Lichfield District Council

A38, Fradley

Detailed Assessment

November 2015

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Document Control Sheet

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Executive Summary

Part IV of the Environment Act 1995 places a statutory duty on local authorities to review and assess the air quality within their area. For local authorities that have identified areas where there is a potential risk of exceedence of Air Quality Strategy (AQS) objectives, a Detailed Assessment is required.

Following the assessment of monitoring results for the monitoring period 2012 to 2014 that indicate three sites have been close to or exceeding the annual mean AQS objective for nitrogen dioxide (NO_2), Bureau Veritas UK Ltd has been commissioned by Lichfield District Council to undertake a dispersion modelling Detailed Assessment of the area surrounding the A38 and extending from the A38/A5127 junction to the District north boundary (i.e. to the River Trent).

In order to provide consistency with the Council's own work on air quality, the guiding principles for air quality assessments, as set out in the latest guidance and tools provided by Defra for air quality assessment (LAQM.TG(09)[1]), have been used.

The area was modelled using the advanced atmospheric dispersion model ADMS-Roads (Version 3.4.2).

The model suggests the 40µg/m^3 annual mean AQS objective for NO_2 may be exceeded at six receptor locations, with one further location within 10% of the objective.

The maximum annual mean NO_2 concentration at an existing receptor was predicted at receptor '2' – A38 Rykneld Street near Croxhall Road, with a predicted annual mean NO_2 concentration of 52.5µg/m^3.

On the basis of the model predicted annual mean NO_2 concentrations and the published empirical relationship with exceedences of the short-term AQS objective limit, it is considered unlikely that the short-term hourly mean NO_2 AQS objective would be exceeded given the concentrations modelled.

Following the results of the report, the below recommendations are made:

- That an Air Quality Management Area (AQMA) be declared in the area, the extent of which is proposed in Figure 7;
- Further monitoring in the area is recommended. It is recommended that an additional site is installed at receptor '1' (the A38 Rykneld Street near Croxhall Road) and receptor '13' (near A5127/A39 junction) to confirm existing concentrations in the modelled exceedence area;
- An Air Quality Action Plan is drawn up to determine the best policies and intervention measures to put in place in order to reduce local NO_2 concentrations; and
- Further Assessment of the area is conducted post implementation of the AQMA as part of the next round of LAQM reporting.

[1] Local Air Quality Management Technical Guidance LAQM.TG(09). February 2009. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.

1 Introduction

1.1 Scope of Assessment

Lichfield District Council (The Council) is only moderately industrialized, but there are a number of major roads in the region, including the M6 Toll, A38 and A5. Consequently, road traffic is the main source of air pollution in the area. The Council has declared one Air Quality Management Area (AQMA) under the existing Local Air Quality Management (LAQM) regime in relation to exceedences of the nitrogen dioxide (NO_2) annual mean Air Quality Strategy (AQS) objective of 40µg/m^3: The Muckley Corner AQMA was declared in 2008 for the area encompassing the Muckley Corner Roundabout on the A5.

Following several years of NO_2 diffusion tube monitoring on the A38 Rykneld Street in Fradley, the Council have identified three locations which have been observed to be exceeding, or close to exceeding, the 40µg/m^3 AQS objective. The 2013 Progress Report confirmed the exceedence of annual mean NO_2 objective at Fradley and recommended that the Council proceed to a Detailed Assessment for this area. A Detailed Assessment based upon monitoring data undertaken in the 2014 Progress Report recommended that the four properties in the vicinity of this tube on the A38 (Rykneld Street) be declared as an AQMA. Subsequently, the appraisal of the 2014 Progress Report further recommended that the Council should investigate whether there were other receptors situated at a similar distance to the road along the A38 further away from the original study area. Therefore, the Council has proceeded to a dispersion modelling Detailed Assessment of the area surrounding the A38 London Road in Fradley.

Bureau Veritas UK Ltd has been commissioned by Lichfield District Council to undertake the Detailed Assessment of the area surrounding the A38 and extending from the A38/A5127 junction to the District north boundary (i.e. to the River Trent). The area considered as part of this study is illustrated in Figure 1.

It is the general purpose and intent of this assessment to determine, with reasonable certainty, the magnitude and geographical extent of any exceedence so that the Council can have confidence in the potential declaration of an AQMA.

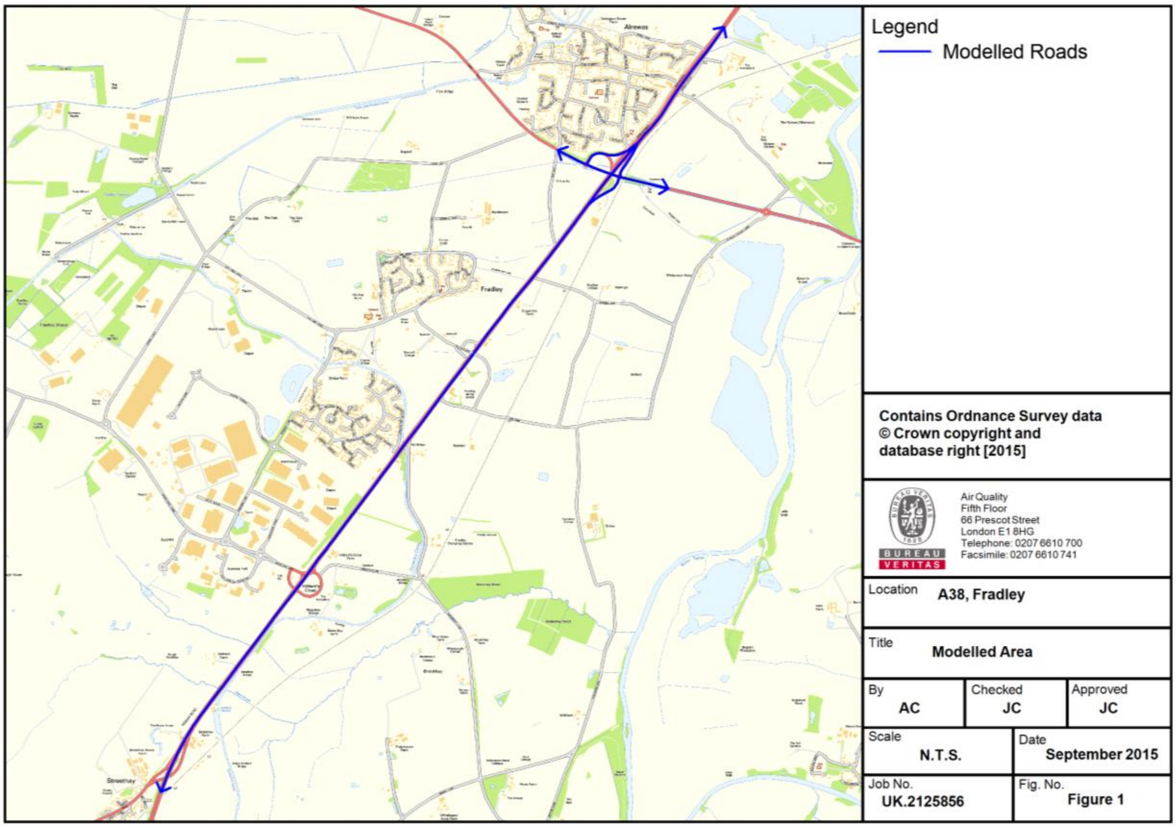
The following are the main objectives of the assessment:

- To assess the air quality at selected locations ("receptors") at the façades of the existing residential units, representative of worst-case exposure, based on modelling of emissions from road traffic on the local road network for 2014;
- To determine the geographical extent of the potential exceedence;
- To attempt to quantify the number of residents exposed to exceedences of the NO_2 annual mean AQS objective; and
- To put forward conclusions and recommendations as to the extent of any proposed AQMA and necessary future monitoring.

The approach adopted in this assessment to assess the impact of road traffic emissions on air quality utilised the atmospheric dispersion model ADMS Roads version 3.4.2, focusing on emissions of NO_2.

In order to provide consistency with the Council's own work on air quality, the guiding principles for air quality assessments as set out in the latest guidance and tools provided by Defra for air quality assessment (LAQM.TG(09)[2]) have been used.

Figure 1 – Modelled Area



[2] Local Air Quality Management Technical Guidance LAQM.TG(09). February 2009. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.

2 Air Quality – Legislative Context

2.1 Air Quality Strategy

The importance of existing and future pollutant concentrations can be assessed in relation to the national air quality standards and objectives established by Government. The Air Quality Strategy[3] (AQS) provides the over-arching strategic framework for air quality management in the UK and contains national air quality standards and objectives established by the UK Government and Devolved Administrations to protect human health. The air quality objectives incorporated in the AQS and the UK Legislation are derived from Limit Values prescribed in the EU Directives transposed into national legislation by Member States.

