Air Quality Consultants

Air Quality Assessment: Staffordshire Moorlands, Leek McDonalds

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Executive Summary

The air quality impacts associated with the operation of the proposed McDonalds drive through restaurant at Broad Street, Leek have been assessed.

Existing air quality conditions have been described using the results of monitoring carried out by Staffordshire Moorlands District Council, information published by Defra and the Environment Agency, and detailed baseline dispersion modelling.

The operational impacts have been assessed using detailed dispersion modelling. Concentrations of the key air pollutants associated with road traffic, i.e. nitrogen dioxide and fine particulate matter (PM_{10} and $PM_{2.5}$), have been determined with and without the development. The predicted concentrations have been compared with air quality objectives set by the Government to protect human health.

Existing air quality conditions within the study area show acceptable air quality, with concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ below the objectives in the baseline year (2014).

The additional traffic generated by the proposed development will affect air quality at existing properties along the local road network. Increases in pollutant concentrations resulting from emissions from these additional traffic movements will have predominantly negligible impacts. There is, however, a risk of slight to moderate adverse impacts relating to increases in annual mean concentrations of nitrogen dioxide at a few locations.

The assessment has been based on conservative assumptions, regarding both the volume of traffic generated by the proposed restaurant, and future reductions in vehicle emissions brought about by EU legislation. The combined effect of these conservative assumptions means that the impacts relating to annual mean nitrogen dioxide concentrations are likely to be overestimated.

Overall, the air quality impacts of the proposed development are judged to be not significant.

Contents

Tables

Figures

1 Introduction

1.1 This report describes the potential air quality impacts associated with the operation of a proposed McDonalds drive-through restaurant at Broad Street, Leek. The assessment has been carried out by Air Quality Consultants Ltd on behalf of McDonalds Restaurants Limited.

1.2 The development will lead to an increase in traffic on the local roads, which may impact on air quality at existing residential properties. The main air pollutants of concern related to traffic emissions are nitrogen dioxide and fine particulate matter (PM_{10} and $PM_{2.5}$).

1.3 This report describes existing local air quality conditions (2014), and the predicted air quality in the future assuming that the proposed development does, or does not proceed. The assessment of traffic-related impacts focuses on 2017, which is the anticipated year of opening of the proposed restaurant.

1.4 This report has been prepared taking into account all relevant local and national guidance and regulations, and follows a methodology agreed with Staffordshire Moorlands District Council.

2 Policy Context and Assessment Criteria

Air Quality Strategy

2.1 The Air Quality Strategy published by the Department for Environment, Food, and Rural Affairs (Defra) provides the policy framework (Defra, 2007) for air quality management and assessment in the UK. It provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. Local authorities are seen to play a particularly important role. The strategy describes the Local Air Quality Management (LAQM) regime that has been established, whereby every authority has to carry out regular reviews and assessments of air quality in its area to identify whether the objectives have been, or will be, achieved at relevant locations, by the applicable date. If this is not the case, the authority must declare an Air Quality Management Area (AQMA), and prepare an action plan which identifies appropriate measures that will be introduced in pursuit of the objectives.

Planning Policy

National Policies

2.2 The National Planning Policy Framework (NPPF) (2012) sets out planning policy for England in one place. It places a general presumption in favour of sustainable development, stressing the importance of local development plans, and states that the planning system should perform an environmental role to minimise pollution. One of the twelve core planning principles notes that planning should *"contribute to…reducing pollution"*. To prevent unacceptable risks from air pollution, planning decisions should ensure that new development is appropriate for its location. The NPPF states that the effects of pollution on health and the sensitivity of the area and the development should be taken into account.

2.3 More specifically the NPPF makes clear that:

"Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan".

2.4 The NPPF is now supported by Planning Practice Guidance (PPG) (DCLG, 2014), which includes guiding principles on how planning can take account of the impacts of new development on air quality. The PPG states that *"Defra carries out an annual national assessment of air quality using* *modelling and monitoring to determine compliance with EU Limit Values"* and *"It is important that the potential impact of new development on air quality is taken into account … where the national assessment indicates that relevant limits have been exceeded or are near the limit".* The role of the local authorities is covered by the LAQM regime, with the PPG stating that local authority Air Quality Action Plans "*identify measures that will be introduced in pursuit of the objectives*".

2.5 The PPG states that:

"Whether or not air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to generate air quality impact in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU legislation (including that applicable to wildlife)".

2.6 The PPG sets out the information that may be required in an air quality assessment, making clear that *"Assessments should be proportional to the nature and scale of development proposed and the level of concern about air quality"*. It also provides guidance on options for mitigating air quality impacts, as well as examples of the types of measures to be considered. It makes clear that *"Mitigation options where necessary, will depend on the proposed development and should be proportionate to the likely impact".*

Local Transport Plan

2.7 Staffordshire County Council's Local Transport Plan 2011 Strategy Plan document (Staffordshire County Council, 2011) states that:

"Poor air quality, resulting from transport emissions, whilst not widespread in the county, will need addressing".

2.8 The document includes an appendix on air quality, but this only refers to the AQMAs in the county, and none of these are in Staffordshire Moorlands District.

Local Policies

2.9 Staffordshire Moorlands District Council's Core Strategy (Staffordshire Moorlands District Council, 2014a), adopted in March 2014, contains a single policy relating to consideration of air pollution in planning applications. Policy SD4 – Pollution and Flood Risk states:

"The Council will ensure that the effects of pollution (air, land, noise, water, light) are avoided or mitigated by refusing schemes which are deemed to be (individually or cumulatively) environmentally unacceptable and by avoiding unacceptable amenity impacts by refusing schemes which are pollution-sensitive adjacent to polluting developments, or polluting schemes adjacent to pollution sensitive areas, in accordance with national guidance."

Assessment Criteria

2.10 The Government has established a set of air quality standards and objectives to protect human health. The 'standards' are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. The objectives for use by local authorities are prescribed within the Air Quality (England) Regulations, 2000, Statutory Instrument 928 (2000) and the Air Quality (England) (Amendment) Regulations 2002, Statutory Instrument 3043 (2002).

2.11 The objectives for nitrogen dioxide and PM_{10} were to have been achieved by 2005 and 2004 respectively, and continue to apply in all future years thereafter. The $PM_{2.5}$ objective is to be achieved by 2020. Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded where the annual mean concentration is below 60 $\mu g/m^3$ (Defra, 2009). Therefore, 1-hour nitrogen dioxide concentrations will only be considered if the annual mean concentration is above this level. Measurements have also shown that the 24-hour PM_{10} objective could be exceeded where the annual mean concentration is above 32 $\mu g/m^3$ (Defra, 2009). The predicted annual mean PM_{10} concentrations are thus used as a proxy to determine the likelihood of an exceedence of the 24-hour mean PM_{10} objective. Where predicted annual mean concentrations are below 32 $\mu g/m^3$ it is unlikely that the 24-hour mean objective will be exceeded.

2.12 The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Defra explains where these objectives will apply in its Local Air Quality Management Technical Guidance (Defra, 2009). The annual mean objectives for nitrogen dioxide and PM_{10} are considered to apply at the façades of residential properties.

2.13 The European Union has also set limit values for nitrogen dioxide, PM_{10} and $PM_{2.5}$. The limit values for nitrogen dioxide are the same numerical concentrations as the UK objectives, but achievement of these values is a national obligation rather than a local one (Directive 2008/50/EC of the European Parliament and of the Council, 2008). In the UK, only monitoring and modelling carried out by UK Central Government meets the specification required to assess compliance with the limit values. Central Government does not recognise local authority monitoring or local modelling studies when determining the likelihood of the limit values being exceeded.

2.14 The relevant air quality criteria for this assessment are provided in Table 1.

Table 1: Air Quality Criteria for Nitrogen Dioxide, PM_{10} and $PM_{2.5}$

Pollutant	Time Period	Objective
Nitrogen Dioxide	1-hour Mean	200 $\mu g/m^3$ not to be exceeded more than 18 times a year
	Annual Mean	40 $\mu g/m^3$
Fine Particles (PM_{10})	24-hour Mean	50 $\mu g/m^3$ not to be exceeded more than 35 times a year
	Annual Mean	40 $\mu g/m^3$ [b]
Fine Particles ($PM_{2.5}$) [a]	Annual Mean	25 $\mu g/m^3$

[a] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

[b] A proxy value of 32 $\mu g/m^3$ as an annual mean is used in this assessment to assess the likelihood of the 24-hour mean PM_{10} objective being exceeded. Measurements have shown that, above this concentration, exceedences of the 24-hour mean PM_{10} objective are possible (Defra, 2009).

Descriptors for Air Quality Impacts and Assessment of Significance

2.15 There is no official guidance in the UK on how to describe air quality impacts, nor how to assess their significance. The approach developed jointly by Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM)[1] (EPUK & IAQM, 2015) has therefore been used. This includes defining descriptors of the impacts at individual receptors, which take account of the percentage change in concentrations relative to the relevant air quality objective, rounded to the nearest whole number, and the absolute concentration relative to the objective. The overall significance of the air quality impacts is determined using professional judgement, taking account of the impact descriptors. Full details of the EPUK/IAQM approach are provided in Appendix A1. The approach includes elements of professional judgement, and the experience of the consultants preparing the report is set out in Appendix A2.

[1] The IAQM is the professional body for air quality practitioners in the UK.

3 Assessment Approach

Existing Conditions

3.1 Existing sources of emissions within the study area have been defined using a number of approaches. Industrial and waste management sources that may affect the area have been identified using Defra's Pollutant Release and Transfer Register (Defra, 2015a) and the Environment Agency's website 'what's in your backyard' (Environment Agency, 2015). Local sources have also been identified through examination of the Council's Air Quality Review and Assessment reports.

