# Air Quality Assessment for the proposed development at Maria Fidelis School, Camden

## Report to FBM Architects

## February 2019

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# Contents

# 1 Introduction

Aether has been commissioned by FBM Architects to undertake an air quality assessment for the proposed development at the Maria Fidelis School near Euston Station, London. The development will consist of converting the school building into a managed workspace and creating an open space plus a new construction skills centre. No car parking spaces will be provided with the development. The current school building has air pollutant emitting on site energy generation in the form of five gas boilers, which will continue to be used in the new development. However, no information is currently available on the specifics of the boilers and therefore at the present time this aspect has not been included in the assessment.

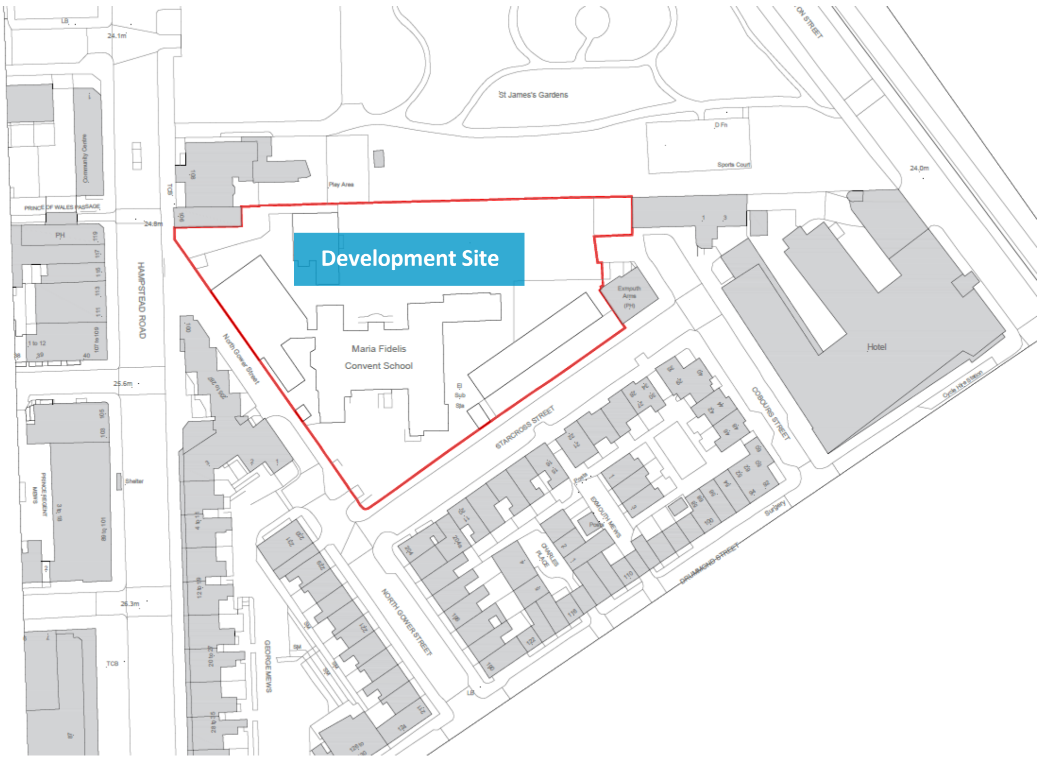
The development falls within the London Borough of Camden, which suffers from elevated levels of air pollution, primarily due to high levels of traffic. It is therefore important to assess whether there will be an exceedance of the air quality objectives for particulate matter ($PM_{10}$) or nitrogen dioxide ($NO_2$) at the proposed site and then advise whether any action is required to reduce the students' and workers' 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 2020. The assessment has therefore been completed for 2021, the expected first full year of occupation.

## 1.1 The Location of the Development

The proposed development is located on Starcross Street and Hampstead Road, near Euston Station. (**Figure 1**).

*Figure 1: Location of the development site*



## 1.2 Assessment Criteria

A summary of the air quality objectives relevant to the London Borough of Camden 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
- Where members of the public are regularly present.

