absolute scientific certainty is rare. That is the nature of scientific endeavour. It often takes decades for scientific doubt to be satisfied. (Climate change is such an example).

7.4 The assessment should be appropriate to the risk

7.4.1 The European Commission guidance also suggests that the assessment should be proportional to the risk.

7.4.2 This means that the assessment must provide sufficient detail to enable a robust conclusion to be drawn regarding the air quality impacts. The level of detail required will depend on the specific circumstances of the project.

7.5 The assessment should be undertaken with an ecologist

7.5.1 The assessment of the impact of air pollution on designated wildlife sites is best undertaken in collaboration with a suitably qualified and experienced ecologist. An air quality specialist should not be making judgements on whether there is a likely significant effect or an adverse effect on the integrity of a site.

7.6 Always consult with the regulator

7.6.1 It is important that the assessment team consults with the regulator to agree the scope of the assessment. This includes agreeing the other projects that need to be considered in the in-combination impact assessment. The regulator is the decision maker and failure to consult can

result in an assessment being rejected at a late stage in the process. This consultation should be undertaken early in the project to avoid unnecessary work.

7.7 Future Clarity

7.7.1 As alluded to above, there has been much litigation on the interpretation of the Habitats Directive and this is likely to continue. Whether or not the UK will voluntarily be bound by its rulings is a matter of conjecture at the current time. There are also increasing legal challenges on environmental decisions in the UK courts and therefore it is likely that litigation on this issue will continue and further clarity will be produced on the principles of assessment.

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[70] The Precautionary Principle eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Al32042.

Appendix A: Glossary & Terminology

Term	Abbreviation	Description
Acid deposition		Atmospheric input to ecosystems of pollutants which may acidify soils and freshwaters.
Air Pollution Information System	APIS	An information system that provides a comprehensive source of information on air pollution and the effects on habitats and species (online at www.apis.ac.uk).
Air Quality Assessment	AQA	The process of assessing the impact of a project or plan on air quality.
Air Quality Modelling and Risk Assessment Team	AQMRAT	A Natural Resources Wales team that specialises in air quality related issues and assessments.
Air Quality Modelling and Assessment Unit	AQMAU	An Environment Agency team that specialises in air quality related issues and assessments.
Air Quality Standards Regulations 2010		UK regulations that transposed Directive 2008/50/EC into UK legislation. It contains mandatory limit values, targets and information levels for ambient air quality for the protection of human health and vegetation.
Air Quality Strategy	AQS	The 2007 AQS for England, Scotland, Wales and Northern Ireland provides details of national air quality objectives for air pollutants.
Air Quality Technical Advisory Group	AQTAG	AQTAG was established in 2000 by the Environment Agency's Habitats Directive Project to provide technical guidance on the assessment of air emissions from IPC/IPPC processes. Membership has since expanded to include all UK regulators and conservation agencies.
Ammonia	NH_3	A gas which may cause acidification of soils and physically damage vegetation.
Annual Average Daily Traffic	AADT	The number of vehicles using a road in a 24-hour period averaged over a year.
Ancient Woodland		Typically, a woodland that has existed continuously since 1600 or before (this can include areas where trees have been cut down and or replanted).
Annual Mean		The average of concentrations measured for one year (usually a calendar year).
Appropriate Assessment	AA	An assessment required by the Habitats Directive and Habitats Regulations, where a project (or plan) would be likely to have a significant effect on a European site, either alone or in-combination with other plans or projects. Undertaken by the competent authority (i.e. the decision maker).
Area of Outstanding Natural Beauty	AONB	A landscape designation protected under the Countryside and Rights of Way Act, 2000.
Area of Special Scientific Interest	ASSI	A Northern Ireland designation.
Avoidance		Prevention of adverse impacts occurring through, for example, decisions about project location or design.
Background		When used in the context of concentration or deposition rate this refers to the average over a 1km by 1km or 5km by 5km grid provided by Defra or CEH e.g. the LAQM background maps.
Baseline		The conditions that exist in the absence of the proposed project either at the time an assessment or survey is undertaken or in the future when the project would be constructed, operated or decommissioned.
Chartered Institute of Ecology and Environmental Management	CIEEM	Professional body governing ecology/ecologists.

Term	Abbreviation	Description
Centre for Ecology and Hydrology	CEH	Natural Environment Research Council research organisation focusing on land and freshwater ecosystems and their interaction with the atmosphere.
Compensation		Measures taken to make up for the loss of, or permanent damage to, ecological features despite mitigation Under the Habitats Directive and Habitats Regulations. Any replacement area should be similar in terms of biological features and ecological functions that have been lost or damaged, or with appropriate management, have the ability to reproduce the ecological functions and conditions of those biological features.
Conservation objective		The objective for the conservation of biodiversity (e.g. specific objective for a designated site or broad objectives of policy).
Conservation status		The state of a species or habitat including, for example, extent, abundance, distribution and their trends.
Critical level		The concentration of an air pollutant above which adverse effects on ecosystems may occur based to present knowledge.
Critical load		Deposition flux of an air pollutant below which significant harmful effects on sensitive ecosystems do not occur, according to present knowledge. Usually measured in units of kilograms per hectare per year (kg/ha/yr).
Cumulative effect		Changes caused by a proposed project in conjunction with other projects and plans.
Department for Environment, Food and Rural Affairs	Defra	The government department responsible for environmental protection, food production and standards, agriculture, fisheries and rural communities.
Deposition		The main pathway for removing pollutants from the atmosphere, by settling on the earth's surface.
Deposition flux		Deposition velocity x concentration.
Designated Site		Land designated for its wildlife interest. These include the following designations (note different names may be given to locally designated sites): • Ramsar site • Special Area of Conservation (SAC) • Special Protection Area (SPA) • Site of Special Scientific Interest (SSSI) • Areas of Special Scientific Interest (ASSI) • Local Wildlife Site (LWS) • Local Nature Conservation Site (LNCS) • Site of Importance for Nature Conservation (SINC) • Area in the Ancient Woodland Inventory (AWI) • National Nature Reserves (NNR) • Local Nature Reserves (LNR) • Ancient Woodland (AW).
Ecological feature		Habitat, species or ecosystem.
Ecosystem		An entire functional ecological system i.e. the plant and animal species that make up the constituent habitat (or habitats) plus the air, water, soil etc. that they require to persist and thrive.

