Britannia Street, Camden: Air Quality Assessment

Prepared for
Morrison Design Ltd

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1 INTRODUCTION

1.1 Scope

GEM Air Quality Ltd has been commissioned by Morrison Design Ltd to undertake a detailed air quality assessment based on the potential impacts of a Combined Heat and Power (CHP) plant associated with a proposed mixed-use development along Britannia Street in Camden, London. The pollutants modelled as part of this assessment are nitrogen dioxide (NO_2) and particulate matter (PM_{10}). The impact of emissions from the CHP has been assessed in combination with local traffic emissions at existing and proposed receptors.

In addition to this, the assessment has assessed the potential impact on local air quality from demolition and construction activities at the site.

The impact of emissions from the CHP and road traffic will be assessed using the ADMS-Roads air dispersion model. This model has been devised by Cambridge Environmental Research Consultants (CERC) and is described as a comprehensive tool for investigating air pollution problems due to small networks of roads that may be in combination with industrial sources.

The impacts of vehicle emissions on the proposed development have been assessed using the techniques detailed within Volume 11, Section 3 of the Design Manual for Roads and Bridges (DMRB)[1] and the Local Air Quality Management Technical Guidance (LAQM.TG09)[2]. Horizontal Guidance Note H1 - Annex (f)[3] has been used to assess the impact of emissions from the CHP.

With regards to the assessment of emissions from the CHP, no screening has been undertaken as the development lies within an existing Air Quality Management Area (AQMA). As such, a full dispersion modelling assessment has been undertaken. This approach has been chosen in order to model the cumulative impact of emissions from traffic and the proposed CHP, which can be modelled simultaneously using ADMS-Roads. However, this can only be done with predicted annual mean contributions from both sources. Short term impacts of NO_2 emissions have not been modelled as dispersion models are inevitably poor at predicting short-term peaks in pollutant concentrations, which are highly variable from year to year, and from site to site. Furthermore, it has been assumed that the CHP will be operating continuously meaning any predicted peaks in short terms concentrations may not be representative of their overall operation. Notwithstanding this, general assumptions have been made about short term concentrations based on the modelled annual mean concentrations.

1 Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1 – HA207/07, Highways Agency, May 2007

2 Part IV of the Environment Act 1995, Local Air Quality Management Technical Guidance (TG09), Defra, February 2009

3 Horizontal Guidance Note H1 - Environmental risk assessment for permits, Environment Agency, April 2010

Based on LAQM Technical Guidance (TG09), a hotel does not represent relevant exposure with regards to predicted annual mean concentrations. The guidance states that "[annual mean] objectives should generally not apply at hotels, unless people live there as their permanent residence". As such, the impact of emissions from traffic and the proposed CHP has focused on the proposed residential development as well as existing residential properties in the area.

2 POLLUTANTS & LEGISLATION

2.1 Pollutant Overview

In most urban areas of the UK, traffic generated pollutants have become the most common pollutants. These are nitrogen dioxide (NO_2), fine particulates (PM_{10}), carbon monoxide (CO), 1,3-butadiene and benzene, as well as carbon dioxide (CO_2). This air quality assessment focuses on NO_2 and PM_{10}, as these pollutants are least likely to meet their Air Quality Strategy objectives near roads. Table 1 provides an overview of NO_2 and PM_{10}.

Table 1 – Overview of NO_2 and PM_{10}

Pollutant	Properties	Anthropogenic Sources	Natural Sources	Potential Effects
Particles (PM_{10})	Tiny particulates of solid or liquid nature suspended in the air	Road transport; Power generation plants; Production processes e.g. windblown dust	Soil erosion; Volcanoes; Forest fires; Sea salt crystals	Asthma; Lung cancer; Cardiovascular problems
Nitrogen Dioxide (NO_2)	Reddish-brown coloured gas with a distinct odour	Road transport; Power generation plants; Fossil fuels – extraction & distribution; Petroleum refining	No natural sources, although nitric oxide (NO) can form in soils	Pulmonary edema; Various environmental impacts e.g. acid rain

2.2 Air Quality Strategy

The UK Government and the devolved administrations published the latest Air Quality Strategy for England, Scotland, Wales and Northern Ireland on 17 July 2007[4]. The Strategy provides an over-arching strategic framework for air quality management in the UK by way of the following:

- setting out a way forward for work and planning on air quality issues;
- setting out the air quality standards and objectives to be achieved;
- introducing a new policy framework for tackling fine particles; and
- identifying potential new national policy measures which modelling indicates could give further health benefits and move closer towards meeting the Strategy's objectives.

With regards to this assessment, the Air Quality Strategy contains national air quality standards and objectives established by the Government to protect human health. The

[4] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, Department for Environment, Food and Rural Affairs in partnership with the Scottish Executive, Welsh Assembly Government and Department of the Environment Northern Ireland, July 2007

objectives for nitrogen dioxide and particulates (PM_{10} and $PM_{2.5}$) have been set, along with seven other pollutants (benzene, 1,3-butadiene, carbon monoxide, lead, PAHs, sulphur dioxide and ozone). Those which are limit values required by EU Daughter Directives on Air Quality have been transposed into UK law through the Air Quality Standards Regulations 2007 which came into force on 15th February 2007. Table 2 provides the UK Air Quality Objectives for NO_2 and PM_{10}.

Table 2 – UK Air Quality Objectives for Nitrogen Dioxide and Particulate Matter

Pollutant	Objective	Concentration measured as	Date to be achieved by and maintained thereafter
Particles (PM_{10})	50µg/m^3 not to be exceeded more than 35 times a year	24 hour mean	31 December 2004
	40µg/m^3	Annual mean	31 December 2004
Nitrogen Dioxide (NO_2)	200µg/m^3 not to be exceeded more than 18 times a year	1 hour mean	31 December 2005
	40µg/m^3	Annual mean	31 December 2005

Objectives for $PM_{2.5}$ have also been introduced by the UK Government and the Devolved Administrations, but these are not included in Regulations. As such, this assessment has not considered the impact on $PM_{2.5}$.

2.3 Local Air Quality Management

Part IV of the Environment Act 1995 requires local authorities to review and assess existing air quality within their boundaries, as well as predict future air quality as part of an ongoing Review and Assessment process. The current timetable for Review and Assessment (rounds 4, 5 and 6) requires every local authority to report to Defra up to and including 2017, with the different elements repeated over a three year cycle.

2.3.1 London Borough of Camden

The Council have declared a Borough wide AQMA and have completed a Progress Report in September 2011. The report concluded that the air quality objectives for benzene, 1,3-butadiene, lead, sulphur dioxide, carbon monoxide, particulate matter and ozone were met in 2010. However, the report also concluded that the long and short term air quality objectives for nitrogen dioxide continued to be exceeded.

The Council is currently in the process of producing its latest Updating and Screening Assessment.

3 Planning Policy & Guidance

3.1 National Planning Policy & Guidance

3.1.1 National Planning Policy Framework

On a national level, air quality can be a material consideration in planning decisions. The National Planning Policy Framework (NPPF) for England, released on 27th March 2012, is considered a key part of the Governments reforms to make the planning system less complex and more accessible, to protect the environment and to promote sustainable growth. The NPPF replaces the Planning Policy Statement 23 (PPS23) *Planning and Pollution Control*[5].

The NPPF states that the "planning system should contribute to and enhance the natural and local environment by preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability".

It goes on to state 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".

3.1.2 Environmental Protection UK

In 2006, the National Society for Clean Air and Environmental Protection (NSCA) issued a guidance document with regards to assisting both developers and planning authorities on air quality issues[6]. In April 2010, this guidance was updated by Environmental Protection UK (formerly known as the National Society for Clean Air and Environmental Protection)[7].

The updated guidance provides a set of criteria used to determine whether a development will have a significant impact on air quality. If the proposed development results in a significant change in air quality or results in a change of relevant exposure to air quality then it is reasonable to expect an air quality assessment to be undertaken. The report describes how, in all cases, professional judgement is required when deciding if an air quality assessment is necessary, as it is not possible to apply an exact and precise set of criteria to all development proposal situations.