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

[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

spend that amount of time. Therefore, in this assessment the hourly objective will also apply at all levels and buildings 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 has declared one AQMA[3] covering the whole borough. This AQMA was declared in 2000 due to exceedances of the annual mean $NO_2$ and 24-Hour mean $PM_{10}$ objectives. The latest AQAP was published in 2016, which includes some specific measures such as offering free trials of electric vehicles for local businesses and providing training to public health professionals on the health effects of air quality.[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 (v4.1.1) was issued in January 2018 and requires the following information to assess the impact at sensitive receptor locations:

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

## 2 Methodology

[3] https://uk-air.defra.gov.uk/aqma/
[4] https://www.camden.gov.uk/ccm/cms-service/stream/asset/?asset_id=3478895&

## 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 Camden has two automatic monitoring sites which monitor nitrogen dioxide ($NO_2$) and particulate matter ($PM_{10}$). Two of these automatic monitoring sites lie fairly close to the development site. $NO_2$ concentrations are also measured passively at diffusion tube sites across the Borough. Six of these diffusion tube sites lie within 1,400 m of 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).[5]

*Table 2: Monitoring sites within 1,400 m of the Maria Fidelis School, Camden development*

| Site Name | Site Type | Pollutant(s) | Grid Reference | Distance to Kerb (m) | Approx. Distance to development site (m) |
|---|---|---|---|---|---|
| Euston Road* | R | $NO_2$, $PM_{10}$ | 529878, 182648 | 0.5 | 590 |
| London Bloomsbury* | UB | $NO_2$, $PM_{10}$ | 530123, 182014 | 27 | 1040 |
| CA4 | R | $NO_2$ | 530110, 182795 | 5 | 840 |
| CA6 | UB | $NO_2$ | 530430, 182430 | 30 | 1160 |
| CA10 | UB | $NO_2$ | 529880, 182334 | 25 | 660 |
| CA11 | K | $NO_2$ | 529568, 181728 | <1 | 940 |
| CA20 | R | $NO_2$ | 529914, 183147 | <5 | 810 |
| CA21 | R | $NO_2$ | 529962, 181620 | 1 | 1220 |
| CA4 | R | $NO_2$ | 530110, 182795 | 5 | 840 |

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

The 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. London Borough of Camden has applied a national bias adjustment factor (0.97) to their 2017 diffusion tube results.

Monitoring results are presented in **Table 3**. The data shows that the annual mean $NO_2$ objective was exceeded for every year where data was collected between 2015 and

[5] https://www.camden.gov.uk/ccm/cms-service/stream/asset/?asset_id=3735283&
[6] This is a national QA/QC scheme.

2017 at the Euston Road automatic monitoring site and the CA4, CA11, CA20 and CA21 diffusion tube monitoring sites. The annual mean $NO_2$ objective was also exceeded in both 2015 and 2016 for the London Bloomsbury monitoring site and in 2015 at the CA10 diffusion tube site. The hourly mean $NO_2$ objective was exceeded 118 times between 2015 and 2017 at the Euston Road monitoring site; 18 exceedances are allowed per year and therefore the hourly objective was not met all three years. 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/m$^3$. Therefore, exceedances of the hourly mean objectives are expected at the CA4, CA11 and CA21 diffusion tube monitoring sites.

The annual mean $PM_{10}$ objective was  not exceeded at either automatic monitoring site between 2015 and 2017. Exceedances of the daily mean $PM_{10}$ objective have been recorded between 2015 and 2017 across both monitoring sites; however, 35 exceedances are allowed per year and therefore the hourly objective was met.

