Air Quality CONSULTANTS

Review:
Air Quality Assessment of M4 Smart Motorway in Hillingdon

September 2015

Experts in air quality management & assessment

Document Control

Client	London Borough of Hillingdon	**Principal Contact**	Val Beale

Job Number	J2378

Report Prepared By:	Prof. Duncan Laxen

Document Status and Review Schedule

Report No.	Date	Status	Reviewed by
J2378/1/F1	30 September 2015	Final	Dr Ben Marner (Technical Director)

Air Quality Consultants Ltd
23 Coldharbour Road, Bristol BS6 7JT Tel: 0117 974 1086
12 Airedale Road, London SW12 8SF Tel: 0208 673 4313
aqc@aqconsultants.co.uk

Registered Office: 12 St Oswalds Road, Bristol, BS6 7HT
Companies House Registration No: 2814570

Contents

1 Introduction 2
2 Review 2
3 Observations 5
4 Recommendation 7
5 References 7
6 Appendices 8
A1 Consultants' Experience 8

Figures

Figure 1: Extract from Figure 6.14e of the ES, Showing Correct Location of Monitoring Site HD31. 4
Figure 2: Monthly-Mean Nitrogen Dioxide Concentrations (µg/m^3) at the London Hillingdon AURN site over Fifteen Years from 2000 to 2014, with Fitted Smooth Trend Line, and the Modelled 2013 and 2022 Concentration at receptor B877. 6
Figure 3: Modelled Nitrogen Dioxide Concentration at Receptor B877. Lower Line links 2013 and 2022 Values Presented in the ES. Upper Line Adjusted to Match Measured 2013 Value at the 'London Hillingdon' Monitoring Site 6

1 Introduction

1.1 Air Quality Consultants Ltd has been commissioned by the London Borough of Hillingdon to review the air quality assessment prepared by Highways England (HE) to support the proposed M4 smart motorway scheme.

1.2 The review has covered Chapter 6 of the Environmental Statement (ES) and associated Appendices focussing on the results for Junctions 3 to 4b. In particular, the following documents have been considered:

6-1-ES-Chapters_06-Air-Quality.pdf

6-2-ES-Figures_06-Air-Quality_Sht15.pdf

6-2-ES-Figures_06-Air-Quality_Sht14.pdf

6-3-ES-Appendices_06-6-Results-for-all-receptors.pdf

1.3 The experience of the consultants carrying out this review is summarised in Appendix A1.

2 Review

Methodology

2.1 The assessment follows the methodology established by HE as set out in the Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3 and supporting documents including: IAN 174/13, which is used to assess significance and IAN 170/12, which addresses the uncertainty over emissions of new vehicles entering the fleet, which have not been reducing as expected. The methodology is appropriate for a HE scheme. Since completion of the ES, IAN 185/15 has been issued. This provides a different way of calculating emissions based on speed bands rather than speed emission curves, and is designed, in part, to address the role of congestion on motorways. It is not clear what difference this approach would have made to the predicted concentrations.

2.2 The assessment is appropriately based on use of the ADMS-Roads model, using emissions from the Emission Factor Toolkit (EFT v6.0.1). This EFT has the latest 'official' emission factors for current and future years. Appropriate model verification has been carried out, and the adjustment factors seem reasonable.

2.3 Chapter 6 of the ES makes clear in paragraphs 6.2.57-6.2.60 that the Gap Analysis approach set out in IAN 170/12 has been used to address the evidence that the emissions of new vehicles entering the fleet have not been reducing as expected. Use has been made of the Long Term Gap Analysis Calculator v1.1 (INTERIM HA Long Term Gap Analysis Calculator v1.1(LTTE6).xls) that accompanies the guidance, which is only available by direct request from Highways England (the

published version on the Highways England website (http://www.standardsforhighways.co.uk/ians/) is v1.0). The Gap Analysis Calculator provides adjusted long-term trend (LTT) results. Results for the LTT profile are included in Appendix 6.6 of the ES (6-3-ES-Appendices_06-6-Results-for-all-receptors.pdf). They are only slightly above the results of the base case analysis presented in the ES. This is because the majority of the vehicles in 2022 are assumed to be Euro VI or Euro 6 compliant[1], and both scenarios use the same emission factors for these vehicles.

