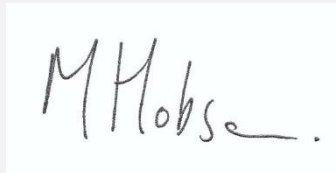


Air Quality Assessment for the proposed development at Caversham Park, Reading

**Report to Beechcroft
Developments Ltd**

July 2023

Title	Air Quality Assessment for the proposed development at Caversham Park
Customer	Beechcroft Developments Ltd
Recipient	Joanne Nayler
Report Reference	AQ_assessment/2022/Caversham Park
Report Status	Version 6
Revisions	Version 6 – updated to reflect new site plans and TAA Version 5 – updated to take into account new site plans Version 4 – updated to incorporate new traffic data (1st Nov 2023) Version 3 – updated to incorporate the committed golf club development and the current planning permission scenario (16th October 2022) Version 2 – updated to take into account new site plans (15th March 2022) Version 1 – draft for customer comment (17th February 2022)

Author	Annie Thornton
Reviewed by	Melanie Hobson
Signature	
Date	12 th May 2023

Company Details:	Aether Ltd Oxford Centre for Innovation New Road Oxford OX1 1BY UK Registered in England 6630896
Contact:	enquiries@aether-uk.com +44(0)1865 261466 www.aether-uk.com

Contents

1	Introduction	1
1.1	The Location of the Development	1
1.2	Assessment Criteria	2
1.3	Local Air Quality Management.....	3
1.4	The ADMS-Roads Method	3
2	Methodology	4
2.1	Local Pollutant Concentrations	4
2.1.1	Local monitoring data	4
2.1.2	Background mapped data.....	6
2.2	Model input data	6
2.3	Traffic data	11
2.3.1	Queuing Traffic	12
2.4	Conversion of NO _x to NO ₂	12
2.5	Model Verification	12
3	Results	13
3.1	Results of the Dispersion Modelling	13
3.2	Significance	16
3.3	Mitigation Measures	17
3.4	Mitigating the Impacts of the Construction Phase	19
4	Summary and Conclusions.....	20
	Appendix A – Model Verification	22
	Appendix B – Traffic Data	23

1 Introduction

Aether has been commissioned by Beechcroft Developments Ltd to undertake an air quality assessment for the proposed development at Caversham Park. From 1943, the site was home to BBC monitoring and related uses; however, in recent years the BBC has been winding down its operations. The development will consist of redevelopment of Caversham Park to create 65 assisted living units (Class C2) for the over 55's through the conversion of Caversham Park House, 64 bed care home (Class C2), 61 age-restricted retirement dwellings (Class C3), including conversion of the existing buildings (The Bursars House and The Lodge), 27 affordable dwellings (Class C3), and refurbishment and extension of the existing pavilion to provide changing facilities, café/studio/interpretation hub and sports provision comprising 2 croquet lawns, 2 bowling greens, refurbishment of the existing tennis court and associated parking.

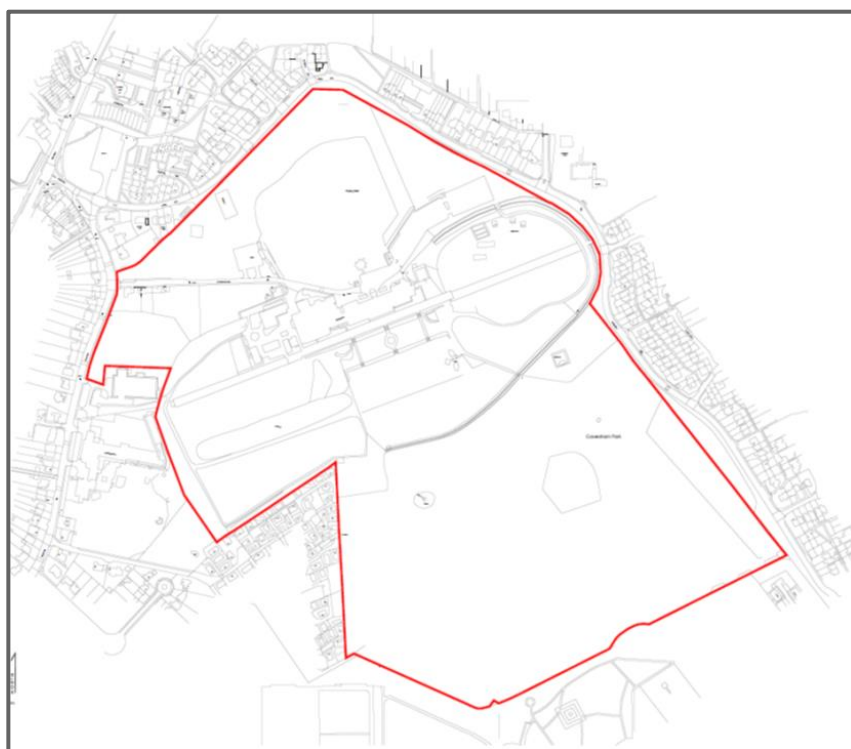
The development falls within the Borough of Reading, which suffers from elevated levels of air pollution, primarily due to high levels of traffic. It is therefore important to assess whether there will be an exceedance of the air quality objectives for particulate matter (PM₁₀) or nitrogen dioxide (NO₂)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

2019 has been used as the base year for the modelling as this is the last full year prior to the impact of the Covid pandemic. The expected completion date of the proposed development is 2025. The assessment has therefore been completed for 2026, the expected first full year of occupation.

1.1 The Location of the Development

The proposed development is located in Caversham Park, Reading (**Figure 1**).

Figure 1: Location of the development site



1.2 Assessment Criteria

A summary of the air quality objectives relevant to the development site, 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 (99.8th 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 (90.4th percentile)

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

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. https://uk-air.defra.gov.uk/assets/documents/Air_Quality_Objectives_Update.pdf

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.

