GOSH CCC
Air Quality Assessment

20/05/2022

GOSHCCC-442998AQ/01 (05)

RSK GENERAL NOTES

Project No.: 442998/AQ/01 (05)

Title: Great Ormond Street Hospital Children's Cancer Centre (GOSHCCC) Air Quality Assessment

Client: John Sisk and Son Limited on behalf of the Great Ormond Street Hospital for Children NHS Foundation Trust

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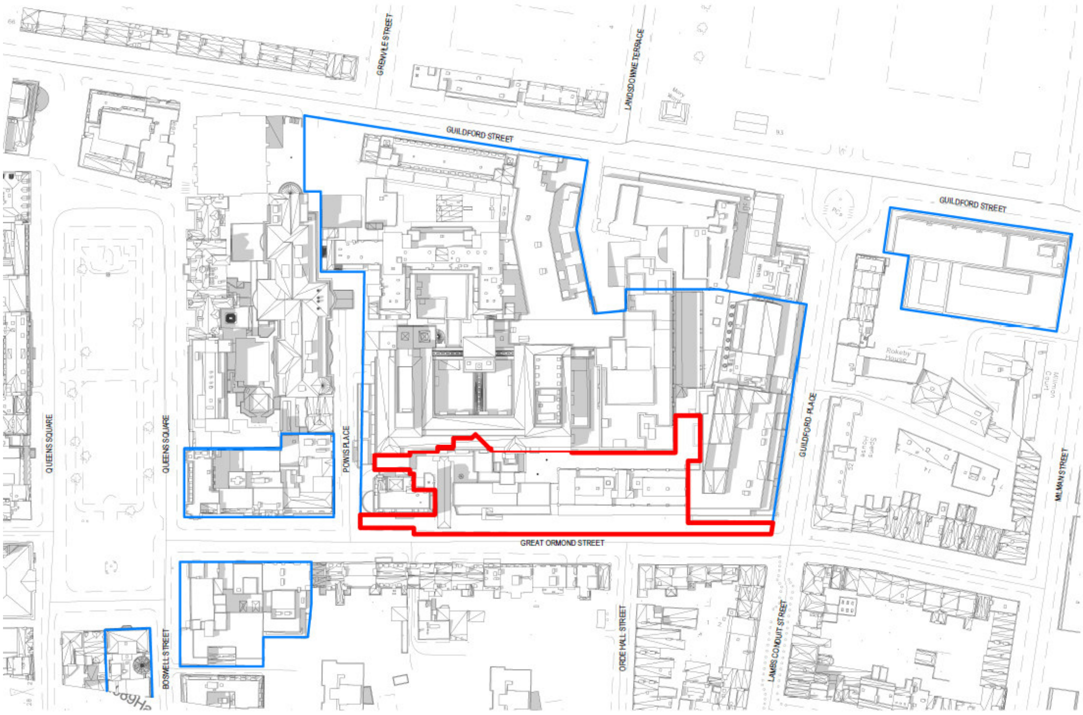
1 INTRODUCTION

RSK Environment Limited (RSK) was commissioned to undertake an assessment of the potential air quality impacts associated with the proposed redevelopment of the Frontage Building for Great Ormond Street Children's Cancer Centre (GOSHCCC), within the London Borough of Camden (LBC). Figure 1.1 shows the redline boundary of the proposed development site.

Figure 1.1: Development Redline Boundary



The redevelopment of the Great Ormond Street Hospital (GOSH) Frontage Building comprises demolition of the existing building and erection of a replacement 8 storey hospital building (Class C2 Use) together with 2 basement floors, roof top, balcony and ground floor landscaped amenity spaces, cycle storage, refuse storage and other ancillary and associated works pursuant to the development.

It is understood that the redevelopment and therefore the ground impact will be largely restricted to the footprint of the existing Frontage Building, although the north-west face of the GOSHCCC will be extended into an existing courtyard and vehicle access to the rear of the building.

The existing building consists of six levels (Frontage). The basement level is represented by the courtyard and vehicle access to the rear of the Frontage building and the base of the light wells along Great Ormond Street, while level 2 is at street level. The proposed development will comprise 10 floors of accommodation and plant of which 2 floors will be located below ground (one level below the existing lower ground floor).

This report presents the findings of an assessment of existing/baseline air quality conditions and potential air quality impacts during the construction and operational phase of the proposed development. The report also contains an 'air quality neutral' assessment, and recommends mitigation measures as appropriate.

2 LEGISLATION, PLANNING POLICY AND GUIDANCE

2.1 Air Quality Strategy

UK air quality policy is published under the umbrella of the Environment Act 1995, Part IV and specifically Section 80, the National Air Quality Strategy. The latest *Air Quality Strategy for England, Scotland, Wales and Northern Ireland – Working Together for Clean Air*, published in July 2007 sets air quality standards and objectives for ten key air pollutants to be achieved between 2003 and 2020.

The EU (European Union) Air Quality Framework Directive (1996) established a framework under which the EU could set limit or target values for specified pollutants. The Directive identified pollutants for which limit or target values have been, or will be setin subsequent 'daughter directives'. The framework and daughter directives were consolidated by Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe, which retains the existing air quality standards and introduced new objectives for fine particulates ($PM_{2.5}$).

2.1.1 Air Quality Objectives and Standards

The air quality standards (AQSs) in the United Kingdom are derived from the European Commission (EC) Directive 2008/50/EC and are adopted into English law via the Air Quality (England) Regulations 2000 and Air Quality (England) Amendment Regulations 2002. The relevant[1] air quality objectives and AQSs for England and Wales to protect human health are summarised in Table 2.1. The standard for $PM_{2.5}$ is a target value and is not legally binding.

Table 2.1: Air Quality Objectives and Standards Relevant to the Proposed Development

Substance	Averaging period	Exceedances allowed per year	Ground level concentration limit (μg/m^3)
Nitrogen dioxide (NO_2)	1 calendar year	-	40
	1 hour	18	200
Particles (PM_{10})	1 calendar year	-	40
	24 hours	35	50
$PM_{2.5}$	1 year	N/A	25

2.1.2 The Environment Act

The set objectives are to be used in the review and assessment of air quality by local authorities under Section 82 of the Environment Act (1995). If exceedances are

[1] Relevance, in this case, is defined by the scope of the assessment.

measured or predicted through the review and assessment process, the local authority must declare an air quality management area (AQMA) under Section 83 of the Act, and produce an air quality action plan to outline how air quality is to be improved.

2.2 Planning Policy and Guidance

The land use planning process is a key means of improving air quality, particularly in the long term, through the strategic location and design of new developments. Any air quality concern that relates to land use and its development can be a material consideration in the determination of planning applications.

2.2.1 National Planning Policy Framework

In 2021 the revised National Planning Policy Framework (NPPF) was published, superseding the previous NPPF with immediate effect. The NPPF includes a presumption in favour of sustainable development.

Section 15 of the NPPF deals with Conserving and Enhancing the Natural Environment, and states that the intention is that the planning system should prevent *'development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability' and goes on to state that 'new development [should be] appropriate for its location' and 'the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as wells as the potential sensitivity of the site or wider area to impacts that could arise from the development.'*

With specific regard to air quality, the NPPF states that: *"Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan."*

2.2.2 Regional Planning Policy

In March 2021 the latest version of the London Plan was adopted. Policy SI 1 Improvingair quality states:

"A Development Plans, through relevant strategic, site-specific and area-based policies, should seek opportunities to identify and deliver further improvements to air quality and should not reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality.
B To tackle poor air quality, protect health and meet legal obligations the following

criteria should be addressed:

1) Development proposals should not:

a) lead to further deterioration of existing poor air quality

b) create any new areas that exceed air quality limits, or delay the date at which compliance will be achieved in areas that are currently in exceedance of legal limits

c) create unacceptable risk of high levels of exposure to poor air quality.

2) In order to meet the requirements in Part 1, as a minimum:

a) development proposals must be at least Air Quality Neutral

b) development proposals should use design solutions to prevent or minimise increased exposure to existing air pollution and make provision to address local problems of air quality in preference to post-design or retro-fitted mitigation measures

c) major development proposals must be submitted with an Air Quality Assessment. Air quality assessments should show how the development will meet the requirements of B1

d) development proposals in Air Quality Focus Areas or that are likely to be used by large numbers of people particularly vulnerable to poor air quality, such as children or older people should demonstrate that design measures have been used to minimise exposure.

C Masterplans and development briefs for large-scale development proposals subject to an Environmental Impact Assessment should consider how local air quality can be improved across the area of the proposal as part of an air quality positive approach. To achieve this a statement should be submitted demonstrating:

1) how proposals have considered ways to maximise benefits to local air quality, and

2) what measures or design features will be put in place to reduce exposure to pollution, and how they will achieve this.

D In order to reduce the impact on air quality during the construction and demolition phase development proposals must demonstrate how they plan to comply with the Non-Road Mobile Machinery Low Emission Zone and reduce emissions from the demolition and construction of buildings following best practice guidance.

E Development proposals should ensure that where emissions need to be reduced to meet the requirements of Air Quality Neutral or to make the impact of development on local air quality acceptable, this is done on-site. Where it can be demonstrated that emissions cannot be further reduced by on-site measures, off-site measures to improve local air quality may be acceptable, provided that equivalent air quality benefits can be demonstrated within the area affected by the development."

<u>The Sustainable Design and Construction Supplementary Planning Document (SDC SPG)</u>

The SDC SPG, which was adopted in 2014 to accompany the London Plan, provides detail on how air quality and air quality neutral assessments should be undertaken. It also sets minimum target emissions standards for CHP and biomass boilers and includes recommendations for reducing the impacts of point sources on local air quality.

<u>The Control of Dust and Emissions during Construction and Demolition Supplementary Planning Guidance, 2014 ('the MOL SPG')</u>

Following an assessment of the impacts of fugitive dust and emissions on local air quality, the MOL SPG (which was adopted in 2014 to accompany the London Plan) report outlines a mechanism for assigning mitigation measures proportionate to the dust 'risks'identified. The MOL SPG recommends that the latest version of the IAQM construction dust guidance is followed to undertake the risk assessment; therefore this document hasalso been listed below.

2.2.3 Local Planning Policy

Camden Local Plan

Policy CC4 Air Quality of the LBC 2017 Local Plan states the following:

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

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

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

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

Camden Planning Guidance: Air Quality (2021)

The Air Quality Supplementary Planning Guidance adopted in 2021 provides information on key air quality issues and support Local Plan Policy CC4 Air quality (outlined above).

2.2.4 Best Practice Guidance - Land-Use Planning & Development Control: Planning for Air Quality (Environmental Protection UK and Institute of Air Quality Management, 2017) ('the EPUK-IAQM guidance')

This guidance, issued by the Institute of Air Quality Management in 2017, provides guidance on the steps which may be taken assess odour impact and outlines the steps which should be taken to predict or observe odour concentrations at these receptors to this end.

Environmental Protection UK (EPUK) and the IAQM jointly published a revised version of the guidance note 'Land-Use Planning & Development Control: Planning for Air Quality' in 2017 (herein the 'EPUK-IAQM' guidance) to facilitate the consideration of air quality in the land-use planning and developmental control process. It provides a framework for air quality considerations within local development control processes, promoting a consistent approach to the treatment of air quality issues within development control decisions.

2.2.5 Best Practice Guidance - Local Air Quality Management Technical Guidance (Department for Environment, Food and Rural Affairs, 2016)

The Department for Environment, Food and Rural Affairs (Defra) has published the above technical guidance for use by local authorities in their air quality review and assessment work. This guidance, referred to in this document as LAQM.TG.16, has been used where appropriate.

2.2.6 Best Practice Guidance - Guidance on the Assessment of Dust from Demolition and Construction (Institute of Air Quality Management (IAQM), 2014) ('the IAQM 2014 guidance')

The IAQM 2014 guidance establishes a method for the assessment of dust and emissions generated during the construction phase of a development, each for demolition, earthworks, construction and trackout. For each construction activity, the risk of dust arising to cause annoyance and/or health or ecological impacts is determined using three risk categories: low, medium and high risk. The risk category may be different for each of the four activities and depends on sensitivity of the area.

The assessment is used to define the appropriate level of mitigation required and the measures to reduce the identified potential impact. The method is summarised in Appendix A of this report.

2.2.7 Best Practice Guidance – Air Quality and Planning Guidance (The London Air Pollution Planning and the Local Environment (APPLE) working group, 2007) ('the APPLE guidance')

The APPLE guidance outlines an appropriate procedure to adopt in the preparation of an air quality assessment, a framework to assess significance where new receptors are being exposed to poor ambient air quality, and appropriate mitigation measures.

The exposure assessment significance criteria have been adopted within this assessment with regard to annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations.

2.2.8 Guidance Document – Air Quality Neutral Planning Support ('the GLA AQN guidance')

The GLA AQN guidance, published in 2014, provides a description of the 'air quality neutral' concept, including methods to calculate building and transport-related emissions associated with the development to building and transport emissions benchmarks. The guidance has been designed to enable assessment of air quality neutrality as is required in the SDC SPG. Relevant excerpts from the EPUK-IAQM guidance are summarised in Appendix C.

3 ASSESSMENT SCOPE AND METHOD

3.1 Overall Approach

The approach taken for assessing the potential air quality impacts of the proposed development may be summarised as follows:

- Consultation with London Borough of Camden (LBC);
- Characterisation of baseline air quality;
- Qualitative impact assessment of construction phase of the development;
- Advanced dispersion modelling assessment of air quality impacts of the proposeddevelopments under the following scenarios:
  - **Scenario 1 (S1):** 'Base case' scenario (2018) using 2018 emissions factors from the emissions factor toolkit (EFT);
  - **Scenario 2 (S2): Without development scenario during 2026**, the anticipated year of proposed development operation, without the proposed development in place but with the Tybald's Estate consented scheme in place, using 2026 emissions factors from the EFT;
  - **Scenario 2a (S2a) worst case sensitivity test scenario: Without development scenario during 2026**, without the proposed development in place but with the Tybald's Estate consented scheme in place, using 2018 NO_x, PM_{10} and $PM_{2.5}$ emissions factors from the EFT;
  - **Scenario 3 (S3): With development scenario during 2026**, with the proposed development and Tybald's Estate consented scheme in place, using 2026 emissions factors from the EFT; and,
  - **Scenario 3a (S3a) worst case sensitivity test scenario: With development scenario during 2026**, with the proposed development and Tybald's Estate consented scheme in place, using 2018 NO_x, PM_{10} and $PM_{2.5}$ emissions factors from the EFT;
- Determination of whether the development can be classified as 'air quality neutral';
- Recommendation of mitigation measures, where appropriate, for any adverse effects on air quality and to allow for the development to be classified as air quality neutral; and,
- Assessment of residual impacts resulting from the proposed development.

3.2 Baseline Characterisation

Existing or baseline air quality refers to the concentrations of relevant substances that are already present in ambient air. These substances are emitted by various sources, including road traffic, industrial, domestic, agricultural and natural sources.

A desk-based study has been undertaken using data obtained from continuous and diffusion tube monitoring stations maintained by LBC and installed along Great Ormond Street as part of the Breathe London programme. It has also reviewed estimated pollutant concentrations from the London Atmospheric Emissions Inventory (LAEI) and from the LAQM (Local Air Quality Management) Support/ United Kingdom Air Information Resource (UK-AIR) website maintained by the Department for Environment, Food and Rural Affairs (Defra).

3.3 Construction Phase Impact Assessment

Construction of the proposed development may have the potential to lead to the release of fugitive dust and PM_{10}. There are human receptors (residential and hospital use) within close proximity of the boundary of thesite and within 50m of the trackout route; therefore, a full qualitative construction impact assessment has been undertaken, in accordance with the IAQM 2014 guidance.

Appendix A explains how the magnitude of impacts associated with demolition, earthworks, construction and trackout, is combined with the sensitivity of ecological receptors, and human receptors to particulate matter and dust nuisance, to determine the overall dust risk.

3.4 Operation Impact Assessment

Dispersion modelling was undertaken to assess the impacts of the proposed development (in terms of road traffic) on the local area, and to determine the impact of ambient air quality on future site users. It is understood that the only point sources proposed for the development are standby generators. These emissions sources have been assessed separately and the report is reproduced in Appendix G.

The method utilised to determine the significance of impacts associated with the proposed development was the EPUK-IAQM guidance (see Appendix B).

3.5 Air Quality Neutral Assessment

The air quality neutral assessment has been undertaken with reference to the SDC SPG (2014) and the Moorcroft et al. (2014) 'Air Quality Neutral Planning Support' guidance (the GLA AQN guidance). A description of the 'air quality neutral' concept including building and transport emission benchmarks with reference to these guidance documents is presented in Appendix D. The approach taken for the air quality neutral assessment for the proposed development may be summarised as follows:

- Estimation of building and transport emissions associated with the development and comparison against the provided benchmarks; and,
- Recommendations of measures to reduce the total emissions, where appropriate, in order for the development to be classified as 'air quality neutral' as per the definitions in the guidance documents.

4 BASELINE AIR QUALITY CHARACTERISATION

4.1 Emissions Sources and Key Air Pollutants

Existing or baseline air quality refers to the concentrations of relevant substances that are already present in ambient air. These substances are emitted by various sources, including road traffic, industrial, domestic, agricultural and natural sources.

The following sources of baseline information were investigated to characterise the air quality baseline:

- The presence of air quality management areas (AQMAs) at and around the site;
- Air quality monitoring data from the LBC and neighbouring London Borough of Islington (LBI);and,
- Estimated background concentrations in the LAQM Support website operated by Defra.

4.2 Presence of AQMAs

The proposed development site is located within the LBC and LBI Borough-wide AQMAs. The LBC AQMA was declared in 2002 due to exceedances of annual mean NO_2 and 24-hour mean PM_{10} AQSs. The LBI AQMA was declared in 2001 due to exceedances of annual and 1-hour mean NO_2 and 24-hour mean PM_{10} AQSs.

4.3 Baseline Monitoring Data

According to the 2019 LBC Annual Status Report, there are seven locations within 1km of the site which monitor NO_2, PM_{10} and/or $PM_{2.5}$ using either automatic 'reference method' monitors or passive NO_2 diffusion tubes. An AQMesh indicative automatic monitor, measuring NO_2 and $PM_{2.5}$, has also been installed along Great Ormond Street as part of the Breathe London programme.

Monitored annual mean NO_2 concentrations are presented in Table 4.1 below. It shows generally high results with many sites exceeding the NO_2 air quality standard. Monitored annual mean NO_2 concentrations at the three urban background are all below the annual mean NO_2 AQS, however monitored annual mean NO_2 concentrations at the roadside locations are above the annual mean NO_2 AQS. It should be noted that the monitoring data from 2020 should be treated with caution as pollution levels were greatly impacted by the Covid-19 restrictions.

