RHS/DL/1

Air Quality
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Air Quality Representation by Prof. Duncan Laxen,

on Behalf of Royal Horticultural Society, Wisley:

For DCO Hearings for M25 Junction 10/A3 Wisley Interchange Improvements

November 2019

Experts in air quality
management & assessment

Document Control

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Report Prepared By:	Prof. Duncan Laxen

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Air Quality Consultants Ltd
23 Coldharbour Road, Bristol BS6 7JT Tel: 0117 974 1086
119 Marylebone Road, London NW1 5PU Tel: 020 3873 4780
aqc@aqconsultants.co.uk

Registered Office: 23 Coldharbour Road, Bristol BS6 7JT
Companies House Registration No: 2814570

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1 Introduction

1.1 My name is Duncan Laxen. I hold Bachelor of Science and Master of Science degrees in Environmental Sciences and a Doctor of Philosophy degree in air pollution chemistry, all obtained at Lancaster University in 1971, 1975 and 1978 respectively. I am a Visiting Professor in Air Quality Management and Assessment at the University of the West of England, Bristol. I have over 50 years' experience in environmental sciences, most of them in the field of air pollution. I am an Associate of Air Quality Consultants Ltd, the company I set up in 1993.

1.2 I have been a member of various Government expert groups, including the Department of the Environment, Food and Rural Affairs' ("Defra") *Air Quality Expert Group* and the Department of Health's *Committee on the Medical Effects of Air Pollution.* I have been a member of the Steering Group established by the European Commission to oversee the Clean Air for Europe initiative. I am a Fellow of the Institute of Air Quality Management ("IAQM"), the professional body for air quality practitioners. I have published over 70 scientific and technical papers and have made numerous presentations at conferences.

1.3 I have considerable experience over many years of assessing road traffic emissions, which has frequently included presentation of expert evidence at public inquiries and DCO hearings into road schemes.

1.4 I have been closely involved with the development of air quality management and assessment in the UK. This includes a close involvement in the preparation of technical guidance, on behalf of Defra, to support Local Air Quality Management responsibilities of local authorities, as well as guidance on air quality assessments for the planning regime, on behalf of the IAQM and Environmental Protection UK.

1.5 In recent years I have been involved in assessing the impacts of road traffic on Special Areas of Conservation ("SACs") and Special Protection Areas ("SPAs") protected under the Habitats Directive. This includes involvement in the work on Ashdown Forest SAC on behalf of Wealden District Council ("DC"), work on Burnham Beeches SAC on behalf of South Bucks DC, work on Epping Forest SAC in support of a developer, work on the Thames Basin Heaths SPA on behalf of the Wisley Action Group, work on Thames Estuary and Marshes SPA on behalf of the Port of Tilbury, and work on the Dorset Heaths SAC on behalf of Bournemouth Christchurch and Poole Council.

1.6 Earlier this year I was invited by the Royal Horticultural Society (RHS), Wisley to provide air quality advice in relation to the impacts of the DCO Scheme and the role of the RHS Alternative Scheme in reducing these impacts.

1.7 The representation I provide to these Hearings is my true and professional judgement based on scientific evidence and my long experience as an air quality professional.

2 Scope

2.1 My representation expands upon the representations related to air quality made by RHS to the Planning Inspectorate on 6 September 2019 (RR-024). In particular, it examines the evidence of the impacts of the DCO Scheme on habitats and human health and how they will be alleviated by the RHS Alternative Scheme. I address three matters:

- impacts on the Thames Basin Heaths SPA;
- impacts on climate change;
- impacts on air quality in Ripley.

2.2 My evidence also draws upon the written representation presented to the hearing by Mike Hibbert (traffic) (RHS/MH/1) and Andrew Baker (ecology) (RHS/AB/1).

3 Impacts on the Thames Basin Heaths SPA

Effect of Excess Distance Travelled to Access RHS Wisley

3.1 The DCO Scheme will increase road traffic on the A3 north of Wisley Lane by requiring traffic accessing the RHS site from the south to pass along this section of road four times for each visit, as described in the written representation of Mike Hibbert (para 2.11, page 4, and paras 4.8 to 4.11, pages 16 and 17, in RHS/MH/1). This section of the A3 passes through the Thames Basin Heaths SPA (see Figure 7.3 in AS-007). The SPA is protected under the Habitats Regulations. Effects on the health and viability of vegetation within the SPA can arise from increases in concentrations of nitrogen oxides (NOx) and increases in nitrogen deposition (Ndep). The NOx concentrations are assessed against the critical level for protection of vegetation of 30 microgrammes per cubic metre $\mu g/m^3$) as an annual mean NOx (see para 5.3.2 in the Scoping Report, APP-132). The Ndep rates are assessed against the critical load of 10 kg N/ ha/ yr (see para 7.2.29 in APP-043). Effects can also arise from increases in ammonia concentrations and acid deposition. Ammonia is discussed further in para 3.12 below.

3.2 Highways England ("HE") says critical levels are to be used on a precautionary basis as a benchmark only (see para 5.3.2 of the Scoping Report (APP-132), on page 46). Critical levels are defined on the Air Pollution Information (APIS) website and are levels above which direct adverse effects on receptors may occur (see para A1.2 in Appendix A1, on page 12 of this report). Furthermore, Natural England confirms that critical levels are the relevant benchmark for assessment (see paragraph 2.2 in Appendix A2 on page 15 of this report). The implications are addressed further in para 3.8 below.

3.3 In relation to NOx concentrations, the Air Quality Assessment (APP-050) refers (para 5.8.21, page 31) to a transect of receptors extending into the SPA either side of the A3 to the south of junction 10 – Receptors R141 to R148 to the northwest and R149 to R156 to the southeast, as shown in Figure 5.10, sheet 3 of 4 (page 11) of APP-065. The Air Quality Assessment (APP-050) shows that "In the opening year of 2022, there were still exceedances of the critical level both with and without the Scheme at the majority of sites" (para 5.8.23, page 31). The results in the Air Quality Assessment show that there are clear exceedances of the critical level at the receptor points close to the A3 on the two transects, and that the scheme will give rise to medium to large increases in 2022. Results for the receptors closest to the A3 on the two transects are reproduced in Table 1, and are taken from Table 5.7.10 in APP-080 (page 67).

Table 1: Nitrogen Oxides Concentrations ($\mu g/m^3$) Along Two Transects Running from the A3 (see text for source)

Receptor	2022 Concentration Do Minimum	2022 Concentration With Scheme	Change	Impact – HE Descriptors
West of A3				
R141	67.7	69.9	+2.2 (7.3%)	Medium
R142	58.1	59.6	+1.5 (5.0%)	Small
R141	40.8	41.1	+0.3 (1.0%)	Imperceptible
East of A3				
R149	94.8	98.9	+4.1 (13.7%)	Large
R150	79.8	82.7	+2.9 (9.7%)	Medium
R151	53.6	54.5	+0.9 (3.0%)	Small
R152	39.5	39.6	+0.1 (0.3%)	Imperceptible

3.4 The Ndep rates calculated for these same receptors alongside the A3 are set out in the Statement to Inform Appropriate Assessment ("SIAA") (APP-043) as transects 3 and 4 in Table 8 (page 41). The increases, due to the DCO Scheme alone, range up to 1.1% of the Critical Load to the west of the A3, and up to 1.6% to the east. In both cases the Ndep rates are well above the critical load of 10 kg/ha/yr at all receptors, and rise to 15.2 kg/ha/yr (west) and 16.1 kg/ha/yr (east). The importance of the exceedences of the critical load is discussed by Andrew Baker in his written representation (see in particular paras 15 to 19 and 23 in RHS/AB/1).

3.5 A significant part of these increases in NOx concentrations and Ndep rates within the SPA will be due to the additional vehicle movements undertaken by RHS visitors, as required by the DCO scheme. These additional traffic movements are described in the written representation of Mike Hibbert (para 2.11, page 4, and paras 4.8 to 4.11, pages 16 and 17, in RHS/MH/1).

3.6 The RHS Alternative Scheme for south-facing slip roads for the A3 at Ockham Roundabout would remove this increased traffic through the SPA and therefore reduce the adverse effects of the DCO Scheme on the SPA.

