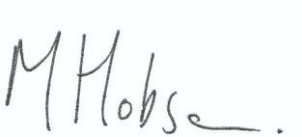


Air Quality Assessment for the proposed residential development at 173 – 175 King's Road, Reading



Report to WYG / Christina Meyer
November 2015

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Contents

1. Introduction	1
1.1 Assessment Criteria	1
1.2 Local Air Quality Management	2
1.3 The ADMS-Roads Method	3
2. Methodology.....	3
2.1 Local Pollutant Concentrations.....	3
2.2 Traffic data.....	6
2.3 Model input data	7
2.4 Conversion of NO _x to NO ₂	9
2.5 Model Verification	9
3. Results	10
3.1 Results of the dispersion modelling	10
3.2 Significance	11
3.3 Mitigation Measures.....	12
4. Summary and Conclusions	13
Appendix A – Model Verification	14
Appendix B – Traffic Data	15

1. Introduction

Aether has been commissioned by WYG to undertake an air quality assessment for the proposed conversion of an office building to 13 flats at 173 – 175 King's Road, Reading. The development will include parking for 36 cars. The report assesses the impact of local road traffic on sensitive receptor locations. This air quality assessment has been driven by the planning consent notice, which states:

“(10) The development hereby approved shall not be commenced until a scheme comprising measures to reduce the effects of poor air quality on the occupiers of the dwellings has been submitted to and approved in writing by the Local Authority. The scheme shall include a ventilation system that draws fresh air from the rear, or main roof level of the building.....”

The development falls within Reading Borough Council, which suffers from elevated levels of air pollution, primarily due to high levels of traffic. It is therefore important to assess whether there will be an exceedence of the air quality objectives for particulate matter (PM₁₀) or nitrogen dioxide (NO₂) at the proposed site and then advise whether any action is required to reduce the residents' exposure to air pollution. The assessment utilises ADMS-Roads, a comprehensive dispersion modelling tool for investigating air pollution problems due to small networks of roads and industrial sources.

The expected completion date of the proposed development is 2017. This assessment has therefore been completed for 2018, the expected first full year of occupation.

1.1 Assessment Criteria

A summary of the air quality objectives relevant to the Reading development, as set out in the UK Air Quality Strategy¹, is presented in Table 1 below.

Table 1: UK Air Quality Objectives for NO₂ and PM₁₀

Pollutant	Concentration	Measured as
Nitrogen Dioxide (NO ₂)	40 µg/m ³	Annual mean
	200 µg/m ³	Hourly mean not to be exceeded more than 18 times per year (99.8 th percentile)
Particulate Matter (PM ₁₀)	40 µg/m ³	Annual mean
	50 µg/m ³	24 hour mean not to be exceeded more than 35 times a year (90.4 th percentile)

¹ The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2007), Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland

The oxides of nitrogen (NO_x) comprise principally of nitric oxide (NO) and nitrogen dioxide (NO₂). NO₂ is a reddish brown gas (at sufficiently high concentrations) and occurs as a result of the oxidation of NO, which in turn originates from the combination of atmospheric nitrogen and oxygen during combustion processes. NO₂ can also form in the atmosphere due to a chemical reaction between NO and ozone (O₃). Health based standards for NO_x generally relate to NO₂, where acute and long-term exposure may adversely affect the respiratory system.

Particulate matter is a term used to describe all suspended solid matter, sometimes referred to as Total Suspended Particulate matter (TSP). Sources of particles in the air include road transport, power stations, quarrying, mining and agriculture. Chemical processes in the atmosphere can also lead to the formation of particles. Particulate matter with an aerodynamic diameter of less than 10 µm is the subject of health concerns because of its ability to penetrate deep within the lungs and is known in its abbreviated form as PM₁₀.

Further information on the health effects of air pollution can be found in the reports produced by the Committee on the Medical Effects of Air Pollutants².

As defined by the regulations, the air quality objectives for the protection of human health are applicable:

- Outside of buildings or other natural or man-made structures above or below ground; and
- Where members of the public are regularly present.

Using these definitions, the annual mean objectives will apply at locations where members of the public might be regularly exposed such as building façades of residential properties, schools and hospitals and will not apply at the building façades of offices or other places of work, where members of the public do not have regular access. Therefore in this assessment the annual mean objectives will apply at all floors of the residential development. The 24 hour objective will apply at all locations where the annual mean objective would apply together with hotels. The hourly objective will apply at all locations where members of the public could reasonably be expected to spend that amount of time. Therefore, in this assessment the annual mean objectives will apply at all levels of the development.

