Air Quality
CONSULTANTS

Air Quality Assessment:
4 Wild Court, Camden

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Experts in air quality
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Executive Summary

The air quality impacts associated with the construction and operation of the proposed hotel development on Wild Court, Camden have been assessed.

Existing conditions within the study area show poor air quality, with annual mean nitrogen dioxide concentrations consistently above the air quality objectives. The site lies within an Air Quality Management Area declared by Camden Council.

The construction works will give rise to a *Low* Risk of dust impacts. It will therefore be necessary to apply a package of mitigation measures to minimise dust emissions. With the recommended mitigation measures in place, the overall impacts during construction will be ‘not significant’.

Emissions from the proposed CHP and boiler plant within the development will lead to an increase in nitrogen dioxide concentrations at nearby existing properties. The assessment has demonstrated that increases in both 1-hour and annual mean concentrations of nitrogen dioxide at existing properties will be insignificant.

Air quality conditions within the proposed development have also been considered. Pollutant concentrations are predicted to be below the relevant air quality objectives for hotels at the worst-case locations assessed, and air quality conditions for users of the proposed development will be acceptable.

The proposed development exceeds the transport emissions benchmark and mitigating measures may need to be required to be agreed with Camden Council to meet the London Plan’s requirement that new developments are at least ‘air quality neutral’.

Overall, the construction and operational air quality effects of the proposed development are judged to be ‘not significant’.

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1 Introduction

1.1 This report describes the potential air quality impacts associated with the proposed hotel development at 4 Wild Court and 75 Kingsway, in the London Borough of Camden. The assessment has been carried out by Air Quality Consultants Ltd on behalf of Z Hotels Ltd.

1.2 The proposed development involves a change of use from a private college to a hotel, and the erection of a two-storey extension (7^{th} and 8^{th} floors). One façade of the development is located adjacent to the busy Kingsway. The hotel occupants will 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 (NO_2) 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 properties, as well as at receptors within the development itself. The main air pollutant of concern related to CHP and boiler plant is nitrogen dioxide.

1.4 The Greater London Authority's (GLA's) London Plan (GLA, 2016a) requires new developments to be air quality neutral. The air quality neutrality of the proposed development has, therefore, been assessed following the methodology provided in the Greater London Authority's (GLA's) Supplementary Planning Guidance (SPG) on Sustainable Design and Construction (GLA, 2014a).

1.5 The GLA has also released Supplementary Planning Guidance on the Control of Dust and Emissions from Construction and Demolition (GLA, 2014b). The SPG outlines a risk assessment approach for construction dust assessment and helps determine the mitigation measures that will need to be applied. A construction dust assessment has been undertaken and the appropriate mitigation has been set out.

1.6 This report describes existing local air quality conditions (base year 2016), and the predicted air quality in the future assuming that the proposed development proceeds. The assessment of traffic-related impacts focuses on 2018, which is the anticipated year of opening. The assessment of construction dust impacts focuses on the anticipated duration of the works.

1.7 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.

Medium Combustion Plant (MCP) Directive

2.2 The European Union regulates pollutant emissions from combustion plant with a rated input between 1 and 50 megawatts (MW_{th}) in its Medium Combustion Plant (MCP) Directive (Directive 2015/2193/EU of the European Parliament and of the Council, 2015). The MCP Directive must be transposed into UK law by December 2017.

2.3 The MCP Directive sets emission limits to be applied from December 2018 for new plant and by 2025 or 2030 for existing plant (depending on plant size). Member States may choose to exempt existing plant that operate for fewer than 500 hours per year, but current indications are that the UK Government will not apply this exemption (Department of Energy and Climate Change, 2016).

Clean Air Act 1993 & Environmental Protection Act

2.4 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. The local authority's approval will, therefore, not be required for the plant to be installed in this scheme.

2.5 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

2.6 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 (including cumulative effects) of pollution on health, the natural environment or general amenity, and the potential sensitivity of the area or proposed development to adverse effects from pollution, should be taken into account"*.

2.7 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".

2.8 The NPPF is now supported by Planning Practice Guidance (PPG) (DCLG, 2017), 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*".

2.9 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".

2.10 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

2.11 The London Plan (GLA, 2016a) 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.

2.12 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.

2.13 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

2.14 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.

2.15 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

2.16 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 2.13, above) should be implemented.

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

2.17 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's)[1] guidance (IAQM, 2016), and it states that "*the latest version of the IAQM Guidance should be used*".

Air Quality Focus Areas

2.18 The GLA has identified 187 air quality focus areas in London, these being locations that not only exceed the EU annual mean limit value for nitrogen dioxide but also locations with high levels of human exposure. They do not represent an exhaustive list of London's air quality hotspot locations, but locations where the GLA believes the problem to be most acute. They are also areas where the GLA considers there to be the most potential for air quality improvements and thus are where the GLA and Transport for London (TfL) will focus actions to improve air quality. The proposed development is not located within any air quality focus areas.

Local Policies

2.19 The Camden Core Strategy (London Borough of Camden, 2010) was adopted in 2010, and within this there is one policy which refers to air quality. Policy CS16 refers to improving Camden's health and well-being and states that the Council:

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

2.20 A Submission Draft Local Plan (London Borough of Camden, 2016) was submitted to the Secretary of State in June 2016. Policy CC4 concerns air quality and 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.

1 The IAQM is the professional body for air quality practitioners in the UK.

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.[…]"

2.21 With regards to boilers and CHP plant, it is indicated that:

"CHP will only be accepted if it is shown to be the most appropriate choice, it must also be of the highest standard in terms of NOx emissions and it must adhere to the latest emission standards contained in the Mayor's Supplementary Planning Guidance 'Sustainable Design and Construction'. An AQA with full dispersion modelling is required for all proposed Biomass and CHP boilers and this must demonstrate that its impact on nearby receptors is minimal."

2.22 In addition the Council has a set of Development Policies (DP) (London Borough of Camden, 2010), including DP22 which states that:

"*The Council will require development to be resilient to climate change by ensuring schemes include appropriate climate change adaptation measures, such as […] reducing air pollution […]*"

2.23 DP32 relates to Air quality and Camden's clear zone, and states that:

"*The Council will require air quality assessments where development could potentially cause significant harm to air quality […]*"

Air Quality Action Plans

National Air Quality Plans

2.24 Defra has produced Air Quality Plans to reduce nitrogen dioxide concentrations in major cities throughout the UK (Defra, 2015). Following a High Court ruling in November 2016 (Royal Courts of Justice, 2016), Defra undertook to replace these Plans with a new Plan by 31st July 2017. To this end, Defra began consultation on its draft new Plan (Defra, 2017a) in May 2017. There is currently no practical way to take account of the effects of either of the existing Plans, or the draft new Plan, in relation to the assessment presented in this report. This assessment has principally been carried out in relation to the air quality objectives, rather than the EU limit values that are the focus of the draft new Plan..

Local Air Quality Action Plan

2.25 The London Borough of Camden has declared an AQMA for nitrogen dioxide and PM_{10} that covers the whole Borough. The Council has since developed a Clean Air Quality Action Plan (London Borough of Camden, 2016). This sets out actions for each of the five sections that the plan covers, such as monitoring, reducing emissions from buildings and new developments, reducing emissions from transport, raising awareness of air quality and lobbying. With regard to emissions from buildings, Action 8 states that "*Camden will promote the adoption of fuel saving measures to residents through the Green Camden helpline, Well and Warm service and other projects*". Action

16 requires developers to undertake an air quality assessment where a new development could have an adverse impact on air quality. Action 10 refers to regulation of fuel burning processes and states that Camden will "*Ensure that all Part B Installations in the borough maintain the highest standards of air pollution emission control*". While Action 17 looks at *"ensuring the enforcement of CHP and biomass air quality policies".*

Assessment Criteria

2.26 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 (2000) and the Air Quality (England) (Amendment) Regulations 2002 (2002).

2.27 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 at roadside locations where the annual mean concentration is below 60 µg/m^3 (Defra, 2016b). 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 at roadside locations where the annual mean concentration is above 32 µg/m^3 (Defra, 2016b). The predicted annual mean PM_{10} concentrations are thus used as a proxy to determine the likelihood of an exceedance of the 24-hour mean PM_{10} objective. Where predicted annual mean concentrations are below 32 µg/m^3 it is unlikely that the 24-hour mean objective will be exceeded.

2.28 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, 2016b). 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, pavements of busy shopping streets and hotels.

2.29 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.

2.30 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, exceedances of the 24-hour mean PM_{10} objective are possible (Defra, 2016b).

[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.

Construction Dust Criteria

2.31 There are no formal assessment criteria for dust. In the absence of formal criteria, the approach developed by the Institute of Air Quality Management (2016), on which the assessment methodology outlined in the GLA's SPG (GLA, 2014b) is based, has been used. Full details of this approach are provided in Appendix A2.

Screening Criteria for Point Source Assessments

2.32 The approach developed jointly by Environmental Protection UK (EPUK) and the Institute of Air Quality Management (Moorcroft and Barrowcliffe et al, 2017), as described in Appendix A3, 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 11-20% of the relevant Air Quality Assessment Level (AQAL), then their magnitude can be described as small, those in the range 21-50% medium and those above 51% 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".

2.33 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?

2.34 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. In particular, for short-term process concentrations, the approach recommended in Environment Agency EPR H1 (Department for Environment, Food & Rural Affairs and Environment Agency, 2016) has been used, which adds the relevant process contribution to twice the annual mean background.

Descriptors for Air Quality Impacts and Assessment of Significance

Construction Dust Significance

2.35 Guidance from IAQM (2014) is that, with appropriate mitigation in place, the effects of construction dust will be 'not significant'. This is the guidance upon which the assessment methodology set out in the GLA guidance (GLA, 2014b) is based. The assessment thus focuses on determining the appropriate level of mitigation so as to ensure that effects will normally be 'not significant'.

Operational Significance

2.36 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 Institute of Air Quality Management (Moorcroft and Barrowcliffe et al, 2017) has therefore been used. 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 A3. The approach includes elements of professional judgement, and the experience of the consultants preparing the report is set out in Appendix A4.

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, 2017b) and the Environment Agency's website 'what's in your backyard' (Environment Agency, 2017). 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. This covers both the study area and nearby sites, the latter being used to provide context for the assessment. Background concentrations have been defined using the national pollution maps published by Defra (2017a). These cover the whole country on a 1x1 km grid.

3.3 Exceedances 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 2015 (Defra, 2017c) and for 2020 (Defra, 2016a). 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 exceedances of the limit value to the EU. The maps are currently available for the past years 2001 to 2015 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 2015, show no exceedances of the limit values anywhere in the UK in 2015.

Construction Impacts

3.4 The construction dust assessment considers the potential for impacts within 350 m of the site boundary; or within 50 m of roads used by construction vehicles. The assessment methodology follows the GLA's SPG on the Control of Dust and Emissions During Construction and Demolition (GLA, 2014b), which is based on that provided by IAQM (2016). This follows a sequence of steps. Step 1 is a basic screening stage, to determine whether the more detailed assessment provided in Step 2 is required. Step 2a determines the potential for dust to be raised from on-site works and by vehicles leaving the site. Step 2b defines the sensitivity of the area to any dust that may be raised. Step 2c combines the information from Steps 2a and 2b to determine the risk of dust impacts without appropriate mitigation. Step 3 uses this information to determine the appropriate level of mitigation required to ensure that there should be no significant impacts. Appendix A2 explains the approach in more detail.

Road Traffic Impacts

Sensitive Locations

3.5 Concentrations of nitrogen dioxide and PM_{10} have been predicted at a number of locations within the proposed development. Receptors have been identified to represent worst-case exposure within these locations, being located on the façades of the development closest to the sources. These locations are described in Table 2 and shown in Figure 1. In addition, concentrations have been modelled at the diffusion tube monitoring site located at St. Dunstan's Church, Fleet Street, in order to verify the model outputs (see Appendix A5 for verification method).

Table 2: Description of Receptor Locations

Receptor	Description [a]
Receptor 1 [b]	Existing Café and Proposed Hotel Entrance on Kingsway
Receptor 2	Existing College and Proposed Hotel Window on Wild Court
Receptor 3	Existing College and Proposed Hotel Window on Wild Court
Receptor 4	Existing College and Proposed Hotel Window on Wild Court
Receptor 5	Existing College and Proposed Hotel Window on Wild Court

[a] Receptors modelled at a height of 1.5 m.

[b] There is no relevant exposure to the air quality objectives in this location.

Figure 1: Receptor Locations (Road Traffic Assessment)

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Assessment Scenarios

3.6 Nitrogen dioxide, PM_{10} and $PM_{2.5}$ concentrations have been predicted for a base year (2016) (for model verification purposes) and the proposed year of opening (2018). In addition to the set of 'official' predictions, a sensitivity test has been carried out for nitrogen dioxide that involves assuming much higher nitrogen oxides emissions from certain vehicles than have been predicted by Defra, using AQC's Calculator Using Realistic Emissions for Diesels (CURED V2A) tool (AQC, 2016a). This is to address the potential under-performance of emissions control technology on modern diesel vehicles (AQC, 2016b).

Modelling Methodology

3.7 Concentrations have been predicted using the ADMS-Roads dispersion model. Details of the model inputs, assumptions and the verification are provided in Appendix A5, together with the method used to derive base and future year background concentrations. Where assumptions have been made, a realistic worst-case approach has been adopted.

Traffic Data

3.8 Traffic data for the assessment have been taken from the London Atmospheric Emissions Inventory (LAEI) (GLA, 2016b). Further details of the traffic data used in this assessment are provided in Appendix A5.

Uncertainty in Road Traffic Modelling Predictions

3.9 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.

3.10 An important stage in the process is model verification, which involves comparing the model output with measured concentrations (see Appendix A5). 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 base year (2016) concentrations.

3.11 Predicting pollutant concentrations in a future year will always be subject to greater uncertainty. For obvious reasons, the model cannot be verified in the future, and it is necessary to rely on a series of projections provided by DfT and Defra as to what will happen to traffic volumes, background pollutant concentrations and vehicle emissions.

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 et al., 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 and 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 et al., 2011) (Carslaw and 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[2] are delivering real on-road improvements. A detailed comparison of the predictions in Defra’s latest Emission Factor Toolkit (EFT) v7.0 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). In order to account for this potential under-prediction, a sensitivity test has been carried out in which the emissions from Euro IV, Euro V, Euro VI, and Euro 6 vehicles have been uplifted as described in Paragraph A5.7 in Appendix A5, using AQC’s CURED (V2A) tool (AQC, 2016a). The results from this sensitivity test are likely to over-predict emissions from vehicles in the future (AQC, 2016b) and thus provide a reasonable worst-case upper-bound to the assessment.