Table 4.1: LBC monitoring site data within 1km of site

Site ID	Site Description	Site Type	Approx. Distance from Site (km)	Annual Mean NO_2 Concentration (µg/m^3)						
				2014	2015	2016	2017	2018	2019	2020
BB	Great Ormond St.	Roadside	0.0	-	-	-	-	-	38.4*	**40.2****
CA6	Wakefield Gardens	Urban Background	0.40	36.4	35.8	31.3	-	26.7	24.6	-
1	London Bloomsbury	Urban Background	0.41	**45**	**48**	**42**	38	36	32	28
CA21	Bloomsbury Street	Roadside	0.71	**80.82**	**71.43**	**72.20**	**80.67**	**59.4**	**48.5**	28.8
CA10	Tavistock Gardens	Urban Background	0.72	**46.5**	**44.6**	39.7	-	35.4	33.1	26.2
CA4	Euston Road	Roadside	0.86	**89.7**	**86.8**	**82.7**	**84.9**	**69.2**	-	-
3	Euston Road	Roadside	0.89	-	-	-	-	**82.3**	-	-
Air Quality Strategy (AQS) Objective				**40**						

Note: BB – Breathing Buildings monitor installed along Great Ormond Street. * Data measured from 5th May – 31st December 2019. **Data measured from 1st January to 30th November 2020.

4.4 Defra UK-AIR Background Data

Estimated background air quality data are available from the LAQM Support website operated by the Defra. The website provides estimated annual average background concentrations of NO_x, NO_2, PM_{10} and $PM_{2.5}$ on a 1 km^2 grid basis.

Table 4.2 identifies estimated annual average background NO_x, NO_2, PM_{10} and $PM_{2.5}$ concentrations at the proposed development site for the years 2020 to 2022. None of the NO_2, PM_{10} or $PM_{2.5}$ estimated background concentrations exceed their respective annual mean AQSs. As Defra has predicted that concentrations will fall with time, exceedances of background NO_2, PM_{10} and $PM_{2.5}$ concentrations would not be expected beyond the proposed development opening year of 2026.

Table 4.2: Estimated Background Annual Average NOx, NO_2, PM_{10} and $PM_{2.5}$ Concentrations at Proposed Development Site (2018 base maps)

Assessment Year	Estimated Annual Average Pollutant Concentrations Derived from the LAQM Support Website (µg/m^3)			
	Annual Average NO_x	Annual Average NO_2	Annual Average PM_{10}	Annual Average $PM_{2.5}$
2020	64.8	37.3	19.7	12.6
2021	62.8	36.4	19.5	12.4
2022	61.0	35.5	19.3	12.2
Air Quality Objective	**30^**	**40**	**40**	**25**

Notes: Presented concentrations for 1km² grid centred on 530500, 182500;
^air quality objective designated for the protection of vegetation and ecosystems only.

4.5 London Atmospheric Emissions (LAEI) Data

According to the LAEI website, the site was modelled as being in a location where annual mean NO_2 concentrations marginally exceeded the AQS during 2016 (40-49µg/m^3, depending on location on site). However, the annual mean PM_{10} and $PM_{2.5}$ AQSs were not predicted to be exceeded.

5 OPERATIONAL PHASE ASSESSMENT METHODOLOGY

The following subsections provide further information regarding input to the dispersion model including traffic emissions sources, meteorological data and receptors included, and the outcomes of the assessment.

5.1 Modelling Software

ADMS-Roads Extra (Version 4.1) was used for assessing the air quality impacts of road traffic emissions sources during the operational phase of the proposed development.

5.2 Traffic Data

Baseline traffic data for Great Ormond Street Hospital were obtained from Automatic Traffic Counts (ATC) commissioned by RSK Land and Development Engineering Limited (RSK LDE). RSK LDE estimated the annual average daily traffic (AADT) flows, percentage of heavy-duty vehicles (percentage HDVs, i.e. lorries, buses and coaches) and speeds(km/h) along this road.

In the absence of data (in the above format) applicable to the remaining network of other roads, 2018 count data were downloaded from the Department for Transport (DFT) website for a 2018 base year, or the London Atmospheric Emissions Inventory (Kings College London, 2019) for a 2016 base year. 2016 base year traffic were factored to 2018 using a growth factor provided by RSK LDE.

To obtain data for S2, 2018 data were factored to 2026 using 2018-2016 growth factor provided. Traffic from the development were then added onto the local road network as appropriate.

It is understood that the proposed development when in operation is not expected to affect the existing traffic levels of the hospital itself, however, it will result in traffic flows along Great Ormond Street being modified from two-way to one-way flows (during the construction period and potentially permanently during the operation period). We understand that there is expected to be a net reduction of 717 vehicles (expressed as a 24-hour AADT) using Great Ormond Street,although an 24-hour AADT increase of 847 along Boswell Road (which necessarily has to turn left onto Theobold's Road for at least a short distance). For a worst case assessment, it has been assumed that all of this traffic passes from the junction of Boswell Road and Theobald's Road to the four-way junction of Theobold's Road with Grey's Inn Road. By applying this worst case approach, the lower vehicle speeds and greater number of roads connecting at the Theobold's Road/ Grey's Inn Road junction would be expected to result in higher predicted pollutant concentrations. Pollutantconcentrations in the vicinity of the Grey's Inn Road / Theobald's Road junction are therefore expected to be lower.

During consultation with LBC, LBC requested the cumulative air quality effects of developments within 100m of the development site to be considered. Following a review of developments located within 100m of the proposed development site, it is noted that Camden's Planning Committee has resolved to grant planning permission for the intensification of the Tybalds Estate through the creation of 56 new homes (planning reference 2021/3580/P)..

Apart from the Tybalds Estate scheme, we are not aware of any other committed/ consented developments which should be considered as a cumulative scheme.

The traffic data (including % heavy duty vehicle/ HDV movements) used in the modelling are presented in Appendix E. The road network included in the dispersion model is presented in Figure 5.1. Speed data for free-flowing sections of road were taken from the ATC data or using professional judgement, with reference to speed limits. Traffic were slowed at junctions in broad accordance with the guidance offered in LAQM TG.16.

5.3 Emission Factors

Version 9.0.1 of the emissions factor toolkit (EFT), published by Defra, has been used to derive vehicle emissions factors (i.e. the amount of pollution emitted from the average vehicle fleet, in g/km/s) for NO_x, PM_{10} and $PM_{2.5.}$ Within the EFT, emission factors are available for all years between 2017 and 2030 and take into account the most recent evidence relating to factors such as advances in vehicle and exhaust technology and changes in composition of the vehicle fleet. The emission factors consequently reduce over time.

There has historically been uncertainty regarding the rate of drop-off in predicted emission factors within the EFT. Air Quality Consultants Limited (AQC) have reviewed EFT v8.0.1 and found that it now reflects the emissions in the CURED tool v1 and v2. Notwithstanding this AQC produced CURED v3a which offers a more conservative approach for emission factors between 2020 and 2030 and assumes the failure of Euro 6d to provide any benefits over and above the 6d.

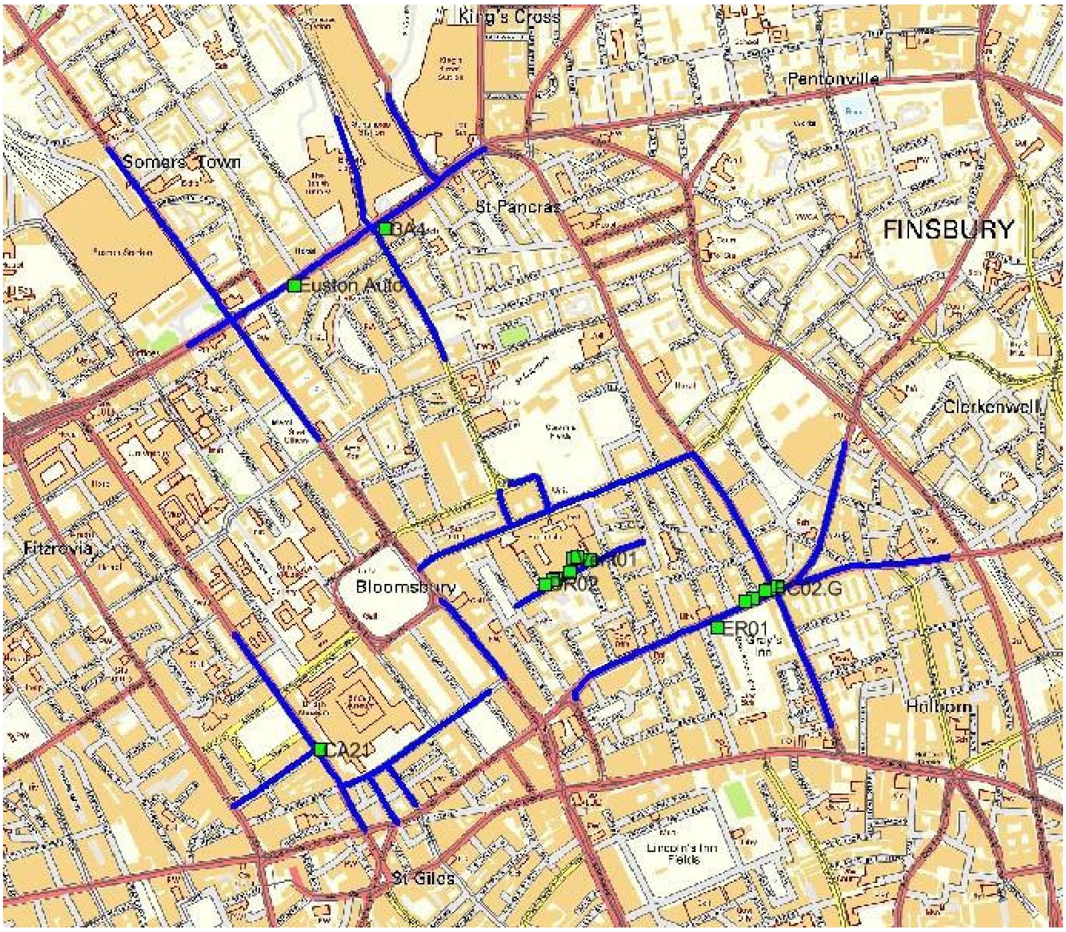
In 2020, following the release of the latest EFT v9.0, AQC undertook a review of emissions factors and have stated *that "The balance of evidence suggests that the EFT is unlikely to over-state the rate at which NO_x and NO_2 concentrations decline in the future at an 'average' site in the UK. In practice, average NO_x and NO_2 concentrations are most likely to decline more quickly in the future than predicted by the EFT. This does not mean that there will be no locations where the EFT under-predicts emissions,* but the most likely situation at most locations, based on current evidence, is that the EFT will overpredict NO_x emissions in the future. On this basis, there seems no need to either update, or continue to use, the CURED mode." Therefore, the EFT has been used in all modelled scenarios.

As requested by LBC, an assessment of the effects of using 2026 traffic data, assuming no reduction in vehicle emissions per unit distance and time has also been undertaken. 2018 EFT v9.0 emissions factors for NO_x, PM_{10} and $PM_{2.5}$ were therefore used in 2026 scenario S2a and S3a, as worst case sensitivity test scenarios.

5.4 Receptor Locations and Model Verification

Pollutant concentrations were predicted at a number of receptors in and around the development site, including two model verification locations (i.e. Euston auto and CA21). Details of all discrete receptors included in the modelling study (and hence the air quality impacts assessed) are summarised in Appendix F. The locations of all assessed receptors are shown in Figure 5.1.

Figure 5.1: Roads and Receptors in and around the Proposed Development Site included in the Dispersion Modelling Assessment



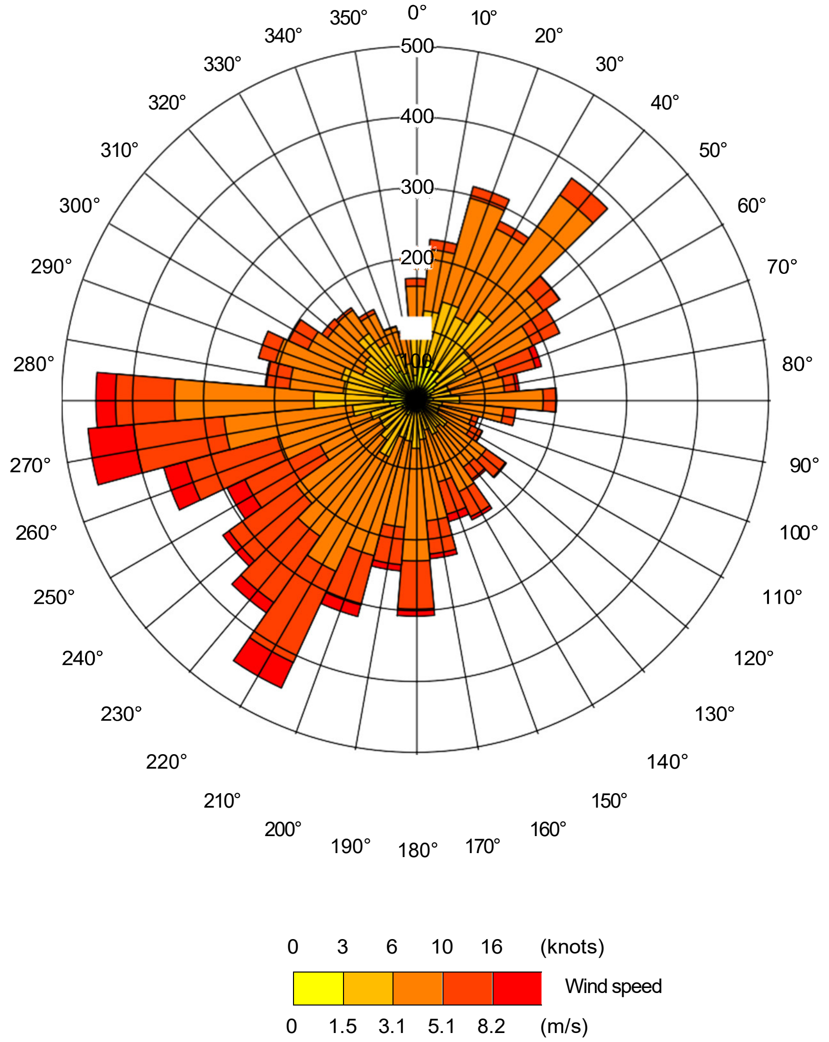
5.5 Time-Varying Profile

Vehicle movements and emissions from the proposed plant may vary with time. These factors are multiplied by the emissions rates (g/km/s), to account for the impacts which hourly variations in traffic volumes using a given road during the year may have on total predicted pollutant concentrations. The national diurnal profile for 2018 (calculated from data downloaded from the DfT website) were applied to all roads. The applied road emissions profiles are displayed in Figure C1 in Appendix C.

5.6 Meteorological Data

Hourly sequential meteorological data were employed in the dispersion model. Data for 2018 from the Heathrow Airport meteorological monitoring station was utilised. The windrose derived from the meteorological data is presented in Figure 5.2, below. The predominant wind direction was south-westerly.

Figure 5.2: Windrose from the Heathrow Airport Meteorological Station in 2018



5.7 Background Air Quality Data Used in the Modelling

Background concentrations used at each receptor location are indicated in Table F5 to F6 in Appendix F.

Background concentrations were derived from the UK-AIR estimated maps, using 2018 concentrations for S1, S2a and S3a, and 2026 concentrations for S2 and S3. Each discrete receptor was modelled using the background applicable for the $1km^2$ site in which it is located, with the exception of DR01, for which the background applied for the remainder of Great Ormond Street Hospital was applied to avoid artificial differences in predicted pollutant concentrations. Concentrations in all scenarios had the 'primary A roads in' contribution removed using version 7 of the 'NO_2 adjustment for NOx sector removal tool' (Defra, 2019) for those receptors located within the 530500, 182500 grid square.

A comparison of the estimated UK-AIR annual mean 2018 NO_2 background concentration for the $1km^2$ grid in which most of the proposed development site is located with 2018 concentrations monitored at the nearby London Bloomsbury automatic monitoring location was undertaken. As the UK-AIR background concentrations were higher, the 2018 UK-AIR background concentrations were applied, for a conservative assessment approach.

5.8 Other Model Input Parameters

The modelling input parameters for the dispersion modelling assessment are presented in Table 5.5.

Table 5.5: Summary of Remaining Inputs to the Dispersion Model

Parameter	Input into model
On-site point sources	RSK understand that within the proposed development there is no boiler plant proposed, as the new building is based on an electric heat pump solution, with heat andcooling occasionally being provided by the existing combined heat and power (CHP) plant and boilers provided in the existing Hospital energy centre. Specifications and emissions parameters for the proposed plant and at the existing Hospital's energy centre were not made available at the time of writing. However, through verbal communication with Brian Needham at Great Ormond Street Hospital, it is understood that the Hospital is served by two existing CHP natural gas fuelled plant which operate continuously at up to full power output (2no. Jenbacher J20 1.4MW plant) and four natural gas fuelled boilers. According to Brian Needham, the boilers a combined capacity of up to 14MW, although typically (except in very cold spells), only 1.5 – 2MW of capacity is used at any one time

Parameter	Input into model
	with power output at any one time not expected to exceed 40%. The boiler flues are located approximately 55m horizontally from the intake to the mechanical ventilation system serving the proposed development and the CHP flues approximately 110m northwest of the intake. RSK understand that the generators shown in the proposed development plans are emergency standby generators. These will only be required in emergency conditions and for a monthly 3-hour test run. Emissions from the emergency standby generators are assessed separately (report reference: 444719-01 (00)), reproduced in Appendix G Based on the above information, it is not initially considered that the existing plant and the proposed emergency standby generators would have a significant adverse effect on future occupiers of the proposed development.
Road elevation	No terrain file used
Road width	Road widths determined based on approximate measurement of roads (internet).
Canyon heights	An 'advanced' canyon was included near existing and proposed receptors and the verification locations as appropriate (i.e. along Great Ormond Street and parts of Southampton Row, Euston Street and Theobald's Street).
Road type	London (Central) settings used
Latitude	51.53°
Surface roughness	1.5m (0.5m at the meteorological site)
Monin-Obukhov length	30m at proposed development site and surrounding area

5.9 Interpretation of Modelled NOx, PM_{10} and $PM_{2.5}$ Concentrations

The following method was used to estimate total annual mean concentrations:

- Modelled road NO_x, PM_{10} or $PM_{2.5}$ concentrations were verified using the method set out in Appendix E of this report and as per LAQM TG.16;
- The road source NO_2 at each receptor was estimated from the verified modelled NO_x concentration using version 7.1 of the NO_x to NO_2 calculator; and,
- The total annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations were calculated by summing the road and background annual mean concentrations.

To calculate the number of days per annum where the daily mean PM_{10} AQS may be exceeded, the following formula, derived from the Local Air Quality Management Technical Guidance (2016), has been used: =-18.5+0.00145*([N] ^3)+(206/[N]), where [N] is the predicted annual mean concentration at each receptor location.

