Air Quality Assessment for the proposed development at Sheldon House, Cromwell Road, Teddington TN11 9EJ

Report to Richmond Housing Partnership

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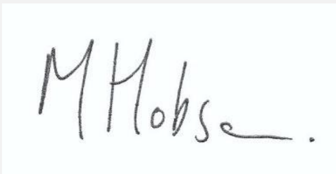
Signature	
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Contents

1 Introduction

Aether has been commissioned by Richmond Housing Partnership to undertake an air quality assessment for the proposed development at Sheldon House, Cromwell Road, Teddington TN11 9EJ. The development will consist of a new residential building of 30 units. Ten car parking spaces will be provided with the development.

The development falls within the London Borough of Richmond Upon Thames, 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 (PM_{10}) or nitrogen dioxide (NO_2) 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. In addition, an air quality neutral assessment has been undertaken.

The expected completion date of the proposed development is 2024. The assessment has therefore been completed for 2025, the expected first full year of occupation.

1.1 The Location of the Development

The proposed development is located at the junction of Cromwell Road and Fairfax Road in Teddington (**Figure 1**).

Figure 1: Location of the development site

1.2 Assessment Criteria

A summary of the air quality objectives relevant to the Teddington development, as set out in the UK Air Quality Strategy[1], is presented in **Table 1** below.

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[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

Table 1: UK Air Quality Objectives for NO_2 and PM_{10}

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 (NO_2). NO_2 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. NO_2 can also form in the atmosphere due to a chemical reaction between NO and ozone (O_3). Health based standards for NO_X generally relate to NO_2, 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 PM_{10}.

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 role[2] 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 25 µg/m^3.

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 Pollutants[3].

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

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

[2] https://laqm.defra.gov.uk/documents/LAQM-TG16-April-21-v1.pdf LAQM TG(16) – paragraph 1.09

[3] https://www.gov.uk/government/collections/comeap-reports

objectives will apply at all floors of the residential development. 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 at all levels of the development.

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 London Borough of Richmond Upon Thames has declared one AQMA[4] covering the whole borough. The proposed development site is therefore located in an AQMA. This AQMA was declared in 2000 due to exceedances of the annual mean NO_2, and both the annual and 24-hour mean PM_{10} objectives. Richmond's most recent AQAP[5] covers the period 2020-2025, with measures focused on the following categories:

- Monitoring of air pollution
- Changing our environment
- Changing behaviour
- Tackling air pollution
- Protecting our schools
- Community action

1.4 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 (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

[4] https://www.richmond.gov.uk/progress_reports_and_air_quality_action_plans

[5] https://www.richmond.gov.uk/services/environment/pollution/air_pollution/air_quality_action_plan/about_the_air_quality_action_plan

- **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 London Borough of Richmond Upon Thames has one automatic monitoring site which measures nitrogen dioxide (NO_2). No monitoring of particulate matter (PM_{10}) is available from Richmond. Unfortunately, the automatic monitoring site is located more than 1 km from the development site and is therefore unlikely to be representative and is not discussed further. NO_2 concentrations are also measured passively at diffusion tube sites across the Borough. Two of these diffusion tube sites lie between 500 m and 1 km from the development site. Details of these monitoring sites are given in **Table 2**.

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

Table 2: Monitoring sites within 1km of the Sheldon House, Cromwell Road development

Site Name	Site Type	Pollutant	Grid Reference	Distance to Kerb (m)	Approx. Distance to development site (m)
DT45 (154 High St, Teddington)	K	NO_2	516383, 171154	0.5	540
DT7 (Broad St, Teddington)	K	NO_2	515695, 170983	0.8	670

Note: K = kerbside

The diffusion tubes were analysed by Gradko International Ltd, who participate in the Proficiency scheme[7]. 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 London Borough of Richmond Upon Thames has applied a national bias adjustment factor (0.83) to their 2020 diffusion tube results.

[6] https://www.richmond.gov.uk/progress_reports_and_air_quality_action_plans
[7] This is a national QA/QC scheme.

Monitoring results are presented in **Table 3**. The data shows that the annual mean NO_2 objective was exceeded once during the three-year period (2018) at the DT7 monitoring site.

As expected, the pollutant concentrations measured in 2020 at both sites are lower than in the previous year due to the impact of the Covid 19 pandemic on traffic levels. As 2020 is not a representative year for air pollutant emissions, 2019 has been used as the baseline year for this assessment.

Diffusion tubes do not provide information on hourly exceedances, but research[8] 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 $\mu g/m^3$. Therefore, no exceedances of the hourly mean objectives are expected at the diffusion tube monitoring sites for the year's shown.