1.2 Local Air Quality Management

Local authorities are required to periodically review and assess the current and future quality of air in their areas. Where it is determined that an air quality objective is not likely to be met, the authority must designate an Air Quality Management Area (AQMA) and produce an Air Quality Action Plan (AQAP).

Reading Borough Council declared an AQMA³ in 2009 due to exceedence of the annual mean NO₂ objective. The AQMA covers Reading Town Centre, areas along the major radial road routes into Reading (including J11 of the M4) and along the railway lines where they pass through built-up areas. The proposed development site falls within the AQMA. An AQAP was produced in 2009

² <https://www.gov.uk/government/collections/comeap-reports>

³ http://uk-air.defra.gov.uk/aqma/details?aqma_id=25

following the declaration of the AQMA⁴, which identifies intervention and education/ promotion as the two keys areas under which actions to improve air quality will be implemented. A range of actions due to be implemented between now and 2020 are detailed in the AQAP.

1.3 The ADMS-Roads Method

Local air quality has been assessed using ADMS-Roads, a comprehensive dispersion model that can be used to predict concentrations of pollutants in the vicinity of roads and small industrial sources. The model has been used for many years in support of planning applications for new residential/commercial developments.

ADMS-Roads is able to provide an estimate of air quality both before and after development, taking into account important input data such as background pollutant concentrations, meteorological data, traffic flows and on-site energy generation (if applicable). The model output can be verified against local monitoring data to increase the accuracy of the predicted pollutant concentrations and this approach has been followed in this assessment.

The use of dispersion modelling enables estimates of concentrations to be made at varying heights. As a result, suggestions for appropriate mitigation measures can be made where necessary, taking into consideration the identification of worst-case locations.

The most recent version of ADMS-Roads (v3.2) was issued in January 2015 and requires the following information to assess the impact at sensitive receptor locations:

- Setup: General site details and modelling options to be used;
- Source: Source dimensions and locations, release conditions, emissions;
- Meteorology: hourly meteorological data;
- Background: Background concentration data;
- Grids: Type and size of grid for output; and
- Output: Output required and sources/groups to include in the calculations.

2. Methodology

2.1 Local Pollutant Concentrations

It is good practice to include up-to-date local background pollutant concentrations in the assessment model, and also to verify modelled outputs against local monitoring data where available. This section provides an overview of the local data available for use in the assessment.

Local monitoring data

Reading Borough Council has four automatic monitoring sites which monitor both nitrogen dioxide (NO₂) and particulate matter (PM₁₀). NO₂ concentrations are also measured passively at diffusion tube sites across the Borough. Two of these diffusion tube sites lie in close proximity to the development site. Details of the monitoring sites near to the development site are given in Table 2.

⁴ http://www.reading.gov.uk/media/4209/Air-Quality-Action-Plan/pdf/AQAP_Proposed_actions.pdf

Monitoring results have been taken from the Council’s latest Updating and Screening Assessment (USA) report⁵.

Table 2: Annual mean NO₂ concentrations recorded in Reading

Site Name	Site Type	Pollutant(s)	Grid Reference	Distance to Kerb (m)	Approx. Distance to Development Site (m)
King’s Road (RD2)*	R	NO ₂ , PM ₁₀	473057, 173205	5	580
Reading AURN*	UB	NO ₂ , PM ₁₀	473441, 173198	100	970
Kings Oak Flat – Queens Rd (DT1)	R	NO ₂	472010, 173222	6.5	480
276 Kings Rd (DT2)	R	NO ₂	472716, 173218	10	250

Note: R = roadside, UB = urban background, * automatic monitor.

The diffusion tubes were analysed by Gradko International Ltd, who participate in the WASP scheme⁶. Whilst diffusion tubes provide an indicative estimate of pollutant concentrations, they tend to under or over read. The data is therefore corrected using a bias adjustment factor. There are two types of bias adjustment factor – local and national. The local factor is derived from co-locating diffusion tubes (usually in triplicate) with automatic monitors, whereas the national factor is obtained from the average bias from all local authorities using the same laboratory. Reading Borough Council has applied the national adjustment factors (0.97) to their 2014 diffusion tube results.