Other Limitations of Highways England's Assessment

3.7 I have also determined that the SIAA (APP-043) is inadequate in a number of other regards.

NOx Concentrations Should be Included in the SIAA

3.8 The SIAA (APP-043) fails to consider the impacts of the DCO Scheme on NOx concentrations within the SPA as part of the assessment, even though NOx concentrations are included in the Air Quality Assessment (APP-050). No reason for this omission is provided. **In my view HE should be required to include NOx concentrations, assessed against the critical level, as part of the SIAA, as without this information the relevant authority will be unable to complete the Appropriate Assessment.**

NOx Concentrations Should be Projected Forward Correctly

3.9 The Air Quality Assessment makes clear that it has used the LTTE6 approach set out in the DMRB to project NO_2 concentrations (paras 5.5.23 and 5.5.24 in APP-050). This LTTE6 approach allows for evidence that emission factors for some vehicles have not declined as fast as expected. As a consequence it projects smaller reductions in NO_2 concentrations than the default approach based on Defra's Emission Factor Toolkit ("EfT") emission factors. The LTTE6 approach is *"considered the most realistic of the projections for estimating future concentrations* (of NO_2)*, taking into account uncertainty in long term trends, and has therefore been used as the basis for determining the impact and significance of the changes"* (para 5.8.7 in App-050).

3.10 An LTTE6 approach has not, however, been applied to the NOx concentrations, so the reduction in NOx concentrations from 2015 to 2022 has been exaggerated. This is evident in some simple calculations using the sites with the highest modelled receptor concentrations, i.e. the receptors most dominated by road traffic, as illustrated in Table 2. The rate of reduction for NO_2 using the default EfT emission factors is much higher (-4.5%/yr) than that for the LTTE6 approach (-3.1%/yr). The rate of NOx reduction using the default EfT emission factors (-4.6%/yr) is similar to that for NO_2 (-4.5%/yr) when using the default EfT emission factors, but much higher than the LTTE6 rate of reduction for NO_2. As already noted, the LTTE6 approach has not been applied to the NOx concentrations, so there is no equivalent LTTE6 reduction rate for NOx.

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Table 2: Calculated Reductions in NO_2 and NOx Concentrations ($\mu g/m^3$) for Receptors Most Influenced by Road Traffic

Receptor	2015 Concentration	2022 Concentration Do Minimum	Total Change from 2015 to 2022	Change per Year
NO_2				
R71 (LTTE6) [a]	55.2 [b]	43.3 [b]	-21.6%	-3.1%/yr
R71 (Default EfT) [a]	55.2 [c]	37.8 [c]	-31.5%	-4.5%/yr
NOx				
R98	176.8 [d]	119.8 [d]	-32.2%	-4.6%/yr

[a] brackets indicate the emission projection approach – see para 3.9

[b] Value from Table 5.7.9, page 64 in APP-080

[c] Value from Table 5.7.2, page 56 in APP-080

[d] Value from Table 5.7.10, page 65 in APP-080

3.11 Support for the LTTE6 approach comes from a recent detailed analysis of trends across the UK for the period 2010 to 2018, which has shown a trend for road sites of -3.10%/yr for NO_2 and -3.02%/yr for NOx (see Tables 1 and 2 reproduced in Appendix A3 on page 15 of this report). These numbers are consistent with the rate for NO_2 derived using the LTTE6 method (-3.1%/yr), and help confirm that the projections for NOx in the HE Air Quality Assessment are exaggerated. Predicted future year NOx concentrations will therefore be too low, and this will affect the assessment of impacts. **In my view HE should be required to apply the LLTE6 method, or something similar, to derive future projections of NOx concentrations for use in the SIAA, as without this information the relevant authority will be unable to complete the Appropriate Assessment (AA).**

Ammonia Should be Included in the SIAA

3.12 The SIAA (APP-043) does not include the contribution of ammonia (NH_3) emissions from the road traffic, both in relation to the critical levels for ammonia itself and in terms of the contribution of ammonia to Ndep. This is an important omission, as ammonia from road traffic can double the traffic component of Ndep close to roads (see Appendix A4, in particular pages 21-23 of this report), and ammonia itself may have direct effects. Furthermore, ammonia emissions from road traffic are unlikely to decrease into the near future (see Appendix A4, in particular pages 23 and 24 of this report). The SIAA is thus incomplete. **In my view HE should be required to include an assessment of ammonia concentrations from road traffic and also to include the contribution of road traffic ammonia emissions in the calculations of Ndep rates, as without this information the relevant authority will be unable to complete the Appropriate Assessment.**

The Ndep Calculations Should use Appropriate Deposition Velocities

3.13 HE has made clear in its response to questions from RHS that it has used the deposition velocity from the DMRB to calculate the NDep from the changed NO_2 concentrations (see Appendix A5 on page 25 of this report). This is a single value of 0.001m/s for short vegetation and trees. The latest guidance from IAQM is that deposition velocities provided by AQTAG are to be used in preference (see Appendix A6). These are 0.0015m/s for short vegetation and 0.003m/s for forest. Following the latest guidance will result in higher Ndep contributions from road traffic than presented in the SIAA. **In my view HE should be required to carry out the calculations of Ndep rates using the deposition rates from AQTAG for short vegetation and forest as appropriate, as without this information the relevant authority will be unable to complete the Appropriate Assessment.**

The In-Combination Assessment for the SIAA Should be Carried out Correctly

3.14 The in-combination assessment has not been carried out correctly. The assessment presented by HE in section 7.3 of the SIAA (APP-043) takes each potential in-combination source and assesses it separately and qualitatively. The in-combination assessment has to establish the combined impacts of all plans and projects on NOx and NH_3 concentrations and Ndep rates, and not treat them separately. **In my view HE should be required to carry out a proper in-combination assessment of the NOx and NH_3 concentrations and Ndep rates, as without this information the relevant authority will be unable to complete the Appropriate Assessment.**

4 Impacts on Climate Change

4.1 The Air Quality Assessment (APP-050) calculates the changes in regional emissions of CO_2, with the results presented in Table 5.13 of APP-050. The emissions will be 25% higher in 2022 than 2015 due to traffic growth, with the DCO Scheme increasing the 2022 emissions by 3,425 tonnes per year or 0.2%, due to an additional 45 million veh-km travelled. A part of this growth in CO_2 emissions with the DCO Scheme will be due to the new arrangements for traffic accessing RHS Wisley.

4.2 The DCO Scheme will increase the distance travelled by RHS traffic, both for visitors approaching from the south and from the north, as set out in the written representation of Mike Hibbert (para 6.6, page 26, in RHS/MH/1). The extra distances travelled by the visitors to RHS Wisley will clearly be adding to the emissions of the greenhouse gas carbon dioxide (CO_2). The RHS Alternative Scheme) would reduce the adverse impact of the DCO Scheme on carbon emissions. It has been calculated that 3.3 million additional miles, equivalent to 5.3 million veh-km, will be saved by the RHS Alternative Scheme, or a 12% reduction in the increase due to the DCO Scheme (para 2.9, page 3, and para 6.9, page 27, in RHS/MH/1).

5 Impacts on Air Quality in Ripley

RHS Traffic through Ripley Not Assessed

5.1 The DCO Scheme, as promoted, will sign RHS traffic approaching on the A3 from the south to stay on the A3 and route via junction 10. However, it is to be expected that some visitors to RHS Wisley will take the route through Ripley. This is explained in the written representation of Mike Hibbert (para 2.12, page 4, and para 4.22, page 19, in RHS/MH/1), and would be avoided with the RHS Alternative Scheme. The impacts of this RHS traffic passing through Ripley have not been assessed by HE. **In my view HE should be required to fully assess the impacts on air quality in Ripley of RHS traffic using the route through Ripley rather than the signed route via the A3 and junction 10, as without this the Examining Authority will have an incomplete picture of the air quality impacts of the DCO Scheme within Ripley**.

Other Concerns about Air Quality Assessment in Ripley

5.2 I am also concerned that HE has not adequately assessed impacts in Ripley in a number of other regards:

- the selection of receptors, which are not worst-case;
- the presentation of baseline concentrations, which are not worst-case; and
- the selection of descriptors for the impacts.