3.2 Information on existing air quality has been obtained by collating the results of monitoring carried out by the local authority. This covers both the study area and nearby sites, the latter being used to provide context for the assessment. The background concentrations across the study area have been defined using the national pollution maps published by Defra (2015b). These cover the whole country on a 1x1 km grid. Current exceedences of the annual mean EU limit value for nitrogen dioxide have been identified using the maps of roadside concentrations published by Defra (2015c). These are the maps, currently based on 2012 data, used by the UK Government, together with the results from national AURN monitoring sites that operate to EU data quality standards, to report exceedences of the limit value to the EU.

Road Traffic Impacts

Sensitive Locations

3.3 Concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ have been predicted at a number of locations close to the proposed development. Receptors have been identified to represent worst-case exposure within these locations. When selecting these receptors, particular attention has been paid to assessing impacts close to junctions, where traffic may become congested, and where there is a combined effect of several road links. The receptors have been located on the façades of the properties closest to the sources.

3.4 Thirteen existing residential properties have been identified as receptors for the assessment. These locations are described in Table 2 and shown in Figure 1. In addition, concentrations have been modelled at diffusion tube monitoring sites located along Broad Street in order to verify the modelled results (see Appendix A3 for verification method).

Table 2: Description of Receptor Locations [a]

Receptor ID	Description
Receptor 1	Residential property fronting onto Broad Street
Receptor 2	Façade of residential property fronting onto Broad Street
Receptor 3	Residential property fronting onto Sneyd Street
Receptor 4	Residential property fronting onto the junction of Sneyd Street and Broad Street
Receptor 5	Residential property fronting onto Compton
Receptor 6	Primary School fronting onto Broad Street
Receptor 7	Residential property fronting onto Broad Street
Receptor 8	Residential property fronting onto Sneyd Street
Receptor 9	Façade of residential property facing Broad Street
Receptor 10	Residential property facing St Edward Street
Receptor 11	Residential property fronting onto St Edward Street
Receptor 12	Residential property facing Brook Street
Receptor 13	Residential property fronting onto Brook Street

[a] All receptors modelled at a height of 1.5 m to represent ground floor level, with the exception of Receptor 6 (4.5 m) and Receptor 7 (5.5 m) which are elevated relative to the adjacent road.

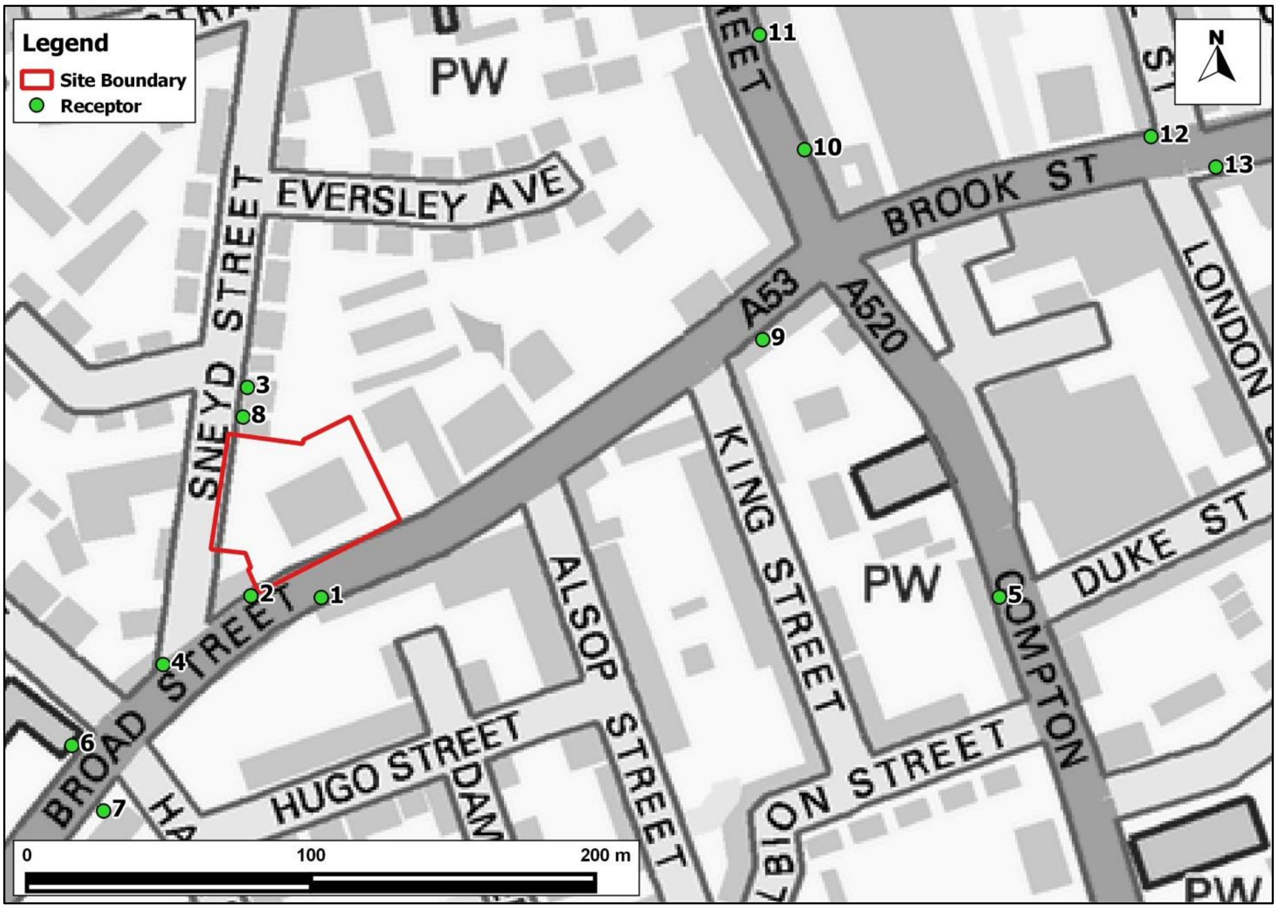

Figure 1: Receptor Locations

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Assessment Scenarios

3.5 Predictions of nitrogen dioxide, PM_{10} and $PM_{2.5}$ concentrations have been carried out for a base year (2014), and the proposed year of opening (2017). For 2017, predictions have been made assuming both that the development does proceed (With Scheme), and does not proceed (Without Scheme). A further 2017 sensitivity test has been carried out for nitrogen dioxide that involves assuming no reduction in emission factors for road traffic from the baseline year. This is to address the issue identified by Defra (Carslaw, Beevers, Westmoreland, & Williams, 2011) that road traffic emissions have not been declining as expected (see later section on uncertainty). Nitrogen dioxide concentrations in 2017 with and without the scheme are thus presented for two scenarios: 'With Emissions Reduction' and 'Without Emissions Reduction'.

Modelling Methodology

3.6 Concentrations have been predicted using the ADMS-Roads dispersion model. Details of the model inputs and the model verification are provided in Appendix A3, together with the method used to derive current and future year background nitrogen dioxide concentrations. The air quality modelling has been carried out based on a number of assumptions that have had to be made, detailed further in Appendix A3.

Uncertainty in Road Traffic Modelling Predictions

3.7 There are many components that contribute to the uncertainty of modelling predictions. The road traffic emissions dispersion model used in this assessment is dependent upon the traffic data that have been input, which will have inherent uncertainties associated with them. There are then additional uncertainties, as the model is required to simplify real-world conditions into a series of algorithms. An important stage in the process is model verification, which involves comparing the model output with measured concentrations (see Appendix A3). Because the model has been verified and adjusted, there can be reasonable confidence in the prediction of current year (2014) concentrations.

3.8 Predicting pollutant concentrations in a future year will always be subject to greater uncertainty. For obvious reasons, the model cannot be verified in the future, and it is necessary to rely on a series of projections provided by DfT and Defra as to what will happen to traffic volumes, background pollutant concentrations and vehicle emissions.

3.9 Historically, large reductions in nitrogen oxides emissions have been projected, which has led to significant reductions in nitrogen dioxide concentrations from one year to the next being predicted. Over time, it was found that trends in measured concentrations did not reflect the rapid reductions that Defra and the DfT had predicted (Carslaw, Beevers, Westmoreland, & Williams, 2011). This was evident across the UK, although the effect appeared to be greatest in inner London; there was also considerable inter-site variation. Emission projections over the 6 to 8 years prior to 2009 suggested that both annual mean nitrogen oxides and nitrogen dioxide concentrations should have fallen by around 15-25%, whereas monitoring data showed that concentrations remained relatively stable, or even showed a slight increase. Analysis of more recent data for 23 roadside sites in London covering the period 2003 to 2012 showed a weak downward trend of around 5% over the ten years (Carslaw & Rhys-Tyler, 2013), but this still falls short of the improvements that had been predicted at the start of this period. This pattern of no clear, or limited, downward trend is mirrored in the monitoring data assembled for this study, as set out in Paragraph 4.6.

3.10 The reason for the disparity between the expected concentrations and those measured relates to the on-road performance of modern diesel vehicles. New vehicles registered in the UK have had to meet progressively tighter European type approval emissions categories, referred to as "Euro" standards. While the nitrogen oxides emissions from newer vehicles should be lower than those from equivalent older vehicles, the on-road performance of some modern diesel vehicles has often been no better than that of earlier models. This has been compounded by an increasing proportion of nitrogen dioxide in the nitrogen oxides emissions, i.e. primary nitrogen dioxide, which has a significant effect on roadside concentrations (Carslaw, Beevers, Westmoreland, & Williams, 2011) (Carslaw & Rhys-Tyler, 2013).

