

Appendix: Air Quality

Annex 1: Professional Experience

Annex 2: Air Quality Policy/Legislation Context

Annex 3: Baseline Air Quality Review

Annex 4: Construction Dust Risk Assessment

Annex 5: Dispersion Modelling Approach

Annex 6: Air Quality Site Suitability



AIR POLLUTION
SERVICES

Chapel House, Barton Manor, Bristol, BS2 0RL
Tel: 01179 112434. Email: contact@airpollutionservices.co.uk

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Quality Assurance

Client: McLaren (Broad Street Mall) Ltd and UREF III LP
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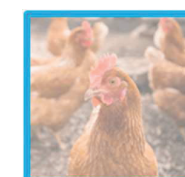
Contact Details

Contact: Dr Austin Cogan
Tel: 01179 112434
Email: contact@airpollutionservices.co.uk



AIR POLLUTION
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Experts in Air Quality, Climate Change, Meteorology and Odour





Contents

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Annex 1: Professional Experience

Client:

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McLaren (Broad Street Mall) Ltd and UREF III LP

APS_P1170A_A1-2

9 January 2024

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B1. Introduction

- B1.1.

B1.2.

B1.3.
- Air Pollution Services (APS), part of KALACO Group Ltd, has been commissioned by the Client to assess the air quality impacts associated with the proposed development of Broad Street Mall (herein the ‘Proposed Development’) located at Broad Street Mall, Broad Street, Reading, RG1 7QE.

The Proposed Development comprises the part-demolition of existing retail units, car park and service areas, demolition and rebuild of car park ramp, and construction of a residential-led, mixed-use development fronting Queens Walk and Dusseldorf Way, including all necessary enabling and alteration works required. It will include temporary construction involving part-demolition of podium deck on Dusseldorf Way and Queens Walk, amendments to existing retaining wall, excavation works and road and hardstanding re-alignment to create a temporary construction area related to proposed redevelopment works at Broad Street Mall.

This document sets out the professional experience of the authors of the air quality assessment.

B2. Professional Experience

Dr Austin Cogan, MPhys (Hons) PhD CEnv MEnvSc MIAQM

Austin is a Director and co-founder of Air Pollution Services, is a Chartered Environmentalist and has over 15 years’ experience in environmental sciences. His expertise covers monitoring, assessments, and research of indoor and ambient air quality as well as dust. He has undertaken many hundreds of planning and permitting projects across the UK and abroad covering a diverse range of industries, including residential, commercial, retail, leisure, transport infrastructure, airports, defence, waste management facilities, industrial processes, power generating facilities, agricultural facilities. This has included provision of expert witness services at public inquiries and hearings. He has also supported many local authorities with Clean Air Zone studies, Local Plan modelling, microsimulation modelling and advised on Air Quality Management Areas and Action Plans. Austin has also been involved in a number of projects for JNCC, EA, GLA, National Highways

and NGOs, undertaking research and development activities. He has contributed to many guidance documents, most recently IAQM’s guidance on indoor air quality. Austin led the development of APS’s AirChecker, a bespoke air quality conveyancing search report, and is an active member of the CoPSO committee. Additionally, he led the development of officially licensed quality assured observational meteorological data at APS, which is used by most of the air quality industry in the UK.

Katya Kaczmarczyk, MBChB BSc (Hons) AMIEnvSc AMIAQM

Mrs Kaczmarczyk is a Consultant. She has over three years’ experience of undertaking air quality, odour, dust, climate change and indoor air quality assessments for planning and permit applications, support for local authorities, regulators and NGOs, and research in the field of indoor air quality. She completed BSc Medical Biochemistry at the University of Leicester and continued her studies at the University of Warwick to complete a MBChB Medicine, working as a Doctor in the Southwest Deanery afterwards. She has undertaken assessments for a diverse range of projects, including residential and commercial developments, sewage treatment works, livestock markets, commercial kitchens, slurry lagoons, slurry towers, mineral sites, landfill sites, industrial facilities, and power generation facilities. She also leads the commercial distribution of meteorological data for KALACO Group and IAQ business development.

Ellie Tsiarapa, MSc BEng AMIEnvSc AMIAQM

Mrs Tsiarapa is an Assistant Consultant with several years’ experience. She previously undertook pollution and bioaerosol research at the Air Quality Management Resource Centre (AQMRC). She has been involved in several EU and UK research projects, and also has experience in dispersion modelling. She holds an MSc in Environmental Consultancy from the University of the West of England (UWE) and has experience in preparing air quality and odour assessments for planning and permitting applications as well as support for local authorities. This has included residential, commercial and retail developments as well as power generation, waste and mineral facilities.

Elen Jones, BSc (Hons) AMIEnvSc AMIAQM

Miss Jones is an Assistant Consultant, with experience in preparing air quality and climate change assessments for planning and permitting applications as well as support for local authorities. This has included residential developments and power generation facilities. She completed a BSc Geography degree at the University of the West of England (UWE). In addition, she has experience in meteorology, having carried out measurements of surface albedo and surface air temperature of different land surfaces and undertaken research into methods for cooling urban pavements to reduce urban heat island effects.

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C1. Introduction

- C1.1.

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- C1.2.

The Proposed Development comprises the part-demolition of existing retail units, car park and service areas, demolition and rebuild of car park ramp, and construction of a residential-led, mixed-use development fronting Queens Walk and Dusseldorf Way, including all necessary enabling and alteration works required. It will include temporary construction involving part-demolition of podium deck on Dusseldorf Way and Queens Walk, amendments to existing retaining wall, excavation works and road and hardstanding re-alignment to create a temporary construction area related to proposed redevelopment works at Broad Street Mall.
- C1.3.

This document sets out relevant context in terms of air quality, including air quality legislation (Section C2), national planning context (Section C3), and local planning context (Section C4), which are material considerations in determining planning applications.

C2. Air Quality Legislation

- C2.1.

Relevant Air Quality Legislation is set out in Table 1.

Table 1: Relevant Air Quality Legislation

Legislation	Text
The Environment Act 1995	Part IV of The Environment Act requires the Government to produce an Air Quality Strategy. This must include standards and objectives for the protection of human health and ecosystems. It also sets out the requirements of the Local Air Quality Management (LAQM) regime.
Air Quality Regulations 2000 (SI 2000/98)	LAQM requires every authority to carry out regular reviews and assessments of air quality in its area to identify whether the air quality objectives (AQOs) have been, or will be, achieved at relevant locations, by the applicable date. If this is not the case, the authority must declare an

Table 1: Relevant Air Quality Legislation

Legislation	Text
Air Quality (England) (Amendment) Regulations 2002 (SI 2002/3043)	Air Quality Management Area (AQMA) and prepare an action plan which identifies appropriate measures to be introduced in pursuit of the objectives. The latest Air Quality Strategy was published in 2023 (Defra, 2023). It includes a list of pollutant limits (also known as AQOs) for use by local authorities when considering human health. These AQOs were incorporated into English legislation by the 2000 and 2002 Regulations. The Strategy also sets out the PM_{2.5} targets and interim targets set under the Environment Act 2021 (see below) and critical levels for the protection of ecosystems. The 2023 Strategy is a framework for local authorities which sets out a series of local and national actions that the government intend to facilitate. The AQOs are policy targets often expressed as a maximum ambient concentration, for a specific averaging period, not to be exceeded, either without exception or with a permitted number of exceedances, within a specified timescale. To protect ecosystems critical levels and critical loads have been derived for different habitats. Exceedance of these values are used as an indication of the risk to the ecosystem. Critical loads are values of pollutants deposited onto a habitat below which significant effects do not occur. Critical levels are the concentrations of pollutants above which direct adverse effects on vegetation or ecosystems may occur.
Air Quality Standards Regulations 2010 (SI 210/1001) The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020 (SI 2020/1313)	In addition to the AQOs, the European Union (EU) has set limit and target values for the protection of human health and critical levels for the protection of ecosystems. These were transposed into UK legislation by the 2010 Regulations. The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020 reduced the EU annual mean limit value for particulate matter (PM_{2.5}) from 25 to 20 µg/m³. Like the AQOs, the limit values, target values and critical levels are set for individual pollutants and are made up of a concentration value, an averaging time over which it is to be measured, the number of exceedances allowed per year (if any) and a date by which it must be achieved. Some pollutants have more than one value covering different dates or averaging times..
Environment Act 2021 Environmental Targets (Fine Particulate Matter) (England) Regulations 2023 (SI 2023/96)	This Act requires the Secretary of State to set a long-term target (defined as no less than 15 years after the date on which the target was set) to reduce people's exposure to PM_{2.5}. It also enables the Secretary of State to set other air quality targets, including for other air pollutants The targets are an annual mean of 10 µg/m³ by 2040 together with a 35% exposure reduction target by 2040 compared to 2018. The 2023 Regulations set these targets in legislation. The Secretary of State must prepare an Environmental Improvement Programme (EIP) and produce an annual report on the implementation of the EIP, including progress towards meeting the targets. Every five years the EIP must be reviewed. The current EIP was published in 2023 (HM Government, 2023). This includes two interim targets to be achieved by the end of January 2028. These are an annual mean of 12 µg/m³ and an exposure reduction target of 22% compared to 2018.

Table notes: All legislation cited is available at legislation.gov.uk The Statutory Instrument (SI) number for Regulations is given in brackets.

Useful Information

- C2.2. In addition, the 2020 coroners court case investigating a young girl's death in 2013 concluded that air pollution was a significant contributing factor to both the induction of the girl's asthma and the exacerbation of her symptoms, due to exposure in exceedance of World Health Organization (WHO) guidelines for pollutants. This set a precedence to consider WHO guidelines when determining the potential for health impacts of air quality and has thus been considered when undertaking this assessment.

- C2.3. For the protection of semi-natural habitats, the United Nations Economic Commission for Europe (UNECE), under the auspices of the Convention on Long-range Transboundary Air Pollution (CLTAP), has adopted a series of critical levels above which adverse effect on ecosystems may occur, and critical loads below which harmful effects on sensitive ecosystems does not occur based on current knowledge. The critical loads are typically expressed as a range in recognition of their uncertainty.

- C2.4. The UK Government is a signatory of CLTAP and its protocols.

C3. National Planning Policy, Strategies and Action Plans

Planning Policy

National Planning Policy Framework

- C3.1. The National Planning Policy Framework (NPPF) (Department for Levelling Up, Housing & Communities, 2023) sets out planning policy for England. It includes advice on when air quality should be a material consideration in development control decisions. Relevant sections are set out in Table 2.

Table 2: Relevant National Planning Policy Framework Policies

Paragraph number	Text
55	<i>"Local planning authorities should consider whether otherwise unacceptable development could be made acceptable through the use of conditions or planning obligations. Planning obligations should only be used where it is not possible to address unacceptable impacts through a planning condition".</i>
174	<i>"Planning policies and decisions should contribute to and enhance the natural and local environment by: ... 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... "</i>
180	<i>"When determining planning applications, local planning authorities should apply the following principles:</i> <i>a) if significant harm to biodiversity resulting from a development cannot be avoided (through locating on an alternative site with less harmful impacts), adequately mitigated, or, as a last resort, compensated for, then planning permission should be refused;</i> <i>b) development on land within or outside a Site of Special Scientific Interest, and which is likely to have an adverse effect on it (either individually or in combination with other developments), should not normally be permitted. The only exception is where the benefits of the development in the location proposed clearly outweigh both its likely impact on the features of the site that make it of special scientific interest, and any broader impacts on the national network of Sites of Special Scientific Interest;</i> <i>c) development resulting in the loss or deterioration of irreplaceable habitats (such as ancient woodland and ancient or veteran trees) should be refused, unless there are wholly exceptional reasons and a suitable compensation strategy exists; and</i> <i>d) development whose primary objective is to conserve or enhance biodiversity should be supported; while opportunities to improve biodiversity in and around developments should be integrated as part of their design, especially where this can secure measurable net gains for biodiversity or enhance public access to nature where this is appropriate".</i>
185	<i>"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development".</i>

186	<i>“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”.</i>
187	<i>“Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or ‘agent of change’) should be required to provide suitable mitigation before the development has been completed”.</i>
188	<i>“The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities”.</i>
Table notes: -	

The Planning Practice Guidance

- C3.2. The NPPF is supported by Planning Practice Guidance on air quality (Ministry of Housing, Communities & Local Government , 2019). The most relevant sections are set out in Table 3.

Table 3: Relevant Sections of the Planning Practice Guidance on Air Quality

Paragraph number	Text
Paragraph 001 Reference ID: 32-001-20191101	What air quality considerations does planning need to address? <i>“The Department for Environment, Food and Rural Affairs carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with Limit Values. It is important that the potential impact of new development on air quality is taken into account in planning where the national assessment indicates that relevant limits have been exceeded or are near the limit, or where the need for emissions reductions has been identified.”</i>
Paragraph: 002 Reference ID: 32-002-20191101	What is the role of plan-making with regard to air quality? <i>“It is important to take into account air quality management areas, Clean Air Zones and other areas including sensitive habitats or designated sites of importance for biodiversity where there could be specific requirements or limitations on new development because of air quality”.</i>
Paragraph: 005 Reference ID: 32-005-20191101	When could air quality considerations be relevant to the development management process? <i>“Whether 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 have an adverse effect on air quality in areas where it is already known to be poor, particularly if it could affect the implementation of air quality strategies and action plans and/or breach legal obligations (including those relating to the conservation of habitats and species). Air quality may also be a material consideration if the proposed development would be particularly sensitive to poor air quality in its vicinity.</i>

	<i>Where air quality is a relevant consideration the local planning authority may need to establish: the ‘baseline’ local air quality, including what would happen to air quality in the absence of the development; whether the proposed development could significantly change air quality during the construction and operational phases (and the consequences of this for public health and biodiversity); and whether occupiers or users of the development could experience poor living conditions or health due to poor air quality”.</i>
Paragraph 006, Reference 32-006-20191101 (revision date 01.11.2019),	What specific issues may need to be considered in determining a planning application: <i>“Considerations that may be relevant to determining a planning application include whether the development would: Lead to changes (including any potential reductions) in vehicle-related emissions in the immediate vicinity of the proposed development or further afield. This could be through the provision of electric vehicle charging infrastructure; altering the level of traffic congestion; significantly changing traffic volumes, vehicle speeds or both; and 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; could add to turnover in a large car park; or involve 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; biomass boilers or biomass-fuelled Combined Heat and Power plant; centralised boilers or plant burning other fuels within or close to an air quality management area or introduce relevant combustion within a Smoke Control Area; or extraction systems (including chimneys) which require approval or permits under pollution control legislation; Expose people to harmful concentrations of air pollutants, including dust. This could be by building new homes, schools, workplaces or other development in places with poor air quality; Give rise to potentially unacceptable impacts (such as dust) during construction for nearby sensitive locations; and Have a potential adverse effect on biodiversity, especially where it would affect sites designated for their biodiversity value.”</i>
Paragraph: 007 Reference ID: 32-007-20191101	How detailed does an air quality assessment need to be? <i>“Assessments need to be proportionate to the nature and scale of development proposed and the potential impacts (taking into account existing air quality conditions), and because of this are likely to be locationally specific”.</i>
Paragraph: 008 Reference ID: 32-008-20191101	How can an impact on air quality be mitigated? <i>“Mitigation options will need to be locationally specific, will depend on the proposed development and need to be proportionate to the likely impact. It is important that local planning authorities work with applicants to consider appropriate mitigation so as to ensure new development is appropriate for its location and unacceptable risks are prevented”.</i>
Table notes: -	

Relevant Government Strategies

- C3.3. The Government has also published a number of strategies and plans which relate to air quality. The most relevant strategies and plans are set out in Table 4.

Table 4: Government Strategies

Strategy	Relevant Information
Air Quality Strategy for England (Defra, 2023)	This document fulfils the statutory requirement of the Environment Act 1995, as amended by the Environment Act 2021, to publish an Air Quality Strategy setting out air quality standards, objectives, and measures for improving ambient air quality every 5 years. It sets out a

	framework to enable local authorities to deliver for their communities and contribute to the government's long-term air quality goals.
Environmental Improvement Plan (HM Government, 2023)	The Environment Act 2021 requires the Secretary of State to produce and update every five years an Environmental Improvement Plan (EIP). The 2023 EIP replaces the first EIP published in 2019. (HM Government, 2019). Goal 2 of the plan is 'clean air'. It sets out the government's interim targets for PM _{2.5} , emission reduction commitments, and measures to reduce emissions from domestic solid fuel combustion and ammonia (NH ₃) emissions from farming. The Government will also consult on an extension to the North Sea Emission Control Area to cover the Irish Sea and encourage local authorities to improve air quality more quickly.
Transport Decarbonisation Plan (Department for Transport, 2021)	This document sets out the Government's commitments to decarbonise all forms of transport including freight transport. For road transport the commitments are: - End the sale of new petrol and diesel cars and vans from 2030 - All new cars and vans must be 100% zero emission at the tailpipe from 2035 - All new two/three wheeled powered vehicles to be fully zero emission from 2035 - End the sale of all non-zero emission HGVs from 2040.
Clean Air Strategy (Defra, 2019a)	The strategy focuses on reducing emissions of nitrogen oxides (NO _x), ammonia (NH ₃), particulate matter (PM), non-methane volatile organic compounds (NMVOCs) and sulphur dioxide (SO ₂). For particulate matter the emission reduction targets are 30% by 2020, and by 46% by 2030 and for NO _x 55% by 2020 and 73% by 2030 all from a 2005 baseline The strategy includes actions to reduce emissions from transport (including road, maritime, rail, aviation and NRM, homes, farming and industry).
The Ten Point Plan for a Green Industrial Revolution (HM Government, 2020)	This sets out how the UK intends to achieve its vision for a cleaner, healthier, net zero carbon future. The focus is on the following ten points: - Point 1 Advancing Offshore Wind - Point 2 Driving the Growth of Low Carbon Hydrogen - Point 3 Delivering New and Advanced Nuclear Power - Point 4 Accelerating the Shift to Zero Emission Vehicles - Point 5 Green Public Transport, Cycling and Walking - Point 6 Jet Zero and Green Ships - Point 7 Greener Buildings - Point 8 Investing in Carbon Capture, Usage and Storage - Point 9 Protecting Our Natural Environment - Point 10 Green Finance and Innovation
National Air Quality Plan. (Defra and Department for Transport, 2017) and (Defra and Department for Transport, 2018)	Defra and the Department for Transport's plans describe how the UK will comply with the annual mean Nitrogen Dioxide (NO ₂) limit values. Alongside a package of national measures, the Plan requires those English Local Authorities (or the GLA in the case of London Authorities) that are predicted to have exceedances of the limit values beyond 2020 to produce local plans by December 2018. These plans must have measures to achieve the statutory limit values within the shortest possible time and may include the implementation of a charging Clean Air Zone (CAZ).
Table notes: -	

C4. Local Planning Policy, Strategies and Action Plans

Local Planning Context

C4.1. Relevant information on local planning policy, strategy and guidance is set out in Table 5 for context.

Table 5: Local Planning Policy and Strategy

Document	Content
Reading Borough Council (RBC) Local Plan 2019-2036 (RBC, 2019)	The Local Plan (2019) contains the policies for how Reading will develop up to 2046, identifying the amount of development that will take place, the area and sites where development is expected to be accommodated, and where it will be restricted, and outlines policies for how planning applications will be decided. Policy CC6: Accessibility and the Intensity of Development refers to air quality in relation to how the scale and density of future development will be related to its level of amenity. The policy requires development to be located in areas accessible by walking and cycling to serve important public health goals including: <i>"fewer cases of lung or heart disease associated with poor air quality".</i> Policy CC9: Securing Infrastructure refers to air quality: <i>"Other measures, as follows, should also be considered where a specific need is identified and justified..."</i> <i>Measures to tackle poor air quality or for on-going air quality monitoring".</i> EN15: Air Quality describes that development should consider the need to improve air quality and reduce the effects of air quality: <i>"i. Development that would detrimentally affect air quality will not be permitted unless the effect is to be mitigated. The following criteria should be taken into account:</i> <i>Whether the proposal, including when combined with the cumulative effect of other development already permitted, would worsen air quality;</i> <i>Whether it can be demonstrated that a local worsening in air quality that would not detrimentally affect human health or the environment would be offset by an overall improvement in air quality, for instance through reduction in the need to travel.</i> <i>ii. Where a development would introduce sensitive uses (such as residential, schools, nurseries, hospitals, care facilities) into, or intensify such uses within, an Air Quality Management Area, detrimental effects on that use will be mitigated. Mitigation measures should be detailed in any planning application. If there are significant detrimental effects that cannot be mitigated the application should be refused.</i> <i>iii. Where required, planning obligations will be used to secure contributions to measures to tackle poor air quality or for air quality monitoring".</i> EM1: Provision of Employment Development refers to air quality: <i>"Freight consolidation centres are locations which serve as a single point for deliveries to a specific area, which are then distributed within the area by fewer vehicles, potentially low-emission vehicles, thus reducing congestion and helping to improve air quality... The Plan should support any such proposals in Reading, and they will be appropriate uses within Core Employment Area, although specific locations will need to be considered against other policies".</i> CR6: Living in Central Reading includes criteria in which proposals for residential development within the central area will be assessed against, and refers to air quality: <i>"Proposals for new residential development within the central area will be required to demonstrate how the issue of potential noise disturbance from neighbouring land uses and other sources, and air quality implications of residential development, have been considered and if necessary, mitigated".</i>
RBC Sustainable Design and Construction Supplementary Planning Document (SPD) (2019)	The Sustainable Design and Construction SPD (2019) explains planning requirements with consideration to energy, climate change, water management and waste reduction. The Document is intended to supplement the policies of the Local Plan. 'Residential Development' discusses the Zero Carbon Home submission requirements and refers to air quality: <i>"Most projects funded through the offset fund are not 'infrastructure' as covered by CIL, and therefore require a Section 106 agreement. Projects funded by the offset fund can also maximise co-benefits, such as alleviating fuel poverty, reducing energy bills, improving air quality..."</i> Section 4 of the Document, Energy Efficiency, describes how green walls and living walls;

Table 5: Local Planning Policy and Strategy

Document	Content
	<i>"The living wall... It is sometimes build indoors to help alleviate poor indoor air quality".</i> Section 5: Climate Change describes how: <i>"Trees and woodlands can provide a significant contribution to helping adapt to and minimise the impacts of climate change, through helping to reduce flood risk, improving air quality through the absorption of vehicle emissions and providing wildlife corridors".</i>
Table notes: -	

Local Air Quality Action Plan

- C4.2. RBC declared an Air Quality Management Area (AQMA) in 2009 for exceedances of the annual mean NO₂ AQO. The Reading AQMA covers Reading Town Centre, areas along the major radial road routes into Reading (including J11 of the M4) and along the railway lines where they pass through built-up areas (RBC, 2016).
- C4.3. RBC published the initial Air Quality Action Plan (AQAP) in 2009, which was then updated in 2016 (RBC, 2016), which outlines the approaches the council will take to improve air quality. The main areas for action proposed by the plan cover:
- Maintaining pollution monitoring networks;
 - Emissions from developments and buildings;
 - Public health and awareness raising;
 - Delivery servicing and freight; and
 - Localised solutions.

