Air Quality Assessment:
Camden Schools Project

August 2016

Experts in air quality
management & assessment

Document Control

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1 Introduction

1.1 This report describes the potential air quality impacts associated with the redevelopment of the William Ellis, Parliament Hill and LaSWAP schools in Camden. The assessment has been carried out by Air Quality Consultants Ltd on behalf of Harvey Group and is required to satisfy Condition 17 of the planning permission for the development, which states that:

"Prior to the commencement of any work on site, an air quality assessment shall be submitted to the local planning authority assessing the existing levels of air quality, the impact of development (including the proposed Combined Heat & Power) on air quality and proposed mitigation measures to reduce this impact to an acceptable level. The air quality statement shall also demonstrate how exposure of sensitive receptors to poor levels of air quality will be mitigated. Full details of the Combined Heat & Power engine shall be provided demonstrating that the Mayor's NOx emissions limits as outlined in the Sustainable Design and Construction supplementary planning guidance (SPG) [are adhered to]"

1.2 The Camden schools site lies within an Air Quality Management Area (AQMA) declared by the London Borough (LB) of Camden for exceedences of the annual mean nitrogen dioxide and 24-hour mean PM_{10} objectives. The development will lead to an increase in traffic on the local roads, which may impact on air quality at existing residential properties. The new school buildings will also be subject to the impacts of road traffic emissions from the adjacent road network. The main air pollutants of concern related to traffic emissions are nitrogen dioxide and fine particulate matter (PM_{10} and $PM_{2.5}$).

1.3 The proposals for the development include Combined Heat and Power (CHP) and boiler plant, the emissions from which could impact upon air quality at existing residential properties, as well as the new school buildings within the development itself. The main air pollutant of concern related to CHP and boiler plant is nitrogen dioxide.

1.4 This report describes existing local air quality conditions (2014), and the predicted air quality with the proposed development in operation. The assessment of traffic-related impacts focuses on the baseline year, 2014. This represents a conservative assessment as vehicle emissions are anticipated to reduce in the future.

1.5 This report has been prepared taking into account all relevant local and national guidance and regulations.

2 Policy Context and Assessment Criteria

Air Quality Strategy

2.1 The Air Quality Strategy (Defra, 2007) published by the Department for Environment, Food, and Rural Affairs (Defra) and Devolved Administrations, provides the policy framework for air quality management and assessment in the UK. It provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. Local authorities are seen to play a particularly important role. The strategy describes the Local Air Quality Management (LAQM) regime that has been established, whereby every authority has to carry out regular reviews and assessments of air quality in its area to identify whether the objectives have been, or will be, achieved at relevant locations, by the applicable date. If this is not the case, the authority must declare an Air Quality Management Area (AQMA), and prepare an action plan which identifies appropriate measures that will be introduced in pursuit of the objectives.

Clean Air Act 1993 & Environmental Protection Act

2.2 Small combustion plant of less than 20 MW net rated thermal input are controlled under the Clean Air Act 1993 (HMSO, 1993a). This requires the local authority to approve the chimney height. Plant which are smaller than 366 kW have no such requirement.

2.3 Measures to ensure adequate dispersion of emissions from discharging stacks and vents are included in Technical Guidance Note D1 (Dispersion) (HMSO, 1993b), issued in support of the Environmental Protection Act (HMSO, 1990).

Planning Policy

National Policies

2.4 The National Planning Policy Framework (NPPF) (2012) sets out planning policy for England in one place. It places a general presumption in favour of sustainable development, stressing the importance of local development plans, and states that the planning system should perform an environmental role to minimise pollution. One of the twelve core planning principles notes that planning should *"contribute to…reducing pollution"*. To prevent unacceptable risks from air pollution, planning decisions should ensure that new development is appropriate for its location. The NPPF states that the effects of pollution on health and the sensitivity of the area and the development should be taken into account.

2.5 More specifically the NPPF makes clear that:

"Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan".

2.6 The NPPF is now supported by Planning Practice Guidance (PPG) (DCLG, 2014), which includes guiding principles on how planning can take account of the impacts of new development on air quality. The PPG states that *"Defra carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU Limit Values"* and *"It is important that the potential impact of new development on air quality is taken into account … where the national assessment indicates that relevant limits have been exceeded or are near the limit".* The role of the local authorities is covered by the LAQM regime, with the PPG stating that local authority Air Quality Action Plans "*identify measures that will be introduced in pursuit of the objectives*". In addition, the PPG makes clear that *"Odour and dust can also be a planning concern, for example, because of the effect on local amenity"*.

2.7 The PPG states that:

"Whether or not air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to generate air quality impact in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU legislation (including that applicable to wildlife)".

2.8 The PPG sets out the information that may be required in an air quality assessment, making clear that *"Assessments should be proportional to the nature and scale of development proposed and the level of concern about air quality"*. It also provides guidance on options for mitigating air quality impacts, as well as examples of the types of measures to be considered. It makes clear that *"Mitigation options where necessary, will depend on the proposed development and should be proportionate to the likely impact".*

The London Plan

2.9 The London Plan (GLA, 2015) sets out the spatial development strategy for London consolidated with alterations made to the original plan since 2011. It brings together all relevant strategies, including those relating to air quality.

2.10 Policy 7.14, 'Improving Air Quality', addresses the spatial implications of the Mayor's Air Quality Strategy and how development and land use can help achieve its objectives. It recognises that

Boroughs should have policies in place to reduce pollutant concentrations, having regard to the Mayor's Air Quality Strategy.

2.11 Policy 7.14B(c), requires that development proposals should be "*at least 'air quality neutral' and not lead to further deterioration of existing poor air quality (such as designated Air Quality Management Areas (AQMAs))*". Further details of the London Plan in relation to planning decisions are provided in Appendix A1.

The Mayor's Air Quality Strategy

2.12 The revised Mayor's Air Quality Strategy (MAQS) was published in December 2010 (GLA, 2010). The overarching aim of the Strategy is to reduce pollution concentrations in London to achieve compliance with the EU limit values as soon as possible. The Strategy commits to the continuation of measures identified in the 2002 MAQS, and sets out a series of additional measures. These additional measures and the role of the Low Emission Zone are described in Appendix A1.

2.13 The MAQS also addresses the issue of 'air quality neutral' and states that the "*GLA will work with boroughs to assist in the development of methodologies that will allow an accurate assessment of the impacts of the emissions of new developments*" (Para 5.3.19).

GLA SPG: Sustainable Design and Construction

2.14 The GLA's SPG on Sustainable Design and Construction (GLA, 2014a) provides details on delivering some of the priorities in the London Plan. Section 4.3 covers Air Pollution. It defines when developers will be required to submit an air quality assessment, explains how location and transport measures can minimise emissions to air, and provides emission standards for gas-fired boilers, Combined Heat and Power (CHP) and biomass plant. It also sets out, for the first time, guidance on how Policy 7.14B(c) of the London Plan relating to 'air quality neutral' (see Paragraph 2.11, above) should be implemented.

GLA SPG: The Control of Dust and Emissions During Construction and Demolition

2.15 The GLA's SPG on The Control of Dust and Emissions During Construction and Demolition (GLA, 2014b) outlines a risk assessment based approach to considering the potential for dust generation from a construction site, and sets out what mitigation measures should be implemented to minimise the risk of construction dust impacts, dependent on the outcomes of the risk assessment. This guidance is largely based on the Institute of Air Quality Management's (IAQM) 2014 guidance on the Assessment of dust from demolition and construction (Institute of Air Quality Management, 2016), and it states that "*the latest version of the IAQM Guidance should be used*".

Local Policies

2.16 Camden Council's Draft Local Plan (Camden Council, 2016) includes a whole section on air quality. Within this, Policy CC4 states that:

"The Council will ensure that the impact of development on air quality is mitigated and ensure that exposure to poor air quality is reduced in the borough.

The Council will take into account the impact of air quality when assessing development proposals, through the consideration of both the exposure of occupants to air pollution and the effect of the development on air quality. Consideration must be taken to the actions identified in the Council's Air Quality Action Plan.

Air Quality Assessments (AQAs) are required where development is likely to expose residents to high levels of air pollution. Where the AQA shows that a development would cause harm to air quality, the Council will not grant planning permission unless measures are adopted to mitigate the impact. Similarly, developments that introduce sensitive receptors (i.e. housing, schools) in locations of poor air quality will not be acceptable unless designed to mitigate the impact.

Development that involves significant demolition, construction or earthworks will also be required to assess the risk of dust and emissions impacts in an AQA and include appropriate mitigation measures to be secured in a Construction Management Plan".

2.17 Until the new Local Plan is adopted the Council's Local Development Framework from 2010 remains the relevant set of planning policy documents. The Local Development Framework Core Strategy (Camden Council, 2010) includes Policy CS16 on improving Camden's health and well-being, where it is stated that:

"The Council will seek to improve health and well-being in Camden. We will… recognise the impact of poor air quality on health and implement Camden's Air Quality Action Plan which aims to reduce air pollution levels".

2.18 The Core Strategy is supported by the Camden Development Policies document (Camden Council, 2010). Policy DP32 sets out how Camden will expect developments to reduce their impact on air quality:

"The Council will require air quality assessments where development could potentially cause significant harm to air quality. Mitigation measures will be expected in developments that are located in areas of poor air quality".

2.19 Camden Council has also prepared a Supplementary Planning Document - Camden Planning Guidance (CPG) 6 Amenity (Camden Council, 2011), which provides further guidance on air quality. It includes information on when an air quality assessment will be required, what an air quality assessment should cover and what measures can reduce air quality emissions and protect public exposure. The Council's overarching aim is for new development to be 'air quality neutral' and not lead to further deterioration of existing poor air quality. Mitigation and offsetting measures to deal with any negative air quality impacts associated with the development proposals may be required. The development should be designed to minimise exposure of occupants to existing poor air quality. It states that the Council requires assessments for:

"development that could have a significant negative impact in air quality. This impact can arise during both the construction and operational stages of a development as a result of increased NOx and PM_{10} emissions".

2.20 This assessment is written taking account of the contents of the CPG on Amenity.

Air Quality Action Plans

National Air Quality Plans

2.21 Defra has produced Air Quality Plans to reduce nitrogen dioxide concentrations in major cities throughout the UK (Defra, 2015). Along with a suite of national measures, the Air Quality Plans identify the need to establish Clean Air Zones within five Zones (Birmingham, Leeds, Southampton, Nottingham and Derby) where exceedences of the EU limit values for nitrogen dioxide have been forecast in 2020 and beyond. Within these Zones, lower-emission vehicles will be encouraged. The precise nature of these Clean Air Zones is still to be decided. In Greater London, Defra will continue to support and monitor the delivery of the Mayor's plans for improving air quality to meet the EU limit value for nitrogen dioxide by 2025. The proposed development lies within the Greater London Zone.

2.22 There is currently no practical way to take account of the effects of these Air Quality Plans on the modelling presented in this report, which is for assessment against the air quality objectives rather than the EU limit values.

Local Air Quality Action Plan

2.23 Camden Council has declared an AQMA for nitrogen dioxide and PM_{10} that covers the whole Borough, and has developed an Air Quality Action Plan (Camden Council, 2014a). This identifies actions and mitigating measures necessary to improve air quality in the borough. It sets out objectives to reduce transport emissions and any emissions associated with new development. Key objectives associated with new development include identifying the impact of new development on air quality and controlling emissions from construction sites.

Assessment Criteria

Health Criteria

2.24 The Government has established a set of air quality standards and objectives to protect human health. The 'standards' are set as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of an individual pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of economic efficiency, practicability, technical feasibility and timescale. The objectives for use by local authorities are prescribed within the Air Quality (England) Regulations, 2000, Statutory Instrument 928 (2000) and the Air Quality (England) (Amendment) Regulations 2002, Statutory Instrument 3043 (2002).