Monitoring Data

2.4 Tables 6.12 and 6.13 in the ES provide the annual mean nitrogen dioxide concentrations for monitoring sites in Hillingdon. For some unknown reason, the ES omits the results of the 'London Hillingdon' automatic monitor located on Sipson Road, around 30 m from the edge of the M4 motorway. This site is operated by Defra and is part of the Automatic Urban and Rural Network (AURN). It is operated to a high standard of quality assurance that meets the requirements of the European Union (Directive 2008/50/EC of the European Parliament and of the Council, 2008). This is one of the monitoring sites used by Defra to report compliance (or lack of compliance) with the EU Limit Value for nitrogen dioxide.

2.5 While the ES has omitted the result for the AURN site, it has reported the less reliable result for the triplicate diffusion tube site HD31a-c, which is co-located with the automatic monitor. It has used the diffusion tube result for HD31 in the verification, but not the automatic monitor result. The verification should have been based on the result for the automatic monitor, not that for the diffusion tubes.

2.6 This omission of the result for the AURN monitor is very significant. The 2013 result for the diffusion tube site HD31 is anomalously low, with a 2013 annual mean concentration of 43.0 $\mu g/m^3$. The value for the AURN automatic monitoring station with which site HD31 is co-located in 2013 was 52.8 $\mu g/m^3$. The anomalous nature of the diffusion tube result is also evident when account is take of the result for two other nearby diffusion tube sites that are further from the M4, 029-031 URS (a triplicate site) and MO65, with 47.4 $\mu g/m^3$ and 50.7 $\mu g/m^3$ respectively.

2.7 The location of HD31 is shown in Figure 6.14e in the ES, and is reproduced in Figure 1 of this review. This has been incorrectly located closer to the M4 than it actually is. This would suggest that the modelled concentration at the location shown in Figure 16.14e would be higher than the modelled value at the actual monitoring location. This will have reduced the model verification factor and thus underestimated modelled concentrations.

[1] Euro VI refers to heavy duty vehicles, while Euro 6 refers to light duty vehicles. The timings for meeting the standards vary with vehicle type and whether the vehicle is a new model or existing model.

Model Verification

2.8 Details of the model verification are lacking. The monitoring data used in the model verification are set out in Table 6.4.3 of the ES. Results are presented for monitoring in a variety of years from 2009 to 2013. It is not made clear whether the results for 2009 to 2012 have been treated as applying in 2013, or whether some adjustment has been made. The approach of using multiple monitoring years is very unusual and may have significantly affected the results of the model verification, depending on exactly what has been done.