C5. Glossary

AA	Appropriate Assessment
APS	Air Pollution Services
AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AQO	Air Quality Objective
AW	Ancient Woodland
CAZ	Clean Air Zone
CLTAP	Convention on Long-range Transboundary Air Pollution
DfT	Department for Transport
EIP	Environmental Improvement Programme
EPR	Environmental Permitting (England and Wales) Regulations
EU	European Union

HRA	Habitats Regulation Assessment
LAQM	Local Air Quality Management
LNR	Local Nature Reserves
LWS	Local Wildlife Sites
NH ₃	Ammonia
NMVOC	Non-Methane Volatile Organic Compound
NNR	National Nature Reserves
NO _x	Nitrogen oxides
NO ₂	Nitrogen dioxide
NPPF	National Planning Policy Framework
PM ₁₀	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
PM _{2.5}	Small airborne particles, more specifically particulate matter less than 2.5 micrometres in aerodynamic diameter
SAC	Special Areas of Conservation
SINC	Sites of Importance for Nature Conservation
SO ₂	Sulphur Dioxide
SPA	Special Protection Areas
SSSI	Sites of Special Scientific Interest
ULEV	Ultra-Low Emission Vehicles
UNECE	United Nations Economic Commission for Europe
SPD	Supplementary Planning Document
RBC	Reading Borough Council
WHO	World Health Organization

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Appendix: Air Quality

Annex 1: Professional Experience

Annex 2: Air Quality Policy/Legislation Context

Annex 3: Baseline Air Quality Review

Annex 4: Construction Dust Risk Assessment

Annex 5: Dispersion Modelling Approach

Annex 6: Air Quality Site Suitability

Annex 3: Baseline Air Quality Review

Client: McLaren (Broad Street Mall) Ltd and UREF III LP
Reference: APS_P1170A_D1-2
Date Published: 9 January 2024

Rev.	Date	Description	Prepared	Reviewed	Authorised
01	28/11/2023	Issued	EJ	KK	AC
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D1. Introduction

- D1.1. Air Pollution Services (APS), part of KALACO Group Ltd, has been commissioned by the Client to assess the air quality impacts associated with the proposed development of Broad Street Mall (herein the 'Proposed Development') located at Broad Street Mall, Broad Street, Reading, RG1 7QE.
- D1.2. The Proposed Development comprises the part-demolition of existing retail units, car park and service areas, demolition and rebuild of car park ramp, and construction of a residential-led, mixed-use development fronting Queens Walk and Dusseldorf Way, including all necessary enabling and alteration works required. It will include temporary construction involving part-demolition of podium deck on Dusseldorf Way and Queens Walk, amendments to existing retaining wall, excavation works and road and hardstanding re-alignment to create a temporary construction area related to proposed redevelopment works at Broad Street Mall.
- D1.3. This document sets out a review of baseline air quality including the methodology (Section D2), concentrations of nitrogen dioxide (NO₂) (Section D4), concentrations of particulate matter less than 10 micrometres in diameter (PM₁₀) (Section D5), concentrations of particulate matter less than 2.5 micrometres in diameter (PM_{2.5}) (Section D6), other sources of air pollution (Section D7), associated health effects (Section D8), the overall baseline conditions (Section D9), and a glossary of useful terms used within the document (Section D10).

D2. Methodology

- D2.1. A baseline air quality review was undertaken to determine the existing air quality in the vicinity of the site. This desk-top study was undertaken using the following sources:
- Aerial photography from Google Satellite.

- Information on existing air quality has been obtained by collating the results of monitoring carried out by the local authority and where available other monitoring networks. This covers both the application site (if there is any) and the surrounding area, the latter being used to provide context to the assessment.
- Industrial and waste management sources that may affect the area have been identified using the UK Pollutant Release and Transfer Register (PRTR) (Defra, 2021). Local sources have also been identified through examination of maps and the Council's Air Quality Review and Assessment reports.
- Background concentrations of NO₂ and particulate matter (PM₁₀ and PM_{2.5}) have been defined using the national pollution maps published by Defra (2022b). These cover the whole of the country on a 1 km x 1 km grid of average concentrations.
- Predicted roadside concentrations of NO₂ in the study area have been identified using the maps of roadside concentrations published by Defra (2022c) as part of its 2017 Air Quality Plan for the baseline year 2015 and for the future years 2017 to 2030. These maps are used by the UK Government, to report exceedances of the Limit Value (LV). The national maps of roadside PM₁₀ and PM_{2.5} concentrations (Defra, 2022a), which are available for the years 2009 to 2030, show no exceedances of the LVs anywhere in the UK in 2015 or afterwards.

- D2.2. Baseline information is only provided for pollutants that may be affected by or affect the Proposed Development.

D3. Air Quality Zones

- D3.1. There are no declared Clean Air Zones (CAZ), Low Emission Zones (LEZs), Ultra Low Emission Zones (ULEZs), or Non-Road Mobile Machinery (NRMM) Zones within the study area.

AQMAs

- D3.2. Reading Borough Council (RBC) declared an Air Quality Management Area (AQMA) in 2009 for exceedances of the annual mean NO₂ Air Quality Objective (AQO) (RBC, 2016). The Proposed Development is located within the Reading AQMA, as shown in Figure 1.

Figure 1: Location of the Proposed Development site in relation to the Reading AQMA



Figure notes: Contains OS data © Crown copyright and database right (2023).

D4. Nitrogen Dioxide

Measurements

Monitoring Surveys

- D4.1. RBC measures NO₂ concentrations at many locations across the borough using both automatic monitors and passive monitors (diffusion tubes). Data for 2017 to 2021 have been taken from the annual status report for 2022 (RBC, 2022). No 2022 data for was available at the time of producing the assessment.
- D4.2. Note that the air quality data for 2020 and 2021 are not considered representative of typical conditions at the monitoring stations due to restrictions associated with the COVID-19 pandemic.
- D4.3. National Government measures concentrations of NO₂ at monitoring sites across the UK, as part of the Automatic Urban and Rural Network ([AURN](#)) regime. The Reading AURN is a National Government monitoring site located approximately 2.5 km east of the Proposed Development. Although the AURN is not considered to be representative of conditions at the Proposed Development, it provides useful information in the context of air quality.
- D4.4. Figure 2 shows relevant monitoring sites in the vicinity of the Proposed Development. These sites are considered to be representative of the conditions at the Proposed Development as they are all

situated within the Reading AQMA, and area all located at roadside locations within approximately 550 m of the Proposed Development. DT18, DT19, DT20, DT33 and DT42 are all considered to be representative of conditions at the Proposed Development due to their similar surroundings and, for example, similar streetscape. DT34, DT39, DT40 and DT41 are not considered to be representative of the Proposed Development, however, they provide useful information in the context of air quality.

- D4.5. The Reading AURN and RD1 are not considered to be representative of the Proposed Development due to their unsimilar locations, and distance from the Proposed Development. They do, however, provide valuable insight into the conditions in the area in terms of air quality and so their data has also been provided in Table 1.

Figure 2: Site Location and Relevant Monitoring Sites

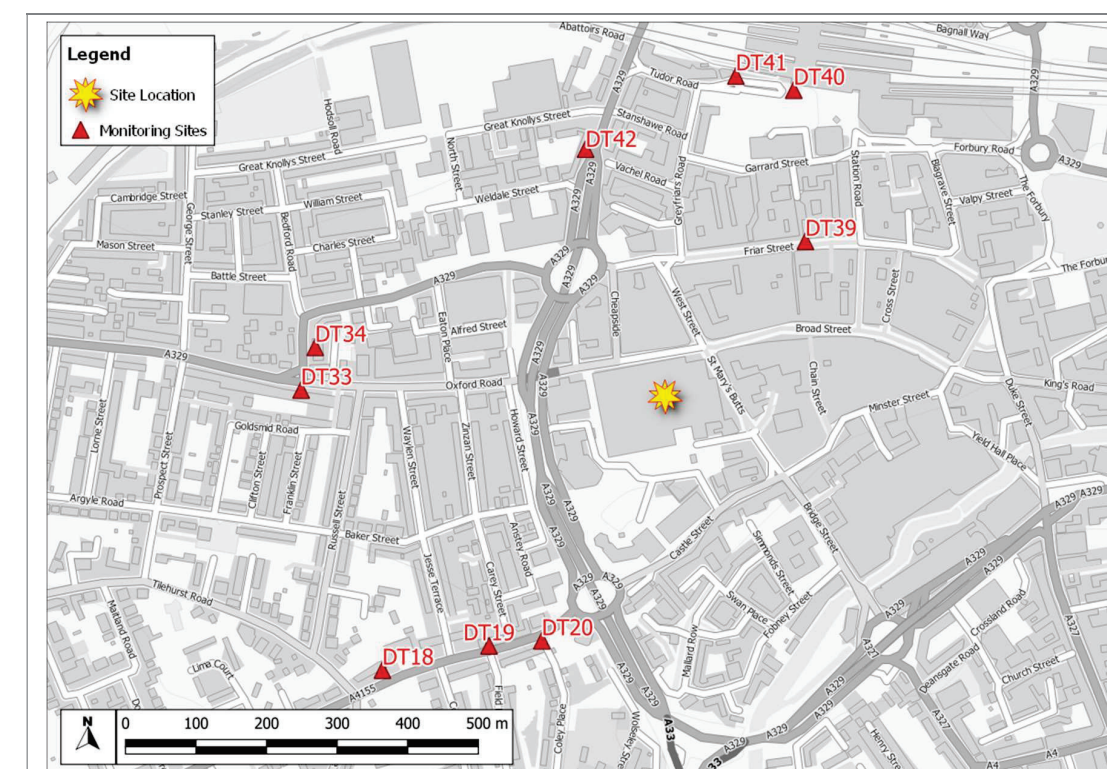


Figure notes: Contains OS data © Crown copyright and database right (2023).

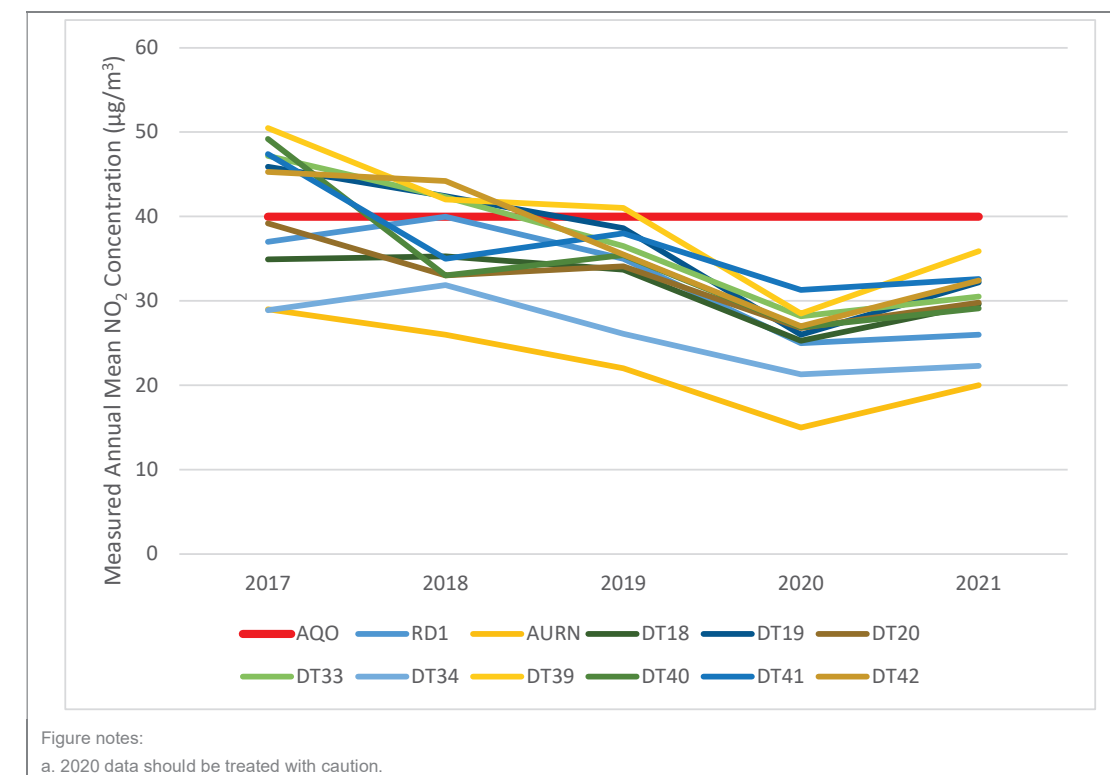
Annual Mean

- D4.6. Measured annual mean NO₂ concentrations for relevant diffusion tubes, and the AURN and RD1 are presented in Table 1. Measured NO₂ concentrations exceeded the annual mean AQO level of 40 µg/m³ at five of the passive monitoring sites (DT33, DT39, DT40, DT41 and DT42). Concentrations have, however, decreased significantly and in 2019 there was only one measured exceedance (at DT39).
- D4.7. Annual mean measured NO₂ concentrations meet the World Health Organisation ([WHO](#)) Interim Target ([IT](#)) 1 at all monitoring sites in 2019 with the exception of DT39.

Table 1: Measured NO₂ Annual Mean Concentrations (µg/m³) ^a

Monitoring Site – Site Name (Type)	Distance from Road (m)	Network ^b	2017	2018	2019	2020 ^e	2021
Automatic Monitoring - Annual Mean Concentrations (µg/m³)							
RD1 – Caversham Road (Roadside)	3	A	37	40	35	25	26
AURN – Reading AURN (Urban background)	100	A & B	29	26	22	15	20
Diffusion Tube Monitoring - Annual Mean Concentrations (µg/m³)							
DT18 – 162a Castle Hill (Roadside)	8	A	34.9	35.3	33.7	25.3	29.6
DT19 – 128 Castle Hill (Roadside)	2.5	A	45.9	42.4	38.6	26.0	32.2
DT20 – Blenheim Terrace (Roadside)	3	A	39.2	33.0	34.1	26.8	29.8
DT33 – 165 Oxford Road (Roadside)	4	A	47.2	42.3	36.5	28.2	30.5
DT34 – 10 Trinity Place (Roadside)	7.5	A	28.9	31.9	26.1	21.3	22.3
DT39 – Friar Street nr Nandos (Roadside)	5	A	50.5	42.0	41.0	28.5	35.9
DT40 – Station 1 (Roadside)	1	A	49.2	33.0	35.4	26.9	29.1
DT41 – Station 2 (Roadside)	1	A	47.4	35.0	38.0	31.3	32.6
DT42 – 33 Caversham Road (Roadside)	3	A	45.3	44.2	35.5	27.0	32.4
AQO			40				
LV ^c			40				
WHO AQG Level (IT 1, IT 2, IT 3) ^d			10 (40, 30, 20)				
Table notes: a. Concentrations above the AQO are presented in bold. These do not necessary represent relevant exposure nor exceedances of the AQO. b. A - Local Authority network, B – AURN. c. Reporting of LV exceedances is only carried out based on approved reference monitoring and at relevant reporting locations. Therefore, while the value is included, the monitoring presented is unlikely to comply with the requirements for LV reporting and assessment. d. Not required to be achieved within UK legislation. e. Air quality monitoring carried out includes periods of national travel restrictions due to the COVID-19 pandemic; measured concentrations are therefore not likely to be representative of typical conditions.							

D4.8. Long term trends of annual means require at least 5 years of data, however, the COVID-19 pandemic has potentially skewed the more recent data. Measured concentrations demonstrate an overall reduction in annual mean NO₂ concentrations between 2017 and 2021, as shown in Figure 3. This is likely to be due to continued improvement in vehicle technologies and thus concentrations are expected to decline further into the future.

 Figure 3: Measured NO₂ Concentrations between 2017 and 2021


Short-term Mean

1-hour Mean

D4.9. The measured number of 1-hour mean NO₂ concentrations above 200 µg/m³ for the monitoring stations which measure 1-hour averages are presented in Table 2. Exceedances of the 1-hour mean NO₂ AQO were not measured in any of the years presented.

 Table 2: Measured Number of NO₂ 1-hour Concentrations above 200 (µg/m³) ^a

Monitoring Site – Site Name (Type)	Network ^b	2017	2018	2019	2020 ^d	2021
AURN – Reading AURN (Urban Background)	A & B	0	4 (112)	0	0	0 (84)
RD1 – Caversham Rd (Roadside)	A	1	0	0	7	0
RD3 – Oxford Rd (Roadside)	A	0	0	1	0	0
RD4 – London Rd (Roadside)	A	-	0	0	0	0
AQO		18 (200) ^c				
LV		18 (200) ^c				
Table notes: a. Exceedances of the AQO are presented in bold. These do not necessary represent relevant exposure nor exceedances of the AQO. b. A - Local Authority network, B – AURN. c. Where data capture was low the 99.79 th percentile of 1-hour mean concentrations is provided in brackets. d. Air quality monitoring carried out in 2020 includes periods of national travel restrictions due to the COVID-19 pandemic; measured concentrations are therefore not likely to be representative of typical conditions. e. No data available.						

Predicted Concentrations

Defra Predicted Background Mapped Concentrations

- D4.10. Ambient background concentrations of NO₂ have been defined using the national pollution maps published by Defra (Defra, 2022b). These cover the whole of the country on a 1 km x 1 km grid for each year from 2018 until 2030.
- D4.11. Concentrations for 2019, 2026 and 2029 have been extracted for the grid cell that covers the Proposed Development. All predicted background concentrations are well below the AQOs and LV in 2019, 2026 and 2029. With respect to the WHO Interim Targets in 2029, the pollutant concentrations are below Interim Target 3 (30 µg/m³) for NO₂.

Table 3: Defra Predicted Background Mapped NO₂ Concentrations (µg/m³)

Year	Proposed Development
2019	34.4
2026	30.0
2029	28.9
AQO	40
LV	40
WHO AQG Level (IT 2, IT 3, IT 4) ^a	10 (40, 30, 20)
Table notes: a. Not in Regulations and there is no legal requirement for local authorities to meet it.	