LAQM TG.16 states that "*Research carried out on behalf of Defra and the Devolved Administrations identified that exceedances of the NO_2 1-hour mean are unlikely to occur where the annual mean is below 60µg/m^3.*" Although this criterion is typically applied to monitoring data, this criterion (as is best practice) has also been used to determine the potential for exceedances of the hourly mean NO_2 AQS.

Due to exceedances of the 60µg/m^3 threshold (predicted following completion of the modelling undertaken in Section 6.2), it was necessary to use the ADMS chemistry module for the purposes of predicting hourly mean NO_2 concentrations in S3a. The method used in this process is described in Section 5.10.

5.10 Prediction of Hourly Mean NO_2 concentrations

The ADMS chemistry module was used to predict the 99.79th percentile of hourly mean NO_2 concentrations. 2018 NOx, NO_2 and ozone data recorded at the London Bloomsbury automatic monitor were used. NO_2 emissions factors, calculated by multiplying the NOx emissions factors by the % of primary NO_2 emitted from each road link, were also utilised, as was the night-time chemistry module.

5.11 Assessment and Comparison to Air Quality Standards

The magnitude of changes in annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations associated with the proposed development was assessed in accordance with the EPUK-IAQM 2017 guidance. The EPUK-IAQM method used is summarised in Appendix B of this report.

For receptors modelled at the façade of the proposed development, the annual mean NO_2, PM_{10} and $PM_{2.5}$ concentrations, and daily mean PM_{10} concentrations, were also compared to the Air Pollution Exposure Criteria (APEC). Significance of effects was determined using professional judgement, based on the impact magnitudes assigned and the APEC exposure criteria assigned to the on-site receptors.

The results of the dispersion modelling are presented in Section 6.2 and Appendix E.

5.12 Additional Uncertainties and Assumptions

- No on-site background monitoring was undertaken and therefore it is assumed that background data used are likely to reasonably represent conditions at site;
- Emissions from the average vehicle fleet using the local road network cannot be known, and therefore it is assumed those generated by the EFT and CURED toolkit (as appropriate) provided an accurate representation of emissions generated by vehicles which currently and will use the modelled roads;
- There will be uncertainties introduced because the modelling has simplified real-world processes into a series of algorithms. For example, it has been assumed that wind conditions measured at Heathrow Airport in 2018 are representative of wind conditions at the site. Furthermore, it has been assumed that the subsequent dispersion of emitted pollutants will conform to a Gaussian distribution over flat terrain in order to simplify the real-world dilution and dispersion conditions;
- In the absence of data indicating the length of traffic ‘queues’ at strategic junctions available to RSK at the time of writing, queues have not been included in ADMS;

- The traffic data derived from the London Atmospheric Emissions Inventory (LAEI) is used by Kings College London to undertake air quality dispersion modelling applicable to all areas within the M25. The data used within this source is derived from manual counts, DfT count sites, Transport for London count sites and modelled data. Some of the data used within the LAEI are estimated or extrapolated based on old count points, and therefore may be less accurate than would have been obtained had an up-to-date traffic count been undertaken; and, the national diurnal profile published by the Department for Transport for 2018, has been assumed to be applicable for the roads assessed; and,
- There is an element of uncertainty in all measured and modelled data. All values presented in this chapter are best possible estimates.

6 IMPACT ASSESSMENT

6.1 Construction Phase

Atmospheric emissions from demolition and construction activities will depend on a combination of the potential for emissions (the type of activity and prevailing conditions) and the effectiveness of control measures. In general terms, there are two sources of emissions that will need to be controlled to minimise the potential for adverse environmental effects:

- exhaust emissions from site plant, equipment and vehicles; and,
- fugitive dust emissions from site activities.

6.1.1 Exhaust Emissions from Plant and Vehicles

The operation of plant, goods vehicles, and vehicles used by site personnel, will result in the emission of exhaust gases containing the pollutants NO_x, PM_{10}, volatile organic compounds, and carbon monoxide (CO). The quantities emitted depend on factors such as engine type, service history, pattern of usage and fuel composition.

Vehicle and plant movements will result in emissions to atmosphere of exhaust gases, but vehicle movements to and from the site will be on a temporary basis and can be mitigated following the implementation of construction phase travel plans and construction logistics plans, and plant emissions are unlikely to be significant when compared to background NO_2 and PM_{10} concentrations. Further details are provided in Section 7.1.

6.1.2 Fugitive Dust Emissions

Fugitive dust emissions arising from construction activities are likely to be variable in nature and will depend upon the type and extent of the activity, soil type and moisture, road surface conditions and weather conditions. Periods of dry weather combined with higher than average wind speeds have the potential to generate more dust.

Construction activities that are considered to be the most significant potential sources of fugitive dust emissions are:

- Demolition – demolition of the existing Frontage Building;
- Earthworks – excavations will be carried out for the piled foundations and two basement floors;
- Construction – a new circa 17,000m^2 building. The building to be constructed will be 10 floors of plant and accommodation of which two will be below ground level; and
- Trackout.

Fugitive dust arising from construction activities is mainly of a particle size greater than the PM_{10} fraction (that which can potentially impact upon human health), however it is noted that construction activities may contribute to local PM_{10} concentrations.

Appropriate dust control measures can be highly effective for controlling emissions from potentially dust generating activities identified above, and adverse effects can be greatly reduced or eliminated.

6.1.3 Potential Dust Emission Magnitude

With reference to the criteria outlined in Appendix A, the dust emissions magnitudes for earthworks, construction and trackout activities are summarised in Table 6.1. All assumptions incorporated into the assessment have been appropriately signposted. Table 6.2 summarises the dust emissions magnitudes assigned to these four categories, based on the information presented in Table 6.1.

Table 6.1: Summary of Dust Emissions Magnitude of Demolition, Earthworks, Construction and Trackout Activities (before mitigation)

Phase and Definition	Requirement	Answer
1. Demolition	Total volume of buildings to be demolished: <20,000m³ or 20,000–50,000m³ or >50,000m³	20,000-50,000m³
	Any on-site crushing and screening proposed? Yes/No	No crushing to be carried out onsite during works.
	Height of demolition activities above ground: <10m or 10–20m or >20m above ground	10-20m above ground
	Any potential dusty demolition materials on site? Yes/No [NB: Materials which might generate dust could include cutting or sawing wood, concrete, mortar and sandstone among others].	Yes
	What time of year are demolition works to be undertaken? Will works only take place during months where it is wetter than average, all year round, or during months where it is drier than average?	All year round 2022 – 2023
2. Earthworks	Total area where earthworks will take place: <2,500m² or 2,500–10,000m² or >10,000m²	<2,500m²
	Soil type of the site: e.g. sand, silt or clay [Note: This information may be provided in a Geo-Environmental assessment. Where it is not, if the site has been used before and a Geo-Environmental assessment has not been undertaken, please let us know as we will assume that the (made) ground may contain various soil types].	Soil is Lynch Hill Gravel Member and London Clay formation, according to the British Geological Survey website. Made ground is also anticipated.
	Number of earthmoving plant/ vehicles: <5 or 5-10 or >10 vehicles active at any one time	5-10
	Height of stockpiled materials: No materials to be stockpiled, <4m or 4–8m or >8m	4–8m

Phase and Definition	Requirement	Answer
	Estimated weight of material moved: No material moved, <20,000 or 20,000–100,000 or >100,000 tonnes	>100,000 tonnes
	Timing of works: Will works only take place during months where it is wetter than average, all year round, or during months where it is drier than average?	All year round
3. Construction	Total volume of buildings to be built: <25,000m³ or 25,000–100,000m³ or >100,000m³	25,000-100,000m³
	Any on-site concrete batching proposed? Yes/No	No
	Any on-site concrete sandblasting proposed? Yes/No	No
	Any potential dusty construction materials on site? Yes/No [NB: Materials which might generate dust could include cutting or sawing wood, concrete, mortar and sandstone among others].	Yes
4. Trackout	Number of heavy vehicles (>3.5t) per day in/out of the site: <10 or 10–50 or >50	<10
	Surface type of the site: e.g. high clay content [NB: If haulage is not to be undertaken across unsurfaced roads, please let us know. Otherwise, this information may be provided in a Geo-Environmental assessment. Where it is not, if the site has been used before and a Geo-Environmental assessment has not been undertaken, please let us know as we will assume that the (made) ground may contain various soil types].	Soil is Lynch Hill Gravel Member and London Clay formation, according to the British Geological Survey website. Made ground is also anticipated.
	Extent of unpaved road length within the site: <50m or 50–100m or >100m	<50m

Table 6.2: Summary of Dust Emission Magnitude of the Site (Before Mitigation)

Construction Activities	Dust Emissions Class
Demolition	Medium
Earthworks	Medium
Construction	Medium
Trackout	Small

6.1.4 Sensitivity of the Area

The 'area sensitivity' is defined separately for the impacts of dust deposition on ecologically sensitive receptors, the potential for loss of amenity of existing receptors due to soiling, and the impacts of PM10 on human health. To ascertain the distance of receptors of each level of sensitivity from the source, it has been assumed that demolition, earthworks and construction activities occur across the proposed development site as the bulk of the works relate to building upwards and downwards parallel to the existing frontage.

The site entrance/ exit will not move throughout the project lifecycle, although RSK assume that traffic/ plant would enter or exit site via Great Ormond Street throughout due to the proximity of the existing Hospital, which is being retained. Consequently, it has been assumed that trackout may occur on these roads and along Great Ormond Street up to 50 metres from the redline boundary. As all buildings to the north of Great Ormond Street and of the proposed development site formpart of the existing Hospital, which will be retained whilst works commence it has been assumed that there are over 100 receptors which are highly sensitive to PM_{10} within 20m of the site boundary or routes along which trackout may occur. A medium sensitivity to the effects of dust soiling on amenity was also assigned.

The determined area sensitivities to each type of impact, for each phase of construction works, is presented in Table 6.3. The dust emission magnitude for trackout is classed as small (Table 6.4); therefore, trackout may occur along the public highway up to 50m, as measured from site exit. Construction activities are relevant up to 350m from theproposed development site boundary whereas trackout activities are only considered relevant up to 50m from the edge of the road, as per the IAQM guidance.

No sites designated as a site of special scientific interest (SSSI), special protection area (SPA), special area of conservation (SAC), local or national nature reserve, Ramsar site or ancient woodlands within 50m of the application site boundary or the anticipated routes along which trackout may occur. Therefore, following the IAQM guidance ecological receptors have been screened out of the assessment and are not considered further.

Table 6.3: Sensitivity of the Area

Potential Impact		Sensitivity of the surrounding area			
		Demolition	Earthworks	Construction	Trackout
Dust soiling	Receptor sensitivity	High	High	High	High
	Number of receptors	>100	>100	>100	>100
	Distance from the source	<20m	<20m	<20m	<20m
	Sensitivity of the area	**High**	**High**	**High**	**High**
Human health	Receptor sensitivity	High	High	High	High
	Annual mean PM_{10} concentration	24-28µg/m^3 (as per LAEI 2016)	24-28µg/m^3 (as per LAEI 2016)	24-28µg/m^3 (as per LAEI 2016)	24-28µg/m^3 (as per LAEI 2016)
	Number of receptors	>10	>10	>10	>10
	Distance from the source	<20m	<20m	<20m	<20m

Potential Impact		Sensitivity of the surrounding area			
		Demolition	Earthworks	Construction	Trackout
	Sensitivity of the area	**High**	**High**	**High**	**High**

6.1.5 Risk of Impacts

The dust emission magnitudes summarised in Table 6.2 were combined with the sensitivity of the area summarised in Table 6.3, to determine the risk of impacts of construction activities before mitigation, as identified in Table 6.4. Site specific mitigation measures to reduce construction phase impacts are defined based on this assessment in Section 7.

Table 6.4: Summary of the Dust Risk from Construction Activities

Potential Impact	Dust Risk Impact			
	Demolition	Earthworks	Construction	Trackout
Dust soiling	Medium risk	Medium risk	Medium risk	Low risk
Human health	Medium risk	Medium risk	Medium risk	Low risk

6.2 Operational Phase Air Quality Assessment

6.2.1 Impacts of the Development on Local Air Quality

6.2.1.1 Annual Mean NO_2 Concentrations – S2 versus S3

Table 6.5 presents the predicted annual mean NO_2 concentrations under the S2 and S3 scenarios at each of the assessed off-site discrete receptor locations representative of exposure relevant to the annual mean AQS and the results of the impact magnitude assessment undertaken in accordance with the EPUK-IAQM method summarised in Appendix B.

The impact of the development on local air quality was assessed as 'moderate adverse' at ER06.1 and 'negligible' at the remaining receptor locations.

The 'moderate adverse' effect is likely to have been affected by the expected overestimation of traffic flows approaching the Grey's Inn Road / Theobald's Road junction. With this in mind and the generally 'negligible' effects, it is not expected that the scheme would have a significant effect on air quality.

Table 6.5: Comparison of Predicted Long-Term NO_2 Concentrations Under S2 and S3

Receptor ID	Without Development		With Development		% Change NO_2 concentration relative to AQAL	Predicted Impact
	(µg/m^3)	% of AQAL	Total (µg/m^3)	% of AQAL		
ER01	38.44	96	38.57	96	0	Negligible
ER02.1	39.09	98	39.17	98	0	Negligible
ER04	39.95	100	**40.12**	**100**	0	Negligible

Receptor ID	Without Development		With Development		% Change NO_2 concentration relative to AQAL	Predicted Impact
	(µg/m^3)	% of AQAL	Total (µg/m^3)	% of AQAL		
ER05	**40.11**	**100**	**40.29**	**101**	0	Negligible
ER06.1	**48.36**	**121**	**48.82**	**122**	1	Moderate adverse

Notes: AQAL – Air quality action level (i.e. annual mean NO_2 AQS).

6.2.1.2 *Annual Mean NO_2 Concentrations – Sensitivity tests*

Table 6.6 presents the predicted annual mean NO_2 concentrations under the S2a and S3a scenarios at each of the assessed off-site discrete receptor locations representative of exposure relevant to the annual mean AQS and the results of the impact magnitude assessment undertaken in accordance with the EPUK-IAQM method summarised in Appendix B.

The impact of the proposed development on local air quality was assessed as either 'moderate adverse' or 'substantial adverse' at each of the assessed receptor locations and did not lead to any new exceedances of the annual mean NO_2 AQS. However, assuming no reduction in estimated background concentrations or vehicle emissions factors is considered an overly pessimistic approach. When considered alongside the overestimated traffic along Theobald's Road, where the receptors were modelled (arising from traffic on Great Ormond Street being re-routed and not being directly attributable to the scheme), it is envisaged that these impacts are likely to be too pessimistic. For these reasons, these impacts have not been considered further within this report.

Table 6.6: Comparison of Predicted Long-Term NO_2 Concentrations Under S2a and S3a

Receptor ID	Without Development		With Development		% Change NO_2 concentration relative to AQAL	Predicted Impact
	(µg/m^3)	% of AQAL	Total (µg/m^3)	% of AQAL		
ER01	54.91	137	55.24	138	1	Moderate adverse
ER02.1	56.62	142	56.85	142	1	Moderate adverse
ER4	58.65	147	59.08	148	1	Moderate adverse
ER05	59.02	148	59.48	149	1	Moderate adverse
EC06.G	82.19	205	83.46	209	3	Substantial adverse

Notes: AQAL – Air quality action level (i.e. annual mean NO_2 AQS).

6.2.1.3 *Annual Mean PM_{10} Concentrations*

Table 6.7 presents the predicted annual mean PM_{10} concentrations under the S2a and S3a scenarios at each of the assessed off-site discrete receptor locations representative of exposure relevant to the annual mean AQS and the results of the impact magnitude assessment undertaken in accordance with the EPUK-IAQM method summarised in Appendix B.

The impact of the proposed development on local air quality was assessed as 'negligible' at all the relevant modelled existing receptor locations, and concentrations with the development in place were all below the annual mean AQS. As exceedances have not been predicted using the more conservative emissions factors, the same impact magnitudes and lower pollutant concentrations would be expected in S2/ S3 as S2a/ S3a, and therefore these results have not been presented.

Table 6.7: Comparison of Predicted Long-Term PM_{10} Concentrations Under S2a and S3a

Receptor ID	Without Development		With Development		% Change PM_{10} concentration relative to AQAL	Predicted Impact
	(µg/m³)	% of AQAL	Total (µg/m³)	% of AQAL		
ER01	21.22	53	21.28	53	0	Negligible
ER02.1	21.37	53	21.41	54	0	Negligible
ER04?	21.94	55	22.03	55	0	Negligible
ER05	22.04	55	22.14	55	0	Negligible
ER06.1	26.40	66	26.67	67	1	Negligible

Notes: AQAL – Air quality action level (i.e. annual mean AQS).

6.2.1.4 *Impact on Annual Mean $PM_{2.5}$ Concentrations*

Table 6.8 presents the predicted annual mean $PM_{2.5}$ concentrations under the S2a and S3a scenarios at each of the assessed off-site discrete receptor locations representative of exposure relevant to the annual mean AQS and the results of the impact magnitude assessment undertaken in accordance with the EPUK-IAQM method summarised in Appendix B.

The impact of the proposed development on local air quality was assessed as 'negligible' at all the relevant modelled existing receptor locations, and concentrations with the development in place were all below the annual mean AQS. As exceedances have not been predicted using the more conservative emissions factors, the same impact magnitudes and lower pollutant concentrations would be expected in S2/ S3 as S2a/ S3a, and therefore these results have not been presented.

Table 6.8: Comparison of Predicted Long-Term $PM_{2.5}$ Concentrations Under S2a and S3a

Receptor ID	Without Development		With Development		% Change $PM_{2.5}$ concentration relative to AQAL	Predicted Impact
	(µg/m³)	% of AQAL	Total (µg/m³)	% of AQAL		
ER01	12.86	51	12.90	52	0	Negligible
ER02.1	12.97	52	13.00	52	0	Negligible
ER04?	13.31	53	13.37	53	0	Negligible
ER05	13.37	53	13.43	54	0	Negligible

Receptor ID	Without Development (μg/m³)	Without Development % of AQAL	With Development Total (μg/m³)	With Development % of AQAL	% Change $PM_{2.5}$ concentration relative to AQAL	Predicted Impact
ER06.1	16.20	65	16.37	65	1	Negligible

Notes: AQAL – Air quality action level (i.e. annual mean AQS).

6.2.1.5 *Impact on daily mean PM_{10} concentrations*

As shown in Appendix F, the number of exceedances of the daily mean PM_{10} AQS at all modelled existing receptor locations in S3 and S3a was below than the objective of 35 days; the maximum number of days where this AQS was exceeded was eight days (at locations representative of relevant exposure, as per the definition in LAQM TG.16).

6.2.1.6 *Impact on hourly mean NO_2 concentrations*

Table 6.9 presents the predicted hourly mean NO_2 concentrations in S3a. As no exceedances of the hourly mean NO_2 AQS have been identified with the development in place, the impacts of the development on local air quality were not explored further.

