Air Quality Assessment

Barnes Hospital

South Worple Way, London, SW14 8SU

For South West London and St George's Mental Health NHS Trust

Quality Management

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Executive Summary

The proposed mixed-use development at Barnes Hospital is located within the administrative area of the London Borough of Richmond upon Thames (LBRT). The entire borough is designated as an Air Quality Management Area (AQMA) due to elevated concentrations of nitrogen dioxide (NO_2) and particulate matter (PM_{10}) attributable to road traffic emissions.

This Air Quality Assessment, undertaken to accompany the planning application, considers the air quality impacts from the construction phase and once the Proposed Development is fully operational.

The assessment has been undertaken based upon appropriate information on the Proposed Development provided by South West London and St George's Mental Health NHS Trust ("The Trust") and its project team. In undertaking this assessment, RPS experts have exercised professional skills and judgement to the best of their abilities and have given professional opinions that are objective, reliable and backed with scientific rigour. These professional responsibilities are in accordance with the code of professional conduct set by the Institution of Environmental Sciences for members of the Institute of Air Quality Management (IAQM).

For the construction phase, the most important consideration is dust. Without appropriate mitigation, dust could cause temporary soiling of surfaces, particularly windows, cars and laundry. The mitigation measures provided within this report should ensure that the risk of adverse dust effects is reduced to a minimum.

Detailed atmospheric dispersion modelling has been undertaken for the first year in which the development is expected to be fully operational, 2023. Pollutant concentrations are predicted to be well within the relevant health-based air quality objectives at the façades of proposed receptors. Therefore, air quality is acceptable at the development site, making it suitable for its proposed uses.

The proposed development does not, in air quality terms, conflict with national or local policies. There are no constraints to the development in the context of air quality.

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1 Introduction

1.1 This report details the air quality assessment undertaken for the planning application for the proposed mixed-use development at Barnes Hospital, South Worple Way, Barnes SW14 8SU. Specifically, the planning application is for the following:

"Outline planning permission for the demolition and comprehensive redevelopment (phased development) of land at Barnes Hospital to provide a mixed use development comprising a health centre (Use Class D1), a Special Educational Needs (SEN) School (Use Class D1), up to 80 new build residential units (Use class C3), the conversion of two of the retained BTMs for use for up to 3no. residential units (Use Class C3), the conversion of one BTM for medical use (Use Class D1), car parking, landscaping and associated works. All matters reserved save for the full details submitted in relation to access points at the site boundaries."

1.2 The report complements RPS' air quality neutral impact calculation *'Air Quality Neutral Calculation: Barnes Hospital'* report. That air quality neutral calculation report quantifies the emissions of atmospheric pollutants from the development at source (i.e. from vehicles and building plant) and compares the emissions with official benchmark levels that define neutrality. In contrast, this report considers the impacts of the development on ambient air quality at the point of exposure (i.e. at sensitive receptor locations) by comparing predicted levels with Air Quality Strategy objectives and EU Limit Values.

1.3 The local planning authority, the London Borough of Richmond upon Thames (LBRT), has designated the entire borough is designated as an Air Quality Management Area (AQMA) due to elevated concentrations of nitrogen dioxide (NO_2) and particulate matter (PM_{10}) attributable to road traffic emissions.

1.4 The proposed scheme is expected to result in a decrease in traffic flows on the local road network compared with the consented scheme. This assessment therefore does not consider the impacts of the development traffic on the local area.

1.5 The heat and power demands for the proposed development are likely to be met by a gas-fired Combined Heat and Power (CHP) plant. There is currently insufficient information available to allow for an assessment of the CHP plant and so this aspect will be dealt with at a later date when precise details are available.

1.6 This air quality assessment covers the:

- Construction phase - an evaluation of the temporary effects from fugitive construction dust and construction-vehicle exhaust emissions; and the
- Operational phase – an evaluation of the impacts on future occupants of the development from their exposure to the prevailing levels of air pollution, which can be a factor in the suitability of the site for its proposed use.

1.7 This report begins by setting out the policy and legislative context for the assessment. The methods and criteria used to assess potential air quality effects have then been described. The baseline air quality conditions have been established taking into account Defra estimates, local authority documents and the results of any local monitoring. The results of the assessment of air quality impacts have been presented. A conclusion has been drawn on the significance of the residual construction-phase effects and the residual operational-phase effects.

2 Policy and Legislative Context

Ambient Air Quality Legislation and National Policy

The Ambient Air Quality Directive and Air Quality Standards Regulations

2.1 The 2008 Ambient Air Quality Directive (2008/50/EC) [1] aims to protect human health and the environment by avoiding, reducing or preventing harmful concentrations of air pollutants; it sets legally binding concentration-based limit values, as well as target values. There are also information and alert thresholds for reporting purposes. These are to be achieved for the main air pollutants: particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), ozone (O_3), carbon monoxide (CO), lead (Pb) and benzene. This Directive replaced most of the previous EU air quality legislation and in England was transposed into domestic law by the Air Quality Standards Regulations 2010 [2], which in addition incorporates the 4^{th} Air Quality Daughter Directive (2004/107/EC) that sets targets for ambient air concentrations of certain toxic heavy metals (arsenic, cadmium and nickel) and polycyclic aromatic hydrocarbons (PAHs). Equivalent regulations exist in Scotland, Wales and Northern Ireland. Member states must comply with the limit values (which are legally binding on the Secretary of State) and the Government and devolved administrations operate various national ambient air quality monitoring networks to measure compliance and develop plans to meet the limit values.

UK Air Quality Strategy

2.2 The Environment Act 1995 established the requirement for the Government and the devolved administrations to produce a National Air Quality Strategy (AQS) for improving ambient air quality, the first being published in 1997 and having been revised several times since, with the latest published in 2007 [3]. The Strategy sets UK air quality standards[♦] and objectives[#] for the pollutants in the Air Quality Standards Regulations plus 1,3-butadiene and recognises that action at national, regional and local level may be needed, depending on the scale and nature of the air quality problem. There is no legal requirement to meet objectives set within the UK AQS except where equivalent limit values are set within the EU Directives.

2.3 The 1995 Environment Act also established the UK system of Local Air Quality Management (LAQM), that requires local authorities to go through a process of review and assessment of air quality in their areas, identifying places where objectives are not likely to be met, then declaring

[♦] Standards are concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. Standards, as the benchmarks for setting objectives, are set purely with regard to scientific evidence and medical evidence on the effects of the particular pollutant on health, or on the wider environment, as minimum or zero risk levels.

[#] Objectives are policy targets expressed as a concentration that should be achieved, all the time or for a percentage of time, by a certain date.

Air Quality Management Areas (AQMAs) and putting in place Air Quality Action Plans to improve air quality. These plans also contribute, at local level, to the achievement of EU limit values.

2.4 For the purposes of this assessment, the limit values set out in the Air Quality Standards Regulations 2010 and the objective levels specified under the current UK AQS have been used.

2.5 The limit values and objectives relevant to this assessment are summarised in Table 2.1.

Table 2.1 Summary of Relevant Air Quality Limit Values and Objectives

Pollutant	Averaging Period	Objectives/ Limit Values	Not to be Exceeded More Than	Target Date
Nitrogen Dioxide (NO_2)	1 hour	200 $\mu g.m^{-3}$	18 times per calendar year	-
	Annual	40 $\mu g.m^{-3}$	-	-
Particulate Matter (PM_{10})	24 Hour	50 $\mu g.m^{-3}$	35 times per calendar year	-
	Annual	40 $\mu g.m^{-3}$	-	-
Particulate Matter ($PM_{2.5}$)	Annual	Target of 15% reduction in concentrations at urban background locations	-	Between 2010 and 2020 (a)
		Variable target of up to 20% reduction in concentrations at urban background locations (c)		Between 2010 and 2020 (b)
	Annual	25 $\mu g.m^{-3}$	-	01.01.2020 (a)
		25 $\mu g.m^{-3}$		01.01.2015 (b)

(a) Target date set in UK Air Quality Strategy 2007
(b) Target date set in Air Quality Standards Regulations 2010
(c) Aim to not exceed 18 $\mu g.m^{-3}$ by 2020

2.6 In July 2017, Defra published the *'UK plan for tackling roadside nitrogen dioxide concentrations'.* This describes the Government's plan for bringing roads with NO_2 concentrations above the EU Limit Value back into compliance within the shortest possible time. In January 2018, the High Court found the plan to be unlawful in certain respects and the UK Government was directed to urgently prepare a Supplement to the 2017 plan. In the interim, the High Court directed that the 2017 plan should remain in force whilst the Supplement is produced, in order to avoid any delay in its implementation.

National Planning Policy

National Planning Policy Framework

2.7 The National Planning Policy Framework (NPPF) [4] is a material consideration for local planning authorities and decision-takers in determining applications. At the heart of the NPPF is a presumption in favour of sustainable development. For determining planning applications, this means approving development proposals if they accord with an up-to-date local development plan, unless material considerations indicate otherwise. If the development plan does not contain relevant policies, or the policies are out of date, then planning permission should be granted unless the application of policies in the NPPF that protect areas or assets of particular importance provides a clear reason for refusing the development, or any adverse impacts would significantly outweigh the benefits.

2.8 The NPPF sets out three overarching objectives to achieve sustainable development. The relevant objective in the context of this air quality assessment is:

*"**an environmental objective** – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution and adapting to climate change, including moving to a low carbon economy"* (Paragraph 8c)

2.9 Under the heading 'Promoting sustainable transport', the NPPF states:

"The planning system should actively manage patterns of growth in support of these objectives. Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions, and improve air quality and public health. However, opportunities to maximise sustainable transport solutions will vary between urban and rural areas, and this should be taken into account in both plan-making and decision-making." (Paragraph 103)

2.10 Under the heading 'Conserving and enhancing the natural environment', the NPPF states:

"Planning policies and decisions should contribute to and enhance the natural and local environment by:

a) …

e) Preventing new and existing 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. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; …" (Paragraph 170)

"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." (Paragraph 181)

National Planning Practice Guidance

2.11 The National Planning Practice Guidance (NPPG) was issued on-line in March 2014 and is updated periodically by government as a live document. The Air Quality section of the NPPG describes the circumstances when air quality, odour and dust can be a planning concern, requiring assessment.

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

2.13 The NPPG states that when deciding whether air quality is relevant to a planning application, considerations could include whether the development would:

- *"Significantly affect traffic in the immediate vicinity of the proposed development site or further afield. This could be by generating or increasing traffic congestion; significantly changing traffic volumes, vehicle speed or both; or significantly altering the traffic composition on local roads. Other matters to consider include whether the proposal involves the development of a bus station, coach or lorry park; adds to turnover in a large car park; or result in construction sites that would generate large Heavy Goods Vehicle flows over a period of a year or more.*
- *Introduce new point sources of air pollution. This could include furnaces which require prior notification to local authorities; or extraction systems (including chimneys) which require approval under pollution control legislation or biomass boilers or biomass-fuelled CHP plant; centralised boilers or CHP plant burning other fuels within or close to an air quality management area or introduce relevant combustion within a Smoke Control Area;*
- *Expose people to existing sources of air pollutants. This could be by building new homes, workplaces or other development in places with poor air quality.*
- *Give rise to potentially unacceptable impact (such as dust) during construction for nearby sensitive locations.*

- *Affect biodiversity. In particular, is it likely to result in deposition or concentration of pollutants that significantly affect a European-designated wildlife site, and is not directly connected with or necessary to the management of the site, or does it otherwise affect biodiversity, particularly designated wildlife sites."*

2.14 The NPPG provides advice on how air quality impacts can be mitigated and notes *"Mitigation options where necessary will be locationally specific, will depend on the proposed development and should be proportionate to the likely impact. It is important therefore that local planning authorities work with applicants to consider appropriate mitigation so as to ensure the new development is appropriate for its location and unacceptable risks are prevented. Planning conditions and obligations can be used to secure mitigation where the relevant tests are met.*

Regional Policy Guidance – The London Plan

2.15 The Mayor of London is responsible for all strategic planning in London. Amongst the Mayor's duties is the requirement to develop a Spatial Development Strategy for London, known as the London Plan [5]. The current version of the London Plan was published in March 2016 and incorporates Further Alterations to the London Plan published in July 2011. The Plan acts as an integrating framework for a set of strategies, including improvements to air quality.