2.25 The objectives for nitrogen dioxide and PM_{10} were to have been achieved by 2005 and 2004 respectively, and continue to apply in all future years thereafter. The $PM_{2.5}$ objective is to be achieved by 2020. Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded where the annual mean concentration is below 60 $\mu g/m^3$ (Defra, 2016a). Therefore, 1-hour nitrogen dioxide concentrations will only be considered if the annual mean concentration is above this level. Measurements have also shown that the 24-hour PM_{10} objective could be exceeded where the annual mean concentration is above 32 $\mu g/m^3$ (Defra, 2016a). The predicted annual mean PM_{10} concentrations are thus used as a proxy to determine the likelihood of an exceedence of the 24-hour mean PM_{10} objective. Where predicted annual mean concentrations are below 32 $\mu g/m^3$ it is unlikely that the 24-hour mean objective will be exceeded.

2.26 The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Defra explains where these objectives will apply in its Local Air Quality Management Technical Guidance (Defra, 2016a). The annual mean objectives for nitrogen dioxide and PM_{10} are considered to apply at the façades of residential properties, schools, hospitals etc.; they do not apply at hotels. The 24-hour objective for PM_{10} is considered to apply at the same locations as the annual mean objective, as well as in gardens of residential properties and at hotels. The 1-hour mean objective for nitrogen dioxide applies wherever members of the public might regularly spend 1-hour or more, including outdoor eating locations and pavements of busy shopping streets.

2.27 The European Union has also set limit values for nitrogen dioxide, PM_{10} and $PM_{2.5}$. The limit values for nitrogen dioxide are the same numerical concentrations as the UK objectives, but achievement of these values is a national obligation rather than a local one (Directive 2008/50/EC of the European Parliament and of the Council, 2008). In the UK, only monitoring and modelling carried out by UK Central Government meets the specification required to assess compliance with the limit values. Central Government does not recognise local authority monitoring or local modelling studies when determining the likelihood of the limit values being exceeded.

2.28 The relevant air quality criteria for this assessment are provided in Table 1.

Table 1: Air Quality Criteria for Nitrogen Dioxide, PM_{10} and $PM_{2.5}$

Pollutant	Time Period	Objective
Nitrogen Dioxide	1-hour Mean	200 µg/m^3 not to be exceeded more than 18 times a year
	Annual Mean	40 µg/m^3
Fine Particles (PM_{10})	24-hour Mean	50 µg/m^3 not to be exceeded more than 35 times a year
	Annual Mean	40 µg/m^3 [a]
Fine Particles ($PM_{2.5}$) [b]	Annual Mean	25 µg/m^3

[a] A proxy value of 32 µg/m^3 as an annual mean is used in this assessment to assess the likelihood of the 24-hour mean PM_{10} objective being exceeded. Measurements have shown that, above this concentration, exceedences of the 24-hour mean PM_{10} objective are possible (Defra, 2016a).

[b] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

Screening Criteria for Point Source Assessments

2.29 The approach developed jointly by Environmental Protection UK (EPUK) and the IAQM (EPUK & IAQM, 2015), as described in Appendix A2, is that any change in concentration smaller than 0.5% of the long-term environmental standard will be *negligible*, regardless of the existing air quality conditions. Any change smaller than 1.5% of the long-term environmental standard will be *negligible* so long as the total concentration is less than 94% of the standard and any change smaller than 5.5% of the long-term environmental standard will be *negligible* so long as the total concentration is less than 75% of the standard. The guidance also explains that:

"Where peak short term concentrations (those averaged over periods of an hour or less) from an elevated source are in the range 10-20% of the relevant Air Quality Assessment Level (AQAL), then their magnitude can be described as small, those in the range 20-50% medium and those above 50% as large. These are the maximum concentrations experienced in any year and the severity of this impact can be described as slight, moderate and substantial respectively, without the need to reference background or baseline concentrations. In most cases, the assessment of impact severity for a proposed development will be governed by the long-term exposure experienced by receptors and it will not be a necessity to define the significance of effects by reference to short-term impacts. The severity of the impact will be substantial when there is a risk

that the relevant AQAL for short-term concentrations is approached through the presence of the new source, taking into account the contribution of other local sources".

2.30 As a first step, the assessment of the emissions from the energy plant within the proposed development has considered the predicted process contributions using the following criteria:

- is the long-term (annual mean) process contribution less than 0.5% of the long-term environmental standard?; and
- is the short-term (24-hour mean or shorter) process contribution less than 10% of the short-term environmental standard?

2.31 Where both of these criteria are met, then the impacts are *negligible* and thus 'not significant'. Where these criteria are breached then a more detailed assessment, considering total concentrations (incorporating local baseline conditions), has been provided.

Descriptors for Air Quality Impacts and Assessment of Significance

2.32 There is no official guidance in the UK in relation to development control on how to describe air quality impacts, nor how to assess their significance. The approach developed jointly by Environmental Protection UK (EPUK) and the IAQM (EPUK & IAQM, 2015) has therefore been used. This includes defining descriptors of the impacts at individual receptors, which take account of the percentage change in concentrations relative to the relevant air quality objective, rounded to the nearest whole number, and the absolute concentration relative to the objective. The overall significance of the air quality impacts is determined using professional judgement, taking account of the impact descriptors. Full details of the EPUK/IAQM approach are provided in Appendix A2. The approach includes elements of professional judgement, and the experience of the consultants preparing the report is set out in Appendix A3.

3 Assessment Approach

Existing Conditions

3.1 Existing sources of emissions within the study area have been defined using a number of approaches. Industrial and waste management sources that may affect the area have been identified using Defra's Pollutant Release and Transfer Register (Defra, 2016c) and the Environment Agency's website 'what's in your backyard' (Environment Agency, 2016a). Local sources have also been identified through examination of the Council's Air Quality Review and Assessment reports.

3.2 Information on existing air quality has been obtained by collating the results of monitoring carried out by the local authority. Background concentrations have been defined using the national pollution maps published by Defra (2016b). These cover the whole country on a 1x1 km grid.

3.3 Exceedences of the annual mean EU limit value for nitrogen dioxide in the study area have been identified using the maps of roadside concentrations published by Defra for 2014 (Defra, 2016e) and for 2020 (Defra, 2016d), as well as from any nearby AURN monitoring sites (which operate to EU data quality standards). These are the maps used by the UK Government, together with the results from national AURN monitoring sites that operate to EU data quality standards, to report exceedences of the limit value to the EU. The maps are currently available for the past years 2001 to 2014 and the future years 2020, 2025 and 2030. The national maps of roadside PM_{10} and $PM_{2.5}$ concentrations, which are available for the years 2009 to 2014, show no exceedences of the limit values anywhere in the UK in 2014.

Road Traffic Impacts

3.4 Concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ have been predicted at a number of locations both within, and close to, the proposed development. Receptors have been identified to represent worst-case exposure within these locations, being located on the façades of the properties closest to the sources.

3.5 Four existing residential properties have been identified as receptors for the assessment. In addition, four receptor locations have been identified within the new development, which represent exposure of future school students to existing sources. These locations are described in Table 2 and shown in Figure 1. Concentrations have also been modelled at three roadside diffusion tube monitoring sites located adjacent to Chetwynd Road, Kentish Town Road and Junction Road (in proximity to the junction with Wyndham Cresent), in order to verify the modelled results (see Appendix A4 for verification method).

Table 2: Description of Receptor Locations

Receptor	Description [a]
Existing receptors	
Receptor 1	Property at junction of Highgate Road and Woodsome Road
Receptor 2	Property at the junction of Highgate Road and Croftdown Road
Receptor 3	Property at junction of Highgate Road and Woodsome Road
Receptor 4	Property at the junction of Highgate Road and Grove Terrace
New receptors	
Receptor D1	LaSWAP Sixth Form College
Receptor D2	LaSWAP Sixth Form College
Receptor D3	Ribbon Building
Receptor D4	Ribbon Building

[a] All receptors modelled at a height of 1.5 m to represent ground floor exposure.

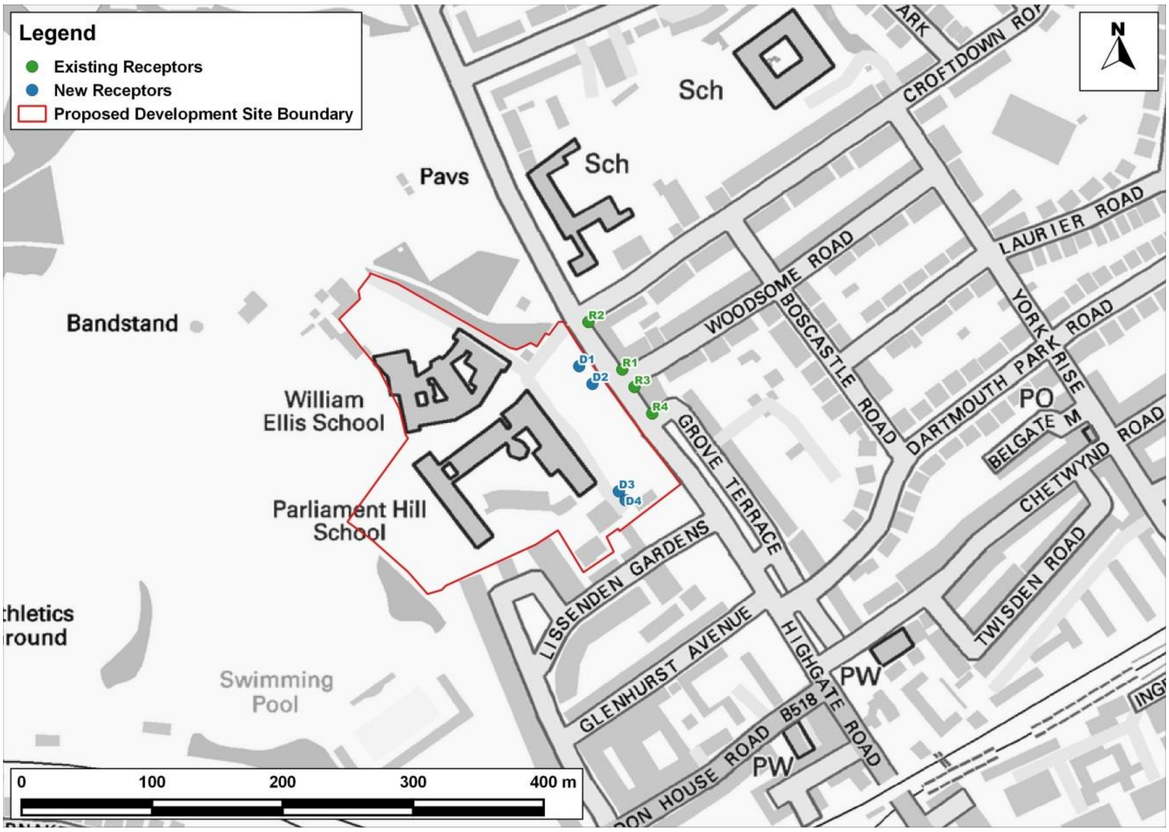

Figure 1: Existing and New Receptor Locations and the Proposed Development Site Boundary

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Assessment Scenarios

3.6 Predictions of nitrogen dioxide, PM_{10} and $PM_{2.5}$ concentrations have been carried out for a base year (2014) both with and without the proposed schools in operation. The 'with schools' scenario considers the predicted additional traffic likely to be generated by the development, which is discussed in detail in Appendix A4.

3.7 Although the schools will not be developed until 2017 or later, the impact assessment focusses upon 2014 as this provides a conservative assessment and accounts for the uncertainty associated with predicted future reductions in road traffic emissions.

Modelling Methodology

3.8 Concentrations have been predicted using the ADMS-Roads dispersion model. Details of the model inputs, assumptions and the verification are provided in Appendix A4, together with the method used to derive background concentrations. Where assumptions have been made, a realistic worst-case approach has been adopted.