*Table 3: Monitoring results for sites close to the proposed development site, 2015-2017*

| Objective | Site Name | 2015 | 2016 | 2017 |
|---|---|---|---|---|
| Annual mean $NO_2$ (µg/m$^3$) | Euston Road* | <u>**90**</u> | <u>**99**</u> | <u>**83**</u> |
| | London Bloomsbury* | **48** | **42** | 38 |
| | CA4 | <u>**87**</u> | <u>**83**</u> | <u>**93**</u> |
| | CA6 | 36 | 31 | |
| | CA10 | **45** | 40 | |
| | CA11 | <u>**86**</u> | <u>**84**</u> | |
| | CA20 | **49** | **48** | **57** |
| | CA21 | <u>**71**</u> | <u>**72**</u> | <u>**81**</u> |
| Hourly mean $NO_2$ (no. exceedances) | Euston Road* | 54 | 39 | 25 |
| | London Bloomsbury* | 0 | 0 | 0 |
| Annual mean $PM_{10}$ (µg/m$^3$) | Euston Road* | 18 | 24 | 20 |
| | London Bloomsbury* | 22 | 20 | 19 |
| Daily mean $PM_{10}$ (no. exceedances) | Euston Road* | 5 | 10 | 3 |
| | London Bloomsbury* | 6 | 9 | 6 |

*Values exceeding the 40 µg/m$^3$ annual mean objective are shown in bold, values above 60 µg/m$^3$ are also underlined,* automatic monitor*

### 2.1.2 Background mapped data

Background pollutant concentration maps are available from the Defra LAQM website[8] and data has been extracted for London Borough of Camden for this assessment. These 2015 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.

[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

The estimated mapped background $NO_X$, $NO_2$ and $PM_{10}$ concentrations around the development site are 77.8 µg/m³, 43.9 µg/m³ and 20.8 µg/m³ respectively in 2017. For 2021 (the estimated first full year of occupation), the concentrations obtained for the same pollutants are 56.1 µg/m³, 34.4 µg/m³ and 20 µg/m³ respectively.

The London Bloomsbury background monitoring site has been used to provide background concentrations for 2017 in this assessment. To provide a conservative estimate, the projected improvements in background air quality by 2021 have not been used in the dispersion modelling.

## 2.2 Model input data

Hourly meteorological data from Heathrow for 2017 has been used in the model. The wind-rose diagram (**Figure 2**) presents this below.