Impacts of the Proposed Combustion Plant

3.15 The proposed combustion plant will consist of two ENER-G E35M CHPs and one EVOMOD 750 kW boiler. Further details of the plant to be installed are provided in Appendix A5.

Sensitive Locations

3.16 In terms of the potential impacts from the proposed combustion plant, concentrations have been modelled for a ground-floor level gridded area (spanning approximately 300 m 300 m around the site) which covers both on-site and off-site receptors. In addition 57 receptors have been modelled at a range of locations and heights on the façades of the proposed development and nearby existing buildings. The locations of these receptors are shown in Figure 2.

2 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.

Figure 2: Receptor Locations (Combustion Plant Assessment)

Assessment Scenarios

3.17 Predictions of nitrogen dioxide concentrations have been carried out assuming that the plant is installed in 2018.

Modelling Methodology

3.18 The impacts of emissions from the proposed combustion 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. Entrainment of the plume into the wake of nearby buildings has been simulated within the model. The model input parameters are set out in Appendix A5. The air quality modelling has been carried out based on a number of necessary assumptions, detailed further in Appendix A5. Where possible a realistic worst-case approach has been adopted.

Emissions Data

3.19 The emissions data input into the model for the energy plant have been provided by BSD Consulting Engineers, who are the mechanical and engineering consultants for the proposed development. Further details of the emissions data used in this assessment are provided in Appendix A5.

Uncertainty

3.20 The point source dispersion model used in the assessment is dependent upon emission rates, flow rates, exhaust temperatures and other parameters, all of which in reality are variable as the plant will operate at different loads at different times. The assessment has, however, addressed this by applying worst-case assumptions where necessary, and provided that the actual plant installed adheres to the restrictions set out in Appendix A8, the conclusions of this assessment will remain valid.

3.21 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.

'Air Quality Neutral'

3.22 The guidance relating to air quality neutral follows a tiered approach, such that all developments are expected to comply with minimum standards for gas and biomass boilers and for CHP plant (GLA, 2014a). Compliance with 'air quality neutral' is then founded on emissions benchmarks that have been derived for both building (energy) use and road transport in different areas of London. Developments that exceed the benchmarks are required to implement on-site or off-site mitigation to offset the excess emissions (GLA, 2014a).

3.23 Appendix A6 sets out the emissions benchmarks. The approach has been to calculate the emissions from the development and to compare them with these benchmarks.

4 Site Description and Baseline Conditions

4.1 The proposed development is located in central London, 200 m south of Holborn Station. The site is bounded by existing buildings including the Kingsway Hall Hotel and other business and leisure premises. It faces the A4200 (Kingsway) to the east and Wild Court to the south. The existing buildings on the site are used by a private college.

Industrial sources

4.2 A search of the UK Pollutant Release and Transfer Register (Defra, 2017b) and Environment Agency's 'what's in your backyard' (Environment Agency, 2017) 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 Management Areas

4.3 The London Borough of Camden has investigated air quality within its area as part of its responsibilities under the LAQM regime. In September 2002, a borough-wide AQMA was declared for exceedances of the annual mean nitrogen dioxide and 24-hour mean PM_{10} objectives. The proposed development is located within this AQMA.

Local Air Quality Monitoring

4.4 The London Borough of Camden operates several automatic monitoring stations within its area. The Shaftesbury Avenue monitoring station closed in 2015 and consequently none of the remaining automatic monitors are within 1 km of the proposed development site. The Council also operates a number of nitrogen dioxide monitoring sites using diffusion tubes prepared and analysed by Gradko Environmental (using the 50% TEA in acetone method). One diffusion tube monitoring site is within 1 km of the proposed development. Results for the years 2011 to 2016 are summarised in Table 3 and the monitoring locations are shown in Figure 3.

4.5 In addition monitoring by other organisations is performed at sites within 1 km of the proposed development. Since 2014 the 'inmidtown' Business Improvement District (BID) has funded and operated an air quality monitoring station outside Holborn Underground station. The City of Westminster Council operates an automatic monitoring station on The Strand and The City of London Corporation operate a diffusion tube monitoring site at St. Dunstan's Church, Fleet Street, (which is prepared and analysed by Gradko Environmental using the 50% TEA in acetone method). Results from these monitors for the years 2011 to 2016 are also summarised in Table 3 and the monitoring locations are shown in Figure 3. Data for the Holborn Underground station monitor is only available for the years 2014, 2015 and 2016.

Table 3: Summary of Nitrogen Dioxide (NO_2) Monitoring (2011-2016) [a]

Site No.	Site Type	Location	2011	2012	2013	2014	2015	2016
Automatic Monitors - Annual Mean (µg/m^3)								
CD3 [b]	Roadside	Shaftesbury Avenue	**76**	**71**	**74**	**69**	Data Capture Issues	Closed in 2016
LB [b, e]	Urban Background	London Bloomsbury	**50**	**55**	**44**	**45**	**48**	**42**
Strand [c, e]	Roadside	The Strand	-	-	-	-	**122(60%)**	**106**
IM1 [b, e]	Kerbside	Kiosk outside Holborn Station	-	-	-	**94**	**83**	**84**
Objective			**40 [d]**					
Automatic Monitors - No. of Hours > 200 µg/m^3								
CD3 [b]	Roadside	Shaftesbury Avenue	15	12	6	1 (140) [h]	Data Capture Issues	Closed in 2016
LB [b, e]	Urban Background	London Bloomsbury	0	1	0	0	0	0
Strand [c]	Roadside	The Strand	-	-	-	-	**284 (60%)** [i]	**335**
IM1 [b, e]	Kerbside	Kiosk outside Holborn Station	-	-	-	**202**	**75**	**46**
Objective			**18 (200)[h]**					
Diffusion Tubes - Annual Mean (µg/m^3)								
CA21 [b]	Roadside	Bloomsbury Street	**77**	**72**	**76**	**81**	**71**	**-**
CL39 [d,g]	Roadside	St. Dunstan's Church, Fleet Street	**98**	**93**	**87**	**80**	**85**	**81**
Objective			**40**					

[a] Exceedances of the objectives are shown in bold.

[b] 2010 - 2015 data have been taken from the Annual Status Report for 2015 (London Borough of Camden, 2016).

[c] 2010 - 2015 data have been taken from the Westminster Air Quality Annual Status Report for 2015 (Westminster City Council, 2016)

[d] 2010 - 2015 data have been taken from the London City Air Quality Annual Status Report for 2015 (City of London Corporation, 2016)

[e] 2016 data have been taken from the London Air website (King's College London, 2017).

[f] 2016 data have been taken from the Defra AURN Archive (Defra, 2017d) .

[g] 2016 data have been provided by The City of London Corporation.

[h] Data capture is quoted in brackets when <75%.

[i] Data capture data was less than 90%, the 99.8th percentile of hourly means is shown in brackets

4.6 Measured concentrations at the automatic monitoring stations have consistently exceeded the annual mean nitrogen dioxide objective in all years presented. The one-hour objective was exceeded in 2015 and 2016 at the Strand automatic monitoring station and at the Holborn Station automatic site in 2014, 2015 and 2016. Annual mean concentrations at the Bloomsbury Street (CA21) roadside diffusion tube monitoring site have exceeded the objective in all years between 2011 and 2015, no data is yet available for 2016. At the St. Dunstan's Church diffusion tube site located on Fleet Street (CL39) concentrations exceeded the annual mean objective in all years between 2011 and 2016.

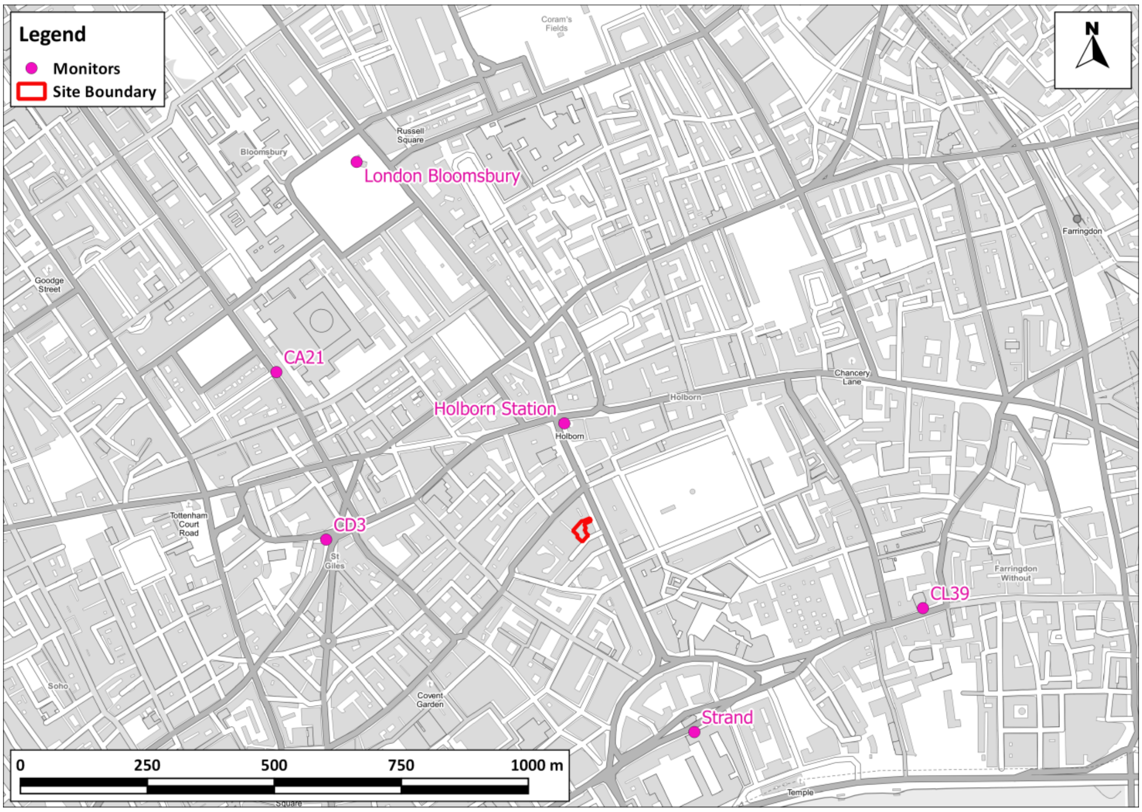


Figure 3: Monitoring Locations

4.7 The Shaftesbury Avenue automatic station also monitored PM_{10} concentrations until 2015 and the London Bloomsbury monitor records both PM_{10} and $PM_{2.5}$ concentrations. Results for the years 2011 to 2016 are summarised in Table 4. Concentrations have consistently been below the relevant objectives.

Table 4: Summary of PM_{10} and $PM_{2.5}$ Automatic Monitoring (2010-2016) [a]

Site No.	Site Type	Location	2011	2012	2013	2014	2015	2016
PM_{10} Annual Mean ($\mu g/m^3$)								
CD3	Roadside	Shaftesbury Avenue	32	29	29	25	22	Closed in 2016
LB [b]	Urban Background	London Bloomsbury	22	19	18	20	22	20
Objective			**40**					
PM_{10} No. Days >50 $\mu g/m^3$								
CD3	Roadside	Shaftesbury Avenue	27	18	17	16	4	Closed in 2016
LB [b]	Urban Background	London Bloomsbury	17	10	4	11	6 (33) [d]	9
Objective			**35 (50)**					
$PM_{2.5}$ Annual Mean ($\mu g/m^3$) [c]								
LB	Urban Background	London Bloomsbury	17	16	12	15	11	12
Objective			**25 [e]**					

[a] 2010 - 2015 data have been taken from the Annual Status Report for 2015 (London Borough of Camden, 2016).

[b] 2016 data have been taken from the London Air website (King's College London, 2017).

[c] 2016 data have been taken from the Defra AURN Archive (Defra, 2017d) .

[d] Reference equivalent. Data capture was 70% in 2015, and thus the 90th percentile of daily means is provided in parentheses.

[e] 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.

Exceedances of EU Limit Value

4.8 There are several AURN monitoring sites within the Greater London Urban Area that have measured exceedances of the annual mean nitrogen dioxide limit value. Furthermore, the national map of roadside annual mean nitrogen dioxide concentrations (Defra, 2017c), used to report exceedances of the limit value to the EU, identifies exceedances of this limit value in 2015 along many roads in London, including the Kingsway near 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. Defra’s mapping for 2020, which takes account of the measures contained in its 2015 Air Quality Action Plan (Defra, 2015), identifies exceedances of the limit value along some major roads within 1 km of the application site.

Background Concentrations

4.9 In addition to the locally measured concentrations, estimated background concentrations at the proposed development have been determined for 2016 and the opening year 2018 using Defra's background maps (Defra, 2017a). The background concentrations are set out in Table 5 and have been derived as described in Appendix A5. The background concentrations are all above the objectives.

Table 5: Estimated Annual Mean Background Pollutant Concentrations in 2016 and 2018 (µg/m^3)

Year	NO_2	PM_{10}	$PM_{2.5}$
2016	54.0	22.7	16.3
2018 [a]	50.3	22.1	16.1
2018 Worst-case Sensitivity Test [b]	51.8	N/A	N/A
Objectives	**40**	**40**	**25** [c]

N/A = not applicable. The range of values is for the different 1x1 km grid squares covering the study area.

[a] In line with Defra's forecasts.

[b] Assuming higher emissions from modern diesel vehicles as described in Appendix A5.

[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.

5 Construction Phase Impact Assessment

5.1 The construction works will give rise to a risk of dust impacts during demolition, earthworks and construction, as well as from trackout of dust and dirt by vehicles onto the public highway. Step 1 of the assessment procedure is to screen the need for a detailed assessment. There are receptors within the distances set out in the guidance (see Appendix A2), thus a detailed assessment is required. The following section sets out Step 2 of the assessment procedure.

Potential Dust Emission Magnitude

Demolition

5.2 There will be minor and generally indoors demolition activities on site. The approximate total volume to be demolished is unknown at this stage, and the method of demolition has not yet been decided. However the volume to be demolished will be less than the 20,000 m^3 upper limit for 'Small' emission magnitude classification (Table A2.1). It is expected that this activity will take place intermittently, for approximately six months. Based on the example definitions set out in Table A2.1 in Appendix A2, the dust emission class for demolition is considered to be *small.*

Earthworks

5.3 There is no requirement for earthworks on site.

Construction

5.4 Construction will involve erection of a two-storey extension at the 7^{th} and 8^{th} floors. The total building volume will be less than the 25,000 m^3 upper limit for 'Small' emission magnitude classification (Table A2.1). There will be some concrete batching on site using a mortar for brickwork. The construction will take place over a 9 month period. Based on the example definitions set out in Table A2.1 in Appendix A2, the dust emission class for construction is considered to be *medium.*

Trackout

5.5 The number of vehicles accessing the site, which may track out dust and dirt, will be a maximum of 4 outward heavy vehicle movements per day. Based on the example definitions set out in Table A2.1 in Appendix A2, the dust emission class for trackout is considered to be *small.*

5.6 Table 6 summarises the dust emission magnitude for the proposed development.

Table 6: Summary of Dust Emission Magnitude

Source	Dust Emission Magnitude
Demolition	Small
Earthworks	N/A
Construction	Medium
Trackout	Small

Sensitivity of the Area

5.7 This assessment step combines the sensitivity of individual receptors to dust effects with the number of receptors in the area and their proximity to the site. It also considers additional site-specific factors such as topography and screening, and in the case of sensitivity to human health effects, baseline PM_{10} concentrations.

