Air Quality Assessment for the proposed development at 328e-h Kilburn High Road, London NW6 2QN

Report to CQD Construction Cost Consultants & Project Managers Ltd

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Aether

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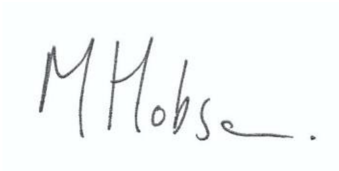
Signature	
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1. Introduction

Aether has been commissioned by Brondes Age to undertake an air quality assessment for the proposed development at 328e-h Kilburn High Road, London NW6 2QN. The development will consist of the demolition and redevelopment of the existing building (Brondes Age pub), providing a commercial unit at ground floor level and eight flats at first, second and third floor levels. No car parking spaces will be provided with the development and no air pollutant emitting on-site energy generation is planned. The report assesses the impact of local road traffic on sensitive receptor locations and presents the results of an air quality neutral assessment.

The development falls within the London Borough of Camden, 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.

The expected completion date of the proposed development is 2018. The assessment has therefore been completed for 2019, the expected first full year of occupation.

1.1 The Location of the Development

The proposed development is located at 328e-h Kilburn High Road (A5) (Figure 1).

Figure 1: Location of the development site

1.2 Assessment Criteria

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

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}.

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[2].

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

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

Using these definitions, the annual mean objectives will apply at locations where members of the public might be regularly exposed such as building façades of residential properties, schools and hospitals and will not apply at the building façades of offices or other places of work, where members

[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

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

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 the first, second and third floors where residential units are planned. 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 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 Camden declared the whole borough as an AQMA[3] in 2002 due to exceedances of the annual mean NO_2 and daily mean PM_{10} objectives. Therefore, the proposed development site falls within an AQMA. Camden's latest AQAP covers the actions to be taken to improve air quality between 2016 and 2017[4].

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 (v4.1) was issued in February 2017 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;

[3] https://uk-air.defra.gov.uk/aqma/details?aqma_id=205

[4] https://www.camden.gov.uk/ccm/cms-service/stream/asset/?asset_id=3420534&

- Grids: Type and size of grid for output; and
- Output: Output required and sources/groups to include in the calculations.

2. Methodology

2.1 Local Pollutant Concentrations

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

Local monitoring data

The London Borough of Camden has four automatic monitoring sites which monitor nitrogen dioxide (NO_2) and particulate matter (PM_{10}). NO_2 concentrations are also measured passively at diffusion tube sites across the Borough. Unfortunately, none of these monitoring sites lie in close proximity to the development site. Therefore, monitoring sites from the London Borough of Brent were also considered. Details of the monitoring sites closest to the development site are given in Table 2.

Monitoring results have been taken from the Councils' latest Annual Status Reports (ASRs)[5].

Table 2: Monitoring sites in Camden and Brent

Site Name	Site Type	Pollutant(s)	Grid Reference	Distance to Kerb (m)	Approx. Distance to development site (m)
CD1: Swiss Cottage*	R	NO_2, PM_{10}	526633, 184392	1.5	1,850
CA25	R	NO_2	525325, 185255	1	940
DT57: Kilburn Bridge†	R	NO_2	525461, 183558	0.5	1,140
DT30: Chichele Road†	R	NO_2	523663, 185353	1	1,420

Note: R = roadside, * automatic monitor, † London Borough of Brent monitors

The London Borough of Brent diffusion tubes were analysed by Gradko International Ltd, who participate in the Proficiency scheme[6]. 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 Brent has applied a national bias adjustment factor (0.94) to their 2016 diffusion tube results. This information was not provided in the London Borough of Camden's 2016 ASR and therefore it is unknown whether they have used a local or national bias adjustment factor.

[5] **Camden:** At the time of completing this report, the 2016 ASR was not publicly available. Other Camden air quality reports can be found at: https://www.camden.gov.uk/ccm/content/environment/air-quality-and-pollution/air-quality/twocolumn/policies-reports-and-research/?page=2

Brent: At the time of completing this report, no London Borough of Brent air quality reports were publicly available.

[6] 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 every year between 2014 and 2016 at the CD1 automatic monitoring site and at the diffusion tube sites. Exceedances of the 1 hour mean NO_2 objective have also been recorded at the automatic monitor; however 18 exceedances are allowed per year and therefore the hourly objective was only exceeded in 2016. Diffusion tubes do not provide information on hourly exceedances, but research[7] 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, it is considered likely that exceedances of the 1 hour mean objective occurred every year between 2014 and 2016 at the Kilburn Bridge diffusion tube site and in 2016 at the Chichele Road diffusion tube site.