A growing body of research has also pointed towards the smaller particles as a metric more closely associated with adverse health impacts. In particular, particulate matter with an aerodynamic diameter of less than 2.5 micrometres, known as PM_{2.5}. Local Authorities in England have a flexible role² in working towards reducing emissions and concentrations of PM_{2.5} as there is no specific objective for them. However, there is a UK (excluding Scotland) annual mean objective of 20 µg/m³.

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 Pollutants³.

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
- 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. The 24 hour objective will apply at all locations where the annual mean objective would apply together with hotels. Therefore, in this assessment the annual mean and 24 hour mean objectives will apply at all of the apartments, houses and care home. 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 hourly objective will also apply across the development site.

1.3 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).

The Borough of Reading has declared one AQMA⁴ covering the town centre and major radial routes into Reading. This AQMA was declared in 2009 due to exceedances of the NO₂ objective. The proposed development is outside of this AQMA. However, an AQAP was updated in 2016, which identifies actions to improve air quality in the region.⁵

1.4 The ADMS-Roads Method

² LAQM TG16 – paragraph 1.09

³ <https://www.gov.uk/government/collections/comeap-reports>

⁴ https://uk-air.defra.gov.uk/aqma/details?aqma_ref=467

⁵ https://images.reading.gov.uk/2020/01/AQAP_Update_2016.pdf

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 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 (v5.0.1) was issued in March 2022 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
- **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.

2.1.1 Local monitoring data

The Borough of Reading has four automatic monitoring sites which measure nitrogen dioxide (NO₂) and particulate matter (PM₁₀). Unfortunately, all of these automatic monitoring sites are located more than 5km from the development site and are therefore unlikely to be representative and are not discussed further. NO₂ concentrations are also measured passively at diffusion tube sites across the Borough. Details of the passive monitoring sites closest to the development site are given in **Table 2**. As shown below, unfortunately none of these are located within close proximity of the site either.

Monitoring results have been taken from the Council's latest Annual Status Report (ASR).⁶

Table 2: Monitoring sites closest to the Caversham Park development site

Site Name	Site Type	Pollutant	Grid Reference	Distance to Kerb (m)	Approx. Distance to development site (m)
59 Prospect Street	R	NO ₂	471599, 174966	1.0	1,550
45 Prospect Street	R	NO ₂	471558, 174919	1.5	1,610
60 Prospect Street	R	NO ₂	471557, 174944	3.0	1,590
241 Gosbrook Road	R	NO ₂	471942, 174600	6.0	1,740
Baron Cadagon	R	NO ₂	471461, 174840	2.3	1,730
40 George Street	R	NO ₂	471909, 174543	3.5	1,810
14 Church Road	R	NO ₂	471103, 174774	2.5	2,000

Note: R = roadside

The diffusion tubes were analysed by Gradko International Ltd, who participate in the Proficiency scheme⁷. 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. The Borough of Reading has applied a national bias adjustment factor of 0.87 to their 2019 diffusion tube results.

Monitoring results are presented in **Table 3**. The data shows that the annual mean NO₂ objective was exceeded three times between 2017 and 2019 at 59 Prospect Street. During this period the annual mean NO₂ objective was also exceeded twice at the Baron Cadagon monitoring site and once at the monitoring site located on George Street. Diffusion tubes do not provide information on hourly exceedances, but research⁸ identified a relationship between the annual and 1 hour mean objective, such that exceedances of the latter were considered unlikely where the annual mean was below 60 µg/m³. Therefore, no exceedances of the hourly mean objectives are expected at the diffusion tube monitoring sites in the years shown.

Table 3: Monitoring results for sites closest to the proposed development site, 2017-2019

Objective	Site Name	2017	2018	2019
Annual mean NO ₂ (µg/m ³)	59 Prospect Street	45	46	41

⁶ <https://www.reading.gov.uk/climate-and-pollution/2020-air-quality-annual-status-report-asr/>

⁷ This is a national QA/QC scheme.

⁸ As described in Box 5.2 of LAQM Technical Guidance (TG16).

Objective	Site Name	2017	2018	2019
	45 Prospect Street	37	36	33
	60 Prospect Street	33	34	29
	241 Gosbrook Road	34	35	31
	Baron Cadagon	44	41	36
	40 George Street	47	45	38
	14 Church Street	36	37	33

Values exceeding the 40 µg/m³ annual mean objective are shown in bold

2.1.2 Background mapped data

Background pollutant concentration maps are available from the Defra LAQM website⁹ and data has been extracted for the local vicinity of the proposed development for this assessment. These 2018 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. The projections in the 2018 LAQM background maps are based on assumptions which were current before the Covid-19 outbreak in the UK. In consequence these maps do not reflect short or longer term impacts on emissions in 2020 and beyond resulting from behavioural change during the national or local lockdowns.

The estimated mapped background NO_x, NO₂ and PM₁₀ concentrations around the development site are 18.5 µg/m³, 13.5 µg/m³ and 15 µg/m³ respectively in 2019 (the baseline year). For the verification sites, the following estimated mapped background NO_x, NO₂ and PM₁₀ concentrations have been applied in the baseline year: 34.5 µg/m³, 22.7 µg/m³ and 17.6 µg/m³ respectively.

For 2026 (the estimated first full year of occupation), the concentrations obtained for the same pollutants at the development site are 14.9 µg/m³, 11.2 µg/m³ and 13.8 µg/m³ respectively.

Due to the lack of a nearby urban background monitoring site, the 2019 mapped background concentrations have been used in this assessment. To provide a conservative estimate, the projected improvements in background air quality by 2026 have not been used in the dispersion modelling. This is in line with best practice to apply worst-case assumptions.

2.2 Model input data

Hourly meteorological data from Heathrow for 2019 has been used in the model. The wind-rose diagram (**Figure 2**) presents this below.