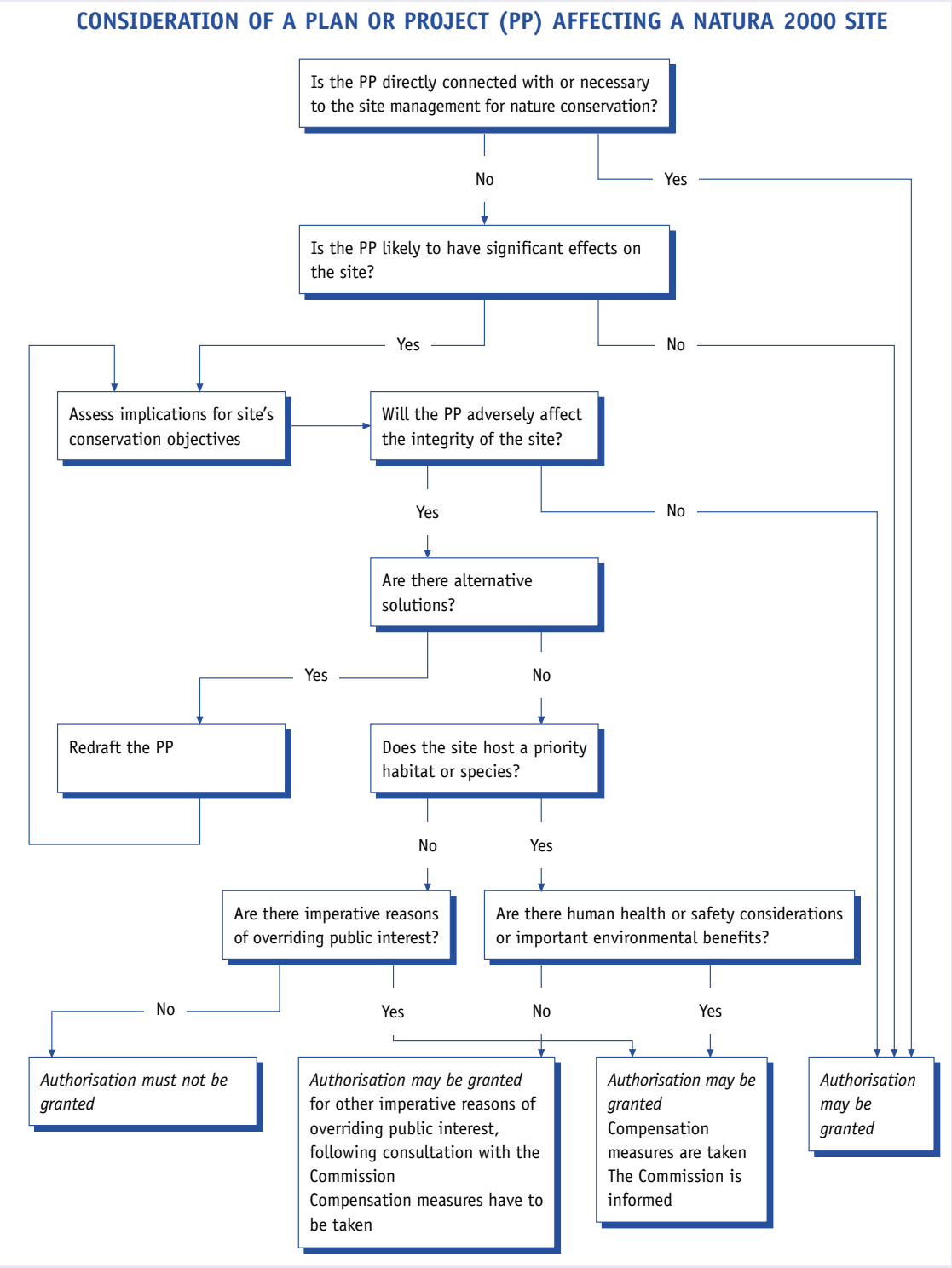
Term	Abbreviation	Description
Effect		The changes that occur to a habitat as a result of changes in concentrations or deposition of air pollution. Also, see 'Impact'.
Emission		The release of a substance into the air. May be discharged from a stack, vent, vehicle exhaust or from diffuse sources.
Emission Limit Value		The legal limit on the emission of a pollutant.
Enhancement		Improved management of ecological features or provision of new ecological features, resulting in a net benefit to biodiversity, which is unrelated to a negative impact or is 'over and above' that required to mitigate/compensate for an impact.
Environment Agency	EA	The Environment Agency is responsible for permitting certain industrial process in England.
Environmental Impact Assessment	EIA	The process of assessing the likely significant environmental effects of a proposed project as part of gaining consent carried out under the EIA Directive and Regulations.
Ecological Impact Assessment	EcIA	A process of identifying, quantifying and evaluating potential effects of development-related or other proposed actions on habitats, species and ecosystems.
Environmental Permit	EP	A permit required by industrial operators in accordance with the Environmental Permitting Regulations.
Environmental Permitting Regulations	EPR	The various sets of national regulations that regulate pollution through a permitting system.
Environmental Protection UK	EPUK	UK environmental Non-Governmental Organisation (NGO) working to improve the quality of the local Environment.
Environmental Statement	ES	The document which reports the process, findings and recommendations of an EIA.
Environmentally Sensitive Area	ESA	A designation for agricultural areas needing special protection by virtue of their landscape, wildlife or historical value.
European sites		A network of European designated sites including Special Protection Areas (designated under Directive 2009/147/EC) and Special Areas of Conservation as listed in Annex I and II of the EU Directive 92/43/EEC ("Habitats Directive"). Also referred to as Natura 2000 sites.
European Union	EU	A political and economic union of 28-member states that are located primarily in Europe.
Eutrophication		The process by which an ecosystem is subject to excessive growth of a few species of competitive plants and/or microorganisms as a result of excessive nutrient supply, thus forcing out less competitive plants and (in aquatic ecosystems) resulting in oxygen depletion and a reduction in animal life.
H1		The screening tool in the Environment Agency's former Horizonal guidance H1. This has been replaced by the Risk Assessment Tool in 'Air emissions risk assessment for your environmental permit'.
Habitat		An assemblage of physical and biological elements which form a recognisable unit. For example, heathland is a different habitat from chalk grassland or wet woodland, most obviously due to differences in specific plant and animal composition and physical structure.

