



Air Quality Assessment

Gamecock Public House

Booth Street West

Manchester

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Client:

**Curlew Alternative Eighth Property LP
11 New Street
St Peter Port
Guernsey
GY1 2PF**

Prepared by:

**Jo Kirk
Kairus Ltd
Higher Metcombe
Devon
EX11 1SL**

**T: 01404 811572
www.kairus.co.uk**

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1 Introduction

1.1 General

Kairus Ltd was commissioned by Curlew Alternative Eighth Property LP to carry out an air quality assessment in relation to the proposed redevelopment of the former Gamecock Public House (PH), Booth Street West, Manchester (the 'Site') to provide student accommodation.

The Site is in the administrative boundary of Manchester City Council (MCC) and also lies within Greater Manchester Combined Authority (GMCA). Due to exceedances of the national air quality annual mean objective for nitrogen dioxide (NO₂), the GMCA has declared a new single Air Quality Management Area (AQMA) covering the wider Greater Manchester area, including arterial routes, district centres and the airport. The Site is located to the south of Manchester City, south of Mancunian Way, within the GMCA AQMA.

The proposal is for the '*demolition of existing building and structure and redevelopment of the site for Purpose Built Student Accommodation (PBSA) units (Sui Generis use class) comprising 261 bedroom units with ancillary amenity space, a ground floor 'community hub' (proposed for use classes F2(b), E(b), E(3), E(f) associated landscape works and infrastructure*'.

This report assesses air quality in the vicinity of the Site. Potential sources of emissions are identified and assessed in the context of existing air quality and emission sources and the nature and location of receptors.

A glossary of common air quality terminology is provided in Appendix A.

1.2 Scope of Assessment

The development would not provide any on-site parking, therefore the main trips generated by the operational development would be as a result of deliveries, taxi's and servicing vehicles. It is not anticipated that the trip generation would exceed current screening criteria set out within current air quality planning guidance published by the Institute for Air Quality management (IAQM)¹ which indicates that within an AQMA, where a development results in less than 100 additional light duty vehicles (LDV) and less than 25 heavy duty vehicles (HDV) per day, impacts are unlikely to be significant and no further assessment is required. On this basis an assessment of operational traffic has been scoped out of this assessment. However, the site falls within the GMCA AQMA and is on the corner of Booth Street West and Boundary Lane. An exposure assessment has therefore been carried out to determine air quality at the Site and its suitability for residential development.

An assessment of impacts associated with the construction phase of the development has also been carried out.

The scope of the assessment was agreed by Lisa Jones, Environmental protection Officer, MCC, via email dated 15 March 2021.

¹ EPUK & IAQM (2017) Land Use Planning & Development Control: Planning for Air Quality, January 2017

2 Site Description

2.1 The Existing Site

The Site is located on the corner of Booth Street West and Boundary Lane, approximately 300 m south of the A57(M) Mancunian Way.

The Site is in a predominantly residential location with residential flats located to the north, east, south and west, with some retail/commercial units to the east at ground floor level of the Mosscafe St Vincents Group residential building located to the east on Booth Street West.

The site is currently occupied by the disused Gamecock Public House.

The location of the Site is shown below in Figure 2.1.

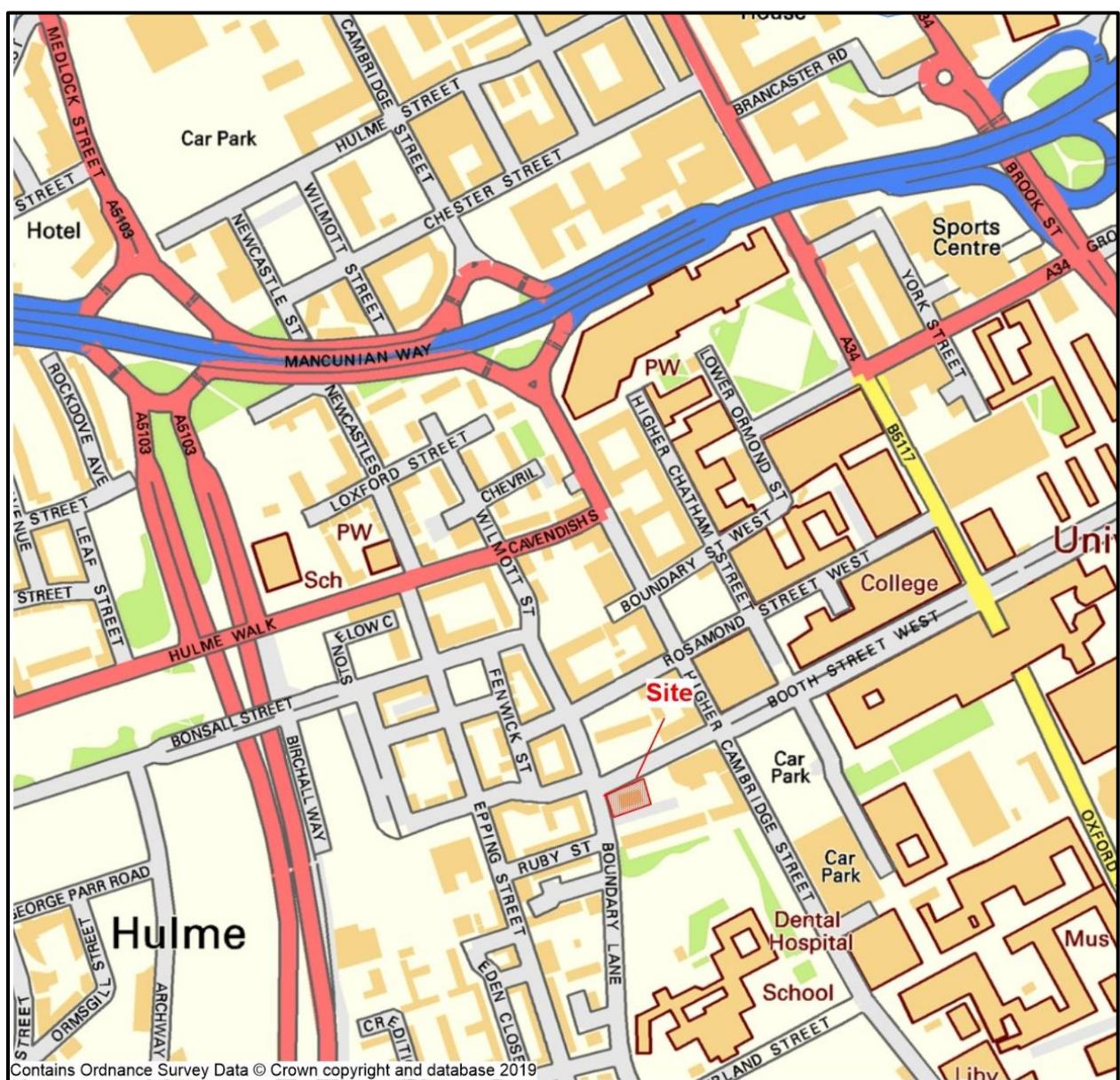


Figure 2.1: Location of Proposed Development

2.2 The Proposed Development

The proposals are for the demolition of the Gamecock PH and the construction of a 13-storey building providing up to 261 student accommodation units with shared communal spaces plus a community hub and amenity gym at ground floor level and large shared amenity area at 1st floor level. All student accommodation units would be located at 1st floor and above.

An indicative layout for the Site at ground floor level is provided in Figure 2.2.



Figure 2.1: Location of Proposed Development

3 Legislation, Policy and Guidance

3.1 International Air Quality Policy

3.1.1 EU Directive 2008

The EU Directive 2008/50/EC² on ambient air quality and cleaner air for Europe (the CAFE directive) sets out the ambient air quality standards for a number of pollutants and the dates by which these objectives should be met. The Air Quality Standards Regulations 2010³ implements the requirements of the Directive into UK legislation. The Directive contains a series of limit values for the protection of human health and critical levels for the protection of vegetation. These limit values are legally binding and the UK may incur infringement action if it does not meet the required objective limits within the agreed time limits. The UK is currently exceeding the objective limits for NO₂ and PM₁₀ within London and a number of other air quality zones within the UK.

3.2 National Air Quality Policy

3.2.1 The UK Air Quality Strategy

The Government's policy on air quality within the UK is set out in the Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland (AQS) published in July 2007⁴, pursuant to the requirements of Part IV of the Environment Act 1995. The AQS sets out a framework for reducing hazards to health from air pollution and ensuring that international commitments are met in the UK. The AQS is designed to be an evolving process that is monitored and regularly reviewed.

The AQS sets standards and objectives for ten main air pollutants to protect health, vegetation and ecosystems. These are benzene (C₆H₆), 1,3-butadiene (C₄H₆), carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO₂), oxides of nitrogen (NO_x), particulate matter (PM₁₀, PM_{2.5}), sulphur dioxide (SO₂), ozone (O₃) and polycyclic aromatic hydrocarbons (PAHs).

The air quality standards are long-term benchmarks for ambient pollutant concentrations which represent negligible or zero risk to health, based on medical and scientific evidence reviewed by the Expert Panel on Air Quality Standards (EPAQS) and the World Health Organisation (WHO). These are general concentration limits, above which sensitive members of the public (e.g. children, the elderly and the unwell) might experience adverse health effects.

The air quality objectives are medium-term policy based targets set by the Government which take into account economic efficiency, practicability, technical feasibility and timescale. Some objectives are equal to the EPAQS recommended standards or WHO guideline limits, whereas others involve a margin of tolerance, i.e. a limited number of permitted exceedances of the standard over a given period.

For some pollutants, there is both a long-term (annual mean) standard and a short-term standard. In the case of NO₂, the short-term standard is for a 1-hour averaging period, whereas for PM₁₀ it is for a 24-hour averaging period. These periods reflect the varying impacts on health of differing exposures to pollutants (e.g. temporary exposure on the pavement adjacent to a busy road, compared with the exposure of residential properties adjacent to a road).