Table 3: Monitoring results for sites close to the proposed development site, 2018-2020

Objective	Site Name	2018	2019	2020
Annual mean NO_2 ($\mu g/m^3$)	DT45 (154 High St, Teddington)	33	32	26
	DT7 (Broad St, Teddington)	**45**	39	34

Values exceeding the 40 $\mu g/m^3$ annual mean objective are shown in bold

2.1.2 Background mapped data

Background pollutant concentration maps are available from the Defra LAQM website[9] and data has been extracted for Teddington 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, NO_2 , PM_{10} and $PM_{2.5}$ concentrations around the development site are 26.1 $\mu g/m^3$, 18.3 $\mu g/m^3$, 15.7 $\mu g/m^3$ and 10.8 $\mu g/m^3$ respectively in 2019. For 2025 (the estimated first full year of occupation), the concentrations obtained for the same pollutants are 20.3 $\mu g/m^3$, 14.7 $\mu g/m^3$, 14.4 and 9.9 $\mu g/m^3$ 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 2025 have not been used in the dispersion modelling. This is in line with best practice to apply worst-case assumptions.

[8] As described in Box 5.2 of LAQM (TG16). April 2021 version.
[9] http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

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.

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

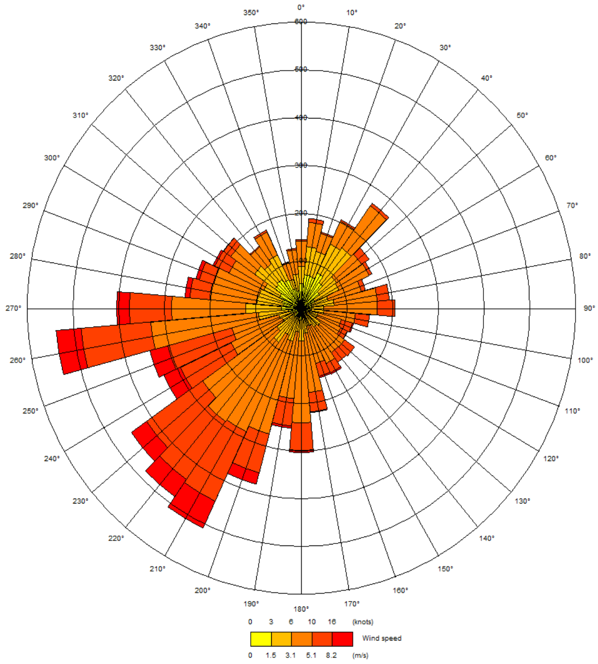
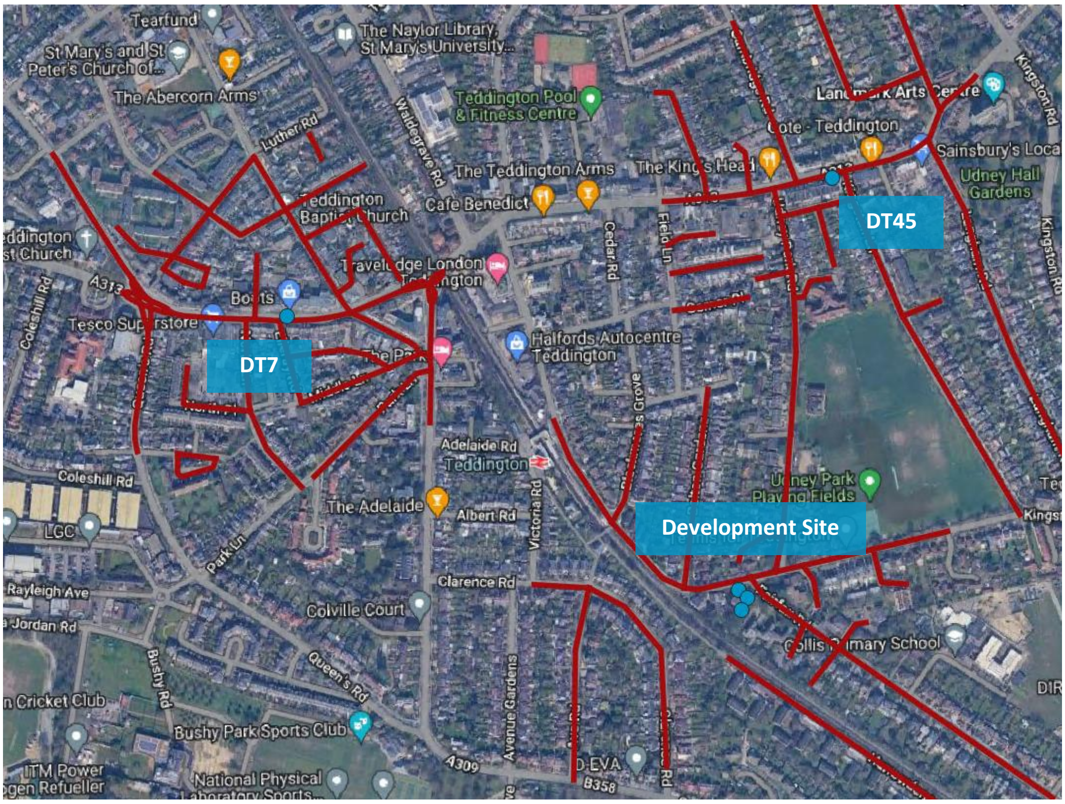