⁹ <http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html>

Figure 2: Wind-rose diagram for Heathrow meteorological data, 2019

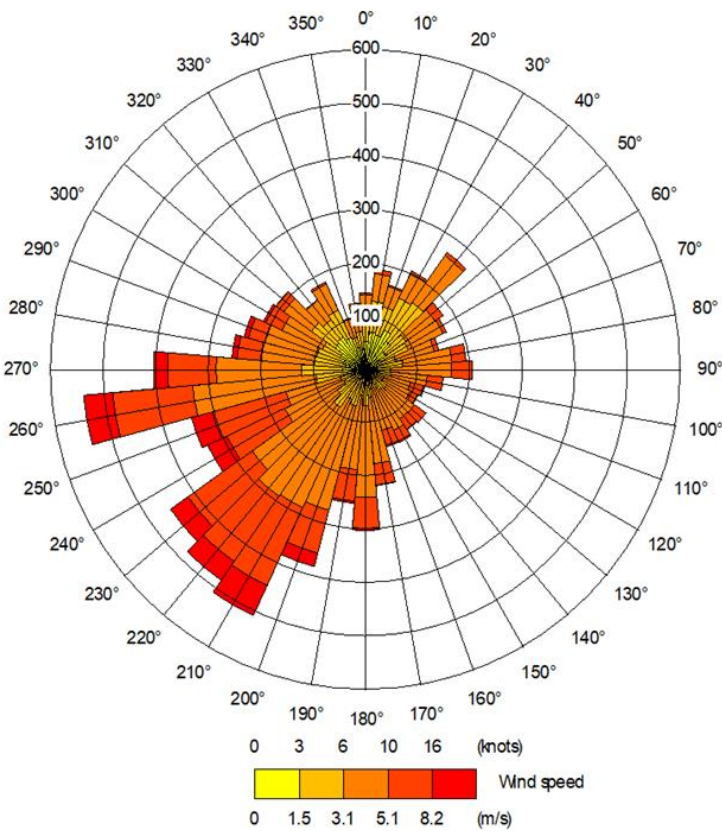
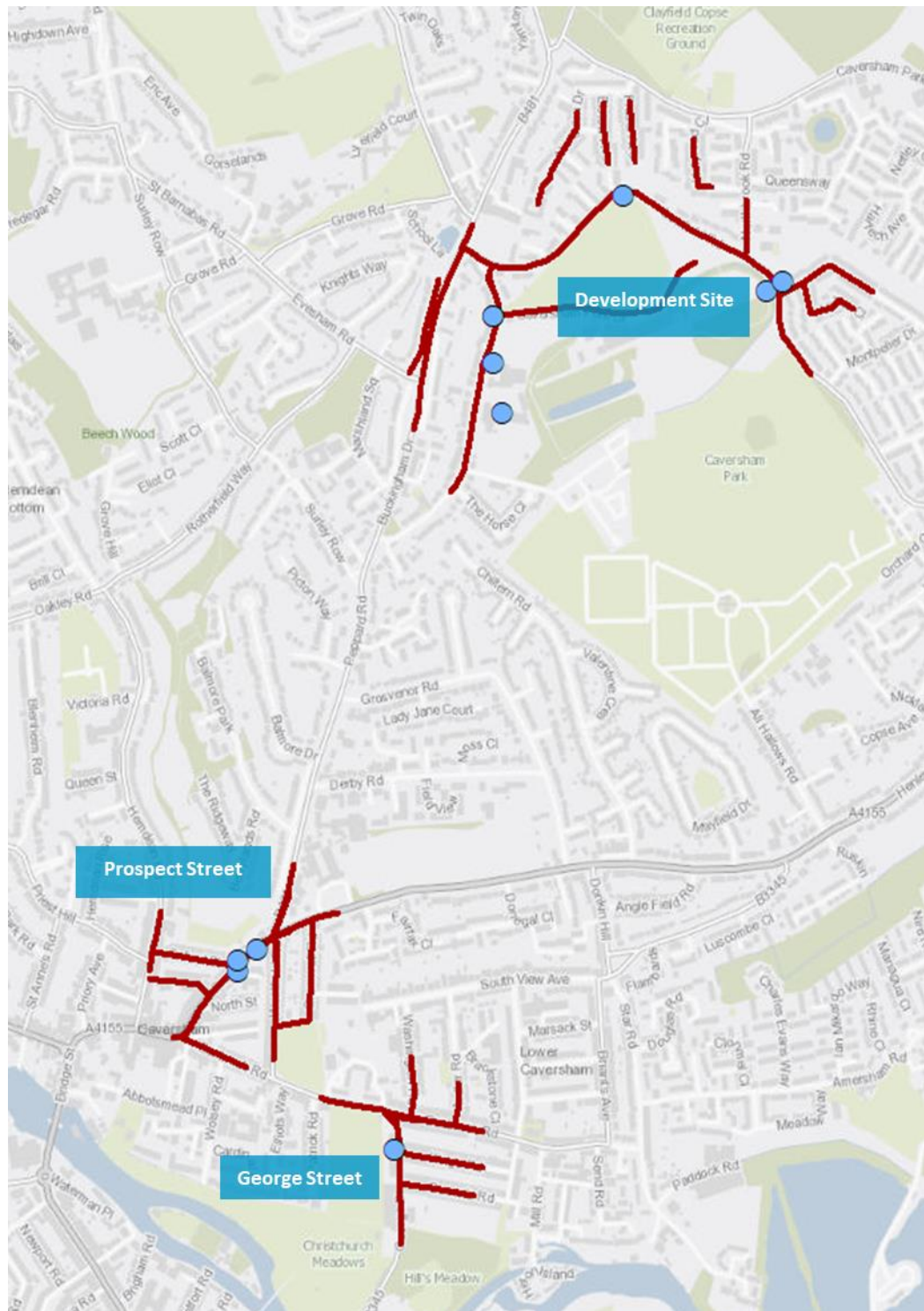


Figure 3: Road sources and receptors



Contains Ordnance Survey data © Crown copyright and database right [2022]

ArcMap software has been used to model the road source locations (red lines) that are within 200 metres of the receptor locations (blue circles). 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 3** above. It is assumed that the contribution of other sources to NO_2 and PM_{10} is included in the background concentrations.