Receptors in Ripley

5.3 The Air Quality Assessment identified only one receptor within Ripley, R59, shown in Figure 5.10 sheet 3 of 4, in APP-065, and described in Table 5.2.1 in APP-080 as Aberdeen House, High Street Ripley (Grid Ref 505165, 156748). The location of this receptor has recently been shown in greater detail on a map provided by HE in response to questions from RHS (this is reproduced in Appendix A7 on page 28 of this report). However, the location is not Aberdeen House, which is around 30m to the northeast. The distance is given as 11.3m from the kerb of High Street and 6.7m from the kerb of Newark Lane. Concentrations decline rapidly on moving away from the kerb and there are receptors closer to the road in Ripley that should have been selected. For instance, further to the east along the High Street, there are properties around 1 to 2m back from the kerb (see photographic evidence in Appendix A8 on page 29 of this report). There are also properties around 1m from the kerb of Newark Lane, which is canyon like and will hence have higher concentrations, near its junction with High Street (see Appendix A8). Concentrations 1 to 2m from the kerb will be significantly higher than those Fh7 to 11m from the kerb. HE has therefore not selected worst-case receptors in Ripley. The DMRB makes clear in para 3.16 that worst-affected properties should be identified (see extract reproduced in Appendix A9, on page 31 of this report). **In my view HE should be required to include receptors in Ripley where the impacts will be**

worst case, as without this the Examining Authority will have an incomplete picture of the air quality impacts of the DCO Scheme within Ripley.

Presentation of Baseline Concentrations in Ripley

5.4 The Air Quality Assessment, as noted in para 5.3 above, has used just one receptor to represent scheme impacts in Ripley, R59. The modelled concentration at this location in 2015 is 16.7 $\mu g/m^3$ (Table 5.7.7 on page 55 in APP-080), presenting baseline air quality within Ripley as being well below the objective of 40 $\mu g/m^3$. The measured concentrations within Ripley are also provided for two sites RP1, High Street and RP2, Newark Lane, with concentrations in 2016 of 34 and 29 $\mu g/m^3$ respectively (Table 5.6.1 on page 28 in APP-080). These concentrations are essentially double the concentration presented for the modelled receptor in Ripley. The modelling carried out by HE has thus presented a false picture of baseline conditions within Ripley. **In my view HE should be required to verify the model using the local monitoring in Ripley, as without this the Examining Authority may have an incomplete picture of the air quality impacts of the DCO Scheme within Ripley.**

Descriptors of Impacts

5.5 The Air Quality Assessment has used impact descriptors as set out in the HE guidance note IAN 174/13, published in 2013, as set out in para 5.2.9 of APP-050. This has a simple description based on the magnitude of the change. The IAQM, which represents air quality professionals in the UK, published its own guidance in 2017 on descriptors for air quality impacts (see Table 6.3 from the guidance reproduced in Appendix A10, on page 34 of this report). The IAQM descriptors take account of the absolute concentration in relation to the air quality assessment levels, as well as the change due to the scheme. The impacts are given more significant descriptors if they are above or close to the assessment level, as is evident in Table 6.3 in Appendix A10, on page 34 of this report). Furthermore, 'imperceptible' is used as a descriptor by HE when the change is <1% of the assessment level, while for IAQM guidance this descriptor applies when the change is <0.5%.

5.6 The Air Quality Assessment should have made use of the IAQM impact descriptors as well as the HE descriptors as used. This position is supported in the findings of the DCO for the M4 Motorway (Junction 3 to 12) (Smart Motorway), as set out in paragraphs 5.7.67 to 5.7.70 of the Report of Findings and Conclusions (reproduced in Appendix A11, on page 35 of this report). **In my view HE should be required to apply the IAQM descriptors to its modelled concentrations for human health impacts, to provide a more complete assessment using the most up-to-date guidance, as without this the Examining Authority will have an incomplete picture of the air quality impacts of the DCO Scheme within Ripley.**

6 Summary and Conclusions

6.1 The HE assessment has shown that the DCO Scheme will give rise to adverse impacts on NOx concentrations and Ndep rates within the SPA alongside the A3. The RHS Alternative Scheme will reduce these impacts. The RHS Alternative Scheme will have the added benefit of reducing the exposure of residents in Ripley to increased concentrations and of reducing emissions of the greenhouse gas (CO_2).

6.2 In preparing my comments I have identified a number of weaknesses in the assessment provided by HE, giving rise to the following recommendations. HE should be required to:

a) include NOx concentrations, assessed against the critical level, as part of the SIAA, as without this information relevant authority will be unable to complete the Appropriate Assessment.

b) apply the LLTE6 method, or something similar, to derive future projections of NOx concentrations for use in the SIAA.

c) include an assessment of ammonia concentrations from road traffic and also to include the contribution of road traffic ammonia emissions in the calculations of Ndep rates.

d) carry out the calculations of Ndep rates using the deposition rates from AQTAG for short vegetation and forest as appropriate.

e) carry out a proper in-combination assessment of the NOx and NH_3 concentrations and Ndep rates.

f) fully assess the impacts on air quality in Ripley of RHS traffic using the route through Ripley rather than the signed route via the A3 and junction 10

g) include receptors in Ripley where the impacts will be worst case

h) verify the model using the local monitoring in Ripley

i) apply the IAQM descriptors to its modelled concentrations for human health impacts, to provide a more complete assessment using the most up-to-date guidance.

6.3 In my view, without taking account of the recommendations I set out above, the Examining Authority does not have a suitable air quality assessment and SIAA with which to determine the DCO, and the relevant authority will not have the necessary information to complete the Appropriate Assessment.

7 Appendices

A1 Extract from APIS Website

A1.1 The Air Pollution Information System (APIS) is the source of information on habitats and their exposure to air pollutants that the Government's Planning Practice Guidance refers users to (from https://www.gov.uk/guidance/air-quality--3):

> Air quality considerations may also be relevant to obligations and policies relating to the conservation of nationally and internationally important habitats and species. The Air Pollution Information System and Natural England's 'Impact Risk Zones' tool (available on MAGIC) can help to determine the types of development proposal which can adversely affect these designated sites of special scientific interest and indicates when consultation with Natural England is required.
>
> Paragraph: 001 Reference ID: 32-001-20191101
>
> Revision date: 01 11 2019

A1.2 APIS has a definition of critical levels as set out in the box below, with the relevant value for NOx set out in Table 1 – see below (from: http://www.apis.ac.uk/critical-loads-and-critical-levels-guide-data-provided-apis#_Toc279788054):

> ## 2. Definitions
>
> Critical Loads are defined as: "*a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge*" (Source: https://www.icpmapping.org/Definitions_and_abbreviations)
>
> Critical levels are defined as "*concentrations of pollutants in the atmosphere above which direct adverse effects on receptors, such as human beings, plants, ecosystems or materials, may occur according to present knowledge*". (Source: https://www.icpmapping.org/Definitions_and_abbreviations)
>
> It is important to distinguish between a critical load and a critical level. The **critical load** relates to the quantity of pollutant **deposited** from air to the ground, whereas the **critical level** is the gaseous **concentration** of a pollutant in the air.

Table1 - Critical levels of air pollutants.

Pollutant	Receptor	Time Period	Critical Level	Reference
NOX	All	Annual mean	30 µg/m^3	WHO, CLRTAP, AQ Directive

A2 Extract from Natural England Advice Note

A2.1 Natural England has a document that set out its advice on assessing road traffic emissions (from http://publications.naturalengland.org.uk/file/5431868963160064). The Advice on critical levels is set out in para 2.2 on page 8 of the document as reproduced below

NATURAL ENGLAND

Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations

Version: June 2018

Green-winged orchids *Anacamptis morio* on a roadside verge (by kind permission of Mark Meijrink @ http://markmeijrink.wordpress.com)