Term	Abbreviation	Description
Habitat Regulations Assessment	HRA	An assessment of a plan or project potentially affecting European (Nature 2000) sites in the UK, required under the Habitats Directive (European Directive 92/43/EEC) and Regulations (Conservation of Habitats and Species Regulations, 2010, as amended).
Impact		The change in concentrations or deposition of an air pollutant. This may or may not rise to an effect on an ecological feature.
Isolated project		A project which, due to its geographical location, is not likely to give rise to in-combination effects on a designated site. This is determined using professional judgement and needs to take account of where there may be an overlap of the air quality impacts of projects and/or plans.
Institute of Air Quality Management	IAQM	The professional body representing air quality specialists.
Joint Nature Conservation Committee	JNCC	The public body that advises the UK government and devolved administrations on UK-wide and international nature conservation.
Kilogram per hectare per year	kg/ha/yr	Unit of measurement used to describe the rate of deposition.
Kilogram equivalent per hectare per year	keq/ha/yr	Unit of measurement used to describe the rate of acid deposition, in terms of hydrogen ion (H^+) equivalent.
Leaching		Leaching is the process whereby nutrients from agricultural fertilisers are washed out of the soil through the percolation of rainfall.
Local Nature Reserve	LNR	Statutory designation for places with wildlife or geological features that are of special interest locally.
Local wildlife sites		'Non-statutory' sites of nature conservation value that have been identified 'locally' (i.e. excluding SSSIs, SPAs, SACs, and Ramsar sites). LNRs are included as they are a designation made by the Local Authority rather than statutory country conservation agencies. These are often called Local Wildlife Sites, Local Nature Conservation Sites, Sites of Importance for Nature Conservation or other, similar names.
Microgram per cubic metre	$\mu g/m^3$	Unit of measurement of the concentration of an air pollutant. Often used for ambient concentrations.
Milligram per cubic metre	mg/m^3	Unit of measurement of the concentration of an air pollutant. Often used to describe emissions and their limit values for industrial processes.
Mitigation		Measures taken to avoid, reduce, or otherwise address the negative effects of air quality impacts. See also compensation (which is separate from mitigation).
Multi-Agency Geographic Information for the Countryside	MAGIC	A web-based mapping browser showing various geographical designations including designated nature conservation site boundaries.
National Nature Reserve	NNR	Statutory designations, supporting wildlife or geological features that are significant at a national level.
Natural Resources Wales	NRW	Welsh Government Sponsored Body, created in 2013, which took over the work of Countryside Council for Wales, Environment Agency Wales and Forestry Commission Wales.
Nitrate Vulnerable Zone	NVZ	A designated area where land drains into and contributes to nitrate found in nitrate-polluted waters.
Nitrogen	N	Nitrogen (N_2) is a relatively inert gas, but certain molecules containing nitrogen are more reactive with other chemicals.

Term	Abbreviation	Description
Nitric oxide	NO	Produced during combustion processes.
Nitrogen dioxide	NO_2	Produced during combustion and formed by the oxidation of NO in the atmosphere.
Oxides of nitrogen	NO_x	A term describing a mixture composed of nitrogen oxides (NO and (NO_2).
Pathway		The route by which a pollutant moves from a source to a receptor.
Predicted Environmental Concentration	PEC	The term used in AQAs of industrial processes to describe the concentration or deposition (i.e. process contribution (PC) plus baseline).
Process Contribution	PC	The term used in AQAs of industrial processes s to describe the incremental impact of the proposed development on the concentration or deposition flux).
Project (also known as plan or permission)		The term used for proposals to which this guidance might be applied (e.g. development proposal, road scheme, industrial facility or other land use change).
Ramsar		A wetland site designated of international importance under the international Convention on Wetlands, known as the Ramsar Convention. These sites are considered in the same way as European (Natura 2000) Sites as a matter of government policy.
Receptor		An identified location where an effect may occur.
Restoration		The re-establishment of a damaged or degraded system or habitat to a close approximation of its pre-degraded condition.
Scoping		A process early on in AQA, EIA or EcIA, to determine the matters to be addressed and ensure effective input to the assessment.
Screening		This term can be used either to determine whether or not an EIA or HRA is necessary or in the context of air quality assessment, to "screen out" emissions that are inconsequential using numerical criteria.
Scottish Environment Protection Agency	SEPA	Responsible for permitting certain industrial process in Scotland.
Significant effect		An effect that either supports or undermines biodiversity conservation objectives for 'important ecological features.
Site of Special Scientific Interest	SSSI	A geological or biological conservation designation denoting a nationally protected area in the UK.
Scottish Natural Heritage	SNH	Funded by the Scottish Government with the purpose to promote, care for, and improve natural heritage.
Special Area of Conservation	SAC	Area of protected habitats and species as defined in the European Union's Habitat Directive (92/43/EEC).
Special Protection Area	SPA	A designated area for birds under the European Union Directive on the Conservation of Wild Birds (2009/147/EC).
Statutory Nature Conservation Organisation	SNCO	E.g. Natural England, Natural Resources Wales, Scottish Natural Heritage.
Sulphur dioxide	SO_2	Combustion product formed from sulphur contained in fuels.
United Nations Economic Commission for Europe	UNECE	Regional commission of the United Nations helping countries to convene and cooperate on standards and conventions in support of the Sustainable Development Goals.