Figure 3: Road sources and receptors



Contains Google maps copyright and database rights [2022]

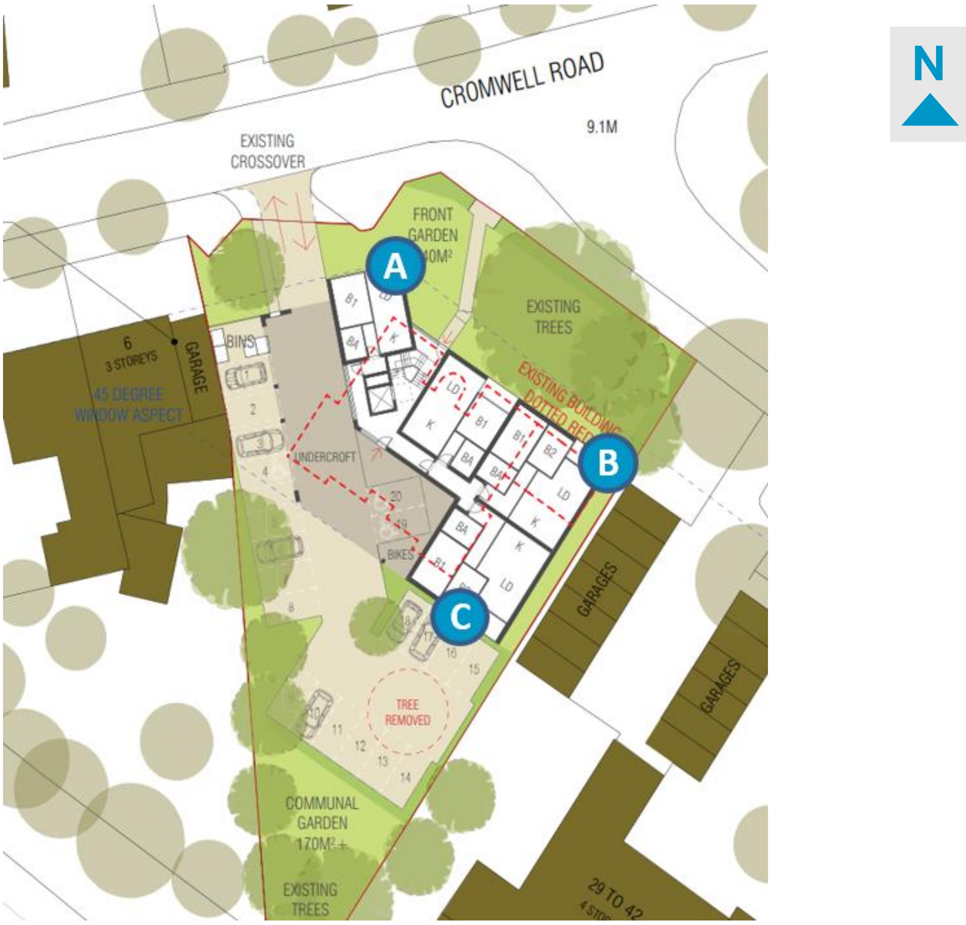
QGIS software has been used to model the road source locations (red lines) that are within 200 metres of the receptor locations (blue circles). This data can then be automatically uploaded to ADMS-Roads. This generates an accurate representation of the surrounding area to be assessed in the model in 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.

Three sensitive receptor locations have been selected for the assessment:

- A: Northern corner of the development, located closest to Cromwell Road
- B: Eastern corner of the development, located adjacent to Fairfax Road
- C: Southern extent of the development, representing the drop off in pollutant concentrations with distance from the road.

These sites 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).

Figure 4: The location of the receptors used in the modelling



2.3 Traffic data

Average annual daily traffic (AADT) count data for major roads in 2019 (the selected baseline year) has been obtained from the 2019 LAEI[10], which provides AADT,

[10] https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2019

percentage HDV and speed data for major roads in London. In the absence of any other data being available for the minor roads, estimates are based upon average values for an 'urban minor road, London' from the DfT National Road Traffic Survey, 2019[11]. All roads within 200 metres of the modelled receptors have been included in the assessment.

For the purpose of this assessment, the Trip End Model Presentation Program (TEMPro)[12] has been used to project traffic flows. It has been assumed that traffic on local roads will increase by 6 % between 2019 and 2025.

The Transport Assessment[13] concludes that the development will result in 30 additional daily vehicular trips. 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 2025. Results (**Section 3** of this report) therefore refer to concentrations modelled in 2025 both without and with the proposed development. However, such a small increase in traffic is not expected to have a discernible impact on local air quality as it is below the IAQM threshold for requiring modelling[14].