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5 Planning Policy Statement 23: Planning and Pollution Control, Office of the Deputy Prime Minister (ODPM), November 2004

6 Development Control: Planning for Air Quality, An Updated guidance from NSCA on dealing with air quality concerns within the development control process, NSCA, 2006

7 Development Control: Planning For Air Quality (2010 Update), Updated guidance from Environmental Protection UK on dealing with air quality concerns within the development control process, Environmental Protection UK, April 2010

3.1.3 The Air Quality Expert Group

The Air Quality Expert Group (AQEG) is an advisory group that provides independent scientific advice on air quality. AQEG published *Air Quality and Climate Change: A UK Perspective*[8] in 2007. The report recognises the potential for both local and global air quality improvements. Local authorities will be looking towards reductions in both and developers should take this into account throughout the design, construction and operational phases of a development, bearing in mind any potential trade-offs between global and local air quality improvements.

3.2 Local Planning Policy

3.2.1 The Mayor's Air Quality Strategy

In October 2009, the Mayor's Draft Air Quality Strategy was released for consultation by the Greater London Authority[9]. The strategy sets out a framework for delivering improvements to London's air quality and includes measures aimed at reducing emissions from transport, homes, offices and new developments, as well as raising awareness of air quality issues and its impact on health.

3.2.2 The London Plan

In October 2009, the London Plan was released for consultation by the Greater London Authority[10]. The London Plan provides an overall strategic plan for London, setting out an integrated economic, environmental, transport and social framework for the development of London over the next 20–25 years. The Plan brings together the geographic and locational aspects of the Mayor's other strategies, including a range of environmental issues such as climate change (adaptation and mitigation), air quality, noise and waste.

Policy 7.14 relates specifically to improving air quality and states the following:

- The Mayor will work with strategic partners to ensure that the spatial, climate change, transport and design policies of this plan support implementation of his Air Quality Strategy to achieve reductions in pollutant emissions and public exposure to pollution;
- Promote sustainable design and construction to reduce emissions from the demolition and construction of buildings following the best practice guidance released by the GLA and London Councils;

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8 Air Quality Expert Group (AQEG) report – Air quality and climate change: a UK perspective, published for the Department for Environment, Food and Rural Affairs, Scottish Executive, Welsh Assembly Government and Department of the Environment in Northern Ireland, 2007

9 Clearing the Air. The Mayor's draft Air Quality Strategy for consultation with the London Assembly and functional bodies, the Greater London Authority, October 2009

10 The London Plan. Spatial Development Strategy for Greater London. Consultation draft replacement plan released by the Greater London Authority, October 2009

- Aim to be "air quality neutral" and not lead to further deterioration of existing poor air quality (such as areas designated as Air Quality Management Areas (AQMAs)). Offsetting should be used to ameliorate negative impacts associated with development proposals. Increased exposure to existing poor air quality should be minimised;
- Boroughs and others with relevant responsibilities should have policies that seek reductions in levels of pollutants referred to in the Government's National Air Quality Strategy having regard to the Mayor's Air Quality Strategy and take account of the findings of the Air Quality Review and Assessments and Action Plans, in particular where AQMAs have been designated.

3.2.3 London Borough of Camden

The Planning and Compulsory Purchase Act 2004 introduced significant changes to the planning system. It provided details for replacing Local Plans with a Local Development Framework (LDF). The LDF consists of a portfolio of local development documents (LDDs), made up from Development Plan Documents (DPDs) or Supplementary Planning Documents (SPDs).

The London Borough of Camden has published an Air Quality Supplementary Planning Guidance note and encourages developers to adopt the London Best Practise Guidance For Controlling Emissions at Demolition and Construction Sites.

4 Assessment Methodology

4.1 Overview

In order to assess the impact of the proposed development two "phases" have been considered. These are as follows:

- Construction phase; and
- Operational phase (CHP and traffic emissions).

Modelling of the operational phase (including emissions from traffic and the proposed CHP) will be undertaken using the latest version of the ADMS-Roads model.

For the purposes of clarity, the methodology for assessing the impacts from construction, traffic emissions and the proposed CHP have been defined in separate sections based on the specific requirements for modelling emissions from traffic and industrial sources.

4.2 Construction Phase

Dust is a major environmental concern associated with construction activities. Residents living in proximity to such a site can potentially be affected by site dust up to 1 km from the source, although continual or severe concerns about dust sources are most likely to be experienced near to dust sources, generally within 100 metres. In general, large dust particles (greater than 30 µm) make up the greatest proportion of dust emitted from construction sites and will largely deposit within 100 m of sources. Intermediate sized particles (10-30 µm) are likely to travel up to 250-500 m. Smaller particles (less than 10 µm), which make up a small proportion of the dust emitted, can travel up to 1km from sources[11].

In November 2006, the Greater London Authority (GLA)[12] released best practice guidance relating to the control of dust and emissions from construction and demolition sites. This guidance is widely referred to in assessments of construction impacts, even in areas outside London. However, the assessment methodology and significance criteria of potential impacts were outside the scope of the guidance document at the time of publication. As such, the Institute of Air Quality Management (IAQM) published guidance on the potential impacts of construction activities in collaboration with the GLA and the Building Research Establishment (BRE) [13].

11 Minerals Policy Statement (MPS) 2: Controlling and Mitigating the Environmental Effects of Minerals Extraction in England, Office of the Deputy Prime Minister, 2005

12 The control of dust and emissions from construction and demolition – Best Practice Guidance, produced in partnership by London Councils and the Greater London Authority, November 2006

13 Guidance of the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance, IAQM, January 2012

Based on this guidance, the main air quality impacts that may arise during construction activities are:

- Dust deposition, resulting in the soiling of surfaces;
- Visible dust plumes, which are evidence of dust emissions;
- Elevated PM_{10} concentrations, as a result of dust generating activities on site; and
- An increase in concentrations or airborne particles and nitrogen dioxide due to exhaust emissions from diesel powered vehicles and equipment on site.

In relation to the most likely impacts, the guidance states the following:

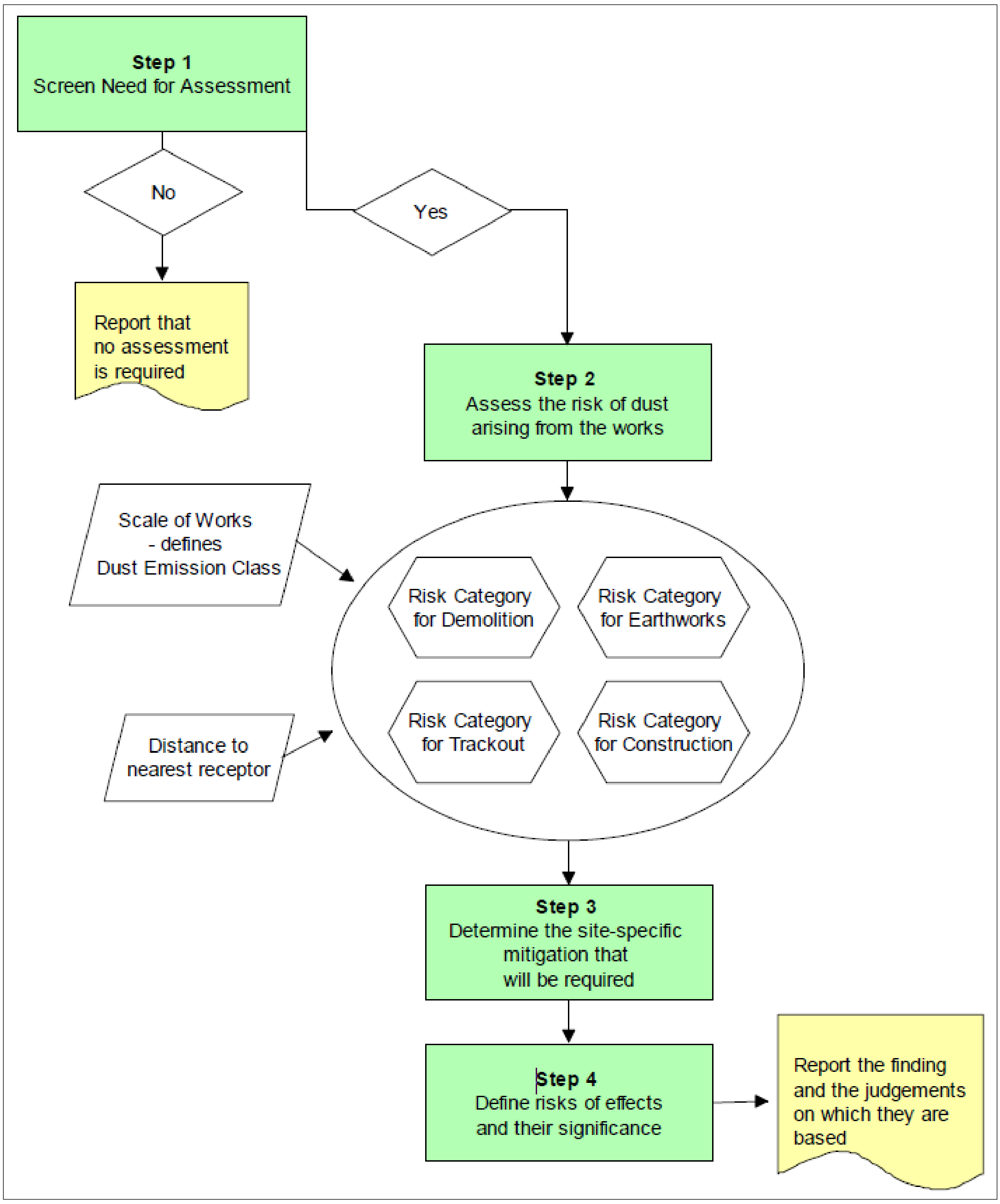
"*The most common impacts are dust soiling and increased ambient PM_{10} concentrations due to dust arising from activities on the site. Dust soiling will arise from the deposition of particulate matter in all size fractions, but will be associated mostly with particulate matter greater than 10 µm. Experience of assessing the exhaust emissions from on-site plant and site traffic suggests that they are unlikely to make a significant impact on local air quality, and in the vast majority of cases they will not need to be quantitatively assessed*".