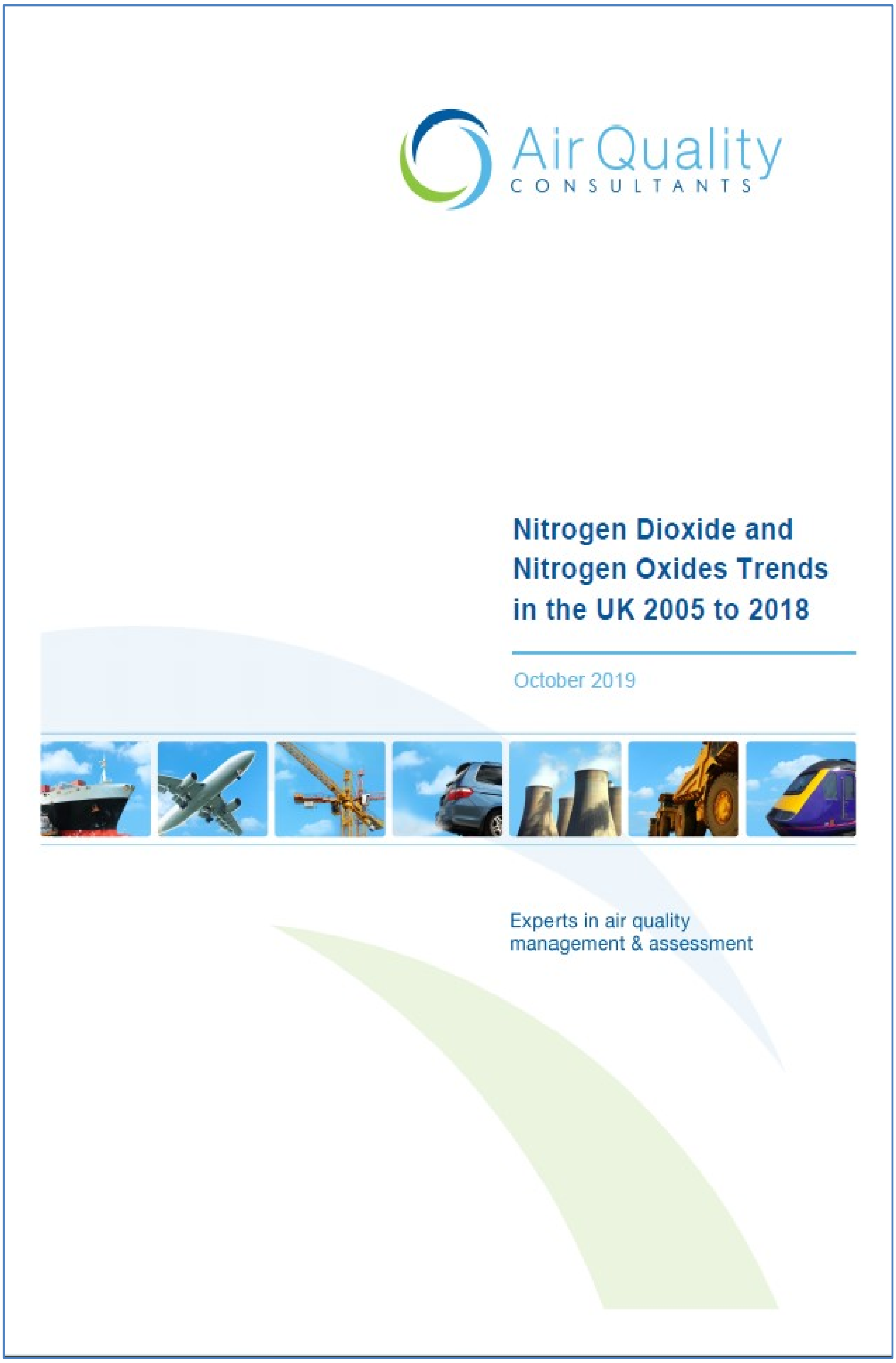
NE Internal Guidance – Approach to Advising Competent Authorities on Road Traffic Emissions and HRAs
V1.4 Final - June 2018 Page 1

2.2 Generally speaking, the risks to qualifying features from air pollution (in simple terms) most frequently arise from:

a) The direct effects which arise when a pollutant which is dispersed in the air is taken up by vegetation (through pores on the surface called stomata). Pollutants taken up by vegetation can cause adverse impacts to plant health and viability. The relevant assessment benchmark for pollutant concentrations 'in the air' is referred to as a **critical level** expressed in units of $\mu g/m^3$ (micrograms per cubic metre).

A3 Nitrogen Dioxide and Nitrogen Oxides Trends in the UK 2005 to 2018

A3.1 Extract from report on nitrogen dioxide and nitrogen oxides trends in the UK (available at: https://www.aqconsultants.co.uk/CMSPages/GetFile.aspx?guid=feb92332-26f7-4989-b86a-21e5732a5404)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Nitrogen Dioxide and Nitrogen Oxides Trends in the UK 2005 to 2018

October 2019

Experts in air quality management & assessment

Table 1: Summary Results for All UK and by Site Type, 2005-2018

Name	Number of Sites	NO_2			NOx		
		Mean Conc ($\mu g/m^3$) [a]	Mean Trend (%/yr)	Mean Trend ($\mu g/m^3$/yr)	Mean Conc ($\mu g/m^3$) [a]	Mean Trend (%/yr)	Mean Trend ($\mu g/m^3$/yr)
All UK							
All UK	112	33.9	-1.82***	-0.70	73.8	-1.86***	-1.48
By Site Type							
Road all UK	52	46.9	-1.80***	-0.96	116.2	-1.74***	-2.16
Urban all UK	45	26.7	-1.65***	-050	44.3	-1.99***	-0.93
Rural all UK	15	9.9	-2.46***	-0.29	13.5	-2.54***	-0.38

[a] Mean of all years and all sites

Table 2: Summary Results for All UK and by Site Type, 2010-2018

Name	Number of Sites	NO_2			NOx		
		Mean Conc ($\mu g/m^3$) [a]	Mean Trend (%/yr)	Mean Trend ($\mu g/m^3$/yr)	Mean Conc ($\mu g/m^3$) [a]	Mean Trend (%/yr)	Mean Trend ($\mu g/m^3$/yr)
All UK							
All UK	182	33.6	-3.13***	-1.19	75.4	-3.07***	-2.53
By Site Type							
Road all UK	109	41.5	-3.10***	-1.46	102.4	-3.02***	-3.37
Urban all UK	57	25.4	-3.09**	-0.89	41.6	-3.08*	-1.37
Rural all UK	16	9.2	-3.41***	-0.36	12.3	-4.09***	-0.57

[a] Mean of all years and all sites

A4 Ammonia Contribution to Ndep

A4.1 The contribution of ammonia from road traffic to Ndep alongside roads is illustrated in Figures 3 and 4 from the Wealden DC submission to the Wealden Local Plan Examination in June 2019. The document is available at: http://www.wealden.gov.uk/nmsruntime/saveasdialog.aspx?lID=27135&sID=6829. The first page is shown below, together with Appendix 2. There are no page numbers to the submission. The submission is also found under item 'Y18 Responses to IAQM Guidance June 2019' in the Wealden Local Plan Examination Library, at: http://www.wealden.gov.uk/Wealden/Residents/Planning_and_Building_Control/Planning_Policy/Wealden_Local_Plan/Wealden_Local_Plan_Examination_Library.aspx:

Wealden Local Plan Examination

Written response on behalf of Wealden District Council to Holman et al (2019) *A guide to the assessment of air quality impacts on designated nature conservation sites – version 1.0*

The IAQM document provides non-statutory guidance to IAQM members. It has not been widely used or tested in planning decisions. The document explains[1] that it may be amended in response to legal clarification or changes to other guidance. It was produced by a small group led by Dr Holman[2] with input from Dr Riley[3,4] and it is thus unsurprising that, whilst there are points of agreement, there are also points of disagreement which have already been presented to the Inspector.

Key areas of Agreement:

- There may be adverse impacts >200m from roads[5].
- Screening and appropriate assessment should be conducted in combination with other plans/projects.
- Air quality specialists may choose suitable deposition velocities[6].
- Tempro growth is an appropriate way to consider 'in-combination' effects[7].
- Spatially-averaged 'background' conditions should not be confused with location-specific 'baseline' conditions[8].
- "*Autonomous measures can only be taken into account if it is sufficiently certain that* [they] *will be deliver as anticipated*"[9] (emphasis added).
- There is no presumption that autonomous improvement can be exploited to allow adverse effects[10].
- The DMRB-predicted 2%/yr reduction in deposition is inappropriate and is precluded because "*it is not supported by monitoring data*" [11].

Key areas of Disagreement:

- The document assumes greater certainty in declining future trends than is warranted[12], particularly in the context of a current upward trend in predicted background deposition[13] and in locally-measured NO_2 concentrations[14,15].
- Conflates[16] the small falls in national-average NOx/NO_2 concentrations with evidence that models are able to predict the scale of reductions beyond reasonable scientific doubt. This is despite overwhelming evidence that the same models[17] have consistently over-stated the rate of improvement in the past[18].
- Suggests[19] that local plans will delay improvements rather than cause deteriorations[20]. As shown in Appendix 1, the WLP cannot be confidently shown to only "delay" the improvements forecast using any relevant emissions tools.
- Recommends that predictions are not made <2m of roads[21] and that the current distribution of qualifying features may constrain the air quality modelling[22]. Automatically disregarding effects <2m of roads, or where species have been precluded[23], is not compliant with the Habitats Regulations, the European Guidance or the rulings on Cases C-258/11[24] or C-461/17[25,26].

