Air Quality Assessment:
17 Branch Hill, Camden

April 2017

Experts in air quality
management & assessment

Document Control

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Executive Summary

The air quality impacts associated with the CHP and boilers at the residential development at 17 Branch Hill have been assessed. The assessment has been prepared to address the requirement of an air quality assessment contained in a Section 106 Agreement applied to the planning permission.

Emissions from the proposed CHP and Boiler Plant will lead to an increase in nitrogen dioxide concentrations at nearby existing properties, and specifically at properties on Branch Hill, immediately to the east. The assessment has demonstrated that increases in 1-hour and annual mean concentrations of nitrogen dioxide at these existing properties will result in *negligible* impacts.

Air quality conditions for new residents within the development have also been considered. Pollutant concentrations are predicted to be well below the air quality objectives, thus air quality conditions for new residents will be acceptable.

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1 Introduction

1.1 This report describes the potential air quality impacts associated with the emissions from the Combined Heat and Power (CHP) and boiler plant proposed for the new residential development on Branch Hill in Camden. The assessment has been carried out by Air Quality Consultants Ltd on behalf of SHH Architects Interior Designers. It has been prepared to discharge a condition in the Section 106 Agreement applied to the planning permission.

1.2 The development site lies within an Air Quality Management Area (AQMA) declared by the London Borough of Camden for exceedances of the annual mean nitrogen dioxide and 24-hour mean PM_{10} objectives. Emissions from the proposed CHP and boiler plant could impact upon air quality at existing residential properties, as well as at the new residential property itself. The main air pollutant of concern related to CHP and boiler plant is nitrogen dioxide.

1.3 This report describes existing local air quality conditions (base year 2015), and the predicted impacts that emissions from the proposed CHP and Boilers will have on local air quality. It has been prepared taking into account all relevant local and national guidance and regulations.

2 Policy Context and Assessment Criteria

Air Quality Strategy

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

Clean Air Act 1993 & Environmental Protection Act

2.2 Small combustion plant of less than 20 MW net rated thermal input are controlled under the Clean Air Act 1993 (HMSO, 1993a). This requires the local authority to approve the chimney height. Plant which are smaller than 366 kW have no such requirement. The local authority's approval will, therefore, not be required for the plant to be installed in this property.

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

Planning Policy

National Policies

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

2.5 More specifically the NPPF makes clear that:

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

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

2.7 The PPG states that:

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

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

The London Plan

2.9 The London Plan (GLA, 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.

2.10 Policy 7.14, 'Improving Air Quality', addresses the spatial implications of the Mayor's Air Quality Strategy and how development and land use can help achieve its objectives. It recognises that Boroughs should have policies in place to reduce pollutant concentrations, having regard to the Mayor's Air Quality Strategy.

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

The Mayor's Air Quality Strategy

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

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

GLA SPG: Sustainable Design and Construction

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

Air Quality Focus Areas

2.15 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 development is not located close to any air quality focus areas.

Local Policies

2.16 The Camden Core Strategy (London Borough of Camden, 2010a) 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 level."*

2.17 A Submission Draft Local Plan (London Borough of Camden, 2016a) 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. 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.[…]"

2.18 With regards to boilers and CHP, 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."*

2.19 In addition the Council has a set of Development Policies (DP) (London Borough of Camden, 2010b), 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 […]"

2.20 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

2.21 Defra has produced Air Quality Plans to reduce nitrogen dioxide concentrations in major cities throughout the UK (Defra, 2015), although these are to be replaced with new plans by 31st July 2017 following a High Court ruling in November 2016 (Royal Courts of Justice, 2016). Along with a suite of national measures, the original Air Quality Plans identify the need to establish Clean Air

Zones within five Zones (Birmingham, Leeds, Southampton, Nottingham and Derby) where exceedances of the EU limit values for nitrogen dioxide have been forecast in 2020 and beyond. Within these Zones, lower-emission vehicles will be encouraged. The precise nature of these Clean Air Zones is still to be decided. In Greater London, Defra will continue to support and monitor the delivery of the Mayor's plans for improving air quality to meet the EU limit value for nitrogen dioxide by 2025. The study area is located within the Greater London Zone.

Local Air Quality Action Plan

2.22 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, 2016b). 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, while Action 17 looks at *"ensuring the enforcement of CHP and biomass air quality policies".*

Assessment Criteria

2.23 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).

2.24 The objectives for nitrogen dioxide were to have been achieved by 2005 and continue to apply in all future years thereafter.

2.25 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 objective for nitrogen dioxide is considered to apply at the façades of residential properties, schools, hospitals etc.; it does not apply at hotels. The 1-hour mean objective for nitrogen dioxide applies wherever members of the public might regularly spend 1-hour or more, including outdoor eating locations and pavements of busy shopping streets.

2.26 The European Union has also set limit values for nitrogen dioxide. These 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.

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

Table 1: Air Quality Criteria for Nitrogen Dioxide

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

Screening Criteria for Point Source Assessments

2.28 The approach developed jointly by Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM)[1] (Moorcroft and Barrowcliffe et al, 2017), as described in Appendix A2, is that any change in concentration smaller than 0.5% of the long-term environmental standard will be *negligible*, regardless of the existing air quality conditions. Any change smaller than 1.5% of the long-term environmental standard will be *negligible* so long as the total concentration is less than 94% of the standard and any change smaller than 5.5% of the long-term environmental standard will be *negligible* so long as the total concentration is less than 75% of the standard. The guidance also explains that:

"Where peak short term concentrations (those averaged over periods of an hour or less) from an elevated source are in the range 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".

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

2.29 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?