No exceedances of either the annual or daily PM_{10} objective have been recorded at the automatic monitoring site in the past three years. Exceedances of the daily PM_{10} objective have been recorded; however 35 exceedances are allowed per year and therefore the daily objective was met.

Table 3: Monitoring results for sites close to the proposed development site, 2014-2016

Objective	Site Name	2014	2015	2016
Annual mean NO_2 (µg/m³)	CD1: Swiss Cottage*	**<u>66</u>**	**<u>61</u>**	**<u>66</u>**
	CA25	**48**	**48**	**52**
	DT57: Kilburn Bridge†	**<u>86</u>**	**<u>85</u>**	**<u>84</u>**
	DT30: Chichele Road†	**59**	**53**	**<u>63</u>**
Hourly mean NO_2 (no. exceedances)	CD1: Swiss Cottage*	13	11	37
Annual mean PM_{10} (µg/m³)	CD1: Swiss Cottage*	22	20	21
Daily mean PM_{10} (no. exceedances)	CD1: Swiss Cottage*	12	8	7

Note: Values exceeding the 40 µg/m³ annual mean objective are shown in bold, values above 60 µg/m³ are also underlined, * automatic monitor, † London Borough of Brent monitors

Background mapped data

Background pollutant concentration maps are available from the Defra LAQM website[8] and data has been extracted for Camden for this assessment. These 2013 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 estimated mapped background NO_x, NO_2 and PM_{10} concentrations around the development site are 47.2 µg/m³, 29 µg/m³ and 19.5 µg/m³ respectively in 2016 (the baseline year used in the assessment). The background maps also provide projections to future years. For 2019 (the first estimated year of occupation), the concentrations obtained for the same pollutants are 40.8 µg/m³, 25.8 µg/m³ and 19 µg/m³ respectively.

[7] As described in Box 5.2 of LAQM Technical Guidance (TG16).

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

Due to the lack of a nearby urban background monitoring site, the 2016 mapped background concentrations have been used in this assessment. To provide a conservative estimate, the projected improvements in background air quality by 2019 have not been used in the dispersion modelling.

2.2 Traffic data

Average annual daily traffic (AADT) count data for 2016 (the selected baseline year) has been obtained for Kilburn High Road (A5) and Chichele Road (A407) from Department for Transport (DfT) Traffic Counts[9], which provides data for major roads. The selected traffic count location for Kilburn High Road is located approximately 570 m from the development site. 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, 2017[10].Therefore there will be some uncertainty in the model input. All roads within 200 metres of the modelled receptors have been included in the assessment. The values are shown in Appendix B.

For the purpose of this assessment, the RTF[11] model has been utilised to project traffic growth. It has been assumed that traffic on local roads will increase by 4.1 % between 2016 and 2019. This is considered to represent a worst-case scenario as recent trends in traffic counts for the A5 show traffic to be declining, with a slight increase (0.2 %) between 2015 and 2016.

The proposed development includes no additional car parking spaces. Therefore, no Transport Assessment has been completed and it has been assumed that there will be no increase in traffic as a result of the development. Results (Section 3 of this report) therefore refer to concentrations modelled in 2019 regardless of whether the development takes place or not. As a result, the assessment and its conclusions are focused on the exposure of residents to elevated levels of pollutant concentrations, rather than assessing the impacts of the development per se.

An average speed of 16.3 kph has been assumed on all surrounding roads, which is the average traffic speed for Inner London during PM peak hours[12]. This provides a worst-case scenario, as it is the slowest time period reported, resulting in highest exhaust emissions.

Queuing Traffic

Special consideration has been given to notable junctions modelled in this assessment. CERC note 60[13] has been used for estimating emissions from queuing traffic. This defines a representative AADT for queuing traffic to be 30,000 at 5 kph, assuming an average vehicle length of 4m. These figures, along with the traffic composition of the corresponding roads were then input into the Emission Factor Toolkit (EFT)[14] to calculate emission rates. The emission rates were then used within the dispersion model as separate road sources of pre-defined length, representing each queue with time-varying emission profiles applied to represent busy periods.

[9] http://www.dft.gov.uk/traffic-counts

[10] http://www.dft.gov.uk/statistics/series/traffic/

[11] http://laqm.defra.gov.uk/documents/RTF-Automated-Traffic-Growth-Calculator-v3-1.xls

[12] Travel in London Report 9: http://www.tfl.gov.uk/corporate/publications-and-reports/travel-in-london-reports

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

[14] Latest version 7.0, http://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

2.3 Model input data

Hourly meteorological data from Heathrow for 2016 has been used in the model. The wind-rose diagram (Figure 2) presents this below.