2.16 The key policy relating to air quality is Policy 7.14: Improving Air Quality:

"Strategic

A. The Mayor recognises the importance of tackling air pollution and improving air quality to London's development and the health and well-being of its people. He will work with strategic partners to ensure that the spatial, climate change, transport and design policies of this plan support implementation of his Air Quality and Transport strategies to achieve reductions in pollutant emissions and minimise public exposure to pollution.

Planning decisions

B Development proposals should:

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

b. promote sustainable design and construction to reduce emissions from the demolition and construction of buildings following the best practice guidance in the GLA and London Councils' 'The control of dust and emissions from construction and demolition'

c. be at least 'air quality neutral' and not lead to further deterioration of existing poor air quality (such as areas designated as Air Quality Management Areas (AQMAs)) *d. ensure that where provision needs to be made to reduce emissions from a development, this is usually made on-site. Where it can be demonstrated that on-site provision is impractical or inappropriate, and that it is possible to put in place measures having clearly demonstrated equivalent air quality benefits, planning obligations or planning conditions should be used as appropriate to ensure this, whether on a scheme by scheme basis or through joint area-based approaches*

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

2.17 The Mayor's Air Quality Strategy (MAQS) [6], referred to in Policy 7.14, sets out policies and proposals seeking to improve London's air quality to the point where air pollution no longer poses a significant risk to human health.

2.18 In April 2014, the Greater London Authority (GLA) published Supplementary Planning Guidance (SPG) Sustainable Design and Construction [7]. The SPG reinforces the existing need for a *'conventional'* Air Quality Assessment where pollutant concentrations, at the point of human exposure, are compared with the relevant national objectives; however, the SPG also details how major developments must demonstrate they are achieving the Mayor of London's *'Air Quality Neutral'* Policy 7.14. The Air Quality Neutral calculations have been undertaken for the Proposed Development and are provided in a separate report.

Local Planning Policy

2.19 The LBRT Local Plan was adopted in July 2018. This document sets out policies and guidance for development of the borough over the next 15 years.

2.20 The following policies are relevant to this assessment:

*"**Policy LP 8***

Amenity and Living Conditions

All development will be required to protect the amenity and living conditions for occupants of new, existing, adjoining and neighbouring properties. The Council will:

1. …

4. ensure there is no harm to the reasonable enjoyment of the use of buildings, gardens and other spaces due to increases in traffic, servicing, parking, noise, light, disturbance, air pollution, odours or vibration or local micro-climate effects.

…"

*"**Policy LP 10***

Local Environmental Impacts, Pollution and Land Contamination

A. *The Council will seek to ensure that local environmental impacts of all development proposals do not lead to detrimental effects on the health, safety and the amenity of existing and new users or occupiers of the development site, or the surrounding land. These potential impacts can include, but are not limited to, air pollution, noise and vibration, light pollution, odours and fumes, solar glare and solar dazzle as well as land contamination.*

Developers should follow any guidance provided by the Council on local environmental impacts and pollution as well as on noise generating and noise sensitive development. Where necessary, the Council will set planning conditions to reduce local environmental impacts on adjacent land uses to acceptable levels.

Air Quality

B. *The Council promotes good air quality design and new technologies. Developers should secure at least 'Emissions Neutral' development. To consider the impact of introducing new developments in areas already subject to poor air quality, the following will be required:*

1. *an air quality impact assessment, including where necessary, modelled data;*
2. *mitigation measures to reduce the development's impact upon air quality, including the type of equipment installed, thermal insulation and ducting abatement technology;*
3. *measures to protect the occupiers of new developments from existing sources;*
4. *strict mitigation for developments to be used by sensitive receptors such as schools, hospitals and care homes in areas of existing poor air quality; this also applies to proposals close to developments used by sensitive receptors.*

…"

3 Assessment Methodology

Approach

3.1 Neither the NPPF nor the NPPG is prescriptive on the methodology for assessing air quality effects or describing significance; practitioners continue to use guidance provided by Defra and non-governmental organisations, including Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM). However, the NPPG does advise that *"Assessments should be proportionate to the nature and scale of development proposed and the level of concern about air quality, and because of this are likely to be locationally specific. The scope and content of supporting information is therefore best discussed and agreed between the local planning authority and applicant before it is commissioned."* It lists a number of areas that might be usefully agreed at the outset.

3.2 This air quality assessment covers the elements recommended in the NPPG. The approach is consistent with the EPUK & IAQM Land-Use Planning & Development Control: Planning For Air Quality document [8], the Mayor of London's Control of Dust and Emissions during Construction and Demolition Supplementary Planning Guidance [9], the IAQM Guidance on the assessment of dust from demolition and construction [10] and, where relevant, the Mayor of London's Local Air Quality Management Technical Guidance: LLAQM.TG16 [11]. It includes the key elements listed below:

- assessment of the existing air quality in the study area (existing baseline) and prediction of the future air quality without the development in place (future baseline), using official government estimates from Defra, publically available air quality monitoring data for the area, and relevant Air Quality Review and Assessment (R&A) documents;
- a qualitative assessment of likely construction-phase impacts with mitigation and controls in place; and
- a quantitative prediction of the future operational-phase air quality impacts on future occupants of the development from their exposure to the prevailing levels of air pollution, which can be factor in the suitability of the site for its proposed uses.

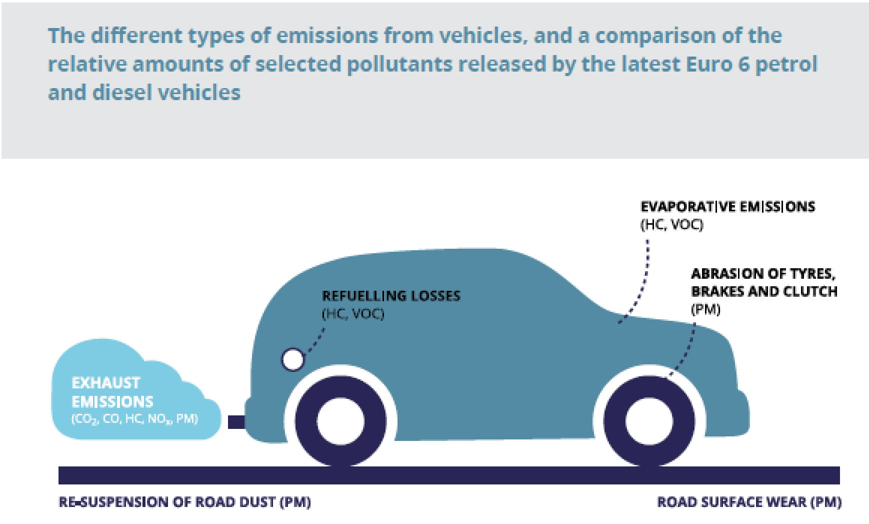
3.3 In line with the guidance set out in the NPPG, the Environmental Health Department at the LBRT was contacted in 2017 to agree the scope and methodology for the original assessment.

3.4 Air quality guidance advises that the organisation engaged in assessing the overall risks should hold relevant qualifications and/or extensive experience in undertaking air quality assessments. The RPS air quality team members involved at various stages of this assessment have professional affiliations that include Fellow and Member of the Institute of Air Quality Management, Chartered Chemist, Chartered Scientist, Chartered Environmentalist and Member of the Royal Society of Chemistry and have the required academic qualifications for these professional bodies. In addition, the Director responsible for authorising all deliverables has over 14 years' experience.

Summary of Key Pollutants Considered

3.5 For the operational phase of the Proposed Development, the main pollutants from road traffic with potential for local air quality impacts are nitrogen oxides (NO_x) and particulate matter (PM_{10}). Emissions of total NO_x from combustion sources comprise nitric oxide (NO) and NO_2. The NO oxidises in the atmosphere to form NO_2. The assessment of operational impacts therefore focuses on changes in NO_2 and PM_{10} concentrations. The impact from fine particulate matter, known as $PM_{2.5}$ (a subset of PM_{10}) concentrations has also been considered.

Figure 3.1 Types of Vehicle Emissions



Source: European Environment Agency (2016) Explaining Road Transport Emissions: A Non-technical Guide

3.6 For the construction phase of the Proposed Development the key pollutant is dust, covering both the PM_{10} fraction that is suspended in the air that can be breathed, and the deposited dust that has fallen out of the air onto surfaces and which can potentially cause temporary annoyance effects.

3.7 Regarding exhaust emissions from construction-related vehicles (contractors' vehicles and Heavy Goods Vehicles (HGVs), diggers, and other diesel-powered vehicles), these are unlikely to have a significant impact on local air quality [10] except for large, long-term construction sites: the EPUK & IAQM Land-Use Planning & Development Control: Planning For Air Quality document [8] indicates that air quality assessments should include developments increasing annual average daily Heavy Duty Vehicle (HDV) traffic flows by more than 25 within or adjacent to an AQMA and more than 100 elsewhere. The aforementioned EPUK & IAQM thresholds are not expected to be exceeded for any individual road during the construction phase of this project; therefore, construction-vehicle exhaust emissions have not been assessed specifically.

3.8 Regarding operational building emissions, the applicant has confirmed that the heat and power demands for the proposed development are likely to be met by a gas-fired Combined Heat and Power (CHP) plant. The applicant acknowledges the potential NO_x emissions associated with CHPs. However, at this stage, a decision on the thermal capacity of the CHP has not been made. Therefore, the applicant requests to be bound by the requirements of the GLA's SPG which state:

"4.3.25 It is acknowledged that developers may not procure plant until planning permission has been obtained. Developers will therefore be required to provide a written statement of their commitment and ability to meet the emission standards within their Air Quality Assessments. When securing these emissions standards, it is best to agree maximum emissions as opposed to the technology. Technology may improve between the time planning permission is granted and the equipment is procured."

Construction Phase - Methodology

3.9 Dust is the generic term used to describe particulate matter in the size range 1-75 µm in diameter [12]. Particles greater than 75 µm in diameter are termed grit rather than dust. Dusts can contain a wide range of particles of different sizes. The normal fate of suspended (i.e. airborne) dust is deposition. The rate of deposition depends largely on the size of the particle and its density; together these influence the aerodynamic and gravitational effects that determine the distance it travels and how long it stays suspended in the air before it settles out onto a surface. In addition, some particles may agglomerate to become fewer, larger particles; whilst others react chemically.

3.10 The effects of dust are linked to particle size and two main categories are usually considered:

- PM_{10} particles, those up to 10 µm in diameter, remain suspended in the air for long periods and are small enough to be breathed in and so can potentially impact on health; and
- Dust, generally considered to be particles larger than 10 µm which fall out of the air quite quickly and can soil surfaces (e.g. a car, window sill, laundry). Additionally, dust can potentially have adverse effects on vegetation and fauna at sensitive habitat sites.

3.11 The IAQM *Guidance on the assessment of dust from demolition and construction* sets out 350 m as the distance from the site boundary and 50 m from the site traffic route(s) up to 500 m of the entrance, within which there could potentially be nuisance dust and PM_{10} effects on human receptors. For sensitive ecological receptors, the corresponding distances are 50 m in both cases. (In this particular application, there are no ecological receptors within the distances and ecological effects have been scoped out). These distances are set to be deliberately conservative.

3.12 Concentration-based limit values and objectives have been set for the PM_{10} suspended particle fraction, but no statutory or official numerical air quality criterion for dust annoyance has been set at a UK, European or World Health Organisation (WHO) level. Construction dust assessments have tended to be risk based, focusing on the appropriate measures to be used to keep dust impacts at an acceptable level.

3.13 The Mayor of London's Control of Dust and Emissions during Construction and Demolition Supplementary Planning Guidance [9] (hereafter referred to as the Construction and Demolition SPG) provides information relating to the approach to the assessment, recommended mitigation measures and appropriate monitoring strategies. In particular, the Construction and Demolition SPG states that the assessment methodology provided in the current version of the Institute of Air Quality Management (IAQM) *Guidance on the assessment of dust from demolition and construction* should be used.