Appendix 2 Traffic-related NH_3

The Importance of Traffic-related NH_3

The IAQM document suggests that traffic-related ammonia (NH_3) emissions are "small" and "declining"[1] (Para D.6.1). Measured roadside NH_3 concentrations are set out in Chapter 8 of document I6 (Ashdown Forest Air Quality Monitoring and Modelling). This includes three transects of NH_3 monitors beside roads. Two of these are alongside the busy A22. The third transect is beside a minor road which makes it less useful for the type of analysis presented below. Figure 1 shows the measured NH_3 concentrations (as shown in Table 8.5 of document I6) vs distance from the A22. Presenting the measurements in this way leaves no doubt that traffic on the A22 represents a significant source of NH_3.

As well as NH_3, all of the monitoring sites shown in Figure 1 also measured NO_2 concentrations. In document I6, these were used to calculate road-NOx concentrations. Figure 2 shows that the spatial pattern in NH_3 and NOx concentrations on moving away from the A22 is very similar, which is to be expected since both are primary pollutants released from the same emission source.

The NH_3 and NO_2 deposition rates are shown in Figure 3. They are based on the measured concentrations with the local measured background values subtracted. The concentrations have been multiplied by the simple deposition velocities presented in Table 5.1 of the IAQM document (assuming deposition to grassland). Figure 3 shows that NH_3 contributes more than half of the local traffic-related increment of nitrogen deposition. This finding is also in line with the more detailed modelling carried out for Ashdown Forest (as described in doc I6). As an example, Figure 4 shows the calculated deposition along ecological Transects J and K (which are also either side of the A22)[2]. The relative contribution of NH_3 to local traffic-related nitrogen deposition is mostly between 50% and 70% along these transects. There should, therefore, be no doubt that traffic-related NH_3 emissions are very important to understanding, and quantifying, nitrogen deposition near to roads in Ashdown Forest.

[1] It is noted that the word "declining" is used specifically in relation to petrol vehicles and is thus not incorrect, although the impression given is one of declining fleet-average emissions.

[2] Using the AQC deposition method - these results are derived directly from those presented in Figures 9.40 and 9.41 of doc I6.

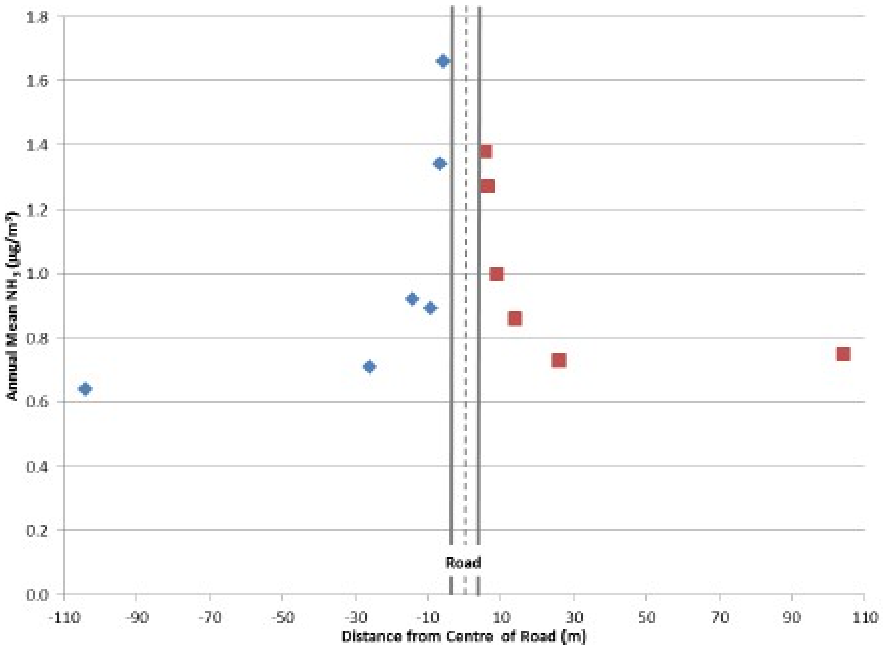

Figure 1 - ALPHA Monitoring Results (µg/m³ of NH_3) on Transects 1 (blue diamonds) and 2 (red squares) vs distance from the centre of road. Negative values are distance westward and positive values are distance eastward.

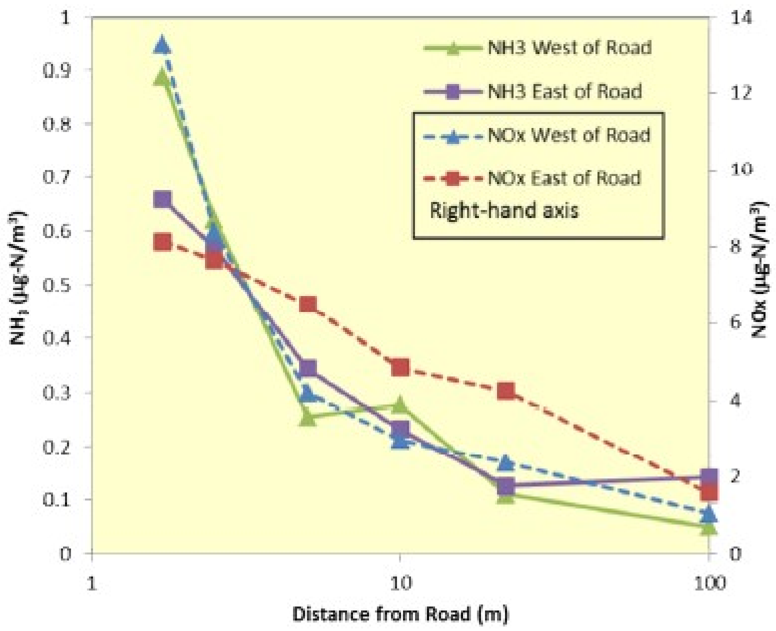

Figure 2 - Two-year (2014-2016) average NH_3 and NOx concentrations along two transects running perpendicular to the A22 after subtracting measured background concentrations.