The guidance continues by providing an assessment procedure. This includes sub-dividing construction activities into four types to reflect their different potential impacts. These are as follows:

- Demolition;
- Earthworks;
- Construction; and
- Track out.

With regards to the proposed development along Britannia Street the potential for dust emissions is assessed for each activity that is likely to take place. The assessment procedure assumes no mitigation measures are applied. The conditions with no mitigation thus form the baseline or 'do-nothing' situation for a construction site. The assessment procedure uses the steps provided in the guidance and summarised in Figure 1.

Figure 1 – Dust Assessment Procedure



4.3 Operational Phase (All Emissions)

4.3.1 ADMS-Roads

The ADMS-Roads model[14] is significantly more advanced than that of most other air dispersion models in that it incorporates the latest understanding of the boundary layer structure, and goes beyond the simplistic Pasquill-Gifford stability categories method with explicit calculation of important parameters. The model uses advanced algorithms for the height-dependence of wind speed, turbulence and stability to produce improved predictions.

The model is described as a comprehensive tool for investigating air pollution problems due to small networks of roads that may be in combination with industrial sources.

4.3.2 Modelled Scenarios

A future year has been chosen (2016) for the assessment, along with the baseline year (2011). The future year represents an assumed year of completion and the first full year of occupation following completion.

4.3.3 Background Concentrations

Background NO_2 concentrations have been obtained from the National Air Quality Archive UK Background Air Pollution Maps[15]. These 1 km x 1 km grid resolution maps are derived from a base year of 2010 (for NOx, NO_2, PM_{10} and $PM_{2.5}$ only).

Background concentrations derived for 2011 have been used for all modelled scenarios. This will present a worst case assessment should future background concentrations decrease. However, as discussed within the LAQM helpdesk[16], monitoring results obtained across the country in 2010 indicate that concentrations of NOx/NO_2 were generally elevated compared to other recent years. This may result in projected mapped background NOx and NO_2 concentrations that are higher than expected in a typical year. As such, in order to have background concentrations which are more characteristic of a typical year the mapped concentrations provided below have been scaled using the method described by the LAQM helpdesk. The original and revised background concentrations for 2011 are provided in Table 5. The revised background concentrations do not apply to PM_{10}.

[14] Interface Version 3.1.0, Build 2.39, Release Date 17 August 2011

[15] UK Air Quality Archive, http://laqm.defra.gov.uk/maps/maps2010.html

[16] LAQM Support, http://laqm.defra.gov.uk/laqm-faqs/faq136.html

Table 3 – Background NOx, NO_2 and PM_{10} Concentrations

Pollutant	X	Y	2011	Revised 2011
NO_2	530500	182500	50.0	44.5
NOx			98.2	83.5
PM_{10}			23.7	N/A

4.3.4 Surface Roughness

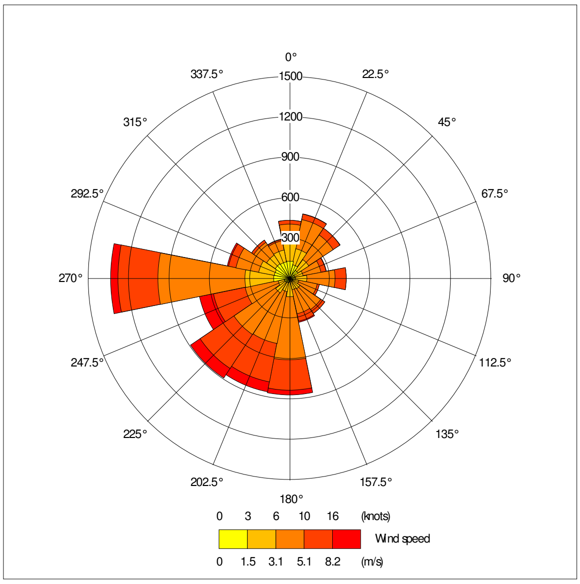
A surface roughness of 1.5 metres has been used in the model. This value is provided by ADMS-Roads as a typical roughness length for large urban areas. This value has been used across the modelled domain.

4.3.5 Meteorological Data

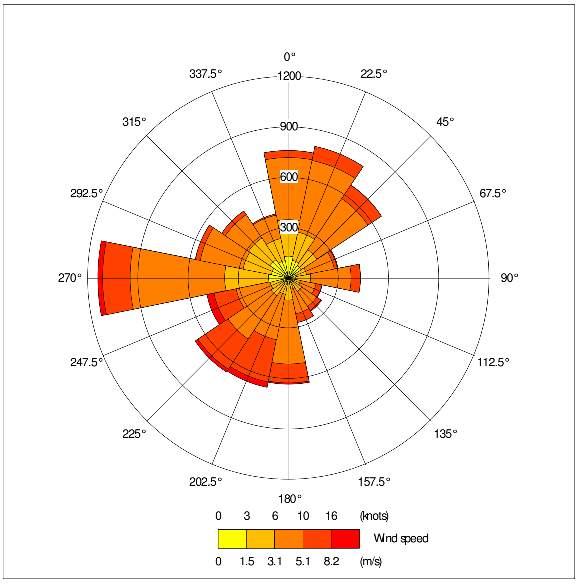
Hourly sequential meteorological data from the Heathrow meteorological station has been used for 2009, 2010 and 2011. Wind speed and direction data from the Heathrow meteorological station has been plotted as a wind rose in Figure 2.

Figure 2 – Wind Speed and Direction Data, Heathrow

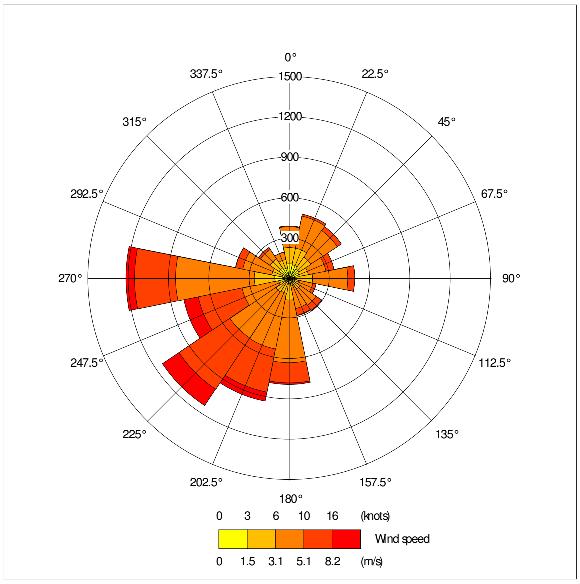
2009



2010



2011



4.3.6 Receptor Locations

Proposed receptors have been identified in order to represent and the potential impact of emissions from traffic and CHP sources. These receptors have focused on the proposed residential development as the hotel does not represent relevant exposure with regards to predicted annual mean concentrations. These receptors are identified in Table 4 and their location shown in Figure 3.