Traffic Data

3.9 Baseline traffic data for the assessment have been taken from the London Atmospheric Emissions Inventory (LAEI) (GLA, 2016). The traffic generated by the proposed development has been determined from the Transport Assessment (TA) produced by Odyssey Markides in support of the planning application. Further details of the traffic data used in this assessment are provided in Appendix A4.

Uncertainty in Road Traffic Modelling Predictions

3.10 There are many components that contribute to the uncertainty of modelling predictions. The road traffic emissions dispersion model used in this assessment is dependent upon the traffic data that have been input, which will have inherent uncertainties associated with them. There are then additional uncertainties, as models are required to simplify real-world conditions into a series of algorithms.

3.11 An important stage in the process is model verification, which involves comparing the model output with measured concentrations (see Appendix A4). This can only be done for the road traffic model. Because the model has been verified and adjusted, there can be reasonable confidence in the prediction of current year (2014) concentrations.

3.12 Historically, large reductions in nitrogen oxides emissions have been projected, which has led to significant reductions in nitrogen dioxide concentrations from one year to the next being predicted. Over time, it was found that trends in measured concentrations did not reflect the rapid reductions that Defra and DfT had predicted (Carslaw, Beevers, Westmoreland, & Williams, 2011). This was evident across the UK, although the effect appeared to be greatest in inner London; there was also considerable inter-site variation. Emission projections over the 6 to 8 years prior to 2009 suggested that both annual mean nitrogen oxides and nitrogen dioxide concentrations should have fallen by around 15-25%, whereas monitoring data showed that concentrations remained relatively stable, or even showed a slight increase. Analysis of more recent data for 23 roadside sites in London covering the period 2003 to 2012 showed a weak downward trend of around 5% over the ten years (Carslaw & Rhys-Tyler, 2013), but this still falls short of the improvements that had been predicted at the start of this period.

3.13 The reason for the disparity between the expected concentrations and those measured relates to the on-road performance of modern diesel vehicles. New vehicles registered in the UK have had to meet progressively tighter European type approval emissions categories, referred to as "Euro" standards. While the nitrogen oxides emissions from newer vehicles should be lower than those from equivalent older vehicles, the on-road performance of some modern diesel vehicles has often been no better than that of earlier models. This has been compounded by an increasing proportion of nitrogen dioxide in the nitrogen oxides emissions, i.e. primary nitrogen dioxide, which has a significant effect on roadside concentrations (Carslaw, Beevers, Westmoreland, & Williams, 2011) (Carslaw & Rhys-Tyler, 2013).

3.14 A detailed analysis of emissions from modern diesel vehicles has been carried out (AQC, 2016b). This shows that, where previous standards had limited on-road success, the ‘Euro VI’ and ‘Euro 6’ standards that new vehicles have had to comply with from 2013/16[1] are delivering real on-road improvements. A detailed comparison of the predictions in Defra’s latest Emission Factor Toolkit (EFT v6.0.2) against the results from on-road emissions tests has shown that Defra’s latest predictions still have the potential to under-predict emissions from some vehicles, albeit by less than has historically been the case (AQC, 2016b).

3.15 In order to account for this potential under-prediction in future road traffic emissions modelling, the impact assessment for road traffic has been undertaken for the baseline year (2014), which negates the need to predict future-year changes to vehicle emissions and provides a robust and worst-case assessment.

Impacts of the Proposed CHP and Boiler Plant

3.16 The proposed development will be provided with electricity, heat and hot water using a small (49.5 kWth input) natural gas-fired CHP unit, supported by three 570 kW natural gas-fired boilers.

3.17 The CHP flue will discharge through a louvre at ground-floor level above the Morant Building plant room. The gas boiler flues will discharge at roof level above the Morant Building.

[1] Euro VI refers to heavy duty vehicles, while Euro 6 refers to light duty vehicles. The timings for meeting the standards vary with vehicle type and whether the vehicle is a new model or existing model.

3.18 The specifications for these plant are set out in Appendix A4.

Sensitive Locations

3.19 With regard to the proposed CHP and boiler plant, concentrations have been modelled at 25 sensitive receptor locations around the Camden Schools site, representing locations where pupils may be exposed to emissions, such as playground areas and school building facades.

3.20 Receptors have been modelled either at ground-floor level (1.5 m), which represents worst-case exposure to the low-level CHP exhaust releases, and/or at roof level (assumed to be 16 m), which represents worst-case exposure to the roof-level boiler plant emissions.

3.21 The receptors selected for inclusion in the CHP and boiler plant modelling are described in Table 3 and shown in Figure 2.

Table 3: Description of Receptor Locations

Receptor	Description [a]	Heights Modelled (m)
School 1	Morant Building Rear 1	1.5 & 16
School 2	Morant Building Rear 2	1.5 & 16
School 3	Ribbon Building North 1	1.5 & 16
School 4	Ribbon Building North 2	1.5 & 16
School 5	Ribbon Building North 3	1.5 & 16
School 6	Ribbon Building North 4	1.5 & 16
School 7	Morant/Ribbon Courtyard	1.5
School 8	Morant Building Rear 3	1.5 & 16
School 9	Morant Building Rear 4	1.5 & 16
School 10	Morant Rear Playground	1.5
School 11	Dining Building	1.5 & 16
School 12	Sports Pitches	1.5
School 13	Morant Building Front 1	1.5 & 16
School 14	Morant Building Front 2	1.5 & 16
School 15	Morant Building Entrance	1.5 & 16
School 16	Morant Building Front 3	1.5 & 16
School 17	Ribbon Building Northeast 1	1.5 & 16
School 18	Ribbon Building Northeast 2	1.5 & 16
School 19	Ribbon Building Southeast	1.5 & 16
School 20	Ribbon Building South	1.5 & 16

Receptor	Description [a]	Heights Modelled (m)
School 21	Ribbon South Playground	1.5
School 22	Ribbon Sports Pitch	1.5
School 23	LaSWAP Sixth Form 2	1.5 & 16
School 24	LaSWAP Sixth Form 1	1.5 & 16
School 25	Morant Front Playground	1.5

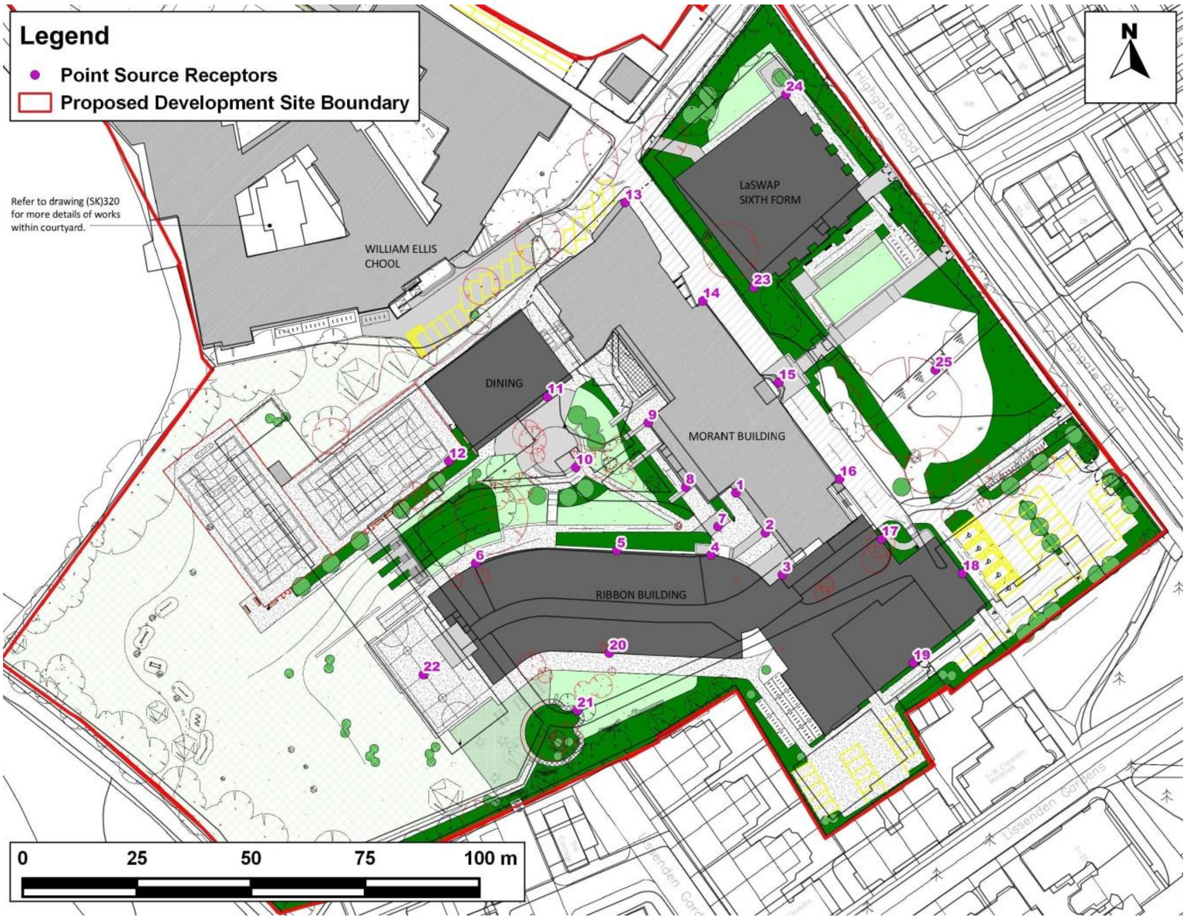

Figure 2: CHP and Boiler Plant Receptor Locations

Contains data from GSS Architects drawing no. (SK)900

3.22 In addition to the receptors presented in Table 3 and Figure 2, process contributions from the CHP and boiler plant have also been predicted at the four existing residential properties adjacent to the schools on Highgate Road (Receptors R1 – R4), and the four on-site receptors identified as representing worst-case exposure to road traffic emissions (Receptors D1 – D4), as set out in Table 2 and Figure 1. This is to allow the combined impacts of traffic and CHP and boiler plant emissions to be determined.

Modelling Methodology

3.23 The emissions from the proposed CHP and boiler plant have been modelled using the ADMS-5 dispersion model. ADMS-5 is a new generation model that incorporates a state-of-the-art understanding of the dispersion processes within the atmospheric boundary layer. The model input parameters are set out in Appendix A4. The air quality modelling has been carried out based on a number of necessary assumptions, detailed further in Appendix A4. Where possible a realistic worst-case approach has been adopted.

Emissions Data

3.24 Emissions data for the energy plant have been provided by Hoare Lea, the mechanical and engineering consultants for the proposed development. Further details of the emissions data used in this assessment are provided in Appendix A4.

Uncertainty

3.25 The point source dispersion model used in the assessment is dependent upon emission rates, flow rates, exhaust temperatures and other parameters for each source, all of which in reality are variable as the plant will operate at different loads at different times. There are then additional uncertainties, as models are required to simplify real-world conditions into a series of algorithms. These uncertainties cannot be easily quantified and it is not possible to verify the point-source model outputs. Where parameters have been estimated the approach has been to use reasonable worst-case assumptions.

4 Site Description and Baseline Conditions

4.1 The Camden schools site is located to the southeast of Hamstead Heath. It is currently occupied by the existing William Ellis and Parliament Hill Schools. The site is bounded by Hamstead Heath to the north and west, residential properties to the south and Highgate Road to the east, with residential properties opposite the schools on Highgate Road.

4.2 The site lies close (less than 1 km) to the west of the boundary between the London Borough of Camden and the London Borough of Islington.

Industrial sources

4.3 A search of the UK Pollutant Release and Transfer Register (Defra, 2016c) and Environment Agency's 'what's in your backyard' (Environment Agency, 2016a) websites has not identified any significant industrial or waste management sources that are likely to affect the proposed development, in terms of air quality.