3.14 The IAQM dust guidance aims to estimate the impacts of both PM_{10} and dust through a risk-based assessment procedure. The IAQM dust guidance document states: *"The impacts depend on the mitigation measures adopted. Therefore the emphasis in this document is on classifying the risk of dust impacts from a site, which will then allow mitigation measures commensurate with that risk to be identified."*

3.15 The IAQM dust guidance provides a methodological framework, but notes that professional judgement is required to assess effects: *"This is necessary, because the diverse range of projects that are likely to be subject to dust impact assessment means that it is not possible to be prescriptive as to how to assess the impacts. Also a wide range of factors affect the amount of dust that may arise, and these are not readily quantified."*

3.16 Consistent with the recommendations in the IAQM dust guidance, a risk-based assessment has been undertaken for the development, using the well-established source-pathway-receptor approach:

- The dust impact (the change in dust levels attributable to the development activity) at a particular receptor will depend on the magnitude of the dust source and the effectiveness of the pathway (i.e. the route through the air) from source to receptor.
- The effects of the dust are the results of these changes in dust levels on the exposed receptors, for example annoyance or adverse health effects. The effect experienced for a given exposure depends on the sensitivity of the particular receptor to dust. An assessment of the overall dust effect for the area as a whole has been made using professional judgement taking into account both the change in dust levels (as indicated by the Dust Impact Risk for individual receptors) and the absolute dust levels, together with the sensitivities of local receptors and other relevant factors for the area.

The detail of the dust assessment methodology is provided in Appendix A.

3.17 The dust risk categories that have been determined for each of the four activities (demolition, earthworks, construction and trackout) have been used to define the appropriate site-specific mitigation measures based on those described in the Mayor of London's SPG. The Mayor of London's SPG states that with the recommended dust mitigation measures in place the residual impact will be *"minimised".*

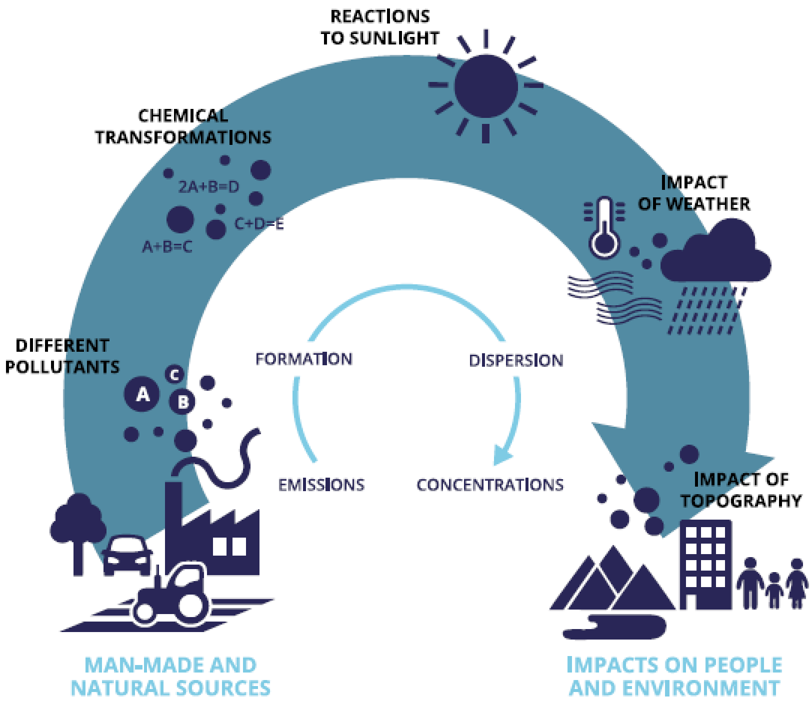
3.18 This assessment does not consider the air quality impacts of dust from any contaminated land or buildings. If contaminated land is identified on the Application Site, the impacts will be assessed in other technical discipline reports.

Operational Phase - Methodology

Atmospheric Dispersion Modelling of Pollutant Concentrations

3.19 In urban areas, pollutant concentrations are primarily determined by the balance between pollutant emissions that increase concentrations, and the ability of the atmosphere to reduce and remove pollutants by dispersion, advection, reaction and deposition. An atmospheric dispersion model is used as a practical way to simulate these complex processes; such a model requires a range of input data, which can include emissions rates, meteorological data and local topographical information. The model used and the input data relevant to this assessment are described in the following sub-sections.

Figure 3.2 Air Pollution: From Emissions to Exposure



Source: European Environment Agency (2016) Explaining Road Transport Emissions: A Non-technical Guide

3.20 The atmospheric pollutant concentrations in an urban area depend not only on local sources at a street scale, but also on the background pollutant level made up of the local urban-wide background, together with regional pollution and pollution from more remote sources brought in on the incoming air mass. This background contribution needs to be added to the fraction from the modelled sources, and is usually obtained from measurements or estimates of urban background concentrations for the area in locations that are not directly affected by local emissions sources. Background pollution levels are described in detail in Section 4.

3.21 The ADMS-Roads model has been used in this assessment to predict the air quality impacts from traffic on the local road network. This is a version of the Atmospheric Dispersion Modelling System (ADMS), a formally validated model developed in the UK by Cambridge Environmental Research Consultants Ltd (CERC) and widely used in the UK and internationally for regulatory purposes.

Model Input Data

Traffic Flow Data

3.22 Traffic data used in the assessment have been provided by the project's transport consultants, Motion. The traffic flow data provided for this assessment are summarised in Table 3.1. The modelled road links are illustrated in Figure 1.

Table 3.1 Traffic Data Used Within the Assessment

Road Link ID	Road Link Name	Speed (km.hr^{-1})	Daily Two Way Vehicle Flow (2023)			
			Without Development		With Development	
			Total Vehicles	HDV %	Total Vehicles	HDV %
1	South Worple Way	42	797	4	686	4
2	White Hart Lane	42	4650	9	4567	9
3	South Circular Road	48	26263	4	26221	4
4*	Priests Bridge	48	13132	4	13111	4

Notes: (km.hr^{-1}) = kilometres per hour
HDV = Heavy Duty Vehicle - vehicles greater than 3.5 t gross vehicle weight including buses
LDV = Light Duty Vehicle
* Traffic flows for this link are assumed to be half of those on Link 3, given that it is a one-way road.

3.23 As shown in Table 3.1 above, the proposals are expected to lead to a reduction in traffic on the local road network.

3.24 The average speed on each road has been reduced by 10 km.hr^{-1} to take into account the possibility of slow moving traffic near junctions and at roundabouts in accordance with LLAQM.TG16.

Vehicle Emission Factors

3.25 The modelling has been undertaken using Defra's 2017 emission factor toolkit (version 8.0) which draws on emissions generated by the European Environment Agency (EEA) COPERT 5 emission calculation tool.

Meteorological Data

3.26 ADMS-Roads requires detailed meteorological data as an input. The most representative observing station for the region of the study area that supplies all the data in the required format is Heathrow approximately 14 km west of the Application Site. Meteorological data from that station for 2016 have been used within the dispersion model. The wind rose is presented in Figure 2.

Receptors

3.27 The air quality assessment predicts the impacts at locations that could be sensitive to any changes. For assessing human-health impacts, such sensitive receptors should be selected where the public is regularly present and likely to be exposed over the averaging period of the objective. LLAQM.TG16 [11] provides examples of exposure locations and these are summarised in Table 3.2.

Table 3.2 Example of Where Air Quality Objectives Apply

Averaging Period	Objectives should apply at:	Objectives should generally not apply at:
Annual-mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes.	Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building's façades), or any other location where public exposure is expected to be short-term.
Daily-mean	All locations where the annual-mean objective would apply, together with hotels. Gardens of residential properties.	Kerbside sites (as opposed to locations at the building's façade), or any other location where public exposure is expected to be short-term.
Hourly-mean	All locations where the annual and 24 hour mean would apply. Kerbside sites (e.g. pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations to which the public might reasonably be expected to spend 1-hour or longer.	Kerbside sites where the public would not be expected to have regular access.

3.28 Representative sensitive receptors for this assessment have been selected at several locations on the site boundary where pollutant concentrations are anticipated to be greatest, as shown in Figure 1.

3.29 The annual, daily and hourly-mean AQS objectives apply at the front and rear façades of all proposed receptors. The approaches used to predict the concentrations for these different averaging periods are described below.

Long-Term Pollutant Predictions

3.30 Annual-mean NO_x and PM_{10} concentrations have been predicted at representative sensitive receptors using ADMS-Roads, then added to relevant background concentrations. Primary NO in the NO_X emissions is converted to NO_2 to a degree determined by the availability of atmospheric oxidants locally and the strength of sunlight. For road traffic sources, annual-mean NO_2 concentrations have been derived from the modelled road-related annual-mean NO_x concentration using Defra's calculator [13].

Short-Term Pollutant Predictions

3.31 In order to predict the likelihood of exceedences of the hourly-mean AQS objectives for NO_2 and the daily-mean AQS objective for PM_{10}, the following relationships between the short-term and the annual-mean values at each receptor have been considered.

Hourly-Mean AQS Objective for NO_2

3.32 Research undertaken in support of LLAQM.TG16 has indicated that the hourly-mean limit value and objective for NO_2 is unlikely to be exceeded at a roadside location where the annual-mean NO_2 concentration is less than 60 $\mu g.m^{-3}$. The threshold of 60 $\mu g.m^{-3}$ NO_2 has been used the guideline for considering a likely exceedence of the hourly-mean nitrogen dioxide objective.

Daily-Mean AQS Objective for PM_{10}

3.33 The number of exceedences of the daily-mean AQS objective for PM_{10} of 50 $\mu g.m^{-3}$ may be estimated using the relationship set out in LLAQM.TG16:

*Number of Exceedences of Daily Mean of 50 $\mu g.m^{-3}$ = -18.5 + 0.00145 * (Predicted Annual-mean $PM_{10})^3$ + 206 / (Predicted Annual-mean PM_{10} Concentration)*

Fugitive PM_{10} Emissions

3.34 Transport PM_{10} emissions arise from both the tailpipe exhausts and from fugitive sources such as brake and tyre wear and re-suspended road dust. Improvements in vehicle technologies are reducing PM_{10} exhaust emissions; therefore, the relative importance of fugitive PM_{10} emissions is increasing. Current official vehicle emission factors for particulate matter include brake dust and tyre wear which studies suggest may account for approximately one-third of the total particulate emissions from road transport; but not re-suspended road dust (which remains unquantified.)

Significance Criteria for New Population Exposure (Site Suitability)

3.35 The London Councils' Air Quality and Planning Guidance [14] provides Air Pollution Exposure Criteria (APEC) for assessing the significance on exposure to air pollution and the levels of mitigation required when considering site suitability. Table 3.3 provides a summary of the criteria.

Table 3.3 Summary of Air Pollution Exposure Criteria (APEC)

Criteria	Applicable Range NO_2 Annual-Mean	Applicable Range PM_{10}	Recommendation
APEC-A	> 5% below national objective	Annual-Mean >5% below national objective 24-Hour >1-day less than national objective	No air quality grounds for refusal; however mitigation of any emissions should be considered.
APEC-B	Between 5% below or above national objective	Annual-Mean Between 5% above or below national objective 24-Hour Between 1-day above or below national objective	May not be sufficient air quality grounds for refusal, however appropriate mitigation must be considered, e.g. maximise distance from pollutant source, proven ventilation systems, parking considerations, winter gardens, internal layout considered and internal pollutant emissions minimised.
APEC-C	>5% above national objective	Annual-Mean >5% above national objective 24-Hour >1-day more than national objective	Refusal on air quality grounds should be anticipated, unless the Local Authority has a specific policy enabling such land use and ensure best endeavours to reduce exposure are incorporated. Worker exposure in commercial/industrial land uses should be considered further. Mitigation measures must be presented with air quality assessment, detailing anticipated outcomes of mitigation measures.

3.36 Concentrations have been predicted at proposed receptors to determine the APEC category that would apply.

Uncertainty

3.37 All air quality assessment tools, whether models or monitoring measurements, have a degree of uncertainty associated with the results. The choices that the practitioner makes in setting-up the model, choosing the input data, and selecting the baseline monitoring data will decide whether the final predicted impact should be considered a central estimate, or an estimate tending towards the upper bounds of the uncertainty range (i.e. tending towards worst-case).

3.38 The atmospheric dispersion model itself contributes some of this uncertainty, due to it being a simplified version of the real situation: it uses a sophisticated set of mathematical equations to approximate the complex physical and chemical atmospheric processes taking place as a pollutant is released and as it travels to a receptor. The predictive ability of even the best model is limited by how well the turbulent nature of the atmosphere can be represented.