Term	Abbreviation	Description
Windfall development		Development that does not have a specific allocation in a local plan, often because local authorities do not allocate development sites below a certain size.
World Health Organization	WHO	Directs and coordinates international health within the United Nations' organisation.

Appendix B: Flowchart reproduced from Annex III of European Commission's guidance on managing Natura 2000 sites



Appendix C: Typical relationship between Ecological Impact Assessment (EclA) and Air Quality Assessment (AQA)

EcIA Stage[71]	Interactions with this guidance
Scoping: Determining the matters to be addressed in the EcIA. Scoping is an ongoing process – the scope of the EcIA may be modified following further ecological survey/ research and during impact assessment.	The initial stages of the air quality assessment process will determine whether air quality impacts on designated sites require consideration. See Chapters 3 and 4.
Establishing the baseline: Collecting information and describing the ecological conditions in the absence of the proposed project, to inform the assessment of impacts.	The ecologist and air quality specialist will often jointly identify designated sites that are relevant to the plan or project and describe these. See Chapters 3 and 4. It should be noted that ecologists are not instructed on all projects that require an AQA, for example, many applications for environmental permits.
Important ecological features: Identifying important ecological features that may be affected, with reference to a geographical context in which they are considered important.	
Impact assessment: An assessment of whether important ecological features will be subject to impacts and characterisation of these impacts and their effects. Assessment of residual ecological impacts of the project remaining after mitigation and the significance of their effects, including cumulative effects.	The assessment of air quality impacts on designated sites is an iterative process, with consideration of potential impacts starting early in the process set out in this guidance. Initial consideration of impacts starts during the air quality scoping (see Chapter 4) with the assessment becoming more detailed in the latter stages (see Chapter 4).
Avoidance, mitigation, compensation and enhancement: Incorporating measures to avoid, reduce and compensate ecological impacts, and the provision of ecological enhancements. Monitoring impacts of the development and evaluation of the success of proposed mitigation, compensation and enhancement measures.	An IAQM Position Statement[72] sets out the basic hierarchical principles for identifying mitigation measures.
Consequences for decision making: Consideration of the legal and policy framework throughout the EcIA process and assessment of how the proposed development has responded to this.	This will be assessed iteratively throughout the process of assessing air quality impacts on designated sites.

[71] Modified from page iv of: CIEEM (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition. Chartered Institute of Ecology and Environmental Management, Winchester.
[72] iaqm.co.uk/text/position_statements/mitigation_of_development.pdf.

Appendix D: Air pollutants and deposition processes

D.1 Introduction

D.1.1 Maintaining good air quality is important for the protection of ecosystems. Air pollution and its deposition onto vegetation, soil and water can damage vegetation directly or indirectly through the addition of nutrients or changes in acidity levels within a habitat. These can cause a shift in the competitive balance between species, changes in plant species composition or subtle changes in vegetation structure, which can affect the use of a habitat by an animal species.

D.2 Pollutant emission and deposition processes

D.2.1 The main air pollutants affecting vegetation and ecosystems are nitrogen oxides (NO_x), sulphur dioxide (SO_2) and ammonia (NH_3). Ozone (O_3) is also important but this pollutant is not addressed by this guide as it is a regional pollutant not assessed at scheme or project level.

D.2.2 These have both direct effects e.g. through exposure to the gas itself; and indirect effects, e.g. through deposition of the gas to soil and freshwater (dry deposition) or with precipitation (wet deposition).

D.2.3 Figure D1[73] illustrates in simple form the sources, pathways and receptors processes.