Sensitivity of the Area to Effects from Dust Soiling

5.8 The IAQM guidance, upon which the GLA's guidance is based, explains that residential properties are 'high' sensitivity receptors to dust soiling, while places of work are a 'medium' sensitivity receptor (Table A2.2 in Appendix A2). There are hotels and education establishments within 100 m and a number of offices and places of work between 20 – 50 m. additionally there are and a small number of residential properties within 50 m of the site (see Figure 4). Using the matrix set out in Table A2.3 in Appendix A2, the area surrounding the onsite works is of 'medium' sensitivity to dust soiling.

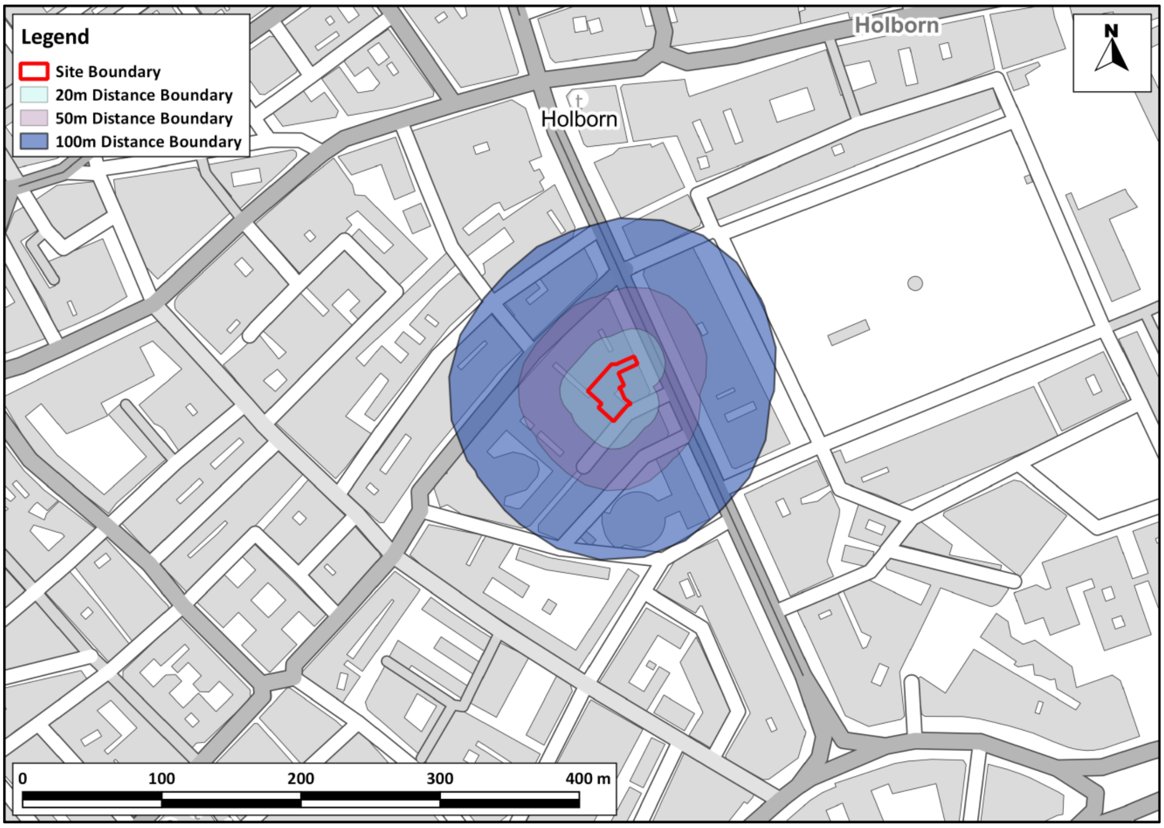


Figure 4: 100 m Distance Band around Site Boundary

5.9 Table 6 shows that the dust emission magnitude for trackout is *small* and Table A2.3 in Appendix A2 thus explains that there is a risk of material being tracked 50 m from the site exit. Since it is not known which roads construction vehicles will use, it has been assumed that all possible routes could be affected. The main roads within 50 m of the roads along which material could be tracked are occupied mainly by street shops, offices and education buildings, which are (see Figure 5).Table A2.3 in Appendix A2 thus indicates that the area is of 'low' sensitivity to dust soiling due to trackout.

5.10 Taking these points into account, it is judged that the area surrounding the onsite works is of 'medium' sensitivity to dust soiling, while the area surrounding roads along which material may be tracked from the site is of 'low' sensitivity.

Figure 5: 50 m Distance Band around Roads Used by Construction Traffic Within 50 m of the Site Exit

Sensitivity of the Area to any Human Health Effects

5.11 Residential properties are also classified as being of 'high' sensitivity to human health effects, while places of work are classified as being of 'medium' sensitivity. The matrix in Table A2.4 in Appendix A2 requires information on the baseline annual mean PM_{10} concentration in the area. Background concentrations on the site and surroundings are between 24-28 µg/m^3 (Table 10). Using the matrix in Table A2.4 in Appendix A2, the area surrounding the onsite works is of 'low' sensitivity to human health effects, while the area surrounding roads along which material may be tracked from the site is of 'low' sensitivity.

Summary of the Area Sensitivity

5.12 Table 7 summarises the sensitivity of the area around the proposed construction works.

Table 7: Summary of the Area Sensitivity

Effects Associated With:	Sensitivity of the Surrounding Area	
	On-site Works	Trackout
Dust Soiling	Medium	Low
Human Health	Low	Low

Risk and Significance

5.13 The dust emission magnitudes in Table 6 have been combined with the sensitivities of the area in Table 7 using the matrix in Table A2.6 in Appendix A2, in order to assign a risk category to each activity. The resulting risk categories for the four construction activities, without mitigation, are set out in Table 8. These risk categories have been used to determine the appropriate level of mitigation as set out in Section 7 (step 3 of the assessment procedure).

Table 8: Summary of Risk of Impacts Without Mitigation

Source	Dust Soiling	Human Health
Demolition	Low	Negligible
Earthworks	N/A	N/A
Construction	Low	Negligible
Trackout	Negligible	Negligible

5.14 The IAQM guidance does not provide a method for assessing the significance of effects before mitigation, and advises that pre-mitigation significance should not be determined. With appropriate mitigation in place, the IAQM guidance is clear that the residual effect will normally be ‘not significant’ (IAQM, 2016).

6 Operational Phase Impact Assessment

Impacts of Combustion Plant Emissions

6.1 The proposed development will contain two natural gas-fired CHP units and an additional natural gas-fired boiler to be located centrally in a ground-floor plant room. The assumed specifications for these plant are set out in Appendices A5 and A8. The actual plant installed within the proposed development must conform to the restrictions set out in Table A8.1 in Appendix A8 in order for the conclusions of this air quality assessment to remain valid.

6.2 Concentrations have been predicted across a modelled ground-level grid, at worst case locations on the façades of adjacent and nearby buildings, and at locations within the development itself. A range of heights have been included for relevant worst case receptors.

6.3 A worst-case assumption has been made that the CHP plant and boiler units will run continuously and at full (100%) load for consideration of concentrations in relation to both the annual mean and short-term objective. This will have led to an over-prediction in modelled concentrations.

Initial Screening assessment

6.4 The predicted nitrogen dioxide concentrations associated with emission from the combustion plant are shown in Table 9. The maximum predicted concentrations within the modelled grid area and at the worst-case receptors are provided.

Table 9: Predicted Maximum Pollutant Concentrations associated with Combustion Plant Emissions (µg/m^3)

Pollutant/Averaging Period	Maximum Modelled Process Contribution		Objective
	µg/m^3	% of Objective	
Annual Mean NO_2	0.7	1.6	40
99.79th %ile of 1-hour NO_2	4.8	2.4	200

6.5 These predicted maximum concentrations 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 (1.6% of the objective) is above the screening criterion (0.5%); and
- the predicted maximum 99.79th percentile of 1-hour mean nitrogen dioxide concentrations (2.4% of the objective) is below the screening criterion (10%).

6.6 As the predicted process contribution to the 99.79th percentile of 1-hour mean nitrogen dioxide concentrations are below the screening criterion, no further assessment is required for nitrogen dioxide against the 1-hour mean objective.

6.7 The predicted maximum annual mean nitrogen dioxide concentration process contribution (1.62% of the objective) of the combustion plant at 100% utilisation (usage), is however **above the screening criterion** (0.5%) and so further consideration for the potential for an adverse impact is necessary.

6.8 Guidance from Environmental Protection UK (EPUK) and the Institute of Air Quality Management (Moorcroft and Barrowcliffe et al, 2017) states that where baseline concentrations are more than 110% of the long-term environmental standard any change in concentration of 0.5% or more has the potential for a moderate adverse impact.

A contour showing the predicted process contribution to nitrogen dioxide concentrations at ground level is shown in

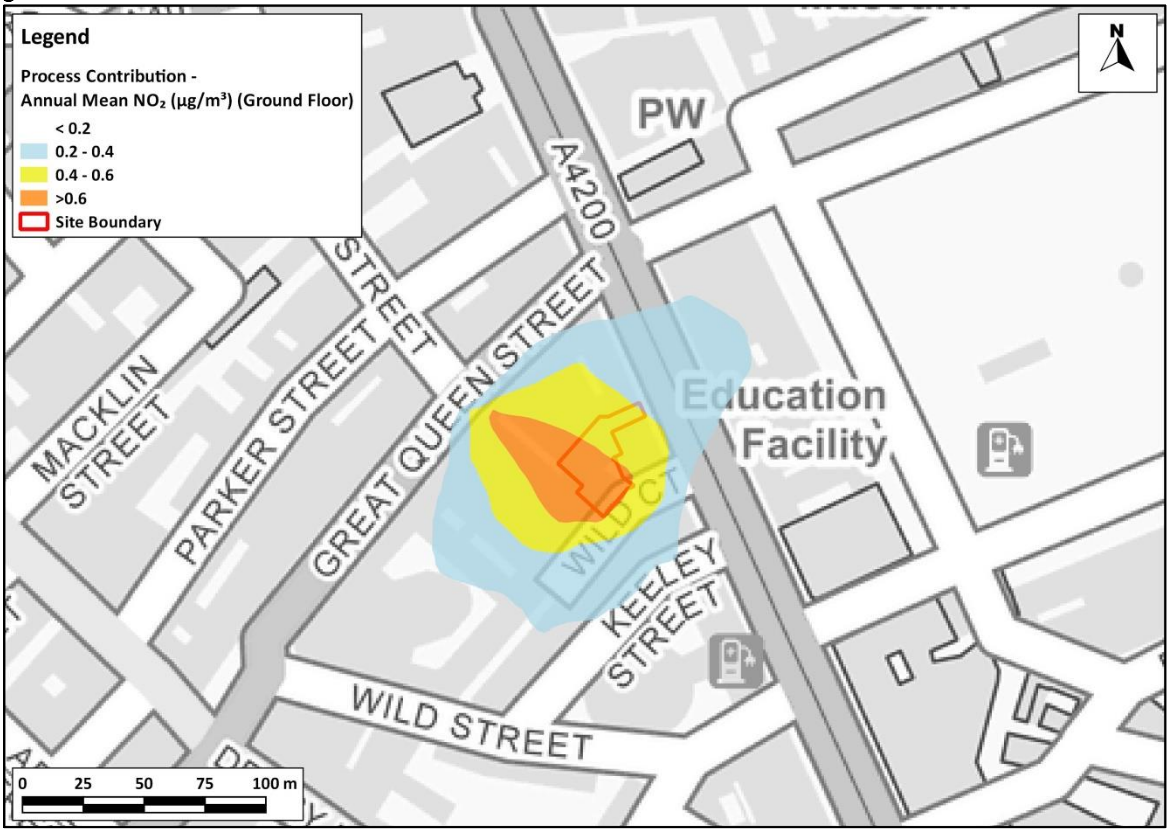
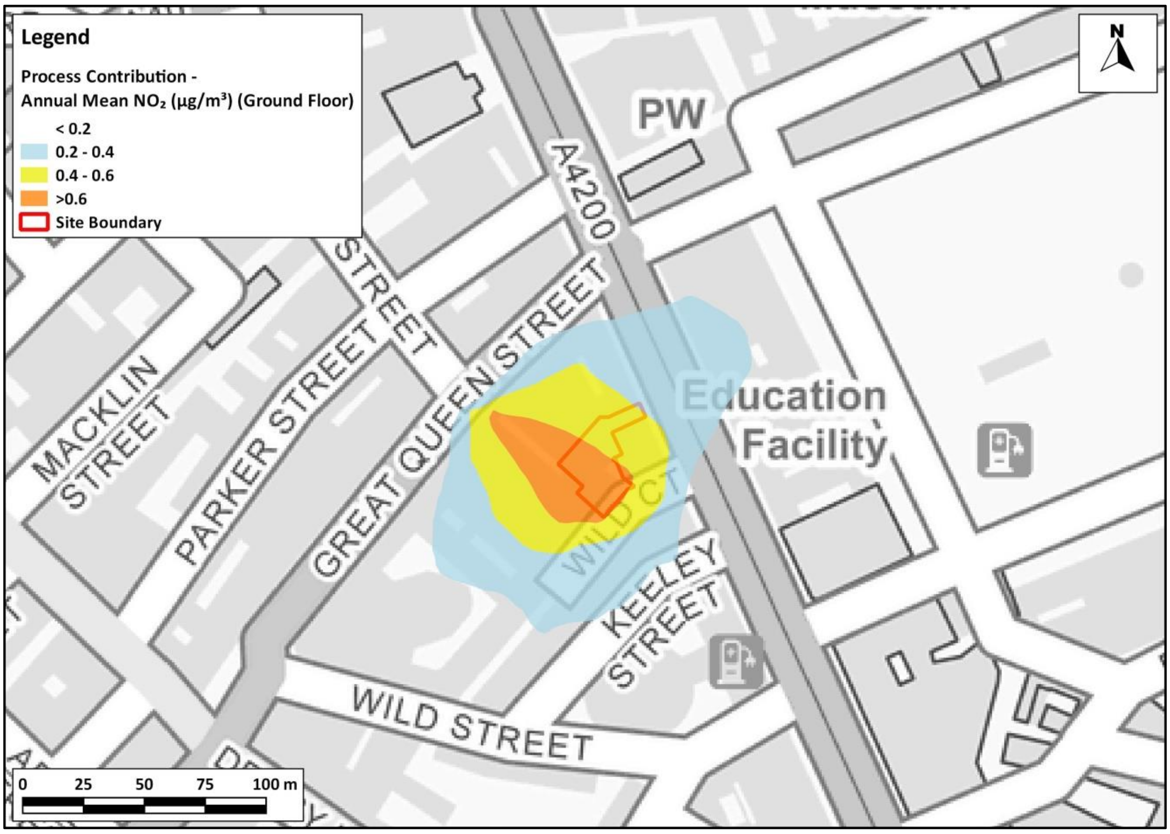


Figure 6. Baseline concentrations in the study area are described in Table 10 and exceed the long-term environmental standard (i.e. the annual mean objective). Therefore the area

shown in



6.9 Figure 6 with an increase greater than 0.2 µg/m^3 (0.5% of the long-term environmental standard) has the potential for a moderate adverse impact. The results for the worst-case receptors, modelled at a range of heights provided in Table A9.1 also demonstrate that there are no relevant locations at any height where the screening criteria are exceeded.