*Figure 2: Wind-rose diagram for Heathrow meteorological data, 2017*

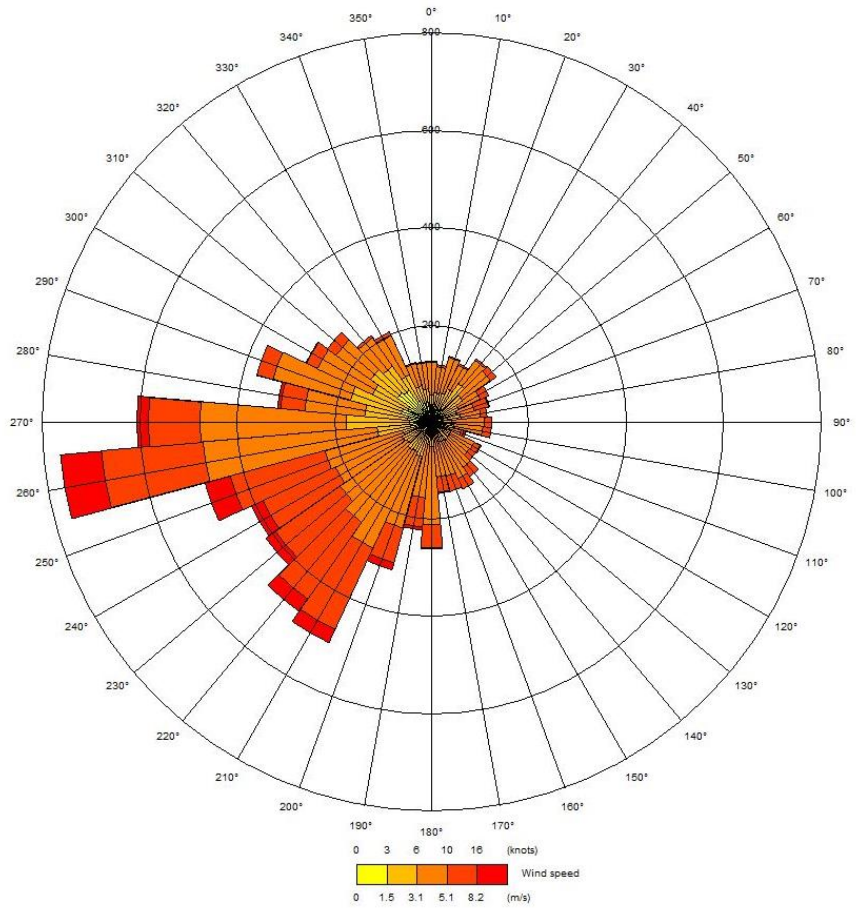
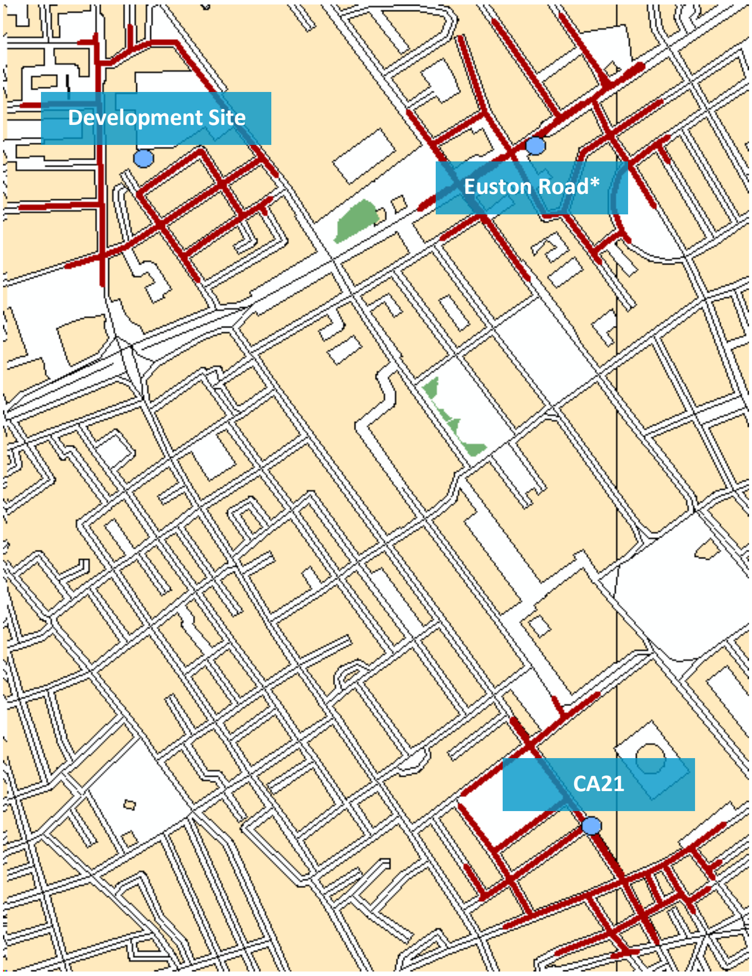