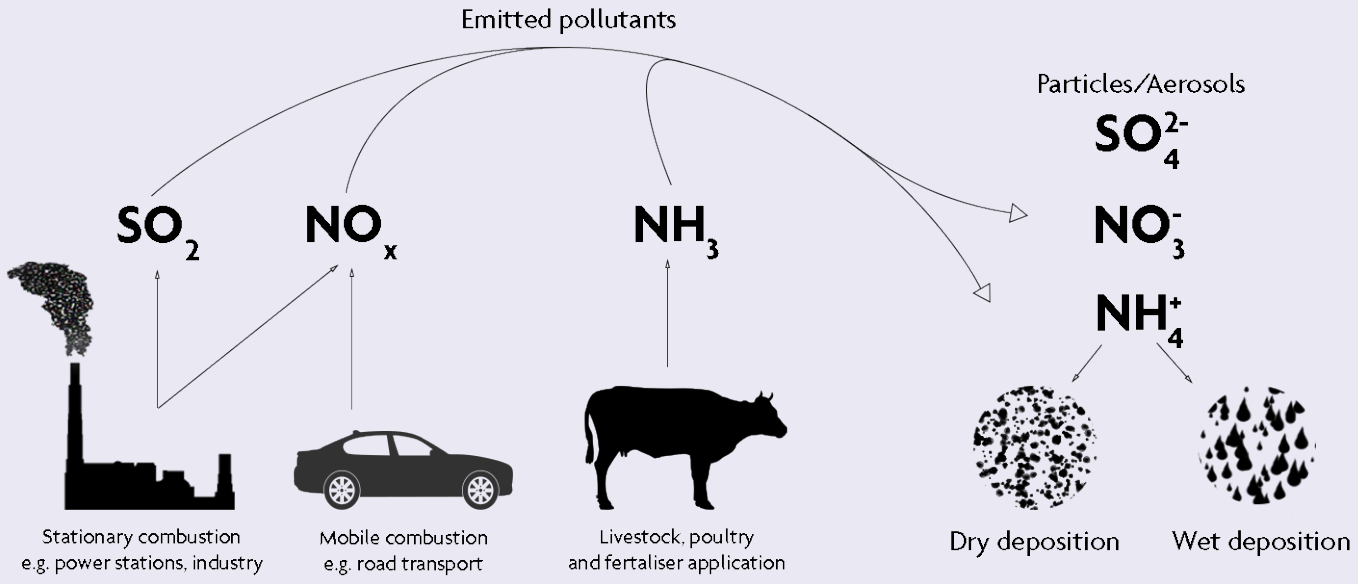
D.3 Critical levels and loads

D.3.1 The concepts of critical levels and critical loads were introduced by the United Nations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution (CLRTAP).

D.3.2 **Critical levels** are defined by the UNECE[74] 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"*. In terms of ecosystem effects, they relate to effects on plant physiology, growth and vitality, and are expressed as atmospheric concentrations over a particular averaging time (hours to years). They are thus important as an indicator of direct adverse effects on ecological receptors and are thus useful tools for ecological assessment.

D.3.3 The critical levels for NO_x and SO_2 are set in the European Union (EU) Ambient Air Quality Directive[75] and transposed into

Figure D1. Schematic of the sources of air pollution



law by the Air Quality Standards Regulations 2010, as amended, and similar Regulations in the devolved administrations. The Directive defines a critical level as *"A level fixed on the basis of scientific knowledge, above which direct adverse effects may occur on some receptors, such as trees, other plants or natural ecosystems but not on humans"*. Under the Directive, assessment of compliance with the critical levels is strictly only required at locations more than 20 km from towns with more than 250,000 inhabitants or more than 5 km from other built-up areas, industrial installations or motorways[76]. In practice, however, assessment against critical levels for vegetation is frequently undertaken to inform planning and permitting processes across the country, regardless of this definition.

D.3.4 The Air Quality Strategy for England, Wales, Scotland and Northern Ireland[77] has adopted these critical levels, as national objectives for the maximum ambient air concentrations of NO_x and SO_2 (and ozone[78]) to be attained, for the aim of protection against the direct effects of air pollution.

D.3.5 The main critical levels used in air quality assessments of designated sites are set out in Table 2.1.

D.3.6 **Critical loads** relate to the potential effects of pollutant deposition [over periods of decades] and are defined by UNECE 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"*.

D.3.7 There are critical loads for nitrogen deposition (leading to eutrophication) and acid deposition (leading to acidification). Critical loads for nitrogen deposition are given as a range and quoted in units of kilograms of nitrogen per hectare per year (kg N/ha/year). A critical load for acidification is described in units of kilograms of H^+ ion equivalents per hectare per year (keq/ha/year). Most assessments consider nitrogen and sulphur deposition, but for some industrial processes, including energy from waste, other chemical species need to be considered, such as hydrogen fluoride (HF).

D.3.8 Critical loads are habitat dependent, further detail and supporting information is provided by the online resource, the Air Pollution Information Service (APIS)[79].

D.4 Oxides of nitrogen (NO_x)

D.4.1 Oxides of nitrogen (NO_x; also referred to as nitrogen oxides), are produced mainly as a result of combustion processes[80]. Almost half of the NO_x emissions in the UK are from road vehicles, mostly diesel engines; approximately one quarter is from power generation and the remainder from other industrial and domestic combustion processes. Emissions of NO_x are also produced naturally by lightning, forest fires and, to a small extent, microbial processes in soils. NO_x is conventionally considered to be a mixture of nitrogen dioxide (NO_2)[81] and nitric oxide (NO)[82]. The general long term UK trend in NO_x has been one of improvement, particularly since 1990, despite an increase in vehicles on the roads[83].

D.4.2 NO_x can affect plants directly or indirectly. It may directly enter a plant via the stomata (as NO or NO_2), where it has phytotoxic effects. Lower plants such as lichens and bryophytes (including mosses, landworts and hornwarts) are particularly vulnerable to direct exposure to the gases in this way[84]. NO_x can also deposit onto soil and, following transformation to nitrate, enrich the soil, leading to eutrophication, as discussed later.

D.4.3 There is no published evidence for any direct toxic effect of NO_x on animals and therefore effects on animals are not directly included in ecological impact assessments, which focus on the effects on vegetation. The effects on animals are sometimes indirectly included in an assessment where species are dependent on particular habitats for their survival and an assessment will focus on this supporting habitat.