6.10 Land use in this area is non-residential, comprising only office and hotel space. The nearest residential properties are outside the contour. There is no relevant exposure to the annual mean objective where the process contribution to nitrogen dioxide concentrations exceeds 0.2 µg/m^3 and therefore there is no significant impact and further detailed assessment not required.

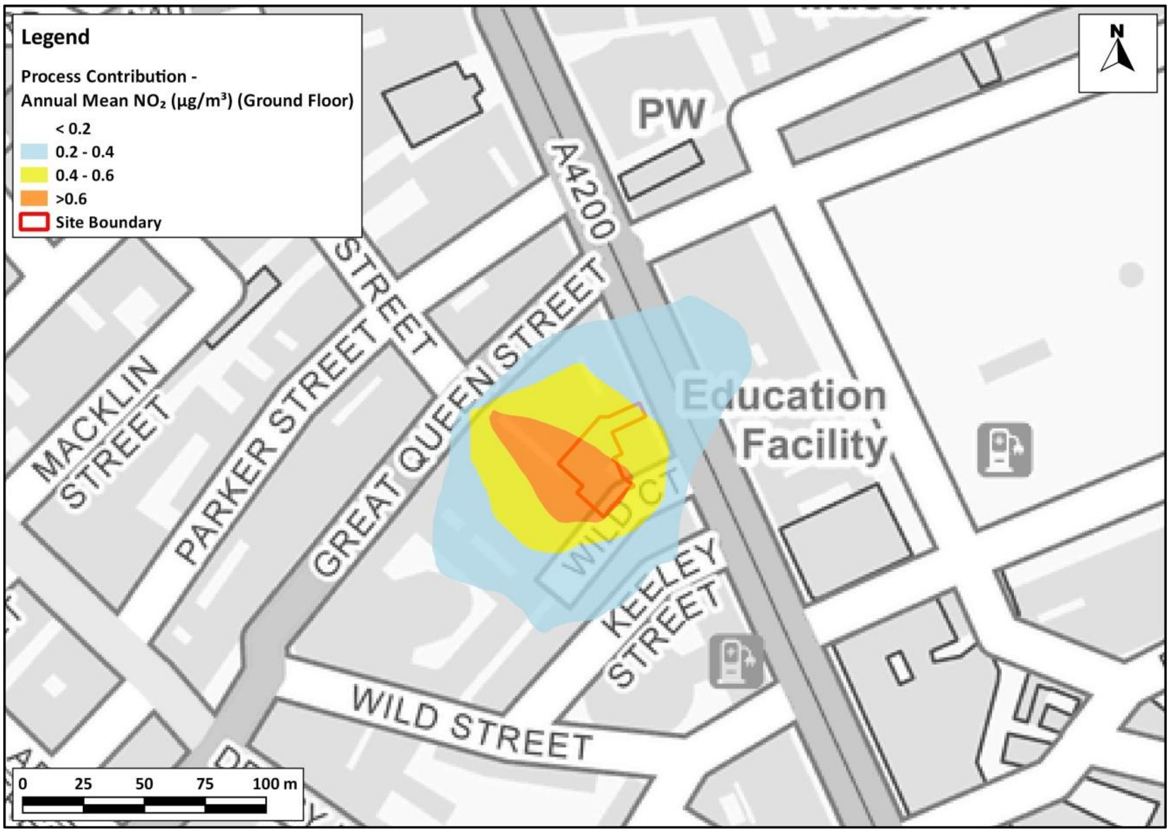


Figure 6: Ground-Level Contour showing the Process Contribution to Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) from the Proposed Combustion Plant

Impacts of Existing Sources on the Development

Road Traffic Impacts

6.11 Predicted annual mean concentrations of nitrogen dioxide and PM_{10} in 2018 for future occupants of the proposed hotel, taking account of emissions from the adjacent road network within the development, are set out in Table 10 (see Table 2 and Figure 1 for receptor locations). For nitrogen dioxide, results are presented for two scenarios so as to include a worst-case sensitivity test. Due to the proposed development being a hotel, there is no relevant exposure to the annual mean objective; however, as outlined in paragraph 2.27 , the predicted annual mean concentrations are used to screen the potential for exceedances of the 1-hour mean and 24-hour mean objectives for nitrogen dioxide and PM_{10} respectively.

6.12 The predicted annual mean concentrations of nitrogen dioxide in 2018 are lower than 60 µg/m^3 at receptors 2 to 5, it is therefore, unlikely that the 1-hour mean nitrogen dioxide objective will be exceeded at these receptors. The annual mean concentration in 2018 at receptor one exceeds the 60 µg/m^3 criterion, however this receptor is located at the proposed hotel entrance hall, where there is no relevant exposure and the 1-hour objective does not apply. The annual mean PM_{10} concentrations are below 32 µg/m^3 and it is, therefore, unlikely that the 24-hour mean PM_{10} objective will be exceeded.

Table 10: Predicted Concentrations of Nitrogen Dioxide (NO_2) and PM_{10} in 2018 for New Receptors in the Development Site

Receptor	Annual Mean NO_2 (µg/m^3)		Annual Mean PM_{10} (µg/m^3)
	'Official' Prediction [a]	*Worst-case Sensitivity Test* [b]	
1 [c]	**61.1**	**62.8**	24.3
2	55.8	57.4	23.2
3	55.4	57.0	23.1
4	55.1	56.7	23.1
5	54.9	56.5	23.0
Criterion	**60** [d]		**32** [e]

[a] In line with Defra's forecasts.

[b] Assuming higher emissions from modern diesel vehicles as described in Paragraph A5.7 in Appendix A5.

[c] There is no relevant exposure at this location.

[d] 60 µg/m^3 is the annual mean concentration above which an exceedance of the 1-hour mean nitrogen dioxide objective is possible, as outlined in LAQM.TG16 (Defra, 2016b). A value of 60 µg/m^3 is thus used as a proxy to determine the likelihood of exceedance of the 1-hour mean nitrogen dioxide objective, as recommended in EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017). Exceedances of this criterion are shown in bold.

[e] While the annual mean PM_{10} objective is 40 µg/m^3, 32 µg/m^3 is the annual mean concentration above which an exceedance of the 24-hour mean PM_{10} objective is possible, as outlined in LAQM.TG16 (Defra, 2016b). A value of 32 µg/m^3 is thus used as a proxy to determine the likelihood of exceedance of the 24-hour mean PM_{10} objective, as recommended in EPUK & IAQM guidance (Moorcroft and Barrowcliffe et al, 2017).

Combined Road Traffic and Proposed Combustion Plant Impacts

6.13 It is necessary to consider the potential for total concentrations at the new receptors to exceed 200 µg/m^3 over a 1-hour mean period (which should not be exceeded more than 18 times in a year) for the combined effects of road traffic and the proposed combustion plant. Consideration to this is given based on the approach outlined in paragraph 2.34, using twice worst-case baseline concentration from Table 10 (2 x 57.4 µg/m^3 = 114.8 µg/m^3) and the worst case process contribution at any on-site new receptor (4.8 µg/m^3). The total concentration (119.6 µg/m^3) is well below the 1-hour mean objective value of 200 µg/m^3. Furthermore, using the receptor results presented in Table A9.1 in Appendix 9 the highest process contributions from the proposed combustion plant do not occur at ground level, next to Kingsway, where the highest road-traffic concentrations are. Bearing this in mind, it is considered extremely unlikely there will be an exceedance of the 1-hour mean objective at the proposed development and therefore, air quality for future occupiers of the proposed development, with respect to 1-hour mean nitrogen dioxide mean concentrations, will thus be acceptable.

Significance of Operational Air Quality Effects

6.14 The operational air quality effects without mitigation are judged to be 'not significant'. This professional judgement is made in accordance with the methodology set out in Appendix A3, and for road traffic also takes into account the results of the worst-case sensitivity test for nitrogen dioxide. Future year concentrations are expected to lie between the two sets of results, but in order to provide a reasonable worst-case assessment, the judgement of significance focuses primarily on the results from the sensitivity test.

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

- concentrations will be below the relevant air quality objectives for all receptors; and
- the process contribution from centralised energy plant emissions will have insignificant impacts on nitrogen dioxide concentrations at locations of relevant exposure.

'Air Quality Neutral'

Building Emissions

6.16 BSD Consulting Engineers has advised that two ENER-G E35M CHP units and an Ideal Commercial EVOMOD 750 kW boiler will be used, which have maximum NOx emission of 50 mg/Nm^3 and 37.9 mg/Nm^3 respectively. The total NOx emission from all of the proposed plant will be 140.1 kg/annum. The installed plant will be required to meet the emission standards set out in the Sustainable Design and Construction SPG (GLA, 2014a). Gas-fired boiler plant must achieve an emission rate of <40 mg/kWh, while there are two sets of emission limits for CHPs. "Band A" developments are in locations where the baseline annual mean nitrogen dioxide and PM_{10} concentrations are less than 95% of the objective levels and baseline 24-hour mean PM_{10} concentrations exceed 50 $\mu g/m^3$ on 34 days or fewer in a year (the objective level is 35 days). Where baseline concentrations exceed any of these thresholds, the development is classed as "Band B".

6.17 The baseline concentrations in the local area, set out in Section 4 of this report, exceed the thresholds set out above, thus the development is classed as "Band B". CHP plant in a Band B development must achieve a NOx emission rate of <95 mg/Nm^3 (normalised conditions[3]).

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3 At 273K, 101.3kPa, 5% O_2, dry gas, as specified in the Sustainable Design and Construction SPG for band B developments.

6.18 Appendix 6 shows the Building Emissions Benchmarks (BEBs) for each land use category. Table 11 shows the calculation of the BEBs for this development.

Table 11: Calculation of Building Emissions Benchmark for the Development

Description		Value	Reference
A	Gross Internal Floor Area (m2) of C1 Use	3,809	Harper Downie Architects
B	NOx BEB for C1 Use (g/m2/yr)	70.9	Table A6.1
Total BEB NOx Emissions (kg/yr)		270.1	(A x B) / 1000

6.19 The Total Building NOx Emission of 140.1 kg/annum is less than Total BEB NOx Emission of 270.1 kg/annum. The proposed development is thus better than air quality neutral in terms of building emissions.

Road Transport Emissions

6.20 The Transport Emissions Benchmarks (TEBs) are based on the number of trips generated by different land-use classes, together with the associated trip lengths and vehicle emission rates.

6.21 The Transport Emissions Benchmarks (TEBs) are based on the number of light vehicle trips generated by different land-use classes, together with the associated trip lengths and vehicle emission rates. However, the guidance (AQC, 2014) only provides trip lengths and emission rates for A1, B1 and C3 uses, thus a TEB cannot be calculated for this proposed C1 Hotel development. The guidance does provide an alternative methodology, based on trip rates only, and this has been followed in considering the air quality neutrality of the proposed development in terms of transport emissions.

6.22 The proposed development is expected to generate a total of 21,353 light vehicle trips per annum. This figure was derived by Traffic Dynamics transport consultancy who used the TRAVL database to determine trip rates by comparison with the a similar and recently consented scheme within the London Borough of Camden at 2-16 Torrington Place.

6.23 Comparison of hotel trip data is difficult and many hotels within the TRAVL database are not comparable because they contain conference or leisure facilities on-site. The trip number may therefore not be representative of the proposed hotel at 4 Wild Court. Which does not contain leisure or conference facilities, has no car parking and is located close to public transport links.

6.24 Table A6.6 in Appendix A6 provides default trip rates for different development categories. This information has been used to calculate a benchmark trip rate of 7,236. This has then been compared with the actual trip rate of the development.

Table 12: Calculation of Transport Emissions Benchmarks for the Development

Description		Value	Reference
C1 Hotel			
A	**Gross Internal Floor Area of Offices (m^2)**	3,809	Harper Downie Architects
B	**Benchmark Trip Rate (trips/m2/annum)**	1.9	Table A6.6
C	**Benchmark Trip Rate (trips/annum)**	7,236	A x B
Entire Development			
Total Benchmark Trip Rate (trips/annum)		**7,236**	C

6.25 The Total Trip Rate is greater than the Total Trip Rate Benchmarks. The proposed development is thus not air quality neutral in terms of transport emissions.

7 Mitigation

Mitigation Included by Design

7.1 The EPUK/IAQM guidance advises that good design and best practice measures should be considered, whether or not more specific mitigation is required. The proposed development incorporates the following good design and best practice measures:

- no provision of car parking spaces, to discourage the use of private vehicles to access the proposed development;
- installation of ultra-low NOx boilers only, with emission rates below 32 mg/kWh;
- installation of a CHP with a very low emission rate of 250 mg/Nm^3; and
- running of the CHP and boiler flue to 1 m above roof level to ensure the best possible dispersion environment.

Recommended Mitigation

Construction Impacts

7.2 Measures to mitigate dust emissions will be required during the construction phase of the development in order to minimise effects upon nearby sensitive receptors.

7.3 The site has been identified as a *Low* Risk site during demolition and construction, and *Negligible* Risk for trackout, as set out in Table 8. The GLA's SPG on *The Control of Dust and Emissions During Construction and Demolition* (GLA, 2014b) describes measures that should be employed, as appropriate, to reduce the impacts, along with guidance on what monitoring should be undertaken during the construction phase. This reflects best practice experience and has been used, together with the professional experience of the consultant who has undertaken the dust impact assessment and the findings of the assessment, to draw up a set of measures that should be incorporated into the specification for the works. These measures are described in Appendix A7.