3.39 Each of the data inputs for the model, listed earlier, will also have some uncertainty associated with them. Where it has been necessary to make assumptions, these have mainly been made towards the upper end of the uncertainty range informed by an analysis of relevant, available data.

3.40 The atmospheric dispersion model used for this assessment, ADMS Roads, has been validated by its supplier and is widely used by professionals in the UK and overseas. A site-specific verification (calibration) provides additional certainty and is particularly important when air quality levels are close to exceeding the objectives/limit values.

3.41 LLAQM.TG16 requires that local authorities verify the results of any detailed modelling undertaken for the purposes of fulfilling their R&A duties. Model verification refers to the checks that are carried out on model performance at a local level. Modelled concentrations are compared with the results of monitoring. Where there is a disparity between modelled and monitored concentrations, the first step is to review the appropriateness of the data inputs to determine whether the performance of the model can be improved. Once reasonable efforts have been made to reduce the uncertainties in the data inputs, an adjustment may be established and applied to reduce any remaining disparity between modelled and monitored concentrations. No adjustment factor is deemed necessary where the modelled concentrations are within 25% of the monitored concentrations.

3.42 For the verification and adjustment of NOx/NO_2 concentrations for R&A purposes, it is recommended that the comparison involves a combination of automatic and diffusion monitoring, rather than a single automatic monitor. This is to ensure any adjustment factor derived is representative of all locations modelled and not unduly weighted towards the characteristics at a single site. Where only diffusion tubes are used for the model verification, the study should consider a broad spread of monitoring locations across the study area to provide sufficient information relating to the spatial variation in pollutant concentrations.

3.43 Local Authorities generally implement a broad spread of monitoring, particularly in areas that are known to be sensitive to changes in air quality. Consequently, Local Authorities are usually able to verify the models they use for R&A purposes; however for individual developments, there is less likely to be a broad range of monitoring locations within the relevant study area. Notwithstanding this, a small number of monitoring locations have been identified within the study area and a model verification study was undertaken for the original (2017) air quality assessment. This is included at Appendix B.

3.44 The main components of uncertainty in the total predicted concentrations, made up of the background concentration and the modelled fraction, include those summarised in Table 3.4.

Table 3.4 Approaches to Dealing with Uncertainty used Within the Assessment

Concentration	Source of Uncertainty	Approach to Dealing with Uncertainty	Comments
Background Concentration	Characterisation of current baseline air quality conditions	The background concentration used within the assessment is a conservative value from a comparison of measured and Defra mapped concentration estimate.	The background concentration is the major proportion of the total predicted concentration.
	Characterisation of future baseline air quality (i.e.	The future background concentration used in the	The conservative assumptions adopted

Concentration	Source of Uncertainty	Approach to Dealing with Uncertainty	Comments
	the air quality conditions in the future assuming that the development does not proceed)	assessment is the same as the current background concentration and no reduction has been assumed. This is a conservative assumption as, in reality, background concentrations are likely to reduce over time as cleaner vehicle technologies form an increasing proportion of the fleet.	ensure that the background concentration used within the model contributes to the result being towards the top of the uncertainty range, rather than a central estimate.
Fraction from Modelled Sources	Traffic flow estimates	Traffic flows provided have all been based on traffic counts, rather than flows derived from a traffic model. High growth assumptions have been used to develop the traffic dataset used within the model.	The modelled fraction is a minor proportion of the total predicted concentration. The modelled fraction is likely to contribute to the result being between a central estimate and the top of the uncertainty range.
	Traffic speed estimates	The average speed has been reduced in congested areas to take account of slow-moving and queuing traffic.	
	Road-related emission factors – projection to future years	The most recently published emission factors have been used within the modelling and these are based on the current and best understanding of the variation in emission factors in future years.	
	Meteorological Data	Uncertainties arise from any differences between the conditions at the met station and the development site, and between the historical met years and the future years. These have been minimised by using meteorological data collated at a representative measuring site. The model has been run for a full year of meteorological conditions. This means that the conditions in 8,760 hours have been considered in the assessment.	
	Receptors	Receptor locations have been identified where concentrations are expected to be highest.	
	Dispersion Modelling	The model predictions have been compared with monitored concentrations. The model outputs have been adjusted accordingly. The fractional bias indicates that the model is performing well.	

3.45 The analysis of the component uncertainties indicates that, overall, the predicted total concentration is likely to be towards the top of the uncertainty range rather than being a central estimate. The actual concentrations that will be found when the development is operational are unlikely to be higher than those presented within this report and are more likely to be lower.

4 Baseline Air Quality Conditions

Overview

4.1 The background concentration often represents a large proportion of the total pollution concentration, so it is important that the background concentration selected for the assessment is realistic. National Planning Practice Guidance and EPUK & IAQM guidance highlight public information from Defra and local monitoring studies as potential sources of information on background air quality. LLAQM.TG16 recommends that Defra mapped concentration estimates are used to inform background concentrations in air quality modelling and states that: "*Where appropriate these data can be supplemented by and compared with local measurements of background, although care should be exercised to ensure that the monitoring site is representative of background air quality*".

4.2 For this assessment, the background air quality has been characterised by drawing on information from the following public sources:

- Defra maps [15], which show estimated pollutant concentrations across the UK in 1 km grid squares; and
- published results of local authority Review and Assessment (R&A) studies of air quality, including local monitoring and modelling studies.

4.3 A detailed description of how the baseline air quality has been derived for this Proposed Development site is summarised in the following paragraphs.

Review and Assessment Process

4.4 The LBRT, has designated the entire borough is designated as an AQMA due to elevated concentrations of NO_2 and PM_{10} attributable to road traffic emissions.

4.5 In September 2017, the LBRT published an updated Air Quality Action Plan (AQAP). This document replaces the previous action plan which ran from 2002 to 2017, and outlines the action that the LBRT will take to improve air quality in the borough between 2017 and 2022.

4.6 The AQAP lists a number of measures to improve air quality:

- For developments and buildings, enforcement of Non Road Mobile Machinery (NRMM) air quality policies.
- Develop South London Low Emission Construction Partnership in line with London LEAP (LLEAP). LLEAP objectives are:
    - Help the construction industry to understand its impact on local air quality.
    - Encourage the uptake of 'best in class' pollution reduction (abatement) measures.

- Improve pollution monitoring and make this data available for construction sites in London.
- Help to fund 'best in class' abatement measures at construction sites.
- Evaluate the cost effectiveness of pollution abatement techniques.

- For developments and buildings, enforcement of CHP (combined heat and power) and biomass air quality policies.
- For developments and buildings, enforce air quality neutral requirement through planning condition/ enforcement.

Local Urban Background Monitoring

4.7 Monitors at urban background locations measure concentrations away from the local influence of emission sources and are therefore broadly representative of residential areas within large conurbations. Monitoring at local urban background locations is considered an appropriate source of data for the purposes of describing baseline air quality for this Proposed Development site.

4.8 The nearest urban background automatic concentration measurements are found within the neighbouring London Borough of Wandsworth (LBW) at the Putney (WA9) monitoring station. The most recently measured annual-mean concentrations are presented in Table 4.1.

Table 4.1 Automatically Monitored Urban Background Annual-Mean Concentrations

Monitor Name (Code)	Approximate Distance from the Application Site (km)	Pollutant	Concentration (µg.m^{-3})					
			2011	2012	2013	2014	2015	2016
Putney (WA9)	2.9	NO_2	43	40	40	41	40	45
		PM_{10}	22	24	24	20	18	18

4.9 The LBRT manually monitors NO_2 concentrations at a number of urban background locations using passive diffusion tubes. The neighbouring LBW Council and London Borough of Hammersmith & Fulham (LBHF) Council also manually monitor NO_2 concentrations. The most recently measured annual-mean concentrations are presented in Table 4.2. The data are taken from the most recently available Annual Status Reports (ASRs) for each borough.

Table 4.2 Passively Monitored Urban Background Annual-Mean NO_2 Concentrations

Monitor Name (Code)	Borough	Approximate Distance from the Application Site (km)	Concentration (µg.m^{-3})						
			2011	2012	2013	2014	2015	2016	2017
Holly Lodge, Richmond Park (28)	Richmond	2.4	20	22	21	18	17	21	17
Wetlands, Barnes (37)		2.1	26	25	25	22	21	25	20

Monitor Name (Code)	Borough	Approximate Distance from the Application Site (km)	Concentration ($\mu g.m^{-3}$)						
			2011	2012	2013	2014	2015	2016	2017
Daylesford Avenue, Putney (W6)	Wandsworth	1.1	30	28	26	26	24	28	*
Werter Road, Putney (W10)		3.0	31	38	36	34	35	35	*
Radipole Road	Hammersmith & Fulham	3.7	27	33	38	33	32	35	*
Cardross Street		3.8	*	*	35	32	31	34	*

Data from All concentrations have been adjusted for bias
* No data.

Defra Mapped Concentration Estimates

4.10 Defra's total annual-mean NO_2 concentration estimates have been collected for the 1 km grid squares of the monitoring sites and the Proposed Development and are summarised in Table 4.3.

Table 4.3 Defra Mapped Annual-Mean Background NO_2 Concentration Estimates

Monitor Name (Code)	Borough	Distance to Site (km)	Concentration ($\mu g.m^{-3}$)	
			Range of Monitored	Estimated Defra Mapped
Application Site			-	23.9
Holly Lodge, Richmond Park (28)	Richmond	2.4	17-22	18.2
Wetlands, Barnes (37)		2.1	20-26	25.0
Putney (WA9)	Wandsworth	2.9	40-45	27.2
Daylesford Avenue, Putney (W6)		1.1	24-30	25.6
Werter Road, Putney (W10)		3.0	31-38	27.2
Radipole Road	Hammersmith & Fulham	3.7	27-38	28.7
Cardross Street		3.8	31-35	30.1

4.11 Similarly, the Defra total annual-mean PM_{10} concentration estimates have been collected for the grid square of the monitoring sites and the Proposed Development and are summarised in Table 4.4.

Table 4.4 Defra Mapped Annual-Mean Background PM_{10} Concentration Estimates

Monitor Name (Code)	Borough	Distance to Site (km)	Concentration ($\mu g.m^{-3}$)	
			Range of Monitored	Estimated Defra Mapped
Application Site			-	16.2
Putney (WA9)	Wandsworth	2.9	18-24	17.4

Appropriate Background Concentrations for the Development Site

4.12 For NO_2, the Defra mapped background concentration estimates are generally within 1 $\mu g.m^{-3}$ of the range of monitored results. The only exceptions to this are the measurements at WA9 and W10. The WA9 monitoring station is located approximately 2.9 km from Application Site and may not be as representative as the nearer monitoring stations. Despite W10 being classified as background, the ASR reports that the monitor is located only 0.8 m from the nearest kerb. On that basis, the background annual-mean NO_2 concentration at the Application Site has been derived from the estimated Defra mapped concentration.

4.13 For PM_{10}, the Defra mapped background concentration estimate is lower than the range of results from monitoring. Automatically monitored annual-mean PM_{10} concentrations at the WA9 range from 18 to 24 $\mu g.m^{-3}$. To ensure the assessment is conservative, the background annual-mean PM_{10} concentration has been derived from the 24 $\mu g.m^{-3}$, monitored in 2012 and 2013.

4.14 In the absence of $PM_{2.5}$ monitoring at this site, the background annual-mean concentration at the Application Site has been derived from the Defra mapped background concentration estimate.

4.15 Historically the view has been that background traffic-related NO_2 concentrations in the UK would reduce over time, due to the progressive introduction of improved vehicle technologies and increasingly stringent limits on emissions. However, the results of recent monitoring across the UK suggest that background annual-mean NO_2 concentrations have not decreased in line with expectations. Inspection of the results of local monitoring presented here indicates that there is no particular trend over time for concentrations of NO_2 in the vicinity of the Application Site. At the WA9 monitoring site however, concentrations of PM_{10} have decreased.

4.16 To ensure that the assessment presents conservative results, no reduction in the background has been applied for future years.

4.17 Table 4.5 summarises the annual-mean background concentrations for NO_2, PM_{10} and $PM_{2.5}$ used in this assessment.