*Figure 3: Road sources and receptors*





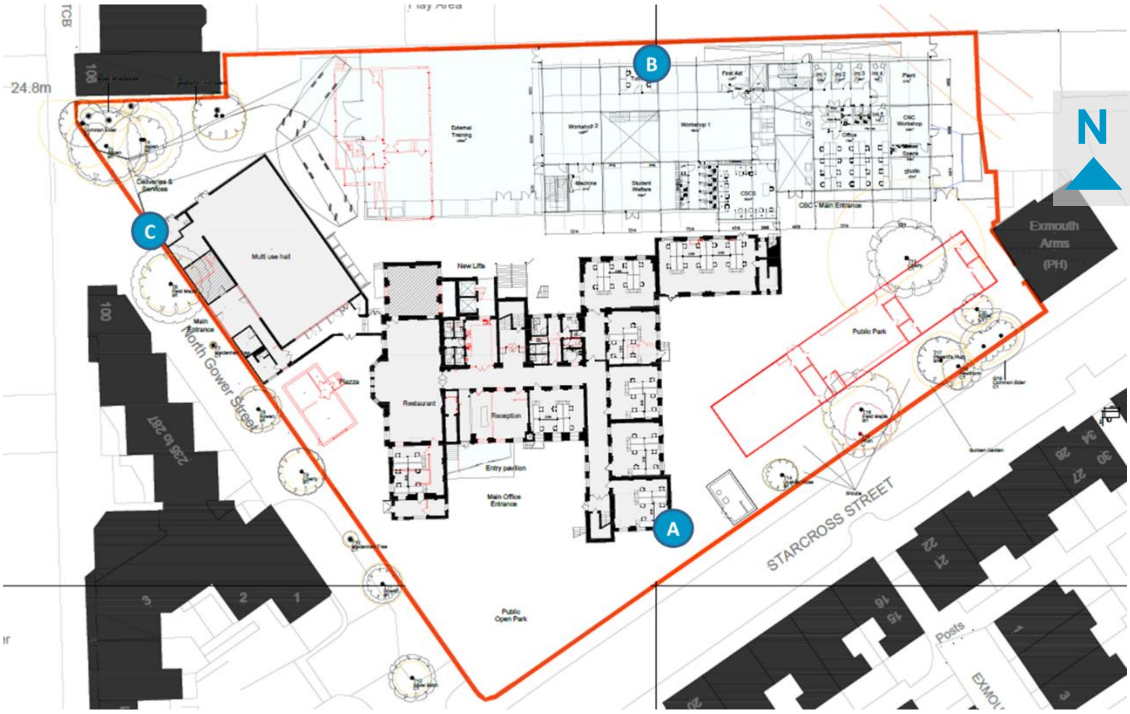

ArcMap software has been used to model the road source locations (red lines) that are within 200 metres of the receptor locations (blue circles). This data can then be automatically uploaded to ADMS-Roads. This generates an accurate representation of the surrounding area to be assessed in the model in terms of the length of roads and distances between sources and receptors. This is shown in **Figure 3** above. It is assumed that the contribution of other sources to $NO_2$ and $PM_{10}$ is included in the background concentrations.

Three sensitive receptor locations have been selected for the assessment:

- A corner of the development, located closest to Starcross Street
- B façade of the development, representing the drop off in pollutant concentrations with distance from the road.
- C corner of the development, located closest to Hampstead 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). An assessment is made for the receptors at varying heights to assess likely concentrations across floor levels. It has been assumed that background concentrations remain constant at all heights of the development based on the 2017 City Air Quality at Height report[9]. 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*




## 2.3 Traffic data

Average annual daily traffic (AADT) count data for 2017 (the selected baseline year) has been obtained for Hampstead Road, Eversholt Street, Upper Woburn Place, Euston Road, Bloomsbury Street and Lower Oxford Street from Department for Transport (DfT) Traffic Counts[10], which provides data for major roads. 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[11]. Starcross Street is a minor road and therefore no specific traffic is available for this road. Therefore, there will be 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[12] model has been utilised to project traffic growth. It has been assumed that traffic on local roads will increase by 5.5 % between 2017 and 2021. Construction traffic from the HS2 project are also expected to impact the roads around the development site, although measures to minimise this have been set out in the Local Environment Management Plan.[13] Large goods vehicle movement is restricted to 25 single movements per day without approval by the London Borough of Camden.

[9] http://www.wsp-pb.com/PageFilesn/80156/WSPPB%20City%20Air%20Quality%20at%20Height.pdf
[10] http://www.dft.gov.uk/traffic-counts
[11] http://www.dft.gov.uk/statistics/series/traffic/
[12] http://laqm.defra.gov.uk/documents/RTF-Automated-Traffic-Growth-Calculator-v3-1.xls
[13] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/669170/camden_local_environment_management_plan.pdf

The Transport Assessment[14] concludes that the development will result in a maximum of 40 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 2021. Results (**Section 3** of this report) therefore refer to concentrations modelled in 2021 both without and with the proposed development.

An average speed of 10.7 kph has been assumed on all surrounding roads, which is the average traffic speed for Central 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 in this assessment. 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. Traffic queues have been modelled on Euston Road, Upper Woburn Place, Eversholt Street and Bloomsbury Street.

## 2.4 Conversion of $NO_X$ to $NO_2$

Recent 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 October 2017)[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.