Air Quality Review and Assessment

4.4 Camden Council has investigated air quality within its area as part of its responsibilities under the LAQM regime. The entire borough was declared an AQMA in 2002 for exceedences of the annual mean nitrogen dioxide objective and the 24-hour mean PM_{10} objective.

Local Air Quality Monitoring

4.5 Camden Council currently operates five automatic monitoring stations within its area, none of which are located at in close proximity to the Camden Schools site. The Council also operates a number of nitrogen dioxide monitoring sites using diffusion tubes prepared and analysed by Gradko (using the 50% TEA in acetone method). These include one deployed at Chetwynd Road (approximately 300 m to the east of the proposed development) and one deployed at Kentish Town Road (approximately 1 km to the southeast of the proposed development.

4.6 Islington Council also operate a number of nitrogen dioxide monitoring sites using diffusion tubes prepared and analysed by Lambeth Scientific Services (using the 50% TEA in acetone method). These include one deployed at the junction between Junction Road and Wyndham Crescent, approximately 750 m to the east of the proposed development).

4.7 Results for the years 2010 to 2014 are summarised in Table 4 and the monitoring locations are shown in Figure 3.

Table 4: Summary of Diffusion Tubes Annual Mean Nitrogen Dioxide (NO_2) Monitoring (2010-2014) [ab]

Site ID	Site Type	Location	2010	2011	2012	2013	2014
Camden Diffusion Tubes							
CA16	Roadside	Kentish Town Road	**74**	**57**	**59**	**65**	**58**
CA24	Roadside	Chetwynd Road	**68**	**44**	**44**	**48**	**45**
Islington Diffusion Tube							
Junction Road	Roadside	Junction Road, adjacent to junction with Wyndham Crescent	**50**	**52**	**45**	**41**	**46**
Objective			40				

[a] Exceedences of the objectives are shown in bold. Potential exceedences of the 1-hour mean nitrogen dioxide objective are underlined.

[b] CA16 and CA24 2010 to 2014 data have been taken from the Camden 2015 Updating and Screening Assessment (Camden Council, 2015). Junction Road 2010 – 2014 data have been taken from the Islington 2015 Updating and Screening Assessment (London Borough of Islington Council, 2015).

4.8 Measured annual mean nitrogen dioxide concentrations at all sites have consistently exceeded the objective over the period 2010 – 2014. Measured concentrations at two of the monitoring sites have exceeded 60 µg/m^3 (CA16 in 2010 and 2013, and CA24 in 2010), indicating a potential exceedence of the 1-hour mean nitrogen dioxide objective.

4.9 All three sites have been used for the road traffic model verification (see Appendix A4) as they are situated at roadside locations reasonably close to the proposed development, and, in the case of CA16 and CA24, adjacent to stretches of road that adjoin Highgate Road.

4.10 There are no clear trends in monitoring results from 2010 - 2015. This contrasts with the expected decline due to the progressive introduction of new vehicles operating to more stringent standards (the implications of this are discussed in Section 3 of this report).

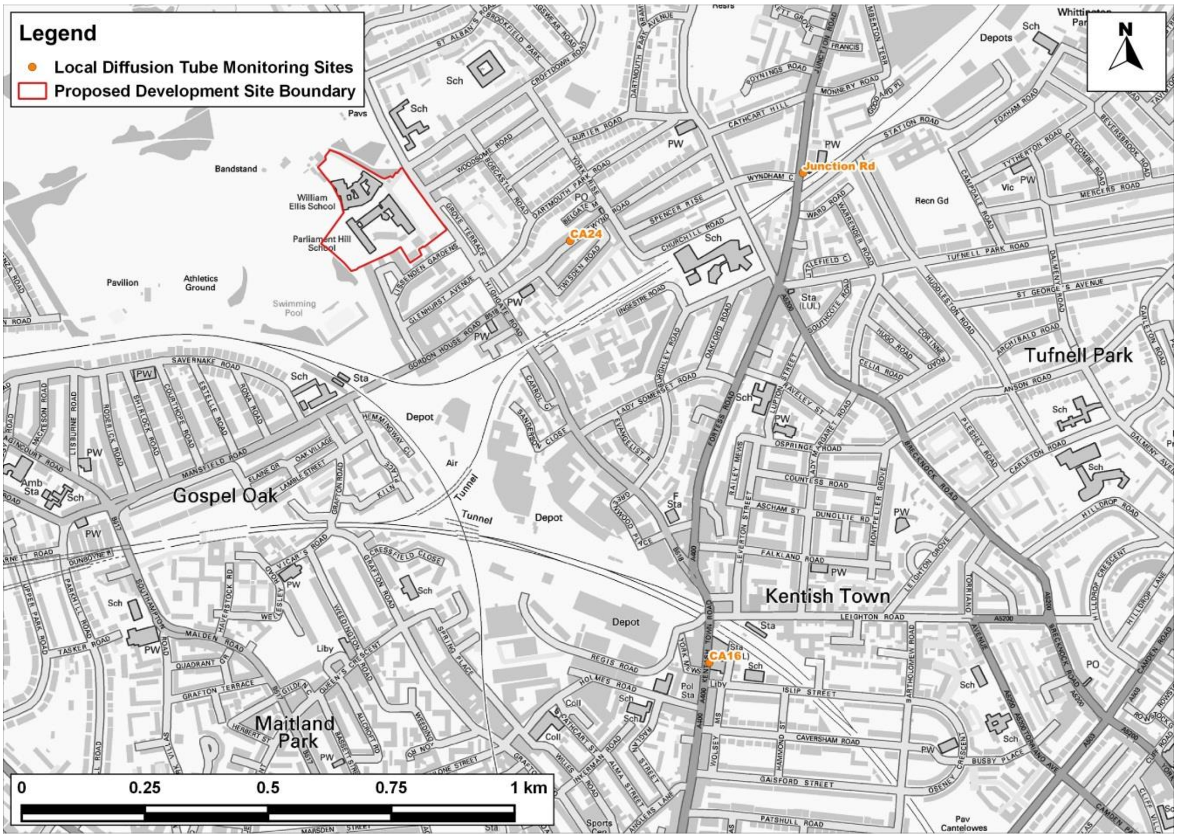

Figure 3: **Local Diffusion Tube Monitoring Site Locations and the Proposed Development Site Boundary**

4.11 Camden Council monitors concentrations of PM_{10} at three automatic monitoring sites within the borough (including the very busy roadside locations at Swiss Cottage and Shaftesbury Avenue), but none are located in close proximity to the Camden Schools site. There have been no recorded exceedences of the PM_{10} objectives at any of the sites in the past five years. It is expected that PM_{10} concentrations at the Camden schools site will be below the relevant objectives.

Exceedences of EU Limit Value

4.12 There are several AURN monitoring sites within the Greater London Urban Area that have measured exceedences of the annual mean nitrogen dioxide limit value. Furthermore, the national map of roadside annual mean nitrogen dioxide concentrations (Defra, 2016e), used to report exceedences of the limit value to the EU, identifies exceedences of this limit value in 2014 along many roads in London, but not for the roads close to the proposed development. The Greater London Urban Area has thus been reported to the EU as exceeding the limit value for annual mean nitrogen dioxide concentrations, but the Camden Schools site itself is unaffected.

Background Concentrations

4.13 In addition to these locally measured concentrations, estimated background concentrations in the study area have been determined for 2014 (Table 5) using Defra's background maps (Defra, 2016b). The background concentrations have been derived as described in Appendix A4. The background concentrations are all below the objectives.

Table 5: Estimated Annual Mean Background Pollutant Concentrations in 2014

Year	NOx	NO_2	PM_{10}	$PM_{2.5}$
2014	42.4	27.1	20.6	14.3
Objectives	**-**	**40**	**40**	**25** [a]

[a] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

5 Operational Phase Impact Assessment

Road Traffic Impacts

5.1 Predicted annual mean concentrations of nitrogen dioxide, PM_{10} and $PM_{2.5}$ associated with road traffic emissions are set out in Table 6, Table 7 and Table 8 for both the “Without Scheme” and “With Scheme” scenarios. These tables also describe the impacts at each receptor using the impact descriptors given in Appendix A2.

Table 6: Predicted Impacts on Annual Mean Nitrogen Dioxide Concentrations in 2014

Receptor	Without Scheme ($\mu g/m^3$)	With Scheme ($\mu g/m^3$)	% Change [a]	Impact Descriptor [b]
R1	37.7	37.8	0	Negligible
R2	38.4	38.5	0	Negligible
R3	38.5	38.6	0	Negligible
R4	38.7	38.8	0	Negligible
Objective	40		-	-

[a] % changes are relative to the objective and have been rounded to the nearest whole number.

Table 7: Predicted Impacts on Annual Mean PM_{10} Concentrations in 2014

Receptor	Annual Mean PM_{10} ($\mu g/m^3$)			
	Without Scheme ($\mu g/m^3$)	With Scheme ($\mu g/m^3$)	% Change [a]	Impact Descriptor
R1	22.2	22.2	0	Negligible
R2	22.3	22.3	0	Negligible
R3	22.3	22.3	0	Negligible
R4	22.3	22.4	0	Negligible
Criterion	32 [b]		-	-

[a] % changes are relative to the criterion and have been rounded to the nearest whole number.

[b] While the annual mean PM_{10} objective is 40 $\mu g/m^3$, 32 $\mu g/m^3$ is the annual mean concentration above which an exceedence of the 24-hour mean PM_{10} concentration is possible, as outlined in LAQM.TG16 (Defra, 2016a). A value of 32 $\mu g/m^3$ is thus used as a proxy to determine the likelihood of exceedence of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (EPUK & IAQM, 2015).

Table 8: Predicted Impacts on Annual Mean $PM_{2.5}$ Concentrations in 2014

Receptor	Annual Mean $PM_{2.5}$ (µg/m^3)			
	Without Scheme (µg/m^3)	With Scheme (µg/m^3)	% Change [a]	Impact Descriptor
R1	15.3	15.3	0	Negligible
R2	15.4	15.4	0	Negligible
R3	15.4	15.4	0	Negligible
R4	15.4	15.4	0	Negligible
Objective	25 [b]		-	-

[a] % changes are relative to the criterion and have been rounded to the nearest whole number.

[b] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

Nitrogen Dioxide

5.2 The annual mean nitrogen dioxide concentrations are below the objective at all receptors.

5.3 The percentage changes in concentrations, relative to the air quality objective (when rounded), are predicted to be 0% at all of the receptors. Using the matrix in Table A2.1 (Appendix A2), these impacts are described as *negligible*.

5.4 The annual mean nitrogen dioxide concentrations are below 60 µg/m^3 at all of the receptor locations. It is, therefore, unlikely that the 1-hour mean nitrogen dioxide objective will be exceeded.

PM_{10} and $PM_{2.5}$

5.5 The annual mean PM_{10} and $PM_{2.5}$ concentrations are well below the objectives at all receptors, with or without the Scheme. Furthermore, as the annual mean PM_{10} concentrations are below 32 µg/m^3, it is unlikely that the 24-hour mean PM_{10} objective will be exceeded at any of the receptors.

5.6 The percentage changes in both PM_{10} and $PM_{2.5}$ concentrations, relative to the air quality objective (when rounded), are predicted to be 0% at all of the receptors. Using the matrix in Table A2.1 (Appendix A2), these impacts are described as negligible.

CHP and Boiler Plant Impacts

Initial Screening assessment

5.7 Predicted nitrogen dioxide concentrations associated with emissions from the energy plant are shown in Table 9. The maximum predicted process contributions at any of the 25 on-site receptor locations are provided in each case.

Table 9: Predicted Maximum Pollutant Process Contribution associated with CHP and Boiler Plant Emissions at Selected Point Source Receptors (µg/m³)

Pollutant/Averaging Period	Maximum Receptor Process Contribution [a]		Objective
	µg/m³	% of Objective	
Annual Mean NO_2	0.3	0.7	40
99.79th %ile of 1-hour NO_2	51.2	25.6	200

[a] Values have been rounded.