Table 4.5 Summary of Background Annual-Mean (Long-term) Concentrations used in the Assessment

Pollutant	Data Source	Concentration ($\mu g.m^{-3}$)
NO_2	Estimated Defra Mapped (2015)	23.9
PM_{10}	Putney (WA9) automatic monitoring station (2012, 2013)	24
$PM_{2.5}$	Estimated Defra Mapped (2015)	10.5

5 Assessment of Construction-Phase Air Quality Impacts

Construction Dust

5.1 Whilst no detailed construction phase information is currently available, the type of activities that could cause fugitive dust emissions are: demolition; earthworks; handling and disposal of spoil; wind-blown particulate material from stockpiles; handling of loose construction materials; and movement of vehicles, both on and off site.

5.2 The level and distribution of construction dust emissions will vary according to factors such as the type of dust, duration and location of dust-generating activity, weather conditions and the effectiveness of suppression methods.

5.3 The main effect of any dust emissions, if not mitigated, could be annoyance due to soiling of surfaces, particularly windows, cars and laundry. However, it is normally possible, by implementation of proper control, to ensure that dust deposition does not give rise to significant adverse effects, although short-term events may occur (for example, due to technical failure or exceptional weather conditions). The following assessment, using the IAQM methodology, predicts the risk of dust impacts and the level of mitigation to minimise air quality impacts.

Risk of Dust Impacts

Source

5.4 The volume of the buildings on site that would be demolished is between 20,000 m^3 and 50,000 m^3. The dust emission magnitude for the demolition phase is therefore classified, using the IAQM dust guidance, as medium.

5.5 The site area is approximately 14,350 m^2. As this is greater than 10,000 m^2, the dust emission magnitude for the earthworks phase is classified as large.

5.6 The total volume of the buildings to be constructed would be between 25,000 and 100,000 m^3, and so the dust emission magnitude for the construction phase is classified as medium.

5.7 Assuming that the maximum number of outwards movements in any one day is between 10 and 50 HDVs, the dust emission magnitude for trackout would be classified as medium.

Table 5.1 Dust Emission Magnitude for Demolition, Earthworks, Construction and Trackout

Demolition	Earthworks	Construction	Trackout
Medium	Large	Medium	Medium

Pathway and Receptor - Sensitivity of the Area

5.8 All demolition, earthworks and construction activities are assumed to occur within the site boundary. As such, receptors at distances within 20 m, 50 m, 100 m, 200 m and 350 m of the site boundary have been identified and are illustrated in Figure 3. The sensitivity of the area has been classified and the results are provided in Table 5.2 below.

Table 5.2 Sensitivity of the Surrounding Area for Demolition, Earthworks and Construction

Potential Impact	Sensitivity of the Surrounding Area	Reason for Sensitivity Classification
Dust Soiling	High	Approximately 9 residential properties on South Worple Way and South Worple Avenue to the north-east of the site, and approximately 20 residential properties on Grosvenor Avenue south of the site. 10 – 100 high sensitivity receptors located within 20 m of the site boundary (Table A.4)
Human Health	High	Approximately 9 residential properties on South Worple Way and South Worple Avenue to the north-east of the site, and approximately 20 residential properties on Grosvenor Avenue south of the site. Background PM_{10} concentrations for the assessment = 24 $\mu g.m^{-3}$ 10 – 100 high sensitivity receptors located within 20 m of the site boundary and PM_{10} concentrations between 24 $\mu g.m^{-3}$ and 28 $\mu g.m^{-3}$ (Table A.5)

5.9 The Dust Emission Magnitude for trackout is classified as medium and trackout may occur on roads up to 200 m from the site. The major routes within 200 m of the site are South Worple Way, White Hart Lane and Upper Richmond Road West. The sensitivity of the area has been classified and the results are provided in Table 5.3 below.

Table 5.3 Sensitivity of the Surrounding Area for Trackout

Potential Impact	Sensitivity of the Surrounding Area	Reason for Sensitivity Classification
Dust Soiling	High	Between 10 and 100 residential properties aligning South Worple Way and White Hart Lane. 10 – 100 high sensitivity receptors located within 20 m of the roads (Table A.4)
Human Health	High	Between 10 and 100 residential properties aligning South Worple Way and White Hart Lane. Background PM_{10} concentrations for the assessment = 24 $\mu g.m^{-3}$ 10 – 100 high sensitivity receptors located within 20 m of the roads and PM_{10} concentrations between 24 $\mu g.m^{-3}$ and 28 $\mu g.m^{-3}$ (Table A.5)

Overall Dust Risk

5.10 The Dust Emission Magnitude has been considered in the context of the Sensitivity of the Area (Tables A.4 and A.5) to give the Dust Impact Risk. Table 5.4 summarises the Dust Impact Risk for the four activities.

Table 5.4 Dust Impact Risk for Demolition, Earthworks, Construction and Trackout

Source	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Medium	High	Medium	Medium
Human Health	Medium	High	Medium	Medium
Overall Risk	Medium	High	Medium	Medium

5.11 Taking the site as a whole, the overall risk is deemed to be medium. The mitigation measures appropriate to a level of risk for the site as a whole and for each of the phases are set out in Section 7.

5.12 Provided this package of mitigation measures is implemented, the residual construction dust effects will not be significant. The IAQM dust guidance states that "*For almost all construction activity, the aim should be to prevent significant effects on receptors through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual effect will normally be 'not significant'."* The IAQM dust guidance recommends that significance is only assigned to the effect after the activities are considered with mitigation in place.

6 Assessment of New Population Exposure (Site Suitability)

6.1 This section of the report summarises the operational-phase air quality impacts on future occupants of the development from their exposure to the prevailing levels of air pollution, which can be a factor in the suitability of the site for its proposed uses.

6.2 Table 6.1 presents the annual-mean NO_2, PM_{10} and $PM_{2.5}$ concentrations predicted at the façades of proposed receptors.

Table 6.1 Predicted Annual-Mean NO_2, PM_{10} and $PM_{2.5}$ Concentrations ($\mu g.m^{-3}$) at Proposed Receptors

Receptor ID	NO_2	APEC Category	PM_{10}	APEC Category	$PM_{2.5}$
1	24.7	APEC-A	24.2	APEC-A	10.6
2	24.7		24.2		10.6
3	24.8		24.2		10.6
4	24.8		24.2		10.6
5	24.8		24.2		10.6
6	24.6		24.2		10.6
7	24.7		24.2		10.6
8	24.5		24.1		10.6
Maximum	**24.8**	**-**	**24.2**	**-**	**10.6**
Minimum	**24.5**	**-**	**24.2**	**-**	**10.6**

6.3 The long-term and short-term objectives apply at the Proposed Development.

6.4 The predicted annual-mean NO_2 concentrations range between 24.5 and 24.8 $\mu g.m^{-3}$, and are all more than 5% below the annual-mean AQS objective of 40 $\mu g.m^{-3.}$ Furthermore, as the annual-mean NO_2 concentration is predicted to be less than 60 $\mu g.m^{-3}$, the hourly-mean AQS objective is expected to be met.

6.5 The predicted annual-mean PM_{10} concentrations are 24.2 $\mu g.m^{-3}$ at all receptors, i.e. more than 5% below the annual-mean AQS objective of 40 $\mu g.m^{-3}$.

6.6 Although there are no APEC categories for PM2.5m the predicted annual-mean $PM_{2.5}$ concentrations are 10.6 $\mu g.m^{-3}$ at all receptors, well below the annual-mean AQS objective of 25 $\mu g.m^{-3}$.

6.7 Table 6.2 sets out a comparison with the daily-mean AQS objective for PM_{10} at the façades of proposed receptors.

Table 6.2 Predicted Exceedances of Daily-Mean PM_{10} Objective at Proposed Receptors

Receptor ID	Number of Daily Means > 50 µg.m^{-3}	APEC Category
1	11	APEC-A
2	11	
3	11	
4	11	
5	11	
6	11	
7	11	
8	10	
Maximum	**11**	**-**
Minimum	**10**	**-**

The Daily-Mean AQS Objective for PM_{10} is 50µg.m^{-3} not to be exceeded more than 35 times per calendar year

6.8 There are predicted to be a maximum of 11 exceedances of daily-mean PM_{10} concentrations of 50 µg.m^{-3}. As this is more than one day less than the national objective of 35 exceedances, the APEC-A category applies.

Significance of Effects

6.9 It is generally considered good practice that, where possible, an assessment should communicate effects both numerically and descriptively. Professional judgement by a competent, suitably qualified professional is required to establish the significance associated with the consequence of the impacts.

6.10 The impacts predicted at individual receptors and the geographical extent over which such impacts occur, can be used to inform the judgement on the impact on the surrounding area as a whole, and whether the resulting overall effect is significant or not. The IAQM guidance states, *"Whilst it may be that there are 'slight', 'moderate', or 'substantial' impacts at one or more receptors, the overall effect may not necessarily be judged as being significant in some circumstances."* and *"…a 'moderate' or 'substantial' impact may not have a significant effect if it is confined to a very small area and where it is not obviously the cause of harm to human health."*

6.11 The AQS objectives for NO_2, PM_{10} and $PM_{2.5}$ are likely to be met at the facades of the Proposed Development. On that basis, future occupants of the development should be exposed to acceptable air quality and the site is deemed suitable for its proposed future in this respect.

Sensitivity and Uncertainty

6.12 Section 3 provided an analysis of the sources of uncertainty in the results of the assessment. The conclusion of that analysis was that, overall, the predicted total concentration is likely to be towards the top of the uncertainty range rather than being a central estimate. The actual concentrations that will be found when the development is operational are unlikely to be higher than those presented within this report and are more likely to be lower.

6.13 The impacts at existing receptors are shown to be not significant even for this conservative scenario. Similarly, the predicted pollutant concentrations at proposed receptors are below the relevant AQS objectives. Consequently, further sensitivity analysis has not been undertaken and, in practice, the impacts at sensitive receptors are likely to be lower than those reported in this conservative assessment.

7 Mitigation

Mitigation During Construction

7.1 The Mayor of London's Control of Dust and Emissions during Construction and Demolition Supplementary Planning Guidance lists mitigation measures for low, medium and high dust risks.

7.2 As summarised in Table 5.4, the predicted Dust Impact Risk is classified as medium for Demolition, Construction and Trackout, and high for Earthworks. The general site measures described as 'highly recommended' for medium risks are listed below. The 'highly recommended' measures for medium risk demolition sites, medium risk construction sites, medium risk trackout and high risk earthworks are also listed.

Communications
▪ Develop and implement a stakeholder communications plan that includes community engagement before work commences on site. ▪ Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager. ▪ Display the head or regional office contact information
Dust Management Plan
▪ Develop and implement a Dust Management Plan (DMP) (which may include measures to control other emissions), approved by the Local Authority. The level of detail will depend on the risk, and should include as a minimum the highly recommended measures in this document. The desirable measures should be included as appropriate for the site. The DMP may include monitoring of dust.
Site Management
▪ Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken. ▪ Make the complaints log available to the local authority when asked. ▪ Record any exceptional incidents that cause dust and/or air emissions, either on- or off- site, and the action taken to resolve the situation in the log book.
Monitoring
▪ 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 (sic) are being carried out, and during prolonged dry or windy conditions. ▪ Agree dust deposition, dust flux, or real-time PM_{10} continuous monitoring locations with the Local Authority. Where possible, commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences. A shorter monitoring period or concurrent upwind and downwind monitoring may be agreed by the local authority. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction [16].
Preparing and maintaining the site
▪ Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible. Use screening intelligently where possible – e.g. locating site offices between potentially dusty activities and the receptors. ▪ Erect solid screens or barriers around the site boundary. ▪ Avoid site runoff of water or mud. ▪ Keep site fencing, barriers and scaffolding clean.

▪ Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below. ▪ Depending on the duration that stockpiles will be present and their size - cover, seed, fence or water to prevent wind whipping.
Operating vehicle/machinery and sustainable travel
▪ Ensure all on-road vehicles comply with the requirements of the London Low Emission Zone. ▪ Ensure all non-road mobile machinery (NRMM) comply with the standards set within the SPG. ▪ Ensure all vehicles switch off engines when stationary – no idling vehicles. ▪ Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable. ▪ Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.
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. ▪ Avoid bonfires and burning of waste materials.
Medium risk measures specific to demolition
▪ Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground. ▪ Avoid explosive blasting, using appropriate manual or mechanical alternatives. ▪ Bag and remove any biological debris or damp down such material before demolition.
Medium risk measures 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.
Medium risk measures 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. ▪ Record all inspections of haul routes and any subsequent action in a site log book. ▪ Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems and regularly cleaned. ▪ Inspect haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable. ▪ Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable). ▪ Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit,

wherever site size and layout permits. ▪ Access gates to be located at least 10m from receptors where possible.
High risk measures specific to Earthworks
▪ 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.