Figure 2: Wind-rose diagram for Heathrow meteorological data, 2016

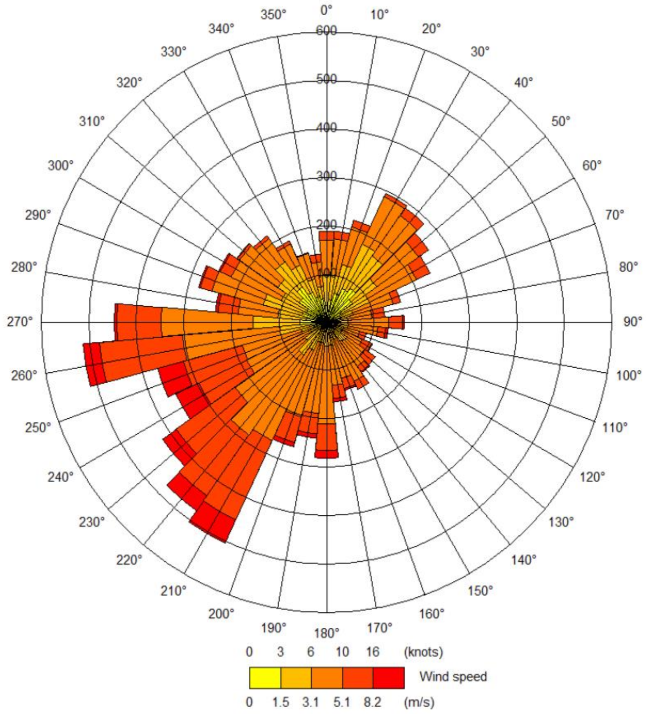
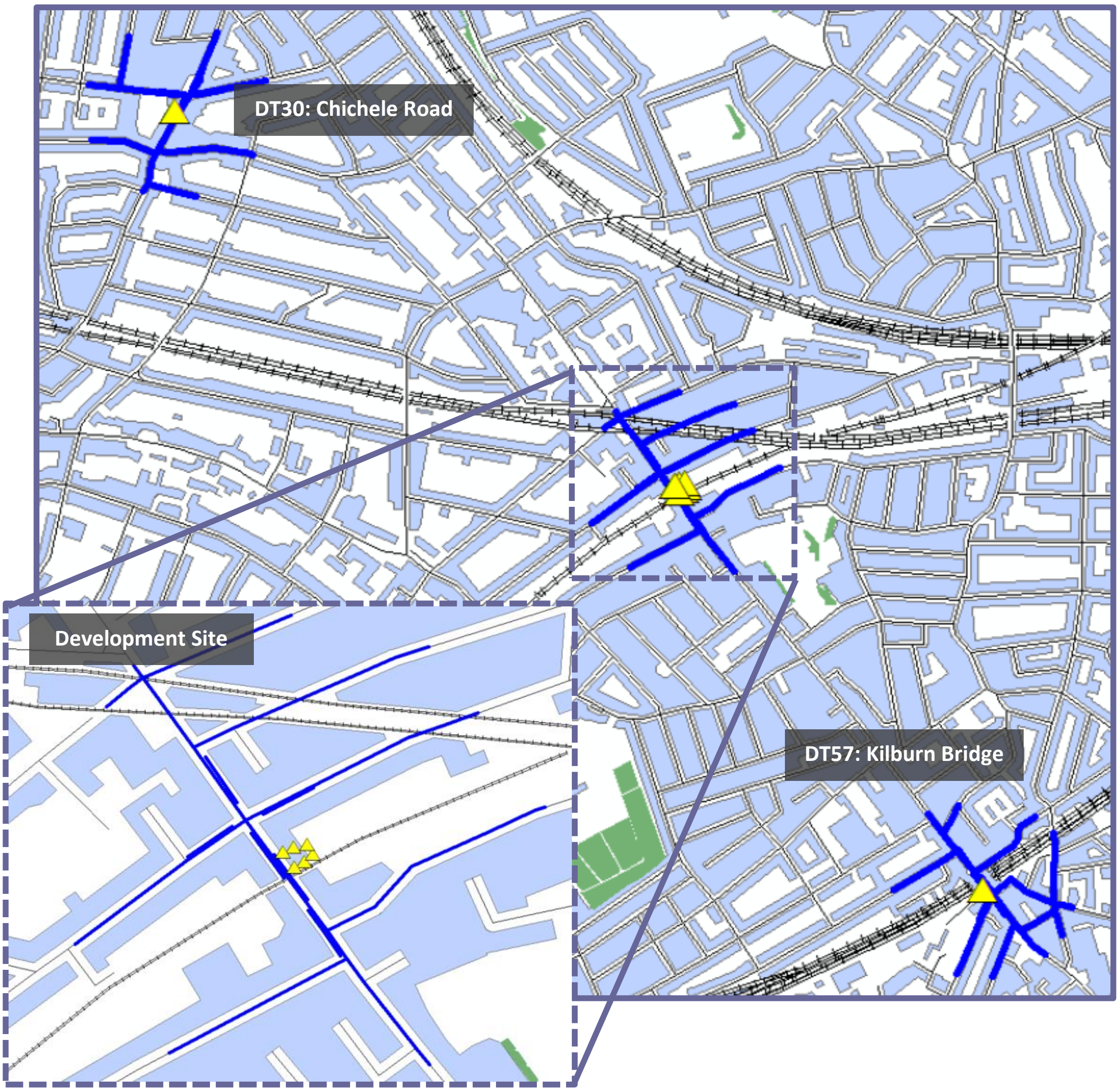