Table 6.9: Predicted hourly mean NO_2 concentrations in S3a

Receptor ID	99.79^{th} percentile of Hourly NO_2 concentrations in S3a (μg/m³)
ER01	113.65
EC02.G	115.99
ER02.1	112.63
EC03.G	117.43
ER04?	112.77
ER05	112.96
EC06.G	141.64
ER06.1	134.68

6.2.2 Impact of Future Air Quality on the Proposed Sensitive Receptors

As shown in Table 6.10 below, no exceedances of the annual mean PM_{10} or $PM_{2.5}$ AQSs or the daily mean PM_{10} AQS were predicted at any of the modelled receptor locations in S3a at any of the modelled receptors at the façades of the proposed development site. In addition, no exceedances of the annual mean NO_2 AQS were predicted at the proposed development site in S3. Overall therefore, the site is considered to fall within APEC exposure category A at all modelled receptor locations. The APPLE guidance states that, for APEC-A states that there are *"no air quality grounds for refusal; however mitigation of any emissions should be considered"* (this is explored further in Section 7). On this basis, air quality at the proposed development site is considered likely to be acceptable such that mitigation would not be required.

It is noted that for the worst case sensitivity test scenario (i.e. S3a) exceedances were identified at all modelled receptor locations. With limited research into the reduction rate of background annual mean pollutant concentrations with height, this assessment has necessarily assumed that background pollutant concentrations would not reduce with height. (based on a conservative approach). However, in reality, it can reasonably be expected that pollutant concentrations would reduce with height, as road traffic impacts would reduce with increased distance from the source. As explained in section 6.2.1.1 and section 6.2.2.2, the results predicted in S3a are considered an overestimate (due to the overly conservative assumption that background pollutant concentrations and vehicle emissions factors will not reduce with time) and therefore have not been considered further within this assessment.

Nevertheless, it is understood that a mechanical ventilation system has been proposed for the development, which is expected to reduce annual mean NO_2 concentrations within the building. Further details are provided within Section 7.2 of this assessment.

Table 6.12: Identification of Impact Significance associated with predicted annual mean Concentrations of NO_2, PM_{10} and $PM_{2.5}$ and daily mean PM_{10}

Receptor ID	Height (m)	S3 NO_2 (annual mean)		S3a PM_{10} (annual mean)		S3a $PM_{2.5}$ (annual mean)		S3a PM_{10} (24-hour mean) No. days exceeding AQS	APEC Exposure Category (S3 NO_2, S3a PM_{10} & $PM_{2.5}$)	S3a NO_2 (annual mean)		APEC Exposure Category (with S3a all pollutants)
		µg/m³	% of AQAL	µg/m³	% of AQAL	µg/m³	% of AQAL			µg/m³	% of AQAL	
Vent01	15.60	30.39	76	19.85	50	11.97	47.89	3	APEC-A	40.24	101	APEC-B
Vent02	15.60	30.39	76	19.86	50	11.97	47.90	3	APEC-A	40.24	101	APEC-B
DR01	1.50	32.37	81	20.81	52	12.56	50.26	4	APEC-A	46.26	116	APEC-C
DR02	1.50	32.37	81	20.86	52	12.64	50.56	5	APEC-A	46.63	117	APEC-C
DR03	1.50	30.73	77	20.80	52	12.56	50.25	4	APEC-A	46.25	116	APEC-C
DR04	1.50	32.39	81	20.79	52	12.55	50.22	4	APEC-A	46.15	115	APEC-C
DR05	1.50	32.49	81	20.87	52	12.60	50.41	5	APEC-A	46.6	117	APEC-C
DR11	6.34	30.32	76	20.64	52	12.46	49.84	4	APEC-A	45.25	113	APEC-C
DR12	6.34	30.32	76	20.66	52	12.52	50.06	4	APEC-A	45.4	114	APEC-C
DR13	5.70	32.5	81	20.66	52	12.47	49.89	4	APEC-A	45.37	113	APEC-C
DR14	5.70	32.63	82	20.65	52	12.47	49.87	4	APEC-A	45.3	113	APEC-C
DR15	5.70	32.49	81	20.68	52	12.49	49.95	4	APEC-A	45.48	114	APEC-C
DR21	9.38	32.46	81	20.53	51	12.40	49.58	4	APEC-A	44.6	112	APEC-C
DR22	9.38	32.63	82	20.54	51	12.44	49.76	4	APEC-A	44.66	112	APEC-C
DR23	9.50	32.13	80	20.53	51	12.39	49.56	4	APEC-A	44.55	111	APEC-C
DR24	9.50	32.18	80	20.52	51	12.39	49.55	4	APEC-A	44.51	111	APEC-C
DR25	9.50	32.18	80	20.53	51	12.39	49.56	4	APEC-A	44.53	111	APEC-C
DR31	13.31	32.16	80	20.43	51	12.33	49.32	4	APEC-A	43.94	110	APEC-C
DR32	13.31	32.23	81	20.43	51	12.37	49.49	4	APEC-A	43.97	110	APEC-C
DR33	13.10	31.9	80	20.43	51	12.33	49.32	4	APEC-A	43.95	110	APEC-C
DR34	13.10	31.92	80	20.43	51	12.33	49.32	4	APEC-A	43.93	110	APEC-C
DR35	13.10	31.88	80	20.43	51	12.33	49.31	4	APEC-A	43.91	110	APEC-C
DR41	17.70	31.87	80	20.31	51	12.25	49.02	4	APEC-A	43.19	108	APEC-C
DR42	17.70	31.88	80	20.31	51	12.30	49.18	4	APEC-A	43.21	108	APEC-C
DR43	16.74	31.67	79	20.35	51	12.28	49.11	4	APEC-A	43.42	109	APEC-C
DR44	16.74	31.67	79	20.34	51	12.28	49.11	4	APEC-A	43.41	109	APEC-C
DR45	16.74	31.67	79	20.34	51	12.28	49.10	4	APEC-A	43.39	108	APEC-C
DR51	21.72	31.67	79	20.16	50	12.16	48.64	4	APEC-A	42.24	106	APEC-C
DR52	21.72	31.66	79	20.16	50	12.20	48.81	4	APEC-A	42.25	106	APEC-C
DR53	20.64	31.4	79	20.19	50	12.18	48.74	4	APEC-A	42.47	106	APEC-C
DR54	20.64	31.4	79	20.19	50	12.18	48.74	4	APEC-A	42.47	106	APEC-C
DR55	20.64	31.48	79	20.19	50	12.18	48.73	4	APEC-A	42.45	106	APEC-C
DR63	24.64	31.48	79	20.06	50	12.10	48.40	3	APEC-A	41.6	104	APEC-B

6.3 Air Quality Neutral Assessment

6.3.1 Building Emissions

It is understood that there is no boiler plant proposed as part of the new development. The new building is based on an electric heat pump solution, with heat and cooling occasionally being provided by the existing CHP plant and boilers provided in the existing Hospital energy centre. Therefore, emissions associated with the proposed building has not been assessed further and the development can be considered air quality neutral in respect to building emissions.

6.3.2 Road Transport Emissions

As outlined in the Traffic and Transport Assessment prepared by RSK LDE, it is not expected that the trip generation of the hospital will be affected by the proposed development. Therefore, transport emissions associated with the proposed development has not been assessed further and the development can be considered air quality neutral in respect to transport emissions.

6.4 Significance of Air Quality Effects

This assessment has identified that the development is not expected to introduce proposed development receptors into an area where ambient air quality exceeds the annual mean NO_2, PM_{10} and $PM_{2.5}$ AQSs, the daily mean PM_{10} AQS or the hourly mean NO_2 AQS during the development opening year (2026), unless it is assumed that there are no reductions in annual mean NO_2 background concentrations from 2018 and no reduction in background concentrations with height (both of which are considered unrealistic). Therefore, future ambient air quality is not expected to have a significant adverse effect on future site users.

The proposed development is also expected to have a negligible impact on annual mean PM_{10} and $PM_{2.5}$ concentrations at the modelled existing receptor locations, and is not predicted to lead to exceedances of the daily mean PM_{10} or hourly mean NO_2 AQS. Whilst some moderate adverse effects were predicted on annual mean NO_2 concentrations in both S3 and S3a (as well as a substantial adverse effect in S3a), these are expected to be derived from the likely overestimated increase in traffic at the Grey's Inn Road/ Theobald's Road junction, as well as (for S3a) assuming no reduction in background concentrations and vehicle emissions factors. In both instances, the development did not contribute to a significant increase in emissions from vehicles, as the impacts were identified were predominantly driven by the already high baseline annual mean NO_2 concentrations.

Therefore, on balance and in light of the fact that the development of the new Hospital building itself is not expected to increase car usage and has no on-site car parking, it is considered that the proposed development is unlikely to have significant adverse effect on local air quality. However, rerouting traffic can reasonably be expected to have some adverse effects on air quality. For this reason, mitigation measures which could be adopted to reduce the residual air quality impacts have been recommended within Section 7.2.

7 MITIGATION MEASURES

7.1 Construction Phase Mitigation

The dust emitting activities outlined in Section 6.1 can be effectively controlled by appropriate dust control measures and any adverse affects can be greatly reduced or eliminated. Controls should be applied throughout the construction period to ensure that emissions are mitigated.

Prior to commencement of demolition/construction activities, it is recommended that a dust management plan (DMP), which could form part of a construction environmental management plan, for the construction phase be agreed with the local authority to ensure that the potential for adverse environmental effects on local receptors is minimised. The DMP should include *inter alia*, an appropriate selection of mitigation measures for controlling dust and general pollution from site construction operations (such as those listed in Appendix C), and include details of any monitoring scheme, if appropriate. Having been classed as 'medium' risk, it is envisaged that at least two real- time PM_{10} monitors (i.e. a Nephelometer such as a Turnkey Osiris or TSI Environmental DustTrak) will be required on site.

It is recommended that plant used on-site comply with the NO_x, PM and CO emissions standards specified in the EU Directive 97/68/EC (as replicated in the MOL SPG) and subsequent amendments as a minimum, where they have net power of between 37kW and 560kW. The emissions standards vary depending on the net power the engine produces. It is recommended that these emissions standards are also applied on site. The following actions can be taken to enable compliance:

- Reorganising the fleet;
- Replacing equipment if required;
- Installing retrofit abatement technology (such as by diesel particulate filters in existing NRMM); and,
- 'Re-engining'.

It is also recommended that emissions from construction phase activities are controlled by developing and implementing a Construction Phase Travel and/or Construction LogisticsPlan (both demonstrating that air quality has been considered), to reduce the likelihood of goods and workers arriving in single-occupancy vehicles where this is practicable.

With the proposed construction activities mitigation measures as described in Section 7.2 in place, the likely residual impact of works undertaken during the construction phase on local air quality can be considered as 'not significant'.

7.3 Operational Mitigation – Air Quality

The proposed development has been considered as having an insignificant effect on local air qualityand future ambient air quality at the site is expected to be acceptable. However, it is recommended that, where feasible, the proposed development could require suppliers to only drive vehicles to and from site which only meet specific emissions standards (or 'Euro classes')and could establish a policy on ordering items in bulk to reduce the number of vehicles required to attend the premises.

It is not envisaged that ambient air quality at and around the proposed development site will have a significant adverse effect on future site users. It is understood that no additional combustion sources are proposed as part of the development, except for emergency generators. The emergency generators have been assessed separately through a dispersion modelling assessment (reference: 444719-01 (00)), reproduced in Appendix G.

In any instances where filters are installed on the inlets to the mechanical ventilation system, Great Ormond Street Hospital would need to ensure that they are appropriately maintained throughout the lifetime of the development or until air quality standards (AQSs) are known to be met at the location of the inlets, whichever is sooner.

By taking account of mitigation measures designed to reduce the potential for air quality to affect air quality at and around the site (potentially at the post-planning stage), any residual effects of the development on local air quality can be reduced once the development is operational.

8 SUMMARY AND CONCLUSIONS

An air quality assessment for the proposed redevelopment of the Frontage Building at Great Ormond Street Hospital, London has been undertaken.

Demolition and construction phase impacts may have the potential to occur, due to emissions from vehicles and plant associated with construction related activities, and the generation of dust and PM emissions during the period of construction. The risk of dust impacts was assessed in accordance with the IAQM 2014 guidance and was predicted to be a maximum of 'medium risk' during the construction phase. Mitigation measures have been recommended to reduce the risk of dust and PM being generated and re-suspended, and of construction related traffic and plant. If appropriate mitigation is implemented, theresidual impact of construction phase air quality impacts is likely to be 'not significant'.

This assessment used detailed dispersion modelling software ADMS-Roads to quantify the effects of ambient air quality (with the development in place) on future site users and of additional road traffic attributable to the development on air quality at existing discrete receptor locations.

Based on the findings of the dispersion modelling, the proposed development is not expected to introduce receptors into an area where air quality may be poor and would have an insignificant effect on local air quality. However, this report has recommended mitigation measures to reduce any residual effects from the proposed development on air quality and the impact of ambient air quality on future site users, in Section 7.2. Following the implementation of an appropriateselection of mitigation measures the residual effects fromthe scheme will have been reduced.

APPENDIX A
CONSTRUCTION DUST ASSESSMENT METHODOLOGY

This appendix contains the construction dust assessment methodology used in the assessment. To assess the potential impacts, construction activities are divided into demolition, earthworks, construction and trackout. The descriptors included in this section are based upon the IAQM 2014 guidance. The assessment follows the steps recommended in the guidance.

Step 1 and Step 2 methods from the IAQM 2014 guidance are described in this Appendix to assign dust risk categories for each of the construction activities.

Step 1: Screen the requirement for assessment

The first step is to screen out the requirement for a construction dust assessment, this is usually a somewhat conservative level of screening. An assessment is usually required where there is:

- a 'human receptor' within:
  - 350m of the boundary of the site; or
  - 50m of the route used by construction vehicles on the public highway, up to 500m from the site entrance(s).
- an 'ecological receptor':
  - 50m of the boundary of the site; or
  - 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s).

Step 2A: Defining the Potential Dust Emission Magnitude

Demolition

The dust emission magnitude category for demolition is varied for each site in terms of timing, building type, duration and scale. Examples of the potential dust emission classes are provided in the guidance as follows:

- **Large**: Total building volume >50,000m^3, potentially dusty construction material, on-site crushing and screening, demolition activities >20m above ground level;
- **Medium**: Total building volume 20,000m^3 – 50,000m^3, potentially dusty construction material, demolition activities 10m – 20m above ground level; and,
- **Small**: Total building volume <20,000m^3, construction material with low potential for dust release, demolition activities <10m above ground, demolition during wetter months.

Earthworks

The dust emission magnitude category for earthworks is varied for each site in terms of timing, geology, topography and duration. Examples of the potential dust emission classes are provided in the guidance as follows:

- **Large:** Total site area >10,000m^2, potentially dusty soil type (e.g. clay), >10 heavy earth moving vehicles active at any one time, formation of bunds >8m in height, total material moved >100,000 tonnes;

- **Medium:** Total site area 2,500 – 10,000m^2, moderately dusty soil type (e.g. silt), 5 – 10 heavy earth moving vehicles active at any one time, formation of bunds 4 – 8m in height, total material moved 20,000 – 100,000 tonnes; and,
- **Small:** Total site area < 2,500m^2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4m in height, total material moved <10,000 tonnes, earthworks during wetter months.

Construction

The dust emission magnitude category for construction is varied for each site in terms of timing, building type, duration, and scale. Examples of the potential dust emissions classes are provided in the guidance as follows:

- **Large**: Total building volume >100,000m^3, piling, on site concrete batching;
- **Medium**: Total building volume 25,000 – 100,000m^3, potentially dusty construction material (e.g. concrete), piling, on site concrete batching; and,
- **Small**: Total building volume <25,000m^3, construction material with low potential for dust release (e.g. metal cladding or timber).

Trackout

Factors which determine the dust emission magnitude class of trackout activities are vehicle size, vehicle speed, vehicle number, geology and duration. Examples of the potential dust emissions classes are provided in the guidance as follows:

- **Large**: >100 HDV (3.5t) trips in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100m;
- **Medium**: 25 – 100 HDV (>3.5t) trips in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 – 100m; and,
- **Small**: <25 HDV (<3.5t) trips in any one day, surface material with low potential for dust release, unpaved road length <50m.

<u>Step 2B</u>: Defining the Sensitivity of the Area

The sensitivity of the area is defined for dust soiling, human health and ecosystems. The sensitivity of the area takes into account the following factors:

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

Table A1 has been used to define the sensitivity of different types of receptors to dust soiling, health effects and ecological effects.

Table A1: Sensitivity of the Area Surrounding the Site

Sensitivity of Area	Dust Soiling	Human Receptors	Ecological Receptors
High	• Users can reasonably expect a enjoyment of a high level of amenity. • The appearance, aesthetics or value of their property would be diminished by soiling. • The people or property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. • Examples include dwellings, museums and other culturally important collections, medium and long term car parks and car showrooms.	• Locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day) • Examples include residential properties, hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.	• Locations with an international or national designation *and* the designated features may be affected by dust soiling. • Locations where there is a community of a particularly dust sensitive species such as vascular species included in the Red Data List For Great Britain. • Examples include a Special Area of Conservation (SAC) designated for acid heathlands or a local site designated for lichens adjacent to the demolition of a large site containing concrete (alkali) buildings.
Medium	• Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home. • The appearance, aesthetics or value of their property could be diminished by soiling. • The people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. • Examples include parks and places of work.	• Locations where the people exposed are workers and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). • Examples include office and shop workers, but will generally not include workers occupationally exposed to PM_{10}, as protection is covered by Health and Safety at Work legislation.	• Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown. • Locations with a national designation where the features may be affected by dust deposition. • Example is a Site of Special Scientific Interest (SSSI) with dust sensitive features.

Low	• The enjoyment of amenity would not reasonably be expected. • Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling. • There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. • Examples include playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.	• Locations where human exposure is transient. • Indicative examples include public footpaths, playing fields, parks and shopping streets.	• Locations with a local designation where the features may be affected by dust deposition. • Example is a local Nature Reserve with dust sensitive features.

Based on the sensitivities assigned of the different types of receptors surrounding the site and numbers of receptors within certain distances of the site, a sensitivity classification for the area can be defined for each. Tables A2 to A4 indicate the method used to determine the sensitivity of the area for dust soiling, human health and ecological impacts, respectively.

For trackout, as per the guidance, it is only considered necessary to consider trackout impacts up to 50m from the edge of the road.