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[14] Email from Helen Jenkins at Conisbee

[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 8.0, http://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

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

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

For this project, modelled annual mean road-$NO_X$ estimates have been verified against the concentrations measured at the Euston Road automatic monitor CA21 diffusion tube site. (see **Appendix A**). These sites were selected because they represent the monitoring sites closest to the proposed development. Of the diffusion tube sites with 2017 monitoring data two were closer than site CA21, CA4 and CA20. These sites were however not used for verification due to construction taking place on the building next door and proximity to a taxi rank respectively. Ideally three verification sites would have been used, but no other sites were deemed suitable due to either their distance from the development site, lack of 2017 monitoring data or the reasons set out above.

In addition, modelled annual mean $PM_{10}$ estimates have been verified against the concentrations measured at the London Bloomsbury automatic site (see **Appendix A**).

# 3 Results

## 3.1 Results of the Dispersion Modelling

**Table 4** below provides the estimated pollutant concentrations in the development year (2021) without and with[20] the development. Given the inherent uncertainties in the modelling, background pollutant concentrations and vehicle fleet emission factors have been maintained at 2017 levels in the development year scenarios to provide a conservative estimate. Traffic growth has been predicted using the RTF calculator.

[20] 'With' development includes the impact of the additional traffic that will be generated with the development.

*Table 4: Estimated pollutant concentrations in 2021 without and with the development (μg/m$^3$)*

| Floor level | Receptor | Annual mean $NO_2$ concentration (μg /m$^3$) | | Annual mean $PM_{10}$ concentration (μg /m$^3$) | | $NO_2$ Change | $PM_{10}$ change |
|---|---|---|---|---|---|---|---|
| | | Without development | With development | Without development | With development | | |
| Ground | A | **42.3** | **42.3** | 19.4 | 19.4 | <0.1 | <0.1 |
| | B | **41.5** | **41.5** | 19.3 | 19.3 | <0.1 | <0.1 |
| | C | **49.1** | **49.1** | 20.1 | 20.1 | <0.1 | <0.1 |
| 1 | A | **41.8** | **41.8** | 19.4 | 19.4 | <0.1 | <0.1 |
| | B | **41.4** | **41.4** | 19.3 | 19.3 | <0.1 | <0.1 |
| 2 | A | **41.0** | **41.0** | 19.3 | 19.3 | <0.1 | <0.1 |

*Note: Exceedances of the objectives are highlighted. The changes in $NO_2$ and $PM_{10}$ presented may not exactly equal the difference in the constituent parts shown due to rounding.*

In the without development scenario, the model predicts annual mean $NO_2$ concentrations to be above (by 19 %) the annual mean objective at all locations. The worst-case location is identified as receptor C at the ground floor. This is to be expected as receptor C is located closest to Hampstead Road, where roadside concentrations will be maximised.

The estimated annual mean $NO_2$ concentrations at the development site are reasonable when compared to the data collected at the Euston Road and HA21 monitoring sites. Concentrations modelled at the development site are significantly lower than those measured at the monitoring sites. However, this is to be expected as the monitoring sites are located on Euston Road and Bloomsbury Street which have a much higher traffic flow and percentage of HGV vehicles and buses respectively compared to Hampstead Road. As well as a higher traffic flow the monitoring sites are both located significantly closer to the road (0.5 m from the kerb) compared to the development site, which is located 17 m from Hampstead Road.

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 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 change by < 0.1 $\mu g/m^3$ at worst-case locations.

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[21], 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 2021 there will be three 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 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[22] 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

[21] Paragraph 7.92 of LAQM TG(16)
[22] 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 % of 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 receptor in the assessment year is 123% 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 the impact on local annual mean $NO_2$ concentrations is likely to be negligible as the change in concentration due to the development is 0%.

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, exposure of those attending the Construction Skills Centre of the development is of significance, as the predicted $NO_2$ concentrations are over the objective at all sensitive receptors in the 'without' and 'with' development (in 2021) scenarios.