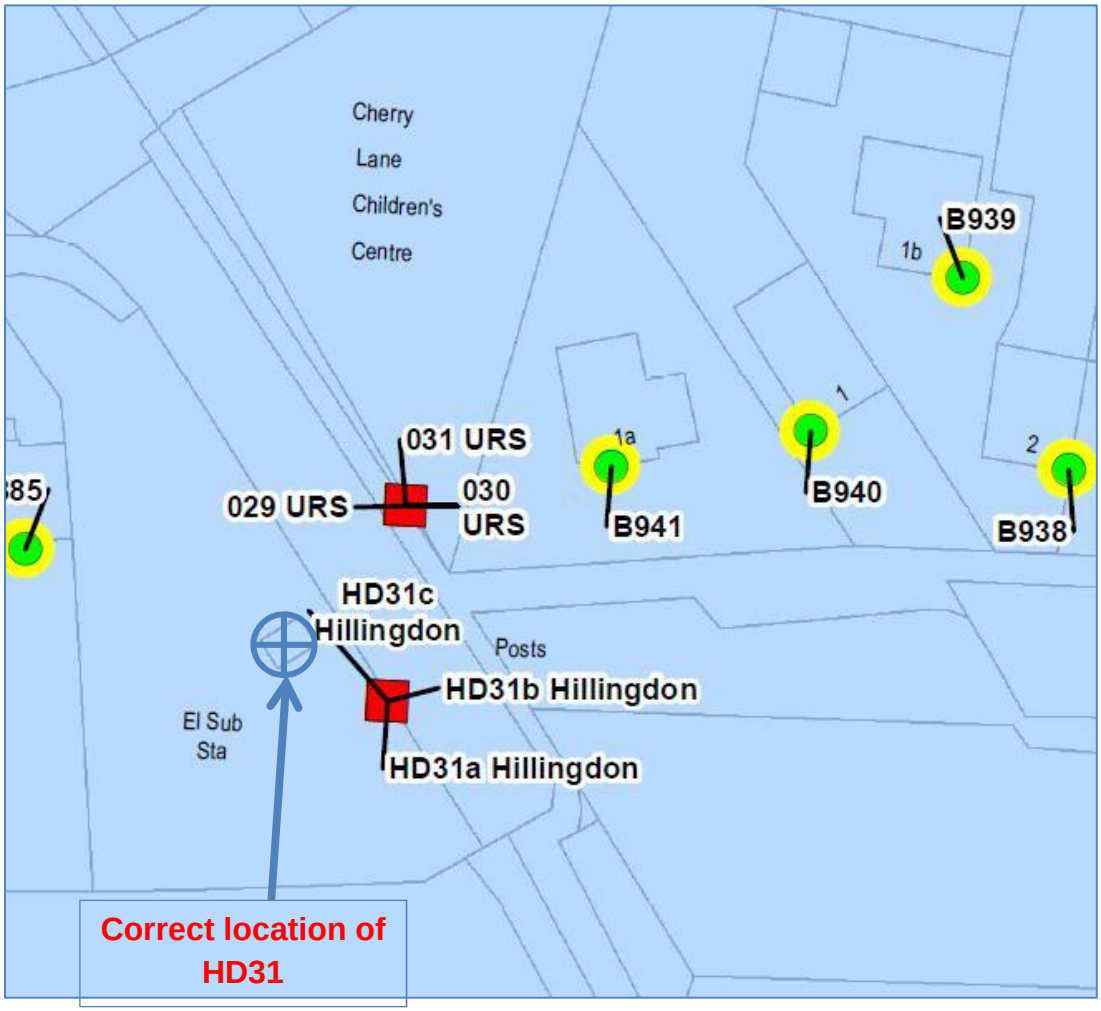

Figure 1: Extract from Figure 6.14e of the ES, Showing Correct Location of Monitoring Site HD31.

3 Observations

Trend and Projection

3.1 The assessment has shown numerous locations within Hillingdon where there will be small adverse changes in annual mean concentrations of nitrogen dioxide based on the HA definitions in IAN 174/13. These are treated as being of negligible significance because it is predicted that concentrations will all be below 40 μg/m^3 by 2022. The ES has followed the current Highways England guidance in IAN 170/12 to allow for the fact that emissions have not been reducing as expected from new vehicles entering the fleet. However, the current spreadsheet tool that accompanies the guidance (v1.1) assumes that Euro VI and Euro 6 vehicles will deliver the same substantial reductions as is assumed in the base-case scenario. Since both the LTT and the base-case scenarios assume these same reductions, there little difference between the predicted results.

3.2 Figure 2 presents the measured monthly-mean nitrogen dioxide concentrations for the London Hillingdon AURN site over the 15 year period 2000-2014, with a smooth trend line fitted to the results using openair software. Also shown are the 2013 and 2022 modelled concentrations for receptor B877, which is nearby and a similar distance from the motorway, and therefore representative of the monitoring site. Two values for 2022 are presented, one for the base case (blue), the other for the LTT scenario (red). The following are important features revealed by Figure 2:

- The modelled concentration that most closely represents the monitoring site is well below the measured value in 2013. The model is therefore underestimating the concentration that is currently reported by Defra to the European Commission to discharge the UK's obligation under the EU Directive.
- The concentrations at the London Hillingdon AURN site have increased significantly over the last 10 years (significance tested with a Theil-Sen analysis using the openair software), and this trend has continued into 2014.
- The ES projects a significant reduction in the annual mean nitrogen dioxide concentration by 2022 (for either scenario). It is clear that a steep drop would be required from 2014 to reach the value presented for 2022. The plausibility of this is entirely dependent on Euro VI and Euro 6 vehicles delivering the emission reductions currently projected. The trend that has been evident at the London Hillingdon monitoring site must cast some doubt on this.
- If the result for receptor B877, that is representative of the monitoring site, were simply adjusted upwards by the same amount in both 2013 and 2022 to match the measured concentration in 2013 then the value at the monitoring site would be above the objective and above the limit value (the limit value directly applies at this site, as it is a Defra monitoring site that meets the requirements to report results to the EU) (see Figure 3).