The CAFE (Clean Air for Europe) programme was initiated in the late 1990s to draw together previous directives into a single EU Directive on air quality. The CAFE Directive[4] has been adopted and replaces all previous air quality Directives, except the 4th Daughter Directive[5]. The Directive introduces new obligatory standards for $PM_{2.5}$ for Government but places no statutory duty on local government to work towards achievement of these standards.

The Air Quality Standards (England) Regulations[6] 2010 came into force on 11 June 2010 in order to align and bring together in one statutory instrument the Government's obligations to fulfil the requirements of the new CAFE Directive.

The objectives for ten pollutants – benzene (C_6H_6), 1,3-butadiene (C_4H_6), carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), particulate matter - PM_{10} and $PM_{2.5}$, ozone (O_3) and Polycyclic Aromatic Hydrocarbons (PAHs), have been prescribed within the AQS[3].

The EU Limit Values are considered to apply everywhere with the exception of the carriageway and central reservation of roads and any location where the public do not have access (e.g. industrial sites). The AQS objectives apply at locations outside buildings or other natural or man-made structures above or below ground, where members of the public are regularly present and might reasonably be expected to be exposed to pollutant concentrations over the relevant averaging period. Typically these include residential properties and schools/care homes for long-term (i.e. annual mean) pollutant objectives and high streets for short-term (i.e. 1-hour) pollutant objectives.

This assessment focuses on NO_2 as this is the pollutant of most concern within the Council's administrative area. The monitoring concentrations on the A2 (London Road) near the junction with Lynsted Lane have been shown to exceed the annual mean objective for NO_2 or be very close to exceedence in recent years. Moreover, as a result of traffic pollution the UK has failed to meet the EU Limit Values for this pollutant by the 2010 target date. As a result, the Government has had to submit time extension applications for compliance with the EU Limit Values. Continued failure to achieve these limits may lead to EU fines. The AQS objectives for these pollutants are presented in Table 1.

[3] Defra (2007) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland.

[4] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe.

[5] Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic hydrocarbons in ambient air.

[6] The Air Quality Standards Regulations (England) 2010, Statutory Instrument No 1001, The Stationary Office Limited.

Table 1 – Relevant AQS Objectives for the Assessed Pollutants in England

Pollutant	AQS Objective	Concentration Measured as:	Date for Achievement
Nitrogen dioxide (NO_2)	200 µg/m³ not to be exceeded more than 18 times per year	1-hour mean	31 December 2005
	40 µg/m³	Annual mean	31 December 2005

2.2 Local Air Quality Management (LAQM)

Part IV of the Environment Act 1995 places a statutory duty on local authorities to periodically Review and Assess the current and future air quality within their area, and determine whether they are likely to meet the AQS objectives set down by Government for a number of pollutants – a process known a Local Air Quality Management (LAQM). The AQS objectives that apply to LAQM are defined for seven pollutants: benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide, sulphur dioxide and particulate matter.

Where the results of the Review and Assessment process highlight that problems in the attainment of health-based objectives for air quality will arise, the authority is required to declare an Air Quality Management Area (AQMA) – a geographic area defined by high concentrations of pollution and exceedences of health-based standards.

Where an authority has declared an AQMA, and development is proposed to take place either within or near the declared area, further deterioration to air quality resulting from a proposed development can be a potential barrier to gaining consent for the development proposal. Similarly, where a development would lead to an increase of the population within an AQMA, the protection of residents against the adverse long-term impacts of exposure to existing poor air quality can provide the barrier to consent. As such, following an increased number of declarations across the UK, it has become standard practice for planning authorities to require an air quality assessment to be carried out for a proposed development (even where the size and nature of the development indicates that a formal Environmental Impact Assessment (EIA) is not required).

One of the objectives of the LAQM regime is for local authorities to enhance integration of air quality into the planning process. Current LAQM Policy Guidance[7] clearly recognises land-use planning as having a significant role in terms of reducing population exposure to elevated pollutant concentrations. Generally, the decisions made on land-use allocation can play a major role in improving the health of the population, particularly at sensitive locations – such as schools, hospitals and dense residential areas.

3 Review and Assessment of Air Quality Undertaken by the Council

3.1 Local Air Quality Management

The Council completed the first Updating and Screening Assessment in 2003 and concluded that a Detailed Assessment was required for nitrogen dioxide (NO_2), due to the likelihood of exceedences of the objectives at locations near to the A5 and A38.

The Detailed Assessment predicted that the annual mean NO_2 objective was likely to be exceeded at several properties near to the A5 and at one residence alongside the A38. However, model verification (and hence the conclusions of the study) were based on a short period of continuous monitoring data in the identified areas, prior to the opening of the M6 Toll road. It was

[7] LAQM Policy Guidance LAQM.PG(09) - February 2009. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.

recommended that further monitoring should be carried out before making a decision on whether to declare any AQMAs.

Following the collection of further monitoring data another Detailed Assessment was produced. This assessment predicted exceedences of the annual mean NO_2 objective at the ground floor of the Muckley Corner Hotel, but future projections indicated that the objective would be met by 2010. As a result it was concluded that the Council should not declare an AQMA for NO_2. However, it was decided that further diffusion tube monitoring should be carried out in the area.

In 2006 the Council entered the Third Round of Review and Assessment and produced the 2006 Updating and Screening Assessment. This included the results of additional monitoring. Further exceedences of the annual mean NO_2 objective were recorded at Muckley Corner, indicating the need for a further Detailed Assessment for NO_2 in this area.

The Detailed Assessment concluded that the annual mean NO_2 objective was likely to be exceeded at several properties surrounding the Muckley Corner roundabout and that an AQMA should be declared covering this area. The Muckley Corner AQMA was declared in August 2008 for the area encompassing the Muckley Corner Roundabout on the A5 along with a number of surrounding buildings. Modelling results for PM_{10} indicated that the air quality objectives were likely to be achieved for this pollutant and no further action was necessary.

Updated diffusion tube monitoring data presented in the 2009 Updating and Screening Assessment indicated that the annual mean NO_2 objective continued to be exceeded at Muckley Corner. The report also indicated the potential for exceedences at residential properties alongside the A38 at Canwell and therefore recommended a Detailed Assessment for NO_2 should be carried out.

In the 2010 Detailed Assessment, one exceedence of the annual mean NO_2 objective was predicted at a residential receptor near to the A38 at Canwell (2 Weeford Park Cottages) in 2009. The modelled results for 2010 predicted that the objective would be met at all receptors. Additionally, the report highlighted that this section of the A38 would be subject to road works over the summer of 2010, which would include a 30 mph speed limit. Staffordshire County Council's plan was to introduce a number of safety measures for the A38 between Weeford Island and Bassett's Pole, including a reduced 60 mph speed limit which would be enforced by average speed cameras.

The 2010 diffusion tube dataset, reported in the 2011 Progress Report showed that 14 diffusion tube sites exceeded the NO_2 annual mean objective. Of these exceedences, four were shown to meet the NO_2 annual mean objective once a facade adjustment was calculated and six were within the boundary of the existing AQMA. Of the remaining exceedences, three are just outside the existing Muckley Corner AQMA. The final exceedence at Fradley on the A38 was confirmed as exceeding the annual mean objective at relevant exposure. A Detailed Assessment was not proposed at this time. However, to support future decision making, additional diffusion tube monitoring sites were set up.

The 2012 Updating and Screening Assessment identified possible exceedences of the annual mean nitrogen dioxide objective near to the A38 at Weeford and Fradley. These were based on adjusted data and therefore further monitoring was proposed in these locations in order to collect further data. The results from this monitoring can then be used to ascertain the need for a Detailed Assessment.

The 2013 Progress Report confirmed the exceedence of annual mean NO_2 objective at Fradley and recommended that the Council proceed to a Detailed Assessment for this area. A Detailed Assessment based upon monitoring data undertaken in the 2013 recommended that the four properties in the vicinity of this tube on the A38 (Rykneld Street) be declared as an AQMA. Subsequently, the appraisal of the 2014 Progress Report further recommended that the Council should investigate whether there were other receptors situated at a similar distance to the road along the A38 further away from the original study area. Therefore, in this report, the Council has proceeded to a dispersion modelling Detailed Assessment of the area surrounding the A38 London Road in Fradley.

3.2 Review of Air Quality Monitoring

There are no permanent continuous monitoring locations in operation in the District and no automatic monitoring was carried out by the Council in 2014.

The Council maintains a network of twenty two NO_2 diffusion tube monitoring locations. Recent monitoring results for the sites in Fradley are shown in Table 2 and their locations illustrated in Figure 3.