Monitoring results are presented in Table 3. The data shows that the annual mean NO₂ concentration has exceeded the objective every year from 2012 – 2014 at the automatic monitoring site, but remained below the objective at both of the diffusion tube sites (although concentrations were very close to the objective level in 2013 at the DT1 site). Some exceedences of the 1 hour mean NO₂ objective have been recorded at the automatic monitor in recent years but this remains below the objective. Diffusion tubes do not provide information on hourly exceedences, but research⁷ identified a relationship between the annual and 1 hour mean objective, such that exceedences of the latter were considered unlikely where the annual mean was below 60 µg/m³. Therefore it is likely that no exceedences of the 1 hour mean NO₂ objective occurred at either of the diffusion tube sites in 2012, 2013 or 2014.

No exceedences of either the annual or hourly PM₁₀ objective have been recorded at the automatic monitoring site in the past three years.

⁵ At the time of completing this report, the 2015 USA was not available through the Council’s website. Reading’s 2013 Progress Report is available from: <http://beta.reading.gov.uk/media/1259/2013-Progress-Report/pdf/2013-Progress-Report-Reading.pdf>

⁶ This is a national QA/ QC scheme

⁷ As described in Section 2.31 of LAQM Technical Guidance (TG09).

Table 3: Monitoring results for sites close to the proposed development site, 2012-2014

Objective	Site Name	2012	2013	2014
Annual mean NO ₂ (µg/m ³)	RD2*	54	<u>61</u>	50
	AURN*	25	27	27
	DT1	37	39	36
	DT2	36	34	36
Hourly mean NO ₂ (no. exceedences)	RD2*	0	4	1
	AURN*	0	0	0
Annual mean PM ₁₀ (µg/m ³)	RD2*	29	32	31
	AURN*	18	13	14
Daily mean PM ₁₀ (no. exceedences)	RD2*	18	24	31 ^a
	AURN*	12	NA	0

Note: Values exceeding the 40 µg/m³ annual mean objective are shown in bold, values above 60 µg/m³ are also underlined, NA – data unavailable, * automatic monitor, ^a Low data capture (< 80%)

Background mapped data

Background pollutant concentration maps are available from the Defra LAQM website⁸ and data has been extracted for Reading for this assessment. These 2011 baseline, 1 kilometre grid resolution maps are derived from a complex modelling exercise that takes into account emissions inventories and measurements of ambient air pollution from both automated and non-automated sites.

There are indications from national monitoring data that 2011 was an unusually high year for PM₁₀. Scaling factors have been derived to calculate a more typical case estimate for projections calculated from a reference year of 2011. A factor of 0.91 has been derived by comparing measured concentrations in 2011 with those for 2008, 2009, 2010 and 2012. This approach has been followed in this assessment⁹

The estimated mapped background NO_x, NO₂ and PM₁₀ concentrations around the development site are 42.3 µg/m³, 26.4 µg/m³ and 17.5 µg/m³ respectively in 2014. The background maps also provide projections to future years. For 2018 (the first estimated year of occupation), the concentrations obtained for the same pollutants are 38.0 µg/m³, 24.2 µg/m³ and 16.8 µg/m³ respectively.

Background concentrations can also be obtained from a nearby urban background monitoring site (Table 2). Results from this monitoring site are detailed in Table 3. However, this monitoring station is located approximately 1 km from the development site, in the adjacent grid square. The monitoring results at the urban background site for 2014 (27 µg/m³) were very similar to the mapped concentration therefore giving confidence to the 2014 mapped background concentrations, which have been used in this assessment. To give a 'worst case' scenario, the projected improvements in background air quality by 2018 have not been used in the dispersion modelling.

⁸ <http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html>

⁹ <http://laqm.defra.gov.uk/documents/Background-maps-user-guide-v1.0.pdf>

2.2 Traffic data

Average annual daily traffic (AADT) count data for 2014 (the selected baseline year) has been obtained for King's Road (A329), London Road (A4) and Queen's Road (A329) from Department for Transport (DfT) Traffic Counts¹⁰, which provides data for major roads. For the minor roads, estimates are based upon average values for an 'urban minor road, South East' from the DfT National Road Traffic Survey, 2013¹¹. All roads within 200 metres of the modelled receptors have been included in the assessment. The values are shown in Appendix B.

According to DfT traffic counts, the AADT increased on King's Road between 2013 and 2014. It is therefore reasonable to assume that traffic levels will continue to grow in the near future. The RTF¹² model has been used to project traffic growth between 2014 (the baseline year) and 2018 (the development year) and a 6% growth is estimated.