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

Descriptors for Air Quality Impacts and Assessment of Significance

2.31 There is no official guidance in the UK in relation to development control on how to describe air quality impacts, nor how to assess their significance. The approach developed jointly by Environmental Protection UK (EPUK) and the IAQM (Moorcroft and Barrowcliffe et al, 2017) has therefore been used. This includes defining descriptors of the impacts at individual receptors, which take account of the percentage change in concentrations relative to the relevant air quality objective, rounded to the nearest whole number, and the absolute concentration relative to the objective. The overall significance of the air quality impacts is determined using professional judgement, taking account of the impact descriptors. Full details of the EPUK/IAQM approach are provided in Appendix A2. The approach includes elements of professional judgement, and the experience of the consultants preparing the report is set out in Appendix A3.

3 Assessment Approach

Existing Conditions

3.1 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.

Impacts of the Proposed CHP and Boiler Plant

3.2 It is proposed to install one SAV XRGI 9 CHP, and two Hoval Topgas 60 boilers, at the property. Further details of the plant to be installed are provided in Appendix A4.

Sensitive Locations

3.3 Concentrations have been modelled across a Cartesian grid of receptors covering both the new property and existing nearby properties (extending to 500 m to the north, east, south and west from the flues of the proposed plant). Four heights were modelled (1.5, 4.5, 7.5 and 10.5 m above ground level), corresponding to ground, first, second and third floor levels.

Modelling Methodology

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

Emissions Data

3.5 The emissions data input into the model for the CHP and boiler plant have been provided by Inspire Consulting, who are the mechanical and engineering consultants for the development. Further details of the emissions data used in this assessment are provided in Appendix A4.

Uncertainty

3.6 The point source dispersion model used in the assessment is dependent upon emission rates, flow rates, exhaust temperatures and other parameters for each source, all of which in reality are variable as the plant will operate at different loads at different times. The assessment has,

however, addressed this by applying worst-case assumptions where necessary, and provided that the plant installed adheres to the restrictions set out in Appendix A5, the conclusions of this assessment will remain valid.

3.7 There are then additional uncertainties, as models are required to simplify real-world conditions into a series of algorithms. These uncertainties cannot be easily quantified and it is not possible to verify the point-source model outputs. Where parameters have been estimated the approach has been to use reasonable worst-case assumptions.

4 Site Description and Baseline Conditions

4.1 The new development is located at 17 Branch Hill. The site is bounded by other residential properties to the north, east and south, and by Firecrest Drive to the west.

Air Quality Review and Assessment

4.2 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. By definition, the new development is located within the AQMA.

Local Air Quality Monitoring

4.3 Camden operates three automatic monitoring stations within its area, one of which is located within 2 km of the new development site. The Council also operates a number of nitrogen dioxide monitoring sites using diffusion tubes. These include one deployed on Frognal Way (700 m to the south of the new development), one located at 47 Fitzjohn's road (1.2 km to the southeast) and one located at Emmanuel C of E Primary School (1.5 km to the southwest). Results for the years 2010 to 2015 are summarised in Table 2 and the monitoring locations are shown in Figure 1.

Table 2: Summary of Nitrogen Dioxide (NO_2) Monitoring (2010-2015) [a]

Site No.	Site Type	Location	2010	2011	2012	2013	2014	2015
Automatic Monitor - Annual Mean (µg/m^3) [a]								
CD1	Kerbside	Swiss Cottage	**82**	**71**	**70**	**63**	**66**	**61**
Objective			**40**					
Automatic Monitor - No. of Hours > 200 µg/m^3								
CD1	Kerbside	Swiss Cottage	**128**	**79**	**43**	**28**	13	11 [b]
Objective			**18**					
Diffusion Tubes - Annual Mean (µg/m^3) [d]								
CA7	Urban Background	Frognal Way	29.0	31.5	28.9	32.0	28.6	27.8
CA17	Roadside	47 Fitzjohn's Road	**73.0**	**58.4**	**61.2**	**65.2**	**60.3**	**55.8**
CA25	Roadside	Emmanuel Primary	No data	**41.5**	**45.9**	**57.9**	**48.4**	**47.7**
Objective			**40**					

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

[b] Data not available in latest Council's report (London Borough of Camden, 2016c), downloaded from Londonair website (King's College London, 2017)

4.4 Results show that annual mean nitrogen dioxide concentrations are above the objective at roadside locations, but below the objective at the background location. The hourly mean nitrogen dioxide objective was exceeded at the automatic monitor between 2010 and 2013, but not in 2014 and 2015.

4.5 Diffusion tube CA7 is the nearest to the new development. It is located away from busy roads, and classifies as an "urban background" site, and concentrations measured at this location are considered representative of the conditions likely to be experienced at and near the new development. Annual mean nitrogen dioxide concentrations are therefore anticipated to be currently well below the objective.