The site A38-2A/B is located at the façade of a relevant receptor on Rykneld Street in Fradley, near the intersection with Fradley Lane. The annual mean concentrations of NO_2 at this site have exceeded the annual mean objective for NO_2 for all years since the site was added in 2011.

The site A38-2/2(1) located in an alley leading to Fradley Lane on a lamp post 20 m away from A38-2A/B has been close to but not exceeded the objective in any of the last three years. This site is surrounded by open space, which may account for lower results at this location due to better dispersal of air pollutants. It is also approximately 2m further from the main road than the site A38-2A/B, which may also contribute to lower results.

The site A38-1, situated on the A38 slip road onto the A513 has shown an exceedence of the objective in 2012 and was within the 10% of the objective in 2013 and 2014.

The recent monitoring data from the A38 shows concentrations close to or exceeding the annual mean objective for NO_2 and therefore supports the Council's decision to progress with a Detailed Assessment.

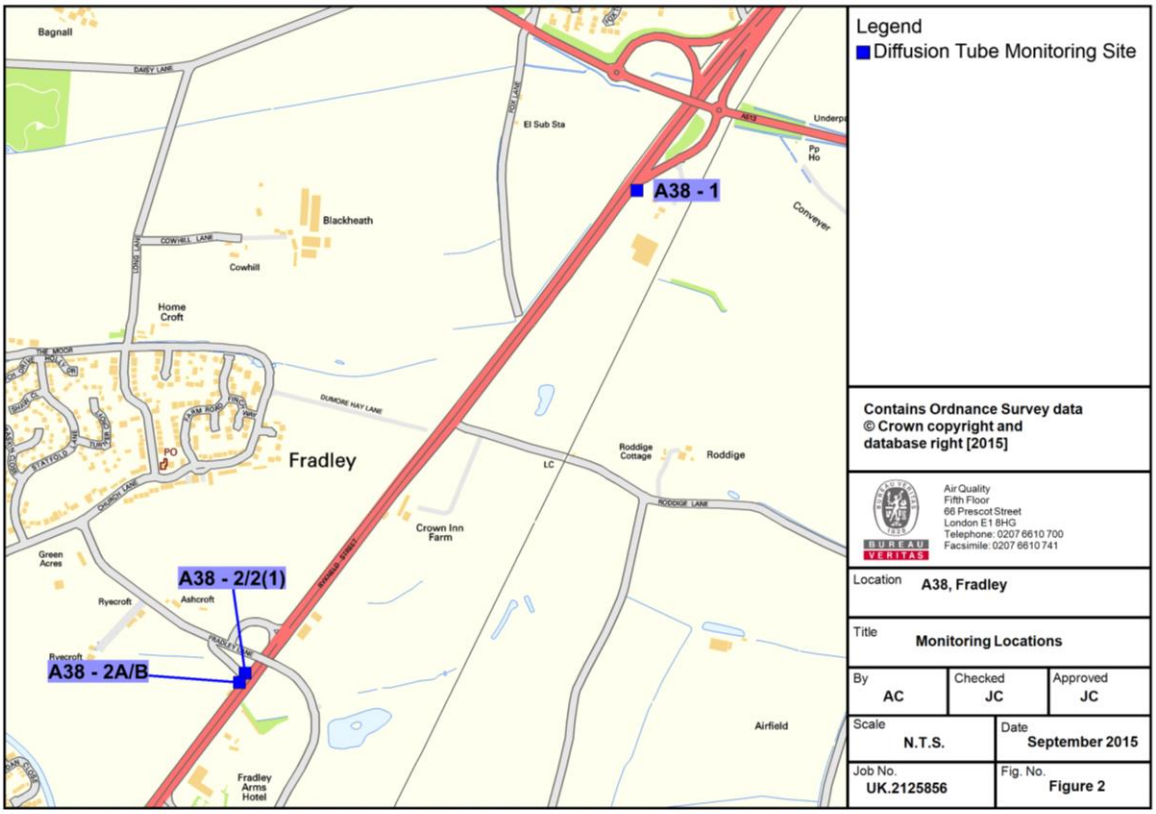
Table 2 – LAQM Diffusion Tube Monitoring undertaken for NO_2 in modelled area

Site ID	Site Location	Site Type	OS Grid Ref*	Distance to Road (m)	Annual Mean NO_2 Concentration ($\mu g/m^3$)		
					2012 (Bias Adjustment Factor = 0.86)	2013 (Bias Adjustment Factor = 0.87)	2014 (Bias Adjustment Factor = 0.83)
A38-1	Rykneld St near the A38 slip onto A513	Roadside	417095, 314170	1.0	**43.5**	38.1	37.1
A38 - 2/2(1)	Rykneld St near Fradley Ln, Fradley	Roadside	416301, 313192	7.0	37.4	35.1	35.9
A38-2A/B	Rykneld St near Fradley Ln, Fradley	Roadside	416289, 313174	5.0	**45.0**	**42.7**	**43.1**

In **bold**, exceedence of the NO_2 annual mean AQS objective of 40 $\mu g/m^3$

* Monitoring sites coordinates were taken from the maps and so are different to coordinates given in the Council's 2015 USA.

Figure 2 – Local Monitoring Locations



3.3 Background Concentrations used in the Assessment

Defra maintains a nationwide model of existing and future background air quality concentrations at a 1km grid square resolution. The data sets include annual average concentration estimates for NO_x, NO_2, PM_{10} and $PM_{2.5}$, using a base year of 2011. The model used is semi-empirical in nature; it uses the national atmospheric emissions inventory (NAEI) emissions to model-predict the concentrations of pollutants at the centroid of each 1km grid square, but then calibrates these concentrations in relation to actual monitoring data.

Annual mean background concentrations have been obtained from the Defra published background maps[8], based on the 1km grid squares which cover the modelled area and the affected road network. The Defra mapped background concentrations for 2014 are presented in Table 3.

[8] Defra Background Maps (2014). http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

Table 3 – Background Pollutant Concentrations (Defra Background Maps)

Grid Square (E,N)	2014 Annual Mean Concentration (µg/m^3)	
	NO_x	NO_2
417500, 314500	22.8	16.3
416500, 313500	22.4	16.0
415500, 312500	24.5	17.3
415500, 311500	24.7	17.5
414500, 311500	22.2	15.9
414500, 310500	25.7	18.1
AQS objective	-	*40*

These mapped background levels are below the respective annual mean AQS objectives.

The predicted annual mean road contributions are added to the relevant annual mean background concentration in order to predict the total pollutant concentration at each receptor location. The total pollutant concentration can then be compared against the relevant AQS objectives to determine the event of an exceedence.

4 Assessment Methodology

The approach used in this assessment has been based on the following:

- Prediction of ambient NO_2 concentrations, to which existing receptors may be exposed and comparison with the relevant AQS objectives.

- Determination of the geographical extent of any potential exceedence.

4.1 Traffic Assessment

Emissions from road traffic have been predicted using version 6.0.2 of the Emissions Factor Toolkit[9]. Road-NO_x contributions at receptor locations were modelled using the ADMS-Roads (Version 3.4.2) atmospheric dispersion model developed by Cambridge Environmental Research Consultants (CERC).

4.1.1 Model Inputs

The ADMS-Roads assessment incorporates numbers of road traffic vehicles, vehicle speeds on the local roads and the composition of the traffic fleet. The traffic data for this assessment has been collated from the Department for Transports (DfT), Traffic Counts web resource[10] and is outlined in Table 4.Traffic speed data was taken from the speed limits on the A38 in the modelling area. Where appropriate, the speeds have been reduced to simulate queues at junctions and traffic lights.

Table 4 – Traffic Data used in the Detailed Assessment

Link Name	2014 24hr AADT	% Car	%LGV	% Rigid HGV	% Artic HGV	% Bus /Coach	% Motorcycle	Speed (kph)	Road Width (m)	Road Height (m)
A38_1	52143	75.7	13.5	3.3	6.9	0.3	0.3	112.7	34	0
A38_2	52143	75.7	13.5	3.3	6.9	0.3	0.3	112.7	26	0
A38_3	52143	75.7	13.5	3.3	6.9	0.3	0.3	90.0	18	0
A38_4	54651	74.3	12.4	5.5	7.4	0.2	0.2	112.7	24	0
A38_5	54651	74.3	12.4	5.5	7.4	0.2	0.2	112.7	22	0
A38_6	54651	74.3	12.4	5.5	7.4	0.2	0.2	80.0	18	0
A38_7	54651	74.3	12.4	5.5	7.4	0.2	0.2	112.7	18	0
A38_8	54651	74.3	12.4	5.5	7.4	0.2	0.2	112.7	21	0
A38_9	54651	74.3	12.4	5.5	7.4	0.2	0.2	112.7	18	0
A38_10	54651	74.3	12.4	5.5	7.4	0.2	0.2	90.0	18	0
A38_11	54651	74.3	12.4	5.5	7.4	0.2	0.2	112.7	19	0
A38_12	54651	74.3	12.4	5.5	7.4	0.2	0.2	90.0	34	0
A513	6678	80.2	14.3	3.2	0.9	0.5	0.9	96.0	8	0
A513 slip onto A38	3339	80.2	14.3	3.2	0.9	0.5	0.9	60.0	6	0
A38 slip onto A513	3339	80.2	14.3	3.2	0.9	0.5	0.9	60.0	7	0

[9] EFT_v6.0.2 available at - http://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

[10] Department for Transport – Traffic Counts (2014) http://www.dft.gov.uk/traffic-counts/

The assessment has assumed traffic flows and background monitoring information for the year 2014.