## 3.3 Mitigation Measures

Based on the ADMS results, the annual mean $NO_2$ objective is predicted to be exceeded at all locations modelled. However, the annual mean objective only applies at the Construction Skills Centre and does not apply to the office space or the multi-purpose hall, where only the hourly objective applies. Therefore, it is recommended that $NO_X/NO_2$ filters or mechanical ventilation with $NO_x/NO_2$ filters are installed to mitigate the worsened air quality at the Construction Skills Centre. If the latter is installed is it recommended that air is extracted from as high up and far back from Hampstead Road as possible. Mechanical ventilation without $NO_x/NO_2$ filters is not recommended due to the $NO_2$ exceedances across the site and a lack of height to draw clean air from.

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'[23]. Some best practice for installing and maintaining mechanical ventilation includes:

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

In addition, it is widely acknowledged that there is no safe level of exposure to air pollution[24], and as such, the developer is encouraged to consider further mitigation measures to reduce emissions arising from the site. The National Planning Policy Framework[25], requires new developments to support sustainable travel and air quality improvements. A key theme of the NPPF is that developments "should ensure that appropriate opportunities to promote sustainable transport can be – or have been taken up". It states that developments should be located and designed where practical to:

- Give priority to pedestrian and cycle movements, and have access to high quality public transport facilities
- Incorporate facilities for charging plug-in and other ultra-low emission vehicles
- A key tool to facilitate the above will be a Travel Plan. All developments which generate a significant amount of movement should be required to provide a Travel Plan.

Building on the NPPF, the Institute of Air Quality Management (IAQM) has provided guidance on the principles of good practice[26] which should be applied to all major development[27]. Examples of good practice include:

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23 http://www.nhbc.co.uk/Builders/ProductsandServices/TechnicalStandards/

24 https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution

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

26 http://www.iaqm.co.uk/text/guidance/air-quality-planning-guidance.pdf

27 Major developments can be defined as developments where:
The number of dwellings is 10 or above
The residential development is carried out on a site of more than 0.5ha where the number of dwellings is unknown

- 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. (Not relevant)
- Where the development generates significant additional traffic, a detailed travel plan should be implemented.
- 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 $PM/Nm^3$

## 3.4 Mitigating the Impacts of the Construction Phase

Emissions and dust from the construction phase of a development can have a significant impact on local air quality. The IAQM has produced a document titled 'Guidance on the assessment of dust from demolition and construction'[28] 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

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The provision of more than 1000 $m^2$ commercial floor space
Development carried out on land of 1ha or more
Developments which introduce new exposure into an area of existing poor air quality (e.g. an AQMA) should also be considered in this context.
[28] http://iaqm.co.uk/guidance/

- 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 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 July 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[29].

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.

### 3.5 Air Quality Neutral Assessment

The air quality neutral assessment will need to be completed once details of the energy strategy are known.

# 4 Summary and Conclusions

An air quality assessment has been undertaken for a proposed managed workspace, open space and construction skills centre at Maria Fidelis School, Euston. The London Borough of Camden has declared one Air Quality Management Area (AQMA) due to the exceedance of the annual mean nitrogen dioxide ($NO_2$) and particulate matter ($PM_{10}$) objective. The proposed development falls within the 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 (2017) and the first year of occupation (2021). With expected improvements to the traffic fleet, improvements in pollutant concentrations may however materialise.

[29] https://nrmm.london/

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 $NO_2$ concentrations are above the objective at all locations in the 'without' development scenario. Concentrations of particulate matter ($PM_{10}$) are predicted to be below the annual mean objective in the 'without' development scenario. Based on the evidence it is 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 by < 0.1$\mu$g/m$^3$. Therefore, the installation of $NO_x$ / $NO_2$ filters is required as the air quality objectives are predicted to be exceeded. In addition, other measures such as providing secure and covered cycle storage, car share schemes, and installing electric charging point(s), should be considered to reduce the emissions arising from the development. 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 details of on-site energy generation are currently unknown. These will be required in order to conduct an Air Quality Neutral and to fully assess the impact of the development on local air quality at a later stage.

# 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 2017 at the Euston Road automatic monitor and CA21 diffusion tube site described in **Table 2**. Of the diffusion tube sites with 2017 results two were closer than site CA21, CA4 and CA20. These sites were however not used for verification due to construction taking place on the building next door and proximity to a taxi rank respectively. Ideally three verification sites would have been used, but no other sites were deemed suitable due to either their distance from the development site, lack of 2017 monitoring data or the reasons set out above.