3.11 Defra has attempted to account for the historical discrepancies in its latest emissions factors published in 2014 and incorporated in the Emission Factor Toolkit v6.0.2 used in this study. The new factors now show only limited reductions in overall vehicle emissions prior to 2014, but project some large improvements thereafter. This is principally because, where previous standards had limited on-road success, the best current evidence is that the 'Euro VI' and 'Euro 6' standards that new vehicles had to comply with from 2013/15[2] will deliver real improvements, as, for the first time, they will be compliant with the World Harmonized Test Cycle, which better represents real-world driving conditions[3] and also includes a separate slow-speed cycle for heavy duty vehicles. There is, nevertheless, limited information on whether the full improvements expected are being, and will be, delivered, so there remains some uncertainty as to whether emissions will reduce at the rates set out in Defra's Emission Factors Toolkit (Defra, 2015b).

3.12 To account for the remaining uncertainty over future vehicle emissions of nitrogen oxides and nitrogen dioxide, a sensitivity test has been conducted assuming that the future (2017) road traffic emissions per vehicle are unchanged from 2014 values (without emissions reduction). The predictions within this sensitivity test will almost certainly be over-pessimistic, as new Euro VI and Euro 6 vehicles will make up roughly 63% of HDVs and 33% of LDVs on the road in 2017, according to Defra's Emission Factors Toolkit (Defra, 2015b). Future concentrations due to road traffic emissions will therefore be below the 'without emissions reduction' values, but may be above Defra's 'with emissions reduction' values i.e. they will lie between the two sets of values, but are likely to be closer to those derived using the official Defra values than those in the 'no emissions reduction' sensitivity test.

2 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.

3 The test cycle for real-world emissions for Euro 6 vehicles will not be implemented until about 2017. However, there is still expected to be a substantial improvement in NOx emissions from Euro 6 vehicles (as compared with Euro 5) from 2015 onwards.

4 Site Description and Baseline Conditions

4.1 The proposed development site is located towards the centre of Leek. The site is bounded by Broad Street to the south, Sneyd Street to the west, a commercial property to the east and existing residential properties to the north. The site is currently occupied by a car showroom.

Industrial sources

4.2 A search of the UK Pollutant Release and Transfer Register (Defra, 2015a) and Environment Agency's 'what's in your backyard' (Environment Agency, 2015) websites did not identify any significant industrial or waste management sources that are likely to affect the proposed development, in terms of air quality.

Air Quality Review and Assessment

4.3 Staffordshire Moorlands District Council has investigated air quality within its area as part of its responsibilities under the LAQM regime. Continuing national and local monitoring results have not yet led to the declaration of any AQMAs in the district, although the area around Broad Street has been identified as potentially requiring a Detailed Assessment (Staffordshire Moorlands District Council, 2014b).

4.4 Staffordshire Moorlands District Council does not currently monitor PM_{10}. Although previous assessments completed in the area considered that there are were no exceedences of the applicable objectives. It is therefore reasonable to assume that existing PM_{10} levels do not exceed the objectives within the study area (Staffordshire Moorlands District Council, 2014b).

Local Air Quality Monitoring

4.5 Staffordshire Moorlands District Council operates a number of nitrogen dioxide monitoring sites using diffusion tubes prepared and analysed by the UKAS accredited Staffordshire County Analyst (using the 50% TEA in acetone method). These include four deployed along Broad Street, with two of these located adjacent to the proposed development. Results for the years 2009 to 2014 are summarised in Table 3 and the monitoring locations are shown in Figure 2.

Table 3: Summary of Nitrogen Dioxide (NO_2) Monitoring (2009-2014) [a]

Site no.	Site Type	Location	2009	2010	2011	2012	2013	2014
Diffusion Tubes - Annual Mean (µg/m³) [b]								
25	Roadside	Broad Street	**46.0**	**49.0**	**47.0**	**47.0**	**46.0**	**46.3**
26	Roadside	Broad Street	34.0	38.0	36.0	37.0	34.0	34.7
33	Roadside	Broad Street	-	**43.0**	39.0	**41.0**	39.0	39.2
34	Roadside	Broad Street	-	32.0	35.0	34.0	31.0	32.5
Objective			**40**					

[a] Exceedences of the objectives are shown in bold

[b] Data for 2009-2014 have been provided by Staffordshire Moorlands District Council. All data presented are bias adjusted.

4.6 Annual mean nitrogen dioxide concentrations measured at site 25 have exceeded the objective in every year from 2009 and 2014. However, this site is located on a commercial property and does not represent relevant exposure to the objective. In addition, concentrations at site 33 have exceeded the annual mean objective in two years during the same time period. Measured concentrations at sites 26 and 34, which are located very close to the proposed development site, have been consistently below the objective over the last six years.

4.7 There are no clear trends in monitoring results for the past six years. This contrasts with the expected decline due to the progressive introduction of new vehicles operating to more stringent standards.

4.8 There are no monitors that measure PM_{10} or $PM_{2.5}$ concentrations in Leek.

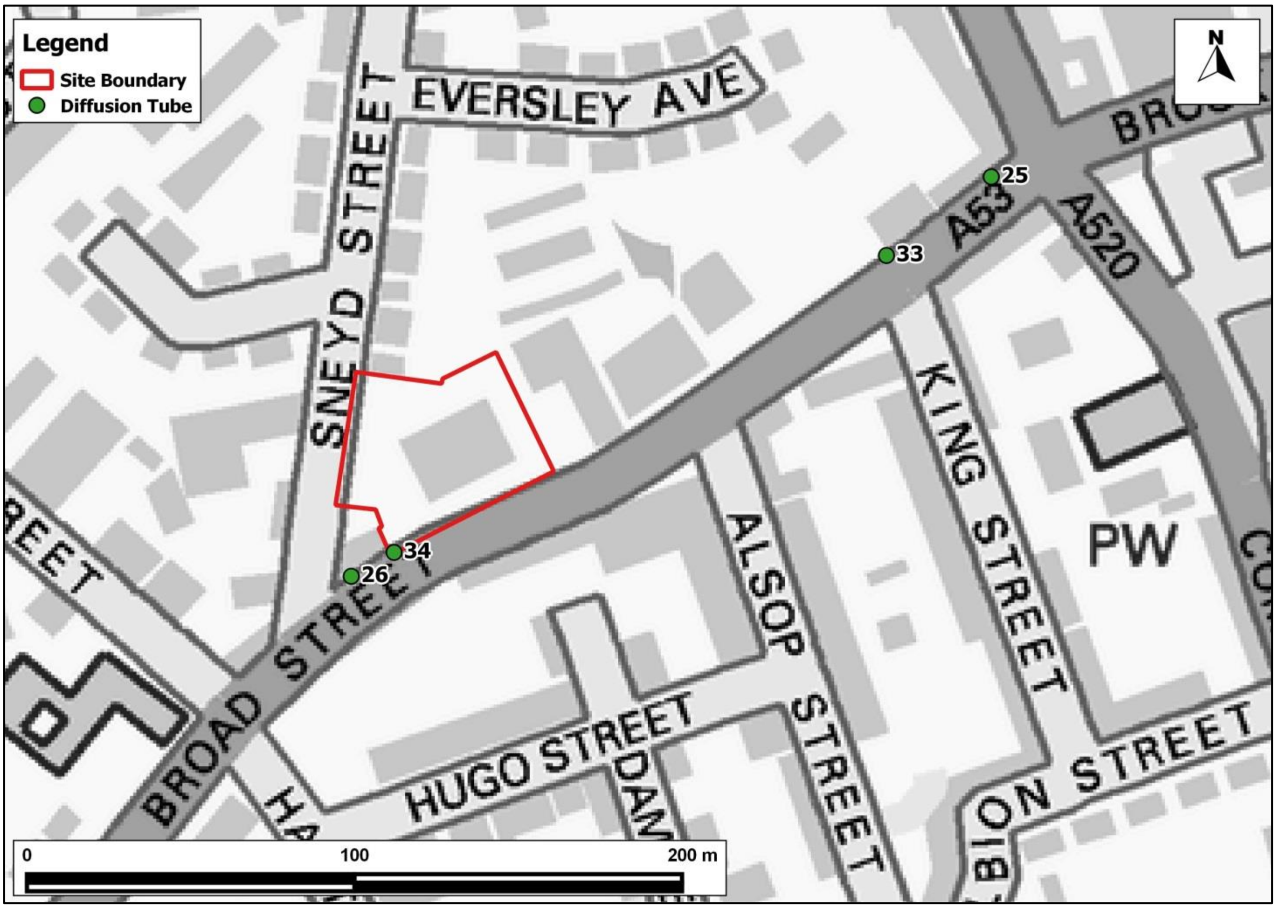

Figure 2: Monitoring Locations

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Exceedences of EU Limit Value

4.9 There are no AURN monitoring sites within the study area. The national map of roadside annual mean nitrogen dioxide concentrations (Defra, UK Ambient Air Quality Interactive Map, 2015c), used to report exceedences of the limit value to the EU, does not identify any exceedences within 1 km of the development site. The national maps of roadside PM_{10} and $PM_{2.5}$ concentrations show no exceedences of the limit values anywhere in the UK. These maps are for 2014 concentrations; detailed maps of predicted future year exceedences are not available.

Background Concentrations

4.10 In addition to these locally measured concentrations, estimated background concentrations in the study area have been determined for 2014 and the opening year 2017 (Table 4). In the case of nitrogen oxides and nitrogen dioxide, two sets of future-year backgrounds are presented to take into account uncertainty in future year vehicle emission factors. The derivation of background concentrations is described in Appendix A3. The background concentrations are all well below the objectives.

Table 4: Estimated Annual Mean Background Pollutant Concentrations in 2014 and 2017 ($\mu g/m^3$)

Year	NO_2	PM_{10}	$PM_{2.5}$
2014 [a]	16.1	15.2	10.6
2017 – Without Reductions in Traffic Emissions [b]	15.2	n/a	n/a
2017 – With Reductions in Traffic Emissions [c]	14.7	14.7	10.1
Objectives	**40**	**40**	**25**

n/a = not applicable.