2 Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

3 Air Quality Regulations 2010 – Statutory Instrument 2010 No. 1001

4 The Air Quality Strategy for England, Scotland, Wales and Northern Ireland – July 2007

Of the pollutants included in the AQS, NO₂ and PM₁₀ would be particularly relevant to this project as these are the primary pollutants associated with road traffic. The current statutory standards and objectives for NO₂ and PM₁₀ in relation to human health are set out in Table 3.1.

The recently published DEFRA Local Air Quality Management Policy Guidance (LAQM.PG(16))⁵ sets out new guidance on the role and responsibilities of local authorities and PM_{2.5}. There is no regulatory standard applied to the PM_{2.5} role for local authorities in England however, local authorities are expected to work towards reducing emissions and concentrations of PM_{2.5} in their area. The policy guidance recommends that local authorities in England use the EU Ambient Air Quality Directive⁶ standards for PM_{2.5} including an exposure reduction obligation, a target value and a limit value as a guide. The objective limit for PM_{2.5} is also set out in Table 3.1.

Table 3.1: Relevant Objectives set out in the Air Quality Strategy			
Pollutant	Concentrations	Measured As	Date to be Achieved By
Nitrogen Dioxide (NO ₂)	200 µgm ⁻³ not to be exceeded more than 18 times per year	1 hour mean	31 December 2005
	40 µgm ⁻³	Annual mean	31 December 2005
Particulate Matter (PM ₁₀)	50 µgm ⁻³ not to be exceeded more than 35 times per year	24 hour mean	31 December 2004
	40 µgm ⁻³	Annual mean	31 December 2004
Particulate Matter (PM _{2.5})	25 µg/m ³	Annual Mean	31 December 2010

The statutory standards and objectives apply to external air where there is relevant exposure to the public over the associated averaging periods within each objective. Guidance is provided within Local Air Quality Management Technical Guidance 2016 (LAQM.TG(16))⁷ issued by DEFRA for Local Authorities on where the objectives apply, as detailed in Table 3.2. The objectives do not apply in workplace locations, to internal air or where people are unlikely to be regularly exposed (i.e. centre of roadways).

5 DEFRA (2016) Local Air Quality Management Policy Guidance (PG16) LAQM.PG(16)

6 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:152:0001:0044:EN:PDF>

7 DEFRA (2016) Local Air Quality Management. Technical Guidance LAQM.TG(16)

Table 3.2: Locations Where Air Quality Objectives Apply		
Averaging Period	Objectives should apply at:	Objectives should generally not apply at:
Annual Mean	All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, care home etc.	Building facades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term.
24 Hour Mean	All locations where the annual mean objective would apply together with hotels. Gardens of residential properties.	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
1 Hour Mean	All locations where the annual mean and 24-hour mean objectives apply. Kerbside Sites (e.g. pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where the public might reasonably be expected to spend 1-hour or more. Any outdoor locations where the public might reasonably be expected to spend 1-hour or longer.	Kerbside sites where the public would not be expected to have regular access.

3.2.2 National Air Quality Plan for Nitrogen Dioxide (NO₂) in the UK

The National Air Quality Plan⁸ was written as a joint venture between the Defra and the Department for Transport (DfT) and aims to tackle roadside concentrations of NO₂ in the UK. It includes a number of measures such as those aimed at investing in Ultra Low Emission Vehicles (ULEVs) charging infrastructure, public transport and grants to help local authorities in improving air quality.

The plan requires all local authorities (LAs) in England with areas expected not to meet the Limit Values by 2020 (known as ‘air quality hotspots’) to develop plans to bring concentrations within these values in “the shortest time possible”. These plans are to be reviewed by the government and suggestions included in the plan include actions such as utilising retrofitting technologies, changing road layout and encouraging public transport and ULEV use. Where these approaches are not considered sufficient, the LA may need to consider implementation of a Clean Air Zone (CAZ) which places restrictions on vehicle access to an area and may include charging certain (or all) vehicles or restrictions on the type of vehicle allowed to access an area.

⁸ Defra and DfT. (2017). UK plan for tackling roadside nitrogen dioxide concentrations. London: HMSO

3.2.3 Road to Zero Strategy

The 'Road to Zero' strategy⁹ sets out the government's plans to encourage zero emissions vehicles. These include the aim that by 2040 all new cars and vans will have zero tailpipe emissions and by 2050 almost every car will have zero emissions. Measures within the Strategy are aimed at encouraging the uptake of the cleanest vehicles and supporting electric charging infrastructure.

3.2.4 Clean Air Strategy

The Clean Air Strategy¹⁰ sets out policies to lower national emissions of pollutants in order to reduce background pollution and human exposure. It aims to create a strong framework to tackle air pollution and to reduce the number of people living in locations with PM_{2.5} concentrations exceeding 10 µg/m³ by 50% by 2025.

3.3 Planning Policy

3.3.1 National Planning Policy

The National Planning Policy Framework (NPPF)¹¹ sets out the Government's planning policies for England and how these are expected to be applied. At the heart of the NPPF is a presumption in favour of sustainable development. It requires Local Plans to be consistent with the principles and policies set out in the NPPF with the objective of contributing to the achievement of sustainable development.

The NPPF states that the planning system has three overarching objectives in achieving sustainable development including a requirement to *'contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.'*

Under Section 15: Conserving and Enhancing the Natural Environment, the NPPF (paragraph 170) requires that *'planning policies and decisions should contribute to and enhance the natural local environment by ...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.'*

In dealing specifically with air quality the NPPF (paragraph 181) states that *'planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan.'*

Paragraph 183 states that *'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*

9 HM Government. (2018). Road to Zero Strategy. London: HMSO

10 Defra. (2019). Clean Air Strategy. London: HMSO

11 Ministry of Housing, Communities and Local Government: National Planning Policy Framework (July 2018)

(where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively’.

3.4 Control of Dust and Particulates Associated with Construction

Section 79 of the Environmental Protection Act (1990)¹² states that where a statutory nuisance is shown to exist, the local authority must serve an abatement notice. Statutory nuisance is defined as:

- ‘any dust or other effluvia arising on industrial, trade or business premises and being prejudicial to health or a nuisance’, and
- ‘any accumulation or deposit which is prejudicial to health or a nuisance’.

Failure to comply with an abatement notice is an offence and if necessary, the local authority may abate the nuisance and recover expenses. In the context of the proposed development, the main potential for nuisance of this nature would arise during the construction phase - potential sources being the clearance, earthworks, construction and landscaping processes.

There are no statutory limit values for dust deposition above which ‘nuisance’ is deemed to exist - ‘nuisance’ is a subjective concept and its perception is highly dependent upon the existing conditions and the change which has occurred. However, research has been undertaken by a number of parties to determine community responses to such impacts and correlate these to dust deposition rates. However, impacts remain subjective and statutory limits have yet to be derived.

3.5 Local Planning Policy

3.5.1 Manchester Core Strategy

The Manchester Core Strategy¹³ was adopted in July 2012 and sets out the policies to guide development within the district up until 2027.

Policy CC5 Transport states that ‘Proposals will be supported that improve pedestrian safety, improve air quality and increase the scope for accessible public realm improvements’.

Policy EN 16 deals specifically with air quality setting out the following:

‘The Council will seek to improve air quality within Manchester, and particularly within Air Quality Management Areas, located along Manchester’s principle traffic routes and at Manchester Airport. Developers will be expected to take measures to minimise and mitigate the local impact of emissions from traffic generation by the development, as well as emissions created by the use of the development itself, including from Combined Heat and Power and biomass plant.

When assessing the appropriateness of locations for new development the Council will consider the impacts on air quality, alongside other plan objectives, This includes cumulative impacts, particularly in Air Quality Management Areas’.

3.5.2 Local Air Quality Management

Where a local authority’s review and assessment of its air quality identifies that air quality is likely to exceed the NAQOs, it must designate these areas as Air Quality Management Areas (AQMA) and draw up an Air Quality Action Plan (AQAP) setting out measures to reduce pollutant concentrations with the aim of meeting the NAQOs.

¹² Secretary of State, The Environment Act 1990 HMSO

¹³ Manchester Core Strategy, Development Plan Document, Adopted 11th July 2012

The GMCA declared a new single AQMA on 1st May 2016 due to predicted exceedances of the annual mean NO₂ objective. The AQMA covers the 10 districts of Greater Manchester (including Tameside), including arterial routes, district centres and airport. As a consequence, the council have developed an Air Quality Action Plan (AQAP)¹⁴. The plan sets out the actions the council will take to improve air quality within the city. There are a number of successful projects which have been delivered through the previous action plan including bus priority packages, an increase in the number of hybrid taxis and electric charging sessions at charging points, completion of the Elizabethan Way Cycle/Pedestrian route and Burnside Road Toucan/Cycle Link, successful campaigns including the Dirty Diesel Campaign, introduction of an electric vehicle for MCC staff and a low emission taxi scheme. The AQAP sets out new actions to reduce emissions across the city. In relation to new development the Plan sets out the following actions:

Action 1.1– Greater Manchester (GM) councils to adopt the most recent IAQM Guidance on the Assessment of Dust from Demolition and Construction as current best practice to assess and mitigate emissions from construction sites.

Action 1.2 – GM councils will adopt the most recent IAQM/EPUK guidance for air quality assessment as current best practice guidance, to help ensure that planning applications consider potential local air quality impacts, and opportunities to improve air quality are realised.

Action 1.3– A centralised database of planning applications and air quality assessments will be managed by Transport for Greater Manchester (TfGM) as a record of cumulative effects of multiple developments and thereby facilitate combined approaches to minimising emissions;

Action 1.4- TfGM will undertake an appraisal of the effects of charging Clean Air Zones (CAZ).