5.8 These predicted maximum concentration can be compared with the EPUK/IAQM screening criteria, as previously described in Section 2, and the following conclusions can be drawn:

- the predicted maximum annual mean nitrogen dioxide concentration (0.7% of the objective) is above the screening criterion (0.5%); and
- the predicted maximum 99.79th percentile of 1-hour mean nitrogen dioxide concentrations (25.6% of the objective) is above the screening criterion (10%).

5.9 The predicted impacts exceed the screening criteria and therefore require further detailed assessment.

5.10 The maximum predicted nitrogen dioxide concentrations associated with emissions from the CHP and boiler plant at the worst-case new and existing receptors used for the road traffic emissions assessment (D1 to D4 and R1 to R4) are shown in Table 10. The maximum process contributions are below the EPUK/IAQM screening criteria and the impacts are thus judged to be insignificant.

Table 10: Predicted Maximum Pollutant Concentrations associated with CHP and Boiler Plant Emissions at Road Traffic Assessment Receptors (µg/m³)

Pollutant/Averaging Period	Maximum Receptor Process Contribution [a]		Objective
	µg/m³	% of Objective	
Annual Mean NO_2	0.1	0.3	40
99.79th %ile of 1-hour NO_2	18.5	9.2	200

[a] Values have been rounded.

Detailed Assessment

5.11 The initial screening assessment of emissions from the CHP and boiler plant has identified the need for detailed assessment of both the annual mean and 1-hour mean nitrogen dioxide concentrations.

5.12 The detailed assessment combines the predicted annual mean and 1-hour mean process contributions from the CHP and boiler plant, with annual mean and hour-by-hour baseline concentrations at the site.

5.13 The baseline nitrogen dioxide concentrations for the assessment of annual mean CHP and boiler plant emissions have been obtained from the ADMS-Roads dispersion model, which takes account of local background and road traffic sources.

5.14 The baseline nitrogen dioxide concentrations for the assessment of 1-hour mean CHP and boiler plant emissions have been obtained from automatic nitrogen dioxide monitoring data from the Islington Arsenal urban background site. This provides hour-by-hour concentrations for the whole year.

5.15 The results of the detailed assessment of CHP and boiler plant emissions are presented in Table 11. Concentrations have been calculated following the methodology set out in Section 3 and in Appendix A4.

Table 11: Predicted Impacts on Annual Mean Nitrogen Dioxide Concentrations in 2014 (µg/m³) [a]

Receptor	Annual Mean NO_2 Concentrations (µg/m³)				99.8th Percentile of 1-Hour Mean NO_2 Concentrations (µg/m³)		
	Without Scheme	With Scheme	% Change [a]	Impact Descriptor	Process Contribution	Total Concentration [b]	Exceedence?
Ground-Floor							
1	31.3	31.5	1	Negligible	51.3	124.3	No
2	31.3	31.4	0	Negligible	10.8	113.2	No
3	31.3	31.4	0	Negligible	12.9	111.3	No
4	31.1	31.2	0	Negligible	8.2	110.3	No
5	31.0	31.1	0	Negligible	10.0	110.1	No
6	30.8	30.9	0	Negligible	11.1	110.1	No
7	31.2	31.3	0	Negligible	6.3	111.0	No
8	31.2	31.2	0	Negligible	6.4	111.0	No
9	31.2	31.3	0	Negligible	13.2	112.1	No
10	31.0	31.1	0	Negligible	10.6	110.4	No
11	28.0	28.0	0	Negligible	12.3	110.5	No
12	30.9	30.9	0	Negligible	12.3	110.1	No
13	28.4	28.5	0	Negligible	18.7	110.4	No
14	28.5	28.6	0	Negligible	15.7	111.3	No
15	28.6	28.7	0	Negligible	10.2	112.8	No
16	31.7	31.8	0	Negligible	12.8	114.0	No
17	31.7	31.8	0	Negligible	16.3	114.2	No
18	31.9	32.0	0	Negligible	19.3	114.3	No
19	31.5	31.5	0	Negligible	7.5	111.1	No
20	30.9	31.0	0	Negligible	9.6	110.1	No
21	30.9	30.9	0	Negligible	9.4	110.1	No
22	30.8	30.8	0	Negligible	2.9	110.1	No
23	28.8	28.9	0	Negligible	8.9	110.6	No
24	31.1	31.2	0	Negligible	5.2	110.4	No
25	30.1	30.2	0	Negligible	13.3	110.6	No
Top-Floor							
1	30.7	30.8	0	Negligible	4.0	112.6	No
2	30.7	30.8	0	Negligible	10.5	113.2	No
3	30.7	30.8	0	Negligible	12.7	110.8	No
4	30.7	30.8	0	Negligible	7.2	110.2	No
5	30.7	30.7	0	Negligible	6.6	110.1	No
6	30.6	30.7	0	Negligible	5.0	110.1	No

Receptor	Annual Mean NO_2 Concentrations (µg/m^3)				99.8th Percentile of 1-Hour Mean NO_2 Concentrations (µg/m^3)		
	Without Scheme	With Scheme	% Change [a]	Impact Descriptor	Process Contribution	Total Concentration [b]	Exceedence?
7	30.7	30.8	0	Negligible	6.2	110.5	No
8	30.7	30.8	0	Negligible	13.2	112.1	No
9	27.6	27.6	0	Negligible	11.8	110.4	No
10	27.6	27.7	0	Negligible	18.7	110.4	No
11	27.6	27.7	0	Negligible	15.7	111.3	No
12	27.6	27.8	0	Negligible	10.2	112.8	No
13	30.7	30.9	0	Negligible	12.8	114.0	No
14	30.7	30.8	0	Negligible	5.9	111.8	No
15	30.8	30.8	0	Negligible	5.5	111.7	No
16	30.7	30.8	0	Negligible	4.2	110.7	No
17	30.7	30.7	0	Negligible	5.6	110.1	No
18	27.6	27.7	0	Negligible	3.8	110.3	No
19	27.6	27.7	0	Negligible	2.9	110.3	No
20	30.7	30.8	0	Negligible	4.0	112.6	No
21	30.7	30.8	0	Negligible	10.5	113.2	No
22	30.7	30.8	0	Negligible	12.7	110.8	No
23	30.7	30.8	0	Negligible	7.2	110.2	No
24	30.7	30.7	0	Negligible	6.6	110.1	No
Objective	40		-	-	-	200	-

[a] % changes are relative to the objective and have been rounded to the nearest whole number.

[b] The 99.8th percentile has been calculated from the total of the energy plant process contribution plus the background concentration, which have been combined for each hour individually.

5.16 The annual mean nitrogen dioxide concentrations are below the objective at all receptors. The percentage changes in concentrations, relative to the air quality objective (when rounded), are predicted to be zero at all of the receptors, apart from Receptor 1 at the ground-floor level where the percentage change is 1%. Using the matrix in Table A2.1 (Appendix A2), these impacts are all described as *negligible*.

5.17 Total 99.8th percentile of 1-hour mean nitrogen dioxide concentrations are below the objective at all receptors.

Impacts on the Development

5.18 Predicted air quality conditions at worst-case sensitive locations within the proposed school are set out in Table 12 for Receptors D1 to D4 (see Table 2 and Figure 1 for receptor locations). The results include contributions from road traffic as well as from the CHP and boiler plant.

5.19 All of the values are below the objectives. Concentrations at the other on-site receptors selected for the assessment of CHP and boiler plant emissions (see Table 11) are also all well below the objectives.

5.20 Air quality at the proposed school will thus be acceptable.

Table 12: Predicted Concentrations of Nitrogen Dioxide (NO_2), PM_{10} and $PM_{2.5}$ in 2014 for New Receptors in the Development Site

Receptor	Annual Mean NO_2 ($\mu g/m^3$) 'Official' Prediction [a]	Annual Mean PM_{10} ($\mu g/m^3$)	Annual Mean $PM_{2.5}$ ($\mu g/m^3$)
D1	31.5	21.2	14.7
D2	31.7	21.2	14.7
D3	29.0	20.8	14.4
D4	29.0	20.8	14.4
Objective / Criterion	**40**	**32** [b]	**25** [c]

[a] In line with Defra's forecasts.

[b] While the annual mean PM_{10} objective is 40 $\mu g/m^3$, 32 $\mu g/m^3$ is the annual mean concentration above which an exceedence of the 24-hour mean PM_{10} concentration is possible, as outlined in LAQM.TG16 (Defra, 2016a). A value of 32 $\mu g/m^3$ is thus used as a proxy to determine the likelihood of exceedence of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (EPUK & IAQM, 2015).

[c] The $PM_{2.5}$ objective, which is to be met by 2020, is not in Regulations and there is no requirement for local authorities to meet it.

Significance of Operational Air Quality Impacts

5.21 The operational air quality impacts without mitigation are judged to be 'not significant'. This professional judgement is made in accordance with the methodology set out in Appendix A2.

5.22 More specifically, the judgement that the air quality impacts will be 'not significant' without mitigation takes account of the assessment that:

- the impacts of nitrogen dioxide, PM_{10} and $PM_{2.5}$ emissions from road traffic generated by the schools development will be negligible at all receptor locations;
- the impacts of annual mean nitrogen dioxide emissions from CHP and boiler plant will be negligible at all receptor locations;

- emissions from the CHP and boiler plant will not result in any exceedences of the 1-hour mean nitrogen dioxide objective; and
- concentrations at the proposed school buildings will be below the objective for all pollutants.

6 Mitigation

Road Traffic

6.1 The assessment has demonstrated that the schools development will not cause any air quality impacts relating to road traffic emissions. As such no specific mitigation measures are recommended; however, a Travel Plan has been developed for the schools, which is designed at encouraging sustainable transport and reducing private vehicle trips to the development.

CHP and Boiler Plant

6.2 The CHP and boiler plant will replace the existing boiler plant at the schools, which is old, inefficient and has significantly greater NOx emissions than modern low-NOx boiler plant.

6.3 The proposed CHP plant is 49.5 kWth input and is not required to comply with the emission standards set out in the GLA's Sustainable Design and Construction SPG (GLA, 2014a) (which apply to plant of 50 kWth input and above). The emission rate for the CHP (293 mg/Nm^3) is slightly above the GLA Band A emission limit of 250 mg/Nm^3.

6.4 The gas boilers conform with the requirements of the SPG:

- boiler NOx emissions will be <40 mg/kWh;
- boiler flues will discharge vertically upwards and be unimpeded by any fixture on top of the stack (e.g., rain cowls etc); and
- the flues discharge at a height that is not lower than the height of any building within a distance of 5 times the flue height.

6.5 It is also generally considered best practice to have a flue terminating at least 1 m above the roof level, which is the case for the boilers installed at the proposed schools.

7 Conclusions

7.1 The assessment has examined the potential air quality impacts associated with the development of the Camden Schools project, at Highgate Road in Camden. The development involves the refurbishment of the existing William Ellis and Parliament Hill Schools and LaSWAP sixth form college.

7.2 The development will generate a small volume of additional traffic movements on local roads, the air quality impacts of which have been demonstrated to be negligible.

7.3 The development also includes CHP and gas boiler plant for space heating and hot water. Impacts of emissions from these plant have been assessed and demonstrated to be negligible.

7.4 The assessment has examined pollutant concentrations at the schools and determined that there will be no exceedences of any of the air quality objectives, at any sensitive location.

7.5 The overall operational air quality impacts of the development are judged to be 'not significant'.

7.6 No specific air quality mitigation is proposed; however a Travel Plan has been developed to encourage sustainable travel and reduce vehicle trips to the schools. The on-site gas boiler plant will conform with the requirements of the Mayor of London's SPG on Sustainable Design and Construction..