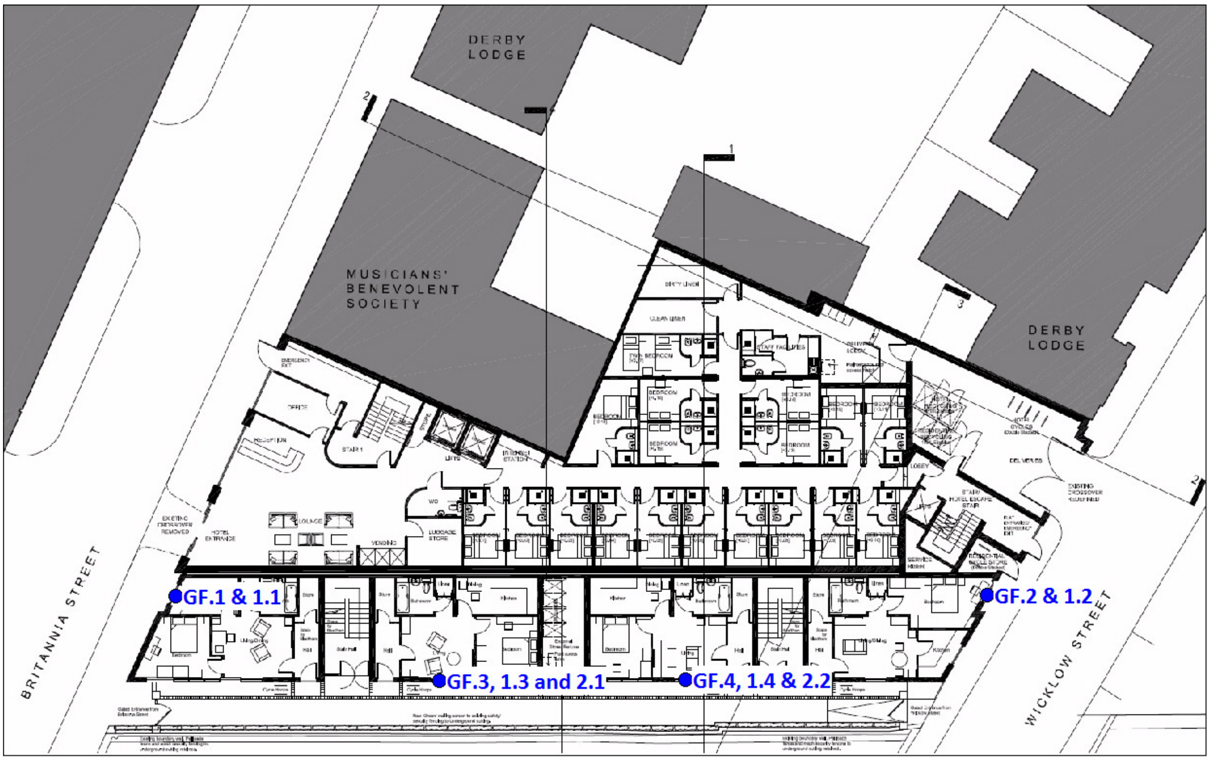
Table 4 – Modelled Receptor Locations

Receptor	X	Y	Height (m)	Receptor Description
GF.1	530628	182894	1.5	Residential Ground Floor, Northern Façade
GF.2	530665	182862	1.5	Residential Ground Floor, Southern Façade
GF.3	530632	182884	1.5	Residential Ground Floor, South Western Façade
GF.4	530650	182869	1.5	
1.1	530628	182894	4.5	Residential First Floor, Northern Façade
1.2	530665	182862	4.5	Residential First Floor, Southern Façade
1.3	530632	182884	4.5	Residential First Floor, South Western Façade
1.4	530650	182869	4.5	
2.1	530632	182884	7.5	Residential Second Floor, Northern Façade
2.2	530650	182869	7.5	Residential Second Floor, Southern Façade

At each modelled receptor location, traffic and CHP emissions will be generated as separate Process Contributions (PC), which will then be added to the background concentration to derive a Predicted Environmental Concentration (PEC). The PEC will be compared to the relevant long term air quality objectives. Assumptions regarding the likely breach of the short term objective will be made based on the long term concentrations.

In order to assess the impact of CHP emissions on existing receptors a 400 x 400 metre grid was modelled using a grid spacing of 10 metres. The grid was modelled at a height of 1.5, 7.5 and 16.5 metres in order to represent the impact of CHP emissions at ground level and at different elevations. The modelled grid was used to produce contour plots so that the Process Contribution (PC) from the CHP only can be visualised.

Figure 3 – Receptor Locations



4.4 Operational Phase (CHP Emissions)

4.4.1 CHP Specifications

Specifications relating to the proposed CHP are detailed in Table 5. These have been provided by Baxi Commercial for three Dachs mini-CHP units.

Table 5 – Input Parameters for the CHP

	CHP 1	CHP 2	CHP 3
OS coordinates of each stack (x,y)	530661,182875	530663,182874	530645,182877
Stack height (m)	34.7	34.7	21.0
Stack diameter (m)	0.08	0.08	0.08
Volumetric Flow fate (m^3/s)	0.0112	0.0112	0.0112
Exit velocity (m/s)	2.24	2.24	2.24
Exit temperature (C or K)	80°C	80°C	80°C
Pollutant emission rates (g/s) for NOx.	0.00041	0.00041	0.00041

4.4.2 Emission Rates

For the purposes of the assessment, it will be assumed that the CHP will be operational 365 days per year at full load. This is based on the continuous operation of the units and does not include any downtime due to system failures and/or maintenance. However, in reality, it is likely that the units will operate for no more than 14 hours a day. As such, predicted concentrations from the CHP are likely to be lower than reported. Emission rates from the proposed CHP have been provided by Baxi Commercial and are detailed in Table 6.

Table 6 – NOx Emission Rates for the Boiler and CHP (g/s)

	CHP 1	CHP 2	CHP 3
Pollutant emission rates (g/s) for NOx.	0.00041	0.00041	0.00041

4.4.3 NOx/NO_2 Relationship

For NOx emissions from the CHP plants, the conversion to NO_2 was calculated using Environment Agency guidance for calculating NO_2 from NOx concentrations. Short term NO_2 concentrations are taken to be 35% of the NOx concentrations and long term NO_2 concentrations are taken to be 70% of the NOx concentrations.

4.5 Operational Phase (Traffic Emissions)

4.5.1 Emission Factors

Defra and the Devolved Administrations have provided an updated Emission Factors Toolkit (Version 5.1) which incorporates updated NOx emissions factors and vehicle fleet information[17]. These emission factors have been integrated into the latest ADMS-Roads modelling software. However, in order to undertake a worst case assessment emission factors for 2011 have been used for all modelled years.

4.5.2 Traffic Data

Traffic data has been derived from the London Atmospheric Emissions Inventory (LAEI)[18]. Baseline data from the LAEI (2010) has been projected to 2011 and 2016. Projection of traffic data has been undertaken using growth factors specific to the London Borough of Camden, obtained from Tempro[19] and National Road Traffic Forecasts (NRTF)[20]. A summary of this data is provided in Table 7. It has been assumed that the percentage HDV and vehicle speeds in 2016 will remain unchanged from the 2011 baseline data.

The annual average speed modelled for the modelled roads are also provided in Table 7. The modelled speed is based on individual speed limits. However, where a link approaches a junction a speed of 5 kph has been modelled in order to account for slow moving traffic at the junction.