3.6 Air Quality Guidance

3.6.1 DEFRA Technical Guidance, LAQM.TG(16)

Local authorities are seen to play a particularly important role in the improvement of air quality. Section 82 of the Environment Act 1995 requires every local authority to conduct a review of the air quality from time to time within the authority's area. The recently released DEFRA technical guidance, LAQM.TG(16), describes a new streamlined approach to the Local Air Quality Management (LAQM) regime, whereby every authority has to undertake and submit a single Annual Status Report/Annual Progress Report within its area, to identify whether the objectives have been or will be achieved at relevant locations by the applicable date. If the objectives are not being met, the authority must declare an Air Quality Management Area (section 83 of the Act) and prepare an action plan (section 84) which identifies measures that will be introduced in pursuit of the objectives.

3.6.2 IAQM Land-Use Planning and Development Control: Planning for Air Quality

The Institute of Air Quality Management (IAQM) and Environmental Protection UK (EPUK) have published joint guidance on the assessment of air quality impacts for planning purposes¹⁵. This includes information on when an air quality assessment is required, what should be included in an assessment and criteria for assessing the significance of any impacts.

¹⁴ Greater Manchester Air Quality Action Plan 2016-2021

¹⁵ EPUK & IAQM (2017) Land Use Planning & Development Control: Planning for Air Quality, January 2017

3.6.3 IAQM Guidance on the Assessment of Dust from Demolition and Construction

Guidance produced by the IAQM on assessing impacts from construction and demolition activities¹⁶ includes a methodology for identifying the risk magnitude of potential dust sources associated with demolition, construction, earthworks and trackout. This is then used to identify the level of mitigation necessary in order for the impacts to be not significant.

¹⁶ IAQM (2014) Guidance on the Assessment of Dust from Demolition and Construction Version 1.1 , February 2014

4 Methodology

4.1 Construction Phase

4.1.1 Construction Traffic

During construction of the proposed development, lorries will require access to the Site to deliver and remove materials; earthmoving plant and other mobile machinery may also work on site including generators and cranes. These machines produce exhaust emissions; of particular concern are emissions of NO₂ and PM₁₀.

Based on the development proposals it is anticipated that there would be no more than 5-10 additional Heavy-Duty Vehicles (HDV) generated on the adjacent road network on any given day.

The EPUK & IAQM air quality guidance assessment criteria indicate that significant impacts on air quality are unlikely to occur where a development results in less than 25 HDV movements per day in locations within or adjacent to an AQMA and less than 100 HDV outside of an AQMA. It is therefore anticipated that construction traffic generated by the proposed development would result in a negligible impact on local NO₂ and PM₁₀ concentrations and has not been considered any further in this assessment.

4.1.2 Construction/Fugitive Dust Emissions

Construction phase activities associated with the Proposed Development may result in the generation of fugitive dust emissions (i.e. dust emissions generated by site-specific activities that disperse beyond the construction site boundaries).

If transported beyond the site boundary, dust can have an adverse impact on local air quality. The IAQM has published a guidance document for the assessment of demolition and construction phase impacts¹⁷. The guidance considers the potential for dust nuisance and impacts to human health and ecosystems to occur due to activities carried out during the following stages of construction:

- Demolition (removal of existing structures);
- Earthworks (soil-stripping, ground-leveling, excavation and landscaping);
- Construction (activities involved in the provision of a new structure); and
- Trackout (the transport of dust and dirt from the construction site onto the public road network where it may be deposited and then re-suspended by vehicles using the network).

A qualitative assessment of air quality impacts due to the release of fugitive dust and particulates (PM₁₀) during the construction phase was undertaken in accordance with the methodology detailed in the IAQM guidance.

The assessment takes into account the nature and scale of the activities undertaken for each source and the sensitivity of the area to an increase in dust and PM₁₀ levels, thus enabling a level of risk to be assigned. Risks are described in terms of there being a low, medium or high risk of dust impacts.

Once the level of risk has been ascertained, then site specific mitigation proportionate to the level of risk is identified, and the significance of residual effects determined.

A summary of the IAQM assessment methodology is provided in Appendix B.

¹⁷ IAQM (June 2016) Guidance on the assessment of dust from demolition and construction Version 1.1

4.2 Operational Phase

4.2.1 Introduction

Pollutant concentrations at the Site due to local traffic emissions have been predicted using the ADMS-Roads dispersion model (version 5.0.1, released March 2020, updated September 2020). This is a commercially available dispersion model and has been widely validated for this type of assessment and used extensively in the Air Quality Review and Assessment process.

The model uses detailed information regarding traffic flows on the local road network and local meteorological conditions to predict pollution concentrations at specific locations selected by the user. Meteorological data from Manchester Meteorological Station for 2019 has been used for the assessment.

Quantitative assessment of the impacts on local air quality from road traffic emissions associated with the operation of the development have been completed against the current statutory standards and objectives set out in Table 3.1 for NO₂ and PM.

4.2.2 Emissions Data

The model uses traffic flow data and vehicle related emission factors to predict road specific concentrations of NO_x at sensitive receptors selected by the user.

The assessment has predicted air quality during 2019 for verification and to predict concentrations at the Site. As the development won't be completed and occupied until at least 2022, use of 2019 emissions factors is considered to represent a cautious approach to predicting air quality at the Site as current emissions data predicts a decline in concentrations in future years.

The emission factors released by DEFRA in August 2020, provided in the emissions factor toolkit EFT2020_10.0 have been used to predict traffic related emissions of NO_x and PM.

4.2.3 Background Concentrations

The ADMS model estimates concentrations arising as a result of vehicle emissions. It is necessary to add an estimate of local background concentrations to obtain the total concentration for comparison against the air quality objectives.

Background concentrations of NO₂ have been taken from the MA78NO monitoring site from 2019. Data from this site is higher than estimated background concentrations set out in the DEFRA background maps.

Background concentrations of PM₁₀ and PM_{2.5} have been taken from the DEFRA 2018-based background maps, published in August 2020¹⁸. Concentrations have been extracted from the 2019 maps for the grid square which represents the Site and adjacent road network.

Details of the background data used within the modelling assessment are provided in Table 5.1 for NO₂ and Table 5.3 for PM₁₀ and PM₁₀.

4.2.4 Traffic Data

Traffic data for use in the ADMS model has been extracted from the Department of Transport (DfT) online data source¹⁹. Data has been obtained for Booth Street West, Hyde Road and Ardwick Green South.

¹⁸ <https://uk-air.defra.gov.uk/data/laqm-background-home>

¹⁹ <https://roadtraffic.dft.gov.uk/downloads>

Data for Booth Street West is only available for 2009. The data has been factored forward to 2019 using TEMPro factors 1.0164 (for 2009 to 2011) and 1.0477 (for 2011 to 2019).

Unfortunately, no data is available within the DfT data base for Boundary Lane. Data to represent this road has been provided by Transport for Greater Manchester (TfGM) from a temporary ATC located at the Greenhays junction during September 2016. The data has been factored forward to 2019 using a TEMPro factor of 1.0555.

The traffic data used within the assessment are provided Table 4.1.

Table 4.1: AADT traffic Flows used in ADMS Modelling Assessment				
Road Link	DfT ID	Speed (kph)	%HGV	2019 Base
Ardwick Green South	26157	48 (25 at junctions)	10.9	19425
Hyde Road	56582	56 (25 at junctions)	4.9	18305
Booth Street West	967005	25	1.5	11943
Boundary Lane	-	48	8.8	5218

4.2.5 Model Outputs and Results Processing

For the 2019 assessment year the ADMS Model has predicted traffic related annual mean emissions of oxides of nitrogen (NO_x) and particulate matter across the Site. Relevant background concentrations have subsequently been added to the model outputs to provide the total concentrations across the Site.

The predicted concentrations of NO_x have been converted to NO₂ using the LAQM calculator (Version 8.1, released August 2020) available on the DEFRA air quality website (<http://uk-air.defra.gov.uk>).

Analysis of long-term monitoring data²⁰ suggests that if the annual mean NO₂ concentration is less than 60 µg/m³ then the one-hour mean NO₂ objective is unlikely to be exceeded where road transport is the main source of pollution. Therefore, in this assessment the annual mean concentration has been used to screen whether the one-hour mean objective is likely to be achieved as recommended within LAQM.TG(16). Similar to NO₂, an annual mean PM₁₀ concentrations below 32 µg/m³ is used to screen whether the 24-hour PM₁₀ mean objective is likely to be achieved, the approach also recommended within LAQM.TG(16).

4.2.6 Verification of Model Results

It is recommended that the model results are compared with measured data to determine whether the model results need adjusting to more accurately reflect local air quality. This process is known as verification.

LAQM.TG(16) recommends that model predictions should be within 25% (preferably 10%) of monitored concentrations for the model to be predicting with any degree of accuracy. Also, the guidance recommends that any adjustment factors applied to model results should be calculated

20 D Laxen and B Marner: Analysis of the relationship between 1-hour and annual mean nitrogen dioxide at UK roadside and kerbside monitoring sites (July 2003).

based on verification using monitoring sites in a similar location i.e. roadside, intermediate or background sites.

To verify the model results, the ADMS model has been used to predict NO_x concentrations at monitoring sites MA96 (Ardwick Green South) and MA88a (Hyde Road).

Further details on the verification and calculation of adjustment factors is provided in Appendix C.

4.3 Receptors

4.3.1 Construction Phase Receptors

The IAQM assessment is undertaken where there are:

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

It is within these distances that the impacts of dust soiling and increased particulate matter in the ambient air will have the greatest impact on local air quality at sensitive receptors.