[a] This assumes that road vehicle emission factors in 2014 remain the same as in 2011 (See Appendix A3).

[b] This assumes that road vehicle emission factors in 2017 remain the same as in 2011.

[c] This assumes that road vehicle emission factors reduce between 2014 and 2017 at the current 'official' rates.

Baseline Dispersion Model Results

4.11 Baseline concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ have been modelled at each of the receptor locations shown in Figure 1 and Table 2. The results, which cover both the existing (2014) and future year (2017) baseline (Without Scheme), are set out in Table 5 and Table 6. The future baseline for nitrogen dioxide covers the two scenarios: with the official reductions in vehicle emission factors and without these reductions. The modelled road components of nitrogen oxides concentrations have been adjusted by a factor of 3.59, which was derived during the model verification process (see Appendix A3 for details of the model verification). The modelled road components of PM_{10} and $PM_{2.5}$ concentrations have also been adjusted by a factor of 3.59.

Table 5: Modelled Annual Mean Baseline Concentrations of Nitrogen Dioxide (μg/m^3) at Existing Receptors

Receptor	2014	2017 Without Scheme	
		With 'Official' Emissions Reduction [a]	Without Emissions Reduction [b]
1	37.6	32.3	37.5
2	38.0	32.6	37.8
3	21.4	19.0	20.8
4	36.4	31.0	36.3
5	35.1	30.1	34.9
6	23.6	20.5	23.0
7	22.8	19.9	22.2
8	21.8	19.3	21.1
9	38.4	33.0	38.3
10	36.3	31.0	36.2
11	30.6	26.3	30.3
12	38.4	32.4	38.4
13	36.1	30.5	35.9
Objective	40		

[a] This assumes that road vehicle emission factors reduce between 2014 and 2017 at the current 'official' rates.

[b] This assumes that road vehicle emission factors in 2017 remain the same as in 2014.

Table 6: Modelled Annual Mean Baseline Concentrations of PM_{10} and $PM_{2.5}$ at Existing Receptors (µg/m³)

Receptor	PM_{10}		$PM_{2.5}$	
	2014	2017 Without Scheme	2014	2017 Without Scheme
1	18.4	17.7	12.6	11.9
2	18.3	17.6	12.5	11.8
3	16.0	15.5	11.1	10.6
4	17.9	17.2	12.3	11.6
5	18.3	17.7	12.5	11.9
6	16.3	15.7	11.2	10.7
7	16.2	15.6	11.2	10.7
8	16.1	15.5	11.1	10.6
9	17.9	17.2	12.3	11.6
10	18.0	17.3	12.3	11.6
11	17.4	16.8	11.9	11.3
12	18.6	18.0	12.7	12.0
13	18.3	17.6	12.5	11.8
Objective / Criterion	32 [a]		25	

[a] While the annual mean PM_{10} objective is 40 µg/m³, 32 µg/m³ is the annual mean concentration above which an exceedence of the 24-hour mean PM_{10} concentration is possible, as outlined in LAQM.TG(09) (Defra, 2009). A value of 32 µg/m³ is thus used as a proxy to determine the likelihood of exceedence of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (EPUK & IAQM, 2015).

2014 Baseline

4.12 The predicted annual mean concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ are below the objectives in 2014 at all receptors. The annual mean PM_{10} concentrations are below 32 µg/m³ and therefore is it unlikely that the 24-hour mean PM_{10} will be exceeded.

2017 Baseline With 'Official' Emission Reduction

4.13 The predicted annual mean concentrations of nitrogen dioxide are below the objective in 2017 at all receptor locations. All of the predictions for PM_{10} and $PM_{2.5}$ are also below the objectives. The annual mean PM_{10} concentrations are below 32 µg/m³ and therefore is it unlikely that the 24-hour mean PM_{10} will be exceeded.

2017 Baseline Without Emission Reduction

4.14 The predicted annual mean concentrations of nitrogen dioxide are below the objective in 2017 at all receptor locations.

4.15 These results are consistent with the conclusions of Staffordshire Moorland District Council in the outcome of its air quality review and assessment work.

5 Impact Assessment

Road Traffic Impacts

5.1 Predicted annual mean concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ are set out in Table 7, Table 8 and Table 9 for both the "Without Scheme" and "With Scheme" scenarios. These tables also describe the impacts at each receptor using the impact descriptors given in Appendix A1. For nitrogen dioxide, results are presented for two scenarios to reflect current uncertainty in Defra's future-year vehicle emission factors.

Table 7: Predicted Impacts on Annual Mean Nitrogen Dioxide Concentrations in 2017 (µg/m³) [a]

Receptor	With 'Official' Emissions Reduction [b]				Without Emissions Reduction [c]			
	Without Scheme	With Scheme	% Change [d]	Impact Descriptor	Without Scheme	With Scheme	% Change [d]	Impact Descriptor
1	32.3	34.3	5	Slight Adverse	37.5	39.7	5	Moderate Adverse
2	32.6	34.4	5	Slight Adverse	37.8	39.9	5	Moderate Adverse
3	19.0	19.3	1	Negligible	20.8	21.1	1	Negligible
4	31.0	31.5	1	Negligible	36.3	36.8	1	Negligible
5	30.1	30.5	1	Negligible	34.9	35.4	1	Negligible
6	20.5	20.7	0	Negligible	23.0	23.2	1	Negligible
7	19.9	20.1	0	Negligible	22.2	22.4	0	Negligible
8	19.3	19.5	1	Negligible	21.1	21.5	1	Negligible
9	33.0	34.6	4	Slight Adverse	38.3	**40.2**	5	Moderate Adverse
10	31.0	31.6	1	Negligible	36.2	36.8	1	Negligible
11	26.3	26.7	1	Negligible	30.3	30.7	1	Negligible
12	32.4	32.8	1	Negligible	38.4	38.7	1	Slight Adverse
13	30.5	30.9	1	Negligible	35.9	36.3	1	Negligible
Objective	**40**		-	-	**40**		-	-

[a] Exceedences of the objective are shown in bold.

[b] This assumes that road vehicle emission factors reduce between 2014 and 2017 at the current 'official' rates.

[c] This assumes that road vehicle emission factors in 2017 remain the same as in 2014.

[d] % changes are relative to the objective and have been rounded to the nearest whole number.

Table 8: Predicted Impacts on Annual Mean PM_{10} Concentrations in 2017 (µg/m^3)

Receptor	Annual Mean PM_{10} (µg/m^3)			
	Without Scheme	With Scheme	% Change [a]	Impact Descriptor
1	17.7	18.2	2	Negligible
2	17.6	18.1	1	Negligible
3	15.5	15.6	0	Negligible
4	17.2	17.4	0	Negligible
5	17.7	17.8	0	Negligible
6	15.7	15.8	0	Negligible
7	15.6	15.7	0	Negligible
8	15.5	15.6	0	Negligible
9	17.2	17.5	1	Negligible
10	17.3	17.4	0	Negligible
11	16.8	16.9	0	Negligible
12	18.0	18.1	0	Negligible
13	17.6	17.7	0	Negligible
Criterion	**32 [b]**		-	-

[a] % changes are relative to the criterion and have been rounded to the nearest whole number.

[b] While the annual mean PM_{10} objective is 40 µg/m^3, 32 µg/m^3 is the annual mean concentration above which an exceedence of the 24-hour mean PM_{10} concentration is possible, as outlined in LAQM.TG(09) (Defra, 2009). A value of 32 µg/m^3 is thus used as a proxy to determine the likelihood of exceedence of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (EPUK & IAQM, 2015).

Table 9: Predicted Impacts on Annual Mean $PM_{2.5}$ Concentrations in 2017 ($\mu g/m^3$)

Receptor	Annual Mean $PM_{2.5}$ ($\mu g/m^3$)			
	Without Scheme	With Scheme	% Change [a]	Impact Descriptor
1	11.9	12.2	1	Negligible
2	11.8	12.1	1	Negligible
3	10.6	10.6	0	Negligible
4	11.6	11.7	0	Negligible
5	11.9	11.9	0	Negligible
6	10.7	10.8	0	Negligible
7	10.7	10.7	0	Negligible
8	10.6	10.7	0	Negligible
9	11.6	11.8	1	Negligible
10	11.6	11.7	0	Negligible
11	11.3	11.4	0	Negligible
12	12.0	12.1	0	Negligible
13	11.8	11.9	0	Negligible
Objective	**25**		-	-

[a] % changes are relative to the criterion and have been rounded to the nearest whole number.

Nitrogen Dioxide With 'Official' Emissions Reduction

5.2 The annual mean nitrogen dioxide concentrations are below the objective at all receptors regardless of whether or not the proposed development proceeds.

5.3 The percentage changes in concentrations, relative to the air quality objective (when rounded), are predicted to be 5 % at two of the receptors, 4 % at one of the receptors, 1 % at eight of the receptors and 0 % at two of the receptors. Using the matrix in Table A1.1 (Appendix A1), these impacts are described as *negligible to slight adverse.*

5.4 This scenario assumes that road traffic emissions will reduce at 'official' rates, which is a trend that has not materialised as expected to date. However, with the introduction of the new EURO 6 and EURO VI vehicle emissions standards in recent years (see paragraphs 3.11 and 3.12), the predicted reductions are expected to start to materialise. As such the actual concentrations in 2017 are expected to be similar to those predicted in this scenario.

5.5 The annual mean nitrogen dioxide concentrations are below 60 $\mu g/m^3$ at all of the receptor locations. It is, therefore, unlikely that the 1-hour mean nitrogen dioxide objective will be exceeded.