The proposed development includes 36 car parking spaces. As a conservative estimate an additional 144 trips a day (2 return trips / day) has been assumed. The resulting estimated increase in daily car trips has been taken into account in the assessment for roads with direct access to the site with development in 2018; however this has no accountable impact on modelled concentrations (see Table 4). As a result, the assessment and its conclusions are focused on the exposure of residents to the currently elevated levels of pollutant concentrations, rather than assessing the impacts of the development per se.

We have assumed an average speed of 48.3kph on all surrounding roads, based on their respective speed limits.

Queuing Traffic

Special consideration has been given to notable junctions modelled in this assessment. CERC note 60¹³ has been used for estimating emissions from queuing traffic. This defines a representative AADT for queuing traffic to be 30,000 at 5 kph, assuming an average vehicle length of 4m. These figures, along with the traffic composition of the corresponding roads were then input into the Emission Factor Toolkit (EFT)¹⁴ to calculate emission rates. The emission rates were then used within the dispersion model as separate road sources of pre-defined length representing each queue with time-varying emission profiles applied to represent busy periods.

¹⁰ <http://www.dft.gov.uk/traffic-counts>

¹¹ <http://www.dft.gov.uk/statistics/series/traffic/>

¹² <http://laqm.defra.gov.uk/documents/RTF-Automated-Traffic-Growth-Calculator-v3-1.xls>

¹³ Cambridge Environmental Research Consultants Ltd, Modelling Queuing Traffic – note 60, 20th August 2004

¹⁴ Latest version 6.0.2, <http://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html>

2.3 Model input data

Hourly meteorological data from Heathrow (2014) has been used in the model. The wind-rose diagram (Figure 1) presents this below. Data from Heathrow has been used as this is deemed to be representative of the development site location.

Figure 1: Wind-rose diagram for Heathrow meteorological data, 2014

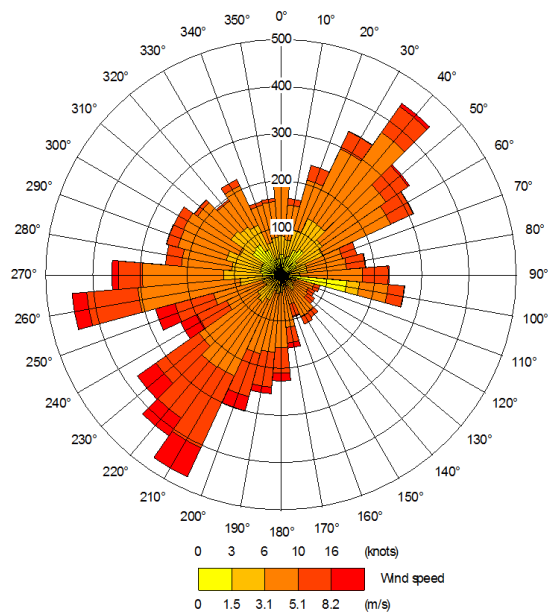
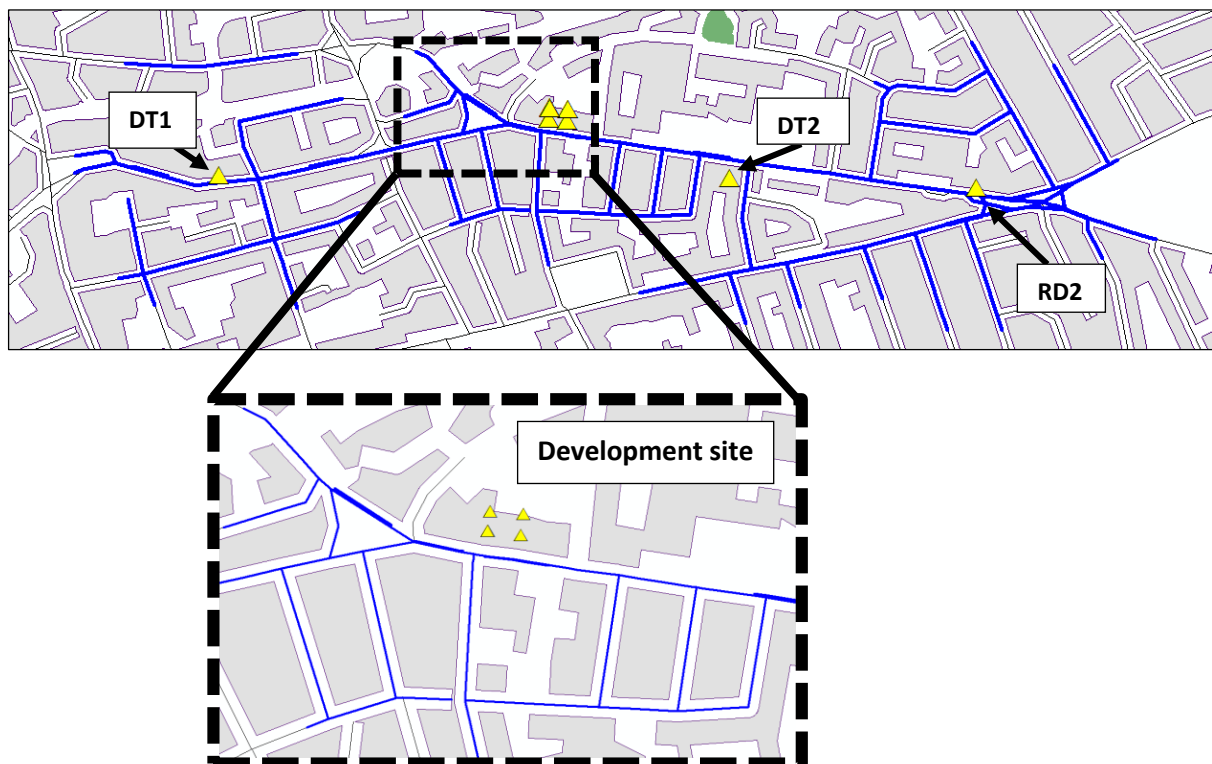