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 2017 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. In addition, the Euston Road monitoring site has been used to verify the annual mean road-$PM_{10}$ concentrations. The results are presented in **Table A.1**.

*Figure A.1: Comparison of Measured road-$NO_X$ to unadjusted modelled road-$NO_X$ concentrations*

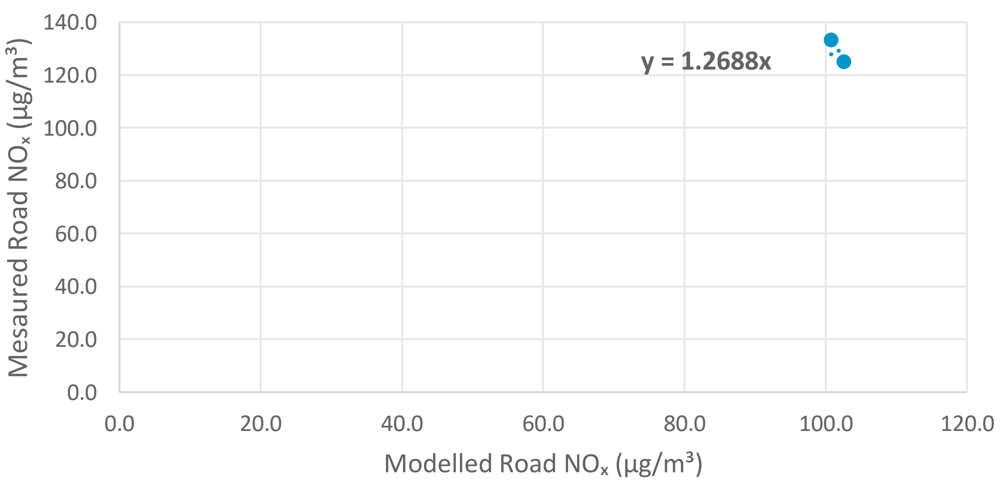


*Table A.1: Comparison of Measured road-PM10 to unadjusted modelled road NOx concentrations*

| Receptor | Measured road-$PM_{10}$ | Unadjusted modelled road-$PM_{10}$ | Adjustment factor |
|---|---|---|---|
| Euston Road* | 1.0 | 4.9 | 0.2 |

**RMSE**

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

$NO_2$: 7.94

$PM_{10}$: 5.74

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 both $NO_2$ and $PM_{10}$. RMSE values of less than 10 µg/m$^3$ are obtained and therefore the model behaviour is acceptable.

# Appendix B – Traffic Data

*Table B.1: Traffic data for 2017 (and prediction for 2021 without development)*

| Development/ verification site | Road links | Annual Average Daily Traffic (AADT) | % Heavy Duty Vehicles (HDV) | Speed (kph) |
|---|---|---|---|---|
| Development site | Hampstead Road | 32,031 (33,780) | 9.6 | 11 |
| | Minor Roads | 2,200 (2,320) | 2.0 | 11 |
| Verification sites | Eversholt Street | 12,191 (12,857) | 10.5 | 11 |
| | Upper Woburn Place | 14,493 (15,284) | 17.5 | 11 |
| | Euston Road | 57,374 (60,507) | 8.4 | 11 |
| | Bloomsbury Street | 17,049 (17,980) | 15.7 | 11 |
| | Lower Oxford Street | 12,694 (13,387) | 15.3 | 11 |
| | Lower Woburn Rd | 30,000 (15,284) | 17.5 | 11 |
| | Traffic Euston Rd | 30,000 (31,638) | 8.4 | 5 |
| | Traffic Lower Woburn Rd | 30,000 (31,638) | 17.5 | 5 |
| | Traffic Eversholts St | 30,000 (31,638) | 10.5 | 5 |
| | Traffic Bloomsbury Street | 30,000 (31,638) | 15.7 | 5 |

*Note: With development results in an average daily traffic increase of 40 vehicles on all roads that have direct access to the site.*

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