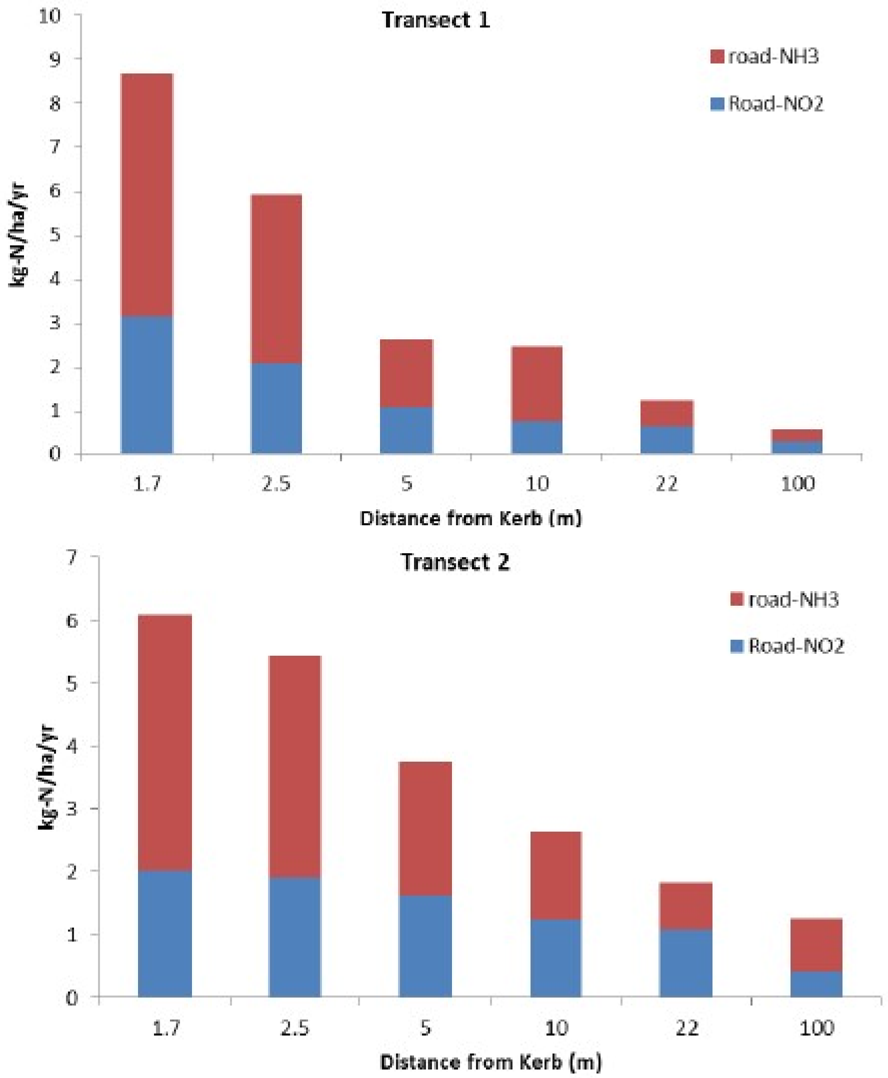

Figure 3 – Local Traffic-related Increment of Deposition from NH_3 and NO_2 Beside the A22. Derived Solely from Measured Concentrations and the Deposition Velocities Published by IAQM.

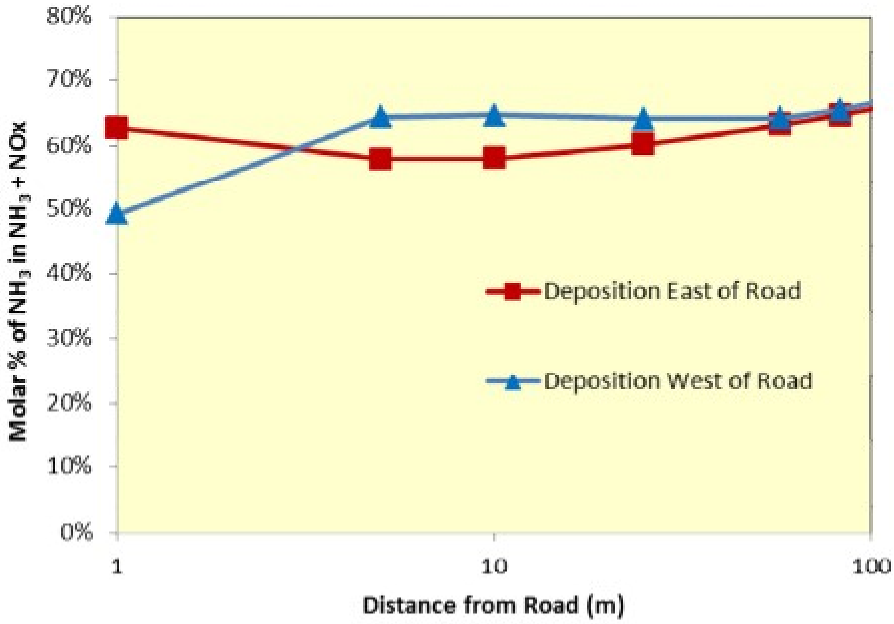

Figure 4 – Relative Importance of Local Traffic-related Increment of Deposition from NH_3 as a Percentage of the Total Local Traffic-related Deposition Beside the A22 (Ecological Transects J and K) from the Detailed "AQC" Modelling. Derived from the Values Presented in Figures 9.40 and 9.41 of doc I6.

<u>Future Trends in Traffic-related NH_3</u>

The modelling set out in document I6, and as used for the HRA, assumes that emissions of NH_3 per vehicle will not change in the future. This is because there is no sound basis to make numerical predictions of the rate of change. The IAQM document implies that NH_3 emissions from road traffic are falling. A preliminary indication of the 'direction of travel' for NH_3 emissions is given by the measurements made by Rose (2018)[3]. These data were collected by analysing the chemical composition of exhaust plumes from large numbers of individual vehicles[4]. In Figure 5, Rose (2018) showed how NH_3 emissions are tending to increase in more modern diesel vehicles. However despite this, NH_3 emissions from diesel vehicles remain small when compared with those from petrol vehicles (Figure 6). It is highly significant that NH_3 emissions, even from the most modern (Euro 6) petrol cars, are so much greater than those from diesel cars. One of the key reasons which has been put forward at the EIP as to why there should be confidence that traffic-related NOx emissions will fall in the future is that a shift from diesel to petrol cars can be anticipated. It is clear from Figure 6 that any shift from diesel to petrol cars is likely to also cause significant increases to traffic-related NH_3 emissions.

Rose (2018)[3] also observed that petrol cars with cold engines emit appreciably more NH_3 than petrol cars with warm engines (Figure 7). Another reason presented to the EIP as to why there should be

[3] Real world measurements of ammonia emissions from vehicles. Rebecca Rose. Routes to Clean Air. Birmingham 30th October 2018.
[4] Termed "remote sensing".

confidence that traffic-related NOx emissions will fall is the increased use of hybrid-electric vehicles. Hybrid vehicles spend part of their time using an electric motor and part of their time using an internal combustion engine. When a vehicle is using its electric motor, the internal combustion engine is allowed to cool. Thus, there is a significant potential for a hybrid vehicle to emit more NH_3 than a non-hybrid vehicle at locations where the internal combustion engine is first used.

Taking all of these points together, it is clear that there can be no confidence in the assumption that traffic-related NH_3 emissions will fall in the future. Instead, there are reasons to believe that such emissions may increase. It has not, however, been possible to factor this effect into the modelling in document I6 and the HRA, which assumes no change in NH_3 emissions per vehicle over time.

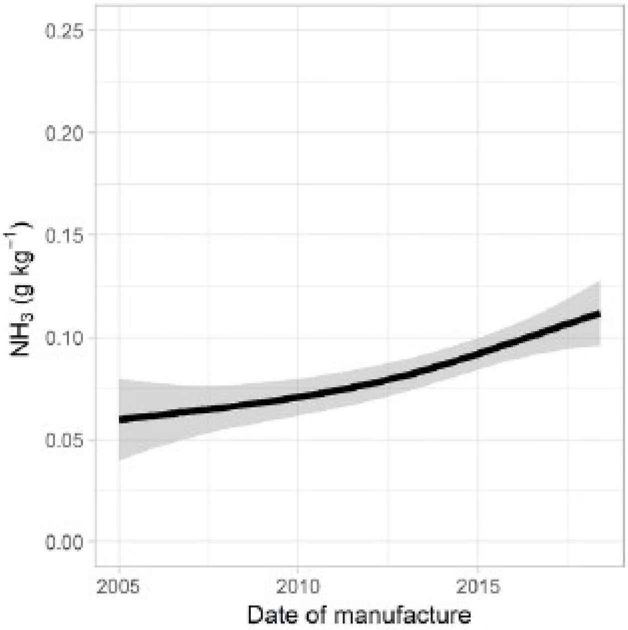

Figure 5 – Measured Increase in NH_3 Emissions per Diesel Vehicle with Year of Vehicle Manufacture (from Rose, 2018)[3].

A5 Response from Highways England

A5.1 The following was provided by HE in November 2019 in response to questions from RHS Wisley. It is Response Item 19.