Table 7 – Annual Average Daily Traffic Flows and Percentage HDV for Selected Roads, 2011 & 2016

Road / Link	AADT (2011)	AADT (2016)	%HDV	Speed (kph)
A501 Pentonville Road	18,405	20,523	10.9%	47
A201 King's Cross Road	8,885	9,908	9.0%	51
A5200 Gray's Inn Road	28,686	31,987	6.9%	31
A201 Swinton Road	13,586	15,149	8.0%	45
A501 Penton Rise	16,557	18,463	3.9%	34
A201 Acton St	8,691	9,691	12.1%	48
A501 Euston Road	52,030	58,018	10.4%	29

17 http://laqm.defra.gov.uk/review-and-assessment/tools/emissions.html#eft, August 2012
18 LAEI (2006), Greater London Authority
19 Tempro (Trip End Model Presentation Program) version 6 , dataset v5.4 Department for Transport
20 National Road Traffic Forecasts (Great Britain) 1997, Department for Transport

It should be noted that traffic data is also available for these links from the Department for Transport (DfT)[21]. For all those links listed in the table above, traffic flows derived from the DfT for 2011 are lower than those derived from the LAEI. Furthermore, recent DfT data has indicated a decrease in vehicle numbers in recent years, which is not reflect in the projected traffic flows provided above. As such, there is speculation that vehicle flows may have peaked in some areas, such as within towns and cities.

In order to undertake a robust and fair approach with regards to the traffic data modelled within the assessment the 2011 data derived from the LAEI has been used for all modelled scenarios. The projected LAEI figures for 2016 have not been used as they may represent an over prediction of modelled NO_2 and PM_{10} concentrations in that year.

4.5.3 Street Canyons

A street canyon may be defined as a relatively narrow street with buildings on both sides. Street canyons may result in elevated pollutant concentrations from road traffic emissions due to a reduced likelihood of the pollutants becoming dispersed in the atmosphere. Street canyons have been considered as part of this assessment along the modelled network.

4.5.4 NOx/NO_2 Relationship

Following recent evidence that shows the proportion of primary NO_2 in vehicle exhaust has increased[22]. As such, a new NOx to NO_2 calculator has been devised[23]. This new calculator has been used to determine NO_2 concentrations for this assessment, based on predicted NOx concentrations using ADMS-Roads.

4.5.5 Model Output

As discussed in the introduction, it has not been possible to model the short term impacts of NO_2 and PM_{10}. Research undertaken in 2003[24] has indicated that the hourly NO_2 objective is unlikely to be exceeded at a roadside location where the annual mean NO_2 concentration is less than 60 µg/m^3.

For PM_{10}, a relationship between the annual mean and the number of 24-hour mean exceedences has been devised and is as follows:

- No. 24-hour mean exceedences = -18.5 + 0.00145 x annual mean^3 + (206/annual mean)

21 http://www.dft.gov.uk/traffic-counts/
22 Trends in Primary Nitrogen Dioxide in the UK, Air Quality Expert Group, 2007
23 http://laqm.defra.gov.uk/documents/NOx-NO2-Calculator-v3.2.xls
24 Analysis of Relationship between 1-Hour and Annual Mean Nitrogen Dioxide at UK Roadside and Kerbside Monitoring Sites, Laxen and Marner, 2003

This relationship has been applied to the modelled annual mean concentrations (traffic emissions only) in order to estimate the number of 24-hourly exceedences.

4.5.6 Model Verification

The London Borough of Camden undertakes monitoring of NO_2 and PM_{10} at a number of locations across the Borough. Monitoring of NO_2 using diffusion tubes is undertaken along Euston Road at Camden Town Hall. Data from this location has been used for the purposes of model verification (traffic emissions only).

4.6 Significance Criteria

4.6.1 Construction Phase

Assessing the risk of dust arising from the construction site (see Step 2, Figure 1) has used the emission classifications provided in Table 8. The overall risk is then defined (Table 9) based on the distance of relevant receptors to the construction activity.

Table 8 – Dust Emission Classifications Applicable to the Construction Site

Activity	Dust Emission Class		
	Large	Medium	Small
Demolition	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	Total building volume 20,000 – 50 000m^3, potentially dusty construction material, demolition activities 10-20 m above ground level	Total building volume <20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months
Earthworks	Total site area >10,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to 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	Total site area 2,500 – 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	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	Total building volume >100,000 m^3, piling, on site concrete batching; sandblasting	Total building volume 25,000 m3 – 100,000 m^3, potentially dusty construction material (e.g. concrete), piling, on site concrete batching	Total building volume <25,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber)
Track out	>100 HDV (>3.5t) trips in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m	25-100 HDV (>3.5t) trips in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50m – 100 m;	<25 HDV (>3.5t) trips in any one day, surface material with low potential for dust release, unpaved road length <50 m.

Table 9 – Risk Categories for each Construction Activity

Construction Activity	Distance to Nearest Receptor (m)		Dust Emission Class		
	Dust Soiling & PM_{10}	Ecological	Large	Medium	Small
Demolition	<20	--	High Risk Site	High Risk Site	Medium Risk Site
	20 – 100	<20	High Risk Site	Medium Risk Site	Low Risk Site
	100 – 200	20 – 40	Medium Risk Site	Low Risk Site	Low Risk Site
	200 – 350	40 – 100	Medium Risk Site	Low Risk Site	Negligible
Earthworks	<20	--	High Risk Site	High Risk Site	Medium Risk Site
	20 – 50	--	High Risk Site	Medium Risk Site	Low Risk Site
	50 – 100	<20	Medium Risk Site	Medium Risk Site	Low Risk Site
	100 – 200	20 – 40	Medium Risk Site	Low Risk Site	Negligible
	200 – 350	40 – 100	Low Risk Site	Low Risk Site	Negligible
Construction	<20	--	High Risk Site	High Risk Site	Medium Risk Site
	20 – 50	--	High Risk Site	Medium Risk Site	Low Risk Site
	50 – 100	<20	Medium Risk Site	Medium Risk Site	Low Risk Site
	100 – 200	20 – 40	Medium Risk Site	Low Risk Site	Negligible
	200 – 350	40 – 100	Low Risk Site	Low Risk Site	Negligible
Track out	<20	--	High Risk Site	Medium Risk Site	Medium Risk Site
	20 – 50	<20	Medium Risk Site	Medium Risk Site	Low Risk Site
	50 – 100	20 – 100	Low Risk Site	Low Risk Site	Negligible

In order to undertake Step 4 (Figure 1) and determine the significance of potential dust effects professional judgement must be used, taking into account the factors that define the sensitivity of the surround area and overall pattern of potential risks derived from Table 9. Based on the IAQM guidance, the sensitivity of the surrounding area may be defined using the criteria provided in Table 10.

Table 10 – Factors Defining Sensitivity of an Area

Sensitivity of Surrounding Area	Human Receptors	Ecological Receptors
Very High	Very densely populated area. More than 100 dwellings within 20 m. Local PM_{10} concentrations exceed the objective. Contaminated buildings present. Very sensitive receptors (e.g. oncology units). Works continuing in one area of the site for more than one year.	European Designated site
High	Densely populated area. 10-100 dwellings within 20 m of site. Local PM_{10} concentrations close to the objective (e.g. annual mean 36-40 µg/m^3). Commercially sensitive horticultural land within 20m.	Nationally Designated site
Medium	Suburban or edge of town area. Less than 10 dwellings within 20 m. Local PM_{10} concentrations below the objective (e.g. annual mean 30-36 µg/m^3).	Locally designated site
Low	Rural area; industrial area No dwellings within 20 m Local PM_{10} concentrations well below the objectives (less than 75%) Wooded area between site and receptors	No designations

The sensitivity of the area surrounding the construction site is combined with the risk of the site giving rise to dust effects to define the significance of the effects for each of the four activities (demolition, earthworks, construction and track out). The significance of effects may be defined with and without mitigation for each activity, as detailed in the following tables.