7.3 The Mayor of London's SPG states that with the recommended dust mitigation measures in place the residual impact will be *"minimised"*, and recommends the mitigation is secured by for a condition or Section 106 agreement as appropriate.

Mitigation for New Population Exposure (Site Suitability)

7.4 The predicted pollutant concentrations at proposed sensitive receptors are below the relevant AQS objectives. As such, the air quality effect of exposure on future occupants is considered to be "not significant". On that basis, no mitigation measures are considered necessary.

8 Conclusions

8.1 This assessment has considered dust effects during the construction phase and the air quality impacts during the operational phase of the proposed mixed-use development at Barnes Hospital.

8.2 Impacts during the construction of the proposed development, such as dust generation and plant vehicle emissions, are predicted to be of short duration and only relevant during the construction phase. The results of the risk assessment of construction dust impacts undertaken using the Mayor of London's guidance indicates that before the implementation of mitigation and controls, the risk of dust impacts will be medium. Implementation of the highly-recommended mitigation measures described in the Mayor of London's Supplementary Planning Guidance *"should ensure the air quality impacts of construction and demolition are minimised and any mitigation measures employed are effective"*.

8.3 The heat and power demands for the proposed development are likely to be met by a gas-fired Combined Heat and Power (CHP) plant which has the potential to impact on the surrounding area. There is currently insufficient information available to allow for an assessment of the CHP plant and so this aspect will be dealt with at a later date when precise details are available. The applicant acknowledges the potential NO_x emissions associated with CHPs. However, at this stage, a decision on the thermal capacity of the CHP has not been made. Therefore, the applicant requests to be bound by the requirements of the GLA's SPG which state:

"4.3.25 It is acknowledged that developers may not procure plant until planning permission has been obtained. Developers will therefore be required to provide a written statement of their commitment and ability to meet the emission standards within their Air Quality Assessments. When securing these emissions standards, it is best to agree maximum emissions as opposed to the technology. Technology may improve between the time planning permission is granted and the equipment is procured."

8.4 The proposed scheme is expected to result in a decrease in traffic flows on the local road network compared with the consented scheme. The assessment therefore focuses on the suitability of air quality at the site for introducing new occupants.

8.5 Detailed atmospheric dispersion modelling has been undertaken for the first year in which the development is expected to be fully operational, 2023. Pollutant concentrations at the façades of proposed receptors are expected to be within the relevant health-based air quality objectives. On that basis, future occupants of the Barnes Hospital development should be exposed to acceptable air quality and the site is deemed suitable for its proposed future use in this respect.

8.6 At the heart of the NPPF is a presumption in favour of sustainable development. For determining planning applications, this means approving development proposals if they accord with the local development plan, unless material considerations indicate otherwise. If the development plan is absent, silent or the policies are out of date, then planning permission should be granted unless any adverse impacts would significantly outweigh the benefits, or specific policies in the NPPF indicate development should be restricted.

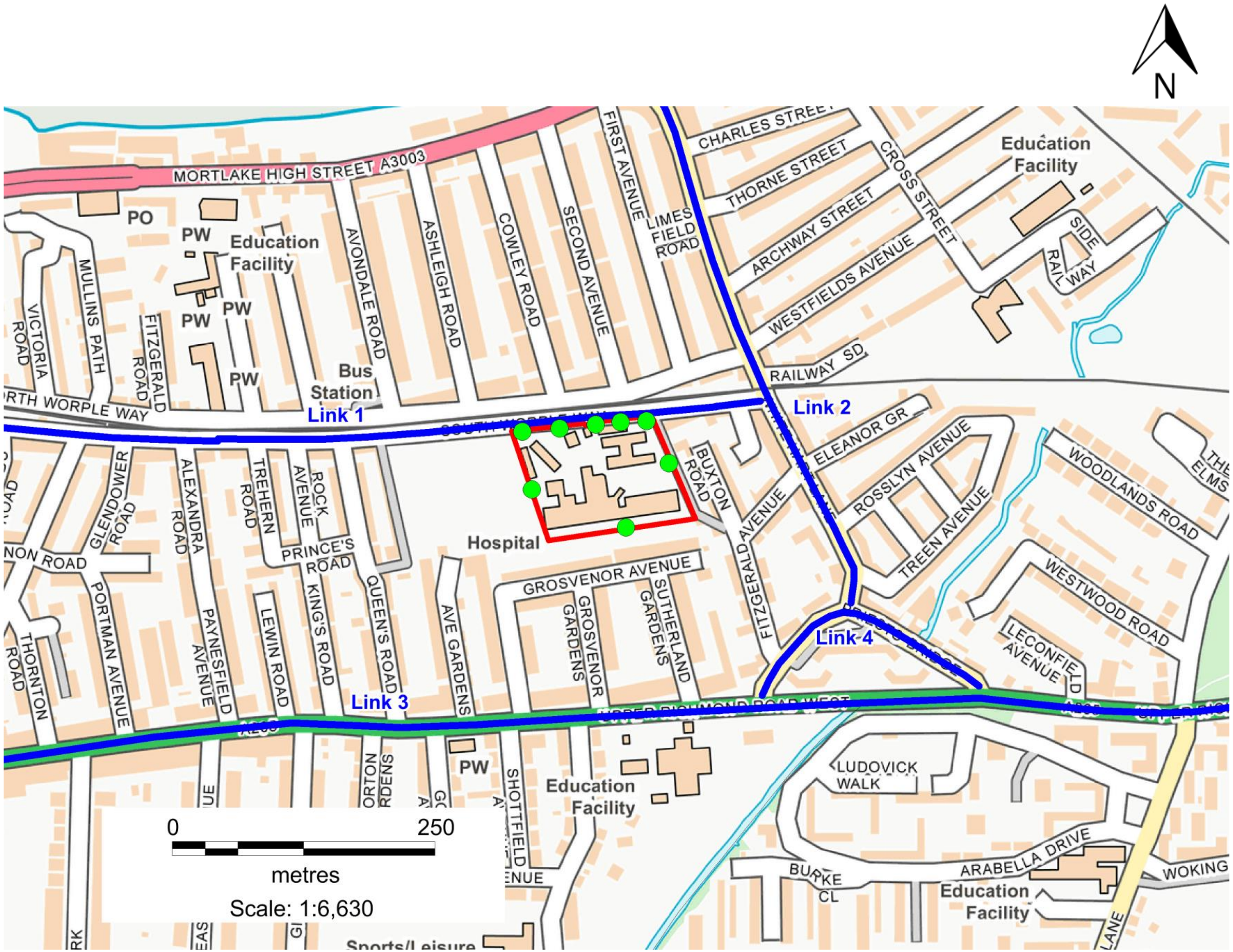
8.7 The NPPG advises that in considering planning permission, the relevant question for air quality is *"will the proposed development (including mitigation) lead to an unacceptable risk from air pollution, prevent sustained compliance with EU limit values or national objectives for pollutants or fail to comply with the requirements of the Habitats Regulations?"* The proposed development will not.

8.8 The Barnes Hospital development does not, in air quality terms, conflict with national or local policies. There are no constraints to the development in the context of air quality.

Glossary

AADT	Annual Average Daily Traffic Flow
ADMS	Atmospheric Dispersion Modelling System
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
Deposited Dust	Dust that has settled out onto a surface after having been suspended in air.
DMP	Dust Management Plan
Dust	Solid particles suspended in air or settled out onto a surface after having been suspended in air
Effect	The consequences of an impact, experienced by a receptor
EPUK	Environmental Protection UK
HGV	Heavy Goods Vehicle
IAQM	Institute of Air Quality Management
Impact	The change in atmospheric pollutant concentration and/or dust deposition. A scheme can have an 'impact' on atmospheric pollutant concentration but no effect, for instance if there are no receptors to experience the impact
LBRT	London Borough of Richmond Upon Thames
LGV	Light Goods Vehicle
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
R&A	Review and Assessment
Receptor	A person, their land or property and ecologically sensitive sites that may be affected by air quality
Risk	The likelihood of an adverse event occurring
Trackout	The transport of dust and dirt from the construction/demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network

Figures



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Project: Barnes Hospital

Job Ref: JAR10415

File location: N/A

Date: 05/11/18	**Rev: 0**
Drawn: RC	**Checked: FP**

Figure 1: Modelled Roads and Receptors

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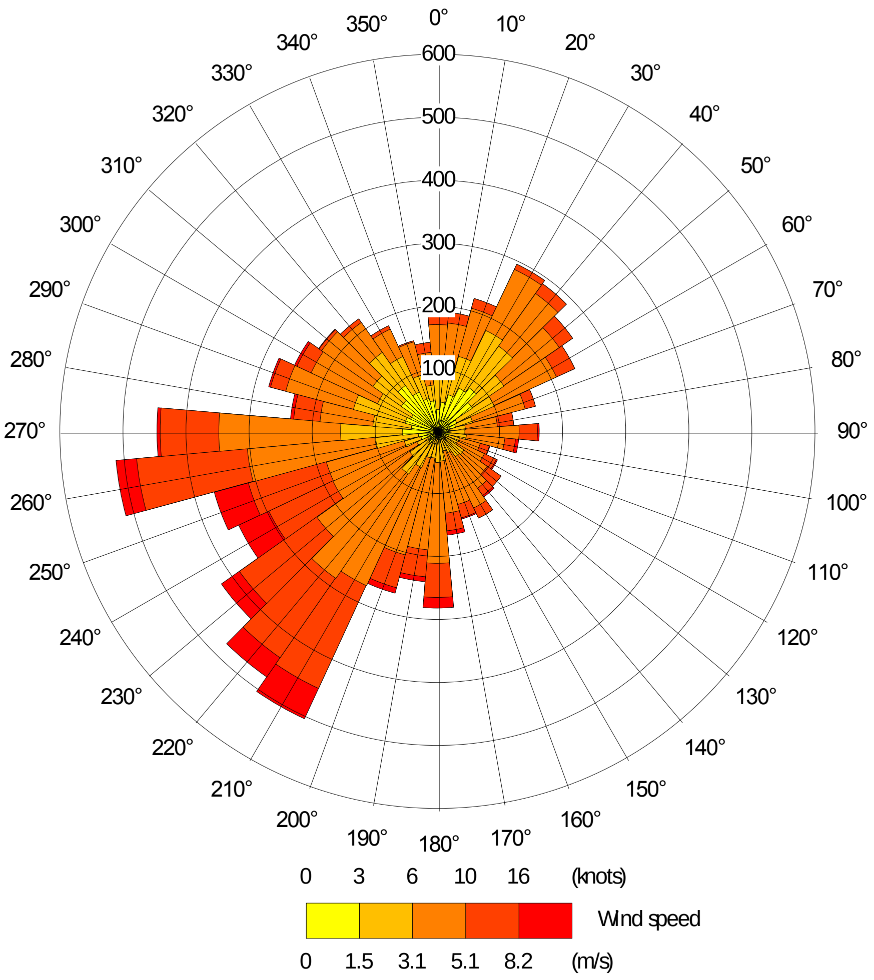