Eleven sensitive receptor locations have been selected for the assessment. A, B and C are all on the perimeter of the proposed site and have been chosen to reflect the extremities of the site and their proximity to road traffic sources. The architect's plans (**Figure 4**) show the development site in more detail with receptor locations highlighted (blue circles). In addition, more detailed plans are provided in Figures 5 and 6.

Eight existing sensitive receptors have also been modelled:

- Hill School - a local primary school located less than 200m from the development site entrance
- 172 Galsworthy Drive: a dwelling located 20m to the east of the development site, on the junction between Lowfield Road and Galsworthy Drive
- 187 Peppard Road - ground floor of dwelling on Peppard Road, which is located opposite the site entrance, Caversham Park Drive.
- 187 Peppard Road - first floor of a dwelling on Peppard Road, which is located opposite the site entrance, Caversham Park Drive
- 40 George Street
- 45 Prospect Street
- 59 Prospect Street
- 60 Prospect Street

Figure 4: The location of the receptors used in the modelling at the proposed development site



Figure 5: Site plan for the east of the development site

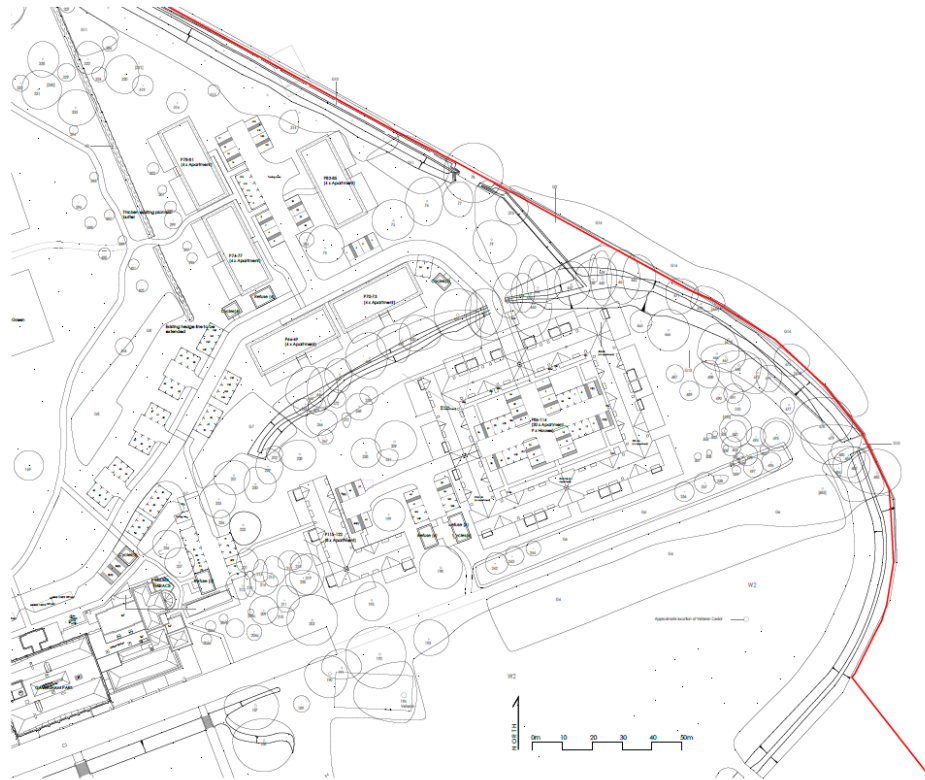


Figure 6: Site plan for the west of the development site



2.3 Traffic data

Three model runs have been undertaken as follows:

- 2019 baseline to enable model verification to be undertaken
- 'Without development' in 2026 which assumes the Beechcroft development does not take place and that the site is vacant, as it is in the base year. This scenario however includes the impact of the new nearby golf course which has recently received planning permission
- 'With development' in 2026 which assumes the Beechcroft development takes place and the golf club is in operation.

Average annual daily traffic (AADT) count data for 2019 (the selected baseline year) has been obtained for Henley Road, Albert Road, B481, Surley Row, the A4074, A4155 and Henley Road from Department for Transport (DfT) Traffic Counts¹⁰, which provides data for major roads. In the absence of any other data being available for the minor roads, estimates are based upon either AADT values from the above dataset for local roads which are comparable in traffic volume and mixture, or average values for an 'urban minor road, South East' from the DfT National Road Traffic Survey, 2019¹¹. Therefore there will be uncertainty in the model input. A time variant factor was applied to all data based on the distribution on all roads by time of day and day of the week in Great Britain¹². All roads within 200 metres of the modelled receptors have been included in the assessment. The values are shown in Appendix B.

For this assessment, Temprow has been utilised to project traffic growth. It has been assumed that traffic on local roads will increase by 5.9% between 2019 and 2026.

Glanville's Transport Assessment produced in March 2022¹³ concluded that the development would result in 684 additional vehicular trips compared to the current traffic levels. A further assessment in October 2022¹⁴ concluded that 342 of these trips would apply to roads north of the site entrance, and 342 would apply to those south of the site entrance. 95% of the trips that use the southern section of Peppard Road are expected to travel via Prospect Street.

However, a Transport Assessment Addendum¹⁵ was produced in June 2023 to reflect the latest site plans which involve five fewer dwellings than the plans used for the original transport assessment. It states that "the submitted scheme would have commensurately less intensive traffic impact". On the basis that the Highway Authority found the traffic impact of the previous scheme to be acceptable, it is assumed that the smaller traffic impact of the updated plans will also be acceptable and therefore no further analysis was undertaken.