Background pollutant concentrations have been taken from the estimated background concentrations compiled by Defra[8], as discussed previously in Section 3. Background concentrations used in the assessment of road traffic emissions are shown in Table 5.

Table 5 – 2014 Background Concentrations used in the Assessment of Road Traffic Emissions

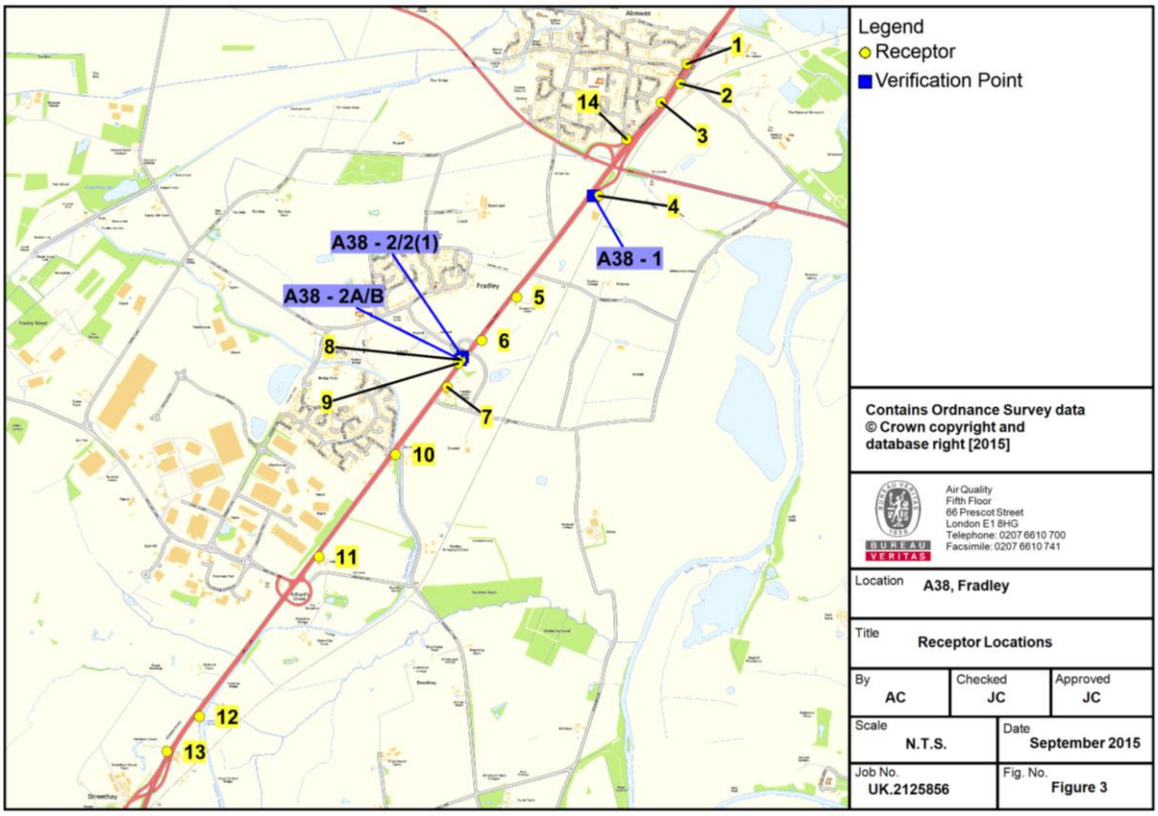
Grid Square (E,N)	2014 Annual Mean Concentration (µg/m^3)	
	NO_2	NO_x
417500, 314500	22.8	16.3
416500, 313500	22.4	16.0
415500, 312500	24.5	17.3
415500, 311500	24.7	17.5
414500, 311500	22.2	15.9
414500, 310500	25.7	18.1

The receptors considered in the assessment of emissions from road traffic are shown in Table 6, and their location illustrated in Figure 3. Concentrations were also modelled across a regular gridded area of 56x52m. Furthermore, additional receptor points were added close to the modelled road links, using the intelligent gridding tool in ADMS Roads.

Table 6 – Receptor Locations considered in the Assessment of Emissions from Road Traffic

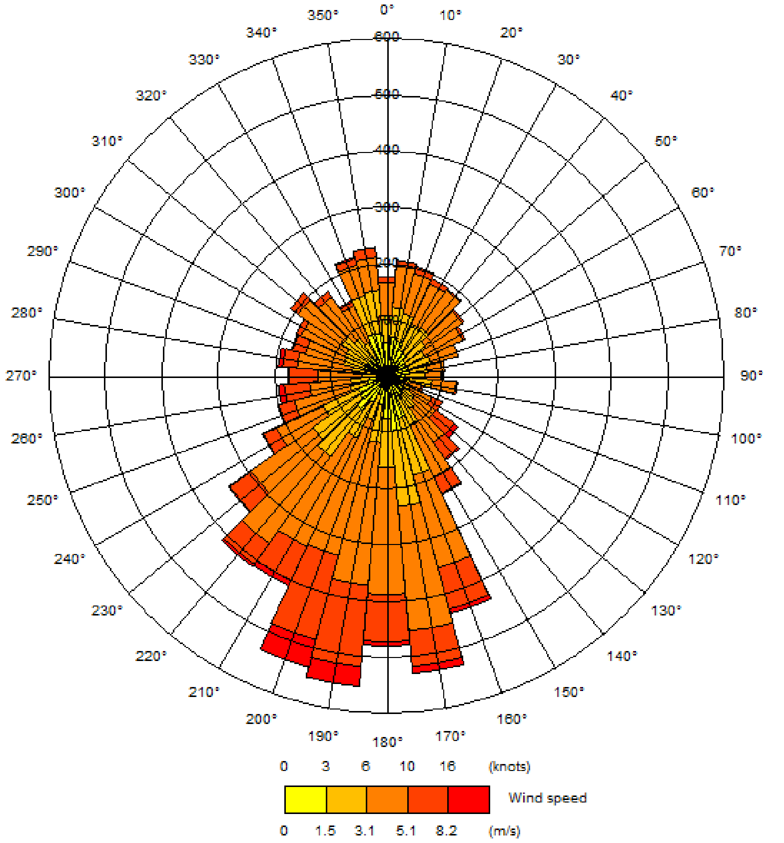
ID	Receptors	Coordinates		Height (m)
		X	Y	
Existing Receptors – all addresses approximate				
1	24 Burton Road, Alrewas	417661.7	314969.4	1.5
2	Rykneld St/Croxhall Rd Jct	417622.8	314851.1	1.5
3	24 Rykneld St, Alrewas	417506.7	314736.2	1.5
4	Levesley Group, A38 slip onto A513	417128.2	314169.8	1.5
5	Crown Inn Farm, Rykneld St	416629.3	313554.9	1.5
6	Amtrain Midland Services, Rykneld St	416416.7	313289.3	1.5
7	Fradley Arms Hotel, Rykneld St	416208.3	313008.1	1.5
8	Rykneld St 1 (A38-2A/B)	416289.3	313173.9	1.5
9	Rykneld St 2 (next to A38-2A/B)	416273.7	313152.5	1.5
10	Bell Bridge Cottage, Rykneld St/Brookhay Ln Jct	415895.3	312599.5	1.5
11	Hilliards Cross Farm, Rykneld St	415431.0	311979.1	1.5
12	Residential at Rykneld St	414705.4	311009.2	1.5
13	Residential near A5127/A39 Jct	414508.0	310796.4	1.5
14	Residential near A513 slip onto A38	417297.9	314511.9	1.5

Figure 3 – Receptor Locations considered in the Assessment of Emissions from Road Traffic



Meteorological data from a representative station is required by the dispersion model. 2014 meteorological data from Coleshill weather station has been used in this assessment. A wind rose for this site for the year 2014 is shown in Figure 4. Most dispersion models do not use meteorological data if they relate to calm winds conditions, as dispersion of air pollutants is more difficult to calculate in these circumstances. ADMS-Roads treats calm wind conditions by setting the minimum wind speed to 0.75m/s. It is recommended in LAQM.TG(09) that the meteorological data file be tested within a dispersion model and the relevant output log file checked, to confirm the number of missing hours and calm hours that cannot be used by the dispersion model. This is important when considering predictions of high percentiles and the number of exceedences. LAQM.TG(09) recommends that meteorological data should only be used if the percentage of usable hours is greater than 75%, and preferably 90%. 2014 meteorological data from Coleshill include 8,665 lines of usable hourly data out of the total 8,760 for the year, i.e. 98.9% usable data. This is therefore suitable for the dispersion modelling exercise.