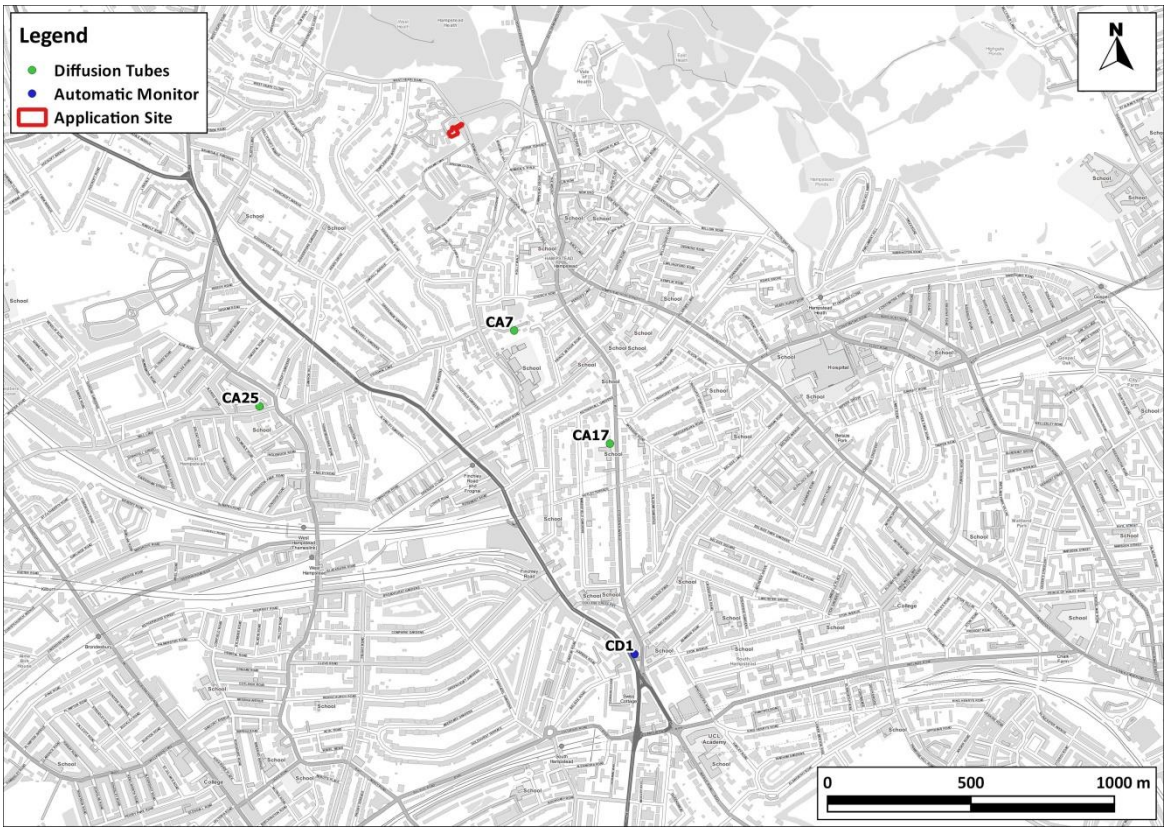

Figure 1: Monitoring Locations

Background Concentrations

4.6 In addition to these locally measured concentrations, an estimated annual mean background nitrogen dioxide concentration at the development site has been determined for 2015 using Defra's background maps (Defra, 2017a), this being 26.8 µg/m^3. This is well below the objective and corresponds well to the measured concentration at diffusion tube monitor CA7.

5 Impact Assessment

5.1 The new development will be provided with heat, hot water and electricity from a small, natural gas-fired CHP unit and condensing natural gas-fired boilers, to be located at lower ground floor level with exhaust flues sited at roof top level. The specifications for these plant are set out in Appendices A4 and A5.

5.2 Concentrations have been predicted for a gridded area covering both the new development and nearby properties, at a range of heights (1.5, 4.5, 7.5 and 10.5 m). These heights represent ground, first, second and third floor levels.

5.3 The worst-case assumption has been made that the CHP plant and boiler units will run continuously and at full (100%) load. This will have led to an over-prediction in modelled concentrations.

Initial Screening Assessment

5.4 The maximum process contributions to the annual mean and the 99.79th percentile of the 1-hour mean nitrogen dioxide concentrations anywhere within the Cartesian grid of receptors, at all considered heights, are presented in Table 3 below. It should be noted that these are maxima values, and do not necessarily represent relevant exposure.

Table 3: Maximum predicted process contributions to annual mean and 99.79th percentile of the 1-hour mean nitrogen dioxide concentrations (µg/m^3) [a]

Averaging Period	Grid Height (m above ground level)	Maximum Grid Area Process Contribution	
		µg/m^3	% of Objective
Annual Mean NO_2	**1.5**	**0.6**	**1.5**
99.79th %ile of 1-hour NO_2		1.1	0.5
Annual Mean NO_2	**4.5**	**0.6**	**1.5**
99.79th %ile of 1-hour NO_2		1.1	0.5
Annual Mean NO_2	**7.5**	**0.6**	**1.5**
99.79th %ile of 1-hour NO_2		1.7	0.8
Annual Mean NO_2	**10.5**	**4.4**	**11.0**
99.79th %ile of 1-hour NO_2		14.1	7.1

[a] Exceedances of the screening criterion are shown in bold.

5.5 The initial screening assessment shows that the predicted maximum process contributions to the annual mean nitrogen dioxide concentrations are above the screening criterion (0.5%) at all modelled heights, and thus require further assessment. The predicted maximum process contributions to the 99.79th percentile of 1-hour mean nitrogen dioxide concentrations are below

the screening criterion (10%) at all modelled heights. Emissions from the CHP and boiler will therefore have a negligible impact on the 1-hour mean nitrogen dioxide concentrations at all sensitive receptor locations, and a more detailed assessment is not necessary.

Detailed Assessment

5.6 A more detailed assessment has been carried out for consideration of impacts from the CHP and boiler plant emissions on annual mean concentrations of nitrogen dioxide. Contour plots of the process contributions to annual mean concentrations of nitrogen dioxide at ground, first, second and third floor levels have been produced in order to determine the impacts from the boiler and CHP emissions at relevant sensitive receptor locations. These contour plots are presented in Figure 2 to Figure 5.