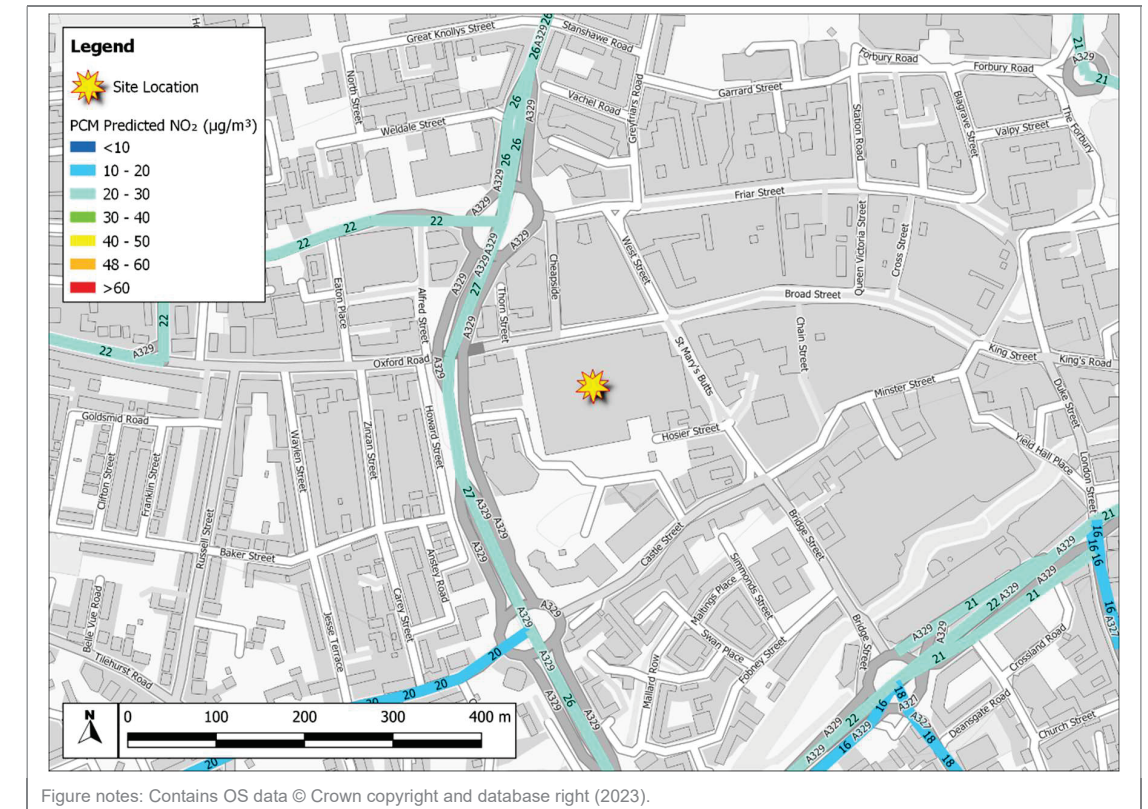
Defra Predicted Roadside Concentrations

- D4.12. Defra has predicted roadside concentrations of NO₂ for the main roads in the UK (Defra, 2022c) for the years 2017 to 2030 as part of Defra's commitment to report exceedances of the LVs. Concentrations from the nearest road with available data are shown in Table 4.
- D4.13. It should also be noted that it is widely accepted that in many locations in the UK Defra's modelling has underpredicted roadside concentrations when compared with local monitoring and these Defra roadside estimates should be treated with caution.

Table 4: Defra Predicted Roadside NO₂ Concentrations (µg/m³)

Road (Census ID)	2019	2026	2029
A329 (27954)	39.6	29.7	27.0
LV	40		
Table notes:			

Figure 4: PCM Modelled NO₂ Concentrations for 2029 and Location of the Application Site



D5. Particulate Matter <10 micrometres (PM₁₀)

Measurements

Monitoring Surveys

- D5.1. RBC measures PM₁₀ concentrations at three automatic monitoring locations, RD1, RD3 and RD4. None of the monitors are considered to be representative of the Proposed Development, but their data has been presented to provide insight into the conditions in the local area. Data for 2017 to 2021 have been taken from the annual status report for 2022 (RBC, 2022).
- D5.2. The air quality data for 2020 and 2021 are not considered representative of typical conditions at the monitoring stations due to restrictions associated with the COVID-19 pandemic.
- D5.3. National Government measures concentrations of PM₁₀ at monitoring sites across the UK, as part of the AURN regime. Reading AURN is approximately 2.5 km east of the Proposed Development, although this AURN is not considered to be representative of conditions at the Proposed Development, measured concentrations from this monitoring site have been presented to provide valuable insight in the context of air quality.
- D5.4. The locations of the monitoring sites are shown in Figure 2.

Annual Mean

D5.5. Measured annual mean PM₁₀ concentrations for relevant monitoring sites are presented in Table 5. Measured PM₁₀ concentrations did not exceed the annual mean AQO level of 40 µg/m³ at any of the monitoring sites. Annual mean measured PM₁₀ concentrations met the WHO IT 3 at RD1 and RD3, and IT 4 at AURN and RD4 in 2019.

Table 5: Measured PM₁₀ Annual Mean Concentrations (µg/m³)^a

Monitoring Site – Site Name (Type)	Distance from Road (m)	Network ^b	2017	2018	2019	2020 ^e	2021
AURN – Reading AURN (Urban Background)	100	A & B	12	13	13	15	15
RD1 – Caversham Rd (Roadside)	3	A	23	24	24	20	20
RD3 – Oxford Rd (Roadside)	6	A	21	23	21	18	17
RD4 – London Rd (Roadside)	3.5	A	18	17	17	19	17
AQO			40				
LV ^c			40				
WHO AQG Level (IT 1, IT 2, IT 3, IT 4) ^d			15 (70, 50, 30, 20)				
Table notes: a. Concentrations above the AQO are presented in bold. These do not necessary represent relevant exposure nor exceedances of the AQO. b. A - Local Authority network, B – AURN. c. Reporting of LV exceedances is only carried out based on approved reference monitoring and at relevant reporting locations. Therefore, while the value is included, the monitoring presented is unlikely to comply with the requirements for LV reporting and assessment. d. Not required to be achieved within UK legislation. e. Air quality monitoring carried out includes periods of national travel restrictions due to the Covid-19 pandemic; measured concentrations are therefore not likely to be representative of typical conditions.							

Short-term Mean

24-hour Mean

D5.6. The measured number of 24-hour mean PM₁₀ concentrations above 50 µg/m³ for the monitoring stations which measure 24-hour averages are presented in Table 6. Exceedances of the 24-hour mean PM₁₀ AQO were not measured in any of the years presented.

Table 6: Measured Number of PM₁₀ 24-hour Mean Concentrations above 50 (µg/m³)^a

Monitoring Site – Site Name (Type)	Network ^b	2017	2018	2019	2020 ^e	2021
AURN – Reading AURN (Urban Background)	A & B	3	1 (24)	0 (20)	0	1
RD1 – Caversham Rd (Roadside)	A	7	3	11	5	2
RD3 – Oxford Rd (Roadside)	A	8	2	11	2	0
RD4 – London Rd (Roadside)	A	3	1	4	3	2

AQO	35 (50) ^d
LV	35 (50) ^d
WHO IT 4 ^c	3
Table notes: a. Exceedances of the AQO are presented in bold. These do not necessary represent relevant exposure nor exceedances of the AQO. b. A - Local Authority network, B – AURN. c. Not required to be achieved within UK legislation. The WHO IT 2 is for 50 µg/m ³ no more than 4 times per year (99 th percentile). There are other ITs for 24-hour PM ₁₀ but they cannot be compared with the measurements presented. Note, where data capture is low, the figure in brackets cannot be compared to the WHO IT 2. d. Where data capture was low the 90.4 th percentile of 24-hour mean concentrations is provided in brackets. e. Air quality monitoring carried out in 2020 includes periods of national travel restrictions due to the Covid-19 pandemic; measured concentrations are therefore not likely to be representative of typical conditions.	

Predicted Concentrations

Defra Predicted Background Mapped Concentrations

- D5.7. Ambient background concentrations of PM₁₀ have been defined using the national pollution maps published by Defra (Defra, 2022b). These cover the whole of the country on a 1 km x 1 km grid for each year from 2018 until 2030.
- D5.8. Concentrations for 2019, 2026 and 2029 have been extracted for the grid cell that covers the Proposed Development. All predicted background concentrations are well below the AQOs and LV in 2019, 2026 and 2029. With respect to the WHO Interim Targets in 2029, the pollutant concentrations are below Interim Target 4 (20 µg/m³) for PM₁₀.

Table 7: Defra Predicted Background Mapped PM₁₀ Concentrations (µg/m³)

Year	Proposed Development
2019	18.8
2026	16.9
2029	16.6
AQO	40
LV	40
WHO AQG Level (IT 1, IT 2, IT 3, IT 4) ^d	15 (70, 50, 30, 20)
Table notes: a. Not in Regulations and there is no legal requirement for local authorities to meet it.	

Defra Predicted Roadside Concentrations

- D5.9. Defra has predicted roadside concentrations of PM₁₀ for the main roads in the UK (Defra, 2022c) for the years 2009 to 2030 as part of Defra's commitment to report exceedances of the LVs. Concentrations from the nearest road with available data are shown in Table 8.

Table 8: Defra Predicted Roadside PM₁₀ Concentrations (µg/m³)

Road (Census ID)	2019	2026	2029
A329 (27954)	18.8	18.1	17.7
LV	40		
Table notes:			

D6. Particulate Matter <2.5 micrometres (PM_{2.5})

Measurements

Monitoring Surveys

- D6.1. RBC does not currently undertake monitoring of PM_{2.5} in its authoritative area.
- D6.2. National Government measures concentrations of PM_{2.5} at monitoring sites across the UK, as part of the AURN regime. PM_{2.5} is measured at the Reading AURN site, approximately 2.2 km east of the Proposed Development. The Reading AURN site is not considered to be representative of the Proposed Development but has been presented to provide valuable insight in the context of air quality.
- D6.3. The location of the Reading AURN is shown in Figure 2.
- D6.4. The air quality data for 2020 and 2021 are not considered representative of typical conditions at the monitoring stations due to restrictions associated with the COVID-19 pandemic.

Annual Mean

- D6.5. Measured annual mean PM_{2.5} concentrations at the Reading AURN are presented in Table 9. Measured PM_{2.5} concentrations did not exceed the annual mean AQO of 20 µg/m³ between 2017 and 2021. Annual mean measured PM_{2.5} concentrations met IT4 but did not meet the AQG (5 µg/m³) during all years presented.

Table 9: Measured PM_{2.5} Annual Mean Concentrations (µg/m³)^a

Monitoring Site – Site Name (Type)	Distance from Road (m)	Network ^b	2017	2018	2019	2020 ^e	2021
AURN – Reading AURN (Roadside)	100	A & B	10	7	8	8	8
AQO			20				
LV ^c			20				
WHO AQG Level (IT 1, IT 2, IT 3, IT 4) ^d			5 (35, 25, 15, 10)				
Table notes: a. Concentrations above the AQO are presented in bold. These do not necessary represent relevant exposure nor exceedances of the AQO. b. A - Local Authority network, B – AURN. c. Reporting of LV exceedances is only carried out based on approved reference monitoring and at relevant reporting locations. Therefore, while the value is included, the monitoring presented is unlikely to comply with the requirements for LV reporting and assessment. d. Not required to be achieved within UK legislation. e. Air quality monitoring carried out includes periods of national travel restrictions due to the Covid-19 pandemic; measured concentrations are therefore not likely to be representative of typical conditions.							

Short-term Mean

24-hour Mean

- D6.6. There is no short-term monitoring of PM_{2.5} in the vicinity of the Proposed Development.

Predicted Concentrations

Defra Predicted Background Mapped Concentrations

- D6.7. Ambient background concentrations of PM_{2.5} have been defined using the national pollution maps published by Defra (Defra, 2022b). These cover the whole of the country on a 1 km x 1 km grid for each year from 2018 until 2030.
- D6.8. Concentrations for 2019, 2026 and 2029 have been extracted for the grid cell that covers the Proposed Development. All predicted background concentrations are well below the AQOs and LV in 2019, 2026 and 2029. With respect to the WHO Interim Targets in 2029, the pollutant concentrations met IT3 (15 µg/m³) for PM_{2.5}.

Table 10: Defra Predicted Background Mapped PM_{2.5} Concentrations (µg/m³)

Year	Proposed Development
2019	13.5
2026	11.8
2029	11.5
AQO	20
LV	20
WHO AQG Level (IT 1, IT 2, IT 3, IT 4) ^d	5 (35, 25, 15, 10)
Table notes: a. Not in Regulations and there is no legal requirement for local authorities to meet it.	

Defra Predicted Roadside Concentrations

- D6.9. Defra has predicted roadside concentrations of PM_{2.5} for the main roads in the UK (Defra, 2022c) for the years 2017 to 2030 as part of Defra's commitment to report exceedances of the LVs. Concentrations from the nearest road with available data are shown in Table 11, and shows all concentrations are below the LV.

Table 11: Defra Predicted Roadside PM_{2.5} Concentrations (µg/m³)

Road (Census ID)	2019	2026	2029
A329 (27954)	12.6	11.8	11.4
LV	20		
Table notes:			

D7. Other Sources of Air Pollution

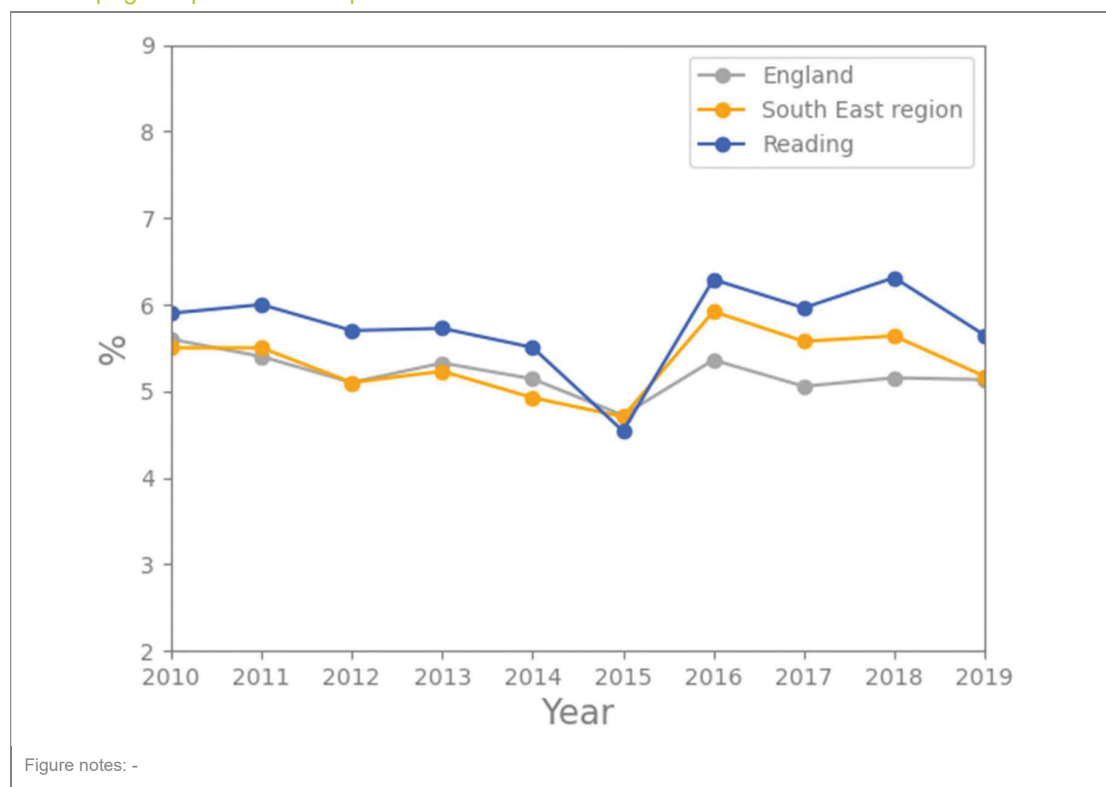
Permitted Facilities

- D7.1. Defra and the Devolved Administrations maintain a database of sites which are at risk of contributing significantly to pollutant concentrations, called the UK Pollutant Release and Transfer Register (Defra, 2021). A search of the 2021 database has not identified any regulated facilities within 1 km of the Proposed Development.

D8. Health Effects

D8.1. The Public Health Outcomes Framework (Public Health England, 2021) provides information on the fraction of mortality attributable to particulate matter (PM_{2.5}) air pollution (indicator D01). For Reading 5.6% of deaths were attributed to PM_{2.5}, which is slightly higher the average for Southeast region (5.2%) and England of 5.1%. The long-term trend in proportion of deaths associated with exposure to PM_{2.5} is shown in Figure 5.

Figure 5: Public Health Framework D01 Fraction of all-cause adult mortality attributable to anthropogenic particulate air pollution



D9. Overall Baseline Conditions

Air Quality Objectives

D9.1. Several relevant monitoring sites have recorded exceedances of the annual mean NO₂ AQO in the vicinity of the Proposed Development (DT19, DT20, DT33, DT39, DT40, DT41, DT42). However, concentrations have shown signs of decreasing; it is expected that concentrations will continue to decrease into the future as vehicle fleets become less polluting.

Limit Value Compliance

D9.2. The road with Defra predicted roadside concentrations in the study area have predicted concentrations of NO₂, PM₁₀ and PM_{2.5} are below the LVs and is therefore compliant with the LVs.

World Health Organization Guidelines

D9.3. Table 12 provides an indication of the baseline air quality at the application for the assessment year of 2029 (when the Proposed Development will first become operational) with respect to the WHO annual mean ITs and AQG.

Table 12: Indicative Achievement of Annual Mean WHO Guidelines / Interim Targets (µg/m³) on the Application Site in 2029

Pollutant	IT1	IT2	IT3	IT4	AQG
NO ₂	✓	✓	✓	n/a	x
PM ₁₀	✓	✓	✓	✓	x
PM _{2.5}	✓	✓	✓	x	x

Table notes:
 ? may achieve IT/AQG; x IT/AQG not achieved; ✓ IT/AQG achieved; n/a not applicable

D10. Glossary

Air Quality Standards

Concentrations recorded over a given time period, which are considered to be acceptable in terms of what is scientifically known about the effects of each pollutant on health and on the environment.

An exceedance

A period of time (defined for each standard) where the concentration is higher than that set out in the Standard.

An objective

The target date on which exceedances of a Standard must not exceed a specified number.

APS

Air Pollution Services

AQMA

Air Quality Management Area

AQO

Air Quality Objective

AURN

Automatic Urban and Rural Network

CAZ

Clean Air Zone

IT

Interim Target

LAQM

Local Air Quality Management

LEZ

Low Emission Zone

Limit Values (LVs)

Legally binding parameters that must not be exceeded. Limit values are set for individual pollutants and are made up of a concentration value, an averaging time over which it is to be measured, the number of exceedances allowed per year, if any, and a date by which it must be achieved. Some pollutants have more than one limit value covering different endpoints or averaging times.

NO₂	Nitrogen dioxide
NRMM	Non-Road Mobile Machinery
PM₁₀	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
PM_{2.5}	Small airborne particles, more specifically particulate matter less than 2.5 micrometres in aerodynamic diameter
PRTR	Pollutant Release and Transfer Register
RBC	Reading Borough Council
ULEZ	Ultra-Low Emission Zone
WHO	World Health Organization
µg/m³	Microgrammes per cubic metre

D11. References

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Appendix: Air Quality

Annex 1: Professional Experience

Annex 2: Air Quality Policy/Legislation Context

Annex 3: Baseline Air Quality Review

Annex 4: Construction Dust Risk Assessment

Annex 5: Dispersion Modelling Approach

Annex 6: Air Quality Site Suitability

Annex 4: Construction Dust Risk Assessment

Client: McLaren (Broad Street Mall) Ltd and UREF III LP
Reference: APS_P1170A_F1-3
Date Published: 9 January 2024

Rev.	Date	Description	Prepared	Reviewed	Authorised
01	29/11/2023	Issued	EJ	KK	AC
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03	09/01/2024	Updated	AC	AC	AC

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F1. Introduction

- F1.1. Air Pollution Services (APS), part of KALACO Group Ltd, has been commissioned by the Client to assess the air quality impacts associated with the proposed development of Broad Street Mall (herein the 'Proposed Development') located at Broad Street Mall, Broad Street, Reading, RG1 7QE.
- F1.2. The Proposed Development comprises the part-demolition of existing retail units, car park and service areas, demolition and rebuild of car park ramp, and construction of a residential-led, mixed-use development fronting Queens Walk and Dusseldorf Way, including all necessary enabling and alteration works required. It will include temporary construction involving part-demolition of podium deck on Dusseldorf Way and Queens Walk, amendments to existing retaining wall, excavation works and road and hardstanding re-alignment to create a temporary construction area related to proposed redevelopment works at Broad Street Mall.
- F1.3. This document sets out a risk assessment of potential dust impacts associated with the construction of the Proposed Development as well as relevant mitigation for the construction works.

F2. Guidance

- F2.1. The assessment has been carried out using approaches set out in the following guidance.
Guidance on the Assessment and Control of Dust from Demolition and Construction
- F2.2. The Institute of Air Quality Management (IAQM) produced guidance (2023) on the assessment of dust from demolition and construction. This document provides a risk-based methodology for assessing construction impacts, including demolition and earthworks where appropriate. The guidance has been used throughout this assessment, which should be read in conjunction with this document.

F3. Construction Dust Risk Assessment

Assessment Approach

- F3.1. The assessment method follows the approach provided by the IAQM guidance document (2023) which follows a sequence of steps:
- Step 1 is a basic screening stage, to determine whether the more detailed assessment provided in Step 2 is required.
 - Step 2 is to assess the risk of dust impacts.
 - Step 2a determines the potential for dust to be raised from on-site works and by vehicles leaving the site.
 - Step 2b defines the sensitivity of the area to any dust that may be raised.
 - Step 2c combines the information from Steps 2a and 2b to determine the risk of dust impacts without appropriate mitigation.
 - Step 3 uses this information to determine the appropriate level of site-specific mitigation required to ensure that there should be no significant impacts.
 - Step 4 is to examine the residual effects and to determine whether these are significant.
- F3.2. The approach developed by the IAQM (2023), divide the activities on construction sites into four types to reflect their different potential impacts. These are:
- demolition;
 - earthworks;
 - construction; and
 - trackout.