Figure 2: Road sources and receptors, detailing the location of the verification sites and a close-up of the development site



ArcMap software has been used to model the road source locations (blue lines) that are within 200 metres of the receptor locations (yellow triangles). This data can then be automatically uploaded to ADMS-Roads. This generates an accurate representation of the surrounding area to be assessed in the model in terms of the length of roads and distances between sources and receptors. This is shown in Figure 2 above.

Twelve sensitive receptor locations have been selected for the assessment:

- A. South-west corner of the development, closest to King's Road and the busy A329 junction (ground, 1st, 2nd and 3rd floor level receptors)
- B. South-east corner of the development, closest to King's Road (ground and 1st floor level receptors)
- C. North-west corner of the development, representing the drop-off in pollutant concentration with distance from the road (ground, 1st, 2nd and 3rd floor level receptors)
- D. North-east corner of the development, representing the drop-off in pollutant concentration with distance from the road (ground and 1st floor level receptors)

These sites have been chosen to reflect the extremities of the site and their proximity to road traffic sources. The architects plans (Figure 3) show the development site in more detail with receptor locations highlighted (yellow triangles). An assessment is made for the receptors at varying heights, based on architect plans (Figure 4), to assess likely concentrations across floor levels. Exposure has been assumed to be represented at the mid-point of each floor.