Nitrogen Dioxide Without Emissions Reduction

5.6 Assuming no reduction in vehicle emissions, the annual mean nitrogen dioxide concentrations are below the objective at all receptors, apart from Receptor 9 with the development. This receptor is not in a location previously identified with exceedences.

5.7 The percentage changes in concentrations, relative to the air quality objective (when rounded), are predicted to be 5 % at 3 of the receptors, 1 % at 9 of the receptors and 0 % at one of the receptors. Using the matrix in Table A1.1 (Appendix A1), these impacts are described as *negligible to moderate adverse.*

5.8 This scenario is based on worst-case assumptions regarding reductions in vehicle emissions and is unlikely to be realistic. In reality, some reduction in vehicle emissions between 2014 and 2017 is expected. The actual concentrations will most likely lie somewhere between this and the 'with emissions reduction' scenarios and are more likely to be represented by the 'with emissions reduction' concentrations. Even if there is no reduction in vehicle emissions between 2014 and 2017, this scenario is still very much conservative as discussed in the mitigation section of this report.

5.9 The annual mean nitrogen dioxide concentrations are below 60 $\mu g/m^3$ at all of the receptor locations. It is, therefore, unlikely that the 1-hour mean nitrogen dioxide objective will be exceeded.

PM_{10} and $PM_{2.5}$

5.10 The annual mean PM_{10} and $PM_{2.5}$ concentrations are well below the annual mean objectives at all receptors, with or without the scheme.

5.11 The percentage changes in both PM_{10} and $PM_{2.5}$ concentrations, relative to the air quality objective (when rounded), are predicted to be between 0 - 2 % at all of the receptors. Using the matrix in Table A1.1 (Appendix A1), these impacts are described as *negligible*.

5.12 The annual mean PM_{10} concentrations are below 32 $\mu g/m^3$ at all of the receptor locations. It is, therefore, unlikely that the 24-hour mean PM_{10} objective will be exceeded.

5.13 Predicted concentrations of both PM_{10} and $PM_{2.5}$ remain well below the objectives in 2017, whether the proposed scheme proceeds or not.

Significance of Operational Air Quality Impacts

5.14 The operational air quality impacts are judged to have potential to be 'not significant'. This professional judgement is made in accordance with the methodology set out in Appendix A1, and takes into account:

- the uncertainty over future projections of traffic-related nitrogen dioxide concentrations, which may not decline as rapidly as expected;
- the extent to which worst-case assumptions have been used about the expected additional traffic generated by the proposed development; and
- the likelihood of the air quality objectives being exceeded.

5.15 Consideration has been given to both sets of modelled results for nitrogen dioxide; those with and without reductions in traffic emissions. It is expected that concentrations will fall in the range between the two sets of results, although by 2017 the impacts are likely to be closer to the 'with reduction' results than the 'without reduction' results.

5.16 Potential *moderate adverse* impacts are only predicted on the assumption that emissions from road traffic do not reduce between 2014 and 2017. New Euro VI/6 emissions standards have recently come into force, requiring all new vehicles registered in the EU to meet much more stringent emissions standards for NOx. Early indications suggest that, unlike some of the older Euro emissions standards, the Euro VI and Euro 6 vehicles are delivering real reductions in emissions on the road. As these vehicles begin to make up an increasingly large proportion of the UK vehicle fleet in coming years, it is expected that this will drive reductions in roadside nitrogen dioxide concentrations. It is therefore judged that the 'with emissions reduction' results presented in this assessment report represent the more realistic suite of air quality impacts from the proposed McDonalds restaurant. In these circumstances the air quality objectives are expected to be achieved and impacts are predicted to be *negligible to slight adverse*.

5.17 In addition, the assessment is based on predictions of traffic generated by the proposed restaurant, which assumes that all vehicles visiting the restaurant will be new trips; i.e. that none of the vehicles arriving and departing from the restaurant would have been driving past the site anyway. In reality, a significant number of these trips will be stop-off visits, which would be passing the site in any case, and which therefore do not actually represent an increase with the scheme as they already exist in the baseline traffic flows. These vehicles have in essence been double counted.

5.18 Overall, based on the likelihood of Euro VI/6 emissions standards bringing about real reductions in vehicle NOx emissions and roadside nitrogen dioxide concentrations, and the degree of double counting in the traffic data used in the assessment, it is judged that the 'without emissions reduction' scenario model results, in which the moderate adverse impacts are predicted, are highly conservative. It is very likely that the actual air quality impacts will be lower than those presented in this scenario.

5.19 More specifically, the judgement that the air quality impacts will be 'not significant' takes account of the assessment that there is a risk of *slight* to *moderate adverse* impacts at some locations along Broad Street where the air quality objectives are expected to be achieved.

6 Conclusions

6.1 The operational impacts of increased traffic emissions arising from the additional traffic on local roads, due to the development, have been assessed. Concentrations have been modelled for thirteen worst-case receptors, representing existing properties where impacts are expected to be greatest. In the case of nitrogen dioxide, the modelling has been carried out assuming both that vehicle emissions decrease (using ‘official’ emission factors), and that they do not decrease in future years. This is to allow for uncertainty over emission factors for nitrogen oxides identified by Defra (Carslaw, Beevers, Westmoreland, & Williams, 2011).

6.2 It is concluded that concentrations of PM_{10} and $PM_{2.5}$ will remain below the objectives at all existing receptors in 2017, whether the scheme is developed or not. This conclusion is consistent with the outcomes of the reviews and assessments prepared by Staffordshire Moorland District Council, which show that exceedences of the PM_{10} objective are unlikely at any location.

6.3 In the case of nitrogen dioxide, it is likely that the annual mean concentrations remain below the objective at all existing receptors in 2017, whether the scheme is developed or not.

6.4 The additional traffic generated by the proposed development will affect air quality at existing properties along the local road network. The assessment has demonstrated that the maximum increase in concentrations of PM_{10} and $PM_{2.5}$ at relevant locations relative to the objectives will be 2% (when rounded) and the impacts will all be *negligible*.

6.5 In the case of nitrogen dioxide, the percentage increases are predicted to range from 5 % to 0 %, and the impacts are expected to range from *negligible* to *slight adverse*. In the unlikely event that there is no reduction in concentrations between 2014 and 2017, impacts may be considered *moderate adverse* at a small number of locations.

6.6 The assessment is based on conservative assumptions regarding traffic flows generated by the proposed restaurant, which ignores the proportion of vehicles using the restaurant which would be travelling along the roads adjacent to the site (Broad Street and Sneyd Street) regardless, and are thus double-counted in the ‘with scheme’ traffic flows. In addition, the latest evidence suggests that Euro VI/6 emissions standards will produce reductions in NOx emissions during real world driving conditions that previous Euro emissions standards did not completely deliver and thus concentrations in the opening year will be lower than predicted in the ‘without emissions reduction’ scenario.

6.7 The overall operational air quality impacts of the development are judged to be ‘insignificant’.

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8 Glossary

AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System model for Roads
AQC	Air Quality Consultants
AQAL	Air Quality Assessment Level
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network
DCLG	Department for Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EFT	Emission Factor Toolkit
EPUK	Environmental Protection UK
Exceedence	A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure
HDV	Heavy Duty Vehicles (> 3.5 tonnes)
HGV	Heavy Goods Vehicle
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
LDV	Light Duty Vehicles (<3.5 tonnes)
µg/m^3	Microgrammes per cubic metre
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides (taken to be NO_2 + NO)
NPPF	National Planning Policy Framework
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides

PM_{10}	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
$PM_{2.5}$	Small airborne particles less than 2.5 micrometres in aerodynamic diameter
PPG	Planning Practice Guidance
SPG	Supplementary Planning Guidance
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal

9 Appendices

A1 EPUK & IAQM Planning for Air Quality Guidance

A1.1 The guidance issued by EPUK and IAQM[4] (EPUK & IAQM, 2015) is comprehensive in its explanation of the place of air quality in the planning regime. Key sections of the guidance not already mentioned above are set out below.

Air quality as a material consideration

"Any air quality issue that relates to land use and its development is capable of being a material planning consideration. The weight, however, given to air quality in making a planning application decision, in addition to the policies in the local plan, will depend on such factors as:

- *the severity of the impacts on air quality;*
- *the air quality in the area surrounding the proposed development;*
- *the likely use of the development, i.e. the length of time people are likely to be exposed at that location; and*
- *the positive benefits provided through other material considerations".*

Recommended Best Practice

A1.2 The guidance goes into detail on how all development proposals can and should adopt good design principles that reduce emissions and contribute to better air quality management. It states:

"The basic concept is that good practice to reduce emissions and exposure is incorporated into all developments at the outset, at a scale commensurate with the emissions".

A1.3 The guidance sets out a number of good practice principles that should be applied to all developments that:

- include 10 or more dwellings;
- where the number of dwellings is not known, residential development is carried out on a site of more than 0.5 ha;
- provide more than 1,000 m^2 of commercial floorspace;
- are carried out on land of 1 ha or more.

A1.4 The good practice principles are that:

[4] The IAQM is the professional body for air quality practitioners in the UK.

- New developments should not contravene the Council's Air Quality Action Plan, or render any of the measures unworkable;
- Wherever possible, new developments should not create a new "street canyon", as this inhibits pollution dispersion;
- Delivering sustainable development should be the key theme of any application;
- New development should be designed to minimise public exposure to pollution sources, e.g. by locating habitable rooms away from busy roads;
- The provision of at least 1 Electric Vehicle (EV) "rapid charge" point per 10 residential dwellings and/or 1000 m^2 of commercial floorspace. Where on-site parking is provided for residential dwellings, EV charging points for each parking space should be made available;
- Where development generates significant additional traffic, provision of a detailed travel plan (with provision to measure its implementation and effect) which sets out measures to encourage sustainable means of transport (public, cycling and walking) via subsidised or free-ticketing, improved links to bus stops, improved infrastructure and layouts to improve accessibility and safety;
- All gas-fired boilers to meet a minimum standard of <40 mgNOx/kWh;
- Where emissions are likely to impact on an AQMA, all gas-fired CHP plant to meet a minimum emissions standard of:
    - Spark ignition engine: 250 mgNOx/Nm^3;
    - Compression ignition engine: 400 mgNOx/Nm^3;
    - Gas turbine: 50 mgNOx/Nm^3.
- A presumption should be to use natural gas-fired installations. Where biomass is proposed within an urban area it is to meet minimum emissions standards of 275 mgNOx/Nm^3 and 25 mgPM/Nm^3.