Figure 4 – Wind rose for Coleshill Meteorological Data 2014



4.1.2 Model Outputs

The background pollutant values available from Defra[8] have been used in the ADMS-Roads model to calculate predicted total annual mean concentrations of NO_x and NO_2. These background pollutant concentrations are based upon all of the sources of air pollutants in the 1km grid square and any air pollutants from adjacent grid squares which may be of relevance.

For the prediction of annual mean NO_2 concentrations for the modelled scenario, the output of the ADMS-Roads model for NO_x has been converted to NO_2 following the methodology in LAQM.TG(09)[2] and using the NO_x to NO_2 conversion tool developed on behalf of Defra. This tool also utilises the total background NO_x and NO_2 concentrations. This assessment has utilised version 4.1 (June 2014) of the NO_x to NO_2 conversion tool. The road contribution is then added to the appropriate NO_2 background concentration value to obtain an overall total NO_2 concentration.

For the prediction of short term NO_2 impacts, LAQM.TG(09)[2] advises that it is valid to assume that exceedences of the 1-hour mean AQS objective for NO_2 are only likely to occur where the annual mean NO_2 concentration is 60µg/m^3 or greater. This approach has thus been adopted for the purposes of this assessment.

Verification of the ADMS assessment has been undertaken using the local authority monitoring locations which are located adjacent to the affected road network. All NO_2 results presented in the assessment are those calculated following the process of model verification, using a factor of 1.397, as detailed in Appendix 2.

5 Results

This assessment has considered emissions of NO_2 from road traffic at existing receptor locations. The results of the dispersion modelling are provided below, for those receptor locations detailed and illustrated in Table 6 and Figure 3 respectively.

Table 7 presents the annual mean NO_2 concentrations predicted at existing residential receptor locations for 2014.

The model suggests that the 40µg/m^3 annual mean AQS objective is observed to be exceeded at a total of six receptor locations, with one further location within 10% of the objective.

The maximum annual mean NO_2 concentration was predicted at receptor '2' – A38 Rykneld Street near Croxhall Road, with a predicted result of 52.5µg/m^3.

The empirical relationship given in LAQM.TG(09)[2] states that exceedences of the 1-hour mean objective for NO_2 are only likely to occur where annual mean concentrations are 60µg/m^3 or above. Annual mean NO_2 concentrations at all receptor locations are below this limit, and therefore short-term NO_2 exposure from road traffic emissions at the assessed receptor locations is not considered to be significant.

Table 7 – Predicted Annual Mean NO_2 Concentrations for 2014

ID	Receptors	Height (m)	Annual Mean NO_2 (µg/m^3)		% of AQS Objective
			AQS objective	2014	
Existing Receptors					
1	24 Burton Road, Alrewas	1.5	40	<u>36.6</u>	91.4%
2	Rykneld St near Croxhall Rd	1.5	40	**52.5**	131.4%
3	24 Rykneld St, Alrewas	1.5	40	35.5	88.6%
4	Levesley Group, A38 slip onto A513	1.5	40	26.1	65.2%
5	Crown Inn Farm, Rykneld St	1.5	40	33.5	83.7%
6	Amtrain Midland Services, Rykneld St	1.5	40	34.7	86.8%
7	Fradley Arms Hotel, Rykneld St	1.5	40	35.4	88.5%
8	Rykneld St 1 (A38-2A/B)	1.5	40	**42.5**	106.2%
9	Rykneld St 2 (next to A38-2A/B)	1.5	40	**43.5**	108.7%
10	Bell Bridge Cottage, Rykneld St/Brookhay Ln Jct	1.5	40	**41.3**	103.1%
11	Hilliards Cross Farm, Rykneld St	1.5	40	**40.2**	100.6%
12	Residential at Rykneld St	1.5	40	33.5	83.7%
13	Residential near A5127/A39 Jct	1.5	40	**42.4**	106.0%
14	Residential near A513 slip onto A38	1.5	40	28.6	71.4%
In **bold**, exceedence of the NO_2 annual mean AQS objective of 40 µg/m^3 <u>Underlined</u>, result within 10% of annual mean NO_2 objective of 40 µg/m^3					

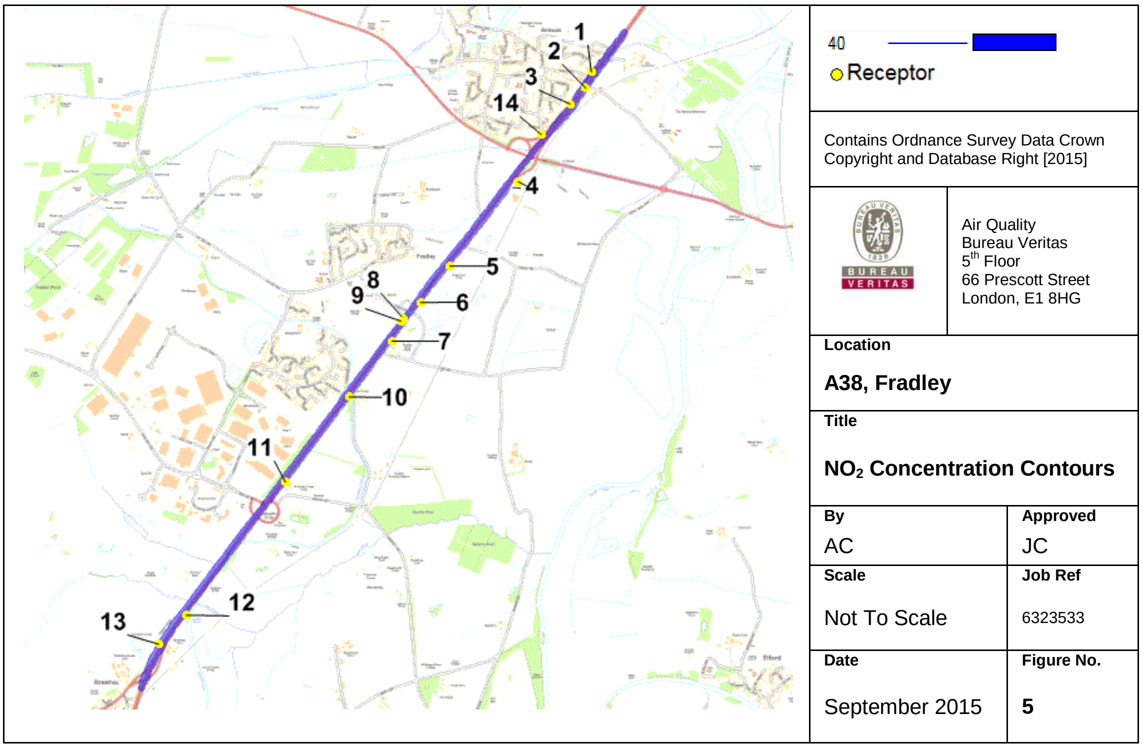
Annual mean NO_2 concentrations were also predicted at generic receptor locations within a grid with a minimum spatial resolution of 56m, covering the modelled area for the purposes of generating concentration isopleths.

Figure 5 and Figure 6 illustrates the annual mean NO_2 concentration isopleths. To mitigate against the uncertainty of modelled exceedences, 40µg/m^3 and 36µg/m^3 concentration isopleths (i.e. ±10% of the AQS objective) are presented.

These predicted areas were used to determine the population exposure to potential exceedence of the annual mean NO_2 AQS objective. The Office for National Statistics[11] provides an average number of 2.4 people per UK household in 2014. Based on the number of properties located within the 36µg/m^3 and above area, the number of people exposed to potential exceedences of the annual mean NO_2 is approximately 86.