Table A2: Sensitivity of the area to dust soiling effects on people and property

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

Table A3: Sensitivity of the area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM_{10} Conc.	Number of Receptors	Distances from the Source (m)				
			<20	<50	<100	<200	<350
High	>32$\mu g/m^3$	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 $\mu g/m^3$	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 $\mu g/m^3$	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 $\mu g/m^3$	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>32$\mu g/m^3$	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	28-32 $\mu g/m^3$	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<28$\mu g/m^3$	>1	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Table A4: Sensitivity of the area to Ecological Impacts

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

<u>Step 2C</u>: Defining the Risk of Impacts

The final step is to use both the dust emission magnitude classification with the sensitivity of the area, to determine a potential risk of impacts for each construction activity, before the application of mitigation. Tables A5 to A7 indicate the method used to assign the level of risk for each construction activity.

Table A5: Risk of Dust Impacts from Demolition

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table A6: Risk of Dust Impacts from Earthworks/Construction

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table A7: Risk of Dust Impacts from Trackout

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

APPENDIX B
OPERATION IMPACT ASSESSMENT METHODOLOGY

This appendix contains the methodology used in the assessment for the operational impact assessment to include reference to EPUK-IAQM guidance.

The impacts of a development are usually assessed at selected 'receptors'. The magnitude of impacts is derived by the percentage of change in pollutant concentration relative to an Air Quality Assessment Level (AQAL) and long term average pollutant concentration at receptor, as presented in Table B1. The significance of effects is then determined using professional judgement.

- **Table B1: Impact Descriptors for Individual Receptors**

Long term average concentration at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
79 – 94% of AQAL	Negligible	Slight	Moderate	Moderate
95 – 102% of AQAL	Slight	Moderate	Moderate	Substantial
103 – 109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

Note: AQAL – air quality assessment level, such as the annual mean NO_2, PM_{10} or $PM_{2.5}$ AQS.

APPENDIX C
SITE-SPECIFIC MITIGATION MEASURES

Site-specific mitigation measures are divided into general measures, applicable to all sites and measures specific to earthworks, construction and trackout. Depending on the level of riskassigned to each site, different mitigation is assigned. The method of assigning mitigationmeasures as detailed in the MOL SPG has been used.

For those mitigation measures that are general, the highest risk assessed has been applied. In this case, the 'medium risk' site mitigation measures have been applied, as determined by the dust risk assessment in Section 6. Two categories of mitigation measure are described in the MOL SPG – 'highly recommended' and 'desirable', which are indicated according to the dust risk level identified in Table 6.6. Desirable measures are presented in *italics*.

Site management

- Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.
- Develop a dust management plan.
- Display the name and contact details of person(s) accountable for air quality pollutant emissions and dust issues on the site boundary.
- Display the head or regional office contact information.
- Record and respond to all dust and air quality pollutant emissions complaints.
- Make a complaints log available to the local authority when asked.
- Carry out regular site inspections to monitor compliance with air quality and dust control procedures, record inspection results, and make an inspection log available to the local authority when asked.
- Increase the frequency of site inspections by those accountable for dust and air quality pollutant emissions issues when activities with a high potential to produce dust and emissions and dust are being carried out, and during prolonged dry or windy conditions.

Preparing and maintaining the site

- Plan site layout: machinery and dust causing activities should be located away from receptors.
- Erect solid screens or barriers around dust activities or the site boundary that are, at least, as high as any stockpiles on site.
- Fully enclosure site or specific operations where there is a high potential for dust production and the site is active for an extensive period.
- Minimise site runoff of water or mud.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove materials from site as soon as possible.

- Carry out regular dust soiling checks of buildings within 100m of site boundary and cleaning to be provided if necessary.
- Agree monitoring locations with the Local Authority. Where possible, commence baseline monitoring at least three months before phase begins.
- Put in place real-time dust and air quality pollutant monitors across the site and ensure they are checked regularly.

Operating vehicle/machinery and sustainable travel

- Ensure all on-road vehicles comply with the requirements of the London Low Emission Zone.
- Ensure all non-road mobile machinery comply with the requirements set in Section 7 of this report.
- Ensure all vehicles switch off engines when stationary – no idling vehicles.
- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment.
- *Impose and signpost a maximum-speed-limit of 10mph on surfaced haul routes and work areas.*
- Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.
- Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).

Operations

- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
- Ensure an adequate water supply on the site for effective dust/particulate matter mitigation (using recycled water where possible).
- Use enclosed chutes, conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
- Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.

Waste management

- Reuse and recycle waste to reduce dust from waste materials
- No bonfires or burning of waste materials.

Specific to Demolition

- *Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).*
- Ensure water suppression is used during demolition operations.

- Avoid explosive blasting, using appropriate manual or mechanical alternatives.
- Bag and remove any biological debris or damp down such material before demolition.

Specific to Earthworks [NB: these measures can be used either instead or in addition to those recommended in the 'preparing and maintaining the site' section. Measures relating to stockpile storage there can also be used instead of those listed here].

- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces.
- Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil.
- Only remove secure covers in small areas during work and not all at once.

Specific to Construction

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

Specific to Trackout

- *Regularly use a water-assisted dust sweeper on the access and local roads, as necessary, to remove any material tracked out of the site.*
- *Avoid dry sweeping of large areas.*
- *Ensure vehicles entering and leaving sites are securely covered to prevent escape of materials during transport.*
- *Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).*

APPENDIX D
AIR QUALITY NEUTRAL ASSESSMENT

Application of the Air Quality Neutral Policy

The GLA's Air Quality Neutral Planning Support Update document published in April 2014 provides guidance on the application of the 'air quality neutral' policy. The air quality neutral policy is said to be applicable to proposed developments with ten or more residential dwellings (or an area of more than 0.5ha) and for all other uses, where the floor space is 1,000m^2 or more (or when the site area is more than 1ha).

There are a number of options available when judging whether a proposed development is air quality neutral, taking into account different types of development and how much information is know on the existing use and the proposed use. The options are presented below.

The guidance has established a building emissions benchmark (BEB) and transport emissions benchmark (TEB) for different land use classes. The proposed development needs to demonstrate compliance with these benchmarks, or where this is not possible, offsetting measures need to be used to meet the benchmarks.

Emissions from buildings and transport are to be treated separately.

Building Emission Benchmark (BEB)

Building emission benchmarks (BEB) have been set for NO_x and PM_{10}, for a series of land-use classes. To calculate the emissions from the buildings, the following information is required for each land-use category:

- Gross floor area (m^2) of development;
- On-site emissions of NO_x associated with building use (kg/annum) calculated from energy use (kWh/annum) and default or site specific emission factors (kg/kWh); and
- On-site emissions of PM_{10} associated with oil or solid fuel use (kg/annum) calculated from energy use (kWh/annum) and default or site specific emission factors (kg/kWh).

On-site emissions are calculated either from the estimates of fossil fuel consumption per annum, using default emission factors provided by the GLA Air Quality Neutral Planning Support 2014 document, or from knowledge of the emission standards that apply to the combustion sources (CHP/boiler). In this case, estimates were made regarding point source emissions in the model (in g/s) and therefore these emissions rates were converted to emissions rates (in kg/annum) based on estimated emissions rates. A calculation of NO_x and PM_{10} emissions (kg/annum), where applicable, for each land use class is undertaken to give total building emissions for the development.

The BEB emissions for the development are also calculated (g/m^2), using the annual emission rates as provided by the Sustainable Design and Construction SPG (2014), reproduced in Table

D3 and the proposed gross internal area/ number of residential units for each type of land use. Following this, a subtraction of the BEB from the total building emissions is undertaken and, should the outcome be negative, the building emissions are therefore within the benchmark however should the outcome be positive, on or off-site mitigation is required.

Table D3: 'Air Quality Neutral' Building Emission Benchmarks

Land Use Class	NO_x (g/m^2)	PM_{10} (g/m^2)
Class A1	22.6	1.29
Class A3 – A5	75.2	4.32
Class A2 – and Class B1	30.8	1.77
Class B2 – B7	36.6	2.95
Class B8	23.6	1.90
Class C1	70.9	4.07
Class C2	68.5	5.97
Class C3	26.2	2.28
D1 (a)	43.0	2.47
D1 (b)	75.0	4.30
Class D1 (c – h)	31.0	1.78
Class D2 (a - d)	90.3	5.18
Class D2 (e)	284	16.3

Source: Sustainable Design and Construction SPG (2014).

Transport Emissions Benchmark (TEB)

Transport emissions benchmarks have been set for NO_x and PM_{10} for a smaller range of land- use classes than for buildings, which are more specific. The following information is required for each land-use category:

- Gross floor area (m^2) of development (A1-A5, B1) and number of dwellings;
- Number of vehicle movements attributable to each proposed land use per annum;
- The average distance travelled per annum; and,
- NO_x and PM_{10} emissions factors (g/vehicle-km (see Table D4).

- **Table D4: Emission Factors**

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

To compile the TEB for a development, the TEB provided in the AQN guidance is multiplied either by the gross floor area of each area of the development, or the number of dwellings (where applicable), to achieve the NOx and PM_{10} emissions in kg/annum. The benchmark was calculated within the AQN guidance based on the emissions factors shown in Table C4 which take into account the distance travelled at the proposed development and more site specific information. The benchmarks are dependent on location within London.

The transport emissions for the development are also calculated by multiplying the number of vehicle movements associated with each portion proposed development (per annum) by the emissions factors shown in Table D5.

The TEB is then subtracted from the calculated 'total transport emissions' (as shown in Section 6) and if the outcome is negative, the transport emissions are said to be within the benchmark. However, should the outcome be positive, on or off-site mitigation is required.

- **Table D5: 'Air Quality Neutral' Transport Emission Benchmarks**

Land Use	CAZ*	Inner	Outer
NO_x (g/m^2/annum)			
Retail (A1)	169	219	249
Office (B1)	1.27	11.4	68.5
NO_x (g/dwelling/annum)			
Residential (C3)	234	558	1553
PM_{10} (g/m^2/annum)			
Retail (A1)	29.3	39.3	42.9
Office (B1)	0.22	2.05	11.8
PM_{10} (g/dwelling/annum)			
Residential (C3)	40.7	100	267

Note: *CAZ = Central Area Zone. Source: Sustainable Design and Construction SPG (2014).

APPENDIX E
TRAFFIC DATA

This appendix contains the traffic data used in the dispersion modelling assessment. Included are traffic flow data in AADT, %HDV and free-flowing speed (km/h).

Table E1 AADT Traffic Flows for Model Scenarios used in the dispersion modelling assessment

Figure E1 National diurnal Profile for other roads utilised in modelling assessment

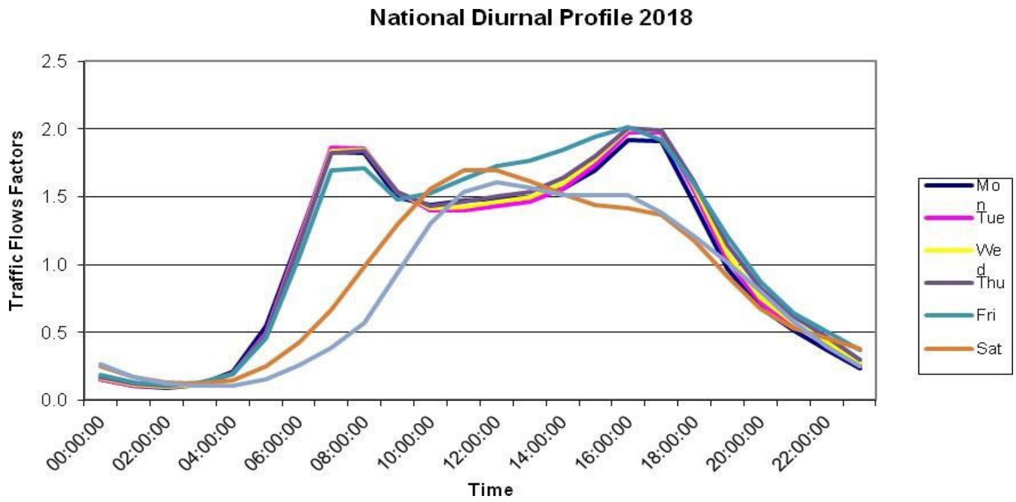
Table E1: AADT Traffic Flows for Model Scenarios used in the dispersion modelling assessment

Road Link	Source of Data	S1		S2		S3	
		AADT	%HDV	AADT	%HDV	AADT	%HDV
Great Ormond Street	ATC count by RSK LDE	2246	16.26	2472	16.26	1756	16.47
A400 Bloosmbury Street	DFT 2018	14191	10.58	15620	10.58	15620	10.58
A501 Euston Road (A4200- A5202)	DFT 2018	56780	8.64	62498	8.64	62498	8.64
A4200 Woburn Place (south of Euston Road)	DFT 2018	14442	16.92	15896	16.92	15896	16.92
A501 Euston Road (west of Woburn Place)	DFT 2018	63322	5.75	69699	5.75	69699	5.75
A4200 Eversholt Street (north of Euston Road)	DFT 2018	10827	8.22	11917	8.22	11917	8.22
A5202 Midland Road (north of Euston Road)	LAEI 2016	11723	9.15	13301	9.15	13301	9.15
B504 Judd Street	LAEI 2016	5483	2.94	6221	2.94	6221	2.94
A5202 Pancras Road	DFT 2018	18215	2.58	20049	2.58	20049	2.58
A501 Euston Road (east of A5202 Pancras Road)	DFT 2018	56780	8.64	62498	8.64	62498	8.64
A501 Euston Road	DFT 2018	56780	8.64	62498	8.64	62498	8.64
B502 Guilford Street	LAEI 2016	6423	4.94	7288	4.94	7288	4.94
Brunswick Square	LAEI 2016	5687	5.98	6452	5.98	6452	5.98
B506 Montague Place	LAEI 2016	6764	5.83	7675	5.83	7675	5.83
Great Russell Street	LAEI 2016	9195	4.38	10432	4.38	10432	4.38
Bedford Avenue	LAEI 2016	5522	10.61	6265	10.61	6265	10.61

Road Link	Source of Data	S1		S2		S3	
A40 New Oxford Street (west of A400 Bloomsbury Street)	LAEI 2016	1222	7.11	1386	7.11	1386	7.11
A401 Theobold's Road (Proctor Street - A5200 Gray's Inn Road)	DFT 2018	19750	10.27	21789	9.31	22636	9.55
Gray's Inn Road (north of A401 Theobold's Road)	DFT 2018	12409	7.22	13659	7.22	13941	7.39
A401 (Gray's Inn Road - Clerkenwell Road/ Roseberry Avenue)	DFT 2018	15981	7.49	17590	7.49	17873	7.62
A5201 Clerkenwell Road (east of Roseberry Avenue)	DFT 2018	15981	7.49	17590	7.49	17873	7.62
A401 Roseberry Avenue (north of A5201 Clerkenwell Road)	DFT 2018	10075	17.05	11090	17.05	11090	17.05
A5200 Gray's Inn Road (south of A5201 Gray's Inn Road)	DFT 2018	11884	10.84	13081	10.84	13081	10.84
Coptic Street	LAEI 2016	2482	6.84	2816	6.84	2816	6.84
Museum Street	LAEI 2016	1533	9.80	1740	9.80	1740	9.80
A4200 Southampton Row	DFT 2018	14442	16.92	15996	15.28	15996	15.28
A4200 Russell Square	DFT 2018	14442	16.92	15996	15.28	15996	15.28
A5203 Caledonian Road	DFT 2018	7902	20.01	8698	20.01	8698	20.01
A5200 Gray's Inn Road (Swinton Street - Acton Street)	DFT 2018	12409	7.22	13659	7.22	13659	7.22
A201 Acton Street	DFT 2018	8750	9.13	9631	9.13	9631	9.13
A201 Swinton Street	DFT 2018	11636	4.35	12808	4.35	12808	4.35
A201 King's Cross Road (south of Acton Street)	DFT 2018	15271	4.73	16809	4.73	16809	4.73
A201 King's Cross Road (Swinton Street- Acton Street)	DFT 2018	12653	6.24	13927	6.24	13927	6.24
A201 King's Cross Road (Penton Rise - Swinton Street)	DFT 2018	12653	6.24	13927	6.24	13927	6.24
A201 King's Cross Road (Pentonville Road - Penton Rise)	DFT 2018	7654	10.22	8425	10.22	8425	10.22
A501 Pentonville Road (A5203 - A201)	DFT 2018	23667	7.88	26050	7.88	26050	7.88
A201 Penton Rise	DFT 2018	12797	4.84	14086	4.84	14086	4.84

Road Link	Source of Data	S1		S2		S3	
A5200 (Swinton Street - A5203)	DFT 2018	23201	7.05	25537	7.05	25537	7.05
A5200 Gray's Inn Road (Euston Road - A5203)	DFT 2018	23201	7.05	25537	7.05	25537	7.05
A501 Pentonville Road Gray's Inn Road (Euston Road - A5203)	DFT 2018	20353	11.17	22403	11.17	22403	11.17

Figure E1: National Diurnal Profile applied to all modelled roads within the Dispersion Modelling Assessment



APPENDIX F
MODELLING OF OPERATIONAL PHASE – VERIFICATION METHODOLOGY AND MODEL RESULTS

The dispersion model results were verified following the relevant guidance in the Local Air Quality Management Technical Guidance (2016) (LAQM.TG(16)). Predicted results from a dispersion model may differ from measured concentrations for a variety of reasons, these are identified in TG(16) to include:

- Estimates of background concentrations;
- Meteorological data uncertainties;
- Uncertainties in source data for example, traffic flow data, stack emissions and emission factors;
- Model input parameters such as roughness length, minimum Monin-Obukhov and overall model limitations; and,
- Uncertainties associated with monitoring data, including locations.

Annual mean NO_2 data collected from CA21 and London Euston (automatic monitor) were used to verify annual mean NO_2 concentrations. At the time of consulting with LBC we requested clarification on where CA4 was located as it was not visible on satellite imagery, but as a response to this point was not received, RSK considered it appropriate to discard this point from model verification.

Attempts were made to verify the predicted annual mean PM_{10} concentrations, although this would have resulted in the modelled total PM_{10} concentrations exceeding those monitored. For this reason and for a conservative assessment, the annual mean NOx adjustment factor was applied to the PM_{10} and $PM_{2.5}$ concentrations predicted, save for the hourly mean NO_2 concentrations (which cannot be verified due to the use of the ADMS chemistry module).

A comparison of modelled versus monitored NO_2 concentrations at these sites is presented in Table F1. They show that the model underpredicted road traffic concentrations by 20.1% and therefore model verification has been undertaken as per the procedure in LLAQM TG.16.

Table F1: Modelled versus Monitored NO_2 Concentrations

Site	Background NO_2	Monitored total NO_2	Modelled total NO_2	% Difference [(modelled – monitored)/monitored]x100
CA21	41.95	59.40	51.15	-13.9
Euston Auto	40.87	82.34	60.70	-26.3

Modelled versus measured road NO_x data at the diffusion tube sites are shown in Table F2. The model as a whole underpredicted road NO_x concentrations by a factor of 2.70; this factor has been applied to model results.