7.4 Where mitigation measures rely on water, it is expected that only sufficient water will be applied to damp down the material. There should not be any excess to potentially contaminate local watercourses.

Energy Plant Impacts

7.5 The energy plant flue will conform with the specifications to minimise air quality impacts set out in the GLA's Sustainable Design and Construction SPG (GLA, 2014a), which includes the following requirements:

- the CHP must be designed such that it will operate with a minimum efflux velocity of 10 m/s to allow for good initial dispersion of emissions; and
- all stacks should discharge vertically upwards and be unimpeded by any fixture on top of the stack (e.g., rain cowls etc).

7.6 It is also generally considered best practice for plant to have a flue terminating at least 1 m above the roof level.

7.7 Further requirements from the SPG are set out in Appendix A8, which also details the specifications of the plant used to assess the boiler and CHP impacts. If the installed plant does not conform to these specifications, additional assessment and/or mitigation may be required. Appendix A8 also sets out measures included in Technical Guidance Note D1 (Dispersion) (HMSO, 1993b) to ensure adequate dispersion of emissions from discharging stacks and vents.

Air Quality Neutral

7.8 While the development itself has no adverse impact on local air quality, the road traffic movements predicted for the scheme to cause the development to exceed the benchmark derived for an average development of this nature in central London. The air quality neutral policy is intended to minimise the cumulative impacts of many schemes throughout London. It may be necessary therefore to determine measures to mitigation measures due to transport emissions with Camden Council.

8 Conclusions

8.1 The construction works have the potential to create dust. During construction it will therefore be necessary to apply a package of mitigation measures to minimise dust emissions. With these measures in place, it is expected that any residual effects will be 'not significant'.

8.2 The impact of the proposed combustion plant on local air quality at existing receptors have been assessed and the impact shown to be 'not significant'.

8.3 The impacts of traffic emissions from local roads on the air quality for future users of the development have been assessed at five worst-case locations within the new development itself. In the case of nitrogen dioxide, a sensitivity test has also been carried out which considers the potential under-performance of emissions control technology on modern diesel vehicles. The effects of local traffic on the air quality for future users of the proposed development have been shown to be acceptable at the worst-case locations assessed, with concentrations being below the relevant air quality objectives.

8.4 The building related emissions associated with the proposed development are below the relevant Air Quality Neutral benchmarks. However transport emissions are expected to exceed the benchmark for this type of development in central London. The proposed development therefore does not comply with the requirement that all new developments in London should be at least 'air quality neutral'.

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

8.6 The development does not introduce new relevant exposure within an area of poor air quality, thus no additional mitigation has been proposed for the operational impacts. However, the road traffic generation of the scheme exceeds the air quality neutral benchmark derived for a hotel development in central London. Therefore the proposed development is not currently compliant with Policy 7.14 of the London Plan. Mitigation may be required to account for the excess transport emissions above the air quality neutral benchmark. The air quality neutral policy is intended to minimise the cumulative impacts of many schemes throughout London. Mitigation measures to offset the excess transport emissions may need to be agreed with Camden Council. Providing this mitigation is applied the development can be considered to meet the air quality neutral requirement of the SPG.

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10 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
BEB	Building Emissions Benchmark
CHP	Combined Heat and Power
DCLG	Department for Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DMP	Dust Management Plan
EFT	Emission Factor Toolkit
EPUK	Environmental Protection UK
Exceedance	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
Focus Area	Location that not only exceeds the EU annual mean limit value for NO_2 but also has a high level of human exposure
GIA	Gross Internal Floor Area
HDV	Heavy Duty Vehicles (> 3.5 tonnes)
HMSO	Her Majesty's Stationery Office
HGV	Heavy Goods Vehicle
IAQM	Institute of Air Quality Management
LAEI	London Atmospheric Emissions Inventory
LAQM	Local Air Quality Management
LB	London Borough

LDV	Light Duty Vehicles (<3.5 tonnes)
LEZ	Low Emission Zone
µg/m^3	Microgrammes per cubic metre
MAQS	Mayor's Air Quality Strategy
NRMM	Non-road Mobile Machinery
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
SAC	Special Area of Conservation
SCR	Selective Catalytic Reduction
SPG	Supplementary Planning Guidance
SPD	Supplementary Planning Document
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal
T-Charge	Toxicity Charge
TEA	Triethanolamine – used to absorb nitrogen dioxide
TEB	Transport Emissions Benchmark
TfL	Transport for London
TRAVL	Trip Rate Assessment Valid for London
ULEZ	Ultra Low Emission Zone

ZEC	Zero Emission Capable

11 Appendices

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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 An Ultra Low Emission Zone (ULEZ) is to be introduced in London on 7 September 2020 (although TfL is currently consulting on bringing this forward to 8 April 2019). 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. The Mayor is also proposing to expand the ULEZ beyond central London in 2020.

Other Measures

A1.5 The Mayor will introduce an Emissions Surcharge (also known as the Toxicity Charge, or T-Charge) in October 2017, which will add an extra £10 charge for vehicles using the congestion charge zone that do not meet the Euro 4/IV emission standards. The Emissions Surcharge aims to discourage the use of older, more polluting vehicles driving into and within central London. It is the first step towards the introduction of the ULEZ.

A1.6 From 2018 all taxis presented for licencing for the first time must be zero emission capable (ZEC). This means they must be able to travel a certain distance in a mode which produces no air pollutants. From 2018 all private hire vehicles (PHVs) presented for licensing for the first time must meet Euro 6 emissions standards. From 1 January 2020, all newly manufactured PHVs presented for licensing for the first time must be ZEC (with a minimum zero emission range of 10 miles). The Mayor’s aim is that the entire taxi and PHV fleet will be made up of ZEC vehicles by 2033.

A1.7 The Mayor has also proposed to make sure that TfL leads by example by cleaning up its bus fleet, implementing the following measures:

- TfL will procure only hybrid or zero emission double-decker buses from 2018;
- a commitment to providing 3,100 double decker hybrid buses by 2019 and 300 zero emission single-deck buses in central London by 2020;
- introducing 12 Low Emission Bus Zones by 2020;
- investing £50m in Bus Priority Schemes across London to reduce engine idling; and
- retrofitting older buses to reduce emissions (selective catalytic reduction (SCR) technology has already been fitted to 1,800 buses, cutting their NOx emissions by around 88%).

A2 Construction Dust Assessment Procedure

A2.1 The criteria developed by IAQM (2016), upon which the GLA's guidance is based, divide the activities on construction sites into four types to reflect their different potential impacts. These are:

- demolition;
- earthworks;
- construction; and
- trackout.

A2.2 The assessment procedure includes the four steps summarised below:

STEP 1: Screen the Need for a Detailed Assessment

A2.3 An assessment is required where there is a human receptor within 350 m of the boundary of the site and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s), or where there is an ecological receptor within 50 m of the boundary of the site and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

A2.4 Where the need for a more detailed assessment is screened out, it can be concluded that the level of risk is *negligible* and that any effects will be 'not significant'. No mitigation measures beyond those required by legislation will be required.

STEP 2: Assess the Risk of Dust Impacts

A2.5 A site is allocated to a risk category based on two factors:

- the scale and nature of the works, which determines the potential dust emission magnitude (Step 2A); and
- the sensitivity of the area to dust effects (Step 2B).

A2.6 These two factors are combined in Step 2C, which is to determine the risk of dust impacts with no mitigation applied. The risk categories assigned to the site may be different for each of the four potential sources of dust (demolition, earthworks, construction and trackout).

Step 2A – Define the Potential Dust Emission Magnitude

A2.7 Dust emission magnitude is defined as either 'Small', 'Medium', or 'Large'. The IAQM guidance explains that this classification should be based on professional judgement, but provides the examples in Table A2.1.

Table A2.1: Examples of How the Dust Emission Magnitude Class May be Defined

Class	Examples
Demolition	
Large	Total building volume >50,000 m^3, potentially dusty construction material (e.g. concrete), on site crushing and screening, demolition activities >20 m above ground level
Medium	Total building volume 20,000 m3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level
Small	Total building volume <20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10 m above ground, demolition during wetter months
Earthworks	
Large	Total site area >10,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry to due small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8 m in height, total material moved >100,000 tonnes
Medium	Total site area 2,500 m^2 – 10,000 m^2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4 m – 8 m in height, total material moved 20,000 tonnes – 100,000 tonnes
Small	Total site area <2,500 m^2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4 m in height, total material moved <10,000 tonnes, earthworks during wetter months
Construction	
Large	Total building volume >100,000 m^3, piling, on site concrete batching; sandblasting
Medium	Total building volume 25,000 m^3 – 100,000 m^3, potentially dusty construction material (e.g. concrete), piling, on site concrete batching
Small	Total building volume <25,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber)
Trackout [a]	
Large	>50 HDV (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m
Medium	10-50 HDV (>3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m
Small	<10 HDV (>3.5t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50 m

[a] These numbers are for vehicles that leave the site after moving over unpaved ground.

Step 2B – Define the Sensitivity of the Area

A2.8 The sensitivity of the area is defined taking account of a number of factors:

- the specific sensitivities of receptors in the area;
- the proximity and number of those receptors;
- in the case of PM_{10}, the local background concentration; and
- site-specific factors, such as whether there are natural shelters to reduce the risk of wind-blown dust.

A2.9 The first requirement is to determine the specific sensitivities of local receptors. The IAQM guidance recommends that this should be based on professional judgment, taking account of the principles in Table A2.2. These receptor sensitivities are then used in the matrices set out in Table A2.3, Table A2.4 and Table A2.5 to determine the sensitivity of the area. Finally, the sensitivity of the area is considered in relation to any other site-specific factors, such as the presence of natural shelters etc., and any required adjustments to the defined sensitivities are made.

Step 2C – Define the Risk of Impacts

A2.10 The dust emission magnitude determined at Step 2A is combined with the sensitivity of the area determined at Step 2B to determine the *risk* of impacts with no mitigation applied. The IAQM guidance provides the matrix in Table A2.6 as a method of assigning the level of risk for each activity.

STEP 3: Determine Site-specific Mitigation Requirements

A2.11 The IAQM guidance provides a suite of recommended and desirable mitigation measures which are organised according to whether the outcome of Step 2 indicates a low, medium, or high risk. The list provided in the IAQM guidance has been used as the basis for the requirements set out in Appendix A7.

STEP 4: Determine Significant Effects

A2.12 The IAQM guidance does not provide a method for assessing the significance of effects before mitigation, and advises that pre-mitigation significance should not be determined. With appropriate mitigation in place, the IAQM guidance is clear that the residual effect will normally be 'not significant'.

A2.13 The IAQM guidance recognises that, even with a rigorous dust management plan in place, it is not possible to guarantee that the dust mitigation measures will be effective all of the time, for instance under adverse weather conditions. The local community may therefore experience occasional, short-term dust annoyance. The scale of this would not normally be considered sufficient to change the conclusion that the effects will be 'not significant'.

Table A2.2: Principles to be Used When Defining Receptor Sensitivities

Class	Principles	Examples
Sensitivities of People to Dust Soiling Effects		
High	users can reasonably expect enjoyment of a high level of amenity; or the appearance, aesthetics or value of their property would be diminished by soiling; and the people or property would reasonably be expected a to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land	dwellings, museum and other culturally important collections, medium and long term car parks and car showrooms
Medium	users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or the appearance, aesthetics or value of their property could be diminished by soiling; or the people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land	parks and places of work
Low	the enjoyment of amenity would not reasonably be expected; or there is property that would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or there is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land	playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads
Sensitivities of People to the Health Effects of PM_{10}		
High	locations where members of the public may be exposed for eight hours or more in a day	residential properties, hospitals, schools and residential care homes
Medium	locations where the people exposed are workers, and where individuals may be exposed for eight hours or more in a day.	may include office and shop workers, but will generally not include workers occupationally exposed to PM_{10}
Low	locations where human exposure is transient	public footpaths, playing fields, parks and shopping streets
Sensitivities of Receptors to Ecological Effects		
High	locations with an international or national designation and the designated features may be affected by dust soiling; or locations where there is a community of a particularly dust sensitive species	Special Areas of Conservation with dust sensitive features
Medium	locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; or locations with a national designation where the features may be affected by dust deposition	Sites of Special Scientific Interest with dust sensitive features
Low	locations with a local designation where the features may be affected by dust deposition	Local Nature Reserves with dust sensitive features

Table A2.3: Sensitivity of the Area to Dust Soiling Effects on People and Property [4]

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

[4] For demolition, earthworks and construction, distances are taken either from the dust source or from the boundary of the site. For trackout, distances are measured from the sides of roads used by construction traffic. Without mitigation, trackout may occur from roads up to 500 m from sites with a *large* dust emission magnitude, 200 m from sites with a *medium* dust emission magnitude and 50 m from sites with a *small* dust emission magnitude, as measured from the site exit. The impact declines with distance from the site, and it is only necessary to consider trackout impacts up to 50 m from the edge of the road.

Table A2.4: Sensitivity of the Area to Human Health Effects [4]

Receptor Sensitivity	Annual Mean PM_{10}	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	>32 µg/m³	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m³	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m³	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m³	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>32 µg/m³	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	28-32 µg/m³	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	24-28 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<24 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Table A2.5: Sensitivity of the Area to Ecological Effects [4]

Receptor Sensitivity	Distance from the Source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Table A2.6: Defining the Risk of Dust Impacts

Sensitivity of the Area	Dust Emission Magnitude		
	Large	Medium	Small
Demolition			
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible
Earthworks			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible
Construction			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible
Trackout			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

A3 EPUK & IAQM Planning for Air Quality Guidance

A3.1 The guidance issued by EPUK and IAQM (Moorcroft and Barrowcliffe et al, 2017) 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

A3.2 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".

A3.3 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.

A3.4 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.

A3.5 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”.

A3.6 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

A3.7 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 following 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.

A3.8 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.

A3.9 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, which sets out indicative criteria for requiring an air quality assessment. The stage 2 criteria relating to vehicle emissions are set out below:

- 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; and

A3.10 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 are likely to be more appropriate.

A3.11 On combustion processes (including standby emergency generators and shipping) where there is a risk of impacts at relevant receptors, the guidance states that:

"Typically, any combustion plant where the single or combined NOx emission rate is less than 5 mg/sec is unlikely to give rise to impacts, provided that the emissions are released from a vent or stack in a location and at a height that provides adequate dispersion. As a guide, the 5 mg/s criterion equates to a 450 kW ultra-low NOx gas boiler or a 30kW CHP unit operating at <95mg/Nm^3.