Figure 3: Road sources and receptors



Contains Ordnance Survey data © Crown copyright and database right [2017]

ArcMap software has been used to model the road source locations (blue lines) that are within 200 metres of the receptor locations (yellow triangles). This data can then be automatically uploaded to ADMS-Roads. This generates an accurate representation of the surrounding area to be assessed in the model in terms of the length of roads and distances between sources and receptors. This is shown in Figure 3 above.

There is a railway line and station close to the development site; this forms part of the Richmond to Stratford line and is operated by London Overground. This line is electric and therefore there will be no air pollutant emissions arising directly from the line at this location.

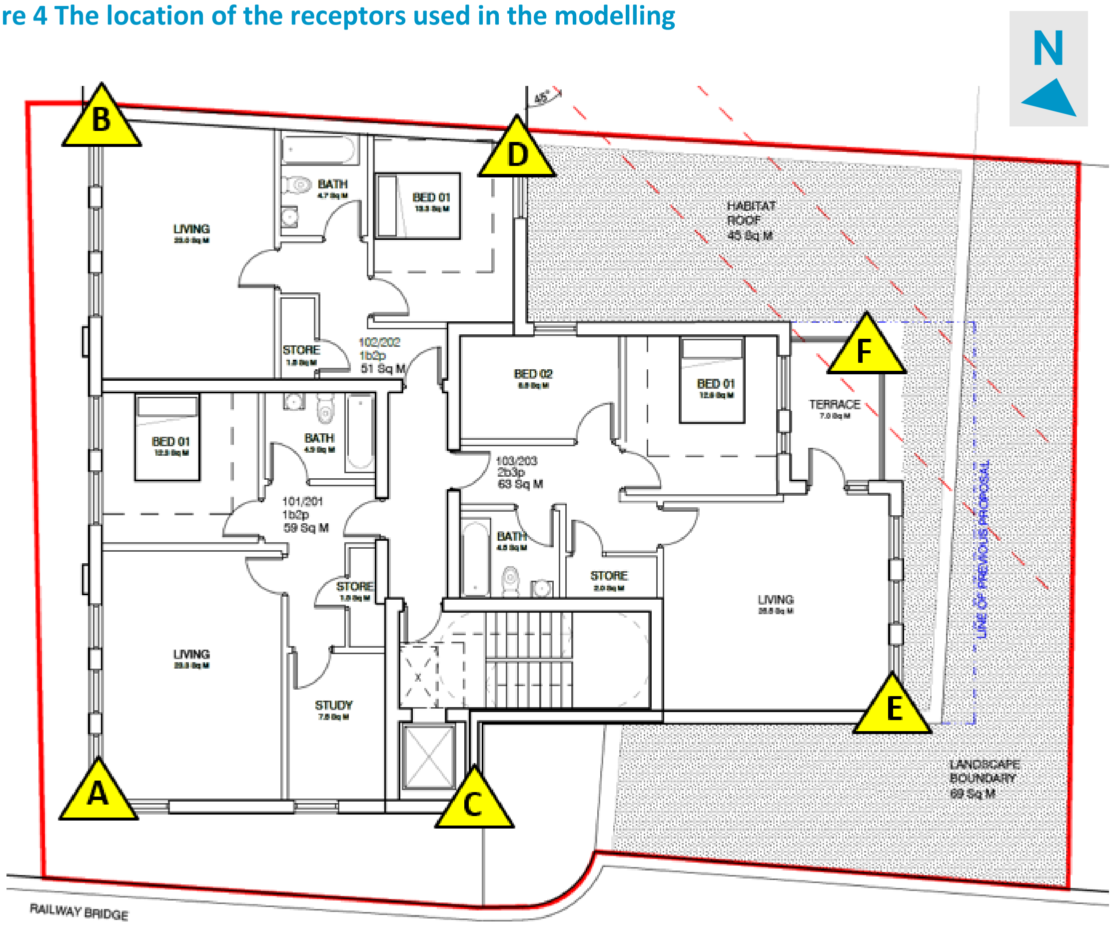
It is assumed that the contribution of other sources to NO_2 and PM_{10} is included in the background concentrations.