F4. Step 1

- F4.1. Step 1 of the assessment procedure is to screen the need for a detailed assessment. The guidance provides distance-based criterion in Box 1 of the guidance which states:
- An assessment will normally be required where there is:*
- a 'human receptor' within:
 - 250 m of the boundary of the site; or
 - 50 m of the route(s) used by construction vehicles on the public highway, up to 250 m from the site entrance(s).
 - an 'ecological receptor' within:
 - 50 m of the boundary of the site; or
 - 50 m of the route(s) used by construction vehicles on the public highway, up to 250 m from the site entrance(s).

F4.2. There are human receptors within the distances set out in the guidance, thus a detailed assessment is required for human receptors. There are no nationally designated ecological receptors within the screening distances and therefore effects on ecological receptors can be discounted as not significant.

F5. Step 2

F5.1. The following section sets out Step 2 of the assessment procedure.

Potential Dust Emission Magnitude

F5.2. The guidance explains that the dust emission magnitude is based on the scale of the anticipated works and should be classified as Small, Medium, or Large. The guidance provides examples of the magnitude classification for each of the potential stages.

Demolition

F5.3. There will be some demolition onsite, including Part-demolition of podium deck on Dusseldorf Way and Queens Walk, amendments to existing retaining wall, excavation works and road and hardstanding re-alignment to create a temporary construction area related to proposed redevelopment works at Broad Street Mall. There will be some internal demolition as part of the change of use works. Based on the illustrative criteria in the IAQM guidance, the dust emission class for demolition is considered *Medium*.

Earthworks

F5.4. The dust generated by the earthworks depends on the nature of the earth and soil at the application site. The characteristics of the soil have been defined using the British Geological Survey's UK Soil Observatory website (2023) and are set out in Table 1. Overall, it is considered that, when dry, this soil will not be very dusty.

Table 1: Soil Conditions at the Application Site

Category	Record
Soil layer thickness	Deep
Soil texture	Sandy (light to medium)
Subsoil grain size	Arenaceous – rudaceous
European Soil Bureau Description	River terrace / sand and gravel
Table notes: -	

F5.5. There will be some earthworks on-site, however the area and extent of earthworks is currently unknown. Dust will arise mainly from the handling and transport of dusty materials (such as dry soil). Based on the illustrative criteria in the IAQM guidance document, the dust emission class for earthworks is considered *Small*.

Construction

F5.6. The Proposed Development includes the construction of three tower blocks with allocations for over 600 residential units. The total volume for the construction/redevelopment of the Proposed

Development is unknown but is anticipated to be over 75,000 m³. Based on the illustrative criteria in the IAQM, the dust emission class for earthworks is considered *Large*.

Trackout

F5.7. The number of HDVs leaving the site on a single day has been provided by Stantec, the transport consultant for the project. There is expected to be up to 50 HDV movements per day. These HDVs may lead to dust and dirt being tracked out. Based on the example definitions set out in the IAQM guidance, the dust emission magnitude for trackout is considered *Medium*.

Summary of Potential Dust Emission Magnitude

F5.8. Table 2 summarises the dust emission magnitude from the construction phases of the Proposed Development.

Table 2: Summary of Potential Dust Emission Magnitudes

Activity	Dust Emission Magnitude
Demolition	Medium
Earthworks	Small
Construction	Large
Trackout	Medium
Table notes: -	

Sensitivity of the Study Area

F5.9. The guidance explains that the sensitivity of the area should take account of a number of factors including:

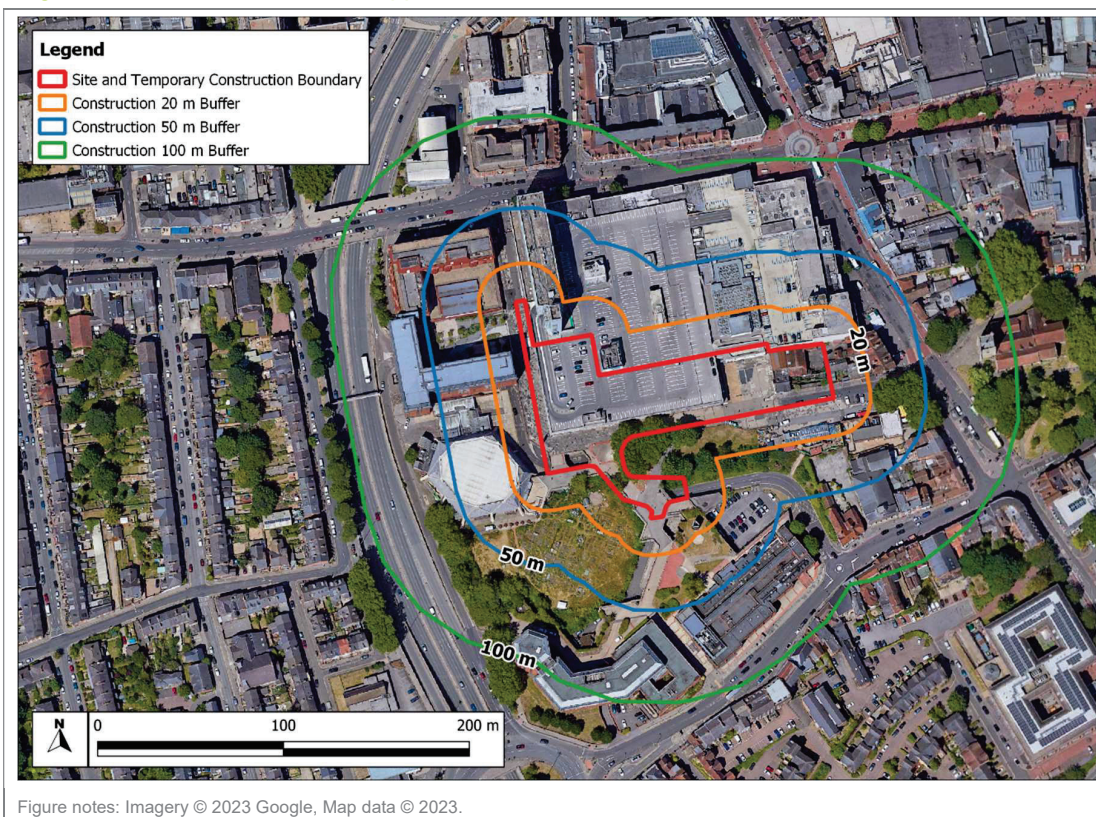
- the specific sensitivities of receptors in the area;
- the proximity and number of those receptors;
- in the case of PM₁₀, the local baseline concentration; and
- site-specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.

F5.10. The IAQM guidance document provides examples of high, medium and low sensitivity receptors for each of the potential effects. These are provided in Box 6 to Box 8 of the guidance and consideration should be given to the additional factors presented in Box 9 of the guidance. The guidance also provides a series of matrices (Tables 2, 3 and 4 of the guidance document) to determine the sensitivity of the area based on the receptor sensitivity, number of receptors, the proximity to the dust emission activity and baseline PM₁₀ concentration. Residential properties are considered high sensitivity receptors to dust soiling and elevated levels of PM₁₀.

F5.11. Figure 1 shows the site location with several bands representing 20 m, 50 m, and 100 m distances from the application site. There are between 10 and 100 high sensitivity properties within 20 m of the application site. Based on Table 2 of the IAQM guidance document, the sensitivity of the area to dust soiling impacts will be *High*.

F5.12. Annual mean PM₁₀ predicted background concentrations in the vicinity of the Proposed Development are predicted to be a maximum of 16.9 µg/m³ (most appropriate value set out in the air quality baseline review). There are between 10 and 100 high sensitivity properties that are likely to be exposed to these concentrations within 20 m of the application site. Based on Table 3 of the IAQM guidance, the sensitivity of the area to human health impacts due to elevated levels of PM₁₀ during the demolition, earthworks and construction stages will be *Low*.

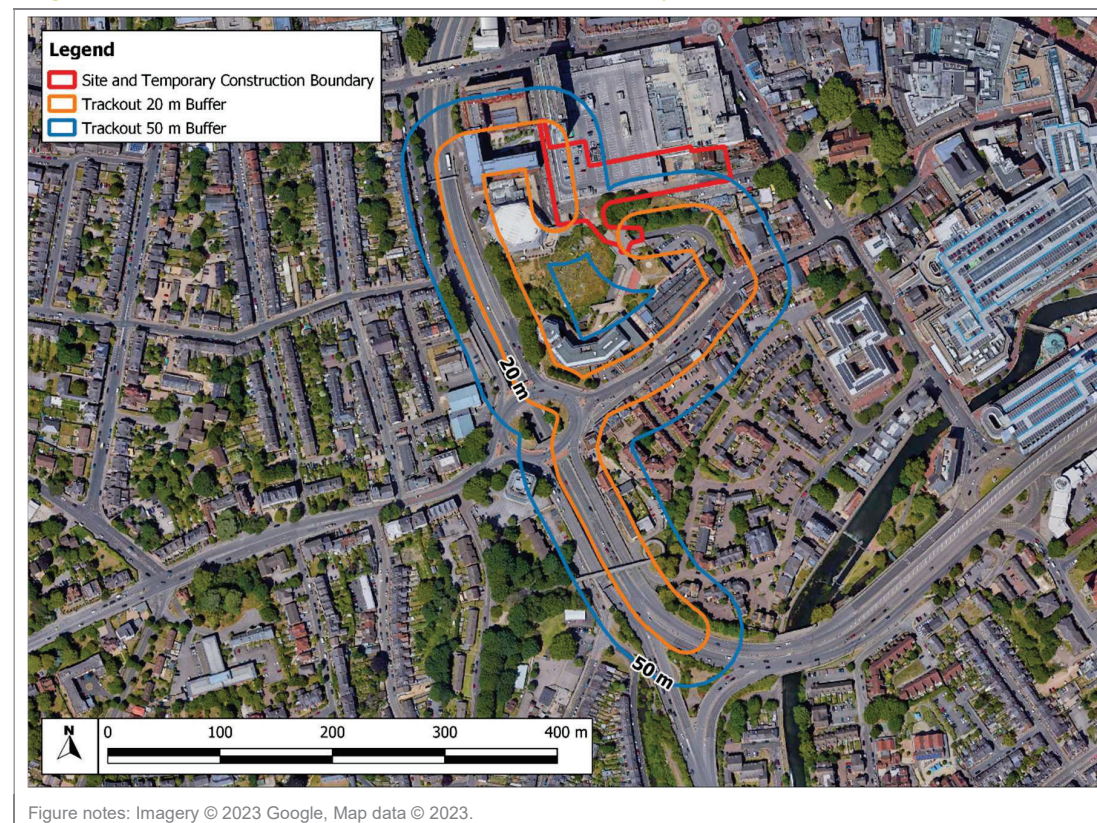
Figure 1: Distance Buffers from Application Site



F5.13. Footnote C of Table 2 of the Guidance explains that where there is a *Medium* dust emission magnitude for trackout there is a high risk of material being tracked up to 200 m from the application site. This includes under the hotel/student accommodation.

F5.14. There will be more than 10 high sensitivity properties within 20 m of the roads along which material could be tracked, and thus the area is considered to be of *High* sensitivity to dust soiling impacts due to trackout. In terms of human health, the area is considered to be of *Low* sensitivity.

Figure 2: Distance Buffers from road lanes where dirt may be tracked out from the site



F5.15. Table 3 summarises the sensitivity of the area around the proposed construction works based on the highest level of sensitivity determined for each stage.

Table 3: Summary of Sensitivity of the Surround Area

Potential Impact	Sensitivity of the Surrounding Area			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	High	High	High	High
Human Health	Low	Low	Low	Low
Ecology	n/a	n/a	n/a	n/a

Table notes:
IAQM Guidance states that trackout may occur along the public highway for up to 500 m from large magnitude sites, 200 m from medium magnitude sites, and 50 m from small magnitude sites, as measured from the site exit.

Risk of Dust Effect

F5.16. The guidance has, helpfully, provided a series of matrices (Table 6, Table 7, Table 8 and Table 9 of the guidance document) to determine the potential impact at receptors based on the receptor sensitivity, number of receptors and the proximity to the dust emission activity.

F5.17. The dust emission magnitudes in Table 2 have been combined with the sensitivities of the area in Table 3 using the matrices in the guidance (Table 6, Table 7, Table 8 and Table 9 of the guidance), in order to assign a risk category to each activity. The resulting risk categories for the four construction activities, without mitigation, are set out in Table 4.

Table 4: Summary of Dust Risk for each Stage

Potential Impact	Risk			
	Demolition ^a	Earthworks ^b	Construction ^c	Trackout ^d
Dust Soiling	Medium Risk	Low Risk	High Risk	Medium Risk
Human Health	Low Risk	Negligible	Low Risk	Low Risk
Ecology	Negligible	Negligible	Negligible	Negligible
Table notes: a. Based on Table 6 of the IAQM guidance document. b. Based on Table 7 of the IAQM guidance document. c. Based on Table 8 of the IAQM guidance document. d. Based on Table 9 of the IAQM guidance document.				

Significance of effects

F5.18. The IAQM guidance does not provide a method for assessing the significance of effects before mitigation and advises that pre-mitigation significance should not be determined.

F6. Step 3

F6.1. The risk categories set out in Table 4 have been used to determine the appropriate level of mitigation as set out in Section F7 of this document (step 3 of the assessment procedure).

F7. Mitigation

F7.1. Measures to mitigate emissions will be required during the construction phase of the Proposed Development in order to minimise impacts upon nearby sensitive receptors.

F7.2. The Proposed Development has been identified as Medium Risk for dust soiling effects during the demolition, construction and trackout, and Low risk for earthworks. In terms of human health, the Proposed Development has been identified as Low risk for demolition, construction and trackout, and Negligible Risk for earthworks, as set out in Table 4.

F7.3. The IAQM guidance document describes measures that should be employed, as appropriate, to reduce the impacts. In addition to this the IAQM has also published guidance on monitoring during demolition and construction (IAQM, 2018). Based on the finding of this assessment, a set of measures that are both highly recommended and desirable to be incorporated into the specification for the construction works has been drawn up. These measures are shown in Table 5 to Table 9.

F7.4. The mitigation measures for the application site could be written into a dust management plan (DMP). The DMP may be integrated into a Code of Construction Practice or the Construction Environmental Management Plan.

F7.5. Where mitigation measures rely on water, it is expected that only sufficient water will be applied to damp down the material. There should not be any excess to potentially contaminate local watercourses.

Table 5: Communication

Measure	Highly Recommend / Desirable
Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	Highly Recommended
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.	Highly Recommended
Display the head or regional office contact information.	Highly Recommended
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.	Highly Recommended

Table 6: Dust Management

Measure	Highly Recommend / Desirable
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.	Highly Recommended
Make the complaints log available to the local authority when asked.	Highly Recommended
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.	Highly Recommended
Hold regular liaison meetings with other high risk construction sites within 500 m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/deliveries which might be using the same strategic road network routes.	Highly Recommended
Monitoring	
Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100 m of site boundary, with cleaning to be provided if necessary.	Highly Recommended
Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked.	Highly Recommended
Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.	Highly Recommended
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	Highly Recommended

large site, before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction.	
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.	Highly Recommended
Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.	Highly Recommended
Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.	Highly Recommended
Avoid site runoff of water or mud.	Highly Recommended
Keep site fencing, barriers and scaffolding clean using wet methods.	Highly Recommended
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.	Highly Recommended
Cover, seed or fence stockpiles to prevent wind whipping.	Highly Recommended
Operating vehicle/machinery and sustainable travel	
Ensure all vehicles switch off engines when stationary - no idling vehicles.	Highly Recommended
Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where practicable.	Highly Recommended
Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate).	Highly Recommended
Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	Highly Recommended
Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).	Highly Recommended
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.	Highly Recommended
Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.	Highly Recommended
Use enclosed chutes and conveyors and covered skips.	Highly Recommended
Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.	Highly Recommended
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.	Highly Recommended
Waste management	
Avoid bonfires and burning of waste materials.	Highly Recommended

Table 7: Measure Specific to Demolition

Measure	Highly Recommend / Desirable
Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).	Desirable
Ensure effective water suppression is used during demolition operations. Handheld 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.	Highly Recommended
Avoid explosive blasting, using appropriate manual or mechanical alternatives.	Highly Recommended
Bag and remove any biological debris or damp down such material before demolition.	Highly Recommended

Table 8: Measure Specific to Construction

Measure	Highly Recommend / Desirable
Avoid scabbling (roughening of concrete surfaces) if possible.	Highly Recommended
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.	Highly Recommended
Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.	Highly Recommended
For smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust.	Desirable

Table 9: Measure Specific to Trackout

Measure	Highly Recommend / Desirable
Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.	Highly Recommended
Avoid dry sweeping of large areas.	Highly Recommended
Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	Highly Recommended
Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	Highly Recommended
Record all inspections of haul routes and any subsequent action in a site log book.	Highly Recommended
Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.	Highly Recommended

Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	Highly Recommended
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.	Highly Recommended
Access gates to be located at least 10 m from receptors where possible.	Highly Recommended

F8. Summary

- F8.1. The construction works for the Proposed Development have the potential to create dust and emissions, including during the temporary construction involving part-demolition of podium deck on Dusseldorf Way and Queens Walk, amendments to existing retaining wall, excavation works and road and hardstanding re-alignment to create a temporary construction area related to proposed redevelopment works at Broad Street Mall.
- F8.2. During construction it will therefore be necessary to apply a package of mitigation measures to minimise dust emission. With these measures in place, it is expected that any residual effects will be '*not significant*'. The IAQM guidance recognises that even with a rigorous dust management plan in place, it is not possible to guarantee that the dust mitigation measures will be effective all the time, for instance under adverse weather conditions. The local community may therefore experience occasional, short-term annoyance.
- F8.3. The scale of this would not normally be considered sufficient to change the conclusion that the effects will be '*not significant*' for the construction of the Proposed Development, including the temporary construction area works.

F9. Glossary

APS	Air Pollution Services
DMP	Dust Management Plan
EPUK	Environmental Protection UK
HDV	Heavy Duty Vehicle
IAQM	Institute of Air Quality Management
µg/m³	Microgrammes per cubic metre
PM₁₀	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
RBC	Reading Borough Council

F10. References

British Geological Survey. (2023). *UK Soil Observatory (UKSO)*. Retrieved from British Geological Survey: <http://mapapps2.bgs.ac.uk/ukso/home.html>

IAQM. (2018). *Guidance on Monitoring in the Vicinity of Demolition and Construction Sites*.

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Appendix: Air Quality

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Annex 5: Dispersion Modelling Approach

Client: McLaren (Broad Street Mall) Ltd and UREF III LP
Reference: APS_P1170A_E1-2
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01	29/11/2023	Issued	ET	KK	AC
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E1. Introduction

- E1.1. Air Pollution Services (APS), part of KALACO Group Ltd, has been commissioned by the Client to assess the air quality impacts associated with the proposed development of Broad Street Mall (herein the 'Proposed Development') located at Broad Street Mall, Broad Street, Reading, RG1 7QE.
- E1.2. The Proposed Development comprises the part-demolition of existing retail units, car park and service areas, demolition and rebuild of car park ramp, and construction of a residential-led, mixed-use development fronting Queens Walk and Dusseldorf Way, including all necessary enabling and alteration works required. It will include temporary construction involving part-demolition of podium deck on Dusseldorf Way and Queens Walk, amendments to existing retaining wall, excavation works and road and hardstanding re-alignment to create a temporary construction area related to proposed redevelopment works at Broad Street Mall.
- E1.3. To carry out the assessment a detailed dispersion modelling study has been completed. Details of the modelling approach are presented in this document. This includes a modelling overview (Section E2), description of the model used (Section E3), modelled receptors (Section E4), meteorology and surface characteristics used (Section E5), details of road modelling (Section E6), Post processing (Section E7), uncertainties and limitations (Section E8) and a glossary of useful terms used (Section E9).

E2. Modelling Overview

- E2.1. Concentrations of nitrogen dioxide (NO₂) and particulate matter (PM₁₀ and PM_{2.5}) have been predicted for:
- the existing year of 2019 (latest year with relevant monitoring data available, unaffected by the COVID-19 pandemic enabling the model to be appropriately verified);
 - the peak construction year of 2026: and

- the future year of 2029 (when the Proposed Development is expected to be first operational).

E3. The Model

- E3.1. Concentration contributions associated with road traffic emissions have been predicted using the Atmospheric Dispersion Modelling System (ADMS) suite of tools developed and validated by Cambridge Environmental Research Consultants (CERC).
- E3.2. ADMS is used extensively throughout the UK for regulatory compliance purposes and Local Air Quality Management (LAQM) and is accepted as an appropriate tool by local authorities and the Environment Agency (EA).
- E3.3. The model requires a range of input parameters which are discussed below.