An average speed of 26.7 kph has been assumed on all minor roads, which is the average traffic speed for Outer London during PM peak hours[15]. This provides a worst-case scenario, as it is the slowest time period reported, resulting in highest exhaust emissions.

2.3.1 Queuing Traffic

Special consideration has been given to notable junctions modelled along the A313 in this assessment that are relevant for model verification (see Section 2.5). CERC note 60[16] 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)[17] 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.

2.4 Conversion of NO_X to NO_2

Evidence shows that the proportion of primary NO_2 in vehicle exhaust has increased[18]. 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

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11 http://www.dft.gov.uk/statistics/series/traffic/
12 https://www.gov.uk/government/publications/tempro-downloads
13 RHP, Sheldon House, Teddington, London Borough of Richmond upon Thames. Transport Statement, May 2022
14 Table 6.2 of IAQM / EPUK Land Use Planning and Development Control: Planning for Air Quality. January 2017
15 Travel in London Report 10: http://www.tfl.gov.uk/corporate/publications-and-reports/travel-in-london-reports
16 Cambridge Environmental Research Consultants Ltd, Modelling Queuing Traffic – note 60, 20th August 2004
17 Latest version v11, https://laqm.defra.gov.uk/air-quality/air-quality-assessment/emissions-factors-toolkit/
18 http://uk-air.defra.gov.uk/assets/documents/reports/aqeg/primary-no-trends.pdf

August 2020)[19] 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

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 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 NO_2, 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 NO_2 concentration.

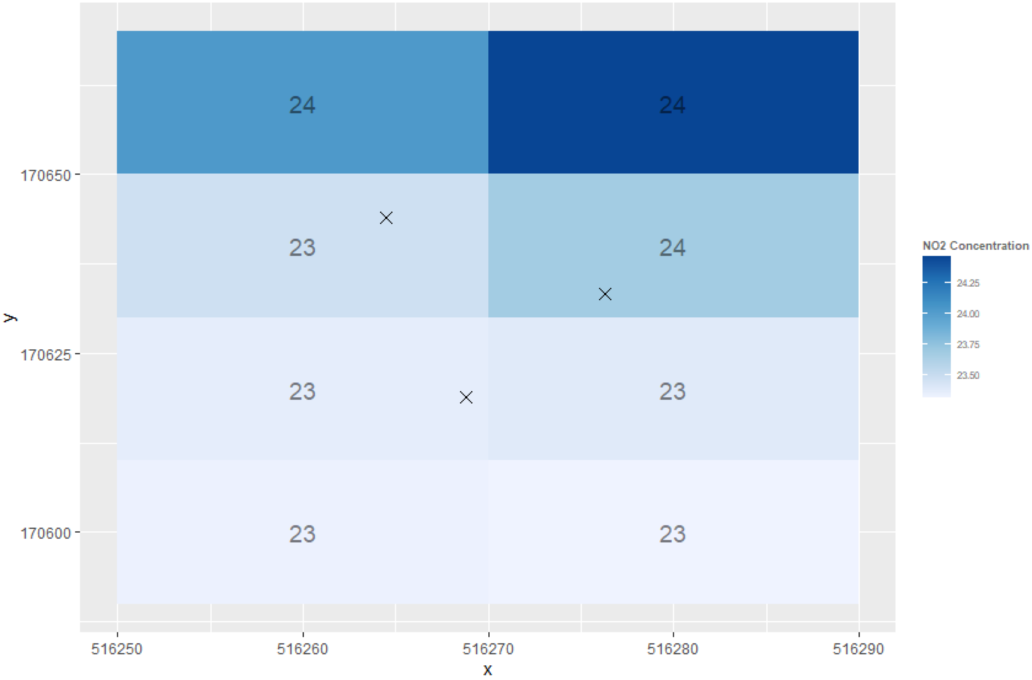
For this project, modelled annual mean road-NO_X estimates have been verified against the concentrations measured at the two nearest diffusion tube sites DT7 and DT45 (see **Appendix A**). These sites were selected because they represent the monitoring sites closest to the proposed development.

The adjustment factor determined for annual mean NO_X concentrations was also applied to the modelled annual mean PM_{10} concentrations. This was done as no PM_{10} monitoring data that is representative of the development site is available, and this approach was considered more appropriate than not applying any adjustment[20].

In addition, the adjusted results have been compared against the 2019 concentrations estimated in the London Atmospheric Emission Inventory (LAEI)[21]. The LAEI predicts annual mean NO_2 and PM_{10} concentrations at a 20 m grid resolution. The highest concentrations estimated across the development site for NO_2 and PM_{10} in 2019 were 24.5 µg/m^3 and 14.9 µg/m^3, respectively. The LAEI output for the development receptors (marked X) are presented in **Figure 5** below.