In situations where the emissions are released close to buildings with relevant receptors, or where the dispersion of the plume may be adversely affected by the size and/or height of adjacent *buildings (including situations where the stack height is lower than the receptor) then consideration will need to be given to potential impacts at much lower emission rates.*

Conversely, where existing nitrogen dioxide concentrations are low, and where the dispersion conditions are favourable, a much higher emission rate may be acceptable".

A3.12 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, provided that professional judgement is applied; the guidance importantly states the following:

"The criteria provided are precautionary and should be treated as indicative. They are intended to function as a sensitive 'trigger' for initiating an assessment in cases where there is a possibility of significant effects arising on local air quality. This possibility will, self-evidently, not be realised in many cases. The criteria should not be applied rigidly; in some instances, it may be appropriate to amend them on the basis of professional judgement, bearing in mind that the objective is to identify situations where there is a possibility of a significant effect on local air quality".

A3.13 Even if a development cannot be screened out, the guidance is clear that a detailed assessment is not necessarily required:

"The use of a Simple Assessment may be appropriate, where it will clearly suffice for the purposes of reaching a conclusion on the significance of effects on local air quality. The principle underlying this guidance is that any assessment should provide enough evidence that will lead to a sound conclusion on the presence, or otherwise, of a significant effect on local air quality. A Simple Assessment will be appropriate, if it can provide this evidence. Similarly, it may be possible to conduct a quantitative assessment that does not require the use of a dispersion model run on a computer".

A3.14 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

A3.15 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 within the EPUK/IAQM guidance has, therefore, been used in this assessment. 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

A3.16 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 A3.1 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 A3.1: 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

A3.17 The guidance recommends 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.

A3.18 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.

A3.19 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 A4.

A4 Professional Experience

Penny Wilson, BSc (Hons) CSci MIEnvSc MIAQM

Ms Wilson is an Associate Director with AQC, with more than seventeen years' relevant experience in the field of air quality. She has been responsible for air quality assessments of a wide range of development projects, covering retail, housing, roads, ports, railways and airports. She has also prepared air quality review and assessment reports and air quality action plans for local authorities and appraised local authority assessments and air quality grant applications on behalf of the UK governments. Ms Wilson has arranged air quality and dust monitoring programmes and carried out dust and odour assessments. She has provided expert witness services for planning appeals and is Member of the Institute of Air Quality Management and a Chartered Scientist.

Suzanne Hodgson, BSc (Hons) MSc CSci MIEnvSc MIAQM

Miss Hodgson is a Principal Consultant with AQC, with over ten years' experience in the field of air quality management and assessment. She has been responsible for a wide range of air quality projects covering impact assessments for new residential, commercial and industrial developments, local air quality management, ambient air quality monitoring of various pollutants and the assessment of nuisance odours and construction dust. She has extensive modelling experience, including the modelling of road traffic, energy centre (including energy from waste) and odour sources, and is familiar with preparing stand-alone air quality reports as well as chapters for inclusion within an Environment Statement. Suzanne has worked with a variety of clients to provide expert air quality services and advice, including local authorities, planners, developers and process operators. She is a Member of the Institute of Air Quality Management and is a Chartered Scientist.

Dr Aidan Farrow, BSc (Hons) PhD MIAQM

Dr Farrow is a Consultant with AQC, having joined the company in 2016. He previously worked for four years as a research scientist at the University of Hertfordshire's Centre for Atmospheric and Instrumentation Research. There he was responsible for the National Centre for Atmospheric Science Air Quality Forecast, as well as working on research projects with a variety of Climate, Weather and Air Quality models. He is now gaining experience in the field of air quality assessment.

Yelena Ortega, BSc (Hons) MSc AIEMA

Mrs Ortega is a Consultant with AQC, with over two years' of relevant experience. Prior to joining AQC she worked as an assistant air quality scientist at Peter Brett Associates. She has undertaken a wide range of air quality impact assessments for development projects across the

UK, including residential, commercial and industrial schemes. Yelena has gained significant experience in undertaking construction dust risk assessments and Air Quality Neutral assessments, and in preparing local authority Annual Status Reports (ASRs). She has also undertaken a number of odour surveys and assessments in the context of planning applications. She is an Associate Member of the Institute for Environmental Management and Assessment.

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

A5 Modelling Methodology

Model Inputs

Road Traffic

A5.1 Predictions have been carried out using the ADMS-Roads dispersion model (v4.1). 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 EFT (Version 7.0) published by Defra (2017a).

A5.2 Hourly sequential meteorological data from London City Airport for 2016 have been used in the model. The London City Airport meteorological monitoring station is located approximately 12 km to the east of the proposed development site. It is deemed to be the nearest monitoring station representative of meteorological conditions in the vicinity of the proposed development site; both the development site and the London City Airport meteorological monitoring station are located within Greater London where they will be influenced by similar meteorology.

A5.3 For the purposes of modelling, it has been assumed that the front façade of the proposed development is within a street canyon formed by the buildings on Kingsway. This road has a number of canyon-like features, which reduce dispersion of traffic emissions, and can lead to concentrations of pollutants being higher here than they would be in areas with greater dispersion. Kingsway has, therefore, been modelled as a street canyon using ADMS-Roads' advanced canyon module, with appropriate input parameters determined from plans, on-site measurements, local mapping and photographs. The advanced canyon module has been used along with the urban canopy flow module, the input data for which have been published by Cambridge Environmental Research Consultants (CERC, 2016), who developed the ADMS models.

A5.4 Traffic data for the modelled road network have been taken from the London Atmospheric Emissions Inventory (LAEI) (GLA, 2016b). Traffic speeds have been estimated based on professional judgement, taking account of the road layout, speed limits and the proximity to a junction. The traffic data used in this assessment are summarised in Table A5.1. Diurnal flow profiles for the traffic have been derived from the national diurnal profiles published by DfT (2015).

Table A5.1: Summary of Traffic Data used in the Assessment [a]

Road Link	2016		2018	
	AADT	%HDV	AADT	%HDV
1 Kingsway Holborn	26,538	3	26,593	3
2 Kingsway	27,042	3	27,100	3
3,4,5 Kingsway	27,177	3	27,235	3
6,7,8 Gt Queen St Junction	4,799	4	4,804	4
9 Drury Lane	12,331	4	12,345	4
10,11,12 Drury Lane	2,634	4	2,641	4
13,14 Kingsway	27,177	3	27,235	3
15 Kingsway	27,328	3	27,385	3
55 Fleet Street 1	22,625	3	22,726	3
56,57 Fleet Street 2	22,650	3	22,768	3
58,59 Fleet Street 6	4,703	3	4,724	3
62,63 Fetter Ln 1	5,623	2	5,633	3
64,65 Fetter Ln 3	11,246	2	11,267	3
66,67 Chancery Lane	3,177	3	3,195	3
80 Long Acre	3,375	4	3,379	4

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

A5.5 The LAEI traffic data include 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. While this may mean that some brake and tyre wear and resuspension may be missed, this is unlikely to have significantly affected the predicted concentrations and will not have affected the conclusions of the assessment. This is because electric vehicle flows are extremely low in comparison to those of other vehicles.

A5.6 Figure A5.1 shows the road network included within the model and Figure A5.2 shows the road speeds used.

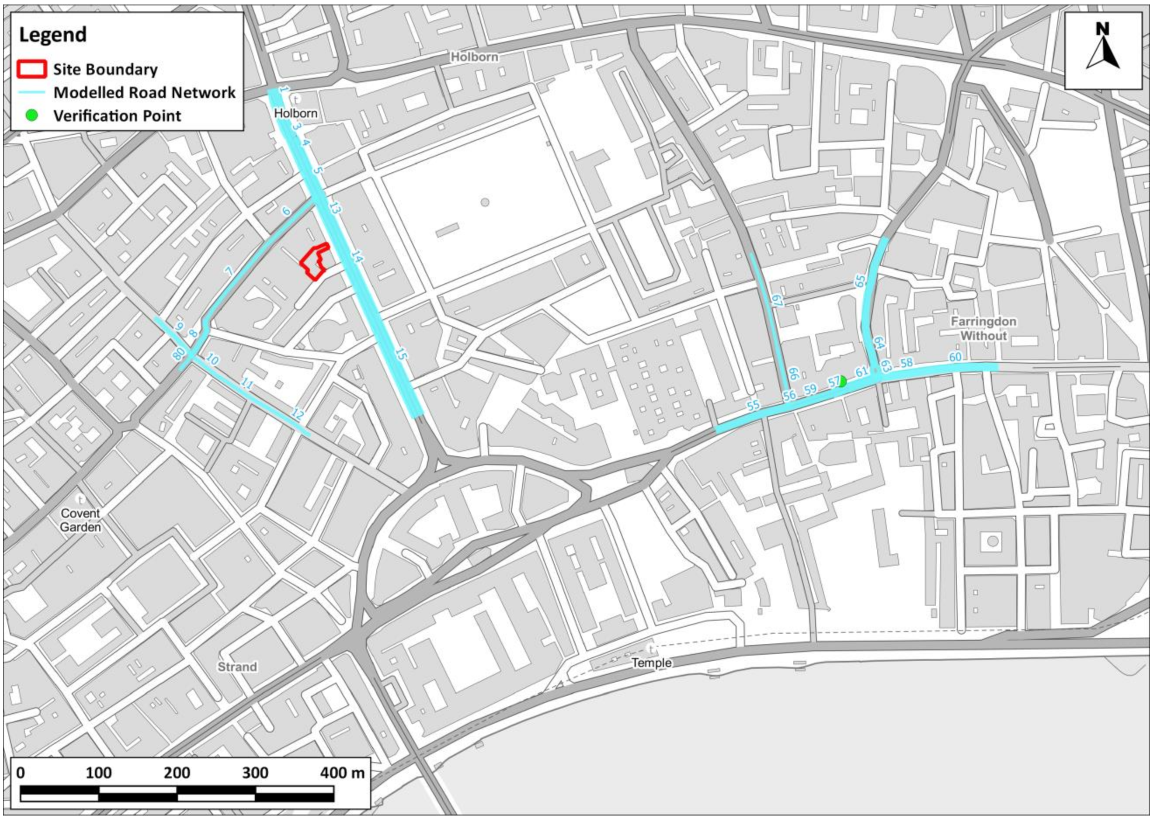

Figure A5.1: Modelled Road Network

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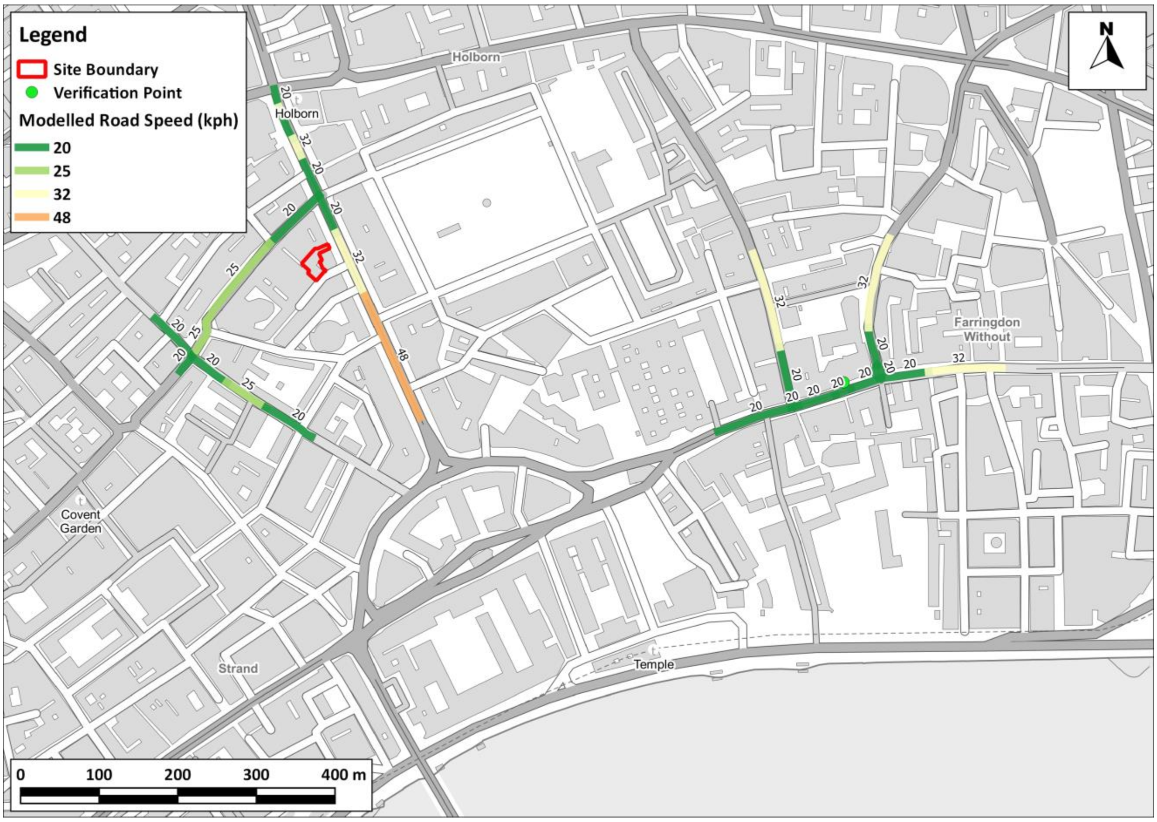

Figure A5.2: Modelled Road Speed (kph)

Sensitivity Test for Nitrogen Oxides and Nitrogen Dioxide

A5.7 As explained in Section 3, AQC has carried out a detailed analysis which showed that, where previous standards had limited on-road success in reducing nitrogen oxides emissions from diesel vehicles, the 'Euro VI' and 'Euro 6' standards are delivering real on-road improvements (AQC, 2016b). Furthermore, these improvements are expected to increase as the Euro 6 standard is fully implemented. Despite this, the detailed analysis suggested that, in addition to modelling using the EFT (V7.0), a sensitivity test using elevated nitrogen oxides emissions from certain diesel vehicles should be carried out (AQC, 2016b). A worst-case sensitivity test has thus been carried out by applying the adjustments set out in Table A5.2 to the emission factors used within the EFT[5], using AQC's CURED (V2A) tool (AQC, 2016a). The justifications for these adjustments are given in AQC (2016b). Results are thus presented for two scenarios: first the 'official prediction', which uses the EFT with no adjustment, and second the 'worst-case sensitivity test', which applies the

[5] All adjustments were applied to the COPERT functions. Fleet compositions etc. were applied following the same methodology as used within the EFT.

adjustments set out in Table A5.2. The results from this sensitivity test are likely to over-predict emissions from vehicles in the future and thus provide a reasonable worst-case upper-bound to the assessment.