4.3.2 Operational Phase – Human Receptors

As set out in Table 3.2, LAQM.TG(16) describes in detail typical locations where consideration should be given to pollutants defined in the Regulations. Generally, the guidance suggests that all locations *‘where members of the public are regularly present’* should be considered. At such locations, members of the public would be exposed to pollution over the time that they are present, and the most suitable averaging period of the pollutant needs to be used for assessment purposes.

For instance, on a footpath, where exposure would be transient (for the duration of passage along that path) comparison with short-term standards (i.e. 15-minute mean or 1-hour mean) may be relevant. In a school, or adjacent to a private dwelling, however; where exposure may be for longer periods, comparison with long-term standards (such as 24-hour mean or annual mean) may be most appropriate. In general terms, concentrations associated with long-term standards are lower than short-term standards owing to the chronic health effects associated with exposure to low level pollution for longer periods of time.

For the completion of this assessment, annual mean NO₂, PM₁₀ and PM_{2.5} concentrations have been predicted as contour plots across the Site at ground floor level. Concentrations have also been predicted at a number of receptors representing the facades of the new building at each floor level. Each receptor represents 1.5 m above floor height, with the height of the ground floor being 4.35 m, 1st floor 3.52 m and the upper floors 2.85 m in height.

The location of each receptor is shown in Figure 4.1 with details provided in Table 4.2.

Table 4.2: Receptors used in Modelling		
Receptor	Floors	Height
1	Ground floor	1.5m
1a	1 st floor up to 8 th floor	5.85m, 9.38m, 12.22m, 15.1m, 17.9m, 20.8m, 23.6m, 26.5m
2	Ground floor	1.5m
2a	1 st floor up to 8 th floor	5.85m, 9.38m, 12.22m, 15.1m, 17.9m, 20.8m, 23.6m, 26.5m
3	Ground up to 8 th floor	1.5m, 5.85m, 9.38m, 12.22m, 15.1m, 17.9m, 20.8m, 23.6m, 26.5m
4	Ground up to 8 th floor	1.5m, 5.85m, 9.38m, 12.22m, 15.1m, 17.9m, 20.8m, 23.6m, 26.5m
5	Ground up to 8 th floor	1.5m, 5.85m, 9.38m, 12.22m, 15.1m, 17.9m, 20.8m, 23.6m, 26.5m
6	Ground up to 8 th floor	1.5m, 5.85m, 9.38m, 12.22m, 15.1m, 17.9m, 20.8m, 23.6m, 26.5m
7	Ground up to 8 th floor	1.5m, 5.85m, 9.38m, 12.22m, 15.1m, 17.9m, 20.8m, 23.6m, 26.5m
8	Ground up to 8 th floor	1.5m, 5.85m, 9.38m, 12.22m, 15.1m, 17.9m, 20.8m, 23.6m, 26.5m

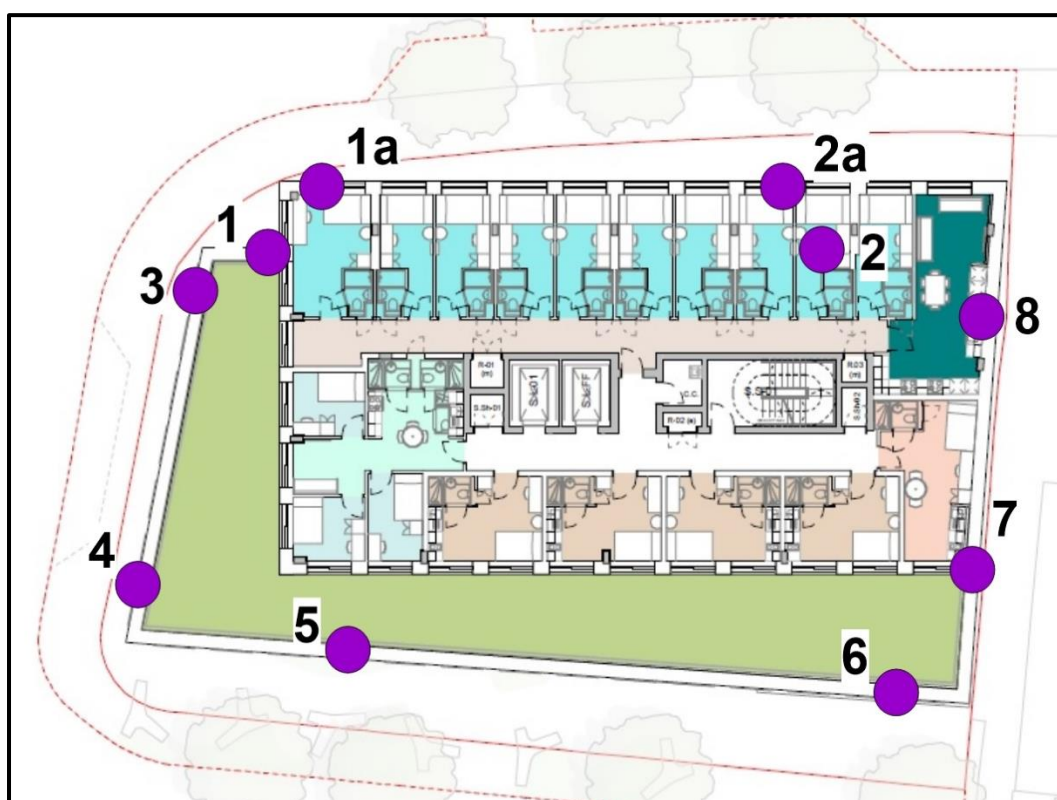


Figure 4.1: Location of Receptors used in Modelling

4.4 Significance Criteria

4.4.1 Construction Phase

The IAQM assessment methodology recommends that significance criteria are only assigned to the identified risk of dust impacts occurring from a construction activity following the application of appropriate mitigation measures. For almost all construction activities, the application of effective mitigation should prevent any significant effects occurring to sensitive receptors and therefore the residual effects will normally be negligible.

4.4.2 Operational Phase

The significance of impacts within the Site is based on whether the air quality objectives for each pollutant are exceeded or not.

4.5 Model Uncertainty

When assessing air quality in relation to new exposure impacts are considered significant where the UK objective limits are exceeded. However, there is always some uncertainty in predicting pollutant concentrations due to year-on-year variations that can occur as a result of changing weather conditions, assumptions based on model input data, such as traffic and emissions data and the influence of microclimatic conditions which can influence concentrations at a specific location.

The process of model verification has been used to improve the accuracy of the model by adjusting the model results to better represent concentrations recorded at similar locations. This can help to improve the uncertainty in modelled concentrations. However, there remains some uncertainty in predicted concentrations. To take account of the uncertainty in model predictions the assessment has assumed that where the predicted concentrations are greater than 90% of the relevant objective limit, i.e. 36 µg/m³ or above for annual mean NO₂ there is a risk of exceeding the objective limit and therefore impacts in terms of new exposure are significant.

5 Baseline Assessment

5.1 Air Quality Monitoring

5.1.1 Nitrogen Dioxide

GMCA monitors NO₂ concentrations at seventeen automatic monitoring sites and 400 non-automatic (passive) monitoring sites. Those sites most representative of air quality in the vicinity of the Site are set out in Table 5.1 below. The locations of the Sites are shown in Figure 5.1.

Diffusion tubes are acknowledged as a less accurate method of monitoring ambient air pollutants than automatic monitors, with diffusion tubes over or under estimating concentrations by as much as 30 %. To allow the results to be reliably compared with the AQ Objectives, the data should be bias corrected using data collected from tubes co-located with continuous monitoring sites. The data provided below has been adjusted by GMCAC using nationally derived adjustment factors.

Table 5.1: Annual Average Nitrogen Dioxide Concentrations (µgm ⁻³)				
Site	Type	OS Grid Ref	Distance to kerb of nearest road m	Year
				2019
MA72NO	UB	384761, 397384	46	32.8
MA78NO	UB	386289, 396828	23	33.0
MA86ANO	R	387150, 396808	4	33.6
MA87ANO	R	387020, 396561	3	34.0
MA88ANO	R	386536, 396699	3	43.3
MA89ANO	R	386681, 396806	2.5	30.3
MA96BNO	R	385189, 397167	3	46.0
MA97BNO	R	382886, 397215	7.5	32.3
R – Roadside UB – Urban Background				

The objective for annual mean NO₂ was met during 2019 at all monitoring locations presented in Table 5.1 with the exception of sites MA88ANO and MA96BNO, located adjacent to Hyde Road and Ardwick Green South, respectively.

It is not possible to monitor short-term NO₂ concentrations using diffusion tubes, however, as discussed previously, research has concluded that exceedances of the 1-hour mean objective are generally unlikely to occur where annual mean concentrations are below 60 µg/m³. Based on the monitoring data presented in Table 5.1, it is unlikely that the short-term objective is being exceeded.



Figure 5.2: Location of Monitoring Sites

5.1.2 Particulate Matter (PM₁₀ and PM_{2.5})

GMCA monitors PM₁₀ and PM_{2.5} at a number of locations across the district. The nearest to the Site are located in Manchester City and are detailed in Table 5.2 below.

The data shows that the annual mean and 24-hour objective limit for PM₁₀ is being met at both the Manchester City monitoring sites. The annual mean objective for PM_{2.5} is also being met at the Piccadilly monitoring site.