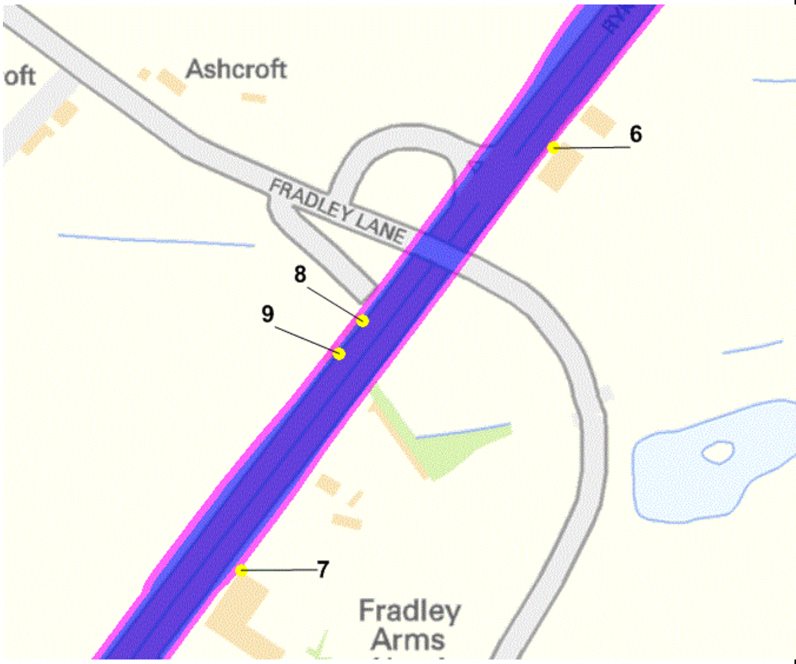
Given the exceedences modelled and the relevant receptors exposed, an AQMA is required in the area, the extent of which is proposed in Figure 7.

Figure 5 – Annual Mean NO_2 Concentration Isopleths (µg/m^3): A38, Fradley



[11] http://www.ons.gov.uk/ons/rel/family-demography/families-and-households/2014/index.html

Figure 6 – Annual Mean NO_2 Concentration Isopleths ($\mu g/m^3$): Close up at Fradley Lane

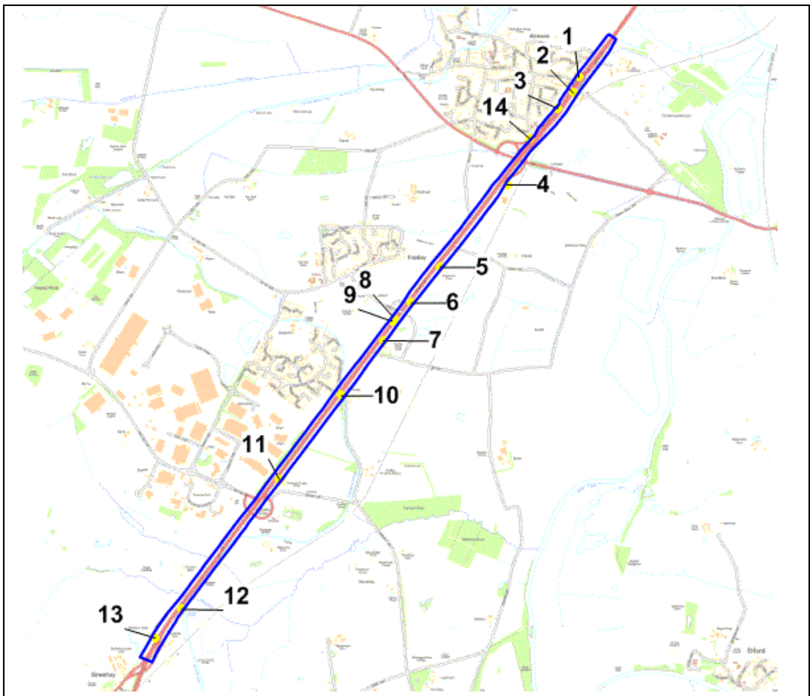


36
40
Receptor

Air Quality
Bureau Veritas
5th Floor
66 Prescott Street
London, E1 8HG

Location A38, Fradley near Fradley Lane	
Title NO_2 Concentration Contours	
By AC	**Approved** JC
Scale Not To Scale	**Job Ref** 6323533
Date September 2015	**Figure No.** 6

Figure 7 – Proposed AQMA Boundary



Proposed AQMA
Receptor

Air Quality
Bureau Veritas
5th Floor
66 Prescott Street
London, E1 8HG

Location A38, Fradley	
Title Proposed AQMA Boundary	
By AC	**Approved** JC
Scale Not To Scale	**Job Ref** 6323533
Date September 2015	**Figure No.** 7

6 Conclusions and Recommendations

Bureau Veritas UK Ltd, on behalf of Lichfield District Council, has produced a Detailed Assessment of the area surrounding the A38 and extending from the A38/A5127 junction to the District north boundary (i.e. to the River Trent). The following section provides the conclusions of this assessment.

6.1 Predicted Concentrations

The ADMS-Roads dispersion model (version 3.4.2) has been used to determine the likely NO_2 concentrations at existing receptor locations.

Assessed locations included fourteen residential receptors around the main road link of concern (the A38), representative of worst-case exposure. Annual mean NO_2 concentrations were found to be exceeding the 40µg/m^3 annual mean AQS objective at six locations. The highest modelled concentration was at receptor '2' – A38 Rykneld Street near Croxhall Road, with a predicted result of 52.5µg/m^3. With respect to the hourly NO_2 objective, all modelled concentrations were below the 60µg/m^3, above which exceedences of the short-term NO_2 AQS objective are considered possible, and thus exceedences of the 1-hour mean AQS objective are considered unlikely.

The gridded output of the model demonstrates that the geographical extent of the exceedence covers the area along the A38 from the junction with the A5127 Burton Road to the to the District north boundary.

In conclusion, this assessment has demonstrated that local air quality is in breach of the 40µg/m^3 annual mean AQS objective for NO_2, so the declaration of an AQMA is required. The suggested extent of this is demonstrated in Figure 7.

6.2 Future Recommendations

Following the above conclusions, the following recommendations are made:

- That an Air Quality Management Area (AQMA) be declared in the area, the extent of which is proposed in Figure 7.
- Further monitoring in the area is recommended. It is recommended that an additional site is installed at receptor '1' (the A38 Rykneld Street near Croxhall Road) and receptor '13' (near A5127/A39 junction) to confirm existing concentrations in the modelled exceedence area.
- An Air Quality Action Plan is drawn up to determine the best policies and intervention measures to put in place in order to reduce local NO_2 concentrations.
- Further Assessment of the area is conducted post implementation of the AQMA as part of the next round of LAQM reporting.

Appendices

Appendix 1 – Background to Air Quality

Emissions from road traffic contribute significantly to ambient pollutant concentrations in urban areas. The main constituents of vehicle exhaust emissions, produced by fuel combustion are carbon dioxide (CO_2) and water vapour (H_2O). However, combustion engines are not 100% efficient and partial combustion of fuel results in emissions of a number of other pollutants, including carbon monoxide (CO), particulate matter (PM), Volatile Organic Compounds (VOCs) and hydrocarbons (HC). For HC, the pollutants of most concern are 1,3 - butadiene (C_4H_6) and benzene (C_6H_6). In addition, some of the nitrogen (N) in the air is oxidised under the high temperature and pressure during combustion; resulting in emissions of oxides of nitrogen (NO_x). NO_x emissions from vehicles predominately consist of nitrogen oxide (NO), but also contain nitrogen dioxide (NO_2). Once emitted, NO can be oxidised in the atmosphere to produce further NO_2.

The quantities of each pollutant emitted depend upon a number of parameters; including the type and quantity of fuel used, the engine size, the vehicle speed, and the type of emissions abatement equipment fitted. Once emitted, these pollutants disperse in the air. Where there is no additional source of emission, pollutant concentrations generally decrease with distance from roads, until concentrations reach those of the background.

This air quality assessment focuses on NO_2 and PM_{10} (PM of aerodynamic diameter less than 10µm) as these pollutants are least likely to meet their respective Air Quality Strategy (AQS) objectives near roads. This has been confirmed over recent years by the outcome of the Local Air Quality Management (LAQM) regime. The most recent statistics[12] regarding Air Quality Management Areas (AQMAs) show that, 601 AQMAs were declared in the UK, of which 562 include NO_2 and 99 include PM_{10} (a number of AQMAs have been declared for both pollutants). The majority (92%) of existing AQMAs have been declared in relation to road traffic emissions.

In line with these results, the reports produced by the Council under the LAQM regime have confirmed that road traffic within their administrative area is the main issue in relation to air quality.

An overview of these two pollutants, describing briefly the sources and processes influencing the ambient concentrations, is presented below.

Particulate Matter (PM_{10})

Particulate matter is a mixture of solid and liquid particles suspended in the air. There are a number of ways in which airborne PM may be categorised. The most widely used categorisation is based on the size of particles such as $PM_{2.5}$, particles of aerodynamic diameter less than 2.5µm (micrometre = 10^{-6} metre), and PM_{10}, particles of aerodynamic diameter less than 10µm. Generically, particulate residing in low altitude air is referred to as Total Suspended Particulate (TSP) and comprises coarse and fine material including dust.