Six sensitive ground receptor locations have been selected for the assessment:

A. South east corner of the development, located close to Kilburn High Road.
B. South west corner of the development, located close to Kilburn High Road.
C. Eastern site of the development.
D. Western site of the development.
E. North east corner of the development, representing the drop off in pollutant concentrations with distance from the road.
F. North west corner 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 (yellow triangles). An assessment is made for the receptors at varying heights to assess likely concentrations across floor levels. Exposure has been assumed to be represented at the mid-point of each floor.

Figure 4 The location of the receptors used in the modelling



2.4 Conversion of NO_x to NO_2

Recent evidence shows that the proportion of primary NO_2 in vehicle exhaust has increased[15]. This means that the relationship between NO_x and NO_2 at the roadside has changed from that currently used in the ADMS model. A NO_x to NO_2 calculator (Published in June 2016) [16] has therefore been developed and has been used in conjunction with the ADMS model to obtain a more accurate picture of NO_2 concentrations.

2.5 Model Verification

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-NOx estimates have been verified against the concentrations measured at the Kilburn Bridge and Chichele Road diffusion tube sites (see Appendix A). Ideally three verification sites would have been used, but no other sites were deemed suitable. These sites were selected as they are the closest monitoring sites to the development that are considered to be representative of the development site. The Kilburn Bridge site is located on the same road as the development, and the Chichele Road site is located on a road with similar AADT (see Appendix B). The CA25 diffusion tube was not considered for model verification as it located off a minor road (Mill Lane) with no available local traffic data. Neither of the selected 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 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[17].

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

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

[17] This is in accordance with Paragraph 7.528 of LAQM TG(16), which states that in the absence of any PM_{10} data for verification, it may be appropriate to apply the road NOx adjustment to the modelled road PM_{10}.

3. Results

3.1 Results of the Dispersion Modelling

Table 4 below provides the estimated pollutant concentrations in the base year (2016) and the development year (2019)[18]. Given the inherent uncertainties in the modelling, background pollutant concentrations and vehicle fleet emission factors have been maintained at 2016 levels in the development year scenarios to provide a conservative estimate. Traffic growth has been predicted using the RTF calculator.

Table 4: Estimated pollutant concentrations in 2016 and 2019 (µg/m³)

Floor level	Receptor	Annual mean NO_2 concentration (µg /m³)		Annual mean PM_{10} concentration (µg /m³)		NO_2 Change	PM_{10} Change
		2016	2019	2016	2019		
Ground	A	**64.5**	**64.8**	24.0	24.1	0.3	<0.1
	B	**61.9**	**62.2**	23.7	23.7	0.3	<0.1
	C	**50.9**	**51.1**	22.1	22.2	0.2	<0.1
	D	**50.4**	**50.6**	22.1	22.2	0.2	<0.1
	E	**44.5**	**44.6**	21.3	21.4	0.2	<0.1
First	A	**44.4**	**44.5**	21.4	21.4	0.2	<0.1
	B	**47.8**	**48.0**	21.7	21.8	0.2	<0.1
	C	**47.1**	**47.3**	21.7	21.7	0.2	<0.1
	D	**44.0**	**44.1**	21.3	21.3	0.2	<0.1
	E	**43.8**	**43.9**	21.3	21.3	0.2	<0.1
Second	A	**40.9**	**41.0**	20.9	20.9	0.1	<0.1
	B	**40.9**	**41.0**	20.9	20.9	0.1	<0.1
	C	37.2	37.3	20.5	20.5	0.1	<0.1
	D	37.2	37.3	20.5	20.5	0.1	<0.1
	E	37.7	37.8	20.5	20.5	0.1	<0.1
Third	A	33.0	33.0	20.0	20.0	<0.1	<0.1
	B	33.0	33.1	20.0	20.0	<0.1	<0.1
	C	33.7	33.8	20.1	20.1	<0.1	<0.1
	D	33.7	33.7	20.1	20.1	<0.1	<0.1
	E	34.0	34.0	20.1	20.1	<0.1	<0.1

Note: Values exceeding the 40 µg/m³ annual mean objective are shown in bold, values above 60 µg/m³ are also underlined

In the base year scenario, the model predicts annual mean NO_2 concentrations to be above (by > 10 %) the annual mean objective at all ground floor locations. However, as the ground floor will be commercial units, only the 1 hour mean NO_2 objective will apply. The worst-case location is identified as receptor A, located closest to Kilburn High Road. Annual mean NO_2 concentrations remain above the annual mean NO_2 objective at first floor level and at the front of the building at second floor level, where the annual mean objective will apply.