Table 11 – Significance of Effects for each Activity with No Mitigation

Sensitivity of Surrounding Area	Risk of Site Giving Rise to Dust Effects		
	High Risk Site	**Medium Risk Site**	**Low Risk Site**
Very High	Substantial adverse	Moderate adverse	Moderate adverse
High	Moderate adverse	Moderate adverse	Slight adverse
Medium	Moderate adverse	Slight adverse	Negligible
Low	Slight adverse	Negligible	Negligible

Table 12 – Significance of Effects for each Activity with Mitigation

Sensitivity of Surrounding Area	Risk of Site Giving Rise to Dust Effects		
	High Risk Site	Medium Risk Site	Low Risk Site
Very High	Slight adverse	Slight adverse	Negligible
High	Slight adverse	Negligible	Negligible
Medium	Negligible	Negligible	Negligible
Low	Negligible	Negligible	Negligible

The final step is to determine the overall significance of the effects arising from the construction phase of a proposed development. An overall summary table has been produced illustrating the potential effects with and without mitigation.

6.1.1 Operational Phase

The guidance released by Environmental Protection UK also provides steps for a Local Authority to follow in order to assess the significance of air quality impacts of a development proposal. This procedure, shown in Figure 4, has also been applied to the modelled Process Contributions (PC) from the CHP.

The guidance released by Environmental Protection UK also provides descriptors for impact magnitude and impact significance in air quality assessments. This is important when determining the magnitude and significance of any changes in air quality as a result if the proposed development. Table 13 provides descriptions for changes in ambient annual means concentrations of NO_2 and PM_{10}. Descriptors for changes to the number of days with PM_{10} concentration greater than 50 µg/m^3 are also provided in Table 13. Table 14 provides air quality impact descriptors for changes to the annual mean NO_2 and PM_{10} concentrations. Table 15 provides air quality impact descriptors for changes to the number of days with PM_{10} concentration greater than 50 µg/m^3.

Figure 4 – Assessing the Significance of Air Quality Impacts of a Development Proposal

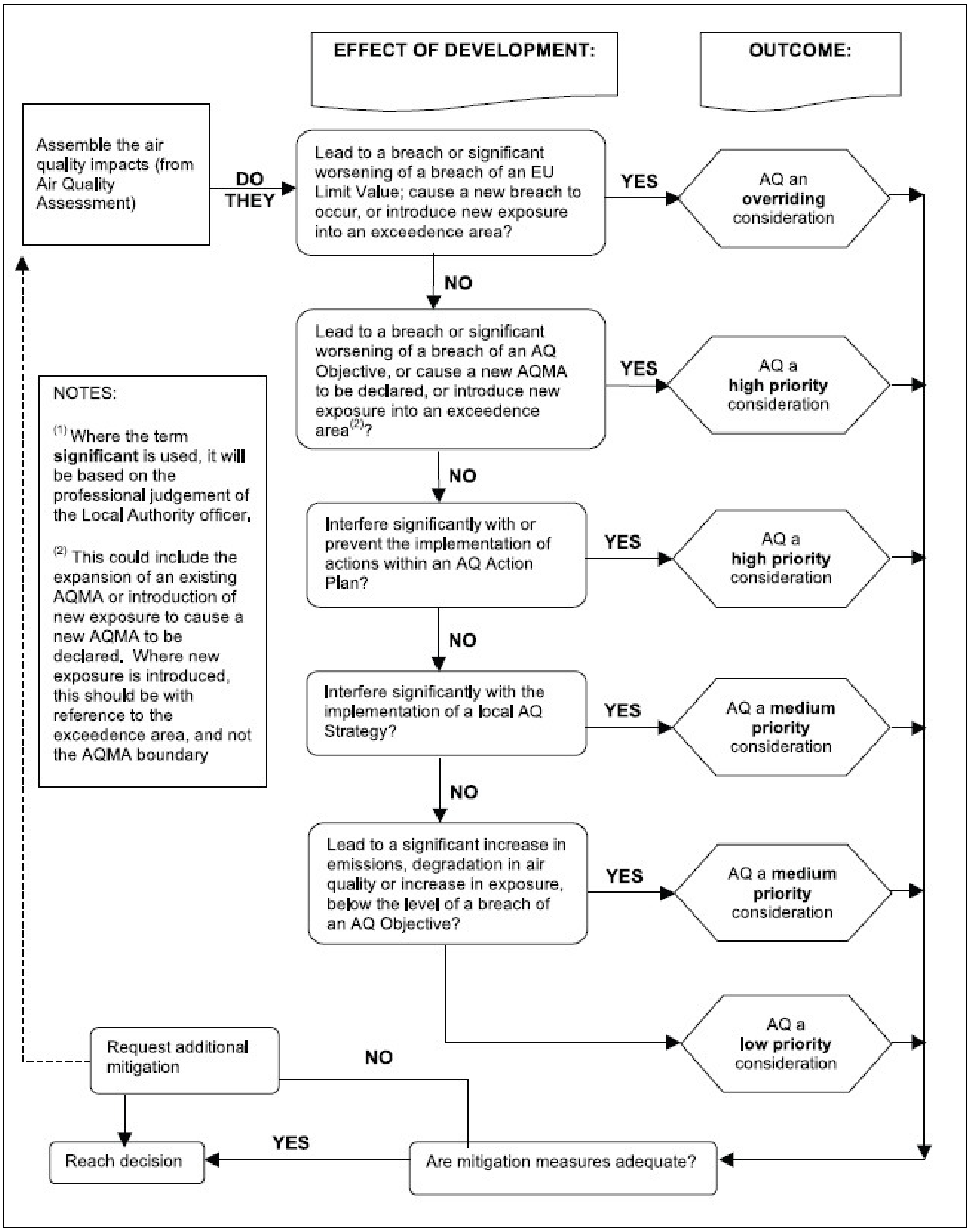


Table 13 – Descriptors for Changes in Ambient Concentrations of NO_2 and PM_{10}

Magnitude of Change	Annual Mean NO_2 / PM_{10}	Days PM_{10} >50 µg/m^3
Large	Increase/decrease >4 µg/m^3	Increase/decrease >4 days
Medium	Increase/decrease 2 – 4 µg/m^3	Increase/decrease 2 – 4 days
Small	Increase/decrease 0.4 – 2 µg/m^3	Increase/decrease 1 – 2 days
Imperceptible	Increase/decrease <0.4 µg/m^3	Increase/decrease <1 day

Table 14 – Descriptors for Impact Significance for Annual Mean NO_2 and PM_{10}

Absolute Concentration in Relation to Objective	Change in Concentration		
	Small	Medium	Large
Increase with the Scheme			
Above Objective With Scheme (>40 µg/m^3)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective With Scheme (36-40µg/m^3)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective With Scheme (30-36 µg/m^3)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective With Scheme (<30 µg/m^3)	Negligible	Negligible	Slight Adverse
Decrease with the Scheme			
Above Objective Without Scheme (>40 µg/m^3)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective Without Scheme (36-40µg/m^3)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective Without Scheme (30-36 µg/m^3)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective Without Scheme (<30 µg/m^3)	Negligible	Negligible	Slight Beneficial

Table 15 – Air Quality Impact Descriptors for Changes to Number of Days with PM_{10} Concentration Greater than 50 µg/m^3

Absolute Concentration in Relation to Objective	Change in Concentration		
	Small	**Medium**	**Large**
Increase with the Scheme			
Above Objective With Scheme (>35 days)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective With Scheme (32-35 days)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective With Scheme (26-32 days)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective With Scheme (<26 days)	Negligible	Negligible	Slight Adverse
Decrease with the Scheme			
Above Objective Without Scheme (>35 days)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective Without Scheme (32-35 days)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective Without Scheme (26-32 days)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective Without Scheme (<26 days)	Negligible	Negligible	Slight Beneficial

7 Air Quality Assessment

7.1 Impact from Construction Activities

The assessment of construction activities has focused on demolition, earthworks, construction and track out activities at the site. Using the criteria provided in Table 8 the dust emission class for each activity is as follows:

- Demolition = Small;
- Earthworks = Small;
- Construction = Small; and
- Track out = Small.

Based on the risk categories for each activity in relation to the surrounding sensitive receptors (Table 9) the site is considered to have a low to high risk depending on the nature of the construction activity. This is summarised in Table 16.