Table A5.2: Summary of Adjustments Made to Defra's EFT (V7.0)

Vehicle Type		Adjustment Applied to Emission Factors
All Petrol Vehicles		No adjustment
Light Duty Diesel Vehicles	Euro 5 and earlier	No adjustment
	Euro 6	Increased by 78%
Heavy Duty Diesel Vehicles	Euro III and earlier	No adjustment
	Euro IV and V	Set to equal Euro III values
	Euro VI	Set to equal 20% of Euro III emissions [a]

[a] Taking account of the speed-emission curves for different Euro classes as explained in AQC (2016b).

Point Sources

A5.8 The impacts of emissions from the proposed combustion plant 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 proposed combustion plant emissions to annual mean concentrations of nitrogen oxides and the 99.79th percentile of 1-hour mean nitrogen oxides concentrations.

A5.9 The two gas-fired CHP plant that will be installed into the development will have an assumed net fuel input of 115 kW_{th} and combine will deliver 70 kW_{el} and 124 kW_{th} in output. The CHP plant emission rate modelled in this report are 125 mg/Nm^3, which is a worst case scenario based on data provided by the project energy consultant. The CHP plant installed however must conform to the Sustainable Design and Construction SPG (GLA, 2014a) requiring emissions to be <95 mg/Nm^3 [6]. Emissions will rise to roof level in a dedicated flue. A fan assisted flue may be required to aid this. It has been assumed the CHP unit will operate for 100% of the year, with the modelling assuming that it is at full load when operational. The exhaust volume flow rate for the natural gas-fired plant has been calculated based on the complete combustion of the assumed natural gas composition in Table A5.3 and the following typical values for CHP units of this size:

- 100% load;
- 120 ˚C exit temperature;
- 0% excess air in (set so that the calculated exhaust gas mass flow matched that on the technical datasheet for the plant); and

[6] Maximum NOx emission rate permitted within the Sustainable Design and Construction SPG (GLA, 2014a).

- Condensing plant removing 50% of the water from the exhaust.

Table A5.3: Typical Gas Fuel Composition

Component	Natural Gas
Methane	90.76%
Ethane	4.64%
Propane	1.22%
Carbon Monoxide	-
Hydrogen	-
Carbon Dioxide	1.07%
Nitrogen	2.32%
Net Calorific Value (LHV) (MJ/kg)	46.5
Gross Calorific Value (HHV) (MJ/kg)	51.5
HHV/LHV	1.11
Molecular Mass (g/mol)	17.61

A5.10 The gas-fired boiler plant that will be installed into the development will have an assumed net fuel input of 714 kW_{th} delivering 47 kW_{th} output. The boiler plant will conform to the Sustainable Design and Construction SPG (GLA, 2014a) requiring emissions to be <40 mg/kWh[7]. Emissions will rise to roof level in two flues. A fan assisted flue may be required to aid this. It is assumed the boiler plant will operate for 100% of the year (100% of the maximum annual load), with the modelling assuming that it is at full load when operational. The exhaust volume flow rate for the natural-gas plant has been calculated based on the complete combustion of the assumed natural gas composition in Table A5.3 and the following typical values for boilers of this size:

- 100% load;
- 60 ˚C exit temperature;
- 31% excess air in (set so that the calculated exhaust gas mass flow matched that on the technical datasheet for the plant); and
- Condensing plant removing 50% of the water from the exhaust.

A5.11 The emissions from the CHP and boiler have been combined in the model into a single flue; the emissions parameters employed in the modelling are set out in Table A5.4. Further details of the energy plant parameters are provided in Appendix A8.

7 Maximum NOx emission rate permitted within the Sustainable Design and Construction SPG (GLA, 2014a).

Table A5.4: Plant Specifications and Modelled Emissions and Release Conditions

Parameter	Value
CHP (2 x ENER-G E35M)	
Flue Internal Diameter (m) [a]	0.1
Calculated Actual Exhaust Volume Flow (m^3/s) [b]	0.049
Calculated Exit Velocity (m/s)	10
Calculated NOx Emission Rate (g/s)	0.00345
Specified Exhaust Temperature (°C)	120
Gas Boiler (EVOMOD 750 kW Boiler)	
Specified Flue Internal Diameter (m)	0.25
Calculated Actual Exhaust Volume Flow (m^3/s) [c]	0.049
Calculated Exit Velocity (m/s)	10
Calculated Gross Fuel Input (kW)	127.4
Calculated NOx Emission Rate (g/s)	0.00879
Specified Exhaust Temperature (°C)	80
Combined Flue Emissions	
Exit Velocity (m/s)	6.86
Flue Internal Diameter (m)	0.27
Actual Exhaust Volume Flow (m^3/s) [d]	0.40417
NOx Emission Rate (g/s)	0.016773
Exhaust Temperature (°C)	72.8
Flue Location (x,y)	530560.22,181293.55
Modelled Flue Height (m)	1

[a] This is the internal flue diameter required to achieve an efflux velocity of 10 m/s, as required by the GLA's Sustainable Design and Construction SPG (GLA, 2014a).

[b] Not normalised.

[c] 'Normal' here refers to 5% O_2, 120˚C, 101.325 kPa and 0% H_2O. This emission rate equates to 328.6 mg/Nm^3 at 0% O_2.

[d] 'Normal' here refers to 0% O_2, 72˚C, 101.325 kPa and 0% H_2O.

A5.12 Entrainment of the plume into the wake of the buildings (the so-called building downwash effect) has been taken into account in the model. The building dimensions and flue location have been obtained from drawings provided by Harper Downie Architects. The location of the flue is shown in Figure A5.3 along with the modelled buildings and their heights. Six buildings were included in the model at varying heights shown in Figure A5.3. The flue has been modelled at a height of 30.81 m

(1 m above the roof level). Three buildings to the north and two buildings to the south are taller than the modelled flue height at 31.96 m.

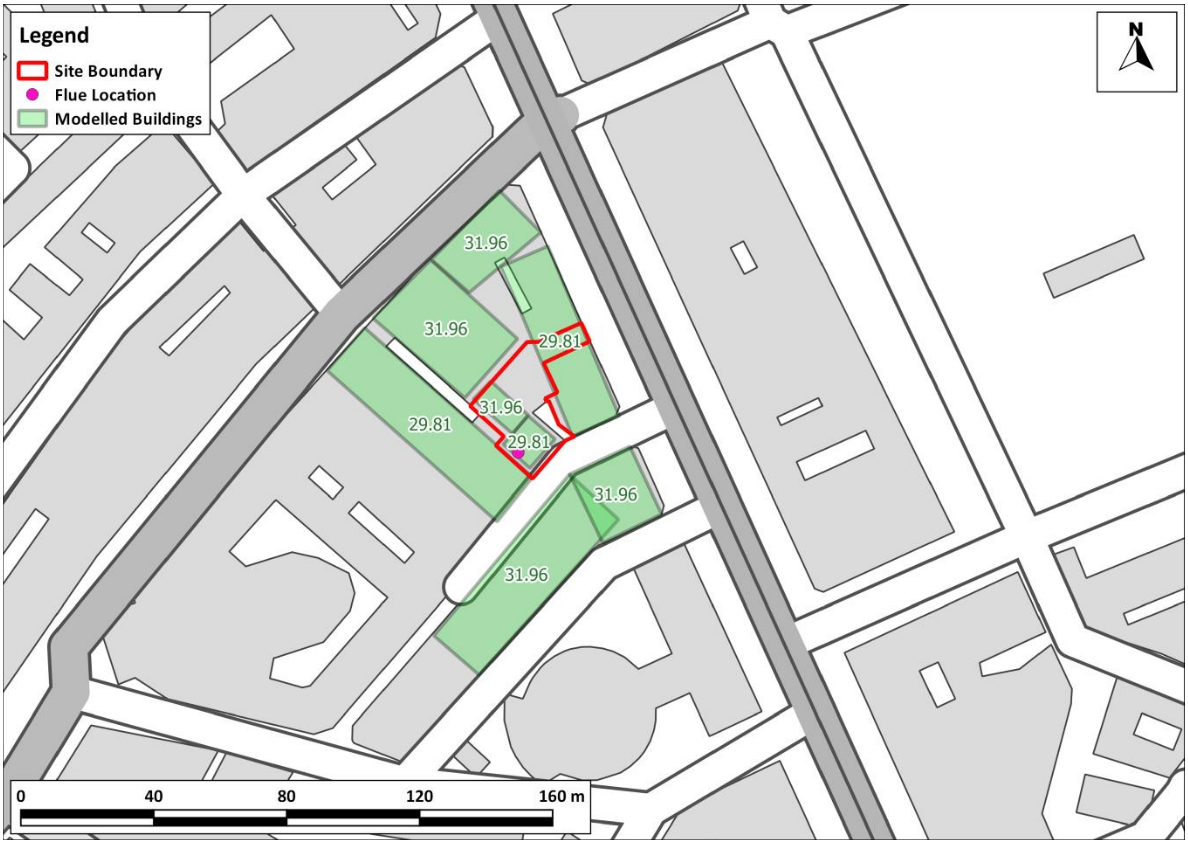

Figure A5.3: Flue Location & Modelled Buildings

A5.13 Hourly sequential meteorological data from London City Airport for 2016 have been used in the model, as for the roads modelling.

Modelling Assumptions

A5.14 The following assumptions have been made:

- The CHP units will operate for 100% of the year;
- The Boiler units will operate for 100% of the year; and
- The CHP units are at full load while operating.

Background Concentrations

A5.15 The background pollutant concentrations across the study area have been defined using the national pollution maps published by Defra (2017a). These cover the whole country on a 1x1 km grid and are published for each year from 2013 until 2030. The background maps for 2016 have been calibrated against concurrent measurements from national monitoring sites. The calibration factor calculated has also been applied to future year backgrounds. This has resulted in slightly higher predicted concentrations for the future assessment year than that derived from the Defra maps (AQC, 2016c).

Background NO_2 Concentrations for Sensitivity Test

A5.16 The road-traffic components of nitrogen dioxide in the background maps have been uplifted in order to derive future year background nitrogen dioxide concentrations for use in the sensitivity test. Details of the approach are provided in the report prepared by AQC (2016c).

Model Verification

A5.17 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, because ADMS-5 does not rely on estimated road-vehicle emission factors, the adjustment used for ADMS-Roads cannot be applied to ADMS-5. Predictions made using ADMS-5 have thus not been verified.

A5.18 The background concentration of nitrogen dioxide for the verification site has been taken from the national maps of background concentrations available from the Defra LAQM Support website (Defra, 2017a). The background concentration for the verification sites is presented in Table A5.5.

Table A5.5: Background Concentrations used in the Verification for 2016

Year	NO_2	PM_{10}	$PM_{2.5}$
2016	53.6	22.5	16.1
2018 [a]	49.8	21.9	15.6
2018 Worst-case Sensitivity Test [b]	*51.3*	*N/A*	*N/A*
Objectives	**40**	**40**	**25** [c]

N/A = not applicable.

[a] In line with Defra's forecasts.

[b] Assuming higher emissions from modern diesel vehicles as described in Appendix A5.

[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.

Nitrogen Dioxide

A5.19 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 2016 at the St Dunstan's Church, Fleet Street, diffusion tube monitoring site. Concentrations have been modelled at 1.5 m, the height of the monitor.

A5.20 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 concentration and the predicted background NO_2 concentration using the NOx from NO_2 calculator (Version 5.1) available on the Defra LAQM Support website (Defra, 2017a).

A5.21 An adjustment factor has been determined as the ratio of the 'measured' road contribution and the model derived road contribution. This factor has then been applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations. 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 (Defra, 2017a).

A5.22 The data used to calculate the adjustment factor are provided below:

- Measured NO_2 : 81 µg/m^3
- Background NO_2 : 53.6 µg/m^3
- 'Measured' road-NOx (using NOx from NO_2 calculator): 78.6 µg/m^3
- Modelled road-NOx = 39.7 µg/m^3
- Road-NOx adjustment factor: 78.6/39.7 = 2.6417[8]

A5.23 The factor implies that the unadjusted model is under-predicting the road-NOx contribution. This is a common experience with this and most other road traffic emissions dispersion models.

Model Verification for NOx and NO_2 Sensitivity Test

A5.24 The approach set out above has been repeated using the predicted road-NOx and background concentrations specific to the sensitivity test. This has resulted in an adjustment factor of 2.1638, which has been applied to all modelled road-NOx concentrations within the sensitivity test.

8 Based on un-rounded values.

PM_{10} and $PM_{2.5}$

A5.25 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

A5.26 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, 2017a). 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.

Point Sources

A5.27 Emissions from the combustion plant will be predominantly in the form of nitrogen oxides (NOx) and PM_{10}. ADMS-5 has been run to predict the contribution of the proposed Energy Centre emissions to annual mean concentrations of nitrogen oxides, and to the 99.79^{th} percentile of 1-hour mean nitrogen oxides concentrations. For the initial screening of the process contributions, the approach recommended by the Environment Agency (Environment Agency, 2005) has been used to predict nitrogen dioxide concentrations, assuming that:

- annual mean NO_2 concentration = annual mean NOx concentration multiplied by 0.7; and
- 99.79^{th} percentile of 1-hour mean NO_2 concentrations = 99.79^{th} percentile of 1-hour mean NOx concentrations multiplied by 0.35.

A6 'Air Quality Neutral'

A6.1 The GLA's SPG on Sustainable Design and Construction (GLA, 2014a), and its accompanying Air Quality Neutral methodology report (AQC, 2014), provide an approach to assessing whether a development is air quality neutral. The approach is to compare the expected emissions from the building energy use and the car use associated with the proposed development against defined emissions benchmarks for buildings and transport in London.

A6.2 The benchmarks for heating and energy plant (termed 'Building Emissions Benchmarks' or 'BEBs') are set out in Table A6.1, while the 'Transport Emissions Benchmarks' ('TEBs') are set out in Table A6.2. In order to assess against the TEBs, it is necessary to combine the expected trip generation from the development with estimates of average trip length and average emission per vehicle. So as to ensure a consistent methodology, the report which accompanies the SPG (AQC, 2014) recommends that the information in Table A6.3 and Table A6.4 (upon which the TEBs are based) is used. Similarly, the information in Table A6.5 may be used if site-specific information are not available (AQC, 2014). For use classes other than A1, B1 and B3, trip lengths and average emissions per vehicle are not provided, thus the trip rates in Table A6.6 alone may be used to consider the air quality neutrality of a development. These have been derived from the Trip Rate Assessment Valid for London (TRAVL) database.