7.7 The proposed development does not conflict with Policy CC4 of the Camden Draft Local Plan, or Policy CS16 of the Camden Local Development Framework, nor does it conflict with, or render unworkable, any elements of the Air Quality Action Plan.

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9 Glossary

AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System model for Roads
ADMS-5	Atmospheric Dispersion Modelling System model for point sources
AQC	Air Quality Consultants
AQAL	Air Quality Assessment Level
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network
CHP	Combined Heat and Power
DCLG	Department for Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EFT	Emission Factor Toolkit
EPUK	Environmental Protection UK
Exceedence	A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure
HDV	Heavy Duty Vehicles (> 3.5 tonnes)
HGV	Heavy Goods Vehicle
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
LB	London Borough
LDV	Light Duty Vehicles (<3.5 tonnes)
LEZ	Low Emission Zone
$\mu g/m^3$	Microgrammes per cubic metre
MAQS	Mayor's Air Quality Strategy
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides (taken to be NO_2 + NO)

NPPF	National Planning Policy Framework
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides
PHV	Private Hire Vehicle
PM_{10}	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
$PM_{2.5}$	Small airborne particles less than 2.5 micrometres in aerodynamic diameter
PPG	Planning Practice Guidance
SPG	Supplementary Planning Guidance
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal
TEA	Triethanolamine – used to absorb nitrogen dioxide
ULEZ	Ultra Low Emission Zone

10 Appendices

A1 London-Specific Policies and Measures

London Plan

A1.1 The London Plan sets out the following points in relation to planning decisions:

"Development proposals should:

a) minimise increased exposure to existing poor air quality and make provision to address local problems of air quality (particularly within AQMAs or where development is likely to be used by large numbers of those particularly vulnerable to poor air quality, such as children or older people) such by design solutions, buffer zones or steps to promote greater use of sustainable transport modes through travel plans (see Policy 6.3);

b) promote sustainable design and construction to reduce emissions from the demolition and construction of buildings following the best practice guidance in the GLA and London Councils "The control, of dust and emissions form construction and demolition";

c) 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 (AQMAs));

d) ensure that where provision needs to made to reduce emissions from a development, these usually are made on site. Where it can be demonstrated that on-sire provision is impractical or inappropriate, and that it is possible to put in place measures having clearly demonstrated equivalent air quality benefits, planning obligations or planning conditions should be used as appropriate to ensure this, whether on a scheme by scheme basis or through joint area-based approaches;

e) where the development requires a detailed air quality assessment and biomass boilers are included, the assessment should forecast pollutant concentrations. Permission should only be granted if no adverse air quality impacts from the biomass boiler are identified."

The Mayor's Air Quality Strategy

A1.2 The Mayor's Air Quality Strategy commits to the continuation of measures identified in the 2002 MAQS, and sets out a series of additional measures, including:

Policy 1 – Encouraging smarter choices and sustainable travel;

Measures to reduce emissions from idling vehicles focusing on buses, taxis, coaches, taxis, PHVs and delivery vehicles;

Using spatial planning powers to support a shift to public transport;

Supporting car free developments.

Policy 2 – Promoting technological change and cleaner vehicles:

Supporting the uptake of cleaner vehicles.

Policy 4 – Reducing emissions from public transport:

Introducing age limits for taxis and PHVs.

Policy 5 – Schemes that control emissions to air:

Implementing Phases 3 and 4 of the LEZ from January 2012

Introducing a NOx emissions standard (Euro IV) into the LEZ for Heavy Goods Vehicles (HGVs), buses and coaches, from 2015.

Policy 7 – Using the planning process to improve air quality:

Minimising increased exposure to poor air quality, particularly within AQMAs or where a development is likely to be used by a large number of people who are particularly vulnerable to air quality;

Ensuring air quality benefits are realised through planning conditions and section 106 agreements and Community Infrastructure Levy.

Policy 8 – Creating opportunities between low to zero carbon energy supply for London and air quality impacts:

Applying emissions limits for biomass boilers across London;

Requiring an emissions assessment to be included at the planning application stage.

Low Emission Zone (LEZ)

A1.3 A key measure to improve air quality in Greater London is the Low Emission Zone (LEZ). This entails charges for vehicles entering Greater London not meeting certain emissions criteria, and affects older, diesel-engined lorries, buses, coaches, large vans, minibuses and other specialist vehicles derived from lorries and vans. The LEZ was introduced on 4th February 2008, and was phased in through to January 2012. From January 2012 a standard of Euro IV was implemented for lorries and other specialist diesel vehicles over 3.5 tonnes, and buses and coaches over 5 tonnes. Cars and lighter Light Goods Vehicles (LGVs) are excluded. The third phase of the LEZ, which applies to larger vans, minibuses and other specialist diesel vehicles, was also implemented in January 2012. As set out in the 2010 MAQS, a NOx emissions standard (Euro IV) is included in the LEZ for HGVs, buses and coaches, from 2015.

Ultra Low Emission Zone (ULEZ)

A1.4 The Mayor has confirmed the introduction of the Ultra Low Emission Zone (ULEZ) in the Capital on 7 September 2020. The ULEZ will operate 24 hours a day, 7 days a week in the same area as the current Congestion Charging zone. All cars, motorcycles, vans, minibuses and Heavy Goods Vehicles will need to meet exhaust emission standards (ULEZ standards) or pay an additional daily charge to travel within the zone. The ULEZ standards are Euro 3 for motorcycles; Euro 4 for petrol cars, vans and minibuses; Euro 6 for diesel cars, vans and minibuses; and Euro VI for HGVs, buses and coaches.

A2 EPUK & IAQM Planning for Air Quality Guidance

A2.1 The guidance issued by EPUK and IAQM (EPUK & IAQM, 2015) is comprehensive in its explanation of the place of air quality in the planning regime. Key sections of the guidance not already mentioned above are set out below.

Air Quality as a Material Consideration

"Any air quality issue that relates to land use and its development is capable of being a material planning consideration. The weight, however, given to air quality in making a planning application decision, in addition to the policies in the local plan, will depend on such factors as:

- *the severity of the impacts on air quality;*
- *the air quality in the area surrounding the proposed development;*
- *the likely use of the development, i.e. the length of time people are likely to be exposed at that location; and*
- *the positive benefits provided through other material considerations".*

Recommended Best Practice

A2.2 The guidance goes into detail on how all development proposals can and should adopt good design principles that reduce emissions and contribute to better air quality management. It states:

"The basic concept is that good practice to reduce emissions and exposure is incorporated into all developments at the outset, at a scale commensurate with the emissions".

A2.3 The guidance sets out a number of good practice principles that should be applied to all developments that:

- include 10 or more dwellings;
- where the number of dwellings is not known, residential development is carried out on a site of more than 0.5 ha;
- provide more than 1,000 m^2 of commercial floorspace;
- are carried out on land of 1 ha or more.

A2.4 The good practice principles are that:

- New developments should not contravene the Council's Air Quality Action Plan, or render any of the measures unworkable;

- Wherever possible, new developments should not create a new “street canyon”, as this inhibits pollution dispersion;
- Delivering sustainable development should be the key theme of any application;
- New development should be designed to minimise public exposure to pollution sources, e.g. by locating habitable rooms away from busy roads;
- The provision of at least 1 Electric Vehicle (EV) “rapid charge” point per 10 residential dwellings and/or 1000 m^2 of commercial floorspace. Where on-site parking is provided for residential dwellings, EV charging points for each parking space should be made available;
- Where development generates significant additional traffic, provision of a detailed travel plan (with provision to measure its implementation and effect) which sets out measures to encourage sustainable means of transport (public, cycling and walking) via subsidised or free-ticketing, improved links to bus stops, improved infrastructure and layouts to improve accessibility and safety;
- All gas-fired boilers to meet a minimum standard of <40 mgNOx/kWh;
- Where emissions are likely to impact on an AQMA, all gas-fired CHP plant to meet a minimum emissions standard of:
    - Spark ignition engine: 250 mgNOx/Nm^3;
    - Compression ignition engine: 400 mgNOx/Nm^3;
    - Gas turbine: 50 mgNOx/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 275 mgNOx/Nm^3 and 25 mgPM/Nm^3.

A2.5 The guidance also outlines that offsetting emissions might be used as a mitigation measure for a proposed development. However, it states that:

“It is important that obligations to include offsetting are proportional to the nature and scale of development proposed and the level of concern about air quality; such offsetting can be based on a quantification of the emissions associated with the development. These emissions can be assigned a value, based on the “damage cost approach” used by Defra, and then applied as an indicator of the level of offsetting required, or as a financial obligation on the developer. Unless some form of benchmarking is applied, it is impractical to include building emissions in this approach, but if the boiler and CHP emissions are consistent with the standards as described above then this is not essential”.

A2.6 The guidance offers a widely used approach for quantifying costs associated with pollutant emissions from transport. It also outlines the following typical measures that may be considered to offset emissions, stating that measures to offset emissions may also be applied as post assessment mitigation:

- Support and promotion of car clubs;
- Contributions to low emission vehicle refuelling infrastructure;
- Provision of incentives for the uptake of low emission vehicles;
- Financial support to low emission public transport options; and
- Improvements to cycling and walking infrastructures.

Screening

Impacts of the Local Area on the Development

"There may be a requirement to carry out an air quality assessment for the impacts of the local area's emissions on the proposed development itself, to assess the exposure that residents or users might experience. This will need to be a matter of judgement and should take into account:

- *the background and future baseline air quality and whether this will be likely to approach or exceed the values set by air quality objectives;*
- *the presence and location of Air Quality Management Areas as an indicator of local hotspots where the air quality objectives may be exceeded;*
- *the presence of a heavily trafficked road, with emissions that could give rise to sufficiently high concentrations of pollutants (in particular nitrogen dioxide), that would cause unacceptably high exposure for users of the new development; and*
- *the presence of a source of odour and/or dust that may affect amenity for future occupants of the development".*

Impacts of the Development on the Local Area

A2.7 The guidance sets out two stages of screening criteria that can be used to identify whether a detailed air quality assessment is required, in terms of the impact of the development on the local area. The first stage is that you should proceed to the second stage if any of the follow apply:

- 10 or more residential units or a site area of more than 0.5 ha residential use;
- more than 1,000 m^2 of floor space for all other uses or a site area greater than 1 ha.

A2.8 Coupled with any of the following:

- the development has more than 10 parking spaces;

- the development will have a centralised energy facility or other centralised combustion process.

A2.9 If the above do not apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area. If they do apply then you proceed to stage 2, the criteria for which are set out below. The criteria are more stringent where the traffic impacts may arise on roads where concentrations are close to the objective. The presence of an AQMA is taken to indicate the possibility of being close to the objective, but where whole authority AQMAs are present and it is known that the affected roads have concentrations below 90% of the objective, the less stringent criteria is likely to be more appropriate.

- the development will lead to a change in LDV flows of more than 100 AADT within or adjacent to an AQMA or more than 500 AADT elsewhere;
- the development will lead to a change in HDV flows of more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
- the development will lead to a realigning of roads (i.e. changing the proximity of receptors to traffic lanes) where the change is 5m or more and the road is within an AQMA;
- the development will introduce a new junction or remove an existing junction near to relevant receptors, and the junction will cause traffic to significantly change vehicle acceleration/deceleration, e.g. traffic lights, or roundabouts;
- the development will introduce or change a bus station where bus flows will change by more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
- the development will have an underground car park with more than 100 movements per day (total in and out) with an extraction system that exhausts within 20 m of a relevant receptor;
- the development will have one or more substantial combustion processes where the combustion unit is:
  - any centralised plant using bio fuel;
  - any combustion plant with single or combined thermal input >300 kW; or
  - a standby emergency generator associated with a centralised energy centre (if likely to be tested/used >18 hours a year).
- the development will have a combustion unit of any size where emissions are at a height that may give rise to impacts through insufficient dispersion, e.g. through nearby buildings.

A2.10 Should none of the above apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area.