Table 16 – Overall Risk of Site based on each Construction Activity

Construction Activity	Distance to Nearest Receptor (m)		Dust Emission Class		
	Dust Soiling & PM_{10}	Ecological	Large	Medium	Small
Demolition	<20	N/A	N/A	N/A	Medium Risk Site
Earthworks	<20	N/A	N/A	N/A	Medium Risk Site
Construction	<20	N/A	N/A	N/A	Medium Risk Site
Track out	<20	N/A	N/A	N/A	Medium Risk Site

Based on Table 10, the sensitivity of the surrounding area is considered high. As such, the significance of effects from demolition, earthworks, construction and track out activities with no mitigation is, at worst, slight adverse (see Table 11). With mitigation, the significance of effects from demolition, earthworks, construction and track out activities is negligible (see Table 12). This is summarised in the following table.

Table 17 – Summary of Significance for Construction Activities

Source	Dust Soiling and PM_{10} Effects	
	With no Mitigation	With Mitigation
Demolition	Moderate Adverse	Negligible
Earthworks	Moderate Adverse	Negligible
Construction	Moderate Adverse	Negligible
Track Out	Moderate Adverse	Negligible

It should also be noted that the likelihood of an adverse impact occurring is correlated to wind speed and wind direction. As such, unfavourable wind speeds and wind directions must occur at the same time as a dust generating activity in order to generate an adverse impact. The overall impacts also assume that the dust generating activities are occurring over the entirety of the site meaning that as an activity moves further away from a potential receptor the magnitude and significance of the impact will be further reduced.

7.2 Impact of Traffic and CHP Emissions

7.2.1 Model Verification (Traffic Only)

Using the guidance provided in Box A3.6 within the Local Air Quality Management Technical Guidance TG(09)[25], the modelled concentration have been verified against the monitoring data obtained from the NO_2 diffusion tube monitoring site along Euston Road. The following tables provide a summary of the model verification process for NOx/NO_2. This has only been undertaken based on traffic emissions. It has not been possible to verify modelled PM_{10} concentrations.

Predicted NO_2 concentrations for 2011 have been compared against the monitored NO_2 concentrations from the diffusion tube listed in Table 6. The results of this comparison are provided in Table 18.

Table 18 – Comparison of Modelled and Monitored NO_2 Concentrations (µg/m^3)

Monitoring Location	Modelled Concentration	Monitored Concentration	Difference [(modelled - monitored)/ monitored] x100
Euston Road, Camden Town Hall	73.3	93.1	-21.2%

As described in the Technical Guidance (LAQM.TG09), in order to provide more confidence in the model predictions and the decisions based on these, the majority of results should be within ±25% (ideally ±10%) of the monitored concentrations. Since the modelled concentration is under-predicting by over ±20% (but still less than ±25%) the predicted modelled concentrations will require adjustment in order to improve the confidence in modelled concentrations across the modelled domain.

The discrepancies between monitored and modelled concentration before application of the adjustment factors may be due to a number of reasons. For example:

- Discrepancies in traffic data (flows, speeds or traffic composition);
- Uncertainty in monitoring data; and
- Background concentrations.

7.2.2 Model Adjustment (Traffic Only)

In order to undertake model adjustment, it is first necessary to derive the monitored and modelled road contributions of NOx (excluding background). The modelled road contribution NOx is taken directly from the ADMS-Roads output before it has been

25 Part IV of the Environment Act 1995, Local Air Quality Management Technical Guidance (TG09), Defra, February 2009

converted to NO_2 using the NOx to NO_2 calculator described in Section 4.6.1. The NOx to NO_2 calculator can also be used to derive monitored road contributions of NOx from NO_2 diffusion tube results. A summary of these calculations is provided in Table 19.

A comparison between the monitored and modelled road NOx contributions is made in Table 20, and an adjustment factor derived. Following adjustment of the modelled NOx concentrations the total NO_2 concentration at each location has been calculated using the method described in Section 4.6.1. These revised NO_2 concentrations, shown in Table 20, indicate a more acceptable model performance when compared against the monitored NO_2 concentrations. As such, an adjustment factor of 1.9 has been applied to all modelled NOx concentrations across the model domain before conversion to NO_2.

Table 19 – Monitored NOx and NO_2 concentrations

Monitoring Location	Monitored Total NO_2	Monitored Total NOx	Defra Background NO_2	Defra Background NOx	Monitored road contribution NO_2 (total – background)	Monitored road contribution NOx (total – background)	Unadjusted modelled road contribution NOx (excludes background)
Euston Road	93.1	248.4	44.5	83.5	48.6	164.9	86.5

Table 20 – Comparison of Monitored and Modelled NOx and NO_2 concentrations

Monitoring Location	Ratio of monitored road contribution NOx / modelled road contribution NOx	Adjustment factor for modelled road contribution	Adjusted modelled road contribution NOx	Adjusted modelled total NOx (including background NOx)	Modelled total NO_2 (based on empirical NOx/NO_2 relationship)	Monitored total NO_2	% Difference [(modelled – monitored) / monitored] x 100
Euston Road	1.9	1.9	164.9	248.4	93.1	93.1	0.0%

7.2.3 Sensitivity Test

In order to present a worst case assessment of emissions from the CHP a comparison of predicted concentrations has been made using the three different sets of meteorological data discussed in Section 4.3.5. This sensitivity test has also considered the impacts at ground level (1.5 metres) and at height (7.5 and 16.5 metres) in order to present the impact from CHP emissions at elevated sensitive receptors. A summary of this comparison is provided in Table 21.

Table 21 – Maximum Predicted Annual Mean Concentrations of NOx and NO_2 (µg/m^3)

Met Year	Height (m)	Process Contribution (PC)		Background	PEC
		NOx	NO_2		
2009	1.5	0.0044	0.0031	44.5	44.5
2010		0.0047	0.0033		44.5
2011		0.0047	0.0033		44.5
2009	7.5	0.0052	0.0036		44.5
2010		0.0057	0.0040		44.5
2011		0.0055	0.0038		44.5
2009	16.5	0.042	0.029		44.5
2010		0.040	0.028		44.5
2011		0.048	0.034		44.5

Based on the table, meteorological data from 2011 gives the worst case results in terms of emissions from the CHP. As such, this meteorological year has been used for all further modelling from the CHP, including when combining the Process Contribution (PC) from the CHP with that of the traffic emissions (see next section). When modelling traffic emissions meteorological data from 2011 has also been used as this corresponds with the 2011 monitoring data used for model verification (see Section 7.2.1).

7.2.4 Process Contributions and Predicted Environmental Concentrations

As discussed in Section 4.3.6, proposed residential receptors have been identified in order to represent and the potential impact of emissions from traffic and CHP sources. The NOx and NO_2 Process Contribution (PC) from the traffic and CHP sources have been modelled. These have then been added together and combined with the background concentration in order to derive the Predicted Environmental Concentration (PEC) at each receptor. For each receptor identified in Table 4 the PC and PEC has been calculated and provided in Table 22.

The PEC exceeds the UK air quality objective for NO_2 at all modelled receptors representing the proposed residential units. This is due to the high background concentration that exceeds the objective before any additional Process Contributions are added to it. The impact of emissions from the CHP at the residential development is negligible compared to emissions from road traffic and the high background concentration.

Table 22 – Long Term PCs and PECs for NO_2

Receptor	PC (Traffic)		PC (CHP)		Background	PEC
	NOx	NO_2	NOx	NO_2		
GF.1	11.7	4.7	<0.001	<0.001	44.5	49.2
GF.2	11.8	4.8	<0.001	<0.001		49.3
GF.3	11.6	4.7	<0.001	<0.001		49.2
GF.4	11.6	4.7	<0.001	<0.001		49.2
1.1	11.4	4.6	<0.001	<0.001		49.1
1.2	11.4	4.6	<0.001	<0.001		49.1
1.3	11.2	4.6	<0.001	<0.001		49.1
1.4	11.2	4.5	<0.001	<0.001		49.0
2.1	10.6	4.3	<0.001	<0.001		48.8
2.2	10.5	4.3	<0.001	<0.001		48.8
Objective						**40.0**

Based on the PECs provided in Table 22 and the relationship described in Section 4.5.5 it is unlikely that the short term NO_2 objective will be exceeded at any location across the proposed development.