Figure 3: The locations of the receptors used in the modelling

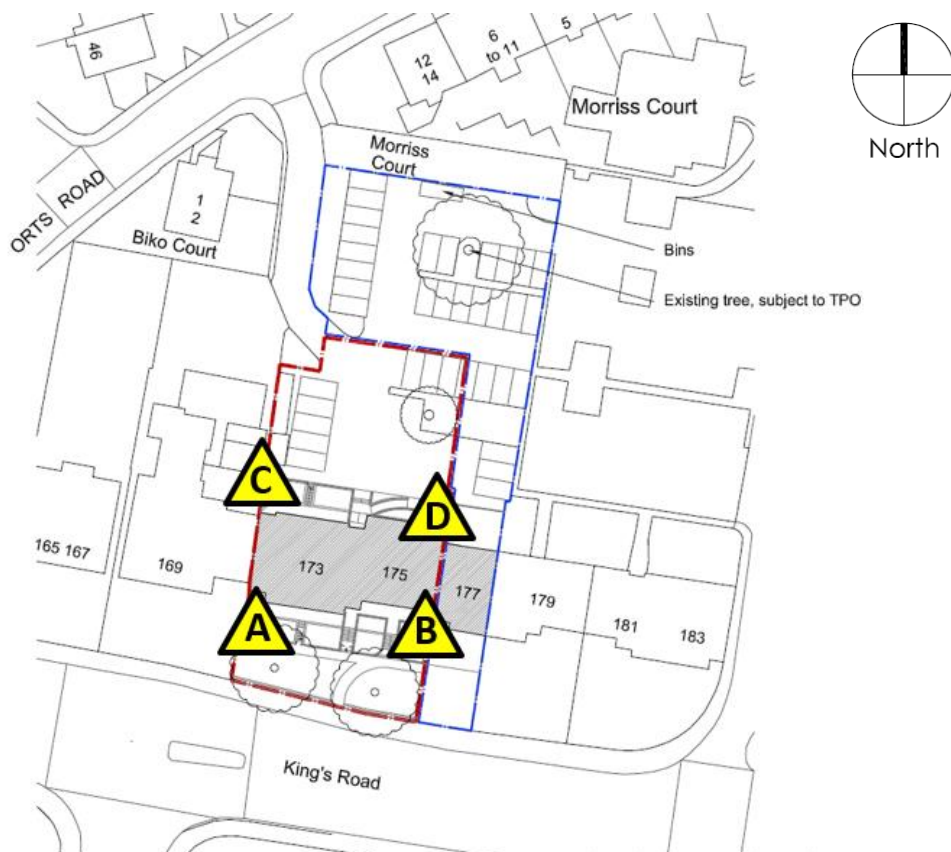


Figure 4: The front of the building, illustrating the location of receptors used in the modelling across varying floor heights



2.4 Conversion of NO_x to NO_2

Recent evidence shows that the proportion of primary NO_2 in vehicle exhaust has increased¹⁵. This means that the relationship between NO_x and NO_2 at the roadside has changed from that currently used in the ADMS model. A NO_x to NO_2 calculator (Published in June 2014)¹⁶ has therefore been developed and has been used in conjunction with the ADMS model to obtain a more accurate picture of NO_2 concentrations.

2.5 Model Verification

Modelled annual mean road- NO_x estimates have been verified against the concentrations measured at the RD2 automatic monitor located on King's Road and two diffusion tube sites (DT1 and DT2) both located on the A329 (see Appendix A). In addition, modelled annual mean PM_{10} estimates have been verified against the concentrations measured at the RD2 automatic monitor (see Appendix A).

¹⁵ <http://uk-air.defra.gov.uk/assets/documents/reports/aqeg/primary-no-trends.pdf>

¹⁶ <http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOXNO2calc>

3. Results

3.1 Results of the dispersion modelling

Table 4 below presents the worst-case scenario for development in 2018, with background concentrations and vehicle fleet emission factors maintained at 2014 levels.

Table 4: Estimated worst-case pollutant concentrations in 2018 ($\mu\text{g}/\text{m}^3$) both with and without the development

Receptor	Floor level	Annual mean NO ₂ concentration ($\mu\text{g}/\text{m}^3$)		Annual mean PM ₁₀ concentration ($\mu\text{g}/\text{m}^3$)	
		With development	Without development	With development	Without development
A	Ground	43.0	43.0	25.4	25.4
B		41.5	41.5	24.7	24.7
C		38.0	38.0	22.8	22.8
D		36.2	36.2	22.0	22.0
A	First	39.6	39.5	23.6	23.6
B		38.2	38.2	23.0	23.0
C		36.4	36.4	22.1	22.1
D		34.9	34.9	21.4	21.4
A	Second	35.0	35.0	21.4	21.4
C		34.0	34.0	20.9	20.9
A	Third	31.6	31.6	19.9	19.9
C		31.6	31.6	19.9	19.9

Note: Exceedences of the objectives are highlighted

For completeness, the model has been run both with and without development. The results indicate that only a slight increase ($< 0.03 \mu\text{g}/\text{m}^3$) in annual mean NO₂ concentrations would occur as a direct result of the development. Annual mean NO₂ concentrations are predicted to be above the annual mean objective at the ground floor receptors A and B, located at the front of the building (see Figure 4). At all other locations the annual mean NO₂ concentrations are predicted to remain below the objective. However, the receptors located at the back of the site on the ground floor (C & D), and the receptors located on the first floor at the front of the building (A and B) are very close to the objective level. Overall, the worst-case location is identified as receptor A, which is located closest to King's Road and the busy A329 junction, where roadside concentrations will be maximised.

The annual mean NO₂ concentrations are in line with expectations. The nearby monitoring data results for annual mean NO₂ concentration in 2014 range from 36 – 50 $\mu\text{g}/\text{m}^3$. All ground floor receptors estimate the annual mean NO₂ concentration to be within this range, but remain lower than the results from the RD2 automatic monitoring site (Table 3). This is likely to be due the proximity of the RD2 site to the busy A329 – A4 junction (Figure 2) where pollutant concentrations are expected to be higher than at the development site.