Although the estimated increase in daily cars trips is now expected to be lower than figures presented in the October 2022 Transport Assessment, as a worst case scenario

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

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

¹² <https://www.gov.uk/government/statistical-data-sets/road-traffic-statistics-tra>

¹³ Transport Assessment. Caversham Park. RG4 8TZ. Work undertaken by Glanville Consultants. 11th March 2022.

¹⁴ Transport note prepared by Glanville Consultants, received 26th October 2022

¹⁵ Transport Assessment Addendum prepared by Glanville Consultants, 28th June 2023

these traffic figures have been taken into account in the assessment for roads with direct access to the site with development in 2026. Results (**Section 3** of this report) therefore refer to concentrations modelled in 2026 both without and with the proposed development.

It is worth noting though that the proposed development is anticipated to result in a significant reduction (of 588 vehicles per day between the hours of 7am and 7pm) in traffic generation of the site compared to its extant use. The Transport Assessment therefore concludes that the re-development would have a beneficial impact on the safety and capacity of the surrounding road network compared to what otherwise could occur if the building and site was fully re-occupied in accordance with its previous lawful planning use.

Average speeds of 24.6 kph and 30.4 kph have been assumed for Henley Road (A4155) and the A4074 respectively. These speeds are the average traffic speeds for these roads in 2019.¹⁶ In the absence of any other data being available for other modelled roads, average speeds have been assumed to be equal to the average speed in Reading in DfT's table CGN0501b in the same data set, equal to 26.7 kph.

2.3.1 Queuing Traffic

Special consideration has been given to notable junctions modelled in this assessment. CERC note 60¹⁷ 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 4 m. These figures, along with the traffic composition of the corresponding roads were then input into the Emission Factor Toolkit (EFT)¹⁸ 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. Traffic queues have been modelled along parts of Prospect Street, Peppard Road and Westfield Road.

2.4 Conversion of NO_x to NO₂

Evidence shows that the proportion of primary NO₂ in vehicle exhaust has increased¹⁹. This means that the relationship between NO_x and NO₂ at the roadside has changed from that currently used in the ADMS model. A NO_x to NO₂ calculator (Published in August 2020)²⁰ has therefore been developed and has been used in conjunction with the ADMS model to obtain a more accurate picture of NO₂ concentrations.

2.5 Model Verification

Model verification refers to checks that are carried out on model performance at a local level. This involves the comparison of predicted versus measured concentrations. Where there is a disparity, the first step is to check the input data and the model parameters in

¹⁶ Department for Transport statistics, Table CGN0501c

¹⁷ Cambridge Environmental Research Consultants Ltd, Modelling Queuing Traffic – note 60, 20th August 2004

¹⁸ Latest version v11, <https://laqm.defra.gov.uk/air-quality/air-quality-assessment/emissions-factors-toolkit/>

¹⁹ <http://uk-air.defra.gov.uk/assets/documents/reports/ageg/primary-no-trends.pdf>

²⁰ <https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOXNO2calc>

order to minimise the errors. If required, the second step will be to determine an appropriate adjustment factor that can be applied.

In the case of NO₂, the model should be verified for NO_x as the initial step and should be carried out separately for the background contribution and the source (i.e. road traffic). Once the NO_x has been verified and adjusted as necessary, a final check should be made against the measured NO₂ concentration.

For this project, modelled annual mean road-NO_x estimates have been verified against the concentrations measured at the three diffusion tube sites which are all located on Prospect Street (see **Appendix A**). These sites were selected because they represent the monitoring sites closest to the proposed development. However, it is worth noting that none of these sites lie in close proximity to the development site and therefore there will be uncertainty in the modelled results.

The adjustment factor determined for annual mean NO_x concentrations was also applied to the modelled annual mean PM₁₀ concentrations. This was done as no PM₁₀ monitoring data that is representative of the development site is available, and this approach was considered more appropriate than not applying any adjustment²¹.

3 Results

3.1 Results of the Dispersion Modelling

Table 4 below provides the estimated pollutant concentrations in the development year (2026) without and with²² the development. Given the inherent uncertainties in the modelling, background pollutant concentrations and vehicle fleet emission factors have been maintained at 2019 levels in the development year scenarios to provide a worst case estimate. Traffic growth has been predicted using Temprow.

²¹ Paragraph 7.529 of LAQM TG(16)

²² 'With' development includes the impact of additional traffic that will be generated with the development

Table 4: Estimated pollutant concentrations in 2026 without and with the development ($\mu\text{g}/\text{m}^3$)

Receptor type	Receptor	Annual mean NO ₂ concentration ($\mu\text{g}/\text{m}^3$)		Annual mean PM ₁₀ concentration ($\mu\text{g}/\text{m}^3$)		NO ₂ change	PM ₁₀ change
		2026 without dev	2026 with dev	2026 without dev	2026 with dev		
Development Site Receptors	A	14.0	14.1	15.1	15.1	<0.1	<0.1
	B	15.0	15.2	15.2	15.3	0.2	<0.1
	C	16.5	16.6	15.5	15.5	0.1	<0.1
Nearby sensitive receptors	45 Prospect St	33.2	33.4	16.2	16.2	0.2	<0.1
	59 Prospect St	40.0	40.2	17.0	17.1	0.2	<0.1
	60 Prospect St	31.1	31.3	16.0	16.0	0.2	<0.1
	Hill School	14.7	14.7	15.2	15.2	<0.1	<0.1
	187 Peppard Rd – ground floor	17.3	17.4	15.6	15.6	0.2	<0.1
	187 Peppard Rd – first floor	16.0	16.1	15.4	15.4	0.1	<0.1
	172 Galsworthy Dr	14.4	14.5	15.1	15.2	0.2	<0.1
	40 George St	41.6	41.6	17.0	17.0	<0.1	<0.1

Note 1: The changes in NO₂ and PM₁₀ presented may not exactly equal the difference in the constituent parts shown due to rounding.