Figure 5: LAEI 2016 gridded annual mean NO2 concentrations (µg/m^3)

[19] https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOXNO2calc
[20] Paragraph 7.541 of LAQM TG(16). April 2021 version.
[21] https://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory--laei--2019



3 Results

3.1 Results of the Dispersion Modelling

Table 4 below provides the estimated pollutant concentrations in the development year without and with[22] 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 conservative estimate. Traffic growth has been predicted using TEMPro.

[22] 'With' development includes the impact of the additional traffic that will be generated with the development (see Section 2).

Table 4: Estimated pollutant concentrations in 2025 without and with the development (µg/m³)

Floor level	Receptor	Annual mean NO_2 concentration (µg /m³)		Annual mean PM_{10} concentration (µg /m³)		Annual mean $PM_{2.5}$ concentration (µg /m³)		NO_2 Change	PM_{10} change	$PM_{2.5}$ change
		Without development	With development	Without development	With development	Without development	With development			
Ground floor	A	21.0	21.0	16.2	16.2	11.1	11.1	<0.1	<0.1	<0.1
	B	20.5	20.5	16.1	16.1	11.0	11.0	<0.1	<0.1	<0.1
	C	20.0	20.0	16.0	16.0	11.0	11.0	<0.1	<0.1	<0.1

Note: The changes in NO_2 and PM_{10} presented may not exactly equal the difference in the constituent parts shown due to rounding.

Nitrogen dioxide

In the without development scenario, the model predicts annual mean NO_2 concentrations to be below (by at least 48 %) the annual mean objective at all locations. The worst-case location is identified as receptor A, which is closest to Cromwell Road, where roadside concentrations will be maximised.

The estimated annual mean NO_2 concentrations at the development site are reasonable when compared to the 2016 LAEI data (**Figure 5**). The development site concentrations are considerably lower than those estimated for the nearby diffusion tubes DT7 and DT45 (**Table 3**). This is to be expected given the location of those sites along the busy A313 which is approximately 500 m from the Sheldon House development.

The Guidance states that authorities may assume exceedances of the hourly mean objective are only likely to occur where annual mean concentrations are 60 $\mu g/m^3$ 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 taking into account predicted increases to traffic levels due to the development. The results indicate that annual mean NO_2 concentrations would increase by less than 0.1 $\mu g/m^3$ at all locations modelled.

Particulate matter

The model estimates no exceedance against the annual mean PM_{10} objective. Potential exceedances of the daily mean PM_{10} objective can be estimated based on the annual mean[23], such that:

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

On this basis, it is estimated that in 2025 there will be no exceedances of the daily mean PM_{10} limit value, regardless of whether the development takes place or not. Therefore, the daily mean PM_{10} objective would be met as 35 exceedances of limit value are allowed per year.

The model also estimates no exceedances of the annual mean $PM_{2.5}$ objective.

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 Document[24] 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

[23] Paragraph 7.93 of LAQM TG(16). April 2021 version.
[24] http://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf

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 the worst case development site receptor A in the assessment year is 52% of the Air Quality Assessment Level (AQAL) and the change in concentration relative to the AQAL is 0%.

In applying these criteria, it can be concluded that there is likely to be no discernible impact on local annual mean NO_2 concentrations.

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:

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 $\mu g/m^3$ should attract less significance than an annual mean of 51 $\mu g/m^3$.

In this case, none of the above criteria are of significance, suggesting that there will be no concerns in terms of exposure to harmful pollutant concentrations across the study area.

3.3 Mitigation Measures

Based on the ADMS results, there is no specific requirement for mitigation, as concentrations are estimated to meet all of the objective levels and no significant impact of the development on local air quality concentrations is predicted.

However, it is widely acknowledged that there is no safe level of exposure to air pollution[25], and as such, the developer is encouraged to consider further mitigation measures to reduce emissions arising from the site. The National Planning Policy Framework[26], 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. *Note: At least 20% of the parking spaces will be provided with active Electric Vehicle Charging Points, whilst the remaining 80% will be provided as passive as a minimum*[13]
- 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. *Not applicable*

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[25] https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution
[26] https://www.gov.uk/government/publications/national-planning-policy-framework--2 Published in July 2018

Building on the NPPF, the Institute of Air Quality Management (IAQM) has provided guidance on the principles of good practice[27] which should be applied to all major development[28]. Examples of good practice include:

- The provision of at least 1 Electric Vehicle (EV) "rapid charge" point per 10 residential dwellings and/or 1000 m^2 of commercial floor space. Where on-site parking is provided for residential dwellings, EV charging points for each parking space should be made. *Note: At least 20% of the parking spaces will be provided with active Electric Vehicle Charging Points, whilst the remaining 80% will be provided as passive as a minimum*[13]
- Where the development generates significant additional traffic, a detailed travel plan should be implemented. *Not applicable*

The following recommendations related to on-site energy generation are not considered applicable due to the planned use of air source heat pumps / ground source heat pumps and solar PV for the Sheldon House scheme. Should that change, the additional guidance should be followed.