Table 5.2: PM ₁₀ and PM _{2.5} Concentrations (µgm ⁻³)							
Site	Paramete r	OS Grid Ref	Year				
			2015	2016	2017	2018	2019
PM ₁₀							
MAN1 – Manchester Oxford Road	Annual Mean	384233, 397287	28	27	27	30	26
	Days >50 µg/m ³		25	16	15	15	18
MAN3 – Manchester Piccadilly	Annual Mean	384310, 398337	20	20	20	21	20
	Days >50 µg/m ³		3	3	3	2	7
PM _{2.5}							
MAN3 – Manchester Piccadilly	Annual Mean	384310, 398337	10	10	8	11	12
R – Roadside							
UB – Urban Background							

5.2 DEFRA Background Maps

Additional information on estimated background pollutant concentrations has been obtained from the DEFRA background maps provided on UK-AIR. Estimated air pollution concentrations for NO_x, NO₂ and PM₁₀ have been extracted from the 2018-based background pollution maps for the UK. The maps are available in 1 km x 1 km grid squares and provide an estimate of concentrations between 2018 and 2030. The average concentrations have been taken from the 2019 maps from the grid square 384500, 396500 which represents the Site and adjacent road network.

The estimated background concentrations at the Site are set out in Table 5.2.

The data indicates that background concentrations of NO₂, PM₁₀ and PM_{2.5} in the vicinity of the Site are comfortably below the annual mean objectives.

Table 5.2: Annual Mean Background Air Pollution Concentrations for 2019 at the Site				
OS Grid Reference	NO _x	NO ₂	PM ₁₀	PM _{2.5}
384500, 396500	25.9	23.3	12.3	8.1

5.3 Air Quality at the Development Site

As previously discussed, the Site is located on the corner of Boundary Lane and Booth Street West. Concentrations are expected to be lower than recorded at monitoring sites MA88ANO and MA96NO, due to lower traffic flows experienced along Boundary Lane and Booth Street West, but higher than concentrations recorded at the other roadside monitoring sites set out in Table 5.1 due to its location on the corner of both roads. Based on professional judgement there is a risk that the annual mean objective may be exceeded at the Site particularly at ground floor locations. However, it is noted that the proposals locate communal uses at ground floor level with all residential units at 1 st floor and above. The annual mean objective is not considered relevant at ground floor locations within the development due to the transient nature of the proposed uses.

Based on the monitoring data presented in Table 5.1, it is expected that NO₂ concentrations will be meeting the 1-hour objective limit at the Site.

In terms of particulate matter, based on the data presented in Table 5.2 and the outcome of the GMCA air quality review and assessment process concentrations of PM₁₀ and PM_{2.5} are expected to be below the objectives at the Site.

6 Construction Impacts

6.1 Site and Surroundings

A summary of the proposed development is provided in Section 2 of this report.

The Site is currently occupied by the disused Gamecock PH. The building will be demolished as part of the development proposals. An assessment of emissions associated with demolition activities has therefore been included in the assessment.

There are residential properties located to the east, west, north and south of the Site within 20-50 m. An assessment of construction related impacts in relation to human receptors is therefore considered necessary.

Dust emissions from construction activities are unlikely to result in significant impacts on ecologically sensitive receptors beyond 50 m from the site boundary. A review of data held on the Defra MAGIC website²¹ shows no sites designated as important for wildlife within 50 m of the Site, therefore impacts on ecological receptors has not been considered any further within this assessment.

As discussed in Section 5, PM₁₀ concentrations in the vicinity of the Site are expected to be 'well below' the relevant objective limits. The Defra data set out in Table 5.3 indicates background concentrations in the region of 12-13µg/m³. Concentrations in the vicinity of the Site are therefore unlikely to exceed 24 µg/m³.

The precise behaviour of the dust, its residence time in the atmosphere, and the distance it may travel before being deposited would depend upon a number of factors. These include wind direction and strength, local topography and the presence of intervening structures (buildings, etc.) that may intercept dust before it reaches sensitive locations. Furthermore, dust would be naturally suppressed by rainfall.

A windrose from the Manchester Meteorological Station is provided below in Figure 6.1, which shows that the prevailing wind is from the south. Receptors located to the north are therefore most at risk of experiencing impacts. Which includes residential flats located immediately north of the Site which would be particularly sensitive to dust effects.

²¹ <http://magic.defra.gov.uk/>

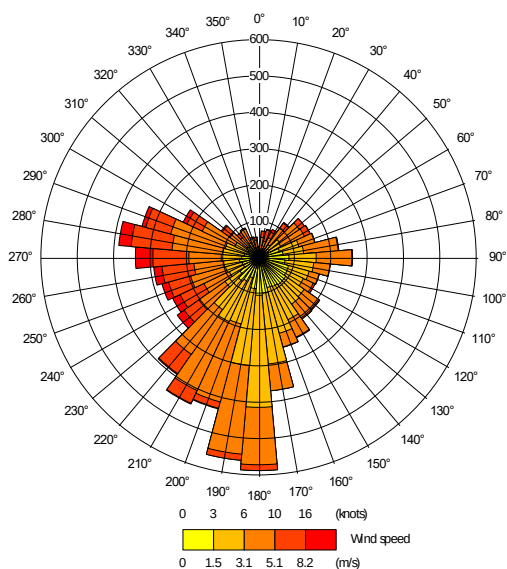


Figure 6.1: Windrose from Manchester Meteorological Station (2019)

6.2 Risk Assessment of Dust Impacts

6.2.1 Potential Dust Emission Magnitude

The dust emission magnitude is based on the scale of anticipated works at the Site and has been classified as small, medium or large for each of the four activities: demolition, earthworks, construction and trackout. A summary of the dust emission magnitude for each activity is set out in Table 6.1.

Demolition

Demolition activities would include demolition of the disused PH. Total building volume to be demolished is approximately 1,200 m³. The Site is therefore considered to have a dust emission class of 'small' with regard to demolition activities.

Earthworks

Earthworks are those activities involved in preparing the Site for construction such as excavation of material, haulage, tipping, stockpiling and leveling.

The Site covers an area of approximately 1,000 m² and during the earthworks stage it is anticipated that there will be only 1-2 heavy earth moving vehicles on site at any one time to undertake site leveling and excavation of footings etc. The Site is therefore considered to have a dust emission class of 'small' with regards to earthwork activities.

Construction

There are a number of issues that can impact the dust emission class during construction activities including the size of the building, materials used for construction, the method of construction and the duration of the build.

The main construction materials would be concrete (construction of concrete frame), bricks and paving materials. There would be a particular risk of dust emissions during the cutting of bricks, paving materials and drylining boards (potentially dusty materials). However, based on the current

design layouts the total building volume proposed for the Site would be approximately 15,000 – 20,000 m³. The Site is therefore considered to have a dust emission class of ‘small’ with regards to construction activities.

Trackout

The risk of impacts occurring during trackout is predominantly dependent on the number of vehicles accessing the Site on a daily basis. However, vehicle size and speed, the duration of activities and local geology are also factors which are used to determine the emission class of the Site as a result of trackout.

Given the size of the Site and nature of the development it is anticipated that there would be no more 5-10 HDV accessing the Site on a daily basis, although given the size of the Site there is limited scope for vehicles to park onsite. The vehicles would therefore remain on the adjacent road and would not travel over unpaved areas, reducing the risk of mud and dust being trackout onto the adjacent road network. The Site is therefore considered to have a dust emissions class of ‘small’ with regards to trackout activities.

Table 6.1: Summary of Dust Emission Magnitude for each Activity	
Source	Magnitude
Demolition	Small
Earthworks	Small
Construction	Small
Trackout	Small

6.2.2 Sensitivity of Area

The sensitivity of the surrounding area takes account of the following factors:

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

Based on the IAQM guidance residential dwellings are considered as high sensitivity receptors in relation to both dust soiling and health effects of PM₁₀. The nearest residential properties to the Site are within Cooper House, approximately 18m to the south. There are over 10 residential flats within this building. There are further residential flats to the north, east and west, within 20-30 m of the Site boundary. The overall sensitivity of the surrounding area is classed as ‘high’ in relation to dust soiling.

As previously discussed, annual mean PM₁₀ concentrations in the vicinity of the Site are not expected to exceed 24 µg/m³. Based on the proximity of sensitive receptors to the site boundary and the local concentrations of PM₁₀ the sensitivity of the surrounding area is considered to be ‘low’ with regards human health impacts.

In relation to trackout, vehicles traveling to and from the Site would travel along Boundary Lane and Booth Street West. As a general guidance, significant impacts from trackout may occur up to 500 m from large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit. There are residential flats within 20m of the roadside along both Boundary Lane and Booth Street West. The sensitivity of the area to trackout for human receptors would therefore be 'high'.

A summary of the sensitivity of the area surrounding the Site in relation to each activity is provided below in Table 6.2.

Table 6.2: Summary of Sensitivity of Surrounding Area				
Potential Impact	Sensitivity of Surrounding Area			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	High	High	High	High
Human Health	Low	Low	Low	Low

6.2.3 Defining the Risk of Impacts

The dust emission magnitude as set out in Table 6.1 is combined with the sensitivity of the area (Table 6.2) to determine the risk of both dust soiling and human health impacts, assuming no mitigation measures applied at site. The risk of impacts associated with each activity is provided in Table 6.3 below and has been used to identify site-specific mitigation measures, which are discussed in Section 8 and set out in Appendix D.

Table 6.3: Summary of Risk Effects to Define Site-Specific Mitigation				
Potential Impact	Sensitivity of Surrounding Area			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Medium Risk	Medium Risk	Medium Risk	Medium Risk
Human Health	Negligible Risk	Negligible Risk	Negligible Risk	Negligible Risk

7 Operational Impacts

7.1 NO₂ Concentrations

Annual mean NO₂ concentrations predicted across the Site at ground floor level are presented in Figure 7.1. Concentrations predicted at the facades of the new building at each floor are set out in Table E1, Appendix E.