Note 2: exceedances of the objectives are shown in bold

Nitrogen dioxide

In the without development scenario (which takes into account the golf course development, but not the Caversham Park development), the model predicts annual mean NO₂ concentrations to be at least 58% below the annual mean objective at receptors at the proposed development site. Similarly low concentrations are also estimated at Hill School, 187 Peppard Road and 172 Galsworthy Road. Higher concentrations are estimated at Prospect Street and George Street, with an exceedance predicted at the latter (shown in bold in Table 4).

The estimated annual mean NO₂ concentrations at the development site are reasonable when compared to the data collected at the verification sites. The verification sites are situated on Prospect Street, a busy A road with high AADTs and frequent traffic queues. Therefore, annual mean NO₂ concentrations are expected to be much higher at these sites than at the development site, which is surrounded by minor residential streets and open fields. It is also situated directly north of a large cemetery.

The Guidance states that authorities may assume exceedances of the hourly mean objective are only likely to occur where annual mean concentrations are 60 µg/m³ or above. Therefore, it is considered highly unlikely that this objective will be exceeded at any of the receptors.

The model has also been run for a with development scenario considering predicted increases to traffic levels due to the development. The results indicate that annual mean NO₂ concentrations would increase by a maximum of 0.2 µg/m³ at the worst-case locations - receptor B which is on the perimeter of the development site, two of the sensitive receptor sites located on roads adjacent to the development site and by a similar amount at all of the Prospect Street sites. Receptor B is adjacent to one of the main access roads for the development site, so it is reasonable that the NO₂ concentration increase is largest at this location at the development site. At other locations, smaller increases are predicted.

Particulate matter

The model estimates no exceedance against the annual mean PM₁₀ objective. Potential exceedances of the daily mean PM₁₀ objective can be estimated based on the annual mean²³, such that:

$$\begin{aligned} & \text{No. 24 – hour mean exceedances} \\ &= -18.5 + 0.00145 \times \text{Annual Mean}^3 + \left(\frac{206}{\text{Annual Mean}} \right) \end{aligned}$$

On this basis, it is estimated that in 2026 there will be one exceedance of the daily mean PM₁₀ limit value, regardless of whether the development takes place or not. Therefore, the daily mean PM₁₀ objective would be met.

For estimating PM_{2.5} concentrations, where no appropriate sites measuring both PM₁₀ and PM_{2.5} are available, then a nationally derived correction ratio of 0.7 can be used²⁴. If

²³ Paragraph 7.92 of LAQM TG(16)

²⁴ LAQM: TG16, paragraph 7.109

this factor is used, then all locations in the modelling meet the UK annual mean PM_{2.5} objective of 20 µg/m³.

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 Environmental Protection UK's Air Quality Guidance Document²⁵ 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 % or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94 % of AQAL	Negligible	Slight	Moderate	Moderate
95-102 % of AQAL	Slight	Moderate	Moderate	Substantial
103-109 % of AQAL	Moderate	Moderate	Substantial	Substantial
110 % or more of AQAL	Moderate	Substantial	Substantial	Substantial

In addition to the criteria provided above, the Guidance document states that the table is intended to be used by rounding the change in percentage pollutant concentrations to whole numbers. Changes of 0 % i.e. less than 0.5 % are described as negligible.

The long term average concentration at 40 George Street (the worst case receptor in terms of modelled pollutant concentrations in the baseline in the modelling) in the assessment year (2026) is 104 % of the Air Quality Assessment Level (AQAL), but the change in concentration relative to the AQAL is less than 0.5% and so the estimated increase can be described as negligible.

At 59 Prospect Street, the annual mean concentration is estimated to be 100% of the AQAL in the assessment year (2026). However, the change in concentrations is predicted to be 0.5% and therefore the estimated increase just falls into the 'slight' category (as less than 0.5% would be described as negligible). However, this is very much a worst-case scenario as no improvement in the road traffic fleet between 2019 and 2026 has been taken into account and therefore it is highly likely that there would in fact be a negligible increase.

It should also be noted that the without development scenario assumes that the site is vacant. If the site was assumed to be in use in accordance with its previous lawful use in the without development scenario, it is expected that there would be a slight reduction in air pollutant concentrations in the 'with development' scenario, compared to the

²⁵ <http://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf>

‘without development’ scenario, because the traffic generation associated with the development is less than that associated with its extant use.

Although the modelling in this assessment does not incorporate improvements in the road traffic fleet, recent case law shows that it is appropriate to in fact do so. For example, in the Anglia Square development public inquiry, Paragraph 557 of the Inspector’s Report²⁶ states: *At the inquiry there was discussion as to whether, in principle, it is right to take account of anticipated improvements in air quality as a result of government policy. Although the Council did not take account of such improvements at the time it considered the application, it now considers that it is right to do so. I agree. The EFT User Guide 2019 [version 9], which is published by Defra states that: “It is a tool that allows users to calculate road vehicle pollutant emission rates for oxides of nitrogen and particulate matter for a specified year, road type, vehicle speed and vehicle fleet composition”. To my mind that makes it clear that Defra is expecting anticipated changes in vehicle emissions to be factored into assessments such as this. The Wealden Local Plan examination, where the Inspector commented that it would be unreasonable to assume no improvements over time, is an example of this approach in action.*

In addition, the IAQM significance criteria is based on a fairly simplistic conclusion and other factors also need to be considered in order to make transparent conclusions. Specific factors to consider may include:

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 exceedance of an objective or limit value is predicted to arise in the study area where none existed before or an exceedance area is substantially increased
5. Whether or not the study area exceeds an objective or limit value and this exceedance is removed or the exceedance 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 µg/m³ should attract less significance than an annual mean of 51 µg/m³.

In this case, 59 Prospect Street is only estimated to marginally exceed the annual mean NO₂ objective and therefore a low significance should be placed on the air quality impact.