- *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/Nm^3*
    - *Compression ignition engine: 400 mg NO_X/Nm^3*
    - *Gas turbine: 50 mg NO_X/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:*
    - *Solid biomass boiler: 275 mg NO_X/Nm^3 and 25 mg PM/Nm^3*

Other additional or alternative mitigation measures include supporting measures in the Local Authority's AQAP (**Section 1.3**).

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 Institute of Air Quality Management (IAQM) has produced a document titled 'Guidance on the assessment of dust from demolition and construction'[29] 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.

A Dust Risk Assessment for the proposed development at Sheldon House is presented in Section 4.

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[27] http://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf
[28] 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 m^2 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.
[29] http://iaqm.co.uk/guidance/

3.5 Air Quality Neutral Assessment

Policy SI1 Part B(2)(a) and Part E of the London Plan 2021 requires development proposals within Greater London to be at least 'air quality neutral' and not lead to further deterioration of existing poor air quality (such as areas designated as Air Quality Management Areas). A method for assessing this is outlined in the Draft[30] London Plan Guidance for Air Quality Neutral[31] November 2021.

The guidance provides two sets of benchmarks which cover the two main sources of air pollution from new developments:

- Building Emissions Benchmark (BEB) – emissions from equipment used to supply heat and energy to the buildings
- Transport Emissions Benchmark (TEB) – emissions from private vehicles travelling to and from the development.

A development must meet both benchmarks separately to be Air Quality Neutral. If one or both benchmarks are not met, appropriate mitigation or offsetting will be required.

The development plans allow for energy and heat provision through air source heat pumps / ground source heat pumps and solar PV. As such, no on-site emissions from buildings are estimated and on this basis the Sheldon House development **meets the air quality neutral requirements for buildings**. Should the energy strategy change, this assessment will need to be re-evaluated.

The TEB is provided in terms of the number of trips per metre squared of floorspace (GIA) over a year (trips/m^2/year) for non-residential use, or the anticipated number of trips per dwelling (trips/dwelling/year) for residential use. The TEB only estimates car or light van trips generated by the development's occupiers. The TEB does not include trips generated by deliveries and servicing, taxis or heavy vehicle movements from non-occupiers.

[30] It is worth noting that the latest version of the AQN guidance is out for Consultation with a final version expected in 2022. The draft version has been utilised, rather than the previous guidance as it is now best practice to use the yet to be published guidance.
[31] https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/london-plan-guidance/air-quality-neutral-aqn-guidance

Table 6: Transport Emission Benchmarks trip rates by Land Use Category and London Zone

Land use class	Annual trips per	London Zone		
		CAZ*	Inner	Outer
Residential (including student accommodation and large-scale purpose-built shared living development)	Dwelling	68	114	447
Office/Light Industrial	m^2 (GIA)	2	1	16
Retail (Superstore)		39	73	216
Retail (Convenience)		18	139	274
Restaurant/Café		64	137	170
Drinking establishments		0.8	8	N/A
Hot food takeaway		N/A	32.4	590
Industrial		N/A	3.9	16.3
Storage and distribution		N/A	1.4	5.8
Hotels		1	1.4	6.9
Care homes and hospitals		N/A	1.1	19.5
Schools, nurseries, doctors' surgeries, other non-residential institutions		0.1	30.3	44.4
Assembly and leisure		3.6	10.5	47.2

**Central Activity Zone: Central area of Greater London containing a unique cluster of vital economic activities*

The Transport Consultants have reviewed the 2011 Census data to understand average car ownership in the local ward (Hampton Wick) for those living in shared ownership properties. This identified average car ownership levels of 0.48 cars per 1-2 bedroom dwelling and 0.763 per 3-bed dwelling; when applied to the proposed unit mix, this suggests a demand of 15 cars. If we assume each vehicle leaves the site once per day and returns once per day that would equate to 30 trips per day. There is potential for additional trips but this level, for the purpose of this assessment, is considered a reasonable estimate.

The predicted trip rate for the development has been compared against that allowable in the TEB for Outer London and land use class: residential.

Table 7: Transport Emissions Input Data

Land use class	TEB (trips/dwelling/yr)	Development trip rate (trips/dwelling/yr)	Difference
Residential (C3)	447	10,950/30 = 365	-82

The results show that **the proposed development meets the air quality neutral requirements for transport.**

Using the above figures in terms of trip rates and combining it with the average distance assumed for journeys at a residential location (5.5km) and emission factors as provided in the AQN guidance, the estimated NOx and $PM_{2.5}$ emissions from the expected increase in road transport is 23.5 kg/year and 1.9 kg/year respectively. The expected emissions from the building element is zero.