The data presented in Figure 7.1 shows annual mean NO₂ concentrations are predicted to exceed the annual mean objective of 40 µg/m³ in the north-western corner of the Site at ground floor level. The contour plot indicates concentrations above 36 µg/m³ across the majority of the Site at ground floor level. The model results therefore indicate a high risk of the objective being exceeded at ground floor locations across the majority of the Site, as discussed in section 4.5. However, as previously discussed, the development would provide a gym and community hub at ground floor level. Due to the transient nature of these uses, the annual mean is not considered relevant at ground floor level. It is the 1-hour objective that applies to these uses.

The model is predicting concentrations below 60 µg/m³ across the ground floor, therefore the 1-hour objective is being met and the impact in terms of exposure at ground floor level is considered to be negligible.

The annual mean objective does apply at the 1st floor facades where proposed student accommodation units are proposed. The data set out in Table E1 shows an annual mean of 36 µg/m³ predicted at receptors 1a and 2a, representing the residential façades along the northern side of the Site at 1st floor level. At all other receptors at 1st floor level concentrations are just below 36 µg/m³. It is concluded that the annual mean objective is unlikely to be exceeded at 1st floor level, particularly given the assessment is based on worst-case assumptions (i.e. use of 2019 emissions data and background concentrations). The impact of the development in terms of new exposure is considered to be negligible at 1st floor level.

At all receptors above 1st floor level annual mean concentrations are predicted to be below 36 µg/m³, therefore the impact of the proposals would also be negligible at these facades.

In terms of short-term NO₂ concentrations, the modelling is predicting annual mean concentrations below 60 µg/m³ at all floors from the 1st floor and above. The impact in relation to short-term NO₂ would also be negligible at the proposed residential facades.

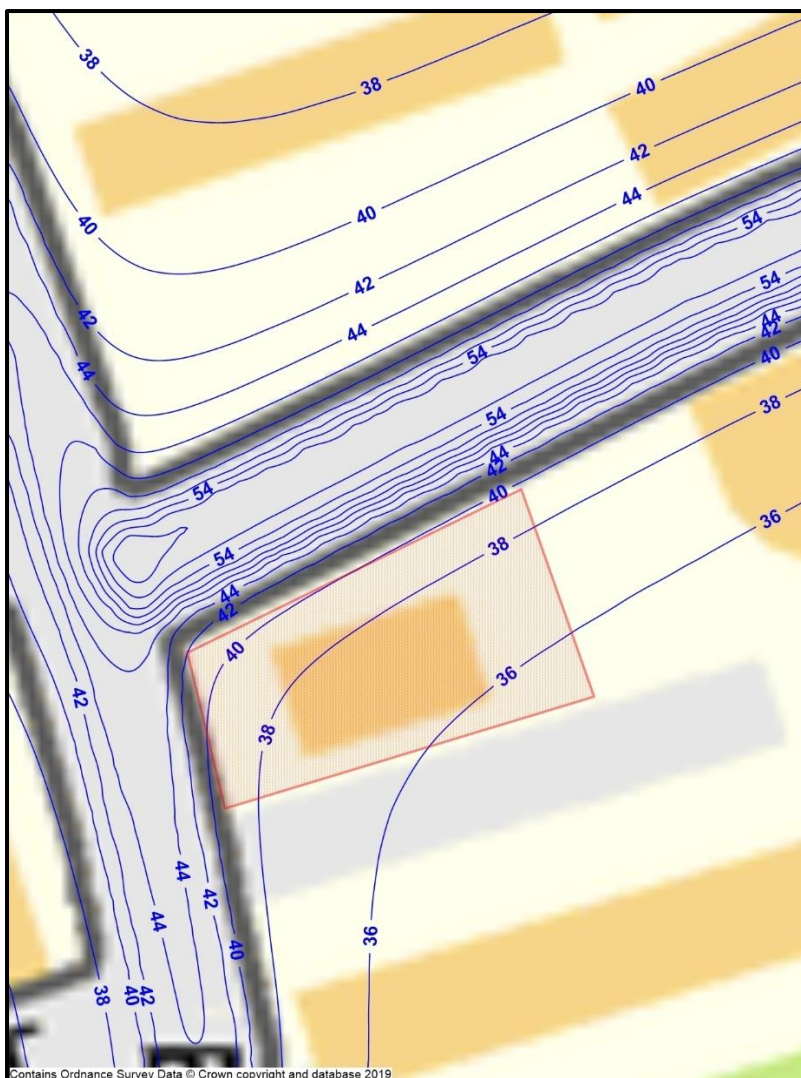


Figure 7.1: Predicted Annual Mean NO₂ Concentrations Across the Site at Ground Floor Level (µg/m³)

7.2 PM₁₀ Concentrations

Annual mean PM₁₀ concentrations predicted across the Site at ground floor level are presented in Figure 7.2. Concentrations predicted at each receptor and each floor are set out in Table E2. Appendix E.

The data presented in Figure 7.2 shows annual mean PM₁₀ concentrations are predicted to be well below (<75%) the objective across the Site at ground floor level. The data set out in Table E2 shows a gradual decline in concentrations with increasing height, therefore concentration remain below the objective at all floors of the new building.

In terms of short-term PM₁₀ concentrations, the modelling is predicting annual mean concentrations below 32 µg/m³ at all locations across the Site and at each floor, therefore short-term PM₁₀ concentrations are meeting the 24-hour objective of 50 µg/m³ at the Site.

The impact of the development in terms of new exposure to PM₁₀ would be negligible.

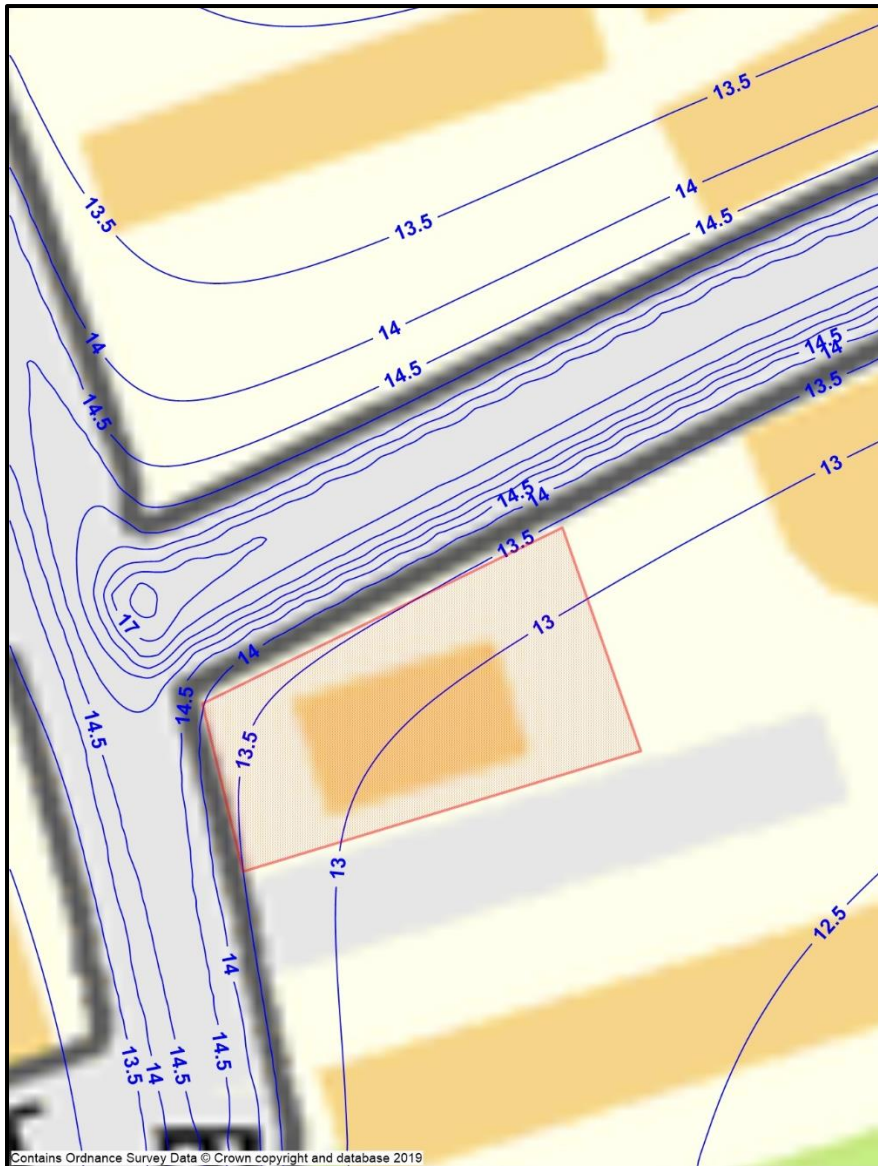


Figure 7.2: Predicted Annual Mean PM₁₀ Concentrations Across the Site at Ground Floor Level (µg/m³)

7.3 PM_{2.5} Concentrations

Annual mean PM_{2.5} concentrations predicted across the Site at ground floor level are presented in Figure 7.3. Concentrations predicted at each floor are set out in Table E3, Appendix E.

The data presented in Figure 7.3 shows annual mean PM_{2.5} concentrations are predicted to be well below the objective of 25 µg/m³ across the Site at ground floor level. Data presented in Table E3, Appendix E, shows concentrations remain well below the objective at all floors of the new building.

The impact of the development in terms of new exposure to PM_{2.5} would be negligible.