D.4.4 The effects of elevated NO_x concentrations on vegetation can be broadly categorised as[85]:

- growth effects: particularly increased biomass, changes in root to shoot ratio and growth of more competitive species, but also including growth suppression of some species;
- physiological effects: e.g. CO_2 assimilation and stomatal conductivity; and
- (bio)chemical effects: e.g. changes in enzyme activity and chlorophyll content (probably through the effects of increased nitrogen, as demonstrated in lichens[86], but also documented in higher plants).

D.4.5 The long term (annual average) critical level for NO_x is 30 $\mu g/m^3$. At concentrations above this critical level, both beneficial and adverse responses have been recorded, and there is evidence suggesting an adverse synergistic effect when plants are exposed to both NO_x and SO_2[87].

D.4.6 The long term critical level for NO_x was set on the basis that growth effects are likely to affect vegetation diversity and survival and occur at lower annual average concentrations than other effects.

D.4.7 Data presented by the World Health Organization (WHO) 2000[85] indicates that, other than growth effects, biochemical or

physiological effects have been demonstrated in vascular plants from exposure to annual average concentrations of more than 100 μg/m^3. With regard to lower plants, Das *et al* (2011)[88] recorded evidence of chlorophyll changes in lichens, also correlated with NO_x at higher concentrations (over 260 μg/m^3). These studies have also attributed the effects to the increase in available nitrogen, but at such high concentrations NO and NO_2 can also increase cellular acidity and inhibit lipid biosynthesis (Wellburn, 1990)[89].

D.4.8 The critical level does not differentiate between the role of nitrogen deposition and NO_x in the air. It is a precautionary general threshold, not specific to a particular habitat, plant species or impact pathway, below which there is currently a high degree of confidence that no adverse effects on vegetation will arise. Long term NO_x concentrations below the critical level are therefore desirable. Some species or habitats may not show adverse effects until higher concentrations are present.

D.4.9 The long term (annual mean) concentration of NO_x is most relevant for its impacts on vegetation, as the effects, particularly through the nitrogen deposition pathway, are additive over months and years. This is reflected in the adoption of the long term guideline in the EU Air Quality Directive as a limit value for vegetation. However, atmospheric exposure to very high concentrations of NO_x for short periods (hours/days) may also have an adverse effect under certain conditions even if the long term concentrations are below the limit value. The WHO guidelines[90] include a short term (24-hour average) NO_x critical level of 75 μg/m^3. Originally set at 200 μg/m^3 as a four-hour mean, the more detailed CD-ROM version of the 2000 WHO guidelines[91] comments: "*Experimental evidence exists that the CLE decreases from around 200 μg/m^3 to 75 μg/m^3 when in-combination with O_3 or SO_2 at or above their critical levels. In the knowledge that short-term episodes of elevated NO_x concentrations are generally combined with elevated concentrations of O_3 or SO_2, 75 μg/m^3 is proposed for the 24 h mean.*" Ozone and SO_2 concentrations are typically low in the UK compared to many other countries. If a regulator does require the use of the short term NO_x critical level, given the low UK SO_2 concentrations IAQM consider it is most appropriate to use 200 μg/m^3 as the short term critical load.

D.4.10 The relative importance of the long term mean compared to the short term mean is reflected in several studies which state that the *'UNECE Working Group on Effects strongly recommended the use of the annual mean value, as the long term effects of NO_x are thought to be more significant than the short term effects'*[92, 93]. This IAQM guidance, therefore, recommends that only the annual mean NO_x concentration is used in assessments unless specifically required by a regulator; for instance, as part of an industrial permit application where high, short term peaks in emissions, and consequent ambient concentrations, may occur.

D.5 Sulphur dioxide (SO_2)

D.5.1 The main anthropogenic source of sulphur dioxide (SO_2) is the combustion of sulphur containing fuel in electricity generation, other industry and domestic heating. Since the 1970s, UK emissions have fallen by 95% with the largest reductions occurring between 1990 and 2000, when emissions reduced by 70%[94].

D.5.2 SO_2 is directly toxic to both higher and lower plants. Lower, non-vascular, plants such as lichens and bryophytes are particularly vulnerable. In the UK, however, many lichen species have increased in abundance after the return to low ambient concentrations (<10 μg/m^3).

D.5.3 The critical level for protection of all vegetation types from the effects of SO_2 is 20 μg/m^3, as an annual mean, except for lichens and bryophytes (including mosses, landworts and hornwarts) for which the criterion is 10 μg/m^3, reflecting their greater sensitivity.

D.5.4 Another key effect of SO_2 is through the indirect effects arising from the acidification of soils. This is discussed in more detail below.

D.6 Ammonia (NH_3)

D.6.1 Agriculture is the main source of anthropogenic ammonia (NH_3) in the UK (82% in 2016[95]). A small amount of ammonia is emitted from petrol vehicles with early three way catalysts, although this source is declining as these older vehicles are retired from the fleet. Vehicles that use Adblue to control NO_x emissions from diesel engines potentially emit ammonia, but vehicles using this technology may have an effective system to remove ammonia from the exhaust gases. Anaerobic digesters used in the waste industry are also an important source of ammonia.

D.6.2 The direct uptake of NH_3 through the stomata increases the amount of nitrogen within the plant. In addition, its alkalinity adversely affects plant biochemistry; lichens and bryophytes are particularly sensitive to this effect[96]. Ammonia also reacts in the atmosphere to produce ammonium ions (NH_4^+) which contribute to nutrient nitrogen and acid deposition. Higher plants are considered to be less sensitive and, for this reason, the annual critical level for higher plants is 3 μg/m^3 but is reduced to 1 μg/m^3 where lower plants (lichens and bryophytes, including mosses, landworts and hornwarts) are a particular interest feature of a habitat. It is the ecologist's role identify the presence of these lower plants.