A1.5 The guidance also outlines that offsetting emissions might be used as a mitigation measure for a proposed development. However, it states that:

"It is important that obligations to include offsetting are proportional to the nature and scale of development proposed and the level of concern about air quality; such offsetting can be based on a quantification of the emissions associated with the development. These emissions can be assigned a value, based on the "damage cost approach" used by Defra, and then applied as an indicator of the level of offsetting required, or as a financial obligation on the developer. Unless some form of benchmarking is applied, it is impractical to include building emissions in this approach, but if the boiler and CHP emissions are consistent with the standards as described above then this is not essential".

A1.6 The guidance offers a widely used approach for quantifying costs associated with pollutant emissions from transport. It also outlines the following typical measures that may be considered to offset emissions, stating that measures to offset emissions may also be applied as post assessment mitigation:

- Support and promotion of car clubs;
- Contributions to low emission vehicle refuelling infrastructure;
- Provision of incentives for the uptake of low emission vehicles;
- Financial support to low emission public transport options; and
- Improvements to cycling and walking infrastructures.

Screening

Impacts of the Local Area on the Development

"There may be a requirement to carry out an air quality assessment for the impacts of the local area's emissions on the proposed development itself, to assess the exposure that residents or users might experience. This will need to be a matter of judgement and should take into account:

- *the background and future baseline air quality and whether this will be likely to approach or exceed the values set by air quality objectives;*
- *the presence and location of Air Quality Management Areas as an indicator of local hotspots where the air quality objectives may be exceeded;*
- *the presence of a heavily trafficked road, with emissions that could give rise to sufficiently high concentrations of pollutants (in particular nitrogen dioxide), that would cause unacceptably high exposure for users of the new development; and*
- *the presence of a source of odour and/or dust that may affect amenity for future occupants of the development".*

Impacts of the Development on the Local Area

A1.7 The guidance sets out two stages of screening criteria that can be used to identify whether a detailed air quality assessment is required, in terms of the impact of the development on the local area. The first stage is that you should proceed to the second stage if any of the follow apply:

- 10 or more residential units or a site area of more than 0.5 ha residential use;
- more than 1,000 m^2 of floor space for all other uses or a site area greater than 1 ha.

A1.8 Coupled with any of the following:

- the development has more than 10 parking spaces;
- the development will have a centralised energy facility or other centralised combustion process.

A1.9 If the above do not apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area. If they do apply then you proceed to stage 2, the criteria for which are set out below. The criteria are more stringent where the traffic impacts may arise on roads where concentrations are close to the objective. The presence of an AQMA is taken to indicate the possibility of being close to the objective, but where whole authority AQMAs are present and it is known that the affected roads have concentrations below 90% of the objective, the less stringent criteria is likely to be more appropriate.

- the development will lead to a change in LDV flows of more than 100 AADT within or adjacent to an AQMA or more than 500 AADT elsewhere;
- the development will lead to a change in HDV flows of more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
- the development will lead to a realigning of roads (i.e. changing the proximity of receptors to traffic lanes) where the change is 5m or more and the road is within an AQMA;
- the development will introduce a new junction or remove an existing junction near to relevant receptors, and the junction will cause traffic to significantly change vehicle acceleration/deceleration, e.g. traffic lights, or roundabouts;
- the development will introduce or change a bus station where bus flows will change by more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
- the development will have an underground car park with more than 100 movements per day (total in and out) with an extraction system that exhausts within 20 m of a relevant receptor;
- the development will have one or more substantial combustion processes where the combustion unit is:
  - any centralised plant using bio fuel;
  - any combustion plant with single or combined thermal input >300 kW; or
  - a standby emergency generator associated with a centralised energy centre (if likely to be tested/used >18 hours a year).
- the development will have a combustion unit of any size where emissions are at a height that may give rise to impacts through insufficient dispersion, e.g. through nearby buildings.

A1.10 Should none of the above apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area.

A1.11 The guidance also outlines what the content of the air quality assessment should include, and this has been adhered to in the production of this report.

Impact Descriptors and Assessment of Significance

A1.12 There is no official guidance in the UK on how to describe the nature of air quality impacts, nor how to assess their significance. The approach developed by EPUK and IAQM[5] (EPUK & IAQM, 2015) has therefore been used. This approach involves a two stage process:

- a qualitative or quantitative description of the impacts on local air quality arising from the development; and
- a judgement on the overall significance of the effects of any impacts.

Impact Descriptors

A1.13 Impact description involves expressing the magnitude of incremental change as a proportion of a relevant assessment level and then examining this change in the context of the new total concentration and its relationship with the assessment criterion. Table A1.1 sets out the method for determining the impact descriptor for annual mean concentrations at individual receptors, having been adapted from the table presented in the guidance document. For the assessment criterion the term Air Quality Assessment Level or AQAL has been adopted, as it covers all pollutants, i.e. those with and without formal standards. Typically, as is the case for this assessment, the AQAL will be the air quality objective value. Note that impacts may be adverse or beneficial, depending on whether the change in concentration is positive or negative.

[5] The IAQM is the professional body for air quality practitioners in the UK.

Table A1.1: Air Quality Impact Descriptors for Individual Receptors for All Pollutants [a]

Long-Term Average Concentration At Receptor In Assessment Year [b]	Change in concentration relative to AQAL [c]				
	0%	1%	2-5%	6-10%	>10%
75% or less of AQAL	Negligible	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Negligible	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Negligible	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Negligible	Moderate	Substantial	Substantial	Substantial

[a] Values are rounded to the nearest whole number.

[b] This is the 'without scheme' concentration where there is a decrease in pollutant concentration and the 'with scheme' concentration where there is an increase.

[c] 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)'.

Assessment of Significance

A1.14 There is no official guidance in the UK on how to assess the significance of air quality impacts. The approach developed by EPUK and IAQM[6] (EPUK & IAQM, 2015) has therefore been used. The guidance is that the assessment of significance should be based on professional judgement, with the overall air quality impact of the scheme described as either significant or not significant. In drawing this conclusion, the following factors should be taken into account:

- the existing and future air quality in the absence of the development;
- the extent of current and future population exposure to the impacts;
- the influence and validity of any assumptions adopted when undertaking the prediction of impacts;
- the potential for cumulative impacts. In such circumstances, several impacts that are described as '*slight*' individually could, taken together, be regarded as having a significant effect for the purposes of air quality management in an area, especially where it is proving difficult to reduce concentrations of a pollutant. Conversely, a '*moderate*' or '*substantial*' impact may not have a significant effect if it is confined to a very small area and where it is not obviously the cause of harm to human health; and
- the judgement on significance relates to the consequences of the impacts; will they have an effect on human health that could be considered as significant? In the majority of cases, the

[6] The IAQM is the professional body for air quality practitioners in the UK.

impacts from an individual development will be insufficiently large to result in measurable changes in health outcomes that could be regarded as significant by health care professionals.

A1.15 The guidance is clear that other factors may be relevant in individual cases. It also states that the effect on the residents of any new development where the air quality is such that an air quality objective is not met will be judged as significant.

A1.16 A judgement of the significance should be made by a competent professional who is suitably qualified. A summary of the professional experience of the staff contributing to this assessment is provided in Appendix A2.

A2 Professional Experience

Penny Wilson, BSc (Hons) CSci MIEnvSc MIAQM

Ms Wilson is a Principal Consultant with AQC, with more than fifteen years' relevant experience in the field of air quality. She has been responsible for air quality assessments of a wide range of development projects, covering retail, housing, roads, ports, railways and airports. She has also prepared air quality review and assessment reports and air quality action plans for local authorities and appraised local authority assessments and air quality grant applications on behalf of the UK governments. Ms Wilson has arranged air quality and dust monitoring programmes and carried out dust and odour assessments. She has provided expert witness services for planning appeals and is a Chartered Scientist and Member of the Institute of Air Quality Management.

Laurence Caird, MEarthSci CSci MIEnvSc MIAQM

Mr Caird is a Principal Consultant with AQC, with ten years' experience in the field of air quality including the detailed assessment of emissions from road traffic, airports, heating and energy plant, and a wide range of industrial sources including the thermal treatment of waste. He has experience in ambient air quality monitoring for numerous pollutants using a wide range of techniques and is also competent in the monitoring and assessment of nuisance odours and dust. Mr Caird has worked with a variety of clients to provide expert air quality services and advice, including local authorities, planners, developers and process operators. He is a Member of the Institute of Air Quality Management and is a Chartered Scientist.

Jonathan Dawson, BSc (Hons)

Mr Dawson is an Assistant Consultant with AQC, having joined the company in March 2015. He is completing an MSc in Environmental Consultancy at the University of West of England, part of which is a research investigation into the dispersion of particulate matter emissions from residential solid-fuel combustion in Bristol. Jonathan is gaining experience of undertaking air quality assessments for a range of developments, including the use of dispersion modelling.

Full CVs are available at www.aqconsultants.co.uk.