3.3 Mitigation Measures

Based on the ADMS results, there is no specific requirement for mitigation to reduce future resident’s exposure to air pollution, as concentrations are estimated to meet all of the objective levels across the site.

²⁶

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/935080/Combined_DL_IR_R_to_C-anglia_square.pdf

However, in order to reduce the impact of the site on the local community, the developer is encouraged to consider mitigation measures to reduce emissions arising from the site. The National Planning Policy Framework²⁷, updated July 2021, requires new developments to support sustainable travel and air quality improvements. A key theme of the NPPF is that *“Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions and improve air quality and public health. However, opportunities to maximise sustainable transport solutions will vary between urban and rural areas, and this should be taken into account in both plan-making and decision-making”* (paragraph 105).

The NPPF also states that *“Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan”* (paragraph 186).

In addition, the following relevant requirements for improving air quality are outlined (paragraph 112-113):

- Give priority first to pedestrian and cycle movements, both within the scheme and with neighbouring areas; and second – so far as possible – to facilitating access to high quality public transport, with layouts that maximise the catchment area for bus or other public transport services, and appropriate facilities that encourage public transport use
- Be designed to enable charging of plug-in and other ultra-low emission vehicles in safe, accessible and convenient locations
- All developments that will generate significant amounts of movement should be required to provide a travel plan, and the application should be supported by a transport statement or transport assessment so that the likely impacts of the proposal can be assessed.

Building on the NPPF, the Institute of Air Quality Management (IAQM) has provided guidance on the principles of good practice²⁸ which should be applied to all major development²⁹. Examples of good practice include:

- The provision of at least 1 Electric Vehicle (EV) “rapid charge” point per 10 residential dwellings and/or 1000 m² of commercial floor space. Where on-site parking is provided for residential dwellings, EV charging points for each

²⁷ <https://www.gov.uk/government/publications/national-planning-policy-framework--2> Published in July 2018

²⁸ <http://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf>

²⁹ Major developments can be defined as developments where:

(1) The number of dwellings is 10 or above, (2) The residential development is carried out on a site of more than 0.5ha where the number of dwellings is unknown, (3) The provision of more than 1000 m² commercial floor space, (4) Development carried out on land of 1ha or more, (5) Developments which introduce new exposure into an area of existing poor air quality (e.g. an AQMA) should also be considered in this context.

parking space should be made. As outlined in the Transport Assessment, 10% of all parking spaces will be provided with charging for electric vehicles.

- Where the development generates significant additional traffic, a detailed travel plan should be implemented. A travel plan has been produced and is being provided as part of the planning application.
- All gas-fired boilers to meet a minimum standard of < 40 mg NO_x/kWh
- All gas-fired CHP plant to meet a minimum emissions standard of:
 - Spark ignition engine: 250 mg NO_x/Nm³
 - Compression ignition engine: 400 mg NO_x/Nm³
 - Gas turbine: 50 mg NO_x/Nm³

Other additional or alternative mitigation measures include supporting measures in the Local Authority's air quality action plan.

3.4 Mitigating the Impacts of the Construction Phase

Emissions and dust from the construction phase of a development can have a significant impact on local air quality. The IAQM has produced a document titled 'Guidance on the assessment of dust from demolition and construction'³⁰ published in May 2015. This guidance contains a methodology for determining the significance of construction developments on local air quality using a simple four step process:

- STEP 1: Screen the requirement for a more detailed assessment
- STEP 2: Assess the risk of dust impacts
- STEP 3: Determine any required site-specific mitigation
- STEP 4: Define post mitigation effects and their significance.

The risk of dust emissions from a demolition/construction site causing loss of amenity and/or ecological impacts is related to a number of factors, including: the activities being undertaken; the duration of these activities; the size of the site; the mitigation measures implemented and meteorological conditions. In addition, the proximity of receptors to the site and the sensitivity of these receptors to dust, impacts the level of risk from dust emissions. Receptors include both 'human receptors' and 'ecological receptors'. The former refers to a location where a person or property may experience adverse effects for airborne dust or dust soiling, or exposure to PM₁₀, over a time period relevant to the air quality objectives (see **Table 1**). Ecological receptors are defined as any sensitive habitat affected by dust soiling, through both direct and indirect effects. Following assessment of the impacts of dust as a result of the development, a qualitative risk impact level can be assigned, ranging from 'negligible' to 'high risk'. Based on the designated risk impact level, the mitigation measures which are appropriate for all sites and are applicable specifically to demolition, earthworks, construction and trackout can be determined. Examples of the general measures include:

- Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site
- Ensure all vehicles switch off engines when stationary – no idling vehicles
- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable
- Ensure all loads entering and leaving the site are covered

³⁰ <http://iaqm.co.uk/guidance/>

- Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation

The use of the outlined IAQM methodology for assessing the impacts of dust from demolition/construction is considered to be current best practice. Therefore, it is recommended that the developer refers to the relevant IAQM documentation, to help reduce the impact of dust and vehicle exhaust emissions and liaises with the Local Authority to come up with an acceptable dust management strategy.

4 Summary and Conclusions

An air quality assessment has been undertaken for a proposed residential development at Caversham Park. The Borough of Reading has declared one Air Quality Management Area (AQMA) due to the exceedances of the annual mean nitrogen dioxide (NO₂) objective. The proposed development falls outside this AQMA.

A conservative approach with regards to expected improvements to air quality has been taken in that no improvement in the pollutant background concentrations or road transport emission factors has been assumed between the base year (2019) and the first year of occupation (2026). With expected improvements to the traffic fleet, improvements in pollutant concentrations may however materialise. This is in line with best practice to apply worst-case assumptions.

The ADMS-Roads dispersion model has been used to determine the impact of emissions from road traffic on sensitive receptors. Predicted concentrations have been compared with the air quality objectives. The results of the assessment indicate that annual mean NO₂ and PM₁₀ concentrations are substantially below the objective in the 'without' and 'with' development scenarios at all of the receptors modelled at the development site. Based on the evidence it is also estimated that there will be no exceedances of either short term objective for NO₂ or PM₁₀ at this location.