D.7 Hydrogen fluoride (HF)

D.7.1 Hydrogen fluoride (HF) is an acidic gas released from industrial processes (such as coal fired power stations, waste incinerators

and aluminium production). In elevated concentrations, HF can have an adverse impact on the chlorophyll content of plants. The WHO recognises that HF concentrations in ambient air should be less than 1 μg/m^3, to prevent effects on livestock and plants; this guideline applies to long term (annual) exposure. The Environment Agency online risk assessment guidance[97] for permitting contains weekly and daily average standards for HF for the protection of vegetation.

D.8 Other pollutants

D.8.1 Other pollutants, for example, heavy metals and hydrogen chloride, are emitted by industrial processes and these pollutants may need to be assessed. It is recommended that prior to the assessment of industrial emissions that would be regulated by the Environment Agency or equivalent country regulator, the scope of any assessment is discussed with the regulator.

D.9 Pollutant deposition

D.9.1 There are two processes for atmospheric deposition of pollutants:

- Dry deposition is the deposition of gases and aerosols directly to the Earth's surface.

- Wet deposition is the process whereby pollutants are removed from the atmosphere by precipitation (e.g. rain, snow, fog) and then deposited to ground or vegetation.

D.9.2 Wet deposition is the dominant component of the background deposition rate[98] and often determines whether the critical load is exceeded. Wet deposition primarily depends on the rate of precipitation, and therefore generally follows rainfall patterns.

D.9.3 Wet deposition is not normally assessed by air quality practitioners because the impacts of a project or local development plan typically occur over short distances and over timescales that are too short for wet deposition to be significant. One exception to this is hydrogen chloride (HCl), which is readily 'washed out' of plumes at short range and can, therefore, be required for some industrial permit applications[99].

D.9.4 Deposition rates are dependent on the habitat as well as atmospheric pollutant concentrations. For example, the typical leaf area and height of a species will affect the available surface area for deposition. The deposition velocities used in assessments should reflect the type of vegetation cover.

D.10 Nitrogen deposition

D.10.1 Dry deposition of nitrogen is high within large conurbations and close to major roads, due to the higher NO_x concentrations in the atmosphere. High rates are also found close to agricultural activities such as intensive livestock farming, due to 'reduced nitrogen', which is derived from emissions of ammonia.

D.10.2 Although nitrogen is an essential growth nutrient, not all plants require the same relative quantities. Plants which are of higher conservation value tend to be those which have lower nitrogen requirements and are associated with lower nutrient status habitats.

D.10.3 The growth stimulation effects of nitrogen deposition are generally subtler than the effects of the application of agricultural fertiliser since the quantities of nitrogen deposited over a given period of time are much smaller. Negative effects have been demonstrated in epiphytic lichens. This is caused by a combination of growth inhibition[100] of more sensitive species and growth stimulation of nutrient tolerant species. This has been demonstrated in several studies in London[101].

D.10.4 The role of nitrogen deposition in growth stimulation depends on the availability of the three macronutrients (nitrogen, phosphorus and potassium). In most terrestrial systems nitrogen and phosphorus are naturally relatively scarce and this ordinarily restricts growth and keeps more competitive species in check. If nitrogen is available in sufficient quantities it ceases to be limiting.

D.10.5 Freshwater habitats are typically phosphorus limited[102]. Therefore, nitrogen deposition is usually less important than in terrestrial systems and control of eutrophication in freshwater environments is often directed towards controlling phosphorus inputs. Be aware some rivers and lakes may have nitrogen limits where nutrient nitrogen deposition is more ecologically important to assess.

D.10.6 Coastal systems are generally nitrogen limited. Therefore, nitrogen inputs are typically more important in coastal environments than in freshwater environments. The situation is more complex for terrestrial habitats because those that have a strong freshwater influence may be phosphate limited, others may be nitrogen limited.

D.10.7 Understanding how nutrients affect particular habitats is essential to understanding the role of nitrogen deposition and avoiding unnecessary time and effort being expended controlling non limiting nutrients.

D.10.8 'Site relevant critical loads' for internationally and nationally important wildlife sites and habitat specific critical loads are available through APIS[103]. The APIS website provides advice on the selection of an appropriate value within the critical load range that should be applied in assessments,

based on the interest features of the site. It is at this point that the advice of an ecologist can be particularly important. This is discussed in **Chapter 3**.

D.11 Acid deposition

D.11.1 A range of air pollutants can cause the acidification of soil and freshwater. Salt water systems naturally buffer (acid neutralizing) any acid deposition in almost all cases. The key pollutants are sulphur, in the form of sulphate ions (SO_4^{2-}), and nitrogen, as nitrate (NO_3^-), nitric acid (HNO_3) and ammonium (NH_4^+) (from ammonia). As these pollutants are removed from the atmosphere the H^+ ion concentrations in the precipitation increases, making it more acidic.

D.11.2 Acid deposition is most likely to affect vegetation indirectly through changes to soil properties. Evidence from national monitoring programmes[104] shows that this occurs through increasing the soil acidity, which tends to increase the mobility of certain toxic metals (e.g. aluminium and manganese) and reduce the buffering capacity of the soil. Acid deposition can also cause nutrient deficiencies, by reducing base cation availability (e.g. phosphorus). In forests, leaching of base cations from the soil has been linked to leaf chlorosis (yellowing) (Huettl *et al*, 1990)[105]. Acid deposition can also lead to leaching of calcium from conifer needles, which subsequently may be less able to withstand winter freezing/desiccation (the removal of moisture) damage (Borer *et al* 2005)[106]. There may also be changes in microbial transformations. Root damage may result, especially from aluminium toxicity. Nutrient imbalance can lead to stunted growth. These effects can lead to changes in species composition.