> Deposition velocities used to calculate N deposition were taken from the Design Manual for Roads and Bridges (DMRB) HA 207/07 Annex F paragraph F2.3 Step 5 which states: *"Dry NO_2 deposition rates should be estimated using the following scaling factor which is based on a deposition velocity for NO_2 of 0.001 m/s (taken from EMEP Eulerian photochemistry model). 1 $\mu g/m^3$ of NO_2 = 0.1 kg N ha^{-1} yr^{-1}"*
>
> No different values were used for short vegetation and trees

A6 IAQM Guidance on Deposition Velocities

A6.1 The following is an extract from IAQM guidance issued in June 2019. Available at: https://iaqm.co.uk/text/guidance/air-quality-impacts-on-nature-sites-2019.pdf

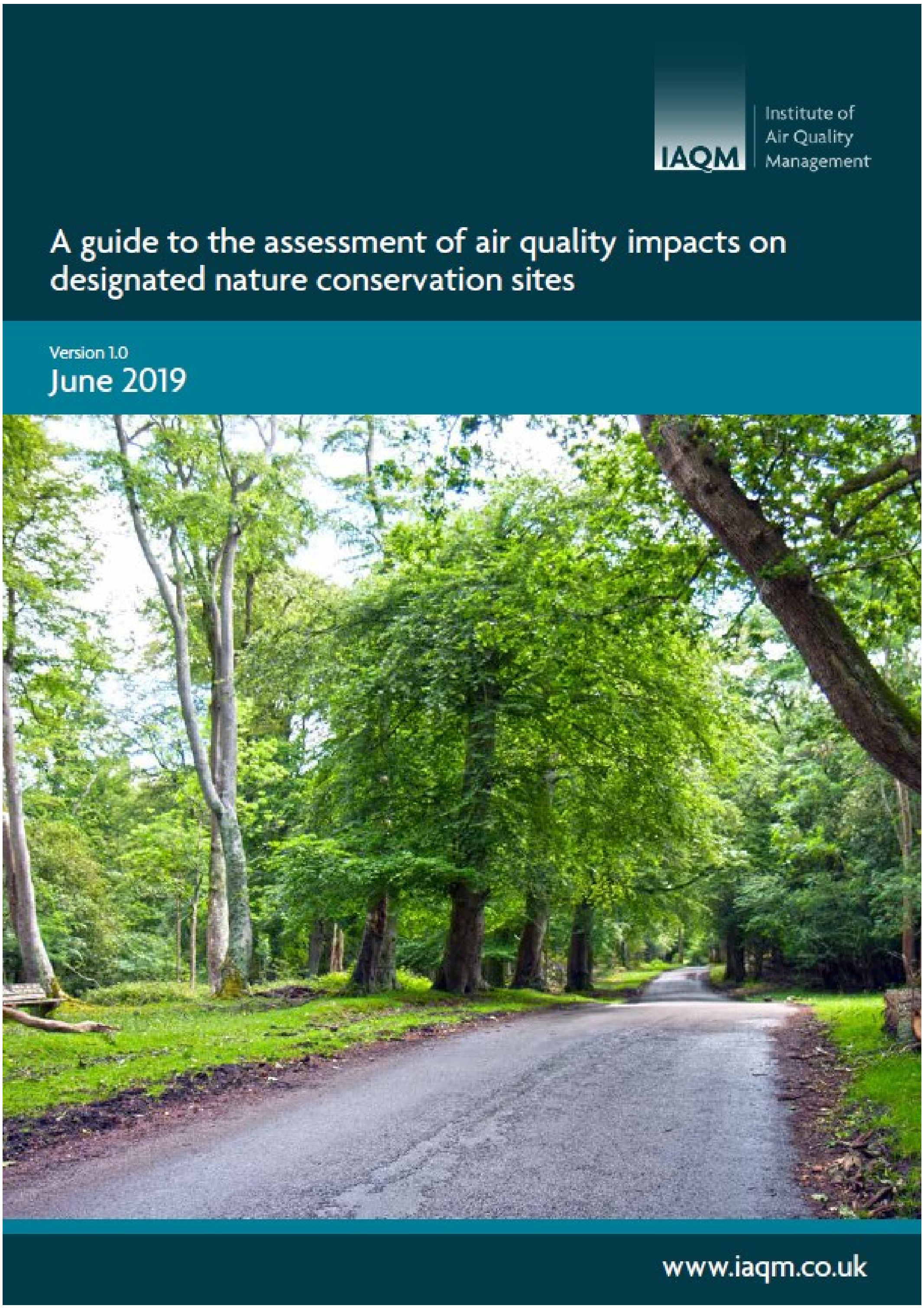

Table 5.1 Deposition velocities (after AQTAG)

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

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Air quality impacts on nature sites

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[52]. 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. An air quality specialist may choose to derive their own deposition velocities based on a review of published data. The source of the deposition velocity and justification for its use should be provided.

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[55, 56].

A7 Location of Highways England Receptor in Ripley

A7.1 The following was provided by HE in November 2019.

Receptor R59 in Ripley has x, y, z coordinates of 505165, 156748, 1.5

The distance from the receptor to the B367 Newark Lane (road link 18273_14728) centre line is 10.3 m (1dp) and kerb (10.3m – 3.65 m [half road width] = 6.7m (1dp))

The distance from the receptor to the B2215 High Street (road link 16156_14728) centre line is 14.9 m (1dp) and kerb (14.9m – 3.65 m [half road width] = 11.3m (1dp))

Contains sensitive information

A8 Alternative Receptors in Ripley

From Google Street View

A8.1 View Along the High Street in Ripley, Looking West, Showing Properties Close to the Kerb

From Google Street View

A8.2 View along Newark Lane from the junction with High Street in Ripley, looking north, showing properties close to the kerb

A9 Extract from DMRB

A9.1 The HE Design Manual for Roads and Bridges has guidance on assessing road schemes, with Volume 11, Section 3, Part 1 dealing with air quality (available at: http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/ha20707.pdf). The Advice on receptors is set out in para 3.16 on page 3 of the document as reproduced below.

DESIGN MANUAL FOR ROADS AND BRIDGES

VOLUME 11 ENVIRONMENTAL ASSESSMENT

SECTION 3 ENVIRONMENTAL ASSESSMENT TECHNIQUES

PART 1

HA 207/07

AIR QUALITY

SUMMARY

This Advice Note gives guidance on the assessment of the impact that road projects may have on local regional air quality. It includes a calculation method to estimate local pollutant concentrations and regional emissions for air including those for carbon. Where appropriate, this advice may be applied to existing roads.

INSTRUCTIONS FOR USE

1. Remove Contents pages from Volume 11 and insert new Contents pages dated May 2007.

2. Remove the document entitled 'Air Quality' dated February 2003 from Volume 11, Section 3, Part 1 which is superseded by HA 207/07 and archive as appropriate.

3. Insert the new Advice Note HA 207/07 into Volume 11, Section 3.

4. Please archive this sheet as appropriate.

Note: A quarterly index with a full set of Volume Contents Pages is available separately from The Stationery Office Ltd.

May 2007

proposals. Affected roads are those that meet any of the following criteria:

- road alignment will change by 5 m or more; or
- daily traffic flows will change by 1,000 AADT or more; or
- Heavy Duty Vehicle (HDV) flows will change by 200 AADT or more; or
- daily average speed will change by 10 km/hr or more; or
- peak hour speed will change by 20 km/hr or more.

3.13 Identify on an appropriate map (typically 1:25,000 or 1:10,000 scale) all existing and planned properties where people might experience a change in local air quality, near the affected roads. Particular attention should be paid to the locations of the young, the elderly and other susceptible populations, such as schools and hospitals. In addition, areas likely to experience higher-than-average pollution concentrations, such as tunnel portals, roundabouts and junctions, should be identified. Also identify any nature conservation sites (Designated Sites) and their characteristics. The Designated Sites that should be considered for this assessment are those for which the designated features are sensitive to air pollutants, either directly or indirectly, and which could be adversely

actual Air Quality Strategy objective exceedence area is within the AQMA and whether the EU limit values are likely to be met at relevant properties in the relevant year. Identify areas where it is likely that air quality will improve or deteriorate as a result of changes to traffic flows and traffic speed, or as a result of reduced congestion or queuing times, due to the proposals.

3.16 The judgement of someone with relevant air quality expertise should be used to identify possible locations alongside affected roads and new roads where there may be exceedences of the Air Quality Strategy objectives or limit values. If such locations are identified then undertake a few calculations for the pollutants of concern using the 'Local' application of the DMRB Air Quality Screening Method spreadsheet for the 'worst' affected properties and identify the extent of mitigation required. The instructions for using the spreadsheet are provided in Annex D. The worst affected properties are those that are likely to have the highest pollution concentrations or the largest increases in pollution due to the proposals. The aim of this screening assessment is to quickly identify impacts on a small sample of properties early in the assessment, so that any potential problems are identified. If the proposals are likely to cause a new exceedence of a limit value or a worsening of an expected exceedence, check the calculations and assumptions made and liaise with the Project Team and Overseeing Organisation immediately.

3.17 Determine whether there is sufficient monitoring

A10 Extract from IAQM Guidance

A10.1 The IAQM has published guidance on describing impacts at individual receptors as set out in Table 6.3 below (available at: http://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf).