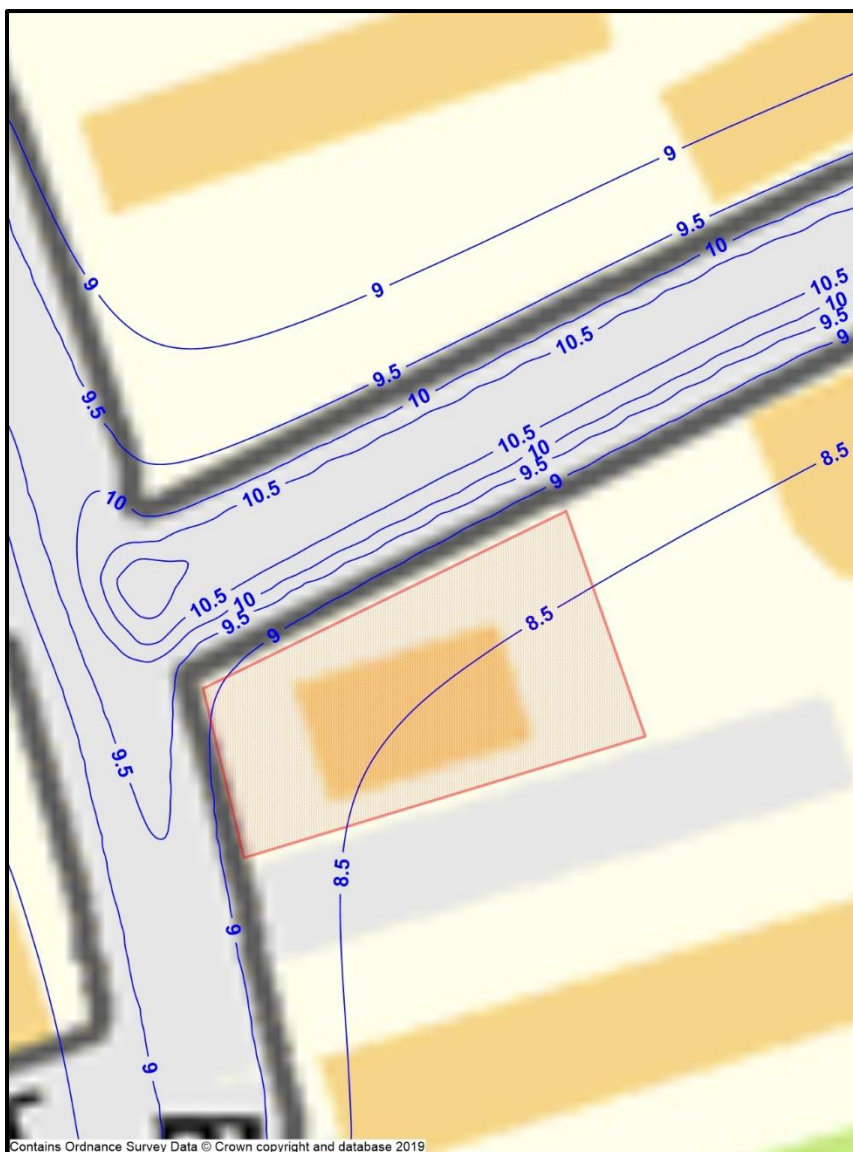


Figure 7.3: Predicted Annual Mean PM₁₀ Concentrations Across the Site at Ground Floor Level ($\mu\text{g}/\text{m}^3$)

8 Mitigation

8.1 Mitigation Measures

8.1.1 Construction Phase

The control of dust emissions from construction site activities relies upon management provisions and mitigation techniques to reduce emissions of dust and limit dispersion. Where dust emission controls have been used effectively, large-scale operations have been successfully undertaken without impacts to nearby properties.

The proposed development has been identified as a medium risk for dust soiling effects as a result of construction activities. Appropriate mitigation measures for the Site have been identified following the IAQM guidance and based on the risk effects presented in Table 6.3. It is recommended that the 'highly recommended' measures set out in Appendix D are incorporated into a Dust Management Plan (DMP) and approved by MCC prior to commencement of any work on site.

In addition to the 'recommended' measures, the IAQM guidance also sets out a number of 'desirable' measures which should also be considered for inclusion within the DMP. These are also set out in Appendix D.

Following implementation of the measures recommended for inclusion within the DMP the impact of emissions during construction of the proposed development would be negligible.

8.1.2 Operational Phase

The assessment has predicted a negligible impact in terms of exposure to NO₂, PM₁₀ and PM_{2.5} concentrations therefore no mitigation of air quality at the Site is required.

8.2 Residual Effects

8.2.1 Construction Phase

The greatest potential for dust nuisance problems to occur would generally be within 200m of the construction site perimeter. There may be limited incidences of increased dust deposited on property beyond this distance.

By following the mitigation measures outlined within this appraisal the impact would be substantially minimised and residual impacts are unlikely to be significant.

8.2.2 Operational Phase

Traffic generated by the proposed development is not predicted to have a significant impact on local air quality therefore residual impacts would be negligible.

9 Conclusion

Kairus Ltd commissioned by Curlew Alternative Eighth Property LP to carry out an air quality assessment in relation to the proposed redevelopment of the former Gamecock Public House, Booth Street West, Manchester to provide student accommodation.

The Site falls within the GMCA AQMA declared due to exceedances of the annual mean NO₂ objective limit.

It is inevitable that with any development, demolition and construction activities will cause some disturbance to those nearby. Dust arising from most construction activities tends to be of a coarse nature, which through dispersion by the wind can lead to soiling of property including windows, cars, external paintwork and laundry. However, as well as giving rise to annoyance due to soiling of surfaces from dust emissions, there is evidence of major construction activities causing increases in long term PM₁₀ concentrations and in the number of days exceeding the short term PM₁₀ objective of 50 µg m⁻³.

The IAQM guidance on assessing impacts on air quality from construction activities and determining the likely significance has been used to determine the risk of impacts occurring during the construction of the development and to identify appropriate mitigation measures to be implemented on site to reduce dust emissions and associated impacts.

Due to the proximity and number of nearby residential receptors the Site is considered to have a medium risk of impacts with regards to dust soiling and PM₁₀ concentrations. Following the implementation of appropriate mitigation measures impacts associated with the construction of the development the impacts would be reduced to insignificant.

The ADMS dispersion model has been used to predict concentrations of NO₂, PM₁₀ and PM_{2.5} across the Site to assess impacts relating to new exposure. The assessment has found that concentrations of all three pollutants will be below the relevant objective limits at all residential facades within the new building. Concentrations will also be below the 1-hour NO₂ objective at ground floor level where only this objective applies. The impact of the proposals in terms of new exposure would be negligible and no mitigation is required.

Based on the results of this assessment air quality does not pose a constraint to development of the Site for residential purposes.

Appendix A – Air Quality Terminology

Term	Definition
Accuracy	A measure of how well a set of data fits the true value.
Air quality objective	Policy target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedences within a specific timescale (see also air quality standard).
Air quality standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive sub groups (see also air quality objective).
Ambient air	Outdoor air in the troposphere, excluding workplace air.
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year. Usually this is for a calendar year, but some species are reported for the period April to March, known as a pollution year. This period avoids splitting winter season between 2 years, which is useful for pollutants that have higher concentrations during the winter months.
AQMA	Air Quality Management Area.
DEFRA	Department for Environment, Food and Rural Affairs.
Exceedence	A period of time where the concentrations of a pollutant is greater than, or equal to, the appropriate air quality standard.
Fugitive emissions	Emissions arising from the passage of vehicles that do not arise from the exhaust system.
LAQM	Local Air Quality Management.
NO	Nitrogen monoxide, a.k.a. nitric oxide.
NO₂	Nitrogen dioxide.
NO_x	Nitrogen oxides.
O₃	Ozone.
Percentile	The percentage of results below a given value.
PM₁₀	Particulate matter with an aerodynamic diameter of less than 10 micrometres.
Ratification (Monitoring)	Involves a critical review of all information relating to a data set, in order to amend or reject the data. When the data have been ratified they represent the final data to be used (see also validation).
µg^{m-3} micrograms per cubic metre	A measure of concentration in terms of mass per unit volume. A concentration of 1µg/m ³ means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.
UKAS	United Kingdom Accreditation Service.
Uncertainty	A measure, associated with the result of a measurement, which characterizes the range of values within which the true value is expected to lie. Uncertainty is usually expressed as the range within which the true value is expected to lie with a 95% probability, where standard statistical and other procedures have been used to evaluate this figure. Uncertainty is more clearly defined than the closely related parameter 'accuracy', and has replaced it on recent European legislation.
USA	Updating and Screening Assessment.
Validation (modelling)	Refers to the general comparison of modelled results against monitoring data carried out by model developers.
Validation (monitoring)	Screening monitoring data by visual examination to check for spurious and unusual measurements (see also ratification).
Verification (modelling)	Comparison of modelled results versus any local monitoring data at relevant locations.

Appendix B – IAQM Construction Dust Assessment Procedure

In order to assess the potential impacts, the activities on construction sites are divided into four categories. These are:

- demolition (removal of existing structures);
- earthworks (soil-stripping, ground-leveling, excavation and landscaping);
- construction (activities involved in the provision of a new structure); and
- trackout (the transport of dust and dirt from the construction site onto the public road network where it may be deposited and then re-suspended by vehicles using the network).

For each activity, the risk of dust annoyance, health and ecological impact is determined using three risk categories: low, medium and high risk. The risk category may be different for each of the four activities. The risk magnitude identified for each of the construction activities is then compared to the number of sensitive receptors in the near vicinity of the site in order to determine the risks posed by the construction activities to these receptors.

Step 1: Screen the Need for an Assessment

The first step is to screen the requirement for a more detailed assessment. An assessment is required where there is:

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

Step 2A: Define the Potential Dust Emission Magnitude

This is based on the scale of the anticipated works and the proximity of nearby receptors. The risk is classified as small, medium or large for each of the four categories.

Demolition: The potential dust emission classes for demolition are:

- Large: Total building volume $>50,000\text{m}^3$, potentially dusty construction material (e.g. Concrete), on site crushing and screening, demolition activities $>20\text{m}$ above ground level;
- Medium: total building volume $20,000\text{m}^3 - 50,000\text{m}^3$, potentially dusty construction material, demolition activities $10\text{--}20\text{ m}$ above ground level; and
- Small: total building volume $<20,000\text{m}^3$, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities $<10\text{m}$ above ground, demolition during wetter months.