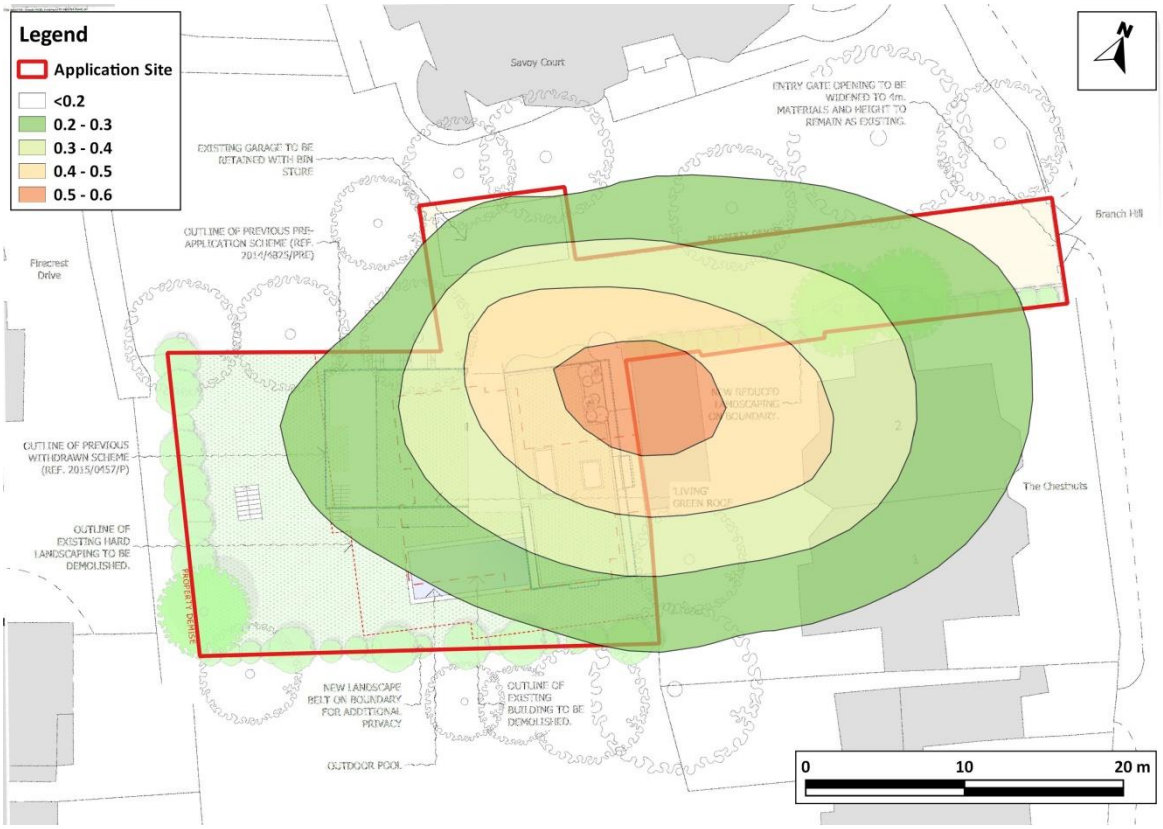

Figure 2: Contour of the Process Contribution to Annual Mean Nitrogen Dioxide Concentrations at 1.5 m (in µg/m^3)

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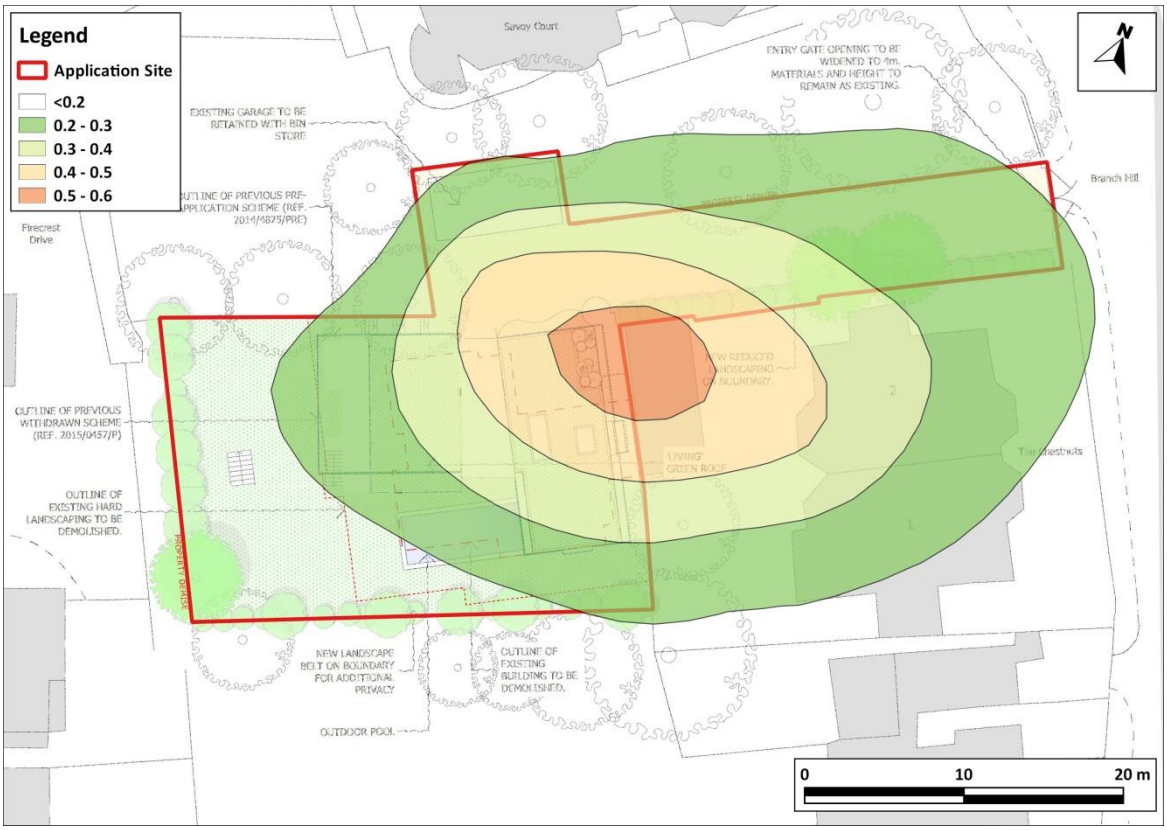

Figure 3: Contour of the Process Contribution to Annual Mean Nitrogen Dioxide Concentrations at 4.5 m (in µg/m^3)