Particulate matter comprises a wide range of materials arising from a variety of sources. Examples of anthropogenic sources are carbon (C) particles from incomplete combustion, bonfire ash, recondensed metallic vapours and secondary particles (or aerosols) formed by chemical reactions in the atmosphere. As well as being emitted directly from combustion sources, man-made particles can arise from mining, quarrying, demolition and construction operations, from brake and tyre wear in motor vehicles and from road dust resuspension from moving traffic or strong winds. Natural sources of PM include wind-blown sand and dust, forest fires, sea salt and biological particles such as pollen and fungal spores.

[12] Statistics from the UK AQMA website available at http://aqma.defra.gov.uk – Figures as of January 2013

The health impacts from PM depend upon size and chemical composition of the particles. For the purposes of the AQS objectives, PM_{10} or $PM_{2.5}$ is solely defined on size rather than chemical composition. This enables a uniform method of measurement and comparison. The short and long-term exposure to PM has been associated with increased risk of lung and heart diseases.PM may also carry surface-absorbed carcinogenic compounds. Smaller PM have a greater likelihood of penetrating the respiratory tract and reaching the lung to blood interface and causing the above adverse health effects.

In the UK, emissions of PM_{10} have declined significantly since 1980, and were estimated to be 114kt (kilotonne) in 2010[13]. Residential / public electricity and heat production and road transport are the largest sources of PM_{10} emissions. The road transport sector contributed 22% (25kt) of PM_{10} emissions in 2010. The main source within road transport is brake and tyre wear.

It is important to note that these estimates only refer to primary emissions, that is, the emissions directly resulting from sources and processes and do not include secondary particles. These secondary particles, which result from the interaction of various gaseous components in the air such as ammonia (NH_3), sulphur dioxide (SO_2) and NO_x, can come from further a field and impact on the air quality in the UK and vice versa.

Similarly to PM_{10}, emissions of $PM_{2.5}$ have declined since 1970, and were estimated to be 67kt in 2010, which makes over 58% of PM_{10} emissions. In 2010, the road transport sector emitted 28% (18kt) of the total $PM_{2.5}$ emissions in the UK.

Nitrogen Oxides (NO_x)

NO and NO_2, collectively known as NO_x, are produced during the high temperature combustion processes involving the oxidation of N. Initially, NO_x are mainly emitted as NO, which then undergoes further oxidation in the atmosphere, particularly with ozone (O_3), to produce secondary NO_2. Production of secondary NO_2 could also be favoured due to a class of compounds, VOCs, typically present in urban environments, and under certain meteorological conditions, such as hot sunny days and stagnant anti-cyclonic winter conditions.

Of NO_x, it is NO_2 that is associated with health impacts. Exposure to NO_2 can bring about reversible effects on lung function and airway responsiveness. It may also increase reactivity to natural allergens, and exposure to NO_2 puts children at increased risk of respiratory infection and may lead to poorer lung function in later life.

In the UK, emissions of NO_x have decreased by 62% between 1990 and 2010. For 2010, NO_x (as NO_2) emissions were estimated to be 1,106kt. The transport sector remained the largest source of NO_x emissions with road transport contribution 34% to NO_x emissions in 2010.

[13] National Atmospheric Emissions Inventory (NAEI) Summary Emission Estimate Datasets 2010. March 2012

Appendix 2 – ADMS Model Verification

The ADMS-Roads dispersion model has been widely validated for this type of assessment and is specifically listed in the Defra's LAQM.TG(09)[2] guidance as an accepted dispersion model.

Model validation undertaken by the software developer (CERC) will not have included validation in the vicinity of the proposed development site. It is therefore necessary to perform a comparison of modelled results with local monitoring data at relevant locations. This process of verification attempts to minimise modelling uncertainty and systematic error by correcting modelled results by an adjustment factor to gain greater confidence in the final results.

The predicted results from a dispersion model may differ from measured concentrations for a large number of reasons, including uncertainties associated with:

- Background concentration estimates;
- Source activity data such as traffic flows and emissions factors;
- Monitoring data, including locations; and
- Overall model limitations.

Model verification is the process by which these and other uncertainties are investigated and where possible minimised. In reality, the differences between modelled and monitored results are likely to be a combination of all of these aspects.

Model setup parameters and input data were checked prior to running the models in order to reduce these uncertainties. The following were checked to the extent possible to ensure accuracy:

- Traffic data;
- Distance between sources and monitoring as represented in the model;
- Speed estimates on roads;
- Background monitoring and background estimates; and
- Monitoring data.

Traffic data was obtained from the Highways Agency Traffic Counts Website[10] as detailed in Section 4.1.1. Separation distances between road sources and receptors were checked using electronic OS mapping data.

Lichfield District Council undertakes passive monitoring as part of its LAQM commitments at 22 locations, three of which are located in the modelled area and have been used for the purpose of model verification.

Details of the three LAQM monitoring sites used for the purposes of model verification are presented in Table A1 below.

Table A1 – Local Monitoring Data Suitable for Model Verification

Site ID	Location	OS Grid Reference [a]	2014 Annual Mean NO_2 ($\mu g/m^3$)
A38-1	Rykneld St near the A38 slip onto A513	417095, 314170	37.1
A38 - 2/2(1)	Rykneld St near Fradley Ln, Fradley	416301, 313192	35.9
A38-2A/B	Rykneld St near Fradley Ln, Fradley	416289, 313174	**43.1**
In **bold**, exceedence of the NO_2 annual mean AQS objective of 40 $\mu g/m^3$			

Verification calculations

The verification of the modelling output was performed in accordance with the methodology provided in Annex 3 of LAQM.TG(09)[2].

For the verification and adjustment of NO_x/NO_2, the LAQM diffusion tube monitoring data was used as detailed above. Data capture for 2014 at the three sites was 100%. Table A2 below shows an initial comparison of the monitored and unverified modelled NO_2 results for the year 2014, in order to determine if verification and adjustment was required.

Table A2 – Comparison of Unverified Modelled and Monitored NO_2 Concentrations

Site ID	Site Type	Background NO_2	Monitored total NO_2 ($\mu g/m^3$)	Modelled total NO_2 ($\mu g/m^3$)	% Difference (modelled vs. monitored)
A38-1	Roadside	16.3	37.1	31.0	-16.5
A38 - 2/2(1)	Roadside	16.1	35.9	33.2	-7.5
A38-2A/B	Roadside	16.1	43.1	34.6	-19.7

The model was clearly under-predicting at each location and no further improvement of the modelled results could be obtained on this occasion. At all sites, the difference between modelled and monitored concentrations was less than 25%. The relevant data was then gathered to allow the adjustment factor to be calculated.

Model adjustment needs to be undertaken based for NO_x and not NO_2. For the diffusion tube monitoring results used in the calculation of the model adjustment, NO_x was derived from NO_2; these calculations were undertaken using a spreadsheet tool available from the LAQM website[14].

Table A3 provides the relevant data required to calculate the model adjustment based on regression of the modelled and monitored road source contribution to NO_x.

Table A3 – Data Required for Adjustment Factor Calculation

Site ID	Monitored total NO_2 ($\mu g/m^3$)	Monitored total NO_x ($\mu g/m^3$)	Background NO_2 ($\mu g/m^3$)	Background NO_x ($\mu g/m^3$)	Monitored road contribution NO_2 (total - background) ($\mu g/m^3$)	Monitored road contribution NO_x (total - background) ($\mu g/m^3$)	Modelled road contribution NO_x (excludes background) ($\mu g/m^3$)
A38-1	37.1	67.2	16.3	22.8	20.8	44.5	30.2
A38 - 2/2(1)	35.9	64.5	16.1	22.4	19.8	42.2	35.8
A38-2A/B	43.1	82.5	16.1	22.4	27.0	60.1	39.1

[14] http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc

Figure A1 provides a comparison of the Modelled Road Contribution NO_x versus Monitored Road Contribution NO_x, and the equation of the trend line based on linear regression through zero. The Total Monitored NO_x concentration has been derived by back-calculating NO_x from the NO_x/NO_2 empirical relationship using the spreadsheet tool available from Defra's website. The equation of the trend lines presented in Figure A1 gives an adjustment factor for the modelled results of 1.397.