A3 Modelling Methodology

Background Concentrations

A3.1 The background pollutant concentrations across the study area have been defined using the national pollution maps published by Defra (2015b). These cover the whole country on a 1x1 km grid and are published for each year from 2011 until 2030. The maps include the influence of emissions from a range of different sources; one of which is road traffic. As noted in Paragraph 3.9, there is evidence that the current 'official' emissions factors published by Defra may over-predicted the rate at which road traffic emissions of nitrogen oxides will fall in the future. The maps currently in use were verified against measurements made during 2011 at a large number of automatic monitoring stations and so there can be reasonable confidence that the maps are representative of conditions during 2011. Similarly, there is reasonable confidence that the reductions which Defra predicts from other sectors (e.g. rail) will be achieved.

A3.2 In order to calculate background nitrogen dioxide and nitrogen oxides concentrations in 2014, it is assumed that there was no reduction in the road traffic component of backgrounds between 2011[7] and 2014. This has been done using the source-specific background nitrogen oxides maps provided by Defra (2015b). For each grid square, the road traffic component has been held constant at 2011 levels, while 2014 values have been taken for the other components. Nitrogen dioxide concentrations have then been calculated using the background nitrogen dioxide calculator which Defra (2015b) publishes to accompany the maps. The result is a set of 'adjusted 2014 background' concentrations.

A3.3 As an additional step, the 'adjusted 2014 background' mapped nitrogen dioxide values have been plotted against national background measurements made as part of the AURN (Defra, 2015d) during 2014 (see Figure A3.1). Based on the 40 sites with more than 75% data capture for 2014, the maps show an almost 1:1 relationship, being just 0.2% different. Thus no further adjustment has been applied to the 'adjusted' 2014 background concentrations and 2017 background concentrations.

[7] This approach assumes that there has been no reduction in emissions per vehicle, but that traffic volumes have remained constant. This is not the same as the assumption made for dispersion modelling, in which emissions per vehicle are held constant while traffic volumes are assumed to change year on year. This discrepancy is unlikely to influence the overall conclusions of the assessment.

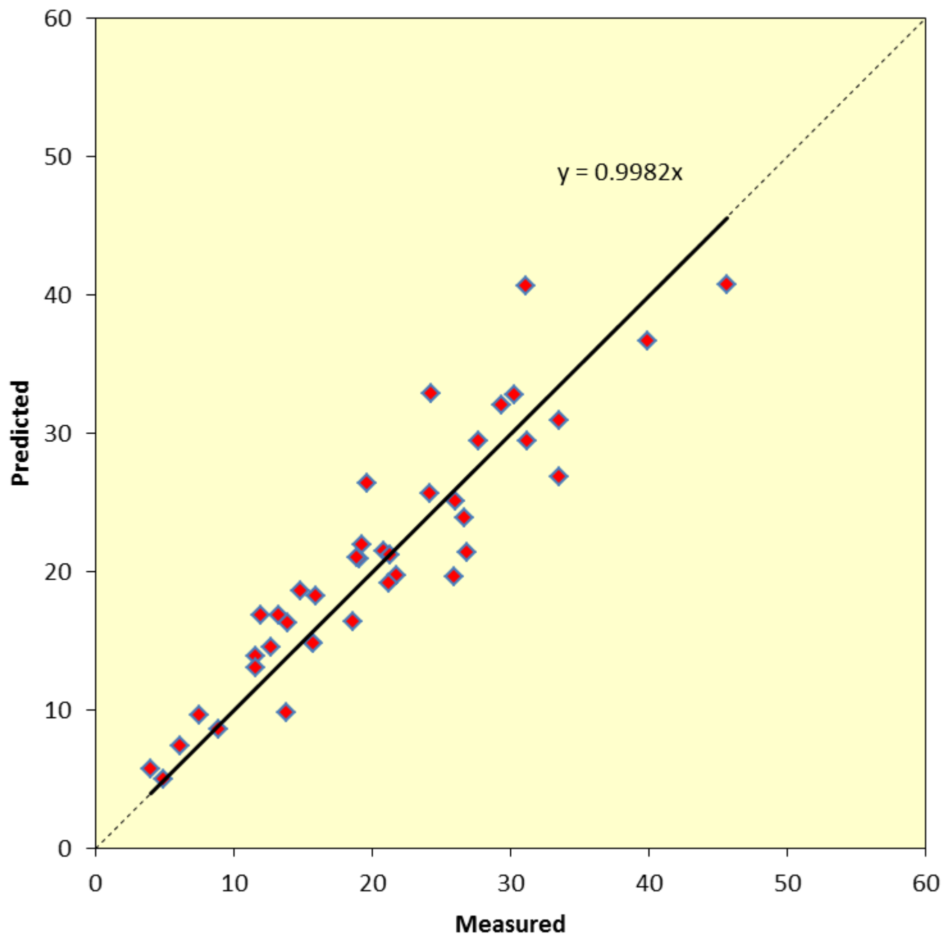

Figure A3.1: Predicted Mapped versus Measured NO_2 Concentrations at AURN Background Sites in 2014

A3.4 Two separate sets of 2017 background nitrogen dioxide and nitrogen oxides concentrations have been used for the future-year assessment. The 2017 background 'without emissions reduction' has been calculated using the same approach as described for the 2014 data: the road traffic component of background nitrogen oxides has been held constant at 2011 values, while 2017 data are taken for the other components. Nitrogen dioxide has then been calculated using Defra's background nitrogen dioxide calculator. The 2017 background 'with emissions reduction' assumes that Defra's revised predicted reductions occur from 2014 onward. This dataset has been derived first by calculating the ratio of the unadjusted mapped value for 2017 to the unadjusted mapped value for 2014. This ratio has then been applied to the adjusted 2014 value (as derived in Paragraph A3.2).

A3.5 For PM_{10} and $PM_{2.5}$, there is no strong evidence that Defra's predictions are unrealistic and so the year-specific mapped concentrations have been used in this assessment.

Model Inputs

A3.6 Predictions have been carried out using the ADMS-Roads dispersion model (v3.4). The model requires the user to provide various input data, including emissions from each section of road, and the road characteristics (including road width and street canyon height, where applicable). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the Emission Factor Toolkit (Version 6.0.2) published by Defra (2015b). For nitrogen dioxide, future-year concentrations have been predicted once using year-specific emission factors from the EFT, and once using emission factors for 2014[8], which is the year for which the model has been verified.

A3.7 The model has been run using the full year of meteorological data that corresponds to the most recent set of nitrogen dioxide monitoring data (2014). The meteorological data has been taken from the monitoring station located at Leek Thorncliffe, which is the nearest official Met Office and World Meteorological Society recognised monitoring site to the proposed development (4.5 km to the northeast) and is considered suitable for this assessment.

A3.8 AADT flows, speeds, and vehicle fleet composition data have been provided by ADL Traffic Engineering. Traffic speeds have been adjusted based on professional judgement, taking account of the road layout, speed limits and the proximity to a junction. The traffic data used in this assessment are summarised in Table A3.1.

Table A3.1: Summary of Traffic Data used in the Assessment (AADT)

Road	2014		2017 (Without Scheme)		2017 (With Scheme)	
	AADT	%HDV	AADT	%HDV	AADT	%HDV
Broad Street West of Sneyd Street	12226	5.5	12633	5.5	13274	5.2
Broad Street East of Sneyd Street	13673	3.4	14128	3.4	16926	2.8
Sneyd Street	3100	1.2	3203	1.2	3365	1.1
St Edward Street	7959	3.8	8224	3.8	8641	3.6
Brook Street	13611	5.5	14064	5.5	14777	5.2
Compton	16519	3.5	17069	3.5	17934	3.3

A3.9 Diurnal flow profiles for the traffic have been derived from the national diurnal profiles published by DfT (DfT, 2011).

A3.10 Figure A3.2 shows the road network included within the model and defines the study area.

8 i.e. combining current-year emission factors with future-year traffic data.