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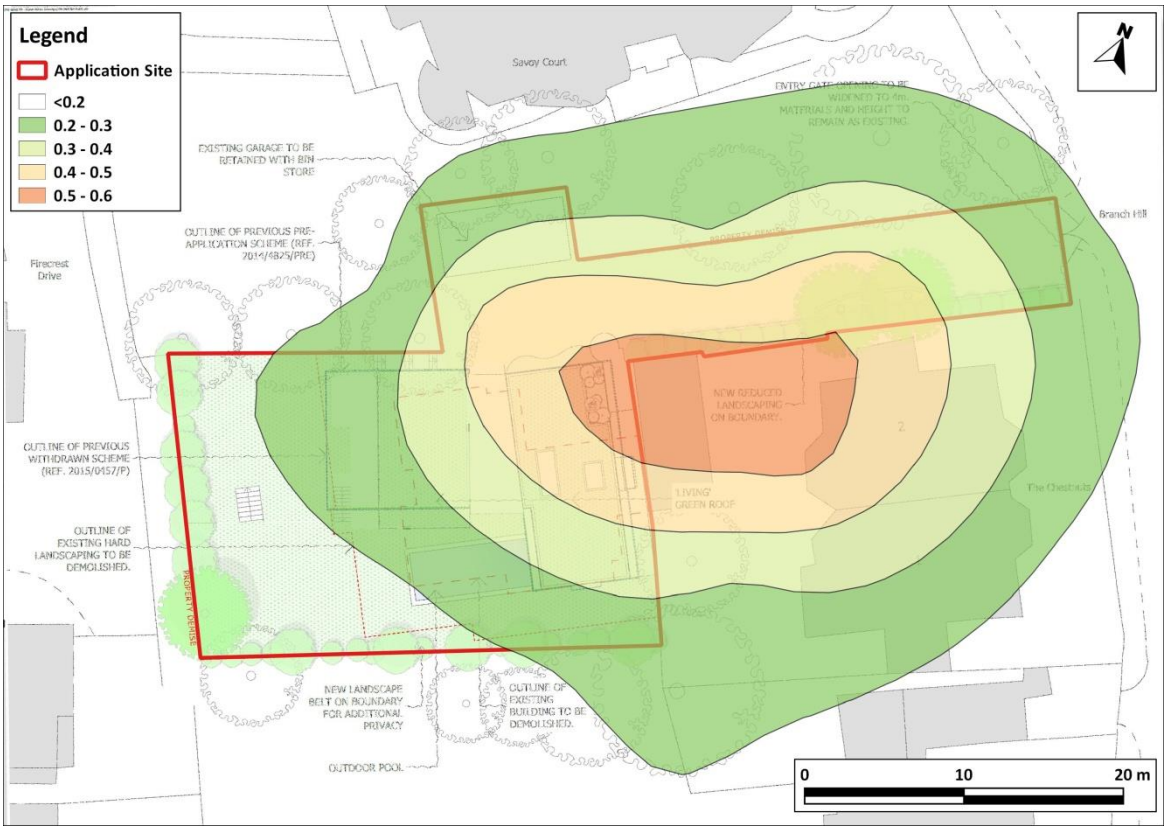

Figure 4: Contour of the Process Contribution to Annual Mean Nitrogen Dioxide Concentrations at 7.5 m (in µg/m^3)

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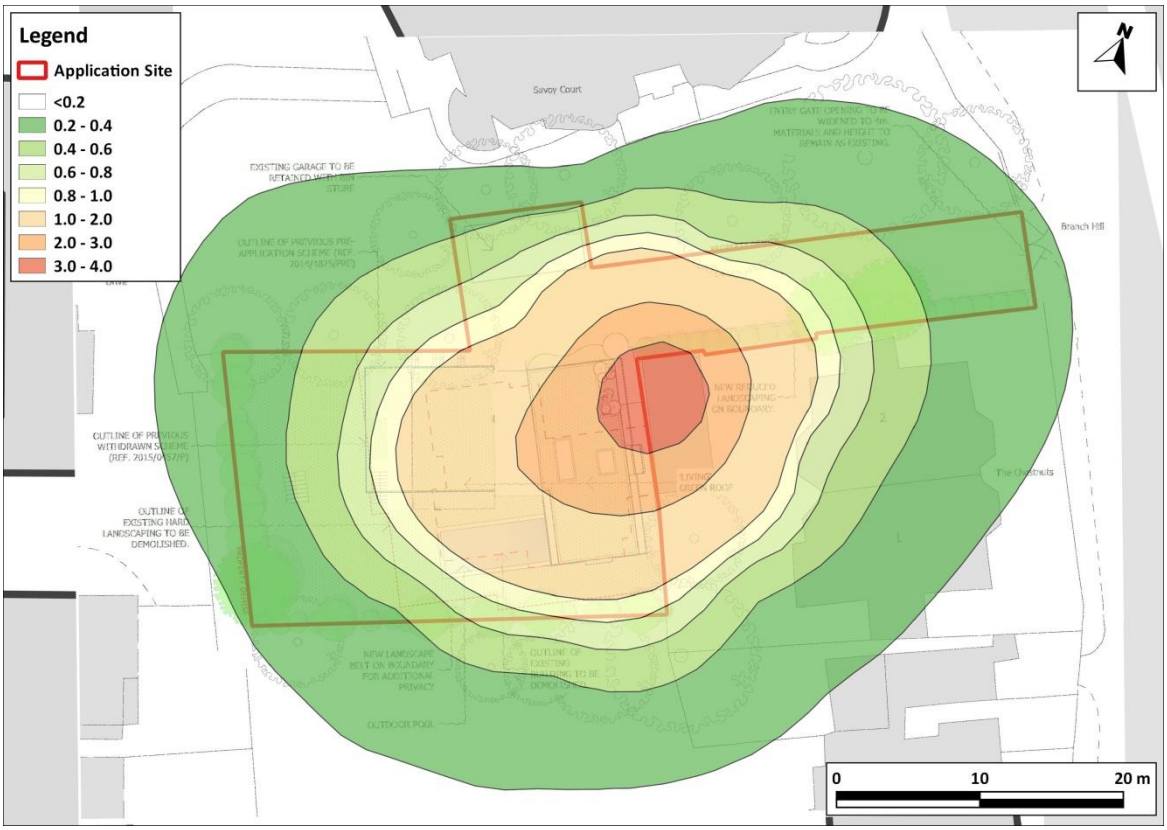