Figure 2: Wind Rose - London Heathrow, 2016

Project Number	**JAR10415**	**Project Title**	**Barnes Hospital**		
Client:	**South West London and St George's Mental Health NHS Trust**	**Rev :**	**0**	**Drawn By:**	**RC**
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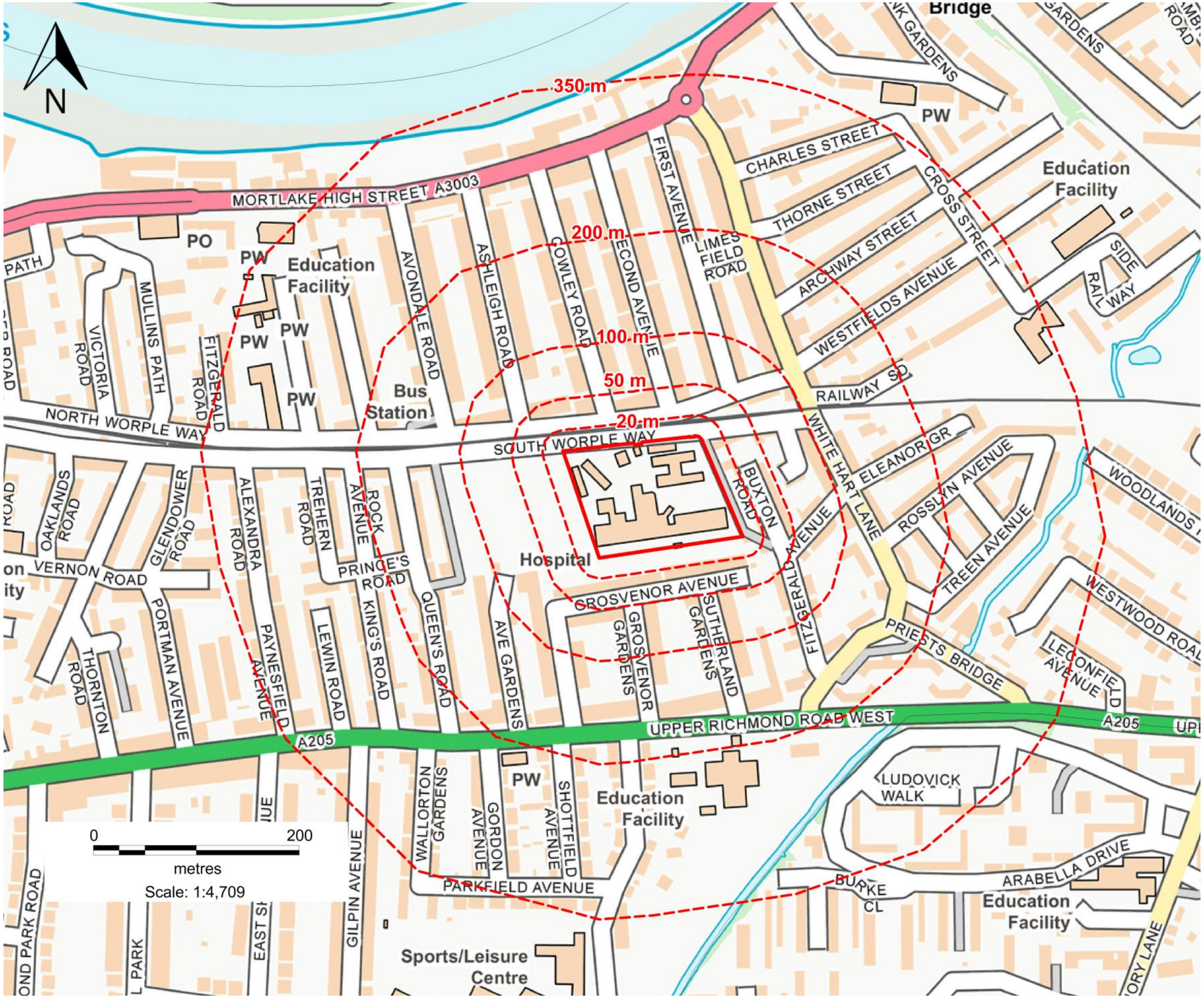

Distance from Site Boundary (m)

Site Boundary

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Figure 3: Assessment of Construction Dust

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Appendices

Appendix A: Detailed Construction Dust Assessment Methodology

Source

The IAQM dust guidance gives examples of the dust emission magnitudes for demolition, earthworks and construction activities and trackout. These example dust emission magnitudes are based on the site area, building volume, number of HDV movements generated by the activities and the materials used. These example magnitudes have been combined with details of the period of construction activities to provide the ranking for the source magnitude that is set out in Table A.1.

Table A.1 Risk Allocation – Source (Dust Emission Magnitude)

Features of the Source of Dust Emissions	Dust Emission Magnitude
Demolition - building over 50,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities > 20 m above ground level. **Earthworks** – total site area over 10,000 m^2, potentially dusty soil type (e.g. clay), >10 heavy earth moving vehicles active at any one time, formation of bunds > 8 m in height, total material moved > 100,000 tonnes. **Construction** - total building volume over 100,000 m^3, activities include piling, on-site concrete batching, sand blasting. Period of activities more than two years. **Trackout** – 50 HDV outwards movements in any one day, potentially dusty surface material (e.g. High clay content), unpaved road length > 100 m.	Large
Demolition - building between 20,000 to 50,000 m^3, potentially dusty construction material and demolition activities 10 - 20 m above ground level. **Earthworks** – total site area between 2,500 to 10,000 m^2, moderately dusty soil type (e.g. silt), 5 – 10 heavy earth moving vehicles active at any one time, formation of bunds 4 - 8 m in height, total material moved 20,000 to 100,000 tonnes. **Construction** - total building volume between 25,000 and 100,000 m^3, use of construction materials with high potential for dust release (e.g. concrete), activities include piling, on-site concrete batching. Period of construction activities between one and two years. **Trackout** – 10 - 50 HDV outwards movements in any one day, moderately dusty surface material (e.g. High clay content), unpaved road length 50 – 100 m.	Medium
Demolition - building less than 20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities < 10 m above ground, demolition during winter months. **Earthworks** – total site area less than 2,500 m^2. Soil type with large grain size (e.g. sand), < 5 heavy earth moving vehicles active at any one time, formation of bunds < 4 m in height, total material moved < 10,000 tonnes earthworks during winter months. **Construction** - total building volume below 25,000 m^3, use of construction materials with low potential for dust release (e.g. metal cladding or timber). Period of construction activities less than one year. **Trackout** – < 10 HDV outwards movements in any one day, surface material with low potential for dust release, unpaved road length < 50 m.	Small

Pathway and Receptor - Sensitivity of the Area

Pathway means the route by which dust and particulate matter may be carried from the source to a receptor. The main factor affecting the pathway effectiveness is the distance from the receptor to the source. The orientation of the receptors to the source compared to the prevailing wind direction is a relevant risk factor for long-duration construction projects; however, short-term construction projects may be limited to a few months when the most frequent wind direction might be quite different, so adverse effects can potentially occur in any direction from the site.

As set out in the IAQM dust guidance, a number of attempts have been made to categorise receptors into high, medium and low sensitivity categories; however there is no unified sensitivity classification scheme that covers the quite different potential effects on property, human health and ecological receptors.

Table A.2 and Table A.3 sets out the IAQM basis for categorising the sensitivity of people and property to dust and PM_{10} respectively.

Table A.2 Sensitivities of People and Property Receptors to Dust

Receptor	Sensitivity
Principles:- ▪ Users can reasonably expect enjoyment of a high level of amenity; or ▪ the appearance, aesthetics or value of their property would be diminished by soiling; and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods as part of the normal pattern of use of the land. Indicative Examples:- ▪ Dwellings. ▪ Museums and other culturally important collections. ▪ Medium and long-term car parks and car showrooms.	High
Principles:- ▪ Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or ▪ the appearance, aesthetics or value of their property could be diminished by soiling; or ▪ the people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. Indicative Examples:- ▪ Parks. ▪ Places of work.	Medium
Principles:- ▪ the enjoyment of amenity would not reasonably be expected; or ▪ there is property that would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or ▪ there is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. Indicative Examples:- ▪ Playing fields, farmland (unless commercially-sensitive horticultural). ▪ Footpaths and roads. ▪ Short-term car parks.	Low

Table A.3 Sensitivities of People and Property Receptors to PM_{10}

Receptor	Sensitivity
Principles:- ▪ Locations where members of the public are exposed over a time period relevant to the air quality objective (in the case of the 24-hour objective for PM_{10}, a relevant location would be one where individuals may be exposed for eight hours or more in a day). Indicative Examples:- ▪ Residential properties. ▪ Schools, hospitals and residential care homes.	High
Principles:- ▪ Locations where the people exposed are workers and exposure is over a time period relevant to the air quality objective (in the case of the 24-hour objective for PM_{10}, a relevant location would be one where individuals may be exposed for eight hours or more in a day). Indicative Examples:- ▪ Office and shop workers (but generally excludes workers occupationally exposed to PM_{10} as protection is covered by Health and Safety at Work legislation).	Medium
Principles:- ▪ Locations where human exposure is transient exposure. Indicative Examples:- ▪ Public footpaths. ▪ Playing fields, parks. ▪ Shopping streets.	Low
Principles:- ▪ Locations with a local designation where the features may be affected by dust deposition. Indicative Examples:- ▪ A Local Nature Reserve with dust sensitive features	Low

The IAQM methodology combines consideration of the pathway and receptor to derive the 'sensitivity of the area'. Table A.4 and Table A.5 show how the sensitivity of the area has been derived for this assessment.

Table A.4 Sensitivity of the Area to Dust Soiling Effects on People and Property

Receptor Sensitivity	Number of Receptors [a]	Distance from the Source (m) [b]			
		<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
The sensitivity of the area has been derived for demolition, construction, earthworks and trackout.					

a The total number of receptors within the stated distance has been estimated. Only the highest level of area sensitivity from the table has been recorded.

b For trackout, the distances have been measured from the side of the roads used by construction traffic. Without site-specific mitigation, trackout may occur from roads up to 500 m from large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit. The impact declines with distance from the site, and trackout impacts have only been considered up to 50 m from the edge of the road.

Table A.5 Sensitivity of the Area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM_{10} Concentration [a]	Number of Receptors [b, c]	Distance from the Source (m) [d]				
			<20	<50	<100	<200	<350
High	> 32 µg.m^{-3}	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28 - 32 µg.m^{-3}	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24 - 28 µg.m^{-3}	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	< 24 µg.m^{-3}	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	> 32 µg.m^{-3}	>10	High	Medium	Low	Low	Low
		1 – 10	Medium	Low	Low	Low	Low
	28 – 32 µg.m^{-3}	> 10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	< 28 µg.m^{-3}	>1	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

The sensitivity of the area has been derived for demolition, construction, earthworks and trackout.

a This refers to the background concentration derived from the assessment of baseline conditions later in this report. The concentration categories listed in this column apply to England, Wales and Northern Ireland but not to Scotland.

b The total number of receptors within the stated distance has been estimated. Only the highest level of area sensitivity from the table has been recorded.

c For high sensitivity receptors with high occupancy (such as schools or hospitals), the approximate number of occupants has been used to derive an equivalent number of receptors.

d For trackout, the distances have been measured from the side of the roads used by construction traffic. Without site-specific mitigation, trackout may occur from roads up to 500 m from large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit. The impact declines with distance from the site, and trackout impacts have only been considered up to 50 m from the edge of the road.

The IAQM dust guidance lists the following additional factors that can potentially affect the sensitivity of the area and, where necessary, professional judgement has been used to adjust the sensitivity allocated to a particular area:

- any history of dust generating activities in the area;
- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between the source and the receptors;
- any conclusions drawn from analysing local meteorological data which accurately represent the area; and if relevant the season during which the works will take place;
- any conclusions drawn from local topography;
- duration of the potential impact, as a receptor may become more sensitive over time; and
- any known specific receptor sensitivities which are considered go beyond the classifications given in the table above.

The matrices in Table A.6, Table A.7, Table A.8 and Table A.9 have been used to assign the risk for each activity to determine the level of mitigation that should be applied. For those cases where the risk category is 'negligible', no mitigation measures are required beyond those mandated by legislation.

Table A.6 Risk of Dust Impacts – 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 A.7 Risk of Dust Impacts – Earthworks

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 A.8 Risk of Dust Impacts – 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 A.9 Risk of Dust Impacts – 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: Model Verification

The approach to model verification that LLAQM.TG16 recommends for local authorities when they carry out their LAQM duties is summarised in Section 3. For the verification and adjustment of NO_X /NO_2 concentrations, the guidance recommends that the comparison considers a broad spread of automatic and diffusion monitoring. The LBRT monitors roadside NO_2 concentrations passively using diffusion tubes at four locations in the vicinity of the Application Site.

The concentrations monitored over recent years are provided in Table B.1.