4 Demolition & Construction Dust Risk Assessment

Emissions and dust from the construction phase of a development can have a significant impact on local air quality. The Institute of Air Quality Management's (IAQM) Guidance on the Assessment of Dust from Demolition and Construction[32] contains a methodology for determining the significance of construction developments on local air quality. The assessment presented below has been produced in accordance with these guidelines.

The main air quality impacts that may arise during demolition and construction activities are:

- Dust deposition, resulting in the soiling of surfaces
- Visible dust plumes, which are evidence of dust emissions
- Elevated PM_{10} concentrations, as a result of dust generating activities on site
- An increase in concentrations of airborne particles and nitrogen dioxide due to exhaust emissions from diesel powered vehicles and equipment used on site (non-road mobile machinery) and vehicles accessing the site.

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 PM_{10}, 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. Details of the assessment procedure in accordance with the IAQM guidance, and the results of the demolition and construction management plan are detailed below.

STEP 1: Screen the requirement for a more detailed assessment

A detailed assessment will normally be required when one of the following conditions applies to the development:

- A human receptor within:
  - 350m of the site boundary
  - 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s)

- An 'ecological receptor' within:
  - 50m of the site boundary
  - 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s)

A 'human receptor', as defined by the IAQM Guidance on the Assessment of Dust from Demolition and Construction[8,] refers to any location where a person or property may experience the adverse effects of airborne dust or dust soiling, or exposure to PM_{10} over a time period relevant to the air quality objectives, as defined in **Section 1.2**. The

[32] http://iaqm.co.uk/guidance/

guidance states that this will most likely refer to dwellings but may apply to other premises.

Human receptors are identified in close proximity to the proposed site boundary and therefore a detailed assessment has been completed.

STEP 2: Assess the risk of dust impacts

The risk of dust arising in sufficient quantities to cause annoyance and/or health and/or ecological impacts has been determined using the following risk factors: negligible, low, medium and high risk. The allocated risk category is based upon two factors, the scale and nature of the works (**Table 10**) and the sensitivity of the area to dust impacts (**Table 11**). These two factors are then combined to determine the risk of dust impacts with no mitigation applied, the results are summarised in **Table 12**. The number of human and ecological receptors near to the development have been considered.

Table 10: Dust Emission Magnitude

Activity	Dust Emission Magnitude	Justification
Demolition	Medium	Existing 7-storey building (4,093 m³) with demolition activities >10 m but not exceeding ~ 20 m above ground
Earthworks	Small	Total site area < 2,500 m² (1,629 m²) London Clay soil with large grain, < 5 heavy vehicles active at any time
Construction	Small	Total building volume < 25,000 m³ (7,238 m³), construction material with medium potential for dust release
Trackout	Small	< 10 HDV outward movements (estimated), in any one day, surface material with low potential for dust release, unpaved road length < 50 m

Table 11: Defining the sensitivity of the area

Potential Impact	Sensitivity of the Surrounding Area			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Medium	Medium	Medium	Medium
Human Health	Low	Low	Low	Low
Ecological	Low	Low	Low	Low

Table 12: Summary of the dust risk impacts for the proposed development

Potential Impact	Risk			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Medium risk	Low Risk	Low Risk	Low Risk
Human Health	Low Risk	Negligible	Negligible	Negligible
Ecological	Low Risk	Negligible	Negligible	Negligible

Stage 2 identifies a "medium" potential emission magnitude of the demolition phase. Even though the existing building volume is not large (4,093 m^3) the height of the demolition activities increases the potential magnitude of release. The potential emission magnitude is defined as "small" for earthworks, construction and trackout, largely due to the small scale of the development and associated vehicle movements.

The sensitivity of the area to dust soiling is identified as "medium" due to the quantity of nearby residential receptors to the development site. The sensitivity of the area in terms of human health is deemed "low" for all three phases due to the low PM_{10} concentrations present in the area (see **Section 2**). Sensitivity to ecological receptors is deemed "low" as no major ecological receptors were identified within close proximity of the development site.

When considering the potential dust emission magnitudes and sensitivities, we define the development as:

- **"Medium risk"** for dust soiling impacts during the demolition phase.
- **"Low risk"** for dust soiling impacts during the earthworks, construction and trackout phases and for human health and ecological impacts during the demolition phase.
- **"Negligible risk"** for human health and ecological impacts during the earthworks, construction and trackout phases.

STEP 3 and STEP 4: Determine any required site-specific mitigation and define post mitigation effects and their significance

Following best practice measures will help to reduce the impact of the construction activities to an acceptable level. The Control of Dust and Emissions during construction and Demolition[33] and the accompanying Supplementary Planning Guidance provided by the Mayor of London is considered to be good practice for London developments and provides detailed guidance on implementation of all relevant policies In the London Plan and Mayor's Air Quality Strategy to neighbourhoods, boroughs, developers and any other parties involved in any aspect of demolition and construction. This guidance is similar to that provided by the IAQM. The developer is encouraged to refer to both of these documents.