The NOx to NO_2 calculator was used to estimate the amount of road NOx which would have been monitored at CA21, based on the annual mean NO_2 concentration monitored at the Euston automatic monitoring site. However, as NOx was monitored at the Euston monitoring site, monitored total concentrations were applied directly. Concentrations were initially annualised using the method established in Box 7.9 of LLAQM TG.16, using annual mean NOx concentrations monitored at the Bloomsbury, Islington Arsenal and Sir John Cass urban background monitoring stations. The background annual mean NO_2 concentrations were taken from the LBC Air Quality Annual Status Report and were annualised prior to being presented in this report.

Table F2: Modelled versus Monitored NO_x/NO_2

Site	Monitored total NO_2/ NOx	Background NO_2 / NOx	Monitored Road Contribution NO_2 / NOx	Monitored Road Contribution NOx	Modelled road contribution NOx	Ratio of Modelled and Measured Road NOx
CA21	59.40	41.95	17.45	46.6	23.19	2.01
Euston Auto	228.44	76.98	151.46	151.46	53.46	2.83

The verified annual average modelled road contribution NO_x concentrations were used to estimate the annual average road NO_2 by using the DEFRA NO_x to NO_2 spreadsheet; a comparison of monitored and model adjusted total NO_2 is presented in Table F6. Following adjustment, the model overpredicted by 7%, which is within the range accepted within LLAQM TG.16.

Table F3: Modelled versus Monitored NO_2 Concentrations

Site	Background NO_2	Monitored total NO_2	Modelled total NO_2 after adjustment	% Difference [(modelled – monitored)/monitored]x100
CA21	41.95	59.40	64.6	8.8
Euston Auto	40.87	82.34	86.99	5.6

A list of the receptor locations included in the dispersion model is displayed in Table F4.

Table F4: Receptors Included in the Dispersion Modelling Assessment

Receptor ID	Receptor Name	X	Y	Z
CA21	Diffusion tube	529961.81	181619.20	1.80
Euston Auto	Automatic monitor	529903.94	182666.88	2.50
CA4	Diffusion tube	530110.00	182795.00	1.80
Vent01	Intake to mechanical ventilation system for Phase 4a of proposed development	530534.00	182052.00	15.60
Vent02	Intake to mechanical ventilation system for Phase 4a of proposed development	530546.81	182059.00	15.60

Receptor ID	Receptor Name	X	Y	Z
ER01	Existing residence	530860.19	181896.06	1.50
EC02.G	Existing commercial receptor	530977.75	181983.16	1.50
ER02.1	Existing residence	530977.75	181983.16	4.50
EC03.G	Existing commercial receptor	530997.00	181989.77	1.50
ER04?	Existing residence (or suspected residential)	530940.12	181961.98	1.50
ER05	Existing residence	530922.50	181955.12	1.50
EC06.G	Existing commercial receptor	530968.56	181978.06	1.50
ER06.1	Existing residence	530968.56	181978.06	4.50
DR01	Proposed development façade	530488.94	182000.64	1.50
DR02	Proposed development façade	530470.88	181990.39	1.50
DR03	Proposed development façade	530496.69	182004.84	1.50
DR04	Proposed development façade	530526.75	182022.03	1.50
DR05	Proposed development façade	530571.56	182047.12	1.50
DR11	Proposed development façade	530488.94	182000.64	6.34
DR12	Proposed development façade	530470.88	181990.39	6.34
DR13	Proposed development façade	530496.69	182004.84	5.70
DR14	Proposed development façade	530526.75	182022.03	5.70
DR15	Proposed development façade	530571.56	182047.12	5.70
DR21	Proposed development façade	530488.94	182000.64	9.38
DR22	Proposed development façade	530470.88	181990.39	9.38
DR23	Proposed development façade	530496.69	182004.84	9.50
DR24	Proposed development façade	530526.75	182022.03	9.50
DR25	Proposed development façade	530571.56	182047.12	9.50
DR31	Proposed development façade	530488.94	182000.64	13.31
DR32	Proposed development façade	530470.88	181990.39	13.31
DR33	Proposed development façade	530496.69	182004.84	13.10
DR34	Proposed development façade	530526.75	182022.03	13.10
DR35	Proposed development façade	530571.56	182047.12	13.10
DR41	Proposed development façade	530488.94	182000.64	17.70
DR42	Proposed development façade	530470.88	181990.39	17.70
DR43	Proposed development façade	530496.69	182004.84	16.74
DR44	Proposed development façade	530526.75	182022.03	16.74
DR45	Proposed development façade	530571.56	182047.12	16.74
DR51	Proposed development façade	530488.94	182000.64	21.72
DR52	Proposed development façade	530470.88	181990.39	21.72
DR53	Proposed development façade	530496.69	182004.84	20.64
DR54	Proposed development façade	530526.75	182022.03	20.64
DR55	Proposed development façade	530571.56	182047.12	20.64
DR63	Proposed development façade	530496.69	182004.84	24.64

Receptor ID	Receptor Name	X	Y	Z
DR64	Proposed development façade	530526.75	182022.03	24.64
DR65	Proposed development façade	530571.56	182047.12	24.64

Model results for long-term and short-term PM_{10}, and long-term NO_2 and $PM_{2.5}$, concentrations at receptors are presented in Table F5, for all modelling scenarios.

Table F5: Predicted Pollutant Concentrations at Modelled Receptor Location

Receptor ID	NO_2 Annual Average Concentrations (µg/m^3)							99.79th percentile of hourly mean NO_2 concentrations (µg/m^3)	PM_{10} Annual Average Concentrations (µg/m^3)				No. days PM_{10} 24-Hour Average Concentrations (µg/m^3)			$PM_{2.5}$ Annual Average Concentrations (µg/m^3)			
	Background (S1, S2a, S3a)	S1	S2a	S3a	Background (S2, S3)	S2	S3		Background (S1, S2a, S3a)	S1	S2a	S3a	S1	S2a	S3a	Background (S1, S2a, S3a)	S1	S2a	S3a
Vent01	38.30	40.06	40.25	40.24	29.7	30.39	30.39	107.75	19.55	19.83	19.86	19.85	3	3	3	11.78	11.96	11.97	11.97
Vent02	38.30	40.06	40.25	40.24	29.7	30.39	30.39	107.77	19.55	19.83	19.86	19.86	3	3	3	11.78	11.96	11.98	11.97
ER01	45.84	54.26	54.91	55.24	34.9	38.44	38.57	113.65	19.55	21.09	21.22	21.28	5	5	5	11.82	12.78	12.86	12.90
EC02.G	45.84	58.67	59.81	60.10	34.9	40.40	40.51	115.99	19.55	21.72	21.93	21.99	6	6	6	11.82	13.20	13.34	13.37
ER02.1	45.84	55.73	56.62	56.85	34.9	39.09	39.17	112.63	19.55	21.21	21.37	21.41	5	5	5	11.82	12.87	12.97	13.00
EC03.G	45.84	64.09	65.69	66.05	34.9	42.92	43.06	117.43	19.55	22.70	23.02	23.08	8	8	8	11.82	13.84	14.04	14.08
ER04	45.84	57.73	58.65	59.08	34.9	39.95	40.12	112.77	19.55	21.75	21.94	22.03	6	6	6	11.82	13.19	13.31	13.37
ER05	45.84	58.08	59.02	59.48	34.9	40.11	40.29	112.96	19.55	21.85	22.04	22.14	6	6	7	11.82	13.25	13.37	13.43
EC06.G	45.84	79.98	82.19	83.46	34.9	49.91	50.42	141.64	19.55	25.86	26.40	26.67	15	16	17	11.82	15.85	16.20	16.37
ER06.1	45.84	76.60	78.59	79.75	34.9	48.36	48.82	134.68	19.55	25.14	25.61	25.85	13	14	15	11.82	15.38	15.69	15.84
Vent01 -7	38.30	39.89	40.07	40.06	29.7	30.32	30.32	107.72	19.55	19.80	19.83	19.83	3	3	3	11.78	11.94	11.96	11.96
Vent02 -7	38.30	39.89	40.07	40.06	29.7	30.33	30.32	107.74	19.55	19.80	19.83	19.83	3	3	3	11.78	11.94	11.96	11.96
DR01	38.30	47.49	48.45	46.26	29.7	33.29	32.50	109.90	19.55	21.02	21.17	20.81	5	5	4	11.78	12.70	12.79	12.56
DR02	38.30	47.93	48.93	46.63	29.7	33.47	32.63	109.96	19.55	21.09	21.25	20.86	5	5	5	11.82	12.78	12.88	12.64
DR03	38.30	47.48	48.44	46.25	29.7	33.29	32.49	109.90	19.55	21.02	21.17	20.80	5	5	4	11.78	12.70	12.79	12.56
DR04	38.30	47.36	48.31	46.15	29.7	33.25	32.46	109.87	19.55	21.00	21.15	20.79	5	5	4	11.78	12.68	12.78	12.55
DR05	38.30	47.90	48.91	46.60	29.7	33.47	32.63	110.05	19.55	21.10	21.26	20.87	5	5	5	11.78	12.74	12.84	12.60
DR11	38.30	46.24	47.08	45.25	29.7	32.79	32.13	109.27	19.55	20.81	20.94	20.64	4	5	4	11.78	12.57	12.65	12.46
DR12	38.30	46.42	47.27	45.40	29.7	32.86	32.18	109.28	19.55	20.84	20.97	20.66	5	5	4	11.82	12.62	12.71	12.52
DR13	38.30	46.40	47.25	45.37	29.7	32.86	32.18	109.26	19.55	20.84	20.97	20.66	5	5	4	11.78	12.58	12.67	12.47
DR14	38.30	46.32	47.17	45.30	29.7	32.83	32.16	109.24	19.55	20.83	20.96	20.65	4	5	4	11.78	12.58	12.66	12.47
DR15	38.30	46.54	47.41	45.48	29.7	32.92	32.23	109.24	19.55	20.86	21.00	20.68	5	5	4	11.78	12.60	12.69	12.49
DR21	38.30	45.46	46.22	44.60	29.7	32.48	31.90	109.18	19.55	20.68	20.80	20.53	4	4	4	11.78	12.49	12.56	12.40
DR22	38.30	45.53	46.29	44.66	29.7	32.50	31.92	109.18	19.55	20.69	20.81	20.54	4	4	4	11.82	12.53	12.61	12.44
DR23	38.30	45.40	46.15	44.55	29.7	32.46	31.88	109.15	19.55	20.67	20.79	20.53	4	4	4	11.78	12.48	12.55	12.39
DR24	38.30	45.36	46.11	44.51	29.7	32.45	31.87	109.14	19.55	20.67	20.78	20.52	4	4	4	11.78	12.48	12.55	12.39
DR25	38.30	45.38	46.14	44.53	29.7	32.46	31.88	109.14	19.55	20.67	20.79	20.53	4	4	4	11.78	12.48	12.55	12.39
DR31	38.30	44.69	45.37	43.94	29.7	32.17	31.67	109.07	19.55	20.55	20.66	20.43	4	4	4	11.78	12.41	12.47	12.33
DR32	38.30	44.71	45.39	43.97	29.7	32.18	31.67	109.07	19.55	20.56	20.66	20.43	4	4	4	11.82	12.45	12.51	12.37
DR33	38.30	44.70	45.38	43.95	29.7	32.18	31.67	109.05	19.55	20.56	20.66	20.43	4	4	4	11.78	12.41	12.47	12.33
DR34	38.30	44.68	45.36	43.93	29.7	32.17	31.67	109.05	19.55	20.55	20.66	20.43	4	4	4	11.78	12.41	12.47	12.33
DR35	38.30	44.65	45.33	43.91	29.7	32.17	31.66	109.04	19.55	20.55	20.66	20.43	4	4	4	11.78	12.41	12.47	12.33
DR41	38.30	43.81	44.40	43.19	29.7	31.82	31.40	108.93	19.55	20.41	20.50	20.31	4	4	4	11.78	12.32	12.37	12.25
DR42	38.30	43.82	44.41	43.21	29.7	31.83	31.40	108.93	19.55	20.41	20.50	20.31	4	4	4	11.82	12.36	12.41	12.30
DR43	38.30	44.08	44.70	43.42	29.7	31.93	31.48	108.95	19.55	20.46	20.55	20.35	4	4	4	11.78	12.35	12.41	12.28
DR44	38.30	44.08	44.70	43.41	29.7	31.93	31.48	108.96	19.55	20.46	20.55	20.34	4	4	4	11.78	12.35	12.41	12.28
DR45	38.30	44.04	44.66	43.39	29.7	31.92	31.47	108.95	19.55	20.45	20.54	20.34	4	4	4	11.78	12.34	12.40	12.28
DR51	38.30	42.67	43.15	42.24	29.7	31.38	31.06	108.78	19.55	20.23	20.30	20.16	4	4	4	11.78	12.21	12.25	12.16
DR52	38.30	42.68	43.15	42.25	29.7	31.38	31.06	108.78	19.55	20.23	20.30	20.16	4	4	4	11.82	12.25	12.29	12.20
DR53	38.30	42.95	43.45	42.47	29.7	31.49	31.14	108.80	19.55	20.27	20.35	20.19	4	4	4	11.78	12.23	12.28	12.18
DR54	38.30	42.95	43.45	42.47	29.7	31.49	31.14	108.81	19.55	20.27	20.35	20.19	4	4	4	11.78	12.23	12.28	12.18

Receptor ID	NO_2 Annual Average Concentrations (µg/m^3)							99.79th percentile of hourly mean NO_2 concentrations (µg/m^3)	PM_{10} Annual Average Concentrations (µg/m^3)				No. days PM_{10} 24-Hour Average Concentrations (µg/m^3)			$PM_{2.5}$ Annual Average Concentrations (µg/m^3)			
	Background (S1, S2a, S3a)	S1	S2a	S3a	Background (S2, S3)	S2	S3		Background (S1, S2a, S3a)	S1	S2a	S3a	S1	S2a	S3a	Background (S1, S2a, S3a)	S1	S2a	S3a
DR55	38.30	42.92	43.42	42.45	29.7	31.48	31.14	108.81	19.55	20.27	20.35	20.19	4	4	4	11.78	12.23	12.28	12.18
DR63	38.30	41.92	42.31	41.60	29.7	31.08	30.84	108.68	19.55	20.11	20.17	20.06	4	4	3	11.78	12.13	12.17	12.10
DR64	38.30	41.92	42.31	41.60	29.7	31.09	30.84	108.69	19.55	20.11	20.17	20.06	4	4	3	11.78	12.13	12.17	12.10
DR65	38.30	41.90	42.29	41.59	29.7	31.08	30.84	108.69	19.55	20.11	20.17	20.06	4	4	3	11.78	12.13	12.17	12.10

APPENDIX G
AIR QUALITY ASSESSMENT OF EMERGENCY GENERATORS

This appendix contains the air quality dispersion modelling assessment of the proposed emergency generators.

GOSH CCC
Air Quality Assessment of Generators

20/05/2022

GOSHCCC-444719-01 (00)

Great Ormond Street Hospital for Children
NHS Foundation Trust

RSK

RSK GENERAL NOTES

Project No.: 444719-01 (00)

Title: Air Quality Assessment of Backup Generators

Client: John Sisk and Son Limited on behalf of the Great Ormond Street Hospital for Children NHS Foundation Trust

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1 INTRODUCTION

1.1 Background

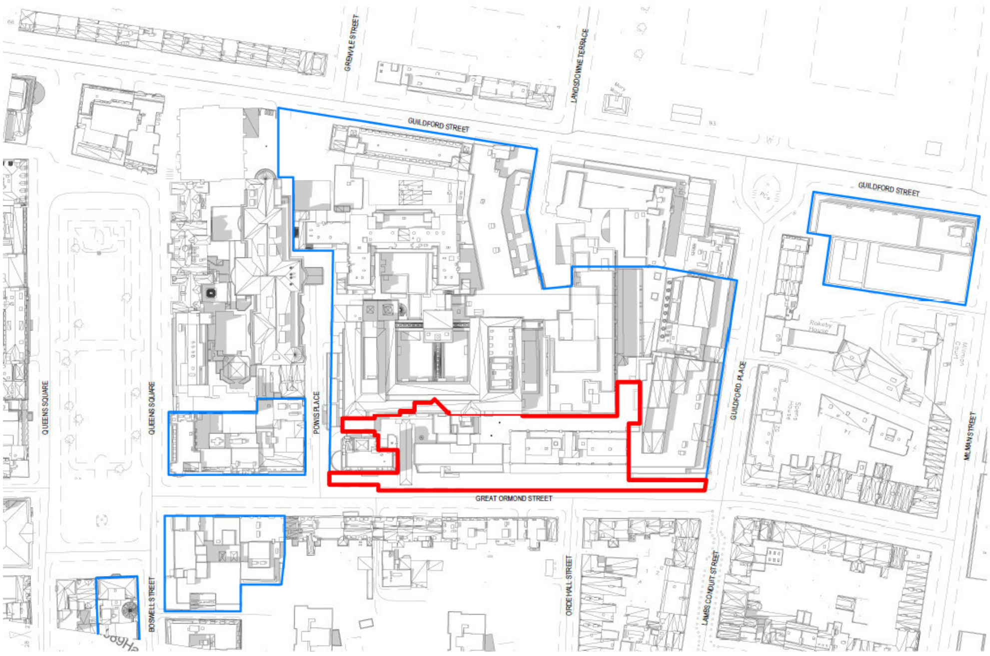
This air quality assessment has been prepared on behalf of the Applicant, Great Ormond Street Hospital for Children NHS Foundation Trust (referred to hereafter as the 'Applicant') in collaboration with the appointed design and build contractor John Sisk & Son (Holdings) Ltd (referred to hereafter as Sisk) to support an application to the London Borough of Camden (LBC) for full planning permission and conservation area consent for the redevelopment of the Great Ormond Street Hospital (GOSH) Frontage Building and Entrance on Great Ormond Street WC1N 3JH X (referred to hereafter as the 'site'), to provide a new Children's Cancer Centre (CCC).

RSK Environment Ltd (RSK) was commissioned to undertake an assessment of the potential air quality impacts associated with the proposed backup generators proposed as part of the redevelopment of the Frontage Building for the Great Ormond Street Hospital Children's Cancer Centre (GOSHCCC).

RSK has previously prepared an air quality assessment focused on the construction phase impacts and operational phase impacts related to transport emissions for the proposed redevelopment of the GOSHCCC (report ref: 443998/AQ/01 (03)).

The following report is focused on the backup generators and the potential impact of these on the users of the GOSHCCC and surrounding buildings only. Therefore, this report should be read in conjunction with the original air quality assessment (report ref: 443998/AQ/01 (03)) for a full air quality assessment of the proposed development.

Figure 1.1: Application Site Location



2 LEGISLATION, PLANNING POLICY & GUIDANCE

2.1 Key Legislation

2.1.1 Air Quality Strategy

UK air quality policy is published under the umbrella of the Environment Act 1995, Part IV and specifically Section 80, the National Air Quality Strategy. The latest *Air Quality Strategy for England, Scotland, Wales and Northern Ireland – Working Together for Clean Air*, published in July 2007 sets air quality standards and objectives for ten key air pollutants to be achieved between 2003 and 2020.