Table A6.1: Building Emissions Benchmarks (g/m^2 of Gross Internal Floor Area)

Land Use Class	NOx	PM_{10}
Class A1	22.6	1.29
Class A3 - A5	75.2	4.32
Class A2 and Class B1	30.8	1.77
Class B2 - B7	36.6	2.95
Class B8	23.6	1.90
Class C1	70.9	4.07
Class C2	68.5	5.97
Class C3	26.2	2.28
D1 (a)	43.0	2.47
D1 (b)	75.0	4.30
Class D1 (c -h)	31.0	1.78
Class D2 (a-d)	90.3	5.18
Class D2 (e)	284	16.3

Table A6.2: Transport Emissions Benchmarks

Land use	CAZ [a]	Inner [b]	Outer [b]
NOx (g/m^2/annum)			
Retail (A1)	169	219	249
Office (B1)	1.27	11.4	68.5
NOx (g/dwelling/annum)			
Residential (C3)	234	558	1553
PM_{10} (g/m^2/annum)			
Retail (A1)	29.3	39.3	42.9
Office (B1)	0.22	2.05	11.8
PM_{10} (g/dwelling/annum)			
Residential (C3,C4)	40.7	100	267

[a] Central Activity Zone.

[b] Inner London and Outer London as defined in the LAEI (GLA, 2016b).

Table A6.3: Average Distance Travelled by Car per Trip

Land use	Distance (km)		
	CAZ	Inner	Outer
Retail (A1)	9.3	5.9	5.4
Office (B1)	3.0	7.7	10.8
Residential (C3)	4.3	3.7	11.4

Table A6.4: Average Road Traffic Emission Factors in London in 2010

Pollutant	g/vehicle-km		
	CAZ	Inner	Outer
NOx	0.4224	0.370	0.353
PM_{10}	0.0733	0.0665	0.0606

Table A6.5: Average Emissions from Heating and Cooling Plant in Buildings in London in 2010

	Gas (kg/kWh)		Oil (kg/kWh)	
	NOx	PM_{10}	NOx	PM_{10}
Domestic	0.0000785	0.00000181	0.000369	0.000080
Industrial/Commercial	0.000194	0.00000314	0.000369	0.000080

Table A6.6: Average Number of Light Vehicle Trips per Annum for Different Development Categories

Land use	Number of Trips (trips/m^2/annum)		
	CAZ	Inner	Outer
A1	43	100	131
A3	153	137	170
A4	2.0	8.0	-
A5	-	32.4	590
B1	1	4	18
B2	-	15.6	18.3
B8	-	5.5	6.5
C1	1.9	5.0	6.9
C2	-	3.8	19.5
D1	0.07	65.1	46.1
D2	5.0	22.5	49.0
Number of Trips (trips/dwelling/annum)			
C3	129	407	386

A7 Construction Mitigation

A7.1 The following is a set of measures that should be incorporated into the specification for the works:

Site Management

- Develop and implement a stakeholder communications plan that includes community engagement before work commences on site;
- develop a Dust Management Plan (DMP);
- display the name and contact details of person(s) accountable for air quality pollutant emissions and dust issues on the site boundary;
- display the head or regional office contact information;
- record and respond to all dust and air quality pollutant emissions complaints;
- make a complaints log available to the local authority when asked;
- carry out regular site inspections to monitor compliance with air quality and dust control procedures, record inspection results, and make an inspection log available to the Local Authority when asked;
- increase the frequency of site inspections by those accountable for dust and air quality pollutant emissions issues when activities with a high potential to produce dust and emissions are being carried out and during prolonged dry or windy conditions; and
- record any exceptional incidents that cause dust and air quality pollutant emissions, either on or off the site, and ensure that the action taken to resolve the situation is recorded in the log book.

Preparing and Maintaining the Site

- Plan the site layout so that machinery and dust-causing activities are located away from receptors, as far as is possible;
- erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site;
- fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period;
- avoid site runoff of water or mud;
- keep site fencing, barriers and scaffolding clean using wet methods;

- remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below;
- cover, or fence stockpiles to prevent wind whipping; and
- carry out regular dust soiling checks of buildings within 100 m of site boundary and provide cleaning if necessary.

Operating Vehicle/Machinery and Sustainable Travel

- Ensure all on-road vehicles comply with the requirements of the London Low Emission Zone;
- ensure all Non-road Mobile Machinery (NRMM) comply with the standards set within the GLA's Control of Dust and Emissions During Construction and Demolition SPG. This outlines that, from 1st September 2015, all NRMM of net power 37 kW to 560 kW used on the site of a major development in Greater London must meet Stage IIIA of EU Directive 97/68/EC (Directive 97/68/EC of the European Parliament and of the Council, 1997) and its subsequent amendments as a minimum. NRMM used on any site within the Central Activity Zone or Canary Wharf will be required to meet Stage IIIB of the Directive as a minimum. From 1st September 2020 NRMM used on any site within Greater London will be required to meet Stage IIIB of the Directive as a minimum, while NRMM used on any site within the Central Activity Zone or Canary Wharf will be required to meet Stage IV of the Directive as a minimum;
- ensure all vehicles switch off engines when stationary – no idling vehicles;
- avoid the use of diesel- or petrol-powered generators and use mains electricity or battery-powered equipment where practicable;
- produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials; and
- implement a Travel Plan that supports and encourages sustainable staff travel (public transport, cycling, walking, and car-sharing).

Operations

- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems;
- ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using recycled water where possible and appropriate;
- use enclosed chutes, conveyors and covered skips;

- minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate; and
- ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.

Waste Management

- Reuse and recycle waste to reduce dust from waste materials; and
- avoid bonfires and burning of waste materials.

Measures Specific to Demolition

- Ensure water suppression is used during demolition operations; and
- bag and remove any biological debris or damp down such material before demolition.

Measures Specific to Construction

- Avoid scabbling (roughening of concrete surfaces), if possible;
- ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place;
- ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery; and
- for smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust.

Measures Specific to Trackout

- Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.

A8 Energy Plant Specifications

A8.1 The proposed development will be provided with heat, hot water and some electricity using a two identical natural gas-fired CHP units and an additional condensing natural gas-fired boiler to be located centrally in a ground floor plant room. Specifications for these plant are shown in Table A8.1 and the restrictions set out must be adhered to in order for the air quality assessment results to remain valid.

Table A8.1: Energy Plant Specifications

Parameter	Value	Restriction
CHP		
Gross Peak Fuel Input (kW)	115	Max
Hours of Use per Annum	8760	Max
Annual Fuel Input (kWh/annum)	547,500	Max
Exhaust Temperature (°C)	120	Min
Flue Internal Diameter (m)	0.079	Max
Efflux Velocity (m/s)	6.9	Min
NOx Emission Rate (mg/Nm^3) [a]	125.0	Max
Boiler		
Gross Peak Fuel Input (kW)	714	Max
Hours of Use per Annum	8760	Max
Annual Fuel Input (kWh/annum)	836,334	Max
Exhaust Temperature (°C)	60	Min
Flue Internal Diameter (m)	0.250	Max
Efflux Velocity (m/s)	6.2	Min
NOx Emission Rate (mg/kWh)	40	Max
Condensing	Yes	-

[a] 'Normal' here refers to 5% O_2, 0˚C, 101.325 kPa and 0% H_2O.

A8.2 In order to ensure that the final plant design does not lead to impacts greater than those modelled, it must adhere to the following minimum specifications:

- the CHP must be designed such that it will operate with a minimum efflux velocity of 10 m/s to allow for good initial dispersion of emissions;

- a boiler system to be comprised of units totalling a maximum of 714 kW fuel input must share a common flue outlet with a maximum internal diameter of 0.27 m at the exit point, terminating at least 1 m above the roof level;
- all stacks should discharge vertically upwards and be unimpeded by any fixture on top of the stack (e.g., rain cowls or 'Chinaman's Hats');
- the system must be designed to conform to the requirements of the GLA's guidance on sustainable design and construction (GLA, 2014a). The gas boilers must conform to a maximum NOx emission of <40 mg/kWh, while the spark ignition CHP must have a maximum NOx emission of 95 mg/Nm^3 (normalised conditions[9]), as the scheme is in a Band B area. The SPG makes clear that the emission standards are 'end-of-pipe' concentrations expressed at specific reference conditions for temperature, pressure, oxygen and moisture content. Compliance with these standards will be confirmed prior to occupation, based on:
  - monitoring undertaken on the actual installed plant; or
  - manufacturer guaranteed performance levels supported by type approval monitoring undertaken by the equipment supplier.
- in order to attain these values, relevant catalyst or alternative abatement will be required.

A8.3 If the design of the energy centre deviates significantly from the modelled specification, additional future modelling may be required in order to ensure that there are no significant adverse air quality impacts.

A8.4 The GLA's Sustainable Design and Construction SPG (GLA, 2014a) also states that the measures set out in Technical Guidance Note D1 (Dispersion) (HMSO, 1993b) should also be adhered to in order to ensure adequate dispersion of emissions from discharging stacks and vents. These include the following:

- Discharges should be vertically upwards and unimpeded by cowls or any other fixtures on top of the stack. However, the use of coning or of flame traps at the tops of stacks is acceptable. In the case of discharge stacks (whether single or multiple stack) with shrouds or casings around the stack(s), the stack(s) alone should extend above the shroud or casing. This extension should be at least 50% of the shroud or casing's greatest lateral dimension;
- Irrespective of the pollutant discharge, there are minimum discharge stack heights based on the heat release and the discharge momentum. These can be calculated following calculations set out in the guidance note, but the absolute minimum value is 1 m;

9 At 273K, 101.3kPa, 5% O2, dry gas, as specified in the Sustainable Design and Construction SPG for band B developments.

- No discharge stack should be less than 3 m above the ground or any adjacent area to which there is general access. For example, roof areas and elevated walkways;
- A discharge stack should never be less than the height of any building within a distance of 5 times the stack height; and
- A discharge stack should be at least 3 m above any opening windows or ventilation air inlets within a distance of 5 times the stack height.

A9 Point Source Modelling Results

Table A9.1: Modelled NO_2 Combustion Plant Process Contributions

Receptor	Description	Height (m)	Annual Mean NO_2 ($\mu g/m^3$)	99.79th %ile of 1-hour NO_2
On-site Receptors[a]				
1	Site Entrance Street Level	1.50	0.13	0.48
2	Wild Court Window Street Level	1.50	0.13	0.48
3	Wild Court Window Street Level	1.50	0.13	0.48
4	Wild Court Window Street Level	1.50	0.13	0.48
5	Wild Court Window Street Level	1.50	0.13	0.48
6a	Wild Court Facade South G Floor	1.50	0.48	0.76
6b	Wild Court Facade South 2nd Floor	10.46	0.48	0.76
6c	Wild Court Facade South 4th Floor	16.97	0.48	0.76
6d	Wild Court Facade South 6th Floor	23.18	0.48	0.76
7a	Wild Court Facade South G Floor	1.50	0.49	0.76
7b	Wild Court Facade South 2nd Floor	10.46	0.49	0.76
7c	Wild Court Facade South 4th Floor	16.97	0.49	0.76
7d	Wild Court Facade South 6th Floor	23.18	0.49	0.76
8a	Wild Court Facade North G Floor	1.50	0.61	0.78
8b	Wild Court Facade North 2nd Floor	10.46	0.61	0.78
8c	Wild Court Facade North 4th Floor	16.97	0.61	0.78
8d	Wild Court Facade North 6th Floor	23.18	0.61	0.78
13	8th Floor Bedroom	29.81	0.65	0.79
14	8th Floor Bedroom	29.81	0.65	0.79
15	8th Floor Bedroom	29.81	0.65	0.79
16	8th Floor Bedroom	29.81	0.65	0.79
17	7th Floor Bedroom	26.47	0.64	0.79
18	7th Floor Bedroom	26.47	0.64	0.79
19	7th Floor Bedroom	26.47	0.62	0.78
20	7th Floor Bedroom	26.47	0.65	0.79
21a	2nd Floor Bedroom	10.46	0.62	0.78
21b	4th Floor Bedroom	16.97	0.62	0.78
22a	2nd Floor Corridor	10.46	0.61	0.78
22b	4th Floor Corridor	16.97	0.61	0.78
23a	2nd Floor Bedroom	10.46	0.65	0.79
23b	4th Floor Bedroom	16.97	0.65	0.79
24a	2nd Floor Bedroom	10.46	0.65	0.79

Receptor	Description	Height (m)	Annual Mean NO_2 (µg/m^3)	99.79th %ile of 1-hour NO_2
On-site Receptors[a]				
24b	4th Floor Bedroom	16.97	0.65	0.79
25	GF Bedroom G	1.50	0.62	0.78
26	GF Bedroom G	1.50	0.62	0.78
27	GF Bedroom G	1.50	0.61	0.78
28	GF Bedroom G	1.50	0.65	0.79
Off-site Receptors				
9a	Adjacent Hotel North G Floor	1.50	0.65	0.79
9b	Adjacent Hotel North 2nd Floor	10.46	0.65	0.79
9c	Adjacent Hotel North 4th Floor	16.97	0.65	0.79
9d	Adjacent Hotel North 6th Floor	23.18	0.65	0.79
9e	Adjacent Hotel North 8th Floor	29.81	0.65	0.79
10a	Office & Hotel Courtyard G Floor	1.50	0.48	0.72
10b	Office & Hotel Courtyard 2nd Floor	10.46	0.48	0.72
10c	Office & Hotel Courtyard 4th Floor	16.97	0.48	0.72
10d	Office & Hotel Courtyard 6th Floor	23.18	0.48	0.72
10e	Office & Hotel Courtyard North 8th Floor	29.81	0.38	0.69
11a	Offices North East of Flue G Floor	1.50	0.62	0.78
11b	Offices North East of Flue 2nd Floor	10.46	0.62	0.78
11c	Offices North East of Flue 4th Floor	16.97	0.62	0.78
11d	Offices North East of Flue 6th Floor	23.18	0.62	0.78
12a	Hotel Alleyway Façade G Floor	1.50	0.65	0.79
12b	Hotel Alleyway Façade 2nd Floor	10.46	0.65	0.79
12c	Hotel Alleyway Façade 4th Floor	16.97	0.65	0.79
12d	Hotel Alleyway Façade 6th Floor	23.18	0.65	0.79
12e	Hotel Alleyway Façade 8th Floor	29.81	0.65	0.79
29	College on Wild Court South Floor 7	26.47	0.25	1.43
30a	Office Tower One Kemble St Floor 10	31.5	0.24	3.52
30b	Office Tower One Kemble St Floor 11	34.50	0.26	4.53
30c	Office Tower One Kemble St Floor 12	37.50	0.24	4.82
30d	Office Tower One Kemble St Floor 13	40.50	0.18	3.85
30e	Office Tower One Kemble St Floor 14	43.50	0.12	2.36
30f	Office Tower One Kemble St Floor 15	46.50	0.07	1.17

a On-site receptors are at worst case locations on the hotel facade