[18] The development is not expected to impact local air quality and therefore the 2019 scenario refers to the concentrations regardless of whether the development takes place or not

The annual mean NO_2 concentrations are reasonable when compared to the data collected at the Chichele Road monitoring site. The ground floor A and B receptor concentrations are similar to the 2016 Chichele Road monitoring site concentration (see Table 3). Higher concentrations were recorded at the Kilburn Bridge diffusion tube site compared to the development, this is due to its proximity to the busy junctions surrounding the Kilburn High Road station.

The Guidance states that authorities may assume exceedances of the mean hourly objective are only likely to occur where annual mean concentrations are 60 $\mu g/m^3$ or above. Therefore, it is considered likely that this objective will be exceeded the ground floor A and B receptors.

The model has also been run for a future year scenario. The results indicate that annual mean NO_2 concentrations would change by ≤ 0.3 $\mu g/m^3$ at all locations. This increase is due to the predicted general increase in local traffic. As no car parking is being provided, it has been assumed that the development will have no impact on local air quality.

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[19], 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 2019 there will be 10 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.

3.2 Mitigation Measures

Based on the ADMS results for estimated NO_2 concentrations, there is a specific requirement for mitigation in the form of mechanical ventilation or NO_x / NO_2 filters, as concentrations are estimated to be above or near to NO_2 objective levels at the ground, first and second floor level. If the former is utilised, as a minimum, for the ground floor, air inlets should be located at the rear of the building and air circulated to the front of the building to prevent exceedances of the 1 hour objective. For upper floors, where residential units are planned, as a minimum, air inlets should be located at the rear of the building at third floor level and air circulated to all residential units. Air inlets should be placed as high as possible to result in the greatest improvement of indoor air quality.

The developer is encouraged to refer to the National House Builders Registration Council's (now NHBC) guidance for installing mechanical ventilation, found in Chapter 8.3'Mechanical ventilation with heat recovery'[20]. Some best practice for installing and maintaining mechanical ventilation includes:

- Insulating ductwork and other components from the cold
- Ensuring the appropriate location of inlet and extract to allow for maintenance and change of filters

[19] Paragraph 7.92 of LAQM TG(16)

[20] http://www.nhbc.co.uk/Builders/ProductsandServices/TechnicalStandards/

- Checking filters following construction as they may be blocked with construction dust

It is widely acknowledged that there is no safe level of exposure to air pollution[21], and as such, further measures to minimise air quality emissions are encouraged. It is recognised that the developer has already included the provision of cycle storage in their development plans and will not provide any provisions for private vehicles.

3.3 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'[22] 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 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. 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
- 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

[21] https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution
[22] http://iaqm.co.uk/guidance/

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.

In addition to the IAQM guidance referred to above, the Mayor of London has introduced standards to reduce emissions of pollutants from construction and demolition activity and associated equipment. In August 2014 the Mayor adopted the Control of Dust and Emissions from Construction and Demolition Supplementary Planning Guidance following extensive consultation. The SPG includes the world's first Non-Road Mobile Machinery Low Emission Zone (NRMM LEZ) combining standards to address both nitrogen oxide (NO_x) and particulate matter (PM) emissions[23].

From 1st September 2015, construction equipment used on the site of any major development within Greater London has been required to meet the EU Stage IIIA as a minimum; and construction equipment used on any site within the Central Activity Zone or Canary Wharf has been required to meet the EU Stage IIIB standard as a minimum. Some exemptions are provided where pieces of equipment are not available at the emission standard stipulated or in the volumes required to meet demand in a construction environment as dynamic as London. From September 2020, the requirements become more stringent.

3.4 Air Quality Neutral Assessment

London Plan Policy 7.14 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 AQMAs). A method for assessing this is outlined in the Sustainable Design and Construction Supplementary Planning Guidance (SPG) April 2014[24]. The SPG outlines building emission benchmarks for NO_x and PM_{10} for all land use classes and these are presented in Table 5 below. This development comes under land use class A1 (retail) and C3 (residential dwellings). As the development is assumed to have no impact on traffic generation, a transport air quality neutral assessment has not been conducted.