If an activity at the site results in unacceptable levels of dust being generated, then that activity should cease until sufficient measures have been adapted which prevent or minimise the dust emission. The implementation of such measures will be the responsibility of the site manager. In addition, the likelihood of concurrent dust generating activities on nearby sites should also be considered.

Compliance with the mitigation measures outlined in the IAQM guidance for developments is considered sufficient to mitigate the potential impacts of construction on local air quality.

The mitigation measures within the guidance are broken down into general and phase-specific sub-sections. The developer should ensure that all "highly recommended" (H)

[33] https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/supplementary-planning-guidance/control-dust-and#Stub-18264

and “desirable” (D) measures are implemented where appropriate using the matrix tables provided[34]. In using this matrix, the site should be classed as **“medium risk”** for mitigation measures specific to demolition. The site should be classed as **“low risk”** for all remaining general mitigation measures and those specific to the earthworks, construction and trackout phases.

5 Summary and Conclusions

An air quality assessment has been undertaken for a proposed residential development at Sheldon House, Cromwell Road, Teddington TN11 9EJ. The London Borough of Richmond Upon Thames has declared one Air Quality Management Area (AQMA) covering the whole borough due to the exceedance of the annual mean nitrogen dioxide (NO_2) and both the annual and 24-hour mean particulate matter (as PM_{10}) objectives. The proposed development is therefore located within an AQMA. The development is expected to generate an additional 30 vehicle journeys a day and this has been considered in the modelling.

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 (2025). 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 nitrogen dioxide (NO_2) and particulate matter (PM_{10}) concentrations are below the objective in the ‘without’ development scenario. Based on the evidence it is also estimated that there will be no exceedances of either short term objective for NO_2 or PM_{10}. The 'with' development scenario predicts that the development will cause NO_2 and PM_{10} concentrations to change negligibly and still be substantially below objective levels. Therefore, no mitigation is required as the air quality objectives are predicted to be met. Instead, other measures such as providing secure and covered cycle storage and installing electric charging point(s), should be considered to reduce the emissions arising from the development.

The proposed development has been assessed and found to be compliant with London’s ‘air quality neutral’ guidance for buildings and transport. The assessment has been completed on the assumption that energy and heat is provided through air source heat pumps / ground source heat pumps and solar PV. If the development plans regarding energy generation do not meet this requirement, re-assessment may be required.

A Demolition & Construction Dust Risk Assessment has been completed, with the site classified as “Medium risk” for dust soiling impacts during the demolition phase and “Low risk” for dust soiling impacts during the earthworks, construction and trackout phases and for human health and ecological impacts during the demolition phase. Appropriate mitigation measures as given in the IAQM guidance should be applied.

[34] Section 8.2: http://iaqm.co.uk/wp-content/uploads/guidance/iaqm_guidance_report_draft1.4.pdf

Appendix A – Model Verification

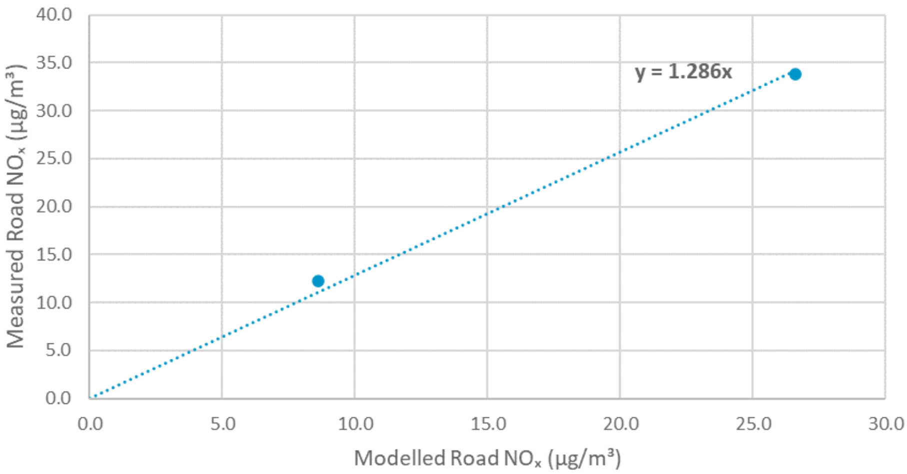
In order to verify modelled pollutant concentrations generated in the assessment, the model has been run to predict the annual mean road-NO_X concentration during 2019 at the two diffusion tube sites DT 7 and DT45 described in **Table 2**.

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 NO_2 calculator[19].

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 NO_2 concentrations were then determined by combining the adjusted modelled road-NO_X concentrations with the 2019 background NO_2 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.

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:

NO_2: 7.9

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. In this case the model is being assessed against the annual mean objective, which is 40 µg/m^3 for NO_2. An RMSE value of less than 10 µg/m^3 is obtained and therefore the model behaviour is acceptable.

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