3.3 The analysis presented above shows that there is a significant risk that the objective and limit value will be exceeded in 2022 at locations near to the M4. The ES shows that the scheme will worsen air quality at these locations.

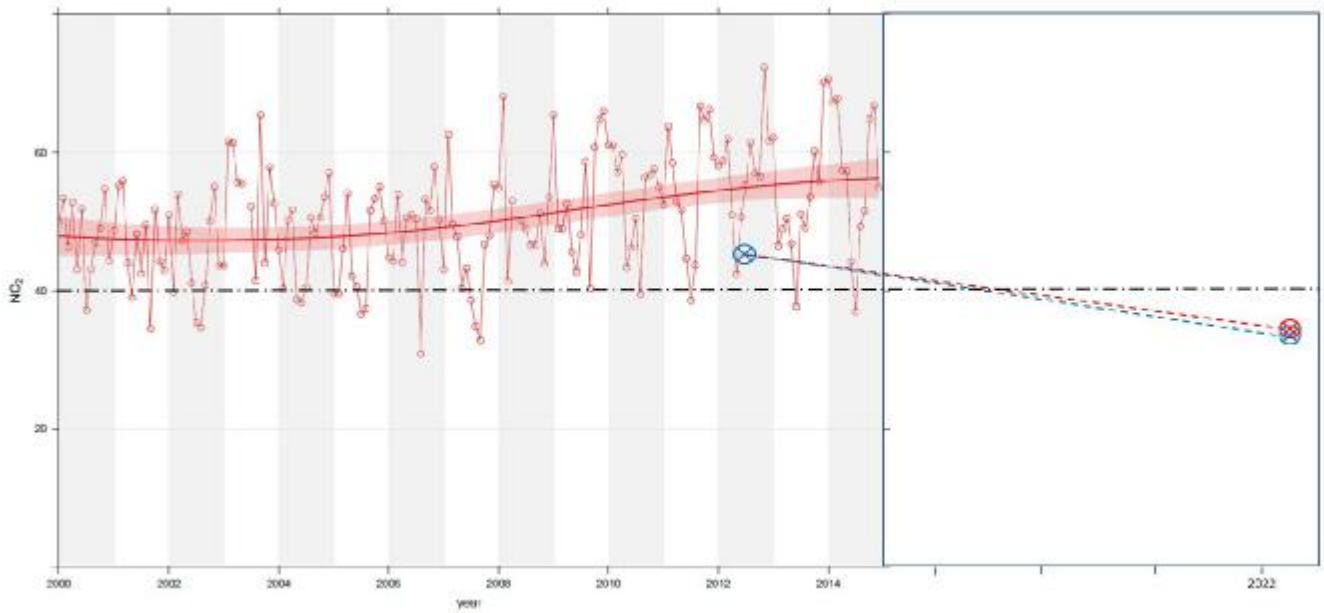

Figure 2: Monthly-Mean Nitrogen Dioxide Concentrations (mg/m^3) at the London Hillingdon AURN site over Fifteen Years from 2000 to 2014, with Fitted Smooth Trend Line, and the Modelled 2013 and 2022 Concentration at receptor B877.

The shaded area around the trend line shows the 95% confidence limits of the trend line. The modelled projections from 2013 to 2022 are shown as a blue dashed line for the base-case scenario and as a red dashed line is for the LTT scenario.