At nearby receptors, negligible increases are estimated, apart from at 59 Prospect Street which even without the development shows an estimated annual mean NO₂ concentration of 40µg/m³. The 'with' development scenario predicts that the development will cause NO₂ concentrations to increase by 0.2µg/m³ at this location compared to the 'without development' scenario. This just falls into the category of being ranked as a 'slight' increase. However, this is very much a worst-case scenario as no anticipated improvements in the road traffic fleet between 2019 and 2026 have been taken into account. It is therefore highly likely that only a negligible increase would occur. In support of this, recent planning case law shows that estimated improvements in the road traffic fleet should be taken into account.

Therefore, no mitigation is required in terms of reducing future residents' exposure to air pollution as the air quality objectives are predicted to be met across the development site and no significant impact on nearby receptors is estimated. However, in order to reduce the impact of the development within the AQMA and on nearby residential locations, the development will install electric charging points, a travel plan is being provided and Air Source Heat Pumps will be used for heating. In addition, the developer is encouraged to refer to the IAQM's 'Guidance on the assessment of dust from demolition and construction' to minimise the impact of the construction phase on

local air quality. This can also be addressed in a Construction Environmental Management Plan.

Appendix A – Model Verification

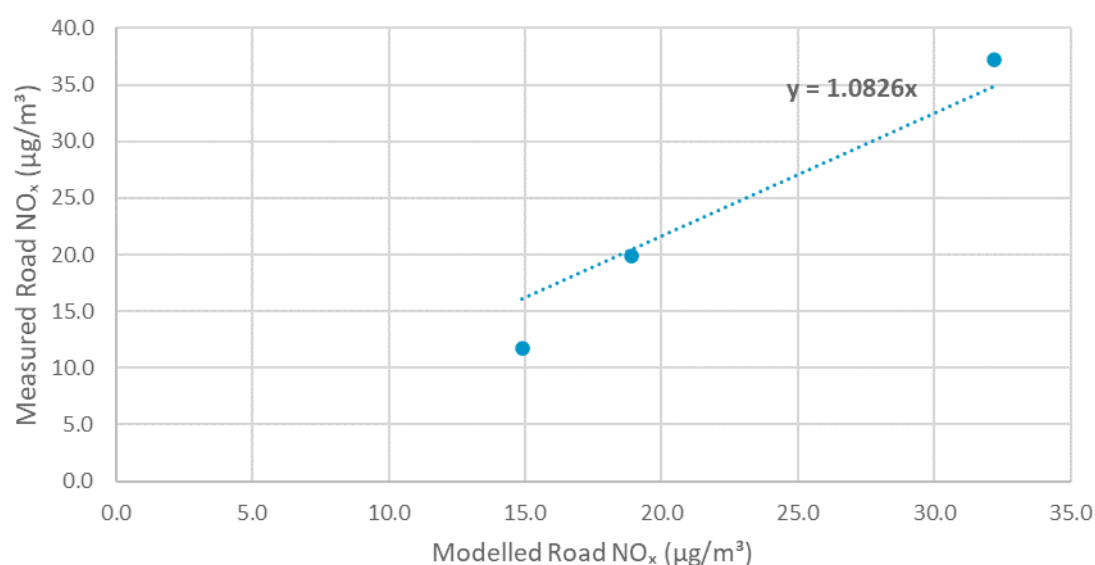
In order to verify modelled pollutant concentrations generated in the assessment, the model has been run to predict the annual mean road-NO_x concentration during 2019 at the three diffusion tube sites on Prospect Street described in **Table 2**.

The model output of road-NO_x has been compared with the 'measured' road-NO_x. Measured NO_x for the monitoring sites was calculated using the NO_x to NO₂ calculator²⁰.

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 2019 background NO₂ concentration.

The results imply that there was good agreement between the modelled and monitored road-NO_x contribution.

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



RMSE

The root mean square error (RMSE) is used to define the average error or uncertainty of the model. The following RMSE value has been calculated:

NO₂: 1.7

If the RMSE values are higher than ±25 % of the objective being assessed, it is recommended that the model inputs and verification should be revisited in order to make improvements. Ideally an RMSE within 10 % of the objective would be derived. In this case the model is being assessed against the annual mean objective, which is 40

$\mu\text{g}/\text{m}^3$ for NO_2 . An RMSE value of less than 10 % of the objective (less than $4 \mu\text{g}/\text{m}^3$) is obtained and therefore the model behaviour is acceptable.

Appendix B – Traffic Data

Table B.1: Traffic data for 2019 (and prediction for 2026 without development)

Development/ verification site	Road links	Annual Average Daily Traffic (AADT)	% Heavy Duty Vehicles (HDV)	Speed (kph)
Verification sites	Henley Road	7,806 (8,606)	2.6	25
	Albert Road	2,601 (2,755)	3.1	27
Development site	B481	10,005 (10,598)	2.4	27
	Surley Row	618 (655)	2.4	27
Verification sites	A4155 junction with Richfield Avenue	27,910 (29,565)	10.5	25
Development site	Henley Rd junc Caversham Park Rd	17,661 (18,708)	1.9	25
	Minor Road	2,600 (2,754)	2.4	27
Verification sites	A4074	11,161 (11,823)	4.0	30

Note 1 :It has been assumed that the “With development” scenario results in an average daily traffic increase of 342 vehicles on all roads that have direct access to the site compared to current levels. It has been assumed that Prospect Street has an annual daily traffic increase of 325 vehicle trips.

Note 2: The site’s currently permitted use as an office was anticipated to result in an additional 1,272 vehicle movements per day

Note 3: planning permission given recently for the new golf course has been taken into account in the ‘without development’ figures.



Oxford Centre for Innovation

New Road

Oxford

OX1 1BY UK

+44(0)1865 261466

www.aether-uk.com