Table B.1 Measured Annual-mean NO_2 Concentrations (μg.m^{-3})

Monitoring Site	Measured Annual-mean NO_2 Concentrations (μg.m^{-3})				
	2012	2013	2014	2015	2016
21	43	44	41	37	39
23	38	39	38	35	35
25	47	51	51	45	46
26	42	43	42	40	40

Ideally, any model verification study should use background concentrations, emissions factors and meteorological data relating to the same year; however, the highest concentrations were monitored at all locations in 2013. This model verification has therefore used measured data collated in 2013, together with 2016 Heathrow meteorological data. Traffic data available from the Department for Transport for 2013 were used.

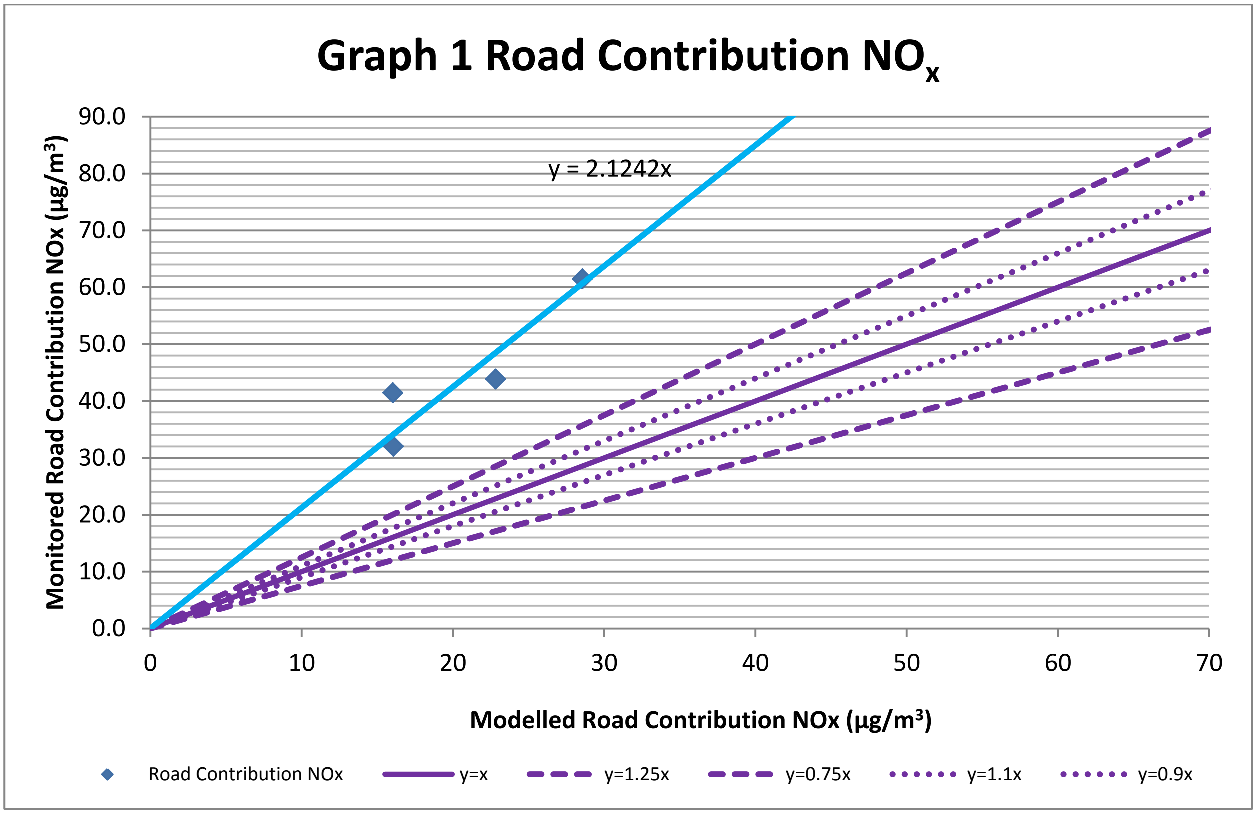
The monitored annual-mean NO_X road contributions have been derived from the monitored annual-mean NO_2 concentrations using the LLAQM.TG16 calculator. The monitored annual-mean NO_X road contributions have then been compared with the modelled annual-mean NO_X road contributions. This comparison is provided in Table B.2 below.

Table B.2 Comparison of Monitored and Modelled Annual-mean Road NO_X Contribution (μg.m^{-3})

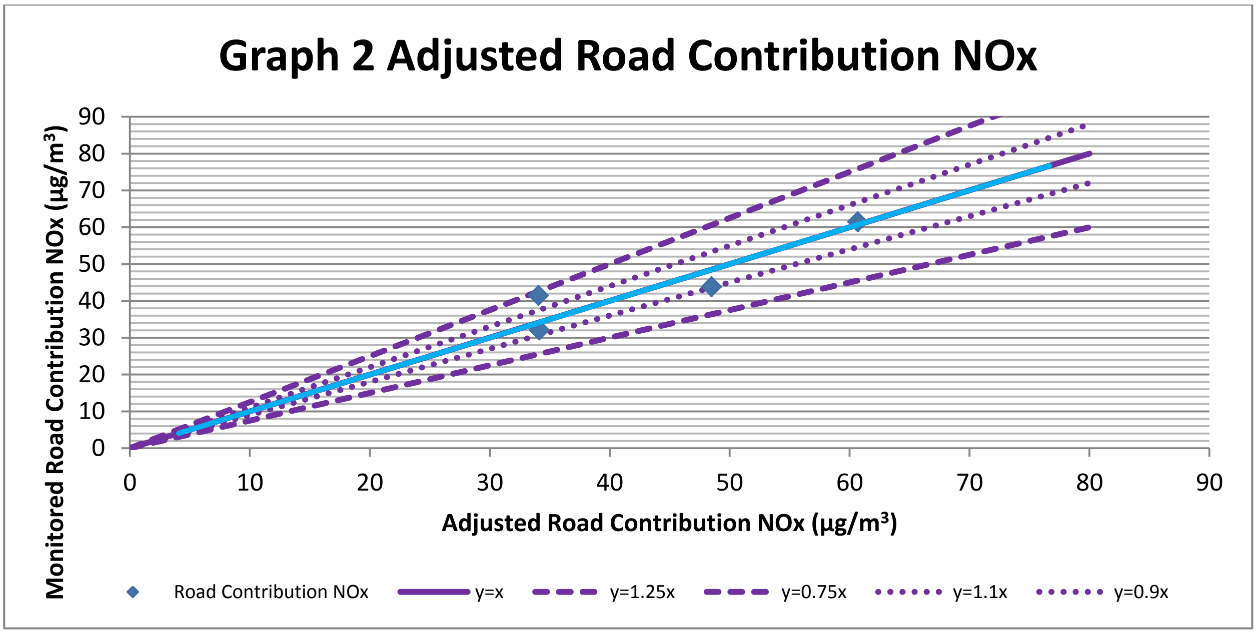
Monitoring Site	Annual-mean Road NO_X Contribution (μg.m^{-3})	
	Modelled	Monitored
21	22.8	43.8
23	16.1	32.0
25	28.6	61.5
26	16.0	41.4

It should be borne in mind that the monitored concentrations are themselves only estimates to the true concentrations at each point; the EU Directive on air quality designates passive NO_2 samplers indicative measures with a potential uncertainty of +/-30 %. Ignoring any uncertainty errors in the monitoring results, Table B.2 above indicates that the model is under-predicting at all monitoring locations.

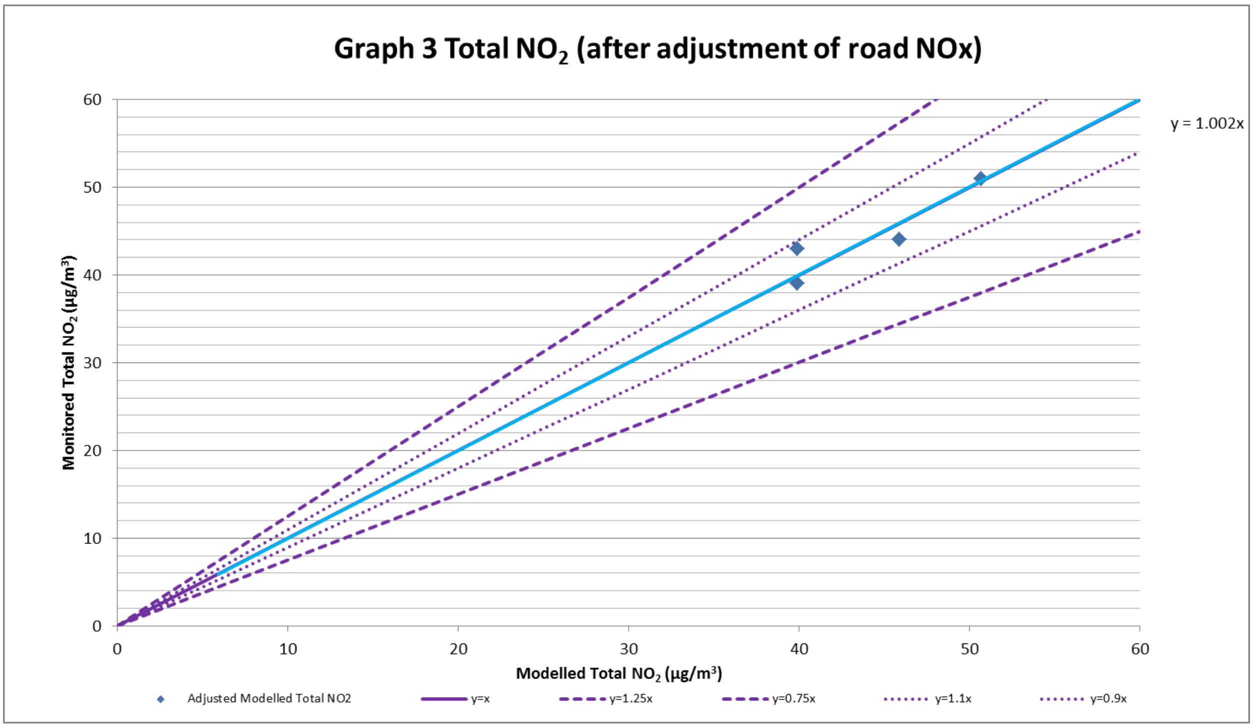
The modelled annual-mean NO_x road contributions for the four 2013 concentrations have been plotted against the monitored annual-mean NO_x road contributions in Graph 1.



The modelled NO_x contributions have been multiplied by the gradient of the trend line (2.1242) to determine the corrected NO_x contributions. The corrected modelled annual-mean NO_x road contributions have been plotted against the monitored annual-mean NO_x road contributions in Graph 2.



Modelled annual-mean NO_2 concentrations have been derived from the corrected modelled annual-mean NO_X road contributions. The corrected modelled annual-mean NO_2 concentrations have been plotted against the monitored annual-mean NO_2 concentrations in Graph 3.



The corrected modelled annual-mean NO_2 concentrations are all within 25% of the monitored annual-mean NO_2 concentrations. The correction factor therefore improves the modelled concentrations and has been applied to all predictions used within the assessment.

The fractional bias can also be used to determine whether the corrected model has a tendency to over or under-predict. The fractional bias is calculated as:

(Average Monitored NO_X Concentration – Average Predicted NOx Concentration) / 0.5 x (Average Monitored NO_X + Average Predicted NOx Concentration)

Fractional bias values vary between +2 and -2 and has an ideal value of zero. A negative value suggests a model over-prediction and a positive value suggests a model under-prediction.

Table B.3 sets out the average monitored concentration and the average predicted concentration.

Table B.3 Comparison of Monitored and Adjusted Modelled Annual-mean Road NO_X Contribution ($\mu g.m^{-3}$)

Monitoring Site	Annual-mean Road NO_X Contribution ($\mu g.m^{-3}$)	
	Corrected Modelled	**Monitored**
21	48.5	43.8
23	34.1	32.0
25	60.7	61.5
26	34.1	41.4
Average	**44.3**	**44.7**

The fractional bias for this study is therefore (44.7 – 44.3) / (0.5 x (44.7 + 44.3)) = 0.01. The fractional bias is close to zero, indicating that the adjusted model is performing well.

References

1 Council Directive 2008/50/EC of 21 May 2008 on ambient air quality and cleaner air for Europe.

2 Defra, 2010, The Air Quality Standards Regulations.

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