Table 23 provides a summary of the PC and PEC for PM_{10}. However, since PM_{10} has not been modelled from the CHP the summary only includes the PC from traffic emissions.

Table 23 – Long Term PCs and PECs for PM_{10}

Receptor	PC (Traffic)	Background	PEC
GF.1	0.4	23.7	24.1
GF.2	0.4		24.1
GF.3	0.4		24.1
GF.4	0.4		24.1
1.1	0.4		24.1
1.2	0.4		24.1
1.3	0.4		24.1
1.4	0.4		24.1
2.1	0.3		24.0
2.2	0.3		24.0
Objective			**40.0**

Based on the relationship described in Section 4.5.5, the number of 24-hour mean exceedences for PM_{10} has been calculated based on the PEC for each receptor. Using this relationship, the number of 24-hour mean exceedences does not exceed 10. This is well within the short term objective for PM_{10} of 35 days of exceedence.

The wider impact of the CHP emissions has also been assessed at existing receptors. Based on the Process Contributions provided in Table 21 the maximum increase in NO_2 concentrations as a result of CHP emissions is 0.034 $\mu g/m^3$. Using the criteria provided in Tables 13 and 14, the magnitude of this change is considered imperceptible and the significance is considered negligible. Given that the CHP will result in a negligible change in NO_2 concentrations in the local area it is not considered necessary to produce contour plots to represent this change.

8 Conclusions And Recommendations

8.1 Impact from Construction Activities

A qualitative assessment of dust levels associated with the proposed development has been carried out. The qualitative assessment shows that although dust is likely to occur from site activities, this can be reduced through appropriate mitigation measures. Implementation of the following Best Practice Measures based on a medium to high risk site will help reduce the impact of the construction activities to an acceptable level:

Site Planning:
- Erect solid barriers to site boundary;
- No bonfires;
- Plan site layout – machinery and dust causing activities should be located away from sensitive receptors;
- All site personnel to be fully trained; and
- Trained and responsible manager on site during working times to maintain logbook and carry out site inspections.

Construction Traffic:
- All vehicles to switch off engines – no idling vehicles;
- Effective vehicle cleaning and specific wheel-washing on leaving site;
- All loads entering and leaving site to be covered;
- No site runoff of water or mud;
- All non road mobile machinery (NRMM) to use ultra low sulphur tax-exempt diesel (ULSD) where available; and
- On-road vehicles to comply with the requirements of a possible future Low Emission Zone (LEZ) as a minimum.

Demolition Works:
- Use water as dust suppressant;
- Cutting equipment to use water as suppressant or suitable local exhaust ventilation systems; and
- Securely cover skips and minimise drop heights.

Site Activities:
- Minimise dust generating activities;
- Use water as dust suppressant where applicable;
- Enclose stockpiles or keep them securely sheeted; and
- If applicable, ensure concrete crusher or concrete batcher has a permit to operate.

With the above mitigation measures enforced, the likelihood of nuisance dust episodes occurring at nearby receptors are considered low. Notwithstanding this, the developer should take into account the potential impact of air quality and dust on occupational exposure standards (in order to minimise worker exposure) and breaches of air quality objectives that may occur outside the site boundary. Monitoring is not recommended at this stage, however, continuous visual assessment of the site should be undertaken and a complaints log maintained in order determine the origin of a particular dust nuisance. Keeping an accurate and up to date complaints log will isolate particular site activities to a nuisance dust episode and help prevent it from reoccurring in the future.

8.2 Impact of Emissions

The ADMS predictions for PM_{10} concentrations in 2011 indicate that the short and long term objectives would be achieved at all the modelled receptor locations. The predicted results fall within APEC Category A, meaning there are "no air quality [PM_{10}] grounds for the refusal of the development, however, mitigation of emissions may still be considered". Using the flow chart presented in Figure 4, air quality (PM_{10}) is a low priority consideration based on the predicted concentrations provided above.

Predicted NO_2 concentrations at all modelled residential receptors exceed the annual mean air quality objective in 2011. Using the Air Pollution Exposure Criteria (APEC) described in Table 7, predicted concentrations at these receptors fall within APEC Category C. Using the flow chart presented in Figure 4, the impact of the proposed development with regards to air quality (NO_2) is a medium to high priority consideration at the modelled locations. This is due to the high background levels that are present in this part of London, which exceed the air quality objective even before consideration of additional emission sources. In relation to background concentrations, it should be noted that the predicted concentrations at the first floor and above do not take account of any potential decrease in background concentrations with height. Since there is currently no guidance relating to this potential drop-off the background concentrations at ground level have been used at all modelled heights. As such, the predicted concentrations at the first floor and above are likely to be lower than presented.

Based on the predicted annual mean concentrations the short term NO_2 objective is unlikely to be exceeded across the development site.

It should also be noted that the existing site is a car park. As such, following completion of the development there will be a small decrease in the amount of traffic on the local road network associated with the development site.

Overall, the impact of NO_2 emissions from the proposed CHP is considered imperceptible at both existing and proposed receptors. The significance of this change is considered to be negligible.

8.3 Building Mitigation

Potential exposure of the residential occupants to poor air quality from road traffic (NO_2) emissions is a potential issue at this development. As such, the developer should consider issues relating to building ventilation.

As detailed in numerous Air Quality and Planning Guidance[26], careful consideration should be given to the site characteristics of the development. More precisely, issues such as ventilation provision and location of opening windows and doors to improve indoor air quality should be considered. Ventilation typically comes in one of three forms – natural, mechanical or mixed mode. These are described in more detail below:

- **Natural Ventilation** – this form of ventilation is relatively inexpensive and requires minimal maintenance. Furthermore, such ventilation can make a worthwhile contribution to a low energy strategy for a building. Modern buildings increasingly apply the principles of natural ventilation by allowing cool air, including cooler ambient air at night, to be drawn in at low levels, and for normal convection currents to encourage the air to move upwards through the building and be ejected at a high level[27]. Unfortunately, ventilation by natural means does not allow for the treatment of incoming air. As such, it is important to identify the sources of pollution around a building and positioning natural air inlets away from the potential sources of poor air quality. For instance, ventilating a property from rear façades at rooftop level is likely to be most effective;
- **Mechanical Ventilation** – these include air conditioning units that incorporate air filtration. However, such systems are often used but rarely designed to reduce common external pollutants. Moreover, mechanical ventilation systems have high capital outlay and running costs through energy consumption and increased emissions of CO_2. Not surprisingly, the Mayor of London's Supplementary Planning Guidance[27] suggests that the need for mechanical ventilation should be minimised for these reasons and that the use of natural ventilation should be used to minimise resource use and maximise the comfort of users over the lifetime of the development;
- **Mixed Mode Ventilation** – where poor ventilation cannot be prevented through natural ventilation and good design, mixed-mode operation using maximum natural ventilation with minimal mechanical ventilation should be used, especially during periods when outdoor pollution levels are highest e.g. during morning and afternoon rush hours.

[26] Draft Air Quality and Planning Guidance Consultation, Kent and Medway Air Quality Partnership, January 2009

[27] Supplementary Planning Guidance – Sustainable Design and Construction, Greater London Authority, May 2006

Based on the predicted NO_2 concentrations provided in this report, the annual mean objective is exceeded at all levels of the residential development. As such, limiting the potential exposure of future occupants may be achieved by ensuring windows cannot be opened. However, this would require an additional form of ventilation to be installed, whereby clean air is drawn in naturally or mechanically (often from the roof and away from any sources of air pollution) and maintained thereafter.

Based on the outcome of the noise and vibration assessment there will be limited ability to open windows, except in an emergency. It is likely that some form of "whole house" ventilation system will be installed by way of air-source heat pumps and air handlers. The air-source heat pumps require a continuous free flow of outside air. As such, based on the outcome of the air quality assessment it is recommended that these inlets be placed as high as possible and away from any emission sources e.g. CHP outlets. If possible, the air-source heat pumps servicing the hotel and residential section should be placed at the roof level of the hotel where the drop off in background concentrations and emissions from road traffic will be even more pronounced than at the roof level of the residential section.