Figure 5: Contour of the Process Contribution to Annual Mean Nitrogen Dioxide Concentrations at 10.5 m (in µg/m^3)

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Impacts at Existing Properties

5.7 The contour plots show that impacts greater than the screening criterion (0.2 µg/m^3) are limited to the building to the east of the new development, along Branch Hill. At 1.5, 4.5 and 7.5 m above ground level, the process contributions to the annual mean nitrogen dioxide concentrations are below 0.6 µg/m^3 (thus 1% of the objective, when rounded) at all locations. Taking the baseline concentration to be 27.8 µg/m^3 (see Paragraph 4.5), adding 0.6 µg/m^3 would result in a total concentration of 28.4 µg/m^3, which is well below the objective. Using the matrix in Table A2.1 (Appendix A2), this increase in concentrations would be described as *negligible*.

5.8 The nearby residential building to the east is four storeys high and there is exposure at approximately 10.5 m above ground. At this location, the process contribution to annual mean nitrogen dioxide is below 2.0 µg/m^3 (or 5% of the objective, when rounded). Adding 2 µg/m^3 to the baseline concentration of 27.8 µg/m^3 would result in a total concentration of 29.8 µg/m^3, which is again well below the objective. Using the matrix in Table A2.1 (Appendix A2), this increase in concentrations would also be described as *negligible*.

5.9 The impacts of the emissions from the CHP and boilers will be *negligible* at all existing sensitive receptors, at all heights.

5.10 It should also be borne in mind that air quality is expected to improve with time, with pollutant concentrations reducing due to the progressive introduction of new vehicles operating to more stringent standards. It can, therefore, be assumed that concentrations in the year of completion of the new development will be lower than those set out above, which are based on a baseline concentration measured in 2015.

Impacts within the Development

5.11 The new development will reach 9.8 m above ground at maximum, and there is, therefore, no exposure at 10.5 m above ground level. It is therefore appropriate to assume that the CHP and boiler emissions will add no more than 0.6 µg/m^3 to annual mean concentrations; taking into account the baseline concentration of 27.8 µg/m^3 results in a total concentration of 28.4 µg/m^3, which is well below the objective. Future residents will, therefore, experience acceptable air quality.

Overall Significance of Air Quality Effects

5.12 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, taking account of the assessment that future residents of the new development will experience acceptable air quality and the impacts of the development on local air quality will be *negligible*.

6 Mitigation

6.1 Given that the combustion plant within the development will not lead to any significant air quality impacts, it is not considered necessary to recommend any mitigation beyond that included by design (such as the installation of a CHP with a very low NOx emission rate of 52 mg/Nm^3 (compared to the emissions standard of 95 mg/Nm^3, set by GLA) and the running of the CHP and boiler flues to 1 m above roof level.

7 Conclusions

7.1 The operational impacts of emissions from the CHP and boiler plant have been assessed. A maximum increase equivalent to 5% of the annual mean nitrogen dioxide objective (when rounded) is predicted at the nearest sensitive receptor. The total annual mean nitrogen dioxide concentration at this location will be less than 75% of the objective, and a 5% increase to an annual mean nitrogen dioxide concentration represents a *negligible* impact. Impacts on hourly mean nitrogen dioxide concentrations have all been screened out as *negligible*.

7.2 In addition, future air quality conditions for occupants of the new development will be acceptable, with concentrations well below the relevant objectives.

7.3 As such, the overall effects of the proposed CHP and boilers will be 'not significant'.

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9 Glossary

AADT	Annual Average Daily Traffic
ADMS-5	Atmospheric Dispersion Modelling System model for point sources
AQC	Air Quality Consultants
AQAL	Air Quality Assessment Level
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network
CHP	Combined Heat and Power
DCLG	Department for Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
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
HDV	Heavy Duty Vehicles (> 3.5 tonnes)
HMSO	Her Majesty's Stationery Office
HGV	Heavy Goods Vehicle
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
LDV	Light Duty Vehicles (<3.5 tonnes)
LEZ	Low Emission Zone
µg/m^3	Microgrammes per cubic metre
MAQS	Mayor's Air Quality Strategy
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides (taken to be NO_2 + NO)
NPPF	National Planning Policy Framework

Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides
PHV	Private Hire Vehicle
PPG	Planning Practice Guidance
SCR	Selective Catalytic Reduction
SPG	Supplementary Planning Guidance
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal
TfL	Transport for London
ULEZ	Ultra Low Emission Zone
ZEC	Zero Emission Capable

10 Appendices

A1 London-Specific Policies and Measures

London Plan

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

"Development proposals should:

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

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

c) be at least "air quality neutral" and not lead to further deterioration of existing poor air quality (such as areas designated as Air Quality Management Areas (AQMAs));

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

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

The Mayor's Air Quality Strategy

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

Policy 1 – Encouraging smarter choices and sustainable travel;

- *Measures to reduce emissions from idling vehicles focusing on buses, taxis, coaches, taxis, PHVs and delivery vehicles;*
- *Using spatial planning powers to support a shift to public transport;*

- *Supporting car free developments.*

Policy 2 – Promoting technological change and cleaner vehicles:

- *Supporting the uptake of cleaner vehicles.*

Policy 4 – Reducing emissions from public transport:

- *Introducing age limits for taxis and PHVs.*

Policy 5 – Schemes that control emissions to air:

- *Implementing Phases 3 and 4 of the LEZ from January 2012*
- *Introducing a NOx emissions standard (Euro IV) into the LEZ for Heavy Goods Vehicles (HGVs), buses and coaches, from 2015.*

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

- *Minimising increased exposure to poor air quality, particularly within AQMAs or where a development is likely to be used by a large number of people who are particularly vulnerable to air quality;*
- *Ensuring air quality benefits are realised through planning conditions and section 106 agreements and Community Infrastructure Levy.*

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

- *Applying emissions limits for biomass boilers across London;*
- *Requiring an emissions assessment to be included at the planning application stage.*

Low Emission Zone (LEZ)

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

Ultra Low Emission Zone (ULEZ)

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

A1.5 The Mayor has now proposed to bring the implementation of the central London ULEZ forward by one year to 2019 and to expand the ULEZ beyond central London in 2020.