D.11.3 Some ecological sites are more at risk from acid deposition than others, depending on the soil type, bedrock geology, weathering rate and buffering capacity. In general, habitats dependent on slightly acidic substrate (i.e. heathland or acid grassland) and bog habitats are at greater risk of being adversely affected by increased rates of acid deposition than those associated with more calcareous habitats (e.g. chalk grassland). However, it should be noted that calcareous substrates are not immune to acidification as the buffering ability of the soil can become exhausted over time.

D.11.4 Emissions of all acidifying pollutants, typically nitrogen and sulphur but also any other relevant compounds e.g. HCl, should be taken into account when assessing potential acidification of soils and impacts on vegetation. Nitrogen and sulphur containing compounds can be assessed using the APIS Critical Load Function tool[107].

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[73] Figure adapted from www.apis.ac.uk/starters guide air pollution and pollution sources.
[74] www.unece.org/env/lrtap/WorkingGroups/wge/definitions.htm.
[75] The EU Ambient Air Quality Directive refers to the Critical Levels as limit values for the protection of vegetation.
[76] The Directive notes that the risk posed by air pollution to vegetation and natural ecosystems is most important in places away from urban areas and that compliance with critical levels for the protection of vegetation should focus on places away from built up areas.
[77] Defra and the devolved adminstrations, 2007, The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, Volume 1.
https://www.gov.uk/government/publications/the-air-quality-strategy-for-england-scotland-wales-and-northern-ireland-volume-1.
[78] There are limit values and target values for ozone set out in the EU Ambient Air Quality Directive.
[79] Available at www.apis.ac.uk.
[80] National Atmospheric Emissions Inventory naei.defra.gov.uk.
[81] NO_2 is the component of NO_x that cause human health effects.
[82] Another oxide of nitrogen, N_2O (nitrous oxide) is not generally considered part of NO_x in terms of ambient air quality but it is an important greenhouse gas.
[83] Emissions of nitrogen oxides fell by 72% between 1970 and 2017. Source: www.gov.uk/government/uploads/system/uploads/attachment_data/file/579200/Emissions_airpollutants_statisticalrelease_2016_final.pdf [accessed 14/06/2019].
[84] www.apis.ac.uk/node/1071.
[85] WHO Regional Office for Europe, Copenhagen, Denmark, 2000. Air Quality Guidelines – Second Edition. Chapter 11 Effects of nitrogen containing air pollutants: critical levels. http://www.euro.who.int/__data/assets/pdf_file/0005/74732/E71922.pdf#page=244.
[86] Tiwari, 2008. Lichens as an Indicator for Air Pollution: A Review. Indian Journal of Pollution Control, 1, 8 17.
[87] This rarely happens in the UK in practice as sulphur dioxide levels in the UK are now generally very low.
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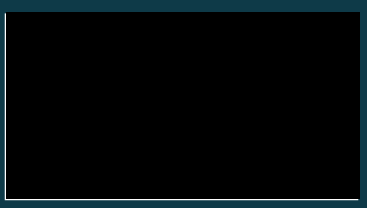
[93] June 2011. Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads & Levels and Air Pollution Effects, Risks and Trends. Chapter 3: Mapping Critical Levels for Vegetation.
[94] naei.defra.gov.uk/overview/pollutants?pollutant_id=8.
[95] naei.defra.gov.uk/overview/pollutants?pollutant_id=21 [accessed 06/03/2019].
[96] www.apis.ac.uk.
[97] www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit.
[98] In this guidance, the term deposition rate is used to describe the amount of pollutant deposited over an area over a period of time, i.e. kg/ha/yr. This is also called the deposition flux.
[99] Where hydrogen chloride (HCl) or nitrate (HNO3) are emitted from industrial activities, advice should be sought from the regulator.
[100] Munzi S, Pisani T, Loppi S. 2009. The integrity of lichen cell membrane as a suitable parameter for monitoring biological effects of acute nitrogen pollution. Ecotoxicology and Environmental Safety 72 2009 2012.
[101] Imperial College & The Natural History Museum. March 2002. Effects of NO_x and NH_3 on lichen communities and urban ecosystems: A pilot study.
[102] However, some riverine designated sites, e.g. the River Clun SAC in Shropshire/Herefordshire, do have targets for nitrogen levels set in their conservation objectives.
[103] APIS recommends values within nutrient nitrogen critical load ranges for use in air pollution impact assessments. www.apis.ac.uk/sites/default/files/downloads/APIS%20critical_load_range_document_0.pdf.
[104] National Soil inventory (NSI), Countryside Survey, Environmental Change Network of sites (ECN), Inter National Co operative Programme (ICP)) and long term experiments.
[105] Huettl, R.F., Fink, S., Lutz, H.J., Poth, M., Wisniewski, J., 1990, Forest decline, nutrient supply and diagnostic fertilisation in southwestern Germany and in southern California. Forest Ecology and Management 30, 341 350.
[106] Borer, C.H., Schaberg, P.G., DeHayes, D.H., 2005, Acidic mist reduces foliar membrane associated calcium and impairs stomatal responsiveness in red spruce, Tree Physiology 25, 673 680.
[107] APIS focuses on the effects of nitrogen and sulphur compounds. These have been incorporated into the Critical Load Function tool, www.apis.ac.uk/critical load function tool.

IAQM
c/o Institution of Environmental Sciences
1st Floor, 6-8 Great Eastern Street, London
EC2A 3NT



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