The Guidance states that authorities may assume exceedences of the mean hourly objective are only likely to occur where annual mean concentrations are 60 µg/m³ or above. Therefore, it is considered unlikely that this objective will be exceeded at any of the receptors. This is comparable with the nearby local monitoring data in which few exceedences of the mean hourly NO₂ objective have been reported (see Section 2.1).

The model estimates no exceedence against either the annual or daily mean PM₁₀ objectives. As with the NO₂ results, the predicted PM₁₀ concentrations are in line with expectations and remain lower than the measured results at the RD2 site, where higher concentrations are to be expected.

3.2 Significance

Professional judgement is an important part of the assessment of significance. However, there are various documents available that attempt to qualitatively or quantitatively provide ways of assessing the significance of a development on air quality. The most commonly applied is the Environmental Protection UK's Air Quality Guidance Document¹⁷ which outlines how impacts may be assessed quantitatively. The assessment is made up of two steps – firstly to assess the magnitude of change in concentration (e.g. between with and without development) relative to the objective level, and secondly the percentage above / below the objective based upon the total modelled concentration at a given location or receptor. By combining these two values, you can obtain the impact descriptor. This method is presented in Table 5 below.

Table 5: Significance of change description

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

In applying these criteria, it can be concluded that there is likely to be no significant impact on local annual mean NO₂ concentrations as the change in concentration due to the development is < 0.03 µg/m³ at the worst-case location. This results in an overall percentage change of less than 1 % in concentration relative to the Air Quality Assessment Level. Therefore, the development is classed as having an 'imperceptible' effect on local air quality.

However, this is a fairly simplistic conclusion and other factors may also need to be considered in order to make transparent conclusions. Specific factors to consider may include:

¹⁷ http://www.iaqm.co.uk/text/guidance/epuk/eq_guidance.pdf

1. Number of properties affected by the slight, moderate or major impacts and a judgement of the overall balance.
2. Where new exposure is being introduced into an existing area of poor air quality, then the number of people exposed to levels above the objective or limit value will be relevant.
3. The magnitude of the changes and descriptions of the impacts at the receptors
4. Whether or not an exceedence of an objective or limit value is predicted to arise in the study area where none existed before or an exceedence area is substantially increased.
5. Whether or not the study area exceeds an objective or limit value and this exceedence is removed or the exceedence area is reduced.
6. Uncertainty, including the extent to which worst case assumptions have been made.
7. The extent to which an objective or limit value is exceeded, for example an annual mean of 41 $\mu\text{g}/\text{m}^3$ should attract less significance than an annual mean of 51 $\mu\text{g}/\text{m}^3$.

In this case, new exposure is being introduced into an existing area of poor air quality, and mitigation measures are required to reduce the exposure of residents to air pollution.

3.3 Mitigation Measures

The development will not cause a significant worsening of air quality as the impact is classed as 'imperceptible'. However, based on the ADMS results for estimated annual mean NO_2 concentrations, it is recommended that mitigation in the form of mechanical ventilation is installed, as concentrations are estimated to be above the annual NO_2 objective level at worst-case locations. It is recommended that mechanical ventilation is installed, with an inlet at roof level at the rear of the building where NO_2 concentrations are lowest, and circulated to all other floors.

The developer is encouraged to refer to the National House Builders Registration Council's (now NHBC) guidance for installing mechanical ventilation, found in Chapter 3.2 'Mechanical ventilation with heat recovery'¹⁸. Some best practice for installing and maintaining mechanical ventilation includes:

- Insulating ductwork and other components from the cold
- Ensuring the appropriate location of inlet and extract to allow for maintenance and change of filters
- Checking filters following construction as they may be blocked with construction dust

In addition, the developer is encouraged to consider further mitigation measures in order to minimise the use of private vehicles by residents. Such measures include: providing cycle storage, promoting car share schemes, and installing electric charging points.

¹⁸ <http://www.nhbc.co.uk/Builders/ProductsandServices/TechnicalStandards/>

4. Summary and Conclusions

An air quality assessment has been undertaken for a proposed conversion of an office building to 13 residential flats at 173 – 175 King's Road, Reading. Reading Borough Council has declared an Air Quality Management Area covering Reading Town Centre, areas along the major radial road routes into Reading and along some railway lines. The proposed development lies within this AQMA.