Other Measures

A1.6 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.

A1.7 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.

A1.8 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 EPUK & IAQM Planning for Air Quality Guidance

A2.1 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

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

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

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

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

A2.4 The good practice principles are that:

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

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

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

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

A2.6 The guidance offers a widely used approach for quantifying costs associated with pollutant emissions from transport. It also outlines the following typical measures that may be considered to

offset emissions, stating that measures to offset emissions may also be applied as post assessment mitigation:

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

Screening

Impacts of the Local Area on the Development

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

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

Impacts of the Development on the Local Area

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

A2.8 Coupled with any of the following:

- the development has more than 10 parking spaces;

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

A2.9 If the above do not apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area. If they do apply then you proceed to stage 2, 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

A2.10 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.

A2.11 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".

A2.12 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".

A2.13 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".

A2.14 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

A2.15 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

A2.16 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 A2.1 sets out the method for determining the impact descriptor for annual mean concentrations at individual receptors, having been adapted from the table presented in the guidance document. For the assessment criterion the term Air Quality Assessment Level or AQAL has been adopted, as it covers all pollutants, i.e. those with and without formal standards. Typically, as is the case for this assessment, the AQAL will be the air quality objective value. Note that impacts may be adverse or beneficial, depending on whether the change in concentration is positive or negative.

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

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

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

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

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

Assessment of Significance

A2.17 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.

A2.18 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.

A2.19 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 A3.

A3 Professional Experience

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

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

Ricky Gellatly, BSc (Hons) AMIEnvSc MIAQM

Mr Gellatly is a Senior Consultant with AQC with over five years' relevant experience. He has undertaken air quality assessments for a wide range of projects, assessing many different pollution sources using both qualitative and quantitative methodologies, with most assessments having included dispersion modelling (using a variety of models). He has assessed road schemes, airports, energy from waste facilities, anaerobic digesters, poultry farms, urban extensions, rail freight interchanges, energy centres, waste handling sites, sewage works and shopping and sports centres, amongst others. He also has experience in ambient air quality monitoring, the analysis and interpretation of air quality monitoring data, the monitoring and assessment of nuisance odours and the monitoring and assessment of construction dust. He is a Member of the Institute of Air Quality Management.

Pauline Jezequel, MSc MIEnvSc AMIAQM

Miss Jezequel is a Senior Consultant with AQC with seven years' relevant experience. Prior to joining AQC she worked as an air quality consultant at AECOM. She has also worked as an air quality controller at Bureau Veritas in France, undertaking a wide range of ambient and indoor air quality measurements for audit purposes. She now works in the field of air quality assessment, undertaking air quality impact assessments for a wide range of development projects in the UK and abroad, including for residential and commercial developments, transport schemes (rail, road and airport), waste facilities and industrial sites. Miss Jezequel has also undertaken a number of odour

surveys and assessments in the context of planning applications. She has experience in monitoring construction dust, as well as indoor pollutant levels for BREEAM purposes.

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

A4 Modelling Methodology

Model Inputs

A4.1 The impacts of emissions from the proposed CHP and boilers 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 CHP and boiler emissions to annual mean and the 99.79th percentile of 1-hour mean nitrogen oxides concentrations.

A4.2 The gas-fired CHP plant that will be installed into the development will have a net fuel input of 29.5 kW_{th}. This is outside the thermal input range for which the emission standards set out in the GLA's Sustainable Design and Construction SPG (GLA, 2014a) apply. However, it can be noted that the proposed CHP will have a NOx emission rate of 52mg/Nm^3, which is below the emission standards for developments in Band A or Band B (respectively 250mg/Nm^3 and 95mg/Nm^3).

A4.3 Emissions from the CHP will rise to roof level in a dedicated flue. In order to present conservative results, the CHP unit has been assumed to operate for 100% of the year at full load. 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 A4.1 and the following values:

- 100% load;
- 100 ˚C exit temperature at the point of release to the atmosphere; and
- 0% excess air in (set so that the calculated exhaust gas mass flow matched that on the technical datasheet for the plant).

Table A4.1: 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

A4.4 Each of the two gas-fired boiler plant that will be installed into the development will have a net fuel input of 57.3 kW_{th}. The boiler plant will conform to the Sustainable Design and Construction SPG (GLA, 2014a), requiring emissions to be <40 mg/kWh[2].

A4.5 Emissions will rise to roof level in one common flue for the two boilers. In order to present conservative results, the boiler units have also been assumed to operate for 100% of the year at full load. 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 A4.1 and the following values:

- 100% load;
- 49 ˚C exit temperature at the point of release to the atmosphere;
- 40.7% 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.

A4.6 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 A4.2. Further details of the energy plant parameters are provided in Appendix A5.