E4. Modelled Receptors

- E4.1. The model output locations are often referred to as receptors, although in some cases the locations may not represent locations of relevant exposure. For ease, this study uses the phrase receptor to represent the modelled output location.
- E4.2. Concentrations of NO₂, PM₁₀ and PM_{2.5} have been predicted at:
- 27 receptor locations within the local area (prefixed with C for Construction Route Receptors, shown in Figure 1). These receptors have been selected to represent likely worst-case locations of relevant exposure along the local road network where impacts from construction traffic are most likely to occur.
 - 32 receptor locations within the Proposed Development (prefixed with D, shown in Figure 2), at a range of heights covering all floors of the Proposed Development. These receptors represent a range of exposure throughout the Proposed Development.
 - 5 monitoring site locations (DT20, DT19, DT18, DT33 and DT42), to carry out a model performance verification for the roads modelling as shown in Figure 3. The receptors have been modelled at the height of the monitor inlets. Other monitoring sites could not be included due to a lack of traffic data available.

Figure 1: Receptor Locations in the Local Area



Figure 2: Receptor Locations at the Proposed Development

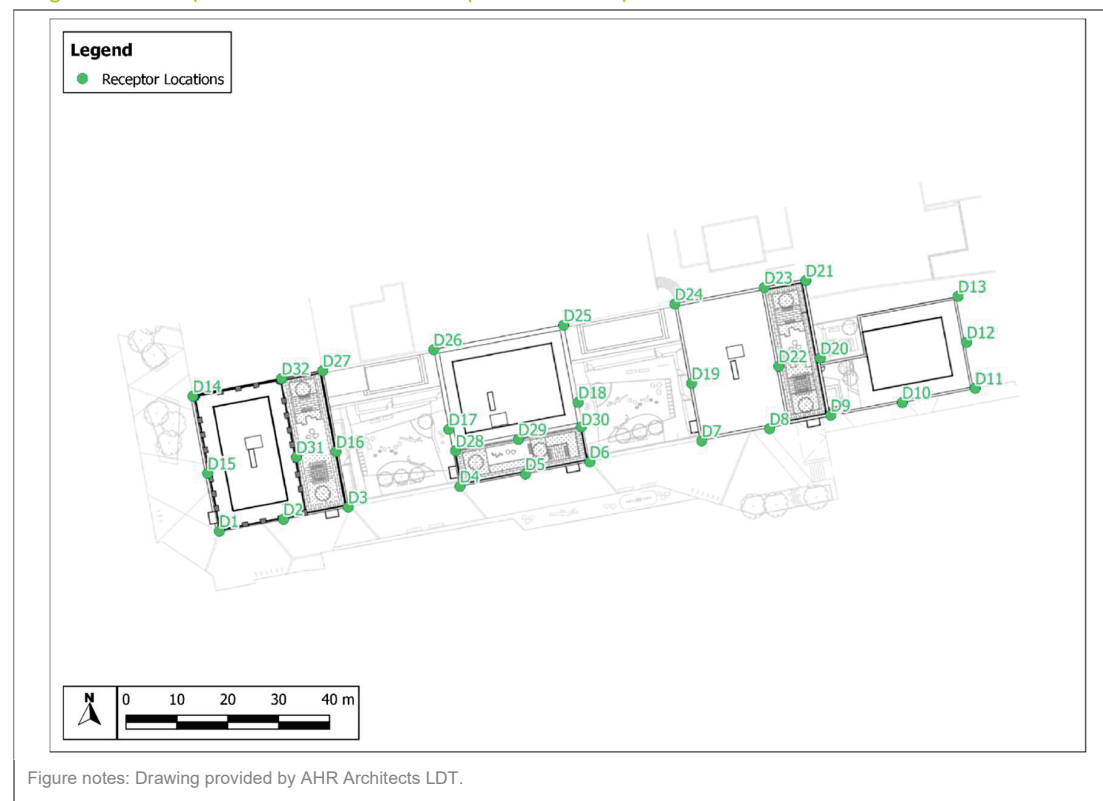


Figure 3: Monitoring Sites in the Local Area used for Model Verification

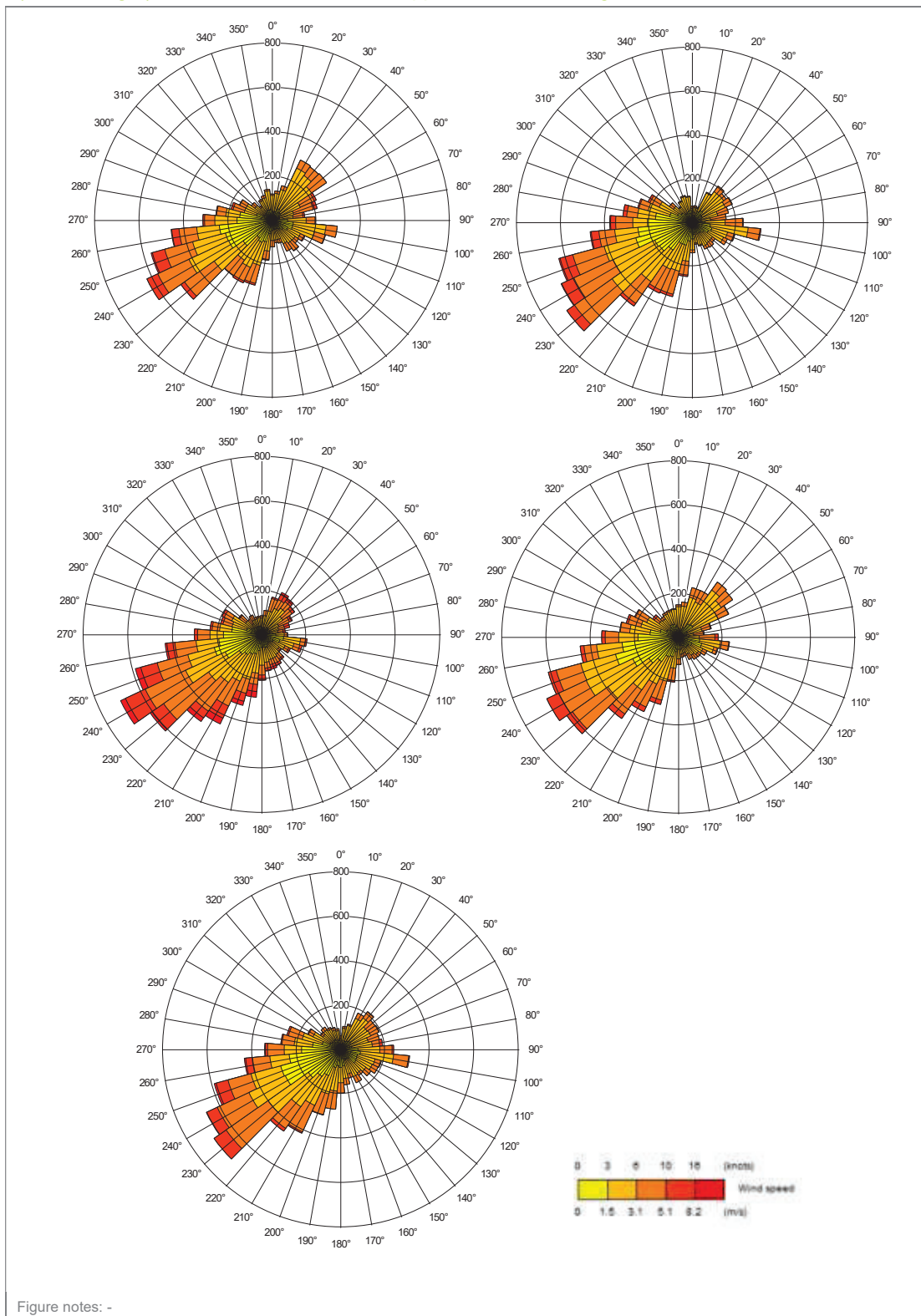


E5. Meteorology and surface characteristics

Meteorology

- E5.1. The dispersion model includes a meteorological pre-processor developed by the UK Met Office to calculate values of meteorological parameters in the boundary-layer. The pre-processor requires a set of meteorological parameters on an hour-by-hour basis: wind speed, wind direction, temperature and cloud cover.
- E5.2. It is important to use meteorological data which is representative of the conditions within the Study Area. The Proposed Development is located in flat lying urban location within Reading, observational data from Cippenham has been used, approximately 24 km northeast of the application site, and is considered to be representative of meteorological conditions in Reading. Wind roses for years 2018 to 2022 for this site are shown in Figure 4. Theoretically, the observed meteorological data typically represents measurements at a height of approximately 10 m above ground level.

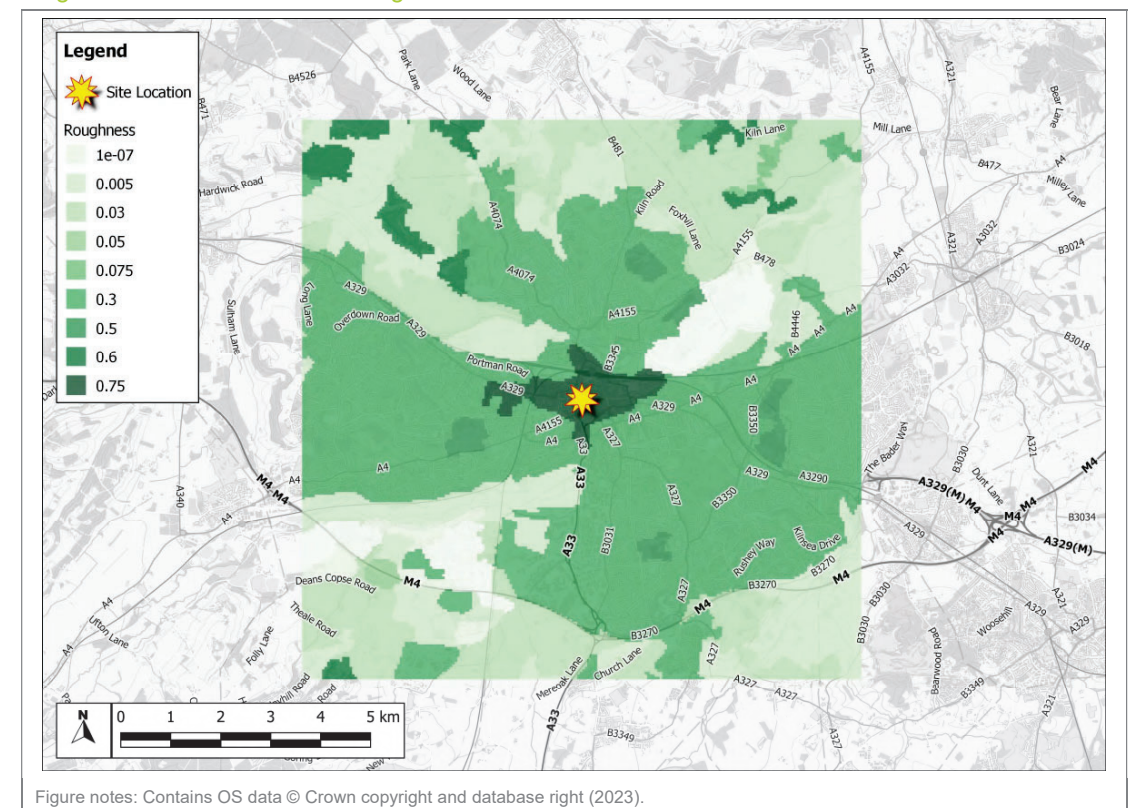
Figure 4: Windrose of Wind Speed and Direction for Each Year from 2018 (Top Left) to 2022 (Bottom Right) of Observational Data at Cippenham Meteorological Station



Surface Characteristics

- E5.3. In addition to the meteorological data, the model requires values to be set for a number of meteorological related parameters, for both the area the meteorological data represents and the Study Area. Land-use and surface characteristics have an important influence in determining turbulent fluxes and, hence, the stability of the boundary layer and atmospheric dispersion. Details of the parameter values used in the modelling are provided in Table 1 below.
- E5.4. Surface roughness length used within the model represents the aerodynamic effects of surface friction and is defined as the height at which the extrapolated surface layer wind profile tends to zero. This value is an important parameter used by the built-in meteorological pre-processor of ADMS to interpret the vertical profile of wind speed and estimate friction velocities which are, in turn, used to define heat and momentum fluxes and, consequently, the degree of turbulent mixing. Surface roughness values for different land-use classifications have been specified. Accounting for differences between the area the data represents, and the Study Area is essential. Due to the size of the model domain, a variable surface roughness file has been used within the model based on the spatially variable land-uses and the equivalent roughness values from the dataset. Figure 5 shows the values used across the modelled domain.

Figure 5: Modelled Surface Roughness



- E5.5. The surface albedo is the ratio of reflected to incident shortwave solar radiation at the surface of the earth. This varies depending on the land use, and thus area-weighted average albedos have been derived for the meteorological data area and the dispersion site study area and used in the models. Albedo values have been associated with the different land uses. For this study Albedo has been calculated as an arithmetic mean based on land-use up to 5,000 m from the centre point (both

the Study Area and the observation site). The mean includes an inverse distance weighting for distances over 1,000 m.

- E5.6. The Priestley-Taylor parameter is a parameter representing the surface moisture available for evaporation. A Priestley-Taylor parameter of 1 has been set in the model.
- E5.7. The CERC user guide explains that “the Monin-Obukhov length provides a measure of the stability of the atmosphere. In very stable conditions in a rural area its value would typically be 2 to 20 m. In urban areas, there is a significant amount of heat generated from buildings and traffic, which warms the air above the town/city”. For large urban areas this is known as the urban heat island. It has the effect of preventing the atmosphere from ever becoming very stable. Minimum Monin-Obukhov length can be defined in the model to account for the urban heat island effect which is not represented by the meteorological data. The Minimum Monin-Obukhov length has been calculated as a geometric mean based on land-uses up to 5,000 m from the centre point (both the Site and the observation site). The mean includes an inverse distance weighting for distances over 1,000 m.

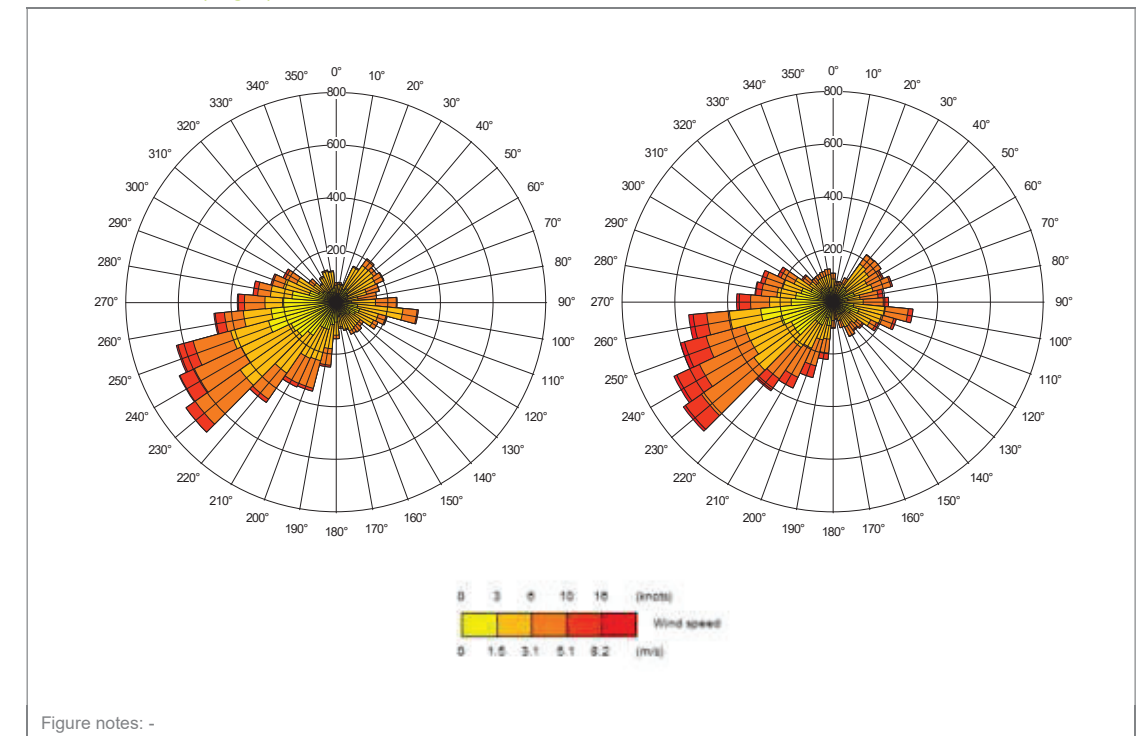
Table 1: Meteorological Parameters Values Used in the Model

Parameter	Dispersion Site Value	Meteorological Site value
Latitude (°)	51.45	n/a
Surface roughness (m)	1.443 ^a	0.555
Surface albedo	0.195	0.220
Minimum Monin-Obukhov length (m)	49.536	19.432
Priestley-Taylor parameter	1	1
Table notes: a. Note that the Urban Canopy module within the model has been used instead of surface roughness.		

Processed Meteorological Data

- E5.8. The meteorological parameters alter the meteorological data inputted into the model to reflect conditions at the dispersion site (the Study Area). For example, if the dispersion site has a higher surface roughness value than the meteorological site, then the model will reduce the wind speed at the dispersion site to reflect this. Figure 6 shows the frequency of wind speeds and directions measured at the Cippenham meteorological station in 2019 (left), which has been inputted into the model, as well as the frequency of wind speeds and directions processed by the ADMS-roads model for the dispersion site (right). These illustrate that wind predominantly comes from the southwest and is slower at the meteorological station than in the Study Area.

Figure 6: Windrose of Wind Speed and Direction for 2019 at the meteorological station (Left) and that modelled (Right)



E6. Roads Modelling

Traffic Flows

- E6.1. Traffic data for the study area was provided by Stantec, the transport consultants for the project. Traffic data provided was for 2019, 2026 (with and without the Development) and 2029 (with the Development). The traffic data for the modelled scenarios are provided in Table 2 and Table 3, and the links shown in Figure 7.

Table 2: Traffic data used in the model (2019 and 2026 Without the Development)

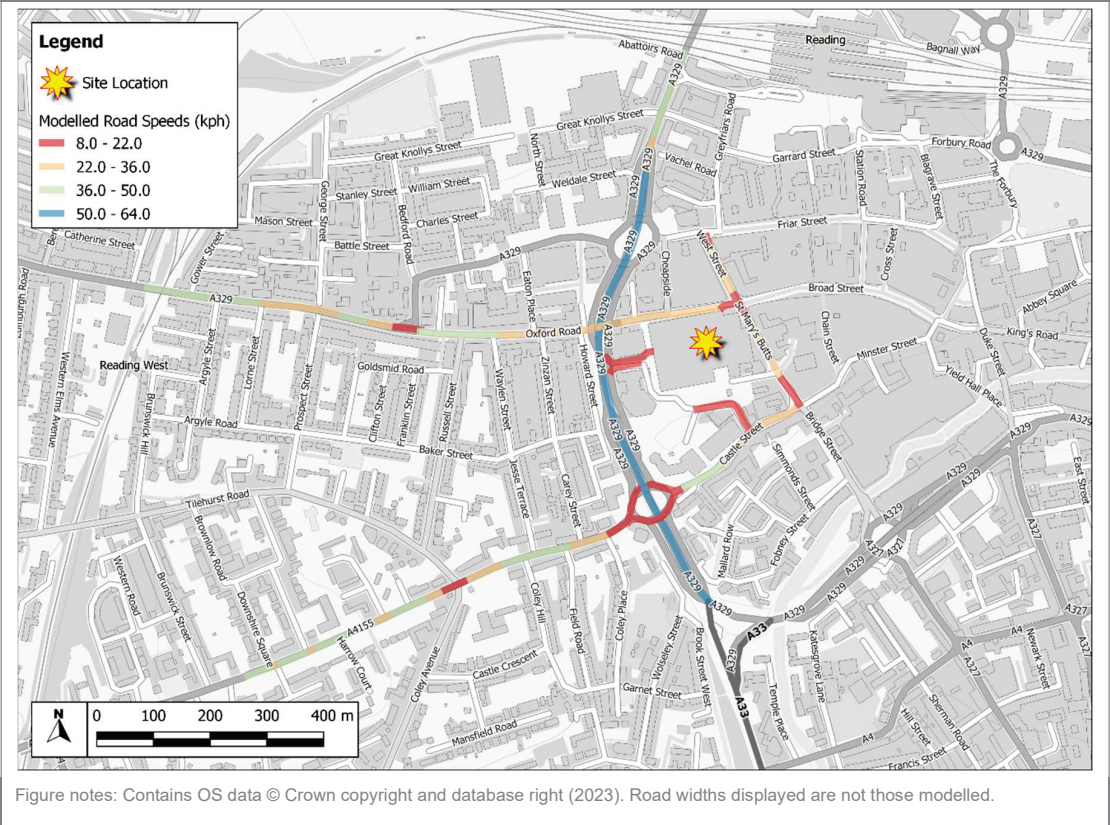
Link	2019			2026 Without Development		
	AADT	HGV	%HGV	AADT	HGV	%HGV
Oxford Road	13,721	853	6%	13,138	781	6%
A4155 Castle Hill	25,168	529	2%	24,146	672	3%
A329 IDR	47,889	1,121	2%	44,870	1,666	4%
A329 IDR	35,769	1,140	3%	27,698	1,349	5%
A33	29,413	985	3%	27,974	1,362	5%

Oxford Road	6,168	315	5%	5,637	287	5%
St Mary's Butts	3,584	896	25%	3,800	950	25%
Table notes: -						

Table 3: Traffic data used in the model (2026 and 2029 With the Development)

Link	2026 With Development			2029 With Development		
	AADT	HGV	%HGV	AADT	HGV	%HGV
Oxford Road	13,138	781	6%	13,138	781	6%
A4155 Castle Hill	24,146	672	3%	24,146	672	3%
A329 IDR	44,880	1,670	4%	44,870	1,666	4%
A329 IDR	27,698	1,349	5%	27,698	1,349	5%
A33	28,013	1,376	5%	27,974	1,362	5%
Oxford Road	5,637	287	5%	5,637	287	5%
St Mary's Butts	3,800	950	25%	3,800	950	25%
Table notes: -						

Figure 7: Modelled Road Links and Proposed Development



Time-Based Profiles

E6.2. Vehicle emissions vary over time depending on the volume of traffic, this includes hourly, daily and seasonal variations. Seasonal (monthly) and diurnal (hourly) traffic flow profiles have been taken from DfT national statistics (DfT, 2020). Both profiles have been assumed to follow an urban traffic profile for all modelled roads. These have been used in the model to adjust the emissions for each hour of the year modelled. Diurnal and seasonal traffic flow profiles are shown in Figure 8 and Figure 9.