A2.11 The guidance also outlines what the content of the air quality assessment should include, and this has been adhered to in the production of this report.

Impact Descriptors and Assessment of Significance

A2.12 There is no official guidance in the UK in relation to development control on how to describe the nature of air quality impacts, nor how to assess their significance. The approach developed by EPUK and IAQM (EPUK & IAQM, 2015) has therefore been used. This approach involves a two stage process:

- a qualitative or quantitative description of the impacts on local air quality arising from the development; and
- a judgement on the overall significance of the effects of any impacts.

Impact Descriptors

A2.13 Impact description involves expressing the magnitude of incremental change as a proportion of a relevant assessment level and then examining this change in the context of the new total concentration and its relationship with the assessment criterion. Table A2.1 sets out the method for determining the impact descriptor for annual mean concentrations at individual receptors, having been adapted from the table presented in the guidance document. For the assessment criterion the term Air Quality Assessment Level or AQAL has been adopted, as it covers all pollutants, i.e. those with and without formal standards. Typically, as is the case for this assessment, the AQAL will be the air quality objective value. Note that impacts may be adverse or beneficial, depending on whether the change in concentration is positive or negative.

Table A2.1: Air Quality Impact Descriptors for Individual Receptors for All Pollutants [a]

Long-Term Average Concentration At Receptor In Assessment Year [b]	Change in concentration relative to AQAL [c]				
	0%	1%	2-5%	6-10%	>10%
75% or less of AQAL	Negligible	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Negligible	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Negligible	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Negligible	Moderate	Substantial	Substantial	Substantial

[a] Values are rounded to the nearest whole number.

[b] This is the 'without scheme' concentration where there is a decrease in pollutant concentration and the 'with scheme' concentration where there is an increase.

[c] AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency 'Environmental Assessment Level (EAL)'.

Assessment of Significance

A2.14 The IAQM guidance (EPUK & IAQM, 2015) is that the assessment of significance should be based on professional judgement, with the overall air quality impact of the scheme described as either 'significant' or 'not significant'. In drawing this conclusion, the following factors should be taken into account:

- the existing and future air quality in the absence of the development;
- the extent of current and future population exposure to the impacts;
- the influence and validity of any assumptions adopted when undertaking the prediction of impacts;
- the potential for cumulative impacts and, in such circumstances, several impacts that are described as '*slight*' individually could, taken together, be regarded as having a significant effect for the purposes of air quality management in an area, especially where it is proving difficult to reduce concentrations of a pollutant. Conversely, a '*moderate*' or '*substantial*' impact may not have a significant effect if it is confined to a very small area and where it is not obviously the cause of harm to human health; and
- the judgement on significance relates to the consequences of the impacts; will they have an effect on human health that could be considered as significant? In the majority of cases, the impacts from an individual development will be insufficiently large to result in measurable changes in health outcomes that could be regarded as significant by health care professionals.

A2.15 The guidance is clear that other factors may be relevant in individual cases. It also states that the effect on the residents of any new development where the air quality is such that an air quality objective is not met will be judged as significant. For people working at new developments in this situation, the same will not be true as occupational exposure standards are different, although any assessment may wish to draw attention to the undesirability of the exposure.

A2.16 A judgement of the significance should be made by a competent professional who is suitably qualified. A summary of the professional experience of the staff contributing to this assessment is provided in Appendix A3.

A3 Professional Experience

Stephen Moorcroft, BSc (Hons) MSc DIC MIEnvSc MIAQM CEnv

Mr Moorcroft is a Director of Air Quality Consultants, and has worked for the company since 2004. He has over thirty-five years' postgraduate experience in environmental sciences. Prior to joining Air Quality Consultants, he was the Managing Director of Casella Stanger, with responsibility for a business employing over 100 staff and a turnover of £12 million. He also acted as the Business Director for Air Quality services, with direct responsibility for a number of major Government projects. He has considerable project management experience associated with Environmental Assessments in relation to a variety of development projects, including power stations, incinerators, road developments and airports, with particular experience related to air quality assessment, monitoring and analysis. He has contributed to the development of air quality management in the UK, and has been closely involved with the LAQM process since its inception. He has given expert evidence to numerous public inquiries, and is frequently invited to present to conferences and seminars. He is a Member of the Institute of Air Quality Management.

Laurence Caird, MEarthSci CSci MIEnvSc MIAQM

Mr Caird is a Principal Consultant with AQC, with ten years' experience in the field of air quality including the detailed assessment of emissions from road traffic, airports, heating and energy plant, and a wide range of industrial sources including the thermal treatment of waste. He has experience in ambient air quality monitoring for numerous pollutants using a wide range of techniques and is also competent in the monitoring and assessment of nuisance odours and dust. Mr Caird has worked with a variety of clients to provide expert air quality services and advice, including local authorities, planners, developers and process operators. He is a Member of the Institute of Air Quality Management and is a Chartered Scientist.

Dr Joshua Nunn, MSci (Hons) PhD MRSC

Dr Nunn is a Consultant with AQC. Prior to joining he conducted over three years of scientific research at the University of Bristol, examining the use of sustainable materials in chemical processes using a range of analytical tools and computational modelling. He now works in the field of air quality assessment and has been involved in the analysis and assessment of air quality impacts for a number of residential and commercial developments. These have included the use of ADMS dispersion models to study the impacts of a variety of sources of nitrogen dioxide, PM_{10} and $PM_{2.5}$, and the preparation of air quality assessment reports.

Nicole Holland, BSc (Hons) AIEMA

Miss Holland is an Assistant Consultant with AQC, having joined the company in March 2016. She is gaining experience of undertaking air quality assessments for a range of developments, including the use of dispersion modelling. Prior to joining AQC she worked for 3 years as an environmental consultant, gaining particular experience of Environmental and Social Management System (ESMS) and Environmental and Social Impact Assessment (ESIA) development.

Full CVs are available at www.aqconsultants.co.uk.

A4 Modelling Methodology

Model Inputs

Road Traffic

A4.1 Predictions have been carried out using the ADMS-Roads dispersion model (v4.0). The model requires the user to provide various input data, including emissions from each section of road, and the road characteristics (including road width, street canyon width, street canyon height and porosity, where applicable). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the Emission Factor Toolkit (Version 6.0.2) published by Defra (2016b).

A4.2 Hourly sequential meteorological data from Northolt for 2014 have been used in the model. The Northolt meteorological monitoring station is located at Northolt Airfield, approximately 18 km to the west of the proposed development site. It is deemed to be the nearest monitoring station representative of meteorological conditions at the proposed development site; both the development site and the Northolt meteorological monitoring station are located at urban inland locations in Greater London where they will be influenced by the effects of inland meteorology on urban topography.

A4.3 Baseline traffic data for Highgate Road and other roads within the assessment study area have been taken from the London Atmospheric Emissions Inventory (LAEI) (GLA, 2016). Traffic speeds have been based on those presented in the LAEI. The additional traffic predicted to be generated by the scheme (principally through evening recreational uses of the school facilities) has been obtained from the Transport Assessment (TA) produced by Odyssey Markides in support of the planning application.

A4.4 The traffic data used in this assessment are summarised in Table A4.1. The worst-case assumption has been made that all the additional traffic on Highgate Road generated by the school's after hours recreational uses will travel both north and south on Highgate Road. It has also been assumed that these additional flows will be generated 7 days per week, which is likely to be a conservative assumption.

Table A4.1: Summary of Traffic Data used in the Assessment (AADT Flows) [a]

Road Link	2014 (Without Scheme)		2014 (With Scheme)	
	AADT	%HDV	AADT	%HDV
Highgate Road north of Schools	15,239	10.1	15,381	10.1
Highgate Road South of Schools	19,972	6.6	20,114	6.6
Chetwynd Road	10,911	3.3	10,911	3.3

[a] This is just a summary of the data entered into the model, which have been input as hourly average flows of motorcycles, cars, buses, Light Goods Vehicles and Heavy Goods Vehicles, as well as diurnal flow profiles for these vehicles.

A4.5 The LAEI traffic data include (low volume) flows for electric vehicles, which generate no tailpipe emissions, but will generate some particulate matter through brake and tyre wear and resuspension. The EFT's default inputs do not allow for electric vehicles to be entered separately, thus they have not been included when calculating emissions. Some brake and tyre wear and resuspension emissions may be excluded, but this is unlikely to have affected the predicted concentrations and will not influence the conclusions of the assessment.

A4.6 Diurnal flow profiles for the traffic have been derived from the national diurnal profiles published by DfT (2015).

A4.7 Figure A4.1 shows the road network included within the model.

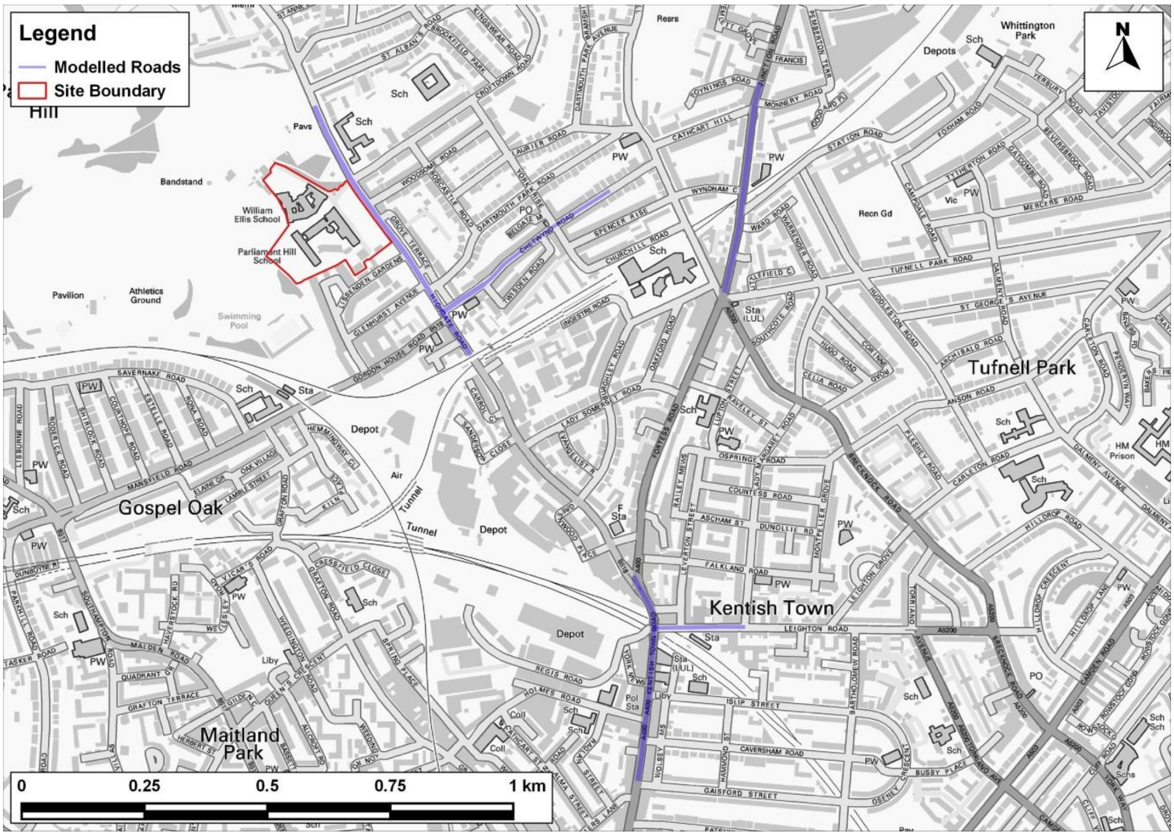

Figure A4.1: Modelled Road Network

Point Sources

A4.8 The impacts of emissions from the CHP and boiler have been predicted using the ADMS-5 dispersion model. ADMS-5 is a new generation model that incorporates a state-of-the art understanding of the dispersion processes within the atmospheric boundary layer. The model has been run to predict the contribution of the CHP and boiler emissions to annual mean concentrations of nitrogen oxides and the 99.79th percentile of 1-hour mean nitrogen oxides concentrations.