An air quality assessment has been carried out using the ADMS-Roads dispersion model to determine the impact of emissions from road traffic on sensitive receptors. Additional car journeys generated as a result of the development have been considered and are estimated to have an 'imperceptible' significance on local air quality. The assessment is therefore primarily concerned with the potential exposure of residents in the new development to elevated concentrations of NO₂ and PM₁₀, the primary pollutants associated with road traffic, rather than the impact of the development per se.

Predicted concentrations have been compared with the air quality objectives. The results of the assessment indicate that annual mean NO₂ concentrations are above the objective at worst-case locations. Concentrations of PM₁₀ are predicted to be well within the annual mean objective in 2018. Based on the evidence it is considered unlikely that there will be exceedences of either short term objective for NO₂ or PM₁₀.

On the ground and first floor of the development, all receptors are predicted to either be in exceedence of, or close to, the annual mean NO₂ objective. It is recommended that mechanical ventilation is installed with inlets at the rear of the building at the main roof level of the building, and circulated to all other floors of the development. Other measures, such as providing cycle storage, car share schemes, and installing electric charging points, could also be considered to minimise the use of private vehicles by residents.

Appendix A – Model Verification

In order to verify modelled pollutant concentrations generated in the assessment, the model has been run to predict the annual mean road-NO_x concentration during 2014 at the RD2 automatic monitor site and two diffusion tube sites described in Table 2.

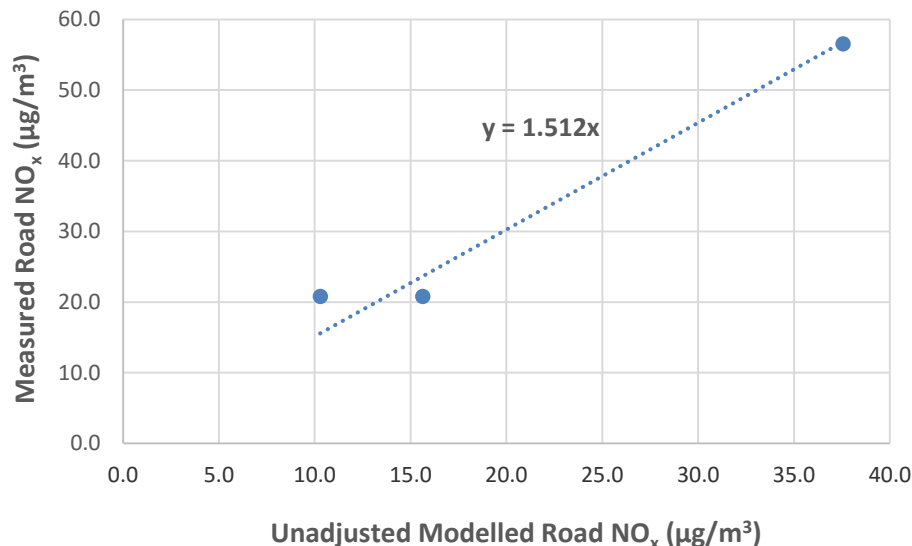
The model output of road-NO_x has been compared with the ‘measured’ road-NO_x. Measured road-NO_x for the monitoring sites was calculated using the NO_x to NO₂ calculator¹⁶.

A primary adjustment factor was determined to convert between the ‘measured’ road contribution and the model derived road contribution (Figure A.1). This factor was then applied to the modelled road-NO_x concentration for each receptor to provide adjusted modelled road-NO_x concentrations. Total NO₂ concentrations were then determined by combining the adjusted modelled road-NO_x concentrations with the 2014 background NO₂ concentration.

The results imply that the model was under-predicting the road-NO_x contribution. This is a common experience with ADMS and most other models.

Separate model verification was undergone for the PM₁₀ results, the modelled PM₁₀ concentrations at the RD2 automatic monitor site were compared to the measured 2014 results, detailed in Table 3. The results imply that the model was under-predicting the PM₁₀ contribution, a conversion factor of 1.6 was applied to the modelled PM₁₀ results.

Figure A.1: Comparison of Measured road-NO_x to unadjusted modelled road-NO_x concentrations



Appendix B – Traffic Data

Table B.1: Traffic data for 2014 (and predictions for 2018)

Development / verification site	Road links	Annual Average Daily Traffic (AADT)	% Heavy Duty Vehicles (HDV)	Speed (kph)
Development site	King’s Road (A329)	21,136 (22,414)	5.46	48.3
	Minor roads	2,300 (2,439)	2.60	48.3
Verification sites	London Road (A4)	22,500	4.86	48.3
	Queen’s Road (A329)	19,870	2.45	48.3



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