Figure 8: Urban diurnal profile for each day of the week used in the model, where the factor is the value that the average daily emissions are multiplied by in the model

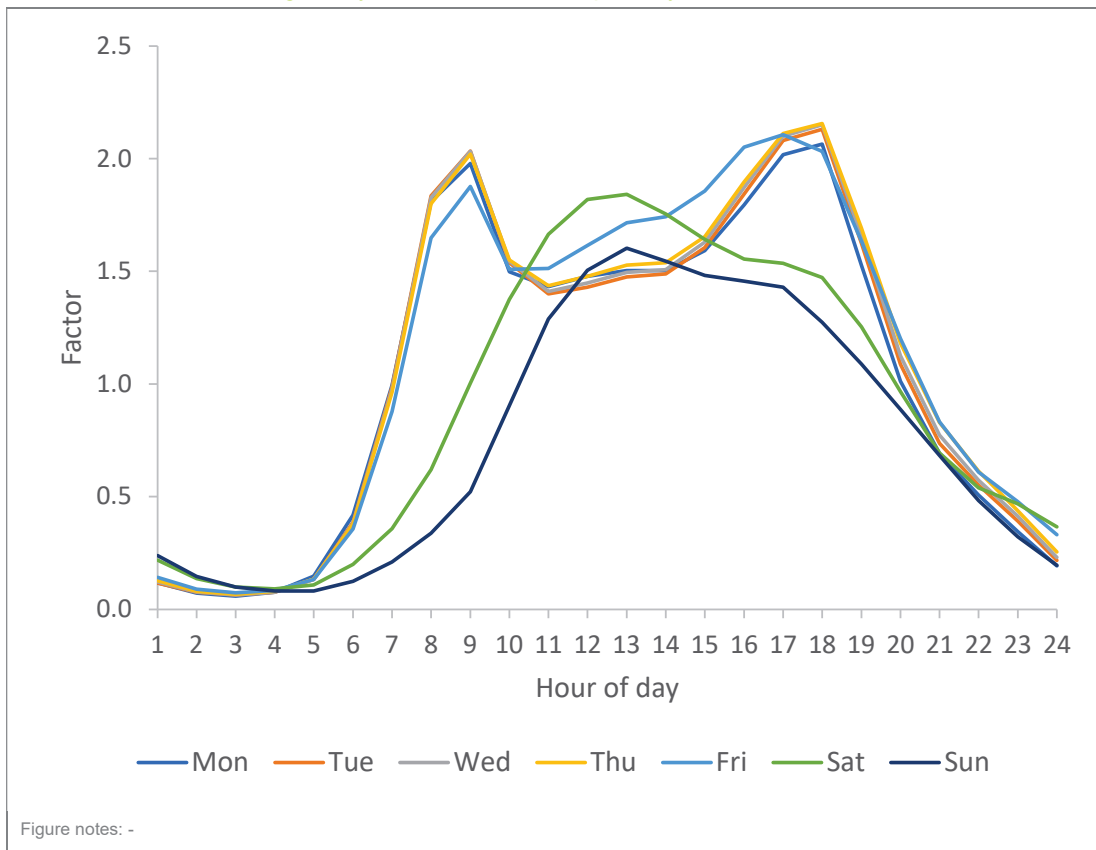
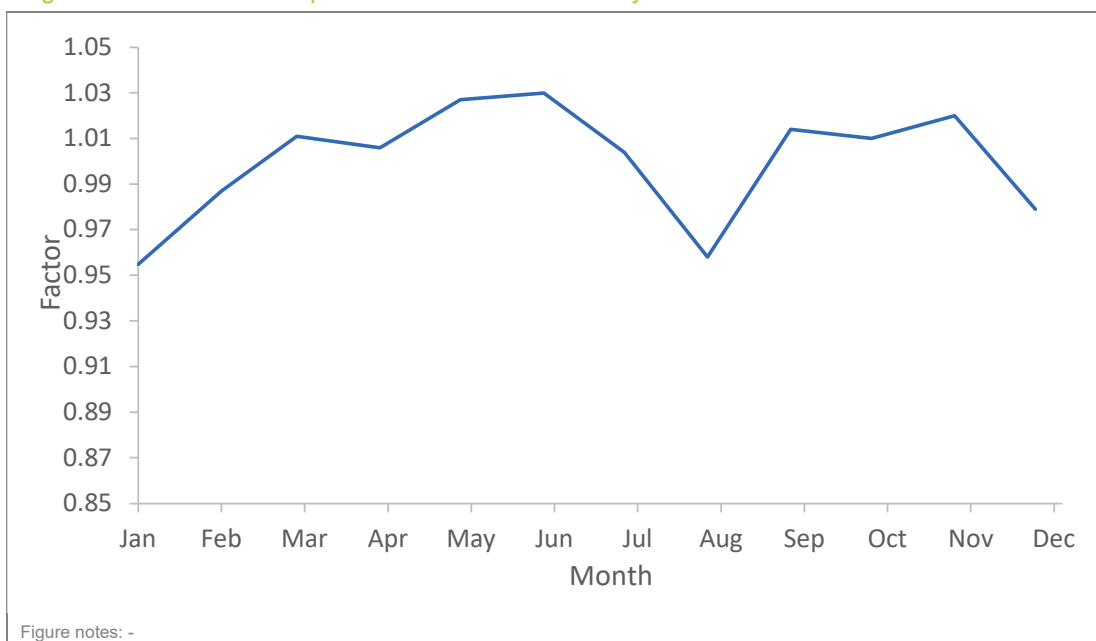


Figure 9: Urban seasonal profile for each month of the year used in the model



Vehicle Speeds

- E6.3. Daily average vehicle speeds are required to calculate the pollutant emissions. These have derived based on speed limits, information from Google Traffic maps on typical speeds during different times of the day, professional experience and taking account of reduced speeds due to junctions, queuing and narrowing of roads. The traffic speeds used are shown in Figure 7.
- E6.4. Vehicle speeds within the car parks have been assumed to be 5 kph, the minimum speed for which emissions can be obtained from Defra's EFT.

Vehicle Emissions

- E6.5. Emissions of road-NO_x (i.e. the contribution from vehicles using roads), road-PM₁₀ and road-PM_{2.5} have been derived from the latest version of Defra's Emissions Factors Toolkit (EFT) (v11.0) using the traffic data presented in Table 2. The EFT is based on the COPERT 5 (Computer Programme to calculate Emissions from Road Transport) vehicle emission model and provides speed-average based emission rates. The EFT provides vehicle emission rates for the years 2017-2030; future years are based on a range of factors, such as expected vehicle fleet release dates, anticipated improvements in emission reduction technologies, expected uptake rates of different vehicles based on government policies, etc. It is, therefore, possible that the expected future emission rates in the EFT may differ from reality.
- E6.6. As a result of the pandemic, the vehicle fleet turnover in the UK has been slower than expected due to the pandemic. New vehicle sales were reduced, with higher rates of private vehicle owners retaining their existing vehicles; leading to predicted reductions in emissions not materialising. However, electric vehicles have increased over the same period, accounting for more than one in ten new car registrations in 2020 and a 90% increase of plug-in hybrid cars, albeit much low numbers of new vehicles were sold. While there may be some uncertainty in the EFT's emission factors, overall, they are considered to be broadly representative.
- E6.7. Vehicle emissions associated with car parking have been based on the EFT and supplemented with cold-start emissions derived from Defra's EXEMPT Cold Start Tool. Cold start emissions from the NAEI were reviewed but found to be less conservative.

Road Gradients

- E6.8. The road gradients included when calculating emissions have been derived from LIDAR data obtained from the Environment Agency.

Fraction of Primary NO₂

- E6.9. In addition to emission rates, the fraction of primary NO₂ (f-NO₂) has been obtained from the EFT for road vehicles. For railway locomotives an f-NO₂ value of 15% has been used, which is a typical value for large diesel engines. This represents the amount of NO₂ released from vehicle exhausts, before any further chemical reactions in the atmosphere, which becomes an important variable when post-processing the model predictions. In order to obtain the f-NO₂ value at each receptor location, the nitrous oxide (NO_x) emission rates have been multiplied by f-NO₂ values to derive NO₂

emission rates. These NO₂ emissions have been included in the model and primary NO₂ concentrations have been predicted at the receptors. The predicted NO_x concentrations have been divided by the predicted primary NO₂ concentrations to calculate the f-NO₂ values at the receptor locations. The f-NO₂ values have been used in the model post-processing.

Wake Effects

- E6.10. As vehicles travel along a road a wake is left behind the vehicles as air in the path of travel is forced around the vehicle. The wake can be considered the turbulence induced by the movement of the vehicle, which affects the dispersion of pollution away from roads. The AADT traffic flows have been entered into the ADMS-roads dispersion modelling in order to account for vehicle wake effects which will vary on each link depending on the proportion of large vehicles to small vehicles.

Modelled Roads

- E6.11. The road geometries, widths, and heights included in the dispersion model have been aligned with data from Google Satellite and Ordnance Survey maps, which included carefully considering relative distances from the roads to receptors and monitoring sites.
- E6.12. A proportion of the roads in the local area are enclosed by buildings and vegetation, leading to restricted dispersion of pollution away from the roads and higher concentrations close to the roads. This is known as a 'street canyon' effect. These roads have therefore been modelled as asymmetric street canyons using the Advanced Street Canyon Module, within the ADMS-Roads model, accounting for the fraction of 'covered' canyons. Where dispersion may be significantly affected, canyons have been included to account for this. Where there are no modelled receptor locations, adjacent to road links, no canyons have been entered for those links, but this does not mean there are not canyon like parameters along these road links.

Carpark Emissions

- E6.13. Emissions of road-NO_x (i.e. the contribution from vehicle movement and idling in the carpark), road-PM₁₀ and road-PM_{2.5} have been modelled as an area source within ADMS-Roads. The number of vehicle movements through the car park have been provided by Stantec. There are expected to be 494 vehicle movements within the car park per day. Emissions for vehicles travelling through the car park have been derived from Defra's EFT assuming a vehicle speed of 5 kph. In addition, excess emissions from cold-starting of vehicle engines has been taken into account; these emissions have been calculated based on cold-start emission factors from Defra's EXEMPT Cold Start Tool and applied over a length of approximately 448.5 m (the calculated average length over which vehicles will travel to exit to car park). The air within levels 1 and 2 of the car park will be exhausted via extracts above the roof (two sources both 14.3 m and 14.77 m above ground) at utilising dual fans per extract, each with a velocity of 7.5 m/s. The extracts are existing and have been modelled based on Google Satellite imagery. These have been modelled as volume sources, which was considered most appropriate for the given source and the level of detail known for the extracts. The air across the third-floor car park will be ventilated passively, as it is open. This has been modelled as four area sources at a height of 10.85 m and 8.85 m above ground for two area sources each, taking account of the car park layout. The new ramp will also be passively ventilated; the emissions

associated with vehicles using the ramp have been accounted for in the model within the area and volume sources. The emissions entered into the model to represent these sources are given in Table 4. The sources modelled are presented in Figure 10.

Table 4: Estimated Emissions from Car Parking

Pollutant	EFT (µg/s)	Cold Start (µg/s)	Combined (µg/s)	Combined (µg/m ² /s)	Combined (µg/m ³ /s)
Area Sources					
NO _x	2422.97	1979.01	4401.98	0.51	n/a
PM _{2.5}	227.76	125.15	352.91	0.04	n/a
PM ₁₀	395.86	125.15	521.01	0.06	n/a
NO ₂	618.42	505.10	1123.52	0.13	n/a
Volume Sources					
NO _x	996.60	1146.39	2143.00	n/a	142.87
PM _{2.5}	93.68	65.28	158.96	n/a	10.60
PM ₁₀	162.82	65.28	228.10	n/a	15.21
NO ₂	254.36	292.60	546.96	n/a	36.46

Table notes: -

Figure 10: Modelled Car Park Sources

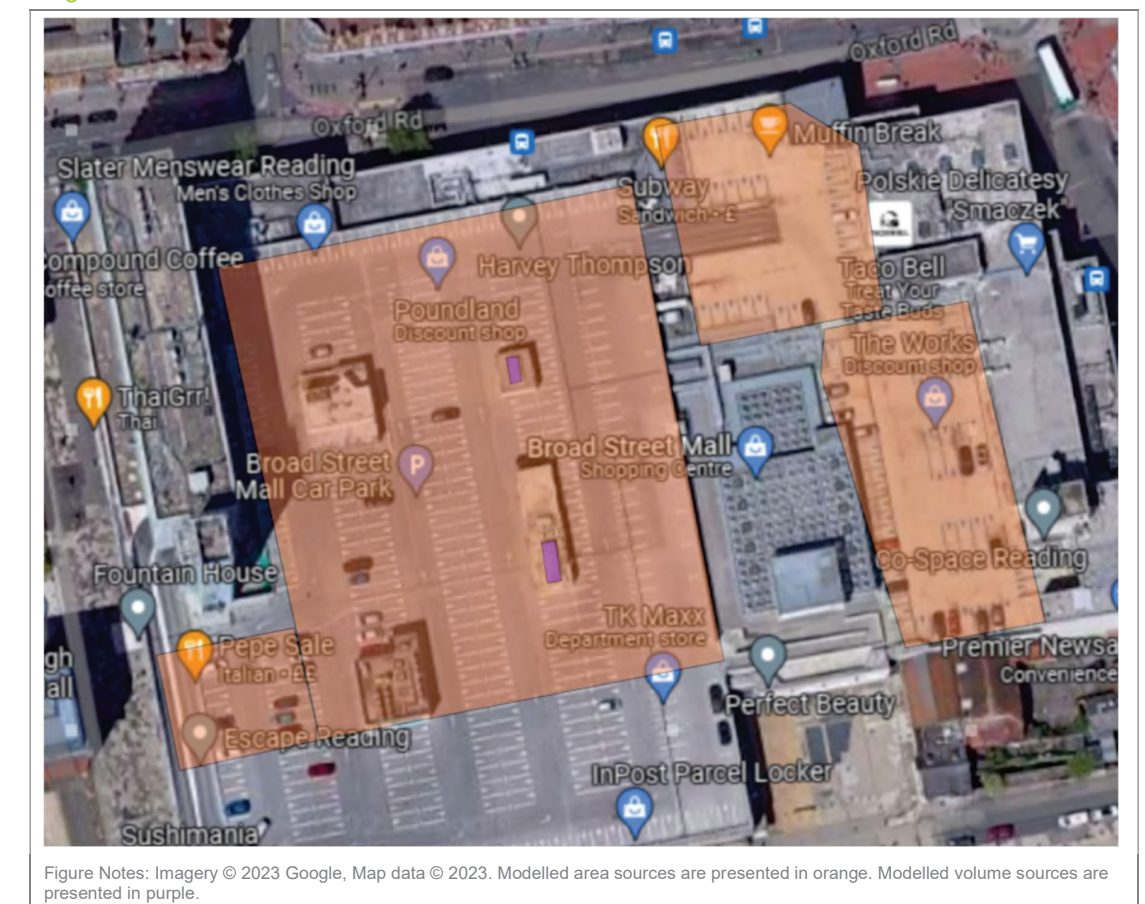


Figure Notes: Imagery © 2023 Google, Map data © 2023. Modelled area sources are presented in orange. Modelled volume sources are presented in purple.

Model Performance

- E6.14. The modelling will inherently have some uncertainties and may not reflect real conditions in the local area. An important part of modelling is reviewing the model results carefully and checking the model setup parameters and input data to minimise uncertainties.
- E6.15. LAQM.TG22 (Defra, 2022), provides local authorities with advice on good practice for modelling air quality. This advice is widely applied for air quality assessments of proposed developments, although it is specifically aimed at local authority's duties to review and assess air quality. LAQM.TG22 states that model verification, defined as a comparison of modelled results with monitoring results at relevant locations, is necessary (paragraph 7.550).
- E6.16. There are many reasons why there may be a difference between modelled and monitored concentrations and LAQM.TG22 states "*Model verification is the process by which these and other uncertainties are investigated and where possible minimized*". (paragraph 7.552). It provides a list of the factors that may explain the differences including meteorological data, source activity data (e.g. data flow and speed), emission factors, model input parameters such as roughness length, and monitoring data.
- E6.17. The advice in LAQM.TG22 is generic for all dispersion models. ADMS has been shown to predict concentrations well given sufficiently accurate data inputs.
- E6.18. It is important to review the results of the modelling carefully and check the model setup parameters and input data. Once reasonable effects have been made to reduce the uncertainties of input data for a model, further comparison of modelled and monitored results should be undertaken. Where discrepancies remain, consideration may be given to adjusting the model.
- E6.19. Using good modelling techniques provides confidence that the model is performing as well as possible everywhere in the modelling area in the base year, not just at the monitoring locations. Modelling is often an iterative process that involves improving the model setup and evaluating the impact on model performance. The same principles need to be applied to the entire modelling study area to ensure the model performs well throughout the study area.
- E6.20. All reasonable efforts have been made to improve the model inputs. The model has gone through several modelling iterations to consider whether to performance of the modelled inputs can be improved. Improvements are based on comparison with the measured concentrations at specific monitoring locations and where improvements have been made, they have been applied as a wholistic approach with systematic updates to the entire model study area to ensure that the model is not performing well exclusively at the monitoring locations. Iterations to the model can include changes in streetscape parameters, widths of road links, the heights of receptors and examining traffic data to improve the model performance using a systematic approach. Ultimately providing a model representative of the modelling area.
- E6.21. A final model verification exercise has been undertaken to determine whether there are any final discrepancies and to derive a factor with which to adjust the predicted concentrations from the model so that they match local conditions as closely as possible.

- E6.22. An acceptable model performance is considered by Defra to be where the final modelled and measured NO₂ root mean square error (RMSE) is less than 10 µg/m³, with an ideal model performance being where the RMSE is less than 4 µg/m³.
- E6.23. Where this is not the case and all reasonable efforts have been made to improve the model, it is then considered likely that the error is due to a fundamental input such as the raw traffic data. In these situations, it is considered important that the assessment should then account for the greater uncertainty in the analysis of the results.

Final Model Verification

- E6.24. A final model verification exercised has been undertaken, following the guidance set out by Defra in Box 7.17 and Box 7.18 of LAQM.TG22 (Defra, 2022).

NO₂

- E6.25. Concentrations of road-NO_x and primary NO₂ have been predicted for the year of 2019 using the ADMS-roads dispersion model at the following relevant monitors at the height of the monitor inlets:
- DT20
 - DT19
 - DT18
 - DT33
 - DT42
- E6.26. Initially, the measured NO₂ concentrations at the monitoring sites were inputted into Defra's NO_x to NO₂ Calculator, along with the background NO₂ concentrations and f-NO₂ values, in order to obtain 'measured' road-NO_x concentrations at the monitoring sites. The f-NO₂ factor at each monitoring site was calculated by taking the ratio of predicted primary NO₂ concentration to predicted road-NO_x concentration.
- E6.27. The predicted road-NO_x concentrations have been compared to the 'measured' road-NO_x concentrations and NO_x factor calculated for each monitor, see Table 5.