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

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

Parameter	Value
CHP (SAV XRGI 9)	
Specified Flue Internal Diameter (m)	0.08
Calculated Actual Exhaust Volume Flow (m^3/s)	0.01197
Calculated Exit Velocity (m/s)	2.38095
Specified NOx Emission Rate (mg/Nm^3)	52
Calculated NOx Emission Rate (g/s)	0.00048
Specified Exhaust Temperature (°C)	100
Gas Boilers (2 x Hoval Topgas 60 Boilers)	
Specified Flue Internal Diameter (m)	0.15
Specified Normalised Exhaust Volume Flow (Nm^3/h)	71.6 (for each boiler)
Calculated Actual Exhaust Volume Flow (m^3/s)	0.05098 (for the two boilers)
Calculated Exit Velocity (m/s)	2.88464
Specified NOx Emission Rate (mg/kWh)	35
Calculated Gross Fuel Input (kW)	63.5
Calculated NOx Emission Rate (g/s)	0.0012
Specified Exhaust Temperature (°C)	49
Combined Flue Emissions	
Exit Velocity (m/s)	2.7731
Flue Internal Diameter (m)	0.17
Actual Exhaust Volume Flow (m^3/s) [b]	0.06294
NOx Emission Rate (g/s)	0.0017
Exhaust Temperature (°C)	57.6
Flue Location (x,y)	526007, 186214
Modelled Flue Height (m)	10.8

A4.7 Entrainment of the plume into the wake of 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 SHH Architects. The location of the flue is shown in Figure A4.1 along with the modelled buildings and their heights (in m above ground level). The flue has been modelled at a height of 10.8 m (1 m above the roof level).

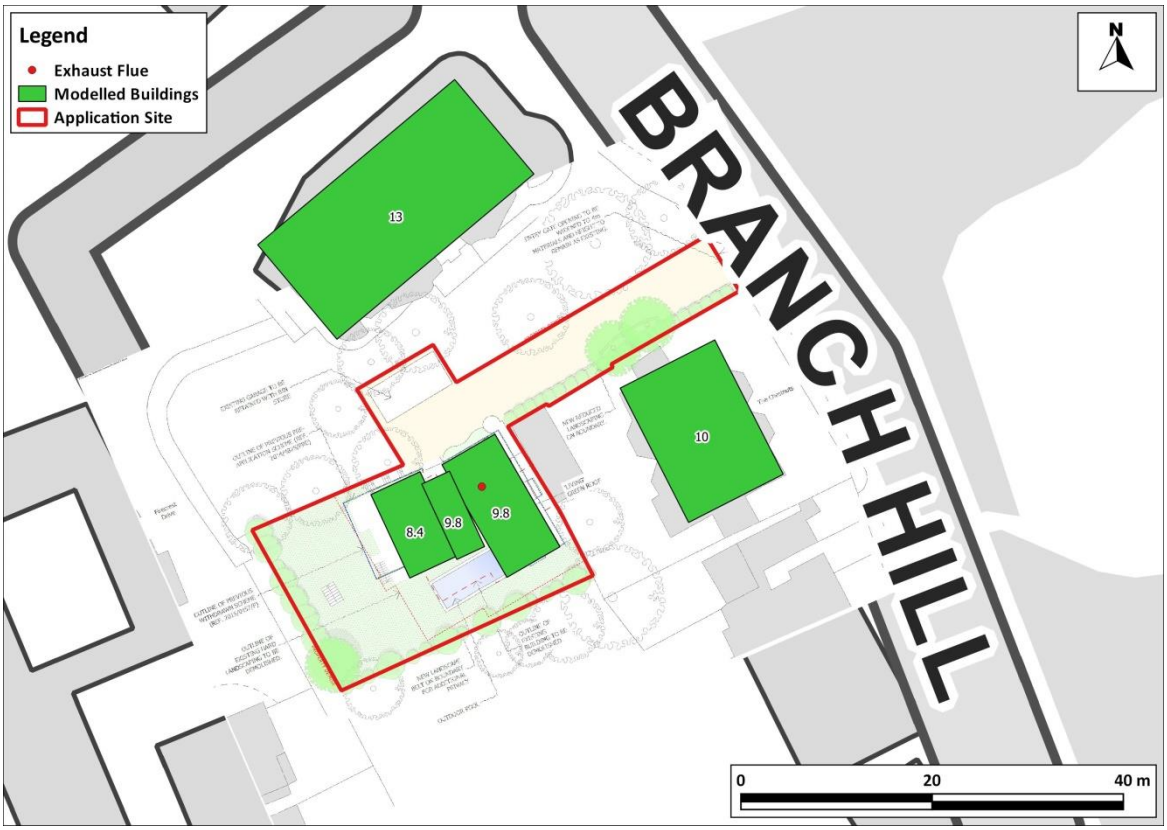

Figure A4.1: Flue Location, Modelled Buildings and their Heights

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A4.8 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 16 km to the southwest of the development site. It is deemed to be the nearest monitoring station representative of meteorological conditions in the vicinity of the development site; both the development site and the London City Airport meteorological monitoring station are located in the Greater London area where they will be influenced by the effects of inland meteorology over urban topography.

Model Post-processing

A4.9 Emissions from the CHP and boiler 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 CHP and boilers emissions to annual mean concentrations of nitrogen oxides, and to the 99.79th percentile of 1-hour mean nitrogen oxides concentrations. 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
- 99.79th percentile of 1-hour mean NO_2 concentrations = 99.79th percentile of 1-hour mean NOx concentrations multiplied by 0.35.

A5 CHP and Boiler Plant Specifications

A5.1 Specifications for the proposed CHP and boiler plant are shown in Table A5.1 and the restrictions set out must be adhered to in order for the air quality assessment results to remain valid.

Table A5.1: Energy Plant Specifications

Parameter	Value	Restriction
CHP		
Gross Peak Fuel Input (kW)	32.7	Max
Hours of Use per Annum	8,760	Max
Annual Fuel Input (kWh/annum)	286,213	Max
Exhaust Temperature (°C)	100	Min
Flue Internal Diameter (m)	0.08	Max
Efflux Velocity (m/s)	2.38	Min
NOx Emission Rate (mg/Nm^3)	52	Max
Boiler		
Gross Peak Fuel Input (kW)	63.5 (each boiler)	Max
Hours of Use per Annum	8,760	Max
Annual Fuel Input (kWh/annum)	555,932 (per boiler)	Max
Exhaust Temperature (°C)	49	Min
Combined Flue Internal Diameter (m)	0.15	Max
Efflux Velocity (m/s)	2.88	Min
NOx Emission Rate (mg/kWh)	35	Max
Condensing	Yes	-

A5.2 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.