[23] https://nrmm.london/

[24] https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/supplementary-planning-guidance/sustainable-design-and

Table 5: Building Emission Benchmarks by Land Use Category

Land use class	NO_x (g/m^2)	PM_{10} (g/m^2)
A1 (Retail)	22.60	1.29
A3-A5 (Restaurants, drinking establishments, hot food takeaway)	75.20	4.32
A2, B1 (Financial/professional services/business)	30.80	1.77
B2-B7 (General industrial)	36.60	2.95
B8 (Storage and distribution)	23.60	1.90
C1 (Hotels)	70.90	4.07
C2 (Residential institutions)	68.50	5.97
C3 (Residential dwellings)	26.20	2.28
D1 (a) (Medical and health services)	43.00	2.74
D1 (b) (Crèche, day centres etc.)	75.00	4.30
D1 (c-h) (Schools, libraries, places of worship etc.)	31.00	1.78
D2 (a-d) (Cinemas, concert halls etc.)	90.30	5.18
D2 (e) (Swimming pools, gymnasium etc.)	284.00	16.30

New major developments[25] in London must meet these benchmarks, or implement mitigation measures to reduce emissions either on-site or off-site. Where this is not practical or desirable, some form of pollutant offsetting could be applied. One route would be to enforce the necessary "air quality neutral" measures via a Section 106 agreement.

The guidance on application of Air Quality Neutral[26] has been followed in this assessment. Building Emissions have been developed for the proposed building based upon:

- Gross Floor Area (m^2) of development
- On-site emissions of NO_x and PM_{10} associated with building use (kg/annum) calculated from energy use (kWh/annum) and a default emission factor (kg/kWh)

Table 6 presents the input data used for the building emissions benchmark calculation. Figures on gross internal area (GIA) were provided by the architect. Annual energy use has been estimated based upon CIBSE TM46:2008 energy benchmarks[27] and it has been assumed that gas will be used as the fuel. As the residential element, makes up the majority of the development site, energy consumption for the site has been compared to the C3 (residential dwellings) benchmark. The CIBSE TM46:2008 energy benchmark for retail is 0 kWh/m^3, as it is assumed that only electricity is used. The approach taken is therefore conservative.

[25] As outlined in the London Plan (10 or more residential dwellings (or where the number is not given, an area of more than 0.5 ha; or for all other uses, where the floor space is 1,000 m^2 or more, or the site area is 1 ha or more).

[26] http://www.london.gov.uk/sites/default/files/GLA%20AQ%20Neutral%20Policy%20Final%20Report%20April%202014%20J1605.pdf

[27] CIBSE TM46:2008 Table 1 Benchmark categories and values – values for "long term residential" applied

Table 6: Building Emissions Input Data

Land use class	Boiler fuel	GIA (m^2)	Energy Use (kWh/ annum)	NO_x EF (kg/kWh)
C3 (Residential dwellings)	Gas	850	535,500	0.00004

It has been possible to estimate annual building NO_x emissions from the input data gathered and compare this total against the relevant Building Emissions Benchmarks (Table 7). The results indicate that the **proposed development site meets the air quality neutral requirements for buildings.** This conclusion is based on the assumption that CSH/ BREEAM Ultra-Low NO_x gas boilers (< 40 mg/Kwh) are installed, and that no other energy generation is associated with the development. Gas consumption will result in negligible particulate matter emissions and therefore compliance with the building emissions benchmarks for PM_{10} are not considered further.

In addition, the developer is directed to recent guidance manuals on reducing air pollution from boilers and buildings[28]. These manuals outline best practice guidance with advice including:

- Maximising energy efficiency
- Guidance on heating / cooling including choice of e.g. boiler systems (and fuel)
- Maintenance and control settings

Table 7: Comparison of development building emissions to NO_x Building Emissions Benchmark

Pollutant	Land use class	BEB (kg/yr)	Development (kg/yr)	+/- (kg/yr)
NO_x	C3 (Residential dwellings)	22.3	21.4	-0.8

4. Summary and Conclusions

An air quality assessment has been undertaken for a proposed mixed use commercial and residential development at 328e-h Kilburn High Road, London NW6 2QN. The London Borough of Camden declared the whole borough as an Air Quality Management Area (AQMA) in 2002, due to exceedances of the annual mean nitrogen dioxide (NO_2) and daily mean particulate matter (PM_{10}) objectives. Therefore, the proposed development lies within an AQMA.

A conservative approach has been taken in that no improvement in the pollutant background concentrations or road transport emission factors has been assumed between the base year (2016) and the first year of occupation (2019). With expected improvements to the traffic fleet, improvements in pollutant concentrations may however materialise.