Table 5: Measured and Modelled NO_x Comparison

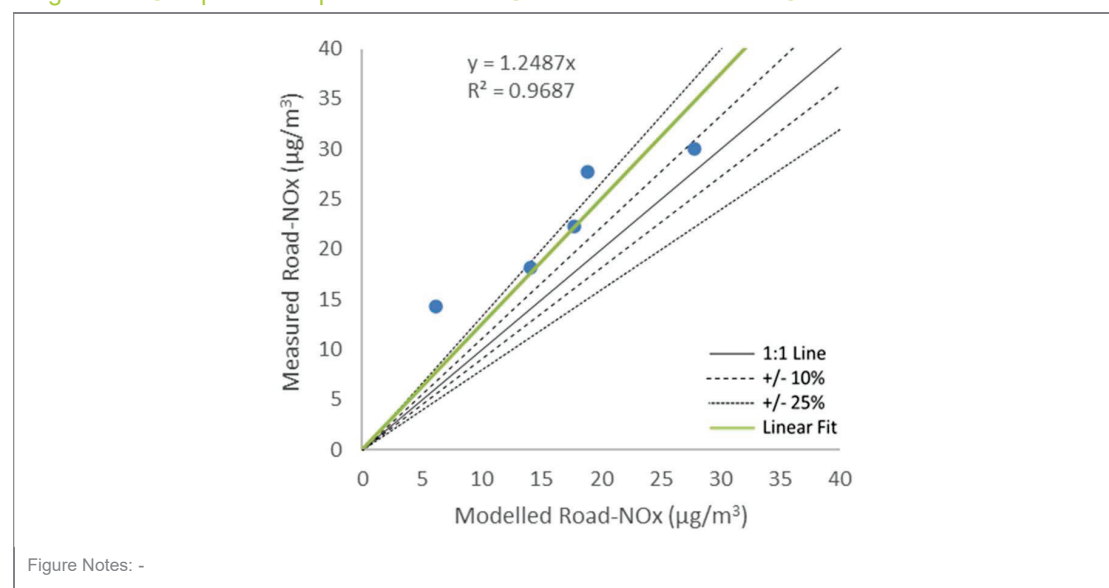
Monitor	Measured NO ₂	Background NO ₂	Predicted f-NO ₂	Measured Road-NO _x	Modelled Road-NO _x	NO _x Factor
DT20	34.00	24.87	0.28	18.19	14.10	1.290
DT19	39.00	24.23	0.28	30.00	27.82	1.078
DT18	34.00	22.83	0.28	22.26	17.70	1.257
DT33	37.00	24.26	0.22	27.78	18.85	1.474
DT42	35.00	27.93	0.27	14.35	6.19	2.318

Table notes: -

- E6.28. The comparison of road-NO_x concentrations to 'measured' road-NO_x concentrations is presented in Figure 11. An adjustment factor of 1.249 has been derived from the equation of the linear trend

line that has been fitted through zero. This factor suggests the model is in general slightly overpredicting concentrations. Taking a conservative approach, the model has thus been left unadjusted. The values still broadly match those measured at the monitoring sites, as shown in Figure 11.

Figure 11: Comparison of predicted road-NOx to 'measured' road-NOx



E6.29. Figure 12 shows a comparison of the measured NO₂ concentrations and the total (i.e. road plus background) predicted NO₂ concentrations. Statistics of this comparison are given in Table 6, which demonstrate that the predicted NO₂ concentrations have an insignificant fractional bias (~0), and an acceptable RMSE.

Figure 12: Comparison of predicted NO₂ to 'measured' NO₂

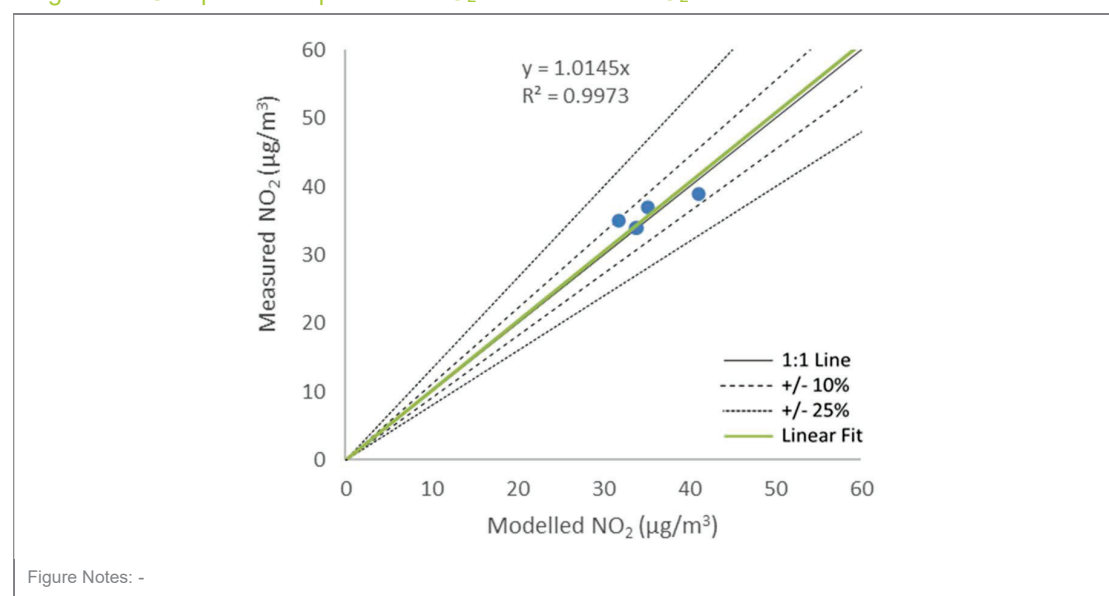


Table 6: Correlation Coefficient, RMSE, and Fractional Bias

Statistic	NO ₂
Correlation Coefficient (r) ^a	0.863
Root Mean Squared Error (RMSE) ^b	1.920
Fractional Bias (FB) ^c	0.018

Table Notes:

a. This is used to measure the linear relationship between predicted and measured concentrations. A value of zero means no relationship and a value of 1 means absolute relationship (ideal value).

b. RMSE is used to define the average error or uncertainty in the model. The ideal value for NO₂ is zero, and a value within 10% of the objective (i.e., 4 µg/m³) is general acceptable although models should always be improved where possible even where the value is less than 10% of the objective. If the value is greater than 25% of the objective (i.e., 10 µg/m³) then it is recommended that the model be revisited (this only applies to NO₂).

c. This is used to identify if the model shows a systematic tendency to over or under predict. FB values range between -2 and +2 and has an ideal value of zero. Negative values indicate a model over-prediction and positive values indicate a model under-prediction.

PM₁₀

- A1.1. Although the Council operate automatic monitoring sites that measure concentrations of PM₁₀ and PM_{2.5}, these monitoring sites are not located near the Proposed Development. In the absence of relevant monitoring sites with which to verify the model predictions of PM₁₀ or PM_{2.5} against, the model adjustment factor for road-NOx has been used to uplift all predicted road-PM₁₀ and road-PM_{2.5} concentrations.

E7. Post Processing

Chemistry (Conversion of NOx to NO₂)

- E7.1. Concentrations of road-NOx and primary NO₂ have been predicted at each receptor using the ADMS-Roads model. The primary NO₂ emission factor (f-NO₂) at each receptor has been calculated by taking the ratio of predicted primary NO₂ concentration to road-NOx concentration.
- E7.2. The f-NO₂ values along with the adjusted modelled road-NOx concentrations and background NO₂ concentrations have been inputted into Defra's NOx to NO₂ calculator (v8.1) in order to obtain predicted road-NO₂ concentrations at each receptor. This tool has been run assuming the traffic is described as 'All other urban UK traffic', which is considered appropriate for the traffic within the Study Area. It should be noted, however, that receptor specific f-NO₂ values have been used in the NOx to NO₂ calculated, which supersede the traffic selection.

Total Concentrations

- E7.3. The road-NO₂ concentrations have then been added to the background NO₂ concentrations to obtain total NO₂ concentrations at the receptors. Similarly, the adjusted road-PM₁₀ and road-PM_{2.5} concentrations have been added to the background PM₁₀ and PM_{2.5} concentrations to obtain total PM_{2.5} and PM₁₀ concentrations at the receptors.

E8. Uncertainty and limitations

- E8.1. The assessment involves a range of uncertainties, including the model inputs, assumptions, the model and post-processing of model results.

- E8.2. Although there is uncertainty associated with air quality modelling, the predictions made by this assessment have been carried out in a robust manner in order to minimise uncertainties where possible; the approach has been to use reasonable worst-case assumptions.
- E8.3. A brief overview of the key uncertainties is discussed below.
- E8.4. This report does not consider the impacts on air quality associated with the COVID-19, as there remains too much uncertainty at this stage to consider this explicitly. In addition, the potential long-term implications of the pandemic on behaviour have not been considered, as it is too uncertain at this stage.
- E8.5. There are inherent uncertainties associated with the traffic data, however the Transport Consultant for the project has reviewed the traffic data available and provided the appropriate AADT information.
- E8.6. The emission factors also involve a considerable amount of uncertainty. Emissions from the EFT are link averages and do not explicitly take account of acceleration or deceleration. Modelled speeds have been adjusted to account for this where possible. Future year vehicle emission rates are also based on a range of factors, such as expected improvements in emission reduction technologies, expected uptake rates of different vehicles based on government policies, etc. It is therefore possible that the expected future emission rates in the EFT may differ from reality. Historically, evidence suggests that Defra's EFT over estimated reductions in NOx emissions from diesel vehicles which were not seen in practice. However, analyses of recent NOx measurements now provide evidence that diesel vehicle emission controls are working and as a result Defra's EFT (v11.0) is considered to be a reasonable reflection of the rate of reductions of specific vehicle emissions into the future. There remains uncertainty of the future traffic fleet composition (built into the EFT). In the absence of officially published alternative emissions, the approach of this assessment has been to utilise the EFT as recommended by Defra in the LAQM.TG22 guidance (Defra, 2022).
- E8.7. The model itself is based on assumptions of a range of parameters, including road geometries, road widths, street canyons and meteorological related parameters. There is uncertainty in all these parameters, but the modelling has been setup in a robust way based on professional experience to best represent the conditions. One of the main uncertainties in the model is meteorological data; this has been based on measurements made at a representative meteorological station, and although meteorological conditions will remain similar, it is entirely likely that meteorological conditions will vary in subsequent years and lead to marginally different concentrations.
- E8.8. The ambient background concentrations are also uncertain. While these are provided by Defra, the 1x1 km resolution is coarse, and the maps do not include all sources of pollution. Given the urban location of the Proposed Development, it is considered likely that the background maps for this area are likely to be reasonable. To minimise uncertainty in the spatial resolution of the maps, the background concentrations have been interpolated to each receptor; essentially smoothing out the coarseness of the maps.
- E8.9. Evidence (Grange, S, et al., 2017) suggests that the f-NO₂ has been decreasing in recent years, which is not taken into account within Defra's EFT or NOx to NO₂ Calculator. If lower f-NO₂ values were assumed, then the predicted concentrations would likely be slightly lower throughout the Proposed

Development and local area. Until more detailed scientific analysis is undertaken to understand the full extent of why f-NO₂ is decreasing and how it will behave in the future, it remains an uncertainty.

- E8.10. A model verification exercise has been undertaken to adjust the predicted concentrations from the model so that they match local conditions as best as possible. This has adjusted concentrations to match average conditions; some locations will remain underpredicted and some overpredicted.

E9. Glossary

AADT	Annual Average Daily Traffic flow
APS	Air Pollution Services
COPERT 5	Computer Programme to Calculate Emissions from Road Transport
DfT	Department for Transport
EFT	Emissions Factors Toolkits
EPUK	Environmental Protection UK
f-NO₂	Fraction of nitrogen dioxide
HDV	Heavy Duty Vehicles
IAQM	Institute of Air Quality Management
NO₂	Nitrogen dioxide
NOx	Nitrogen oxides
PM₁₀	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
PM_{2.5}	Small airborne particles, more specifically particulate matter less than 2.5 micrometres in aerodynamic diameter
µg/m³	Microgrammes per cubic metre

E10. References

- Defra. (2022). *Local Air Quality Management Technical Guidance (TG22)*. Retrieved from <https://laqm.defra.gov.uk/technical-guidance/>
- DfT. (2020). *Road Traffic Statistics (TRA)*. Retrieved from <https://roadtraffic.dft.gov.uk/#6/55.254/-6.064/basemap-regions-countpoints>
- Grange, S, et al. (2017). Lower vehicular primary emissions of NO₂ in Europe than assumed in policy projections. *Nature GeoScience*(ISSN 1752-0908), pp 914-920.

Appendix: Air Quality

Annex 1: Professional Experience

Annex 2: Air Quality Policy/Legislation Context

Annex 3: Baseline Air Quality Review

Annex 4: Construction Dust Risk Assessment

Annex 5: Dispersion Modelling Approach

Annex 6: Air Quality Site Suitability

Annex 6: Air Quality Site Suitability

Client: McLaren (Broad Street Mall) Ltd and UREF III LP
Reference: APS_P1170A_I1-2
Date Published: 10 January 2024

Rev.	Date	Description	Prepared	Reviewed	Authorised
01	29/11/2023	Issued	ET	KK	AC
02	10/01/2024	Amended	AC	AC	AC

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1. Introduction

- 1.1.1. Air Pollution Services (APS), part of KALACO Group Ltd, has been commissioned by the Client to assess the air quality impacts associated with the proposed development of Broad Street Mall (herein the 'Proposed Development') located at Broad Street Mall, Broad Street, Reading, RG1 7QE.
- 1.1.2. The Proposed Development comprises the part-demolition of existing retail units, car park and service areas, demolition and rebuild of car park ramp, and construction of a residential-led, mixed-use development fronting Queens Walk and Dusseldorf Way, including all necessary enabling and alteration works required. It will include temporary construction involving part-demolition of podium deck on Dusseldorf Way and Queens Walk, amendments to existing retaining wall, excavation works and road and hardstanding re-alignment to create a temporary construction area related to proposed redevelopment works at Broad Street Mall.
- 1.1.3. This document sets out the site suitability of the Proposed Development with regards to air quality.

Location Context

- 1.1.4. The Proposed Development will introduce human health exposure to the application site. Future occupiers may be affected by both short-term and long-term exposure to air pollutants.
- 1.1.5. The main air quality concern regarding the suitability of the application site for future occupants is the combined effects of background pollutant concentrations, pollutant contributions from local roads and emissions from the adjacent multi-storey car park.

12. Methodology

Guidance

- 12.1. The assessment has been carried out incorporating approaches set out in the following guidance.

Guidance on Land-Use Planning & Development Control: Planning For Air Quality

- 12.2. Environmental Protection UK (EPUK) in partnership with the Institute of Air Quality Management (IAQM) have produced guidance (EPUK/IAQM, 2017) on Land-Use Planning & Development Control: Planning For Air Quality. EPUK and IAQM have produced this guidance to ensure that air quality is adequately considered in the land-use planning and development control processes. It provides a means of reaching sound decisions, having regard to the air quality implications of development proposals and provides guidance on how air quality considerations of individual schemes may be considered within the development control process, by suggesting a framework for the assessment.

LAQM Technical Guidance

- 12.3. Defra and the devolved administrations have published a guidance document on Local Air Quality Management (LAQM) – Local Air Quality Management Technical Guidance (LAQM.TG22) (Defra, 2022). This document is designed to support local authorities in carrying out their duties under the Environment Act 1995 and subsequent regulations. LAQM is the statutory process by which local authorities monitor, assess, and take action to improve local air quality. The Technical Guidance provides tools, approaches and technical information related to the assessment of air quality.

Approach Overview

- 12.4. The approach to determining site suitability considers two elements:
- Compliance with regulatory thresholds in the context of the planning regime; and
 - A review of the potential air quality health indicators.

Compliance with regulatory thresholds

- 12.5. The human-health related Air Quality Objectives (AQOs) and Limit Values (LVs) for England for the pollutants relevant to this project are detailed in Table 1.

Table 1: Air Quality Objectives and Limit Values

Pollutant	Time Period	Criteria Type ^a	Concentration, and the number of exceedances allowed per year (if any)	Date AQO / LV to be Achieved From and Maintained After
Nitrogen Dioxide (NO ₂)	1-hour Mean	AQO / LV	200 µg/m ³ not to be exceeded more than 18 times a year	31 st December 2005 / 1 st January 2010
	Annual Mean	AQO / LV	40 µg/m ³	31 st December 2005 / 1 st January 2010
Fine Particles (PM ₁₀)	24-hour Mean	AQO / LV	50 µg/m ³ not to be exceeded more than 35 times a year	31 st December 2004
	Annual Mean	AQO / LV	40 µg/m ³	31 st December 2004
Fine Particles (PM _{2.5})	Annual Mean	AQO ^a / LV	20 µg/m ³ / 20 µg/m ³	2020 / 2020
Table notes: a. Not in regulation.				

- 12.6. The National Planning Policy Framework (NPPF) explicitly requires planning decisions to sustain and contribute towards compliance with the LVs and relevant national AQOs. This document therefore

primarily considers whether the introduction of new exposure to the application site would result in an AQO or LV being exceeded in relevant locations.

Air Quality Health Indicators

- I2.7. The World Health Organization (WHO) has recently revised its air quality guidelines (AQGs) and Interim Targets (ITs) (2021) for six pollutants, including PM₁₀, PM_{2.5} and NO₂. The air quality guidelines for these pollutants have become more stringent. Table 2 presents the WHO AQGs and ITs for the pollutants of concern.
- I2.8. In recognition of the difficulty of meeting the AQGs, a series of ITs are proposed by the WHO which should be considered steps towards ultimately achieving the AQGs, rather than as end targets. The WHO document aims to provide quantitative health-based recommendations for air quality management.
- I2.9. The guidelines are not legally binding standards; however, they should be used to inform legislation and policy. Ultimately, the goal of the guidelines is to help reduce the health burden resulting from exposure to air pollution. Air pollution increases morbidity and mortality from cardiovascular and respiratory disease and from lung cancer and there is increasing evidence of effects on all other organ systems.
- I2.10. The WHO AQGs are based solely on the latest epidemiological evidence, whereas the AQOs and LVs were based on health evidence from the 1990s. They also take account of other factors such as the technical and economic feasibility of meeting the standard by a defined date.
- I2.11. It is more than 15 years since WHO published its last AQGs (2006). Over that period there has been a large increase in the evidence of health effects of air pollution. New epidemiological studies have shown adverse effects at much lower levels than had previously observed.
- I2.12. The WHO guidelines are not currently in Regulations and there is no legal requirement for local authorities to meet them.

Table 2: WHO Guidelines

Pollutant	Time Period	IT Levels				AQG Level
		1	2	3	4	
Nitrogen Dioxide (NO ₂)	1-hour Mean	-	-	-	-	200 µg/m ³
	24-hour Mean	120	50	-	-	25 µg/m ³
	Annual Mean	40	30	20	-	10 µg/m ³
Fine Particles (PM ₁₀)	24-hour Mean	150	100	75	50	45 µg/m ³
	Annual Mean	70	50	30	20	15 µg/m ³
Fine Particles (PM _{2.5})	24-hour Mean	75	50	37.5	25	15 µg/m ³
	Annual Mean	35	25	15	10	5 µg/m ³

Table notes: -

- I2.13. To review the potential for health effect due to air quality, consideration has therefore also been given to the 2021 WHO AQGs and ITs. As stated earlier, these thresholds are based solely on the latest evidence of health effects of air pollution.

- I2.14. WHO acknowledges that in many countries, including the UK, achieving the AQGs is difficult, and has set ITs to encourage the reduction in air pollution towards the AQGs. A pragmatic approach has been adopted for identifying an appropriate local level (IT or AQG) for this assessment based on the background concentrations in the local area in the assessment year. This is the level members of the public can reasonably expect to enjoy if away from local emission sources such as road traffic. The aim is to provide information of the level of exposure future users of the application site may experience.
- I2.15. The modelling carried out for the assessment is not suitable for assessing against the WHO short term ITs and there is currently no proxy method for assessment and therefore the focus is on the annual mean levels.
- I2.16. The risk to human health is assessed using the air quality in the first year of occupation of the proposed development using defined AQLs based on the WHO AQG and ITs.
- I2.17. Step 1 – Define AQLs
- I2.18. Table 3 provides descriptions and Air Quality Levels (AQLs) based on the WHO AQGs and ITs. The descriptors are in the context of current air quality in the UK and over time, as air quality improves, will need to be updated to drive reductions in air pollution.
- I2.19. For site suitability assessments accompanying outline planning applications it is recommended that the development AQL be based on the worst-case concentration at the site boundary. This will provide a conservative assessment. Further to this, understanding the spatial variation in concentrations across a site could then help inform the design for a detail full planning application. Where the development site includes areas which are clearly not potential locations for relevant exposure (i.e. buildings could not be erected in specific parts of the site) it may be appropriate to not use the concentration at the site boundary but rather the area where buildings could be located.
- I2.20. For site suitability assessments accompanying reserved matters planning applications it would be more appropriate to base the development AQLs on the concentrations at the worst-case building facades as indicated on the development site plan.
- I2.21. Two AQLs are identified for the first year of occupation of the development:
- **Background AQL** derived from the background concentrations in the 1km x 1km grid where the development is located (Defra, 2023) or suitable local background monitoring data (with relevant forward projection). Where a development covers several grids or is close to the boundary of one with much lower concentrations, it would be prudent to use the highest background concentrations as a worst-case scenario or interpolating to be relevant to the site.
 - **Development AQL** derived from the predicted concentrations at the site, i.e. taking into account local sources of air pollution, such as the emissions from a nearby road. This would be at the site boundary (outline applications) or at the worst-case facade of the buildings on the site plan (detailed/full or reserved matters applications). This would include cumulative impacts, either through assumed traffic growth or the explicitly modelled traffic impact of other developments in the areas.