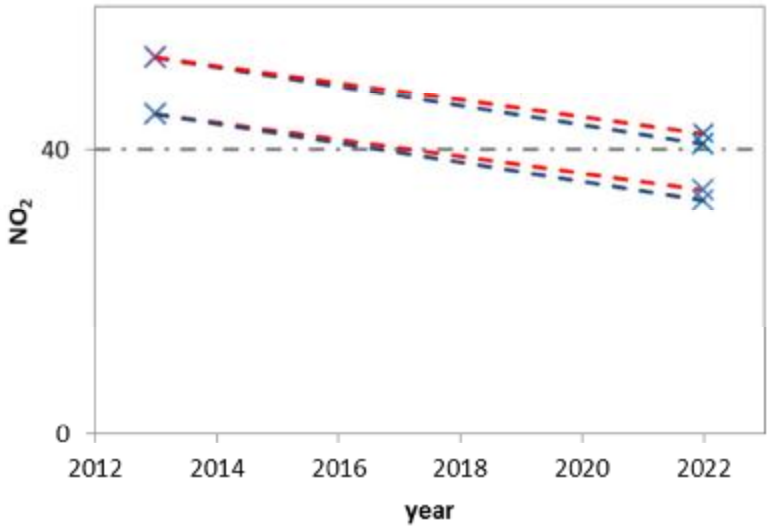

Figure 3: Modelled Nitrogen Dioxide Concentration at Receptor B877. Lower Line links 2013 and 2022 Values Presented in the ES. Upper Line Adjusted to Match Measured 2013 Value at the 'London Hillingdon' Monitoring Site

4 Recommendation

4.1 As set out above, there must be some considerable uncertainty over future concentrations of nitrogen dioxide to which residents living near to the M4 motorway in Hillingdon will be exposed. It is possible that concentrations will remain above the objective and limit value in 2022, and the M4 Smart Motorway scheme will worsen the exceedences. If this happens then it would be appropriate to consider mitigation to protect the residents from worsening air quality.

4.2 It is therefore appropriate that, if the M4 Smart Motorway scheme proceeds, concentrations of nitrogen dioxide should be monitored using automatic monitors operated to EU standards at locations along the M4 between junctions 3 and 4b. For each of the sites the current model should be used to project the year by year concentrations for the monitoring site. If it becomes clear (probably after a minimum of two full years) that measured concentrations are not declining as projected by the model then appropriate mitigation should be instituted.

4.3 It is assumed that one of the automatic monitoring stations will be the London Hillingdon AURN site. It is thus important to confirm that this site will not be affected by any of the construction works. It is recommended that two other sites be established, to start operating from 1 January 2016. The locations should be agreed with the London Borough of Hillingdon.

5 References

Directive 2008/50/EC of the European Parliament and of the Council (2008).

6 Appendices

A1 Consultants' Experience

Prof. Duncan Laxen, BSc (Hons) MSc PhD MIEnvSc FIAQM

A1.1 Prof Laxen is the Managing Director of Air Quality Consultants, a company which he founded in 1993. He has over forty years' experience in environmental sciences and has been a member of Defra's Air Quality Expert Group and the Department of Health's Committee on the Medical Effects of Air Pollution. He has been involved in major studies of air quality, including nitrogen dioxide, lead, dust, acid rain, PM_{10}, $PM_{2.5}$ and ozone and was responsible for setting up the UK's urban air quality monitoring network. Prof Laxen has been responsible for appraisals of all local authorities' air quality Review & Assessment reports and for providing guidance and support to local authorities carrying out their local air quality management duties. He has carried out air quality assessments for power stations; road schemes; ports; airports; railways; mineral and landfill sites; and residential/commercial developments. He has also been involved in numerous investigations into industrial emissions; ambient air quality; indoor air quality; nuisance dust and transport emissions. Prof Laxen has prepared specialist reviews on air quality topics and contributed to the development of air quality management in the UK. He has been an expert witness at numerous Public Inquiries, published over 70 scientific papers and given numerous presentations at conferences. He is a Fellow of the Institute of Air Quality Management.

Dr Ben Marner, BSc (Hons) PhD CSci MIEnvSc MIAQM

A1.2 Dr Marner is a Technical Director with AQC, and has over fifteen years' experience in the field of air quality. He has been responsible for air quality and greenhouse gas assessments of road schemes, rail schemes, airports, power stations, waste incinerators, commercial developments and residential developments in the UK and abroad. He has been an expert witness at several public inquiries, where he has presented evidence on health-related air quality impacts, the impacts of air quality on sensitive ecosystems, and greenhouse gas impacts. He has extensive experience of using detailed dispersion models, as well as contributing to the development of modelling best practices. Dr Marner has arranged and overseen air quality monitoring surveys, as well as contributing to Defra guidance on harmonising monitoring methods. He has been responsible for air quality review and assessments on behalf of numerous local authorities. He has also developed methods to predict nitrogen deposition fluxes on behalf of the Environment Agency, provided support and advice to the UK Government's air quality review and assessment helpdesk, Transport Scotland, Transport for London, and numerous local authorities. He is a Member of the Institute of Air Quality Management and a Chartered Scientist.