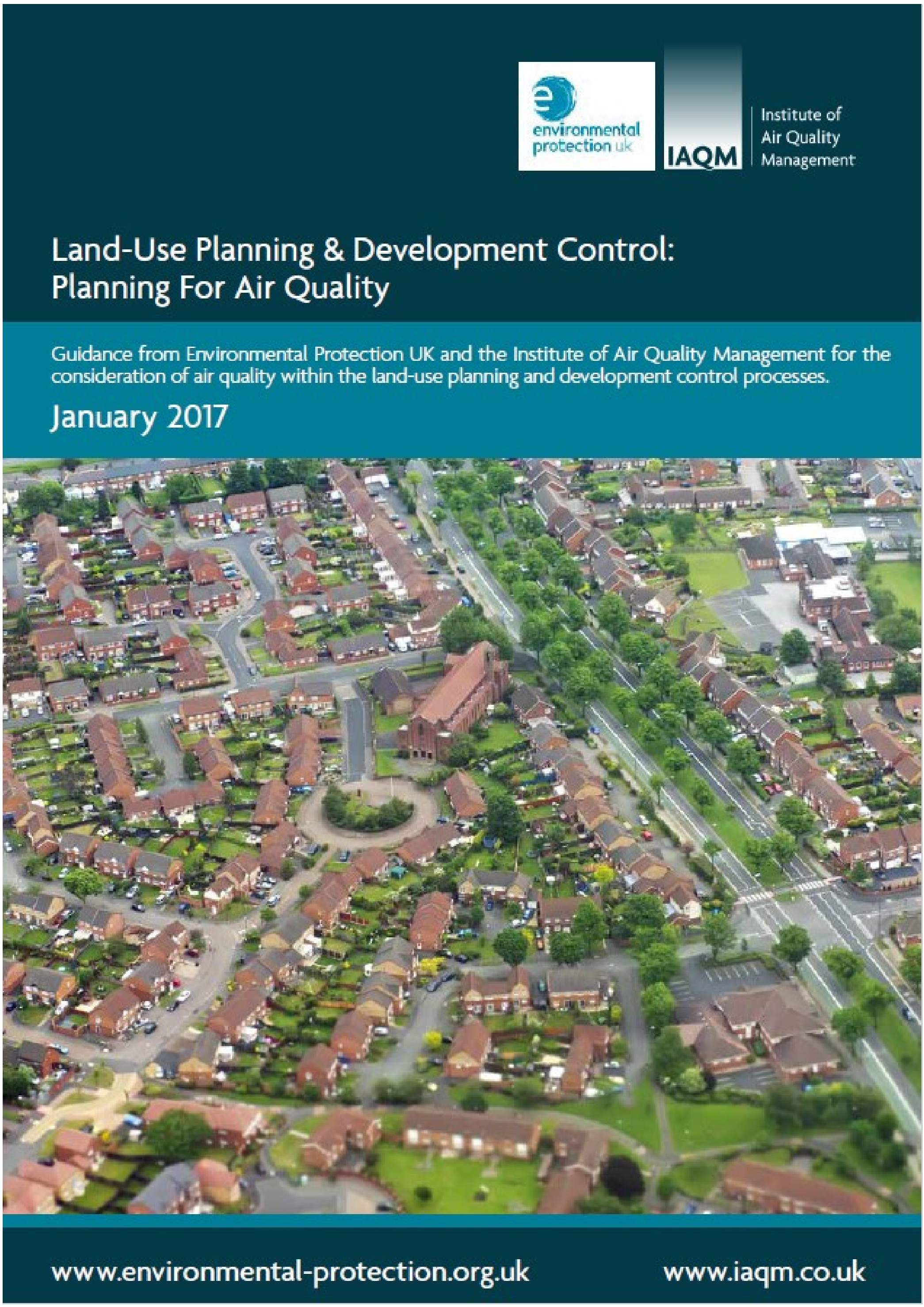

Table 6.3: Impact descriptors for individual receptors.

Long term average Concentration at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

Explanation

1. AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency 'Environmental Assessment Level (EAL)'.
2. The Table is intended to be used by rounding the change in percentage pollutant concentration to whole numbers, which then makes it clearer which cell the impact falls within. The user is encouraged to treat the numbers with recognition of their likely accuracy and not assume a false level of precision. Changes of 0%, i.e. less than 0.5%, will be described as Negligible.
3. The Table is only designed to be used with annual mean concentrations.
4. Descriptors for individual receptors only; the overall significance is determined using professional judgement (see Chapter 7). For example, a 'moderate' adverse impact at one receptor may not mean that the overall impact has a significant effect. Other factors need to be considered.
5. When defining the concentration as a percentage of the AQAL, use the 'without scheme' concentration where there is a decrease in pollutant concentration and the 'with scheme;' concentration for an increase.
6. The total concentration categories reflect the degree of potential harm by reference to the AQAL value. At exposure less than 75% of this value, i.e. well below, the degree of harm is likely to be small. As the exposure approaches and exceeds the AQAL, the degree of harm increases. This change naturally becomes more important when the result is an exposure that is approximately equal to, or greater than the AQAL.
7. It is unwise to ascribe too much accuracy to incremental changes or background concentrations, and this is especially important when total concentrations are close to the AQAL. For a given year in the future, it is impossible to define the new total concentration without recognising the inherent uncertainty, which is why there is a category that has a range around the AQAL, rather than being exactly equal to it.

A11 Extract from Inspectors' Report for M4 Smart Motorway DCO

A11.1 The Inspectors' report on the M4 Smart Motorway DCO includes a section commenting on the limitations of IAN 174/13 as set out in paragraphs 5.7.67 to 5.7.70 below (available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR010019/TR010019-003497-Examining%20Authority%20Report%20and%20Recommendation%20to%20the%20Secretary%20of%20State%20for%20Transport).

The Planning Inspectorate
Yr Arolygiaeth Gynllunio

The Planning Act 2008

M4 Junctions 3 to 12 Smart Motorway

Examining Authority's Report of Findings and Conclusions

and

Recommendation to the
Secretary of State for Transport

Examining Authority

Wendy Burden
Lorna Walker
Dr Mike Ebert

3 June 2016

An element of uncertainty remains in relation to the figures to be used for Euro 6/VI emissions in the Applicant's air quality assessment.

Significance of the effect of the proposed development within the AQMAs

5.7.67 The Applicant's definition of significance is based on the advice in IAN174/13 where imperceptible is defined as less than or equal to 1% of the objective. A change in the concentration of NO_2 of less than 0.4µg/m^3 is considered so small as to be considered imperceptible against a target of 40µg/m^3. The Applicant's case rests on the proposition that a change that is imperceptible, given normal bounds of variation, would not be capable of having a direct effect on air quality that could be considered to be significant [APP-146].

5.7.68 The advice in IAN 174/13 is considered by LBHill to be out of date in its approach to levels of significance. Guidance on describing significance of impacts has been updated in recent Environmental Protection UK (EPUK)/ Institute of Air Quality Management (IAQM) guidance. This effectively halves the criterion used to describe impacts as negligible from the previous 0.4µg/m^3 to 0.2µg/m^3 [REP4-039] and therefore dictates a more precautionary approach to the assessment of significance.

5.7.69 Although IAQM guidance is not intended to replace the more formal guidance of HE in its advice notes, the new guidance does represent the views of the organisation (IAQM) that represents air quality professionals. LBHill points out that it should also be noted that the views of the IAQM informed the HE guidance in IAN 174/13 on page 15 under the heading *Imperceptible* [REP4-039].

5.7.70 Since there are indications that expert views on the definition of significance are changing, we consider that there is some question as to the weight which should be attributed to the advice in IAN 174/13 regarding levels of significance. That in turn calls into question the interpretation of the Applicant's air quality assessment in relation to the effect within the AQMAs where NO_2 levels would be above the objective value.

5.7.71 The Hillingdon AQMA includes the whole of the area through which the M4 passes within the borough. There are residential communities and a school within close proximity of the motorway. LBHill states that the current air quality monitoring in these areas indicates levels far in excess of the air quality objectives [REP4-039], and it is accepted by the Applicant that the motorway is the local source of the higher concentrations experienced at the London Hillingdon Automatic Urban and Rural Network (AURN) site [REP3-017.1]. Monitoring data at the AURN site shows no trend up or down over the last 7 years [REP7-025].

5.7.72 As the Hillingdon AQMA encompasses a wider area than just the M4 corridor, LBHill accepts that the proposed development would not