An air quality assessment has been carried out using the ADMS-Roads dispersion model to determine the impact of emissions from road traffic on sensitive receptors. Predicted concentrations have been

[28] http://www.camden.gov.uk/ccm/content/environment/green/airquality/guidance-for-reducing-pollution-from-boilers-and-buildings.en

compared with the air quality objectives. The results of the assessment indicate that annual mean NO_2 concentrations are above the objective in the base year (2016) and first year of occupation scenario (2019), at worst case locations. Concentrations of PM_{10} are predicted to be below the annual mean objective in2016 and 2019. Based on the evidence, it is also estimated that there will be exceedances of the short term NO_2 objective at the worst case locations, but that there will not be any exceedances of the short term PM_{10} objective. Therefore, the installation of mechanical mitigation or NO_x/NO_2 filters is required as the air quality objectives are predicted to be exceeded. If the former is utilised, as a minimum, for the ground floor, air inlets should be located at the rear of the building and air circulated to the front of the building. For upper floors, where residential units are planned, as a minimum, air inlets should be located at the rear of the building at third floor level and air circulated to all residential units. Air inlets should be placed as high as possible to result in the greatest improvement of indoor air quality. In addition, the developer is encouraged to refer to the IAQM's 'Guidance on the assessment of dust from demolition and construction' in order to minimise the impact of the construction/ demolition phase on local air quality.

The proposed development has been assessed, and found to be compliant with London's 'air quality neutral' guidance for buildings. The assessment has been completed on the assumption that CSH/ BREEAM Ultra-Low NO_x gas boilers are installed. If the development plans regarding energy generation do not meet this requirement, re-assessment may be required.

Appendix A – Model Verification

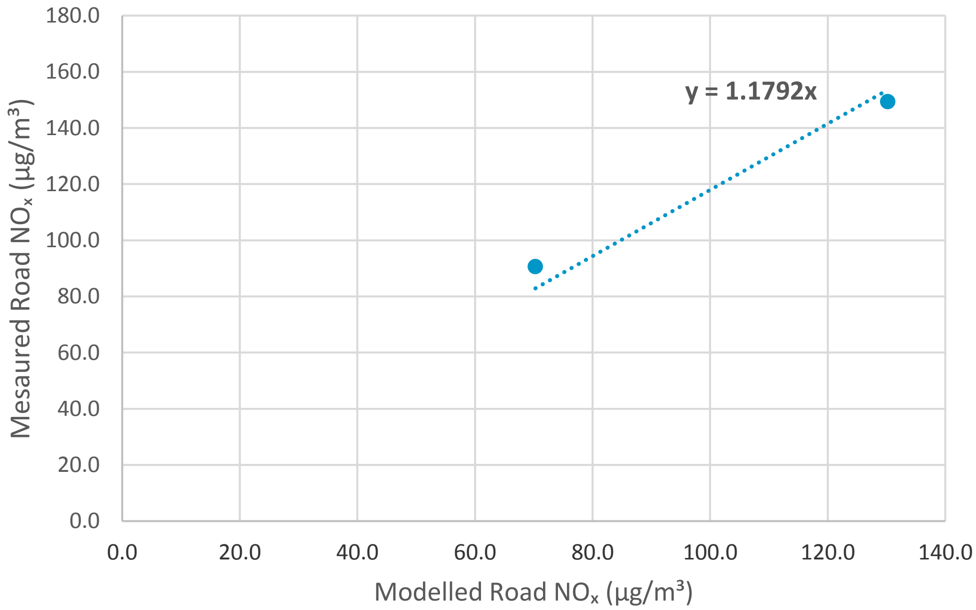
In order to verify modelled pollutant concentrations generated in the assessment, the model has been run to predict the annual mean road-NO_x concentration during 2016 at the DT57: Kilburn Bridge and DT30: Chichele Road diffusion tube sites described in Table 2.

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[16].

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 2016 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: 6.17

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 objectives, which is 40 µg/m^3 for NO_2. RMSE values of less than 10 µg/m^3 is obtained and therefore the model behaviour is acceptable.

Appendix B – Traffic Data

Table B.1: Traffic data for 2016 (and prediction for 2019)

Development / verification site	Road links	Annual Average Daily Traffic (AADT)	% Heavy Duty Vehicles (HDV)	Speed (kph)
Development site	Kilburn High Road (A5)	16,461 (17,145)	15.8	16.3
	Minor Roads	2,200 (2,291)	2.0	16.3
	Traffic queues: Kilburn High Road	30,000	15.8	5.0
	Traffic queues: Minor Roads	30,000	2.0	5.0
Verification sites	Chichele Road (A407)	10,687	8.2	16.3
	Traffic queues: Chichele Road	30,000	8.2	5.0

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