Figure A1 – Comparison of the Modelled Road Contribution NO_x versus Monitored Road Contribution NO_x

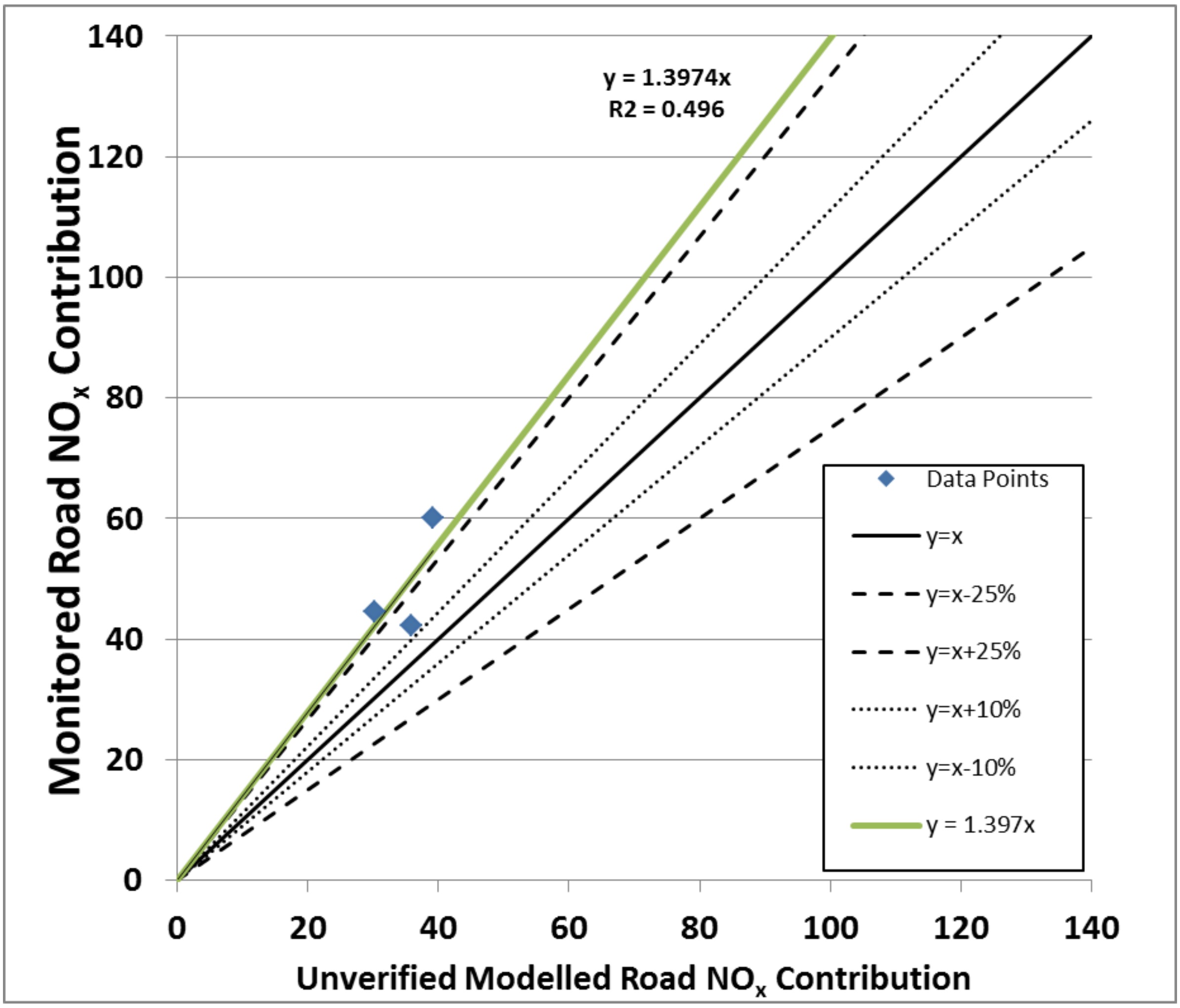
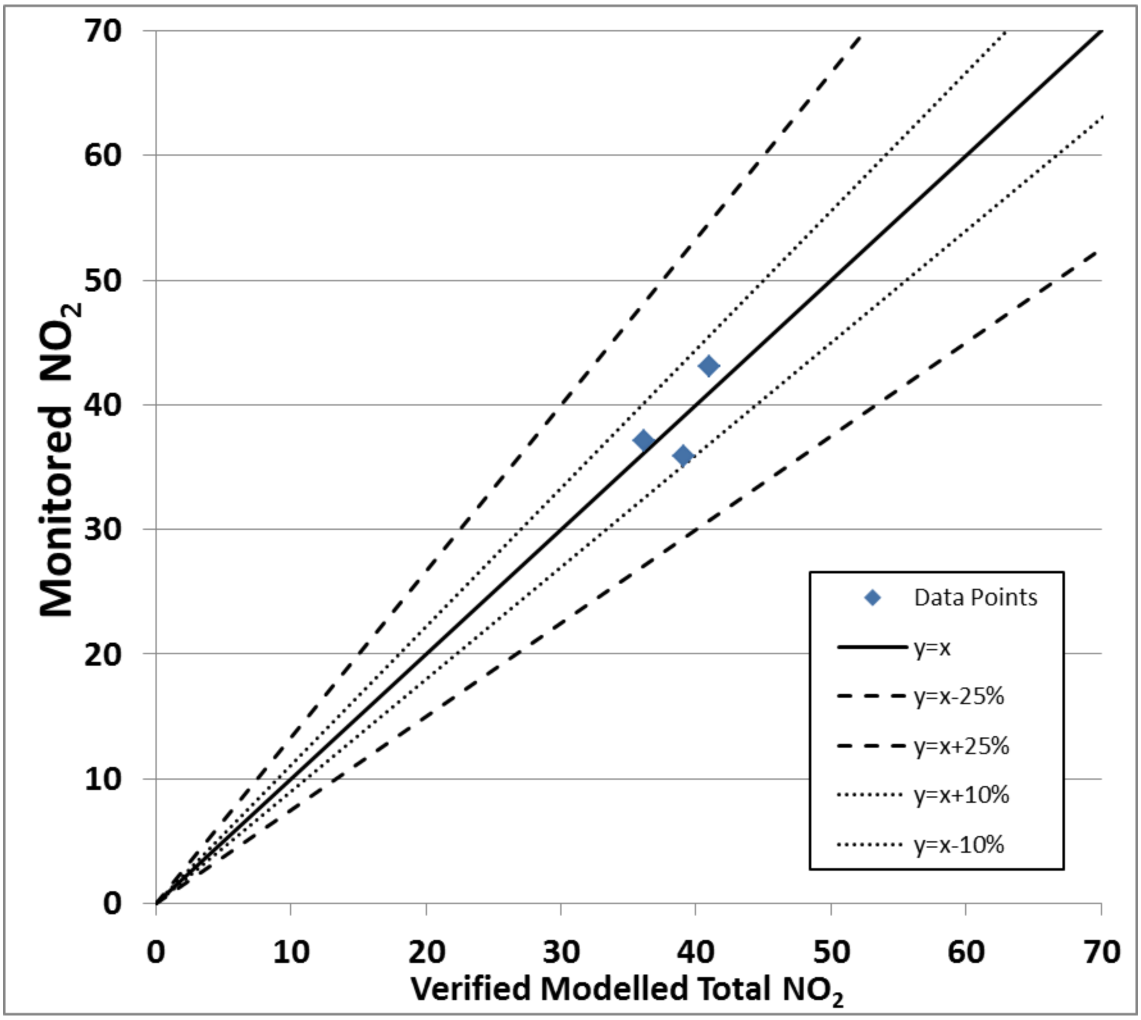


Table A4 and Figure A2 show the ratios between monitored and modelled NO_2 for each monitoring location. The three sites show acceptable agreement between the ratios of monitored and modelled NO_2 all being ±10%. A verification factor of 1.397 was therefore used to adjust the model results. A factor of 1.397 reduces the Root Mean Square Error (RMSE) from a value of 6.3 to 2.3.

Table A4 – Adjustment Factor and Comparison of Verified Results Against Monitoring Results

Site ID	Ratio of monitored road contribution NO_x / modelled road contribution NO_x	Adjustment factor for modelled road contribution NO_x	Adjusted modelled road contribution NO_x ($\mu g/m^3$)	Adjusted modelled total NO_x (including background NO_x) ($\mu g/m^3$)	Modelled total NO_2 (based upon empirical NO_x / NO_2 relationship) ($\mu g/m^3$)	Monitored total NO_2 ($\mu g/m^3$)	% Difference (adjusted modelled NO_2 vs. monitored NO_2)
A38-1	1.47	1.397	42.20	65.00	36.14	37.10	-2.59
A38 - 2/2(1)	1.30		50.03	72.42	39.14	35.90	9.03
A38-2A/B	1.40		54.64	77.03	40.99	43.10	-4.90

Figure A2 – Comparison of the Modelled NO_2 versus Monitored NO_2



The adjustment factor of 1.397 was applied to the road-NO_x concentrations predicted by the model to arrive at the final NO_2 concentrations. All NO_2 results presented and discussed herein are those calculated following the process of model verification using an adjustment factor of 1.397.