A4.9 The model input parameters for the CHP plant have been taken from the technical data sheets for the 15 kWe SAV Systems XRGI 15 model CHP, proposed to be installed at the schools. Model input parameters for the gas boilers have been taken from the technical data sheets for the 570 kW Remaha Gas 610 ECO Pro model boilers.

A4.10 The emissions from the three boilers have been combined into a single flue. The CHP flue terminates horizontally through a louvre above ground-floor level. The developers of the ADMS-5 dispersion model, CERC, were consulted and advised that the source be modelled as a vertical point source, with a very low velocity. The low velocity minimises the vertical plume buoyancy, and the use of a point source allows for building effects to be accounted for, which is not possible with a volume or area source in ADMS-5.

A4.11 The emissions parameters assumed are described in Table A4.2.

Table A4.2: Modelled Plant Specifications, Emissions and Release Conditions

Parameter	Value
CHP (SAV LoadTracker XRGI-15)	
NOx Emission rate (mg/Nm^3)	293
NOx Emission rate (g/s)	0.00459
Exit velocity (m/s) [a]	1.37
Flue Diameter (m) [b]	0.15
Actual Exhaust flow (m^3/s)	0.024
Exhaust Temperature (°C)	120
Flue Location (x,y)	528382, 185983
Modelled Flue Height (m)	1.75
Gas Boilers (3 x Remaha Gas 610 ECO 570 Boilers)	
NOx Emission rate (mg/kWh)	33
NOx Emission rare (g/s)	0.00579
Exit velocity (m/s)	5.27
Flue Diameter (m)	0.25
Actual Exhaust flow (m^3/s)	0.259
Exhaust Temperature (°C)	80
Combined Boiler Flue Emissions	
NOx Emission rate (g/s)	0.01736
Exit velocity (m/s)	6.17
Flue Diameter (m) [c]	0.4
Actual Exhaust flow (m^3/s) [d]	0.776
Exhaust Temperature (°C)	80
Flue Location (x,y)	528379, 185983
Modelled Flue Height (m)	17.1

[a] This is the velocity through the horizontal louvre. The CHP was modelled as a point source, with an exit velocity of 0.01 m/s in accordance with the advice of the model developers, CERC.

[b] This is the diameter of the flue within the louvre. For the purposes of dispersion modelling, a flue diameter of 1.8 m was used to achieve a low exhaust velocity of 0.01 m/s.

A4.12 The building dimensions and flue location have been obtained from drawings provided by GSS Architecture. The locations of the flues are shown in Figure A4.2. The CHP flue (louvre) has been modelled above ground floor level, and the boiler plant flues have been modelled at roof level (circa 70.2 m AOD).

Figure A4.2: Flue Locations

Contains data from GSS Architects drawing no. (SK)900

A4.13 Entrainment of the plume into the wake of the energy centre building (the so-called building downwash effect) has been taken into account in the model. The Morant Building has been included in the model, and has been designated as the 'main building' for both the CHP and boiler flues.

A4.14 Hourly sequential meteorological data from Northolt for 2014 have been used in the model, to be consistent with the road traffic modelling.

A4.15 The model has been run using the ADMS chemistry module. To take account of the chemistry in the plume, background concentrations of nitrogen oxides, nitrogen dioxide and ozone have been taken from the rural background Rochester Stoke AURN site for 2014. In order to determine the process contributions from the proposed plant, the model has been run once with a zero emission rate and once using the emissions shown in Table A4.2. The process contributions have then been calculated by taking the difference between the two scenarios. The model has assumed that 5% of the NOx emissions at the point of release is as NO_2.

A4.16 The calculation of short-term means has been carried out on an hour-by-hour basis. The Rochester Stoke data have only been used to inform the chemistry routine, and as such, using a rural site (with relatively high ozone concentrations) provides a worst-case assessment. Where relevant, the process contributions to nitrogen dioxide concentrations derived using this method have been added to local background concentrations (taken either from the Islington Arsenal urban background monitoring site or Defra's background maps). Thus, the use of background data from Rochester Stoke should not be taken to imply that the local background concentrations have been underestimated.

Modelling Assumptions

A4.17 The following assumptions have been made:

- The CHP will operate for 6% of the year;
- The boilers will operate for 11% of the year.

A4.18 Annual mean model outputs have been scaled accordingly. This usage information has been provided by Hoare Lea, who developed the energy strategy for the schools.

A4.19 In terms of the short-term impacts, it has been assumed that the CHP and boilers will operate continuously (i.e. no results scaling has been undertaken as with the annual mean concentrations).

A4.20 All modelling assumes that the CHP and boilers will be operated at 100% load.

Background Concentrations

A4.21 The background pollutant concentrations across the study area have been defined using the national pollution maps published by Defra (2016b). These cover the whole country on a 1x1 km grid and are published for each year from 2011 until 2030.

A4.22 The background maps for 2014 have been calibrated against local measurements made at the London Bloomsbury background automatic monitoring site and three background diffusion tube sites in Camden (CA6, CA7 and CA10). The calibration suggests the background maps align well with monitored concentrations and as such all mapped background nitrogen dioxide concentrations have been used unadjusted.

Model Verification

A4.23 In order to ensure that ADMS-Roads accurately predicts local concentrations, it is necessary to verify the model against local measurements. It is not practical, nor usual, to verify the ADMS-5 model, and therefore the predictions made using ADMS-5 have thus not been verified.

Background Concentrations

A4.24 The 2014 background concentrations for the diffusion tube sites have been derived from the national maps, having been calculated using the same approach as described in Paragraph A4.21/A4.22. The background concentrations for each of the diffusion tube locations are presented in Table A4.3.

Table A4.3: Background Concentrations used in the Verification for 2014

DT Site	Grid square	NO_2
Camden CA16	529500, 185500	32.3
Camden CA24	528500, 185500	30.2
Islington Junction Road	529500, 186500	32.0

Traffic Data

A4.25 Traffic data used in the model verification have been obtained from the LAEI database (GLA, 2016). The traffic data used in the verification are presented in Table A4.4.

Table A4.4: AADT Traffic Data used in the Model Verification

Road Link	2014
Chetwynd Road (7)	10,911
Junction Road (6)	14,102
Kentish Town Road (4)	13,756

Nitrogen Dioxide

A4.26 Most nitrogen dioxide (NO_2) is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides (NOx = NO + NO_2). The model has been run to predict the annual mean NOx concentrations during 2014 at the CA16, CA24 and Junction Road diffusion tube monitoring sites.

A4.27 The model output of road-NOx (i.e. the component of total NOx coming from road traffic) has been compared with the 'measured' road-NOx. Measured road-NOx has been calculated from the measured NO_2 concentrations and the predicted background NO_2 concentration using the NOx from NO_2 calculator (Version 4.1) available on the Defra LAQM Support website (Defra, 2016b).

A4.28 An adjustment factor has been determined as the slope of the best-fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (Figure A4.3). The calculated adjustment factor of 1.276 has been applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations.

A4.29 The total nitrogen dioxide concentrations have then been determined by combining the adjusted modelled road-NOx concentrations with the predicted background NO_2 concentration within the NOx to NO_2 calculator. Figure A4.4 compares final adjusted modelled total NO_2 at each of the monitoring sites to measured total NO_2, and shows a close agreement.

A4.30 The results imply that the model has under predicted the road-NOx contribution. This is a common experience with this and most other road traffic emissions dispersion models.

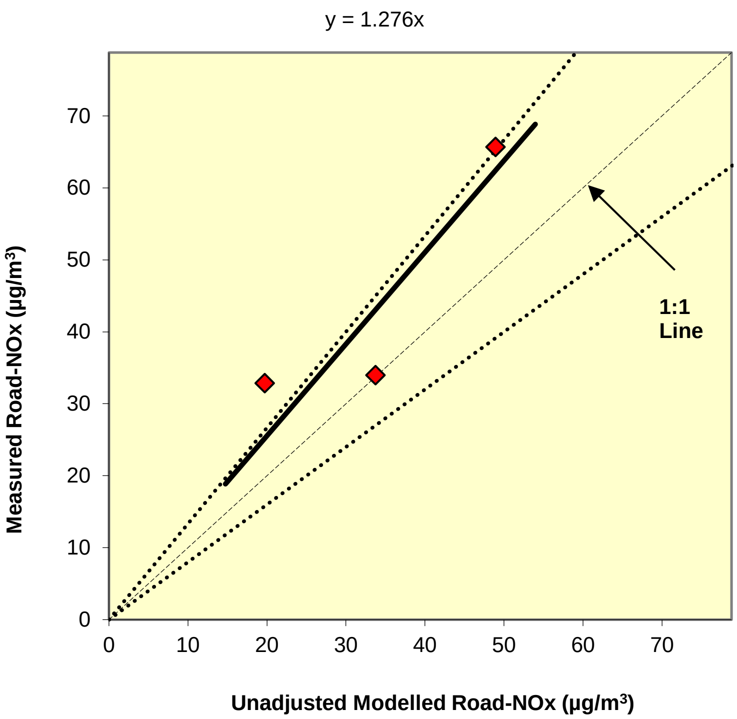

Figure A4.3: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%.

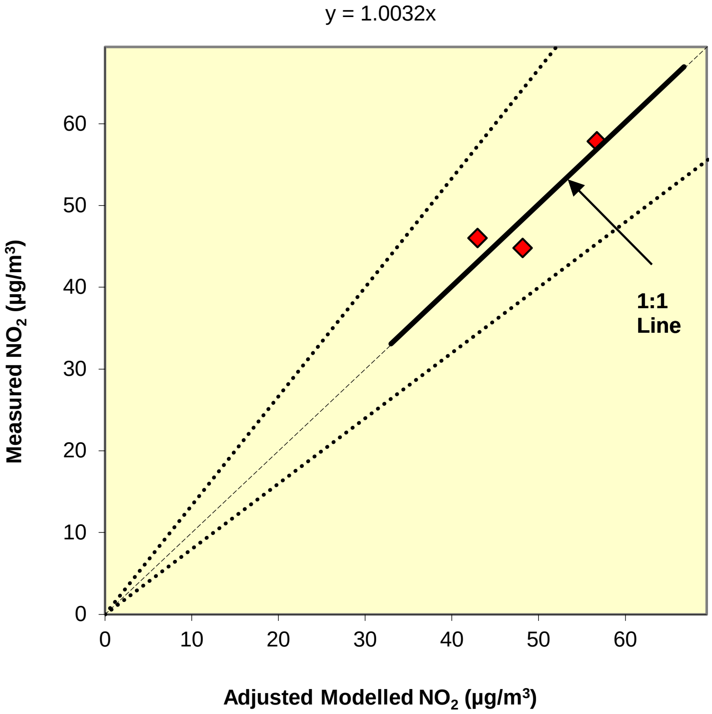

Figure A4.4: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations. The dashed lines show ± 25%.

PM_{10} and $PM_{2.5}$

A4.31 There are no nearby PM_{10} or $PM_{2.5}$ monitors. It has therefore not been possible to verify the model for PM_{10} or $PM_{2.5}$. The model outputs of road-PM_{10} and road-$PM_{2.5}$ have therefore been adjusted by applying the adjustment factor calculated for road NOx.

Model Post-processing

Road Traffic

A4.32 The model predicts road-NOx concentrations at each receptor location. These concentrations have been adjusted using the adjustment factor set out above, which, along with the background NO_2, has been processed through the NOx to NO_2 calculator available on the Defra LAQM Support website (Defra, 2016b). The traffic mix within the calculator has been set to “All London traffic”, which is considered suitable for the study area. The calculator predicts the component of NO_2 based on the adjusted road-NOx and the background NO_2.