Table 3: Future Air Quality Levels*

Pollutant	Concentrations (µg/m³) *	AQL	Description
NO ₂ **	≤10 µg/m³	1	Achieves WHO AQG.
	11-20 µg/m³	2	Achieves WHO IT3.
	21-30 µg/m³	3	Achieves WHO IT2.
	31-40 µg/m³	4	Achieves WHO IT1.
	>40 µg/m³	5	Exceeds regulatory thresholds. ***
PM _{2.5}	≤5 µg/m³	1	Achieves WHO AQG.
	6-10 µg/m³	2	Achieves WHO IT4.
	11-15 µg/m³	3	Achieves WHO IT3
	16-20 µg/m³	4	Achieves WHO IT2
	>20 µg/m³	5	Exceeds regulatory thresholds. ***
PM ₁₀	≤15 µg/m³	1	Achieves WHO AQG.
	16-20 µg/m³	2	Achieves WHO IT4.
	21-30 µg/m³	3	Achieves WHO IT3.
	31-40 µg/m³	4	Achieves WHO IT2.
	>40 µg/m³	5	Exceeds regulatory thresholds. ***
Note: * Concentrations should be rounded to the nearest whole number. ** For NO ₂ there is no WHO IT4. *** Regulatory thresholds refer to the limit values and air quality objectives.			

Step 2 – Define Risk

- 12.22. The difference between the development AQL and the background AQL along with the future AQL at the proposed development are used to assess the risk to the health of future occupiers of the site compared to exposure in the general wider area, as illustrated in Table 4.

Table 4: Health Risk for Future Occupiers of the Proposed Development

Future AQL at Proposed Development	Number of AQL changes in future year at site (i.e. Background AQL – Maximum AQL at Proposed Development) *				
	0	-1	-2	-3	-4
AQL 1	Negligible	**	**	**	**
AQL 2	Low	Medium	**	**	**
AQL 3	Medium	High	High	**	**
AQL 4	High	High	Extremely high	Extremely high	**
AQL 5	Extremely high	Extremely high	Extremely high	Extremely high	Extremely high
Notes: * The difference in Background Air Quality Level – Proposed Development Air Quality Level (see Table 3) ** The grey cells are non-feasible options					

Step 3 - Evaluation

- 12.23. Any proposed development where the future background is AQL 5, i.e. one or more of the regulatory thresholds will be exceeded, should be assessed as described in the section on compliance with regulatory thresholds. This is likely to only apply to a few areas of London where background NO₂ concentrations continue to exceed the thresholds.
- 12.24. Where sensitive development is located where the air quality is poor in the local context additional exposure reduction measures should be adopted to reduce the exposure. In this way future users of the development will be exposed to better air quality than without the additional exposure reduction measures. This is consistent with the WHO advice to use the ITs to drive improvement.
- 12.25. The additional measures may include designing the layout of the development to give a buffer between local sources of pollution and sensitive development, re-orientating buildings to put living rooms and bedrooms away from pollution sources, and the use of mechanical ventilation (which needs to be well maintained).
- 12.26. Air quality is forecast to improve in the future and therefore time is an important factor when considering the recommended exposure reduction measures to reduce the risk. Thus, if future occupiers will suffer exposure for one year the risk is different to exposure over, say, 10 years. If high levels of air pollution are forecast for many years, it may be that the site is not suitable for the proposed use or additional exposure reduction measures are required to reduce the health risk. Information on the rate of change in annual mean concentrations in the locality (e.g. from the local authority's annual status report), together with professional judgement, should be used to assess how long it will be before the development AQL will drop to the same level as the background AQL. For example, where the development predicted concentration is near the top of the AQL band then it is likely that it would take longer for an improvement in air quality to reach the next band down. Where the prediction is just above the lower threshold of the band there is potential for the next AQL to be achieved in a relatively short period.
- 12.27. Greater consideration as to whether a site is suitable, or not, should be given to those sites with increased risk of health effects for future users. Proposals which result in an unacceptable risk to health could be considered for refusal.
- 12.28. Where the risk is assessed to be medium or above, all opportunities to improve air quality should be explored by the development and/or consultant, taking into account the risk of disbenefits of other environmental factors, such as the need to meet net zero emissions.
- 12.29. High and extremely high sites may not be suitable for the proposed land-use, unless suitable exposure reduction measures are introduced to ensure appropriate exposure. This is particularly the case where a large number of people will be exposed and/or the people exposed are likely to be from deprived communities who tend to have a greater risk of poor health.
- 12.30. A proportionate health impact assessment is recommended for extremely high risk sites, while it may also be beneficial for high risk sites in supporting a determination of significant effects on health. We recommend that this is reviewed by the local air quality and/or public health professionals.

- 12.31. The greatest level of risk from any pollutant should be used. However, exposure reduction measures are likely to be pollutant focused.
- 12.32. Any air pollution focused HIA should be reviewed by both air quality and public health officers of the local authority.

Relevant exposure

- 12.33. The locations of relevant exposure for each type of AQAL are set out in Table 5.

Table 5: Locations of relevant exposure

Receptor Locations	Relevant exposure
AQO	The annual mean AQO applies at locations where members of the public might be regularly exposed, such as building façades of residential properties, schools, hospitals, and care homes. The 24-hour mean AQO applies at the annual mean locations of exposure as well as at hotels and residential gardens. The 1-hour mean AQO applies at the annual mean locations of exposure and at hotels, residential gardens and any outdoor location where members of the public might reasonably be expected to spend one hour or longer, such as busy pavements, outdoor bus stations and locations with outdoor seating. Places of work like factories or offices are not considered places where members of the public might be regularly exposed and therefore the AQO's do not apply at these locations.
LV	In accordance with Article 2(1), Annex III, Part A, paragraph 2 of Directive 2008/50/EC detailed locations where compliance with the LVs does not need to be assessed: "Compliance with the limit values directed at the protection of human health shall not be assessed at the following locations: a) Any locations situated within areas where members of the public do not have access and there is no fixed habitation; b) In accordance with Article 2(1), on factory premises or at industrial installations to which all relevant provisions concerning health and safety at work apply; and c) On the carriageway of roads; and on the central reservation of roads except where there is normally pedestrian access to the central reservation". The government models compliance with the Directive at locations 4 m from the kerbside, 2 m high, more than 25 m from major road junctions and adjacent to at least 100 m of road length where the LVs apply.
WHO	The WHO criteria apply wherever there is relevant exposure in relation to each time period for each pollutant.
Table notes: n/a	

Impacts of Emissions Sources on the Development

- 12.34. The EUPK and IAQM guidance explains consideration should be given to:
- the background and future baseline air quality and whether this will be likely to approach or exceed the thresholds set by air quality objectives;
 - the presence of a heavily trafficked road, with emissions that could give rise to sufficiently high concentrations of pollutants (in particular NO₂), that would cause unacceptably high exposure for users of the new development; and
 - the presence and location of Air Quality Management Areas (AQMAs) as an indicator of local hotspots where the air quality objectives may be exceeded.

Annual Mean vs Short Term Impacts

- 12.35. The assessment focuses on annual mean concentrations, however, consideration in relation to compliance with the short-term regulatory thresholds is also provided.
- 12.36. Previous research carried out on behalf of Defra and the devolved administrations identified that, where road traffic is the dominate pollutant source, exceedances of the 1-hour mean NO₂ AQO are unlikely to occur where the annual mean is below 60 µg/m³ (Defra, 2022). Similarly, exceedances of the 24-hour mean PM₁₀ AQO are unlikely to occur where the annual mean is below 32 µg/m³. Where annual mean concentrations are below these levels the short-term impacts are considered negligible.

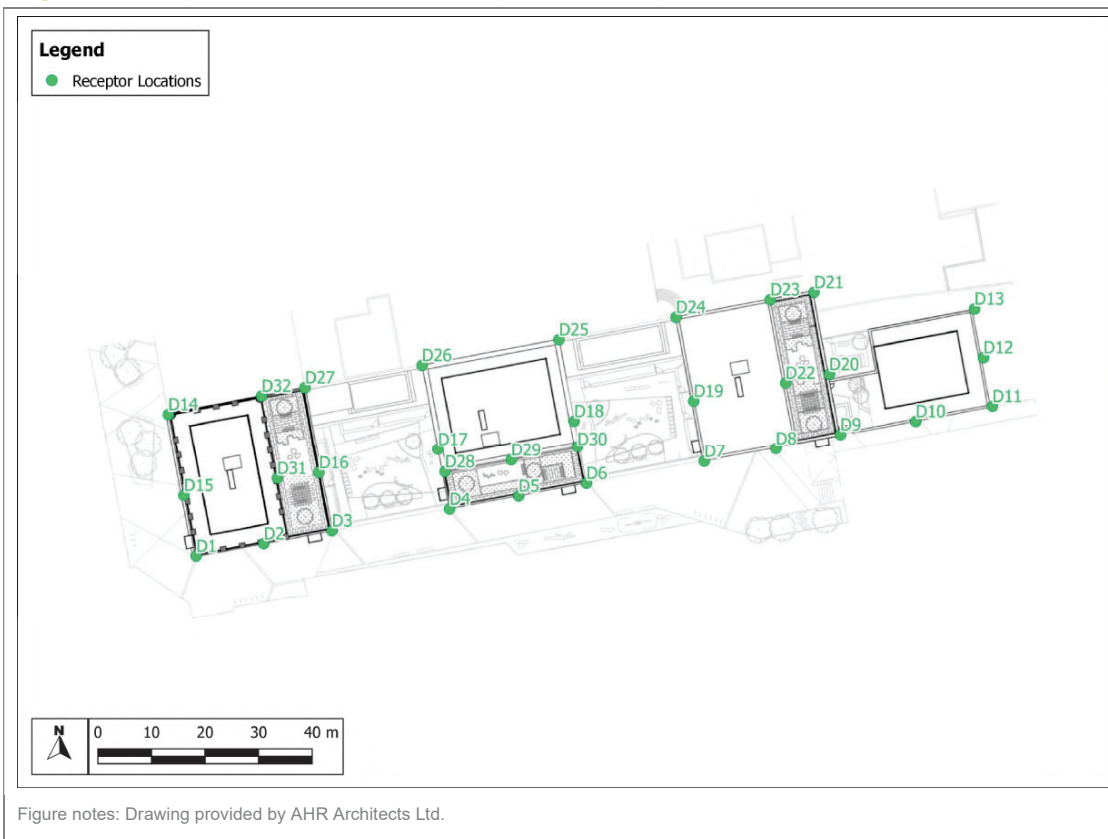
Planning Significance

- 12.37. The approach developed by EPUK and IAQM (2017) has been used. The guidance is that the assessment of significance should be based on professional judgement, with the overall air quality impact described as either 'significant' or 'not significant' (i.e. the site is suitable or not suitable for the proposed use).
- 12.38. In drawing the determination of significance, the following factors should be taken account of:
- the extent of future population exposure to any impacts;
 - the influence and validity of any assumptions adopted when undertaking the prediction of impacts; and
 - the judgement on significance relates to the consequences of the impacts; i.e. will they have an effect on human health that could be considered as significant?
- 12.39. The guidance is clear that other factors may be relevant in individual cases. It also states that the effect on the users of any new development where an AQO is not met will be judged as significant.

13. Site Suitability Assessment

- 13.1. The suitability of the site for future users has been considered. The existing conditions are based on various sources of information available as outlined in the baseline air quality review (APS_P1170A_D1-1). Air quality has been improving over the past decade, largely due to improvements in vehicle emissions, and is expected to continue to improve into the future, as old vehicles are replaced by new lower emission alternatives.
- 13.2. The Proposed Development is adjacent to busy roads in Reading. Contributions from the local roads have been assessed using dispersion modelling, details of which are set out in the air quality modelling approach (APS_P1170A_E1-1). Annual mean concentrations for NO₂, PM₁₀ and PM_{2.5} have been predicted for on-site receptors for the year 2029. The locations of the receptors are shown in Figure 1.

Figure 1: Receptor Locations within the Proposed Development



Predicted Concentrations

- I3.3. Table 6 shows the modelled annual mean concentrations for NO₂, PM₁₀ and PM_{2.5} at modelled on-site receptors for the year of 2029. Concentrations were predicted at all floor heights of the Proposed Development. The maximum predicted concentrations, from all floors, are presented in Table 6, with the height noted in the receptor column. Background pollutant concentrations and road traffic contributions have been considered.

Table 6: Predicted Annual Mean Concentrations at the Proposed Development in 2029 (µg/m³) ^a

Receptor (Height)	NO ₂	PM ₁₀	PM _{2.5}
D1 (1.5 m)	24.3	16.9	11.6
D2 (1.5 m)	24.3	16.9	11.6
D3 (1.5 m)	24.4	16.8	11.6
D4 (1.5 m)	24.6	16.8	11.6
D5 (1.5 m)	24.7	16.8	11.6
D6 (1.5 m)	24.9	16.8	11.6
D7 (1.5 m)	25.1	16.8	11.6
D8 (1.5 m)	25.2	16.8	11.6
D9 (1.5 m)	25.4	16.8	11.6
D10 (1.5 m)	25.5	16.8	11.6
D11 (1.5 m)	25.7	16.9	11.6

Table 6: Predicted Annual Mean Concentrations at the Proposed Development in 2029 (µg/m³) ^a

Receptor (Height)	NO ₂	PM ₁₀	PM _{2.5}
D12 (1.5 m)	25.8	16.8	11.6
D13 (1.5 m)	25.8	16.8	11.6
D14 (1.5 m)	24.5	16.9	11.6
D15 (1.5 m)	24.3	16.9	11.6
D16 (15.07 m)	24.3	16.7	11.5
D17 (15.26 m)	24.5	16.7	11.5
D18 (15.26 m)	24.8	16.7	11.6
D19 (15.13 m)	25.0	16.7	11.6
D20 (27.88 m)	25.0	16.6	11.5
D21 (14.43 m)	25.5	16.7	11.6
D22 (53.17 m)	24.7	16.5	11.4
D23 (26.83 m)	25.1	16.6	11.5
D24 (26.83 m)	24.9	16.6	11.5
D25 (12.29 m)	25.1	16.8	11.6
D26 (12.29 m)	24.8	16.8	11.6
D27 (15.07 m)	24.5	16.7	11.6
D28 (74.63 m)	23.9	16.4	11.4
D29 (74.63 m)	24.0	16.4	11.4
D30 (74.63 m)	24.2	16.4	11.4
D31 (84.06 m)	23.6	16.4	11.4
D32 (84.06 m)	23.7	16.4	11.4
AQO	40	40	20 ^b
LV ^c	40	40	20
WHO AQG Level (ITs) ^b	10 (40, 30, 20)	15 (70, 50, 30, 20)	5 (35, 25, 15, 10)

Table notes:
a. Receptor locations only relevant for comparison with the short term AQOs are shaded in grey.
b. Not in Regulations and there is no legal requirement for local authorities to meet it.
c. Reporting of LV exceedances is only carried out based on approved reference monitoring and at relevant reporting locations. Therefore, while the value is included, the monitoring presented is unlikely to comply with the requirements for LV reporting and assessment.

Compliance with regulatory thresholds and statutory standards

Air Quality Objectives

- I3.4. Concentrations are predicted to be well below the AQOs at all receptors relevant for the annual mean objective for all receptors.
- I3.5. The predicted short term NO₂ and PM₁₀ AQOs are also likely to be achieved (at all receptors) as the predicted concentrations are well below the proxy annual mean equivalents for these AQOs of 60 µg/m₃ for 1-hour NO₂ and 32 µg/m₃ for 24-hour mean PM₁₀.

Limit Values

- I3.6. The application site boundary is over 4 m from the kerb of the local major roads (i.e. the location used for LV compliance reporting) and therefore reporting of LVs at the application site is not required.
- I3.7. However, in recognition that LV apply anywhere members of the public can access, concentrations at the Proposed Development have been considered. The maximum predicted concentrations within the Proposed Development in 2029 are all well below the LVs. There is thus unlikely to be a breach of the LVs within the Proposed Development.

Mitigation Measures

- I3.8. No further mitigation measures are proposed.

Air Quality Health Indicators

- I3.9. Table 7 sets out the predicted background concentrations in the Proposed Development, the WHO level (IT or AQG) which the background concentration achieves, the maximum predicted concentration at the application site, and the WHO level (IT or AQG) that is predicted to be achieved at the Proposed Development in 2029.

Limit Values

- I3.10. Concentrations at the Proposed Development have been considered. Table 6 shows the maximum predicted annual mean concentrations of NO₂, PM₁₀, and PM_{2.5}. The concentrations within the Proposed Development in 2029 are all well below the LVs. There is thus unlikely to be a breach of the LVs within the Proposed Development.

Mitigation Measures

- I3.11. No further mitigation measures are proposed for the building when considering compliance with regulated thresholds.

Air Quality Health Indicators

- I3.12. Table 7 sets out the predicted background concentrations at the Proposed Development, the AQL which the background concentration achieves, the maximum predicted concentration at the application site, and the AQL that is predicted to be achieved at the Proposed Development in 2029.

Table 7: 2029 Annual Mean Concentrations and Relevant WHO Levels

Pollutant	Background Concentrations (µg/m ³)	Applicable background AQL	Maximum predicted concentration on Application Site (µg/m ³)	Development AQL achieved	Change in AQL	Risk
NO ₂	24.8	3	25.8	3	0 Level	Medium
PM ₁₀	16.4	2	16.9	2	0 Level	Low
PM _{2.5}	11.4	3	11.6	3	0 Level	Medium

- I3.13. The Proposed Development is currently occupied by retail and office use, which is considered to have less sensitive exposure in general. The Proposed Development includes Class E use, which is considered to have the same exposure sensitivity, and residential use, which is more sensitive.
- I3.14. Based on the maximum modelled concentration at the Proposed Development, the Proposed Development will introduce exposure at the AQL 2 for both NO₂ and PM_{2.5} AQL 2 and for PM₁₀.
- I3.15. Concentrations of all pollutants (NO₂, PM₁₀ and PM_{2.5}) at the Proposed Development are expected to remain at the same AQL as the background (with therefore no change in WHO level) which suggests local road traffic sources are unlikely to be significant at the Proposed Development. The risk is low for PM₁₀, and medium at the Proposed Development for both NO₂ and PM_{2.5}. The Proposed Development location is considered appropriate.

14. Significance of the impacts of sources in the local area on sensitive human health exposure at the Proposed Development

- I4.1. The assessment has demonstrated that the future users of the Proposed Development will not be exposed to any exceedances of the AQOs or LVs.
- I4.2. The air quality for the future users of the Proposed Development, in relation to compliance with the regulatory thresholds and in the context of the planning regime, is judged to be 'not significant'. This professional judgment is made in accordance with the methodology and assessment criteria set out earlier in this document.
- I4.3. This judgment, without mitigation, takes account of the assessment that the predicted concentrations of NO₂, PM₁₀ and PM_{2.5} concentrations at relevant receptors within the Proposed Development are well below the AQOs and LVs in 2029.

15. Summary

- I5.1. The air quality of the future users of the Proposed Development has been considered for the year of 2029.
- I5.2. The air quality assessment has shown that the impacts of the local area on the Proposed Development will be negligible with respect to the statutory AQOs and LVs, and therefore the site is suitable within the context of the planning regime for the proposed use.
- I5.3. Concentrations of NO₂ at all receptors at the Proposed Development are predicted to be below WHO IT1 of 40 µg/m³ in 2029. Concentrations of PM₁₀ at all receptor locations at the Proposed Development are predicted to be below the WHO IT4 of 20 µg/m³. Concentrations of PM_{2.5} at all receptor locations at the Proposed Development are predicted to be below the WHO IT3 of 15 µg/m³.
- I5.4. As background concentrations reduce due to national policy and strategy the air quality at the Proposed Development is likely to achieve compliance with the WHO AQGs. On this basis the Proposed Development location is considered to be reasonable in relation to the risk to health impacts.
- I5.5. No further mitigation measures are proposed for the Proposed Development.

15.6. Overall, the air quality impacts of local emissions sources on the Proposed Development will be 'not significant' in terms of compliance with AQOs and LVs.

16. Glossary

APS	Air Pollution Services
AQG	Air Quality Guideline
AQMA	Ai Quality Management Area
AQO	Air Quality Objective
EPUK	Environmental Protection UK
HDV	Heavy Duty Vehicle (which comprise of heavy goods vehicles, buses, and coaches)
IAQM	Institute of Air Quality Management
IT	Interim Target
LV	Limit Value
LAQM	Local Air Quality Management
NO ₂	Nitrogen dioxide
PM ₁₀	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
PM _{2.5}	Small airborne particles, more specifically particulate matter less than 2.5 micrometres in aerodynamic diameter
WHO	World Health Organization
µg/m ³	Microgrammes per cubic metre

17. References

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