The EU Air Quality Framework Directive (1996) established a framework under which the EU could set limit or target values for specified pollutants. The directive identified several pollutants for which limit or target values have been, or will be set in subsequent 'daughter directives'. The framework and daughter directives were consolidated by Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe, which retains the existing air quality standards and introduces new objectives for fine particulates ($PM_{2.5}$).

The Clean Air Strategy 2019 supersedes the policies outlined in the 2007 strategy. This latest strategy aims to have a more joined-up approach, outlining actions the Government plans to take to reduce emissions from transport, homes, agriculture and industry. However, the air quality objectives remain as previously detailed within the 2007 strategy.

2.1.2 Air Quality Standards

The air quality standards (AQSs) and air quality objectives (AQOs) in the United Kingdom are derived from EC directives and are adopted into English law via the Air Quality (England) Regulations 2000 and Air Quality (England) Amendment Regulations 2002. The Air Quality Limit Values Regulations 2003 and subsequent amendments implement the Air Quality Framework Directive into English Law. The European Union (Withdrawal) Act retains existing EU environmental provisions in the UK. Directive 2008/50/EC was translated into UK law in 2010 via the Air Quality Standards Regulations 2010.

The relevant[1] standards for England and Wales to protect human health are summarised in Table 2.1.

Table 2.1: Air Quality Standards Relevant to the Proposed Development

Substance	Averaging period	Exceedances allowed per year	Ground level concentration limit ($\mu g/m^3$)
Nitrogen dioxide (NO_2)	1 calendar year	-	40
	1 hour	18	200

[1] Relevance, in this case, is defined by the scope of the assessment.

Substance	Averaging period	Exceedances allowed per year	Ground level concentration limit (μg/m³)
Fine particles (PM_{10})	1 calendar year	-	40
	24 hours	35	50
Fine particles ($PM_{2.5}$)	1 year	-	25
Carbon Monoxide (CO)	Maximum daily running 8 hour mean	-	10,000

2.1.3 The Environment Act

These objectives are to be used in the review and assessment of air quality by local authorities under Section 82 of the Environment Act (1995). If exceedances are measured or predicted through the review and assessment process, the local authority must declare an Air Quality Management Area (AQMA) under Section 83 of the act, and produce an Air Quality Action Plan (AQAP) to outline how air quality is to be improved.

2.2 Planning Policy

The land use planning process is a key means of improving air quality, particularly in the long term, through the strategic location and design of new developments. Any air quality concern that relates to land use and its development can, depending on the details of the proposed development, be a material consideration in the determination of planning applications.

2.2.1 National Planning Policy Framework

In 2021 the revised National Planning Policy Framework (NPPF) was published, superseding the previous NPPF with immediate effect. The NPPF includes a presumption in favour of sustainable development.

Section 15 of the NPPF deals with Conserving and Enhancing the Natural Environment, and states that the intention is that the planning system should prevent '*development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability*' and goes on to state that '*new development* [should be] *appropriate for its location' and 'the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as wells as the potential sensitivity of the site or wider area to impacts that could arise from the development*.'

With specific regard to air quality, the NPPF states that: *"Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-*

making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan."

2.2.2 Regional Planning Policy

In March 2021 the latest version of the London Plan was published. Policy **SI 1 Improving air quality** states:

"A Development Plans, through relevant strategic, site-specific and area-based policies, should seek opportunities to identify and deliver further improvements to air quality and should not reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality.

B To tackle poor air quality, protect health and meet legal obligations the following criteria should be addressed:

1) Development proposals should not:

a) lead to further deterioration of existing poor air quality

b) create any new areas that exceed air quality limits, or delay the date at which compliance will be achieved in areas that are currently in exceedance of legal limits

c) create unacceptable risk of high levels of exposure to poor air quality.

2) In order to meet the requirements in Part 1, as a minimum:

a) development proposals must be at least Air Quality Neutral

b) development proposals should use design solutions to prevent or minimise increased exposure to existing air pollution and make provision to address local problems of air quality in preference to post-design or retro-fitted mitigation measures

c) major development proposals must be submitted with an Air Quality Assessment. Air quality assessments should show how the development will meet the requirements of B1

d) development proposals in Air Quality Focus Areas or that are likely to be used by large numbers of people particularly vulnerable to poor air quality, such as children or older people should demonstrate that design measures have been used to minimise exposure.

C Masterplans and development briefs for large-scale development proposals subject to an Environmental Impact Assessment should consider how local air quality can be improved across the area of the proposal as part of an air quality positive approach. To achieve this a statement should be submitted demonstrating:

1) how proposals have considered ways to maximise benefits to local air quality, and

2) what measures or design features will be put in place to reduce exposure to pollution, and how they will achieve this.

D In order to reduce the impact on air quality during the construction and demolition phase development proposals must demonstrate how they plan to comply with the

Non-Road Mobile Machinery Low Emission Zone and reduce emissions from the demolition and construction of buildings following best practice guidance.

E Development proposals should ensure that where emissions need to be reduced to meet the requirements of Air Quality Neutral or to make the impact of development on local air quality acceptable, this is done on-site. Where it can be demonstrated that emissions cannot be further reduced by on-site measures, off-site measures to improve local air quality may be acceptable, provided that equivalent air quality benefits can be demonstrated within the area affected by the development."

<u>The Sustainable Design and Construction Supplementary Planning Document (SDC SPG)</u>

The SDC SPG, which was adopted in 2014 to accompany the London Plan, provides detail on how air quality and air quality neutral assessments should be undertaken. It also sets minimum target emissions standards for CHP and biomass boilers and includes recommendations for reducing the impacts of point sources on local air quality.

<u>The Control of Dust and Emissions during Construction and Demolition Supplementary Planning Guidance, 2014 ('the MOL SPG')</u>

Following an assessment of the impacts of fugitive dust and emissions on local air quality, the MOL SPG (which was adopted in 2014 to accompany the London Plan) report outlines a mechanism for assigning mitigation measures proportionate to the dust 'risks' identified. The MOL SPG recommends that the latest version of the IAQM construction dust guidance is followed to undertake the risk assessment; therefore this document has also been listed below.

2.2.3 Local Planning Policy

Camden Local Plan

Policy CC4 Air Quality of the LBC 2017 Local Plan states the following:

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

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

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

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

Camden Planning Guidance: Air Quality (2021)

The Air Quality Supplementary Planning Guidance adopted in 2021 provides information on key air quality issues and support Local Plan Policy CC4 Air quality (outlined above).

2.3 Best Practice Guidance Documents

2.3.1 Local Air Quality Management Review and Assessment Technical Guidance

The Department for Environment, Food and Rural Affairs (Defra) has published technical guidance for use by local authorities in their air quality review and assessment work. This guidance, referred to in this document as the Local Air Quality Management Technical Guidance (Defra, 2021) ('LAQM TG.16'), has been used to identify locations where exposure can be considered 'relevant'. This is important as Directive 2008/50/EC indicates that the AQSs should not be applied at any locations situated within areas where members of the public do not have access and there is no fixed habitation.

2.3.2 Land-Use Planning & Development Control: Planning for Air Quality

Environmental Protection UK's (EPUK) and the IAQM jointly published a revised version of the guidance note 'Land-Use Planning & Development Control: Planning for Air Quality' in 2017 (herein the 'EPUK-IAQM 2017 guidance') to facilitate consideration of air quality within local development control processes. It provides a framework for air quality considerations, promoting a consistent approach to the treatment of air quality issues within development control decisions.

The guidance includes methods for undertaken an air quality assessment and an approach for assessing the significance of effects. The guidance note is widely accepted as an appropriate reference method for this purpose.

3 ASSESSMENT SCOPE

3.1 Overall Approach

The approach taken for assessing the potential air quality and odour impacts of the application site may be summarised as follows:

- Baseline characterisation of local air quality;
- Advanced dispersion modelling assessment of air quality impacts of the backup generators: and
- Consideration of possible mitigation measures, where appropriate.

3.2 Baseline Characterisation

Existing or baseline air quality refers to the concentrations of relevant substances that are already present in ambient air. These substances are emitted by various sources, including road traffic, industrial, domestic, agricultural and natural sources.

A desk-based study has been undertaken using data obtained from continuous and diffusion tube monitoring stations maintained by LBC and estimated background data from the LAQM Support website maintained by Defra. Background concentrations have been mapped by Defra at a grid resolution of 1x1km for the whole of the UK. Consideration has also been given to potential sources of air pollution and any AQMAs in the vicinity of the application site.

3.3 Operational Phase Air Assessment

3.3.1 Emission Sources

The proposed development comprises three emergency backup generators. The generators are arranged N+1, meaning two of the generators will be running while one on standby. The generators will not be used on a regular basis and only operate during emergency and during maintenance checks.

It is estimated by the client that the emergency generators will operate 3 hours per month for maintenance checks, of which one generator will operate at any one time. Additional to this, it is estimated that two generators will run on three additional occasions for a period up to 24 hours. Therefore, it is estimated that the generators will operate for a total of 108 hours per year.

Based on the above, generally during testing, only one generator will be operating. At most, two generators will operate at any one-time during emergency. Therefore, the modelling within this report is based on two generators operating at any one time.

To assess long term impacts of the operation of the generators, the model output has been scaled to be representative of 108 hours of operation.

The daily mean PM_{10} concentrations and 8-hour CO concentrations have been assessed based on continuous operation, for a conservative assessment.

To assess compliance with the hourly mean NO_2 AQS the 97.35 percentile of hourly mean NO_2 concentrations was modelled for this assessment. The hourly mean NO_2 concentrations is typically assessed as the 99.79 percentile, to account for the allowed 18 exceedances per annum. However, as the generators are only operating 108 hours per year, the 99.79 percentile is not considered representative for this assessment. Therefore, the 97.35 percentile of the hourly mean NO_2 has been modelled. This percentile was determined for the 1% distribution and indicates that there is only a 1% chance that the hourly mean AQS would be exceeded more than the permissible 18 times per annum, should the generator operate for 400 hours per annum. The method used has been drawn from the Laxen (2017) guidance. This was considered more appropriate than applying a variable emissions profile, as it allows for meteorological conditions over an entire year to be appropriately captured. However, it should be noted that the generators will not operate for 400 hours per year, but more realistically 108 hours per year.

The emission characteristics for the generators are summarised in Table 3.1. The input data have been provided by the client.

Table 3.1: Emissions Characteristics

Source	Stack Height (m)	Stack Diameter (m)	Velocity (m/s)	Temp (°C)	Emission rates (g/s)		
					NO_x	PM_{10}	CO
Emergency Generators	63	0.3	42.9	474	5.7	0.1	0.5

3.3.2 Modelling Software

The model used in this study is UK Atmospheric Dispersion Modelling System (ADMS) Version 5.2.4.0. ADMS is a steady-state atmospheric dispersion model that is based on modern atmospheric physics. It can include treatment of both surface and elevated sources and both simple and complex terrain. The model calculates downwind pollutant concentration in the surrounding area for each hour of the day and night over an appropriate period. Statistics on the frequency and concentration of pollutants at the receptor sites are based upon the hourly calculations.

3.3.3 Meteorological Data

Hourly sequential meteorological data were employed in the dispersion model. The data were recorded in 2019-2021 at the Heathrow Airport meteorological station. Bedford meteorological station is located approximately 24km to the west of the application site and is considered most representative of conditions at the site.

The windroses derived from the 2017 to 2019 datasets are presented in Appendix A. The predominant wind direction was from the southwest.

3.3.4 Discrete Receptors

Pollution concentrations were predicted at locations associated with openable windows, air intakes and discrete human receptor points on the proposed roof terrace of the GOSHCCC. Table 3.2 detail the discrete receptors modelled.

Table 3.2: Discrete Receptors Included in the Model

Receptor ID	Receptor Name	X	Y	Height (m)
R1	Air intake1	530530	182073	52.6
R2	Air intake2	530537	182077	52.6
R3	Air intake3	530533	182066	52.6
R4	Air intake4	530541	182070	52.6
R5	Openable window1	530519	182080	43.6
R6	Openable window2	530522	182075	43.6
R7	Openable window3	530525	182069	43.6
R8	Openable window4	530528	182065	43.6
R9	Openable window5	530531	182059	43.6
R10	Openable window6	530536	182059	43.6
R11	Openable window7	530543	182063	43.6
R12	Openable window8	530522	182049	40.7
R13	Openable window9	530517	182046	40.7
R14	Openable window10	530513	182044	40.7
R15	Openable window11	530500	182036	40.7
R16	Openable window12	530493	182033	40.7
R17	Proposed intake1	530521	182024	55.6
R18	Proposed intake2	530517	182022	55.6
R20	Proposed intake3	530512	182019	55.6
R21	Proposed intake4	530527	182027	55.6
R22	Proposed intake5	530532	182030	55.6

R23	Proposed intake6	530537	182033	55.6
R24	Roof garden1	530517	182026	59.5
R25	Roof garden2	530525	182030	59.5
R26	Roof garden3	530532	182034	59.5
R27	Roof garden4	530534	182042	59.5
R28	Roof garden5	530525	182038	59.5
R29	Roof garden6	530518	182033	59.5
R30	Roof garden7	530509	182029	59.5

3.3.5 Buildings

To capture the potential influence of buildings/structures on the dispersion profile of point source emissions (e.g. building 'downwash' effects), significant buildings as part of the application site were included. The parameters of the modelled buildings are summarised in Table 3.3 below.

Table 3.3: Buildings Included in the Model

Building location	Length (m)	Width (m)	Height (m)
Proposed Building 1	5.2	94.6	52.6
Proposed Building 2	57.6	94.6	57.6
Proposed Building 3	3.7	21.4	58.0
Building West	15.1	23.1	47.7
Premier Inn Clinic	30.7	44.6	52.6
Variety Building	39.1	73.2	43.6
Building East 1	20.0	28.9	39.4
Building East 2	22.4	29.4	39.4

3.3.6 Terrain

Inclusion of terrain data is recommended within the ADMS-5 user guide if the gradient within a modelling area varies more than 1:10. The land immediately around the application site is fairly level with no gradients greater than 1:10, therefore terrain data as to been included in the modelling.

3.3.7 Background Air Quality Data Used in the Modelling

Background concentrations of NO_2 and PM_{10} were taken from the nearby automatic monitor (BL0). This monitoring location is classed as 'urban background' and considered to be representative of conditions at the proposed development site and receptor locations. Although data is available for 2020, monitoring data from 2020 should be treated with caution as pollution levels were greatly impacted by the Covid-19 restrictions. Therefore, monitoring data from 2019 has been used in this assessment.

Given that there are currently no nearby representative background monitoring locations for CO, background air quality data has been obtained from the Defra LAQM Support website, which provides estimated annual average background concentrations of CO on a 1 km^2 grid basis.

The background concentrations included in the dispersion modelling assessment are presented in Table 3.4.

Table 3.4: Background Concentrations Included in the Assessment

NO_2 (µg/m^3)	PM_{10} (µg/m^3)	CO (mg/m^3)
32	18	0.67

3.3.8 Processing of Results

NO_x emitted to the atmosphere as a result of combustion will consist largely of nitric oxide (NO). Once released into the atmosphere, NO is oxidised to NO_2, which is of concern with respect to health and other impacts. The proportion of NO converted to NO_2 depends on a number of factors including wind speed, distance from the source, solar irradiation and the availability of oxidants, such as O_3. The dispersion modelling exercise predicts concentrations of NO_x which subsequently require conversion to NO_2. The long- and short-term predicted NO_x process contributions (PCs) have been converted to the respective NO_2 concentrations using the approach outlined below, utilising 'worst case' conversion criteria referenced by the Environment Agency[2]:

- Predicted NO_2 annual average concentration = 70% of the predicted annual average NO_x concentration; and,
- Predicted NO_2 hourly average concentrations = 35% of the predicted 99.79th percentile of hourly average NO_x concentrations.

3.4 Uncertainties and Assumptions

The following uncertainties and assumptions have been made in the air quality assessment:

[2] Environment Agency, (n.d.). CONVERSION RATIOS FOR NOX AND NO_2.

- In the absence of measured air quality data for CO at the proposed development location, estimated background data from the Defra LAQM website were used in the assessment. In reality, baseline air quality levels vary with time and location but in the absence of on-site baseline monitoring data, the assumption that the baseline concentrations obtained from the above-mentioned data source is applicable to the site location, is considered appropriate;
- There will be uncertainties introduced because the modelling has simplified real-world processes into a series of algorithms. For example, it has been assumed that wind conditions measured at Heathrow Airport meteorological monitoring station for the years 2019 to 2021 were representative of wind conditions at the site; and
- There is an element of uncertainty in all measured and modelled data. All values presented within the report are best possible estimates.

4 BASELINE CHARACTERISATION

4.1 Presence of AQMAs

The proposed development site is located within the LBC Borough-wide AQMA. The LBC AQMA was declared in 2002 due to exceedances of annual mean NO_2 and 24- hour mean PM_{10} AQSs.

4.2 Baseline Monitoring Data

According to the 2019 LBC Annual Status Report, there are seven locations within 1km of the site which monitor NO_2, PM_{10} and/or $PM_{2.5}$ using either automatic 'reference method' monitors or passive NO_2 diffusion tubes. An AQMesh indicative automatic monitor, measuring NO_2 and $PM_{2.5}$, has also been installed along Great Ormond Street as part of the Breathe London programme.

Monitored annual mean NO_2 concentrations are presented in Table 4.1 below. It shows generally high results with many sites exceeding the NO_2 air quality standard. Monitored annual mean NO_2 concentrations at the three urban background are all below the annual mean NO_2 AQS, however monitored annual mean NO_2 concentrations at the roadside locations are above the annual mean NO_2 AQS. It should be noted that the monitoring data from 2020 should be treated with caution as pollution levels were greatly impacted by the Covid-19 restrictions.

Table 4.1: LBC monitoring sites within 1km from site

Site ID	Site Description	Site Type	Approx. Distance from Site (km)	Annual Mean NO2 Concentration (µg/m^3)						
				2014	2015	2016	2017	2018	2019	2020
BB	Great Ormond St.	Roadside	0.0	-	-	-	-	**-**	38.4*	**40.2****
CA6	Wakefield Gardens	Urban Background	0.4	36.4	35.8	31.3	-	26.7	24.6	-
BL0	London Bloomsbury	Urban Background	0.4	**45**	**48**	**42**	38	36	32	28
CA21	Bloomsbury Street	Roadside	0.7	**80.82**	**71.43**	**72.20**	**80.67**	**59.4**	**48.5**	28.8
CA10	Tavistock Gardens	Urban Background	0.7	**46.5**	**44.6**	39.7	-	35.4	33.1	26.2
CA4	Euston Road	Roadside	0.9	**89.7**	**86.8**	**82.7**	**84.9**	**69.2**	**-**	**-**
3	Euston Road	Roadside	0.9	**-**	**-**	**-**	**-**	**82.3**	**-**	**-**
Air Quality Strategy (AQS) Objective				**40**						

Note: BB – Breathing Buildings monitor installed along Great Ormond Street. * Data measured from 5th May – 31st December 2019. **Data measured from 1st January to 30th November 2020.