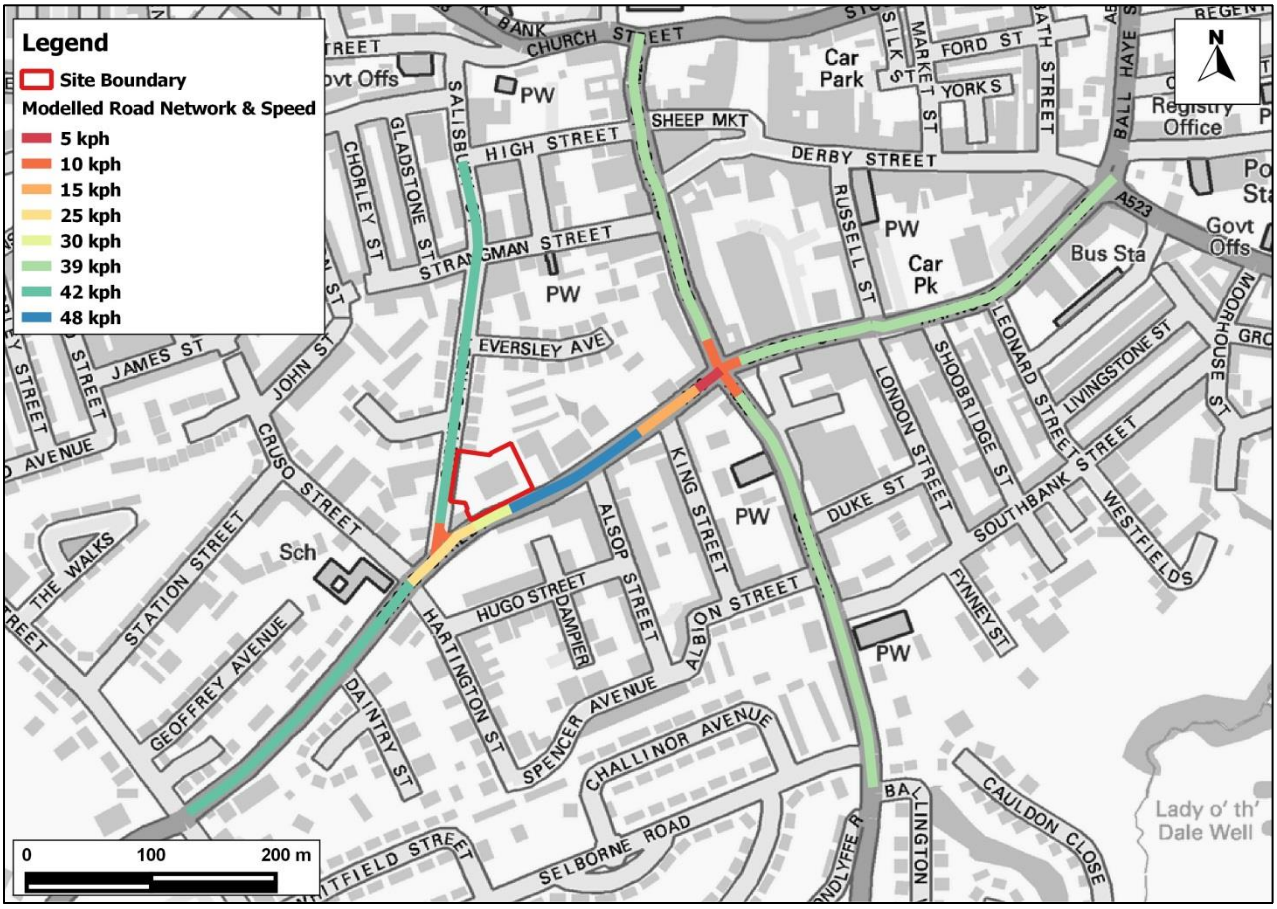

Figure A3.2: Modelled Road Network

Contains Ordnance Survey data © Crown copyright and database right 2015

Model Verification

A3.11 In order to ensure that ADMS-Roads accurately predicts local concentrations, it is necessary to verify the model against local measurements.

A3.12 Most nitrogen dioxide (NO_2) is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides (NOx = NO + NO_2). The model has been run to predict the annual mean NOx concentrations during 2014 at the Broad Street diffusion tube monitoring sites (25, 26, 33 and 34). Concentrations have been modelled at 2.5 m for diffusion tube 34 and 2.3 m for diffusion tubes 25, 26 and 33, which are the height of the monitors.

A3.13 The model output of road-NOx (i.e. the component of total NOx coming from road traffic) has been compared with the 'measured' road-NOx. Measured road-NOx has been calculated from the measured NO_2 concentrations and the predicted background NO_2 concentration using the NOx from NO_2 calculator (Version 4.1) available on the Defra LAQM Support website (Defra, 2015b).

A3.14 A primary adjustment factor has been determined as the slope of the best-fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (Figure A3.3). This factor has then been applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations. The total nitrogen dioxide concentrations have then been determined by combining the adjusted modelled road-NOx concentrations with the predicted background NO_2 concentration within the NOx to NO_2 calculator. A secondary adjustment factor has finally been calculated as the slope of the best-fit line applied to the adjusted data and forced through zero (Figure A3.4).

A3.15 The following primary and secondary adjustment factors have been applied to all modelled nitrogen dioxide data:

- Primary adjustment factor : 3.5865
- Secondary adjustment factor: 0.9949

A3.16 The results imply that the model has under predicted the road-NOx contribution. This is a common experience with this and most other models. The final NO_2 adjustment is minor.

A3.17 Figure A3.5 compares final adjusted modelled total NO_2 at each of the monitoring sites to measured total NO_2, and shows a 1:1 relationship.

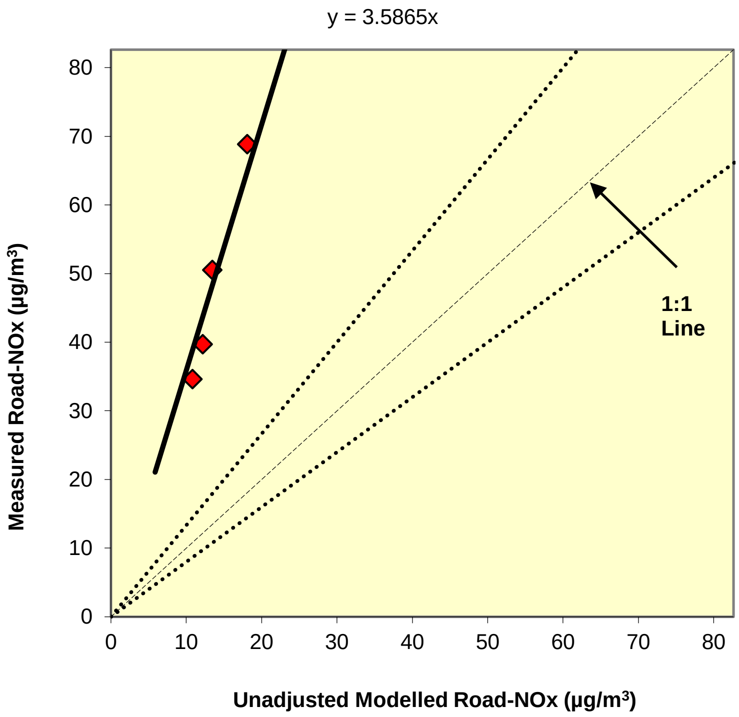

Figure A3.3: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%.

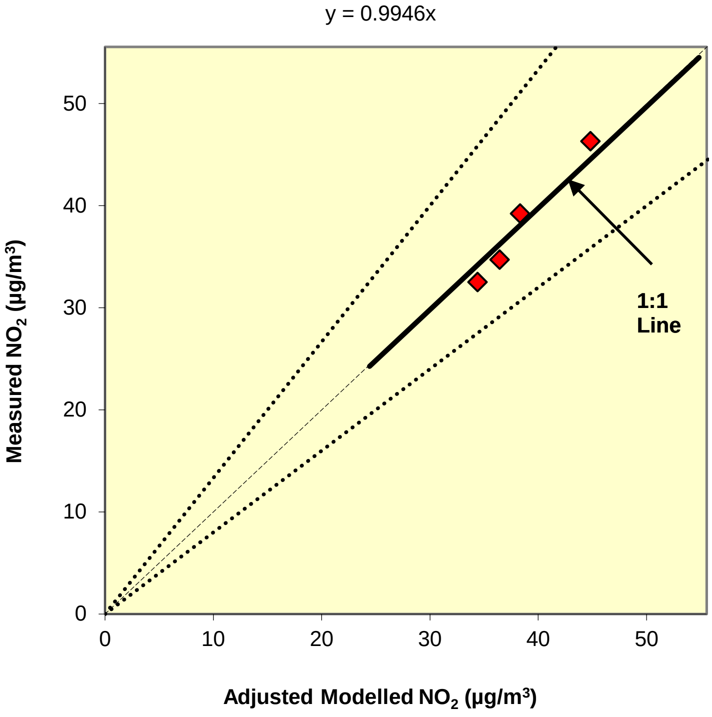

Figure A3.4: Comparison of Measured Total NO_2 to Primary Adjusted Modelled Total NO_2 Concentrations. The dashed lines show ± 25%.

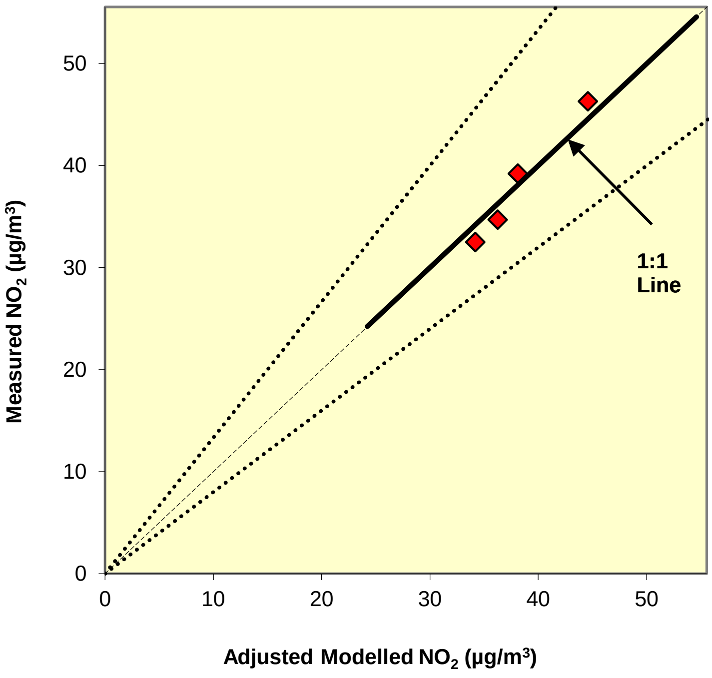

Figure A3.5: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations. The dashed lines show ± 25%.

PM_{10} and $PM_{2.5}$

A3.18 There are no nearby PM_{10} or $PM_{2.5}$ monitors. It has therefore not been possible to verify the model for PM_{10} or $PM_{2.5}$. The model outputs of road-PM_{10} and road-$PM_{2.5}$ have therefore been adjusted by applying the primary adjustment factor calculated for road NOx.

Model Post-processing

Nitrogen oxides and nitrogen dioxide

A3.19 The model predicts road-NOx concentrations at each receptor location. These concentrations have then been adjusted using the primary adjustment factor, which, along with the background NO_2, has been processed through the NOx to NO_2 calculator available on the Defra LAQM Support website (Defra, 2015b). The traffic mix within the calculator has been set to “All UK traffic”, which is considered suitable for the study area. The calculator predicts the component of NO_2 based on the adjusted road-NOx and the background NO_2. This has then been adjusted by the secondary adjustment factor to provide the final predicted concentrations.