4.3 LAQM Background Data

In addition to the local monitoring data, estimated background air quality data available from the LAQM-Tools website, may also be used to establish likely background air quality conditions at the proposed development site.

This website provides estimated annual average background concentrations of NO_2, PM_{10} and $PM_{2.5}$ on a $1km^2$ grid basis. Table 4.2 identifies estimated annual average background concentrations for the grid square containing the application site for years from 2022 to 2023. No exceedances of the NO_2, PM_{10} or $PM_{2.5}$ AQS are predicted. As background concentrations are predicted to fall with time, background concentrations in future years would not be expected to exceed their respective annual mean standards.

Table 4.2: Estimated Background Annual Average NO_2, PM_{10} and $PM_{2.5}$ Concentrations at the Proposed Development Site

Assessment Year	Estimated Annual Average Pollutant Concentrations Derived from the LAQM Support Website (µg/m^3)		
	NO_2	PM_{10}	$PM_{2.5}$
2022	35.5	19.3	12.2
2023	34.8	19.0	12.1
Air Quality Objective	**40**	**40**	**25**

Notes: Presented concentrations for $1km^2$ grid centred on 530500, 182500.

5 ASSESSMENT OF IMPACTS

5.1 Air Quality

A detailed dispersion modelling assessment of the potential air quality impact from the operation of the emergency generators has been carried out to assess pollution concentrations at locations associated with openable windows, air intakes and discrete human receptor points on the proposed roof terrace of the GOSHCCC and neighbouring buildings.

5.1.1 Particulate Matter

Particulate Matter (PM_{10})

The predicted annual mean and daily mean PM_{10} concentrations at all the assessed discrete receptors would not exceed the relevant AQS.

Table 5.1 shows the maximum annual mean PM_{10} at each discrete receptor point across the three meteorological years considered. All predicted total annual mean PM_{10} concentrations (PECs) are below the annual mean PM_{10} AQS at the discrete receptors.

Table 5.2 shows the 90.4 percentile daily mean PM_{10} at each discrete receptor point across the three meteorological years considered. All predicted 90.4 percentile daily mean PM_{10} concentrations (PECs) are below the daily mean PM_{10} AQS at all discrete receptors.

Table 5.1: Predicted Annual Mean PM_{10} Concentrations at Discrete Receptors, Highest Results Selected between 2019-2021 for Each Receptor

Location	PC (µg/m³)	PC as % of Objective	PEC (µg/m³)	PEC as % of Objective
R1	0.00	0%	18.00	45%
R2	0.01	0%	18.01	45%
R3	0.00	0%	18.00	45%
R4	0.00	0%	18.00	45%
R5	0.01	0%	18.01	45%
R6	0.01	0%	18.01	45%
R7	0.01	0%	18.01	45%
R8	0.01	0%	18.01	45%
R9	0.01	0%	18.01	45%
R10	0.01	0%	18.01	45%
R11	0.01	0%	18.01	45%
R12	0.01	0%	18.01	45%
R13	0.01	0%	18.01	45%
R14	0.01	0%	18.01	45%

Location	PC (µg/m³)	PC as % of Objective	PEC (µg/m³)	PEC as % of Objective
R15	0.01	0%	18.01	45%
R16	0.01	0%	18.01	45%
R17	0.00	0%	18.00	45%
R18	0.00	0%	18.00	45%
R20	0.00	0%	18.00	45%
R21	0.00	0%	18.00	45%
R22	0.00	0%	18.00	45%
R23	0.00	0%	18.00	45%
R24	0.00	0%	18.00	45%
R25	0.00	0%	18.00	45%
R26	0.00	0%	18.00	45%
R27	0.03	0%	18.03	45%
R28	0.00	0%	18.00	45%
R29	0.00	0%	18.00	45%
R30	0.00	0%	18.00	45%
AQS	**40 µg/m³**			
Bold and underlined text indicates an exceedance				

Table 5.2: Predicted 90.4th Percentile Daily Mean PM_{10} Concentrations at Discrete Receptors, Highest Results Selected between 2019-2021 for Each Receptor

Location	PC (µg/m³)	PC as % of Objective	PEC (µg/m³)	PEC as % of Objective
R1	1.02	2%	37.0	74%
R2	1.44	3%	37.4	75%
R3	0.73	1%	36.7	73%
R4	1.26	3%	37.3	75%
R5	0.91	2%	36.9	74%
R6	0.91	2%	36.9	74%
R7	0.92	2%	36.9	74%
R8	0.97	2%	37.0	74%
R9	0.98	2%	37.0	74%
R10	0.98	2%	37.0	74%
R11	0.98	2%	37.0	74%
R12	0.98	2%	37.0	74%
R13	0.98	2%	37.0	74%
R14	0.98	2%	37.0	74%

Location	PC (µg/m³)	PC as % of Objective	PEC (µg/m³)	PEC as % of Objective
R15	0.98	2%	37.0	74%
R16	0.98	2%	37.0	74%
R17	0.00	0%	36.0	72%
R18	0.00	0%	36.0	72%
R20	0.00	0%	36.0	72%
R21	0.00	0%	36.0	72%
R22	0.00	0%	36.0	72%
R23	0.01	0%	36.0	72%
R24	0.00	0%	36.0	72%
R25	0.00	0%	36.0	72%
R26	0.81	2%	36.8	74%
R27	7.74	15%	43.7	87%
R28	0.77	2%	36.8	74%
R29	0.04	0%	36.0	72%
R30	0.91	2%	36.9	74%
AQS	**50 µg/m³**			
Bold and underlined text indicates an exceedance				

As detailed above, with the operation of the application site, annual mean and daily mean PM_{10} concentrations at nearby receptors are predicted to be below the air quality objectives.

5.1.2 Nitrogen Dioxide

Table 5.3 shows the maximum annual mean NO_2 at each discrete receptor point across the three meteorological years considered. All predicted total annual mean NO_2 concentrations (PECs) are below the annual mean NO_2 AQS objective level at the discrete receptors.

Table 5.4 shows the maximum 97.35 percentile hourly mean NO_2 at each discrete receptor point across the three meteorological years considered. Most predicted 97.35 percentile hourly mean NO_2 concentrations (PECs) are below the hourly mean NO_2 AQS objective level, with the exception of R27 at the roof garden. Further exceedances of the 97.35 percentile hourly mean NO_2 are predicted at 59.5m height (breathing height of receptors at the roof garden) as shown in the contour plots for the 97.35 percentile hourly mean NO_2 concentrations in Appendix B. It should be acknowledged that the generators will only operate during emergency, estimated as three instances of 24 hours per year. The modelled 97.35 percentile hourly mean NO_2 concentration presented within this report is therefore considered to show worst case scenario, and potentially be overly conservative of actual conditions.

Nonetheless, exceedances of short term NO_2 AQS have been predicted, and it is understood the Trust will be exploring options to eliminate exceedance as part of the detailed design.

Table 5.3: Predicted Annual Mean NO_2 Concentrations at Discrete Receptors, Highest Results Selected between 2019-2021 for Each Receptor

Location	PC (µg/m³)	PC as % of Objective	PEC (µg/m³)	PEC as % of Objective
R1	0.14	0%	32.1	80%
R2	0.21	1%	32.2	81%
R3	0.11	0%	32.1	80%
R4	0.19	0%	32.2	80%
R5	0.24	1%	32.2	81%
R6	0.24	1%	32.2	81%
R7	0.26	1%	32.3	81%
R8	0.28	1%	32.3	81%
R9	0.28	1%	32.3	81%
R10	0.29	1%	32.3	81%
R11	0.28	1%	32.3	81%
R12	0.30	1%	32.3	81%
R13	0.30	1%	32.3	81%
R14	0.30	1%	32.3	81%
R15	0.30	1%	32.3	81%
R16	0.30	1%	32.3	81%
R17	0.00	0%	32.0	80%
R18	0.00	0%	32.0	80%
R20	0.00	0%	32.0	80%
R21	0.00	0%	32.0	80%
R22	0.00	0%	32.0	80%
R23	0.00	0%	32.0	80%
R24	0.00	0%	32.0	80%
R25	0.00	0%	32.0	80%
R26	0.11	0%	32.1	80%
R27	1.14	3%	33.1	83%
R28	0.11	0%	32.1	80%
R29	0.01	0%	32.0	80%
R30	0.12	0%	32.1	80%
AQS	**40 µg/m³**			

Location	PC (µg/m³)	PC as % of Objective	PEC (µg/m³)	PEC as % of Objective
Bold and underlined text indicates an exceedance				

Table 5.4: Predicted 97.35th Percentile Hourly Mean NO_2 Concentrations at Discrete Receptors, Highest Results Selected between 2019-2021 for Each Receptor

Location	PC (µg/m³)	PC as % of Objective	PEC (µg/m³)	PEC as % of Objective
R1	60.45	30%	124.45	62%
R2	82.56	41%	146.56	73%
R3	43.58	22%	107.58	54%
R4	70.46	35%	134.46	67%
R5	42.14	21%	106.14	53%
R6	42.14	21%	106.14	53%
R7	43.15	22%	107.15	54%
R8	43.53	22%	107.53	54%
R9	43.53	22%	107.53	54%
R10	43.53	22%	107.53	54%
R11	43.53	22%	107.53	54%
R12	43.53	22%	107.53	54%
R13	43.53	22%	107.53	54%
R14	43.55	22%	107.55	54%
R15	43.56	22%	107.56	54%
R16	43.56	22%	107.56	54%
R17	0.00	0%	64.00	32%
R18	0.00	0%	64.00	32%
R20	0.03	0%	64.03	32%
R21	0.00	0%	64.00	32%
R22	0.00	0%	64.00	32%
R23	0.21	0%	64.21	32%
R24	0.05	0%	64.05	32%
R25	0.00	0%	64.00	32%
R26	47.61	24%	111.61	56%
R27	**405.55**	**203%**	**469.55**	**235%**
R28	51.74	26%	115.74	58%
R29	1.77	1%	65.77	33%
R30	59.84	30%	123.84	62%
AQS	**200 µg/m³**			
Bold and underlined text indicates an exceedance				

5.1.3 Carbon Monoxide

The predicted maximum daily running 8 hour mean CO concentrations at all the assessed discrete receptors would not exceed the relevant AQO.

Table 5.5 shows the maximum daily running 8 hour mean CO at each discrete receptor point across the three meteorological years considered.

All predicted total maximum daily running 8 hour mean CO concentrations (PECs) are below the AQS objective level at the discrete receptors.

Table 5.5: Predicted Maximum Daily Running 8 Hour Mean CO Concentrations at Discrete Receptors, Highest Results Selected between 2019-2021 for Each Receptor

Location	PC (mg/m^3)	PC as % of Objective	PEC (mg/m^3)	PEC as % of Objective
R1	0.00	0%	1.35	13%
R2	0.00	0%	1.35	13%
R3	0.00	0%	1.35	13%
R4	0.00	0%	1.35	13%
R5	0.00	0%	1.35	13%
R6	0.00	0%	1.35	13%
R7	0.00	0%	1.35	13%
R8	0.00	0%	1.35	13%
R9	0.00	0%	1.35	13%
R10	0.00	0%	1.35	13%
R11	0.00	0%	1.35	13%
R12	0.00	0%	1.35	13%
R13	0.00	0%	1.35	13%
R14	0.00	0%	1.35	13%
R15	0.00	0%	1.35	13%
R16	0.00	0%	1.35	13%
R17	0.00	0%	1.34	13%
R18	0.00	0%	1.34	13%
R20	0.00	0%	1.34	13%
R21	0.00	0%	1.34	13%
R22	0.00	0%	1.34	13%
R23	0.00	0%	1.34	13%
R24	0.00	0%	1.34	13%
R25	0.00	0%	1.35	13%

Location	PC (mg/m^3)	PC as % of Objective	PEC (mg/m^3)	PEC as % of Objective
R26	0.00	0%	1.36	14%
R27	0.01	0%	1.35	13%
R28	0.00	0%	1.34	13%
R29	0.00	0%	1.35	13%
R30	0.00	0%	1.34	13%
AQS	**10 mg/m^3**			
Bold and underlined text indicates an exceedance				

6 CONCLUSIONS

An air quality assessment of the potential air quality impacts associated with the proposed backup generators proposed as part of the redevelopment of the Frontage Building for the GOSHCCC has been undertaken with reference to existing air quality in the area and relevant legislation, policy and guidance.

A detailed dispersion modelling assessment has been undertaken to assess NO_2, CO, and PM_{10} emissions from the operation of the backup generators at locations associated with openable windows, air intakes and discrete human receptor points on the proposed roof terrace of the GOSHCCC and neighbouring buildings.

Concentrations of NO_2, PM_{10} and CO were predicted at the most relevant receptor locations using ADMS 5. The air quality impacts of the backup generators on existing and proposed receptors have been assessed. The predicted PM_{10} and CO concentrations at all assessed receptors would not exceed the relevant air quality standards. The annual mean NO_2 is not predicted to exceed the relevant air quality standards at any receptor points.

The 97.35 percentile hourly mean NO_2 concentration is predicted to exceed the air quality objective across parts of the roof garden. Therefore, it is understood the Trust will be exploring options to eliminate exceedances as part of the detailed design. Following the implementation of an appropriate selection of mitigation measures the residual effects from the scheme will have been reduced.

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APPENDIX A
WIND ROSES

Figure A-1: 2019 Windrose from Heathrow Airport Meteorological Station

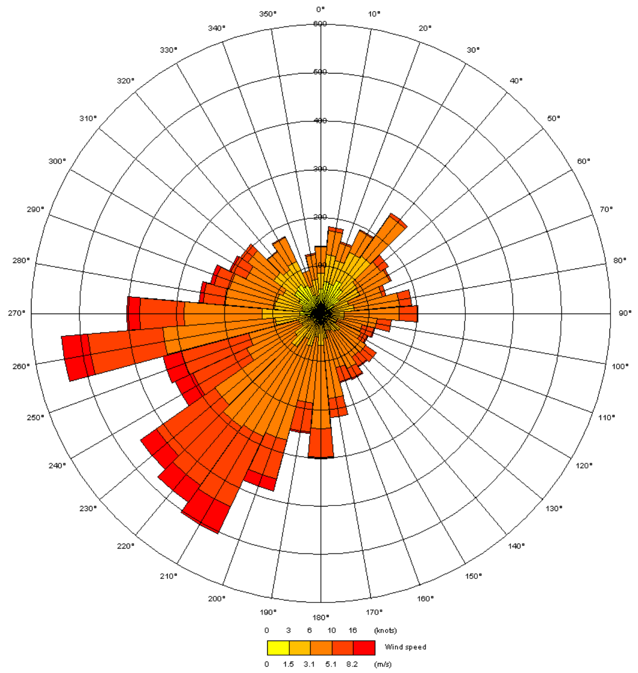


Figure A-2: 2020 Windrose from Heathrow Airport Meteorological Station

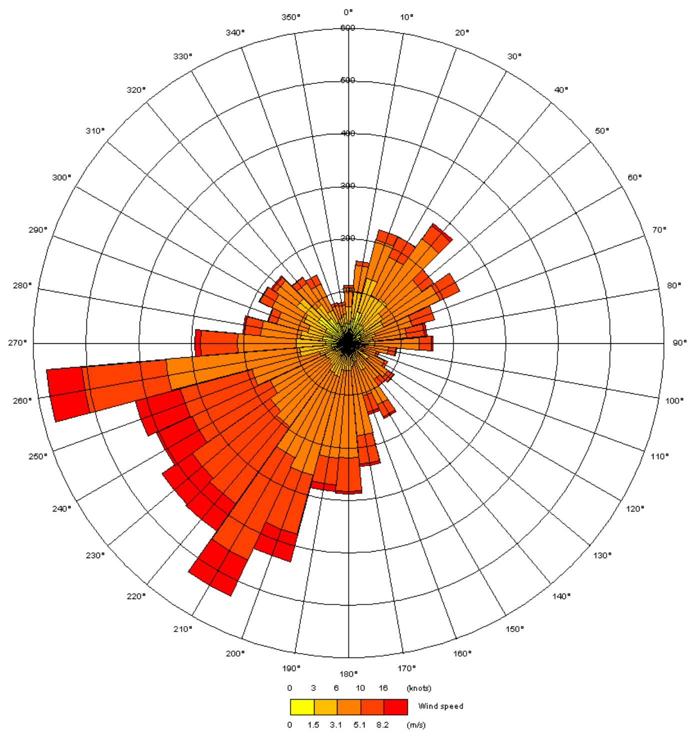
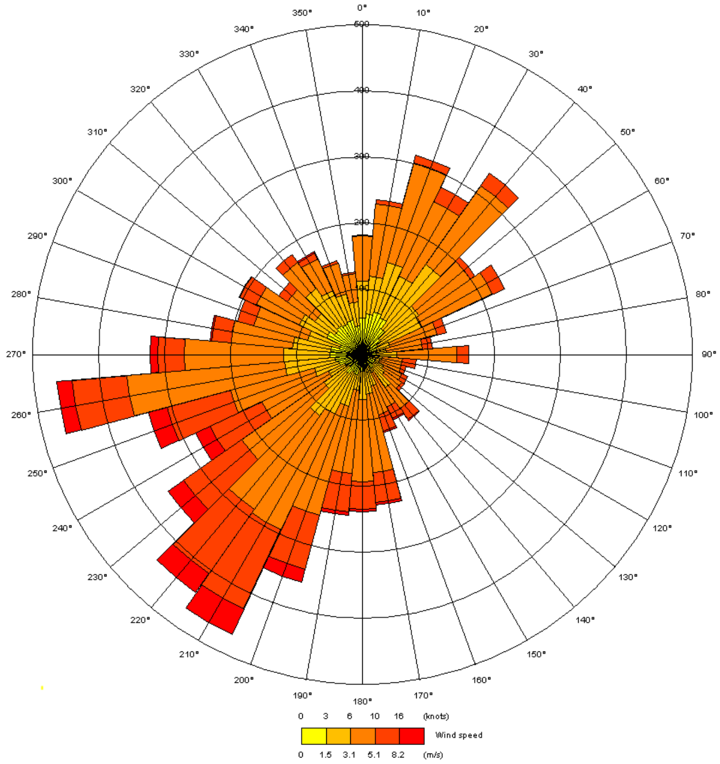


Figure A-3: 2021 Windrose from Heathrow Airport Meteorological Station



APPENDIX B
CONTOUR

Figure B-4: Predicted 97.35 percentile hourly mean NO_2 concentration (µg/m³) (PEC) at 59.5m