Earthworks: This involves excavating material, haulage, tipping and stockpiling. The potential dust emission classes for earthworks are:

- Large: Total site area $>10,000\text{m}^2$, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds $>8\text{ m}$ in height, total material moved $>100,000$ tonnes;
- Medium: Total site area $2,500\text{ m}^2 - 10,000\text{m}^2$, moderately dusty soil (e.g. silt), $5 - 10$ heavy earth moving vehicles active at any one time, formation of bunds $4\text{m} - 8\text{m}$ in height, total material moved $20,000$ tonnes- $100,000$ tonnes; and
- Small: Total site area $<2,500\text{m}^2$, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds $<4\text{ m}$ in height, total material moved $<20,000$ tonnes, earthworks during wetter months.

Construction: The important issues here when determining the potential dust emission magnitude include the size of the building(s)/infrastructure, method of construction, construction materials, and duration of build. The categories are:

Large: Total building volume $>100,000\text{m}^3$, on site concrete batching, sandblasting;

Medium: Total building volume $25,000\text{m}^3 - 100,000\text{m}^3$, potentially dusty construction material (e.g. concrete), on site concrete batching; and

Small: Total building volume $<25,000\text{m}^3$, construction material with low potential for dust release (e.g. metal cladding or timber).

Trackout: The risk of impacts occurring during trackout is predominantly dependent on the number of vehicles accessing the Site on a daily basis. However, vehicle size and speed, the duration of activities and local geology are also factors which are used to determine the emission class of the Site as a result of trackout. The categories are:

Large: >50 HDV ($>3.5\text{t}$) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length $>100\text{m}$;

Medium: $10-50$ HDV ($>3.5\text{t}$) outward movements in any one day, moderately dusty surface material (e.g. high clay content, unpaved road length $50-100\text{m}$; and

Small: <10 HDV ($>3.5\text{t}$) outward movements in any one day, surface material with low potential for dust release, unpaved road length $>50\text{m}$.

Step 2B: Defining the Sensitivity of the Area

The sensitivity of the area is defined for dust soiling, human health (PM_{10}) and ecological receptors. The sensitivity of the area takes into account the following factors:

the specific sensitivities of receptors in the area;

the proximity and number of receptors;

in the case of PM_{10} , the local background concentration; and

site specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.

Table B1 is used to define the sensitivity of different types of receptors to dust soiling, health effects and ecological effects.

Based on the sensitivities assigned to the different receptors surrounding the site and numbers of receptors within certain distances of the site, a sensitivity classification can be defined for each.

Tables B2 to B4 indicate the criteria used to determine the sensitivity of the area to dust soiling, human health and ecological impacts.

Table B1: Examples of Factors Defining Sensitivity of an Area

Sensitivity of Area	Dust Soiling	Human Receptors	Ecological Receptors
High	<p>Users can reasonably expect enjoyment of a high level of amenity</p> <p>The appearance, aesthetics or value of their property would be diminished by soiling'</p> <p>The people or property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land.</p> <p>E.g. dwellings, museums and other important collections, medium and long term car parks and car showrooms.</p>	<p>10 – 100 dwellings within 20 m of site.</p> <p>Local PM₁₀ concentrations close to the objective (e.g. annual mean 36 -40 µg/m³).</p> <p>E.g. residential properties, hospitals, schools and residential care homes.</p>	<p>Locations with an international or national designation and the designated features may be affected by dust soiling.</p> <p>Locations where there is a community of a particularly dust sensitive species such as vascular species included in the Red List for Great Britain.</p> <p>E.g. A Special Area of Conservation (SAC).</p>
Medium	<p>Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home.</p> <p>The appearance, aesthetics or value of their property could be diminished by soiling</p> <p>The people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land.</p> <p>E.g. parks and places of work.</p>	<p>Less than 10 receptors within 20 m.</p> <p>Local PM₁₀ concentrations below the objective (e.g. annual mean 30-36 µg/m³).</p> <p>E.g. office and shop workers but will generally not include workers occupationally exposed to PM₁₀ as protection is covered by the Health and Safety at Work legislation.</p>	<p>Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown.</p> <p>Locations with a national designation where the features may be affected by dust deposition</p> <p>E.g. A Site of Special Scientific Interest (SSSI) with dust sensitive features.</p>
Low	<p>The enjoyment of amenity would not reasonably be expected.</p> <p>Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling.</p> <p>There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land.</p> <p>E.g. playing fields, farmland unless commercially sensitive horticultural, footpaths, short lived car [parks and roads.</p>	<p>Locations where human exposure is transient.</p> <p>No receptors within 20 m.</p> <p>Local PM₁₀ concentrations well below the objectives (less than 75%).</p> <p>E.g. public footpaths, playing fields, parks and shopping streets.</p>	<p>Locations with a local designation where the features may be affected by dust deposition.</p> <p>E.g. Local Nature Reserve with dust sensitive features.</p>

Table B2: Sensitivity of the Area to Dust Soiling on People and Property

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

Table B3: Sensitivity of the Area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM ₁₀ Concentration	Number of Receptors	Distance from Source (m)				
			<20	<50	<100	<200	<350
High	>32 µg/m ³	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 µg/m ³	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 µg/m ³	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 µg/m ³	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>32 µg/m ³	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	28-32 µg/m ³	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	24-28 µg/m ³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<24 µg/m ³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Table B4: Sensitivity of the Area to Ecological Impacts		
Receptor Sensitivity	Distance from the Source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Define the Risk of Impacts

The final step is to combine the dust emission magnitude determined in step 2A with the sensitivity of the area determined in step 2B to determine the risk of impacts with no mitigation applied. Tables B5 to B7 indicate the method used to assign the level of risk for each construction activity. The identified level of risk is then used to determine measures for inclusion within a site-specific Construction Management Plan (CMP) aimed at reducing dust emissions and hence reducing the impact of the construction phase on nearby receptors. The mitigation measures are drawn from detailed mitigation set out within the IAQM guidance document.

Table B5: Risk of Dust Impacts from Demolition			
Sensitivity of Area	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table B6: Risk of Dust Impacts from Earthworks/ Construction			
Sensitivity of Area	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table B7: Risk of Dust Impacts from Trackout			
Sensitivity of Area	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Appendix C – Verification and Adjustment of Modelled Concentrations

Most nitrogen dioxide (NO₂) is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions.

Verification of concentrations predicted by the ADMS model has followed the methodology presented in LAQM.TG(16).

Verification of the model results has been carried out against data recorded at the MA88ANO (Hyde Road) and MA96NO (Ardwick Green South) monitoring sites. Verification has been carried out against 2018 monitoring data.

The model output of road-NO_x (i.e. the component of total NO_x coming from road traffic) has been compared with the 'measured' road-NO_x (Figure C1). The 'measured' road NO_x has been calculated from the measured NO₂ concentrations by using the DEFRA NO_x from NO₂ calculator available on the UK-AIR website.

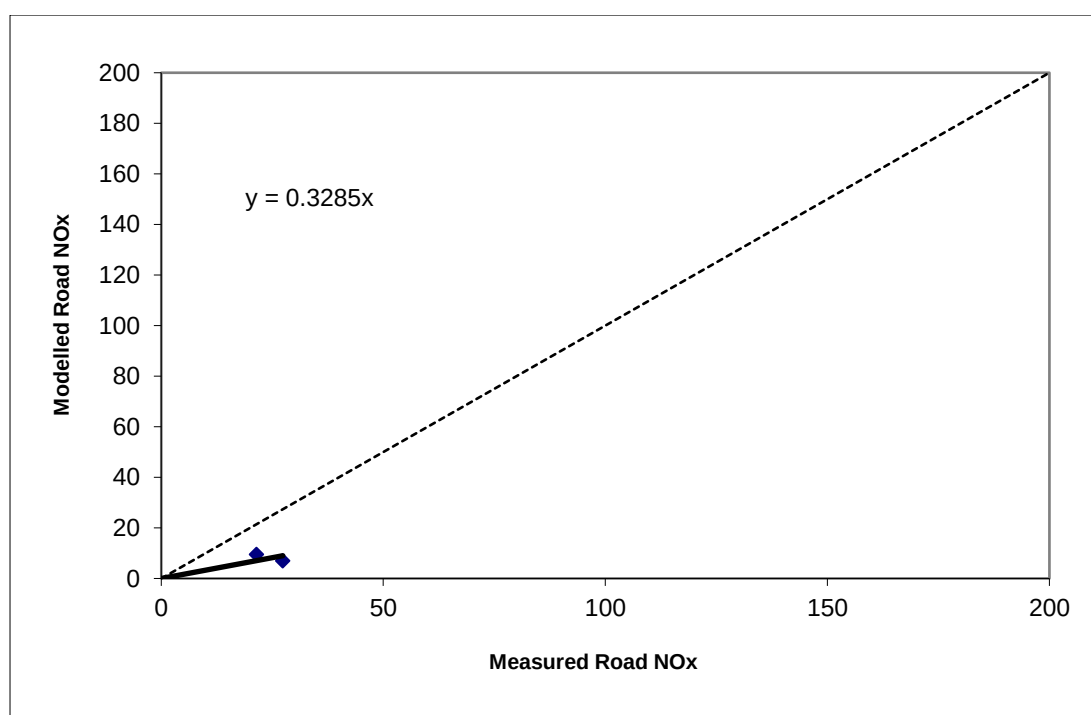


Figure C1: Comparison of Modelled Road NO_x with Measured Road NO_x

Figure C1 shows that the ADMS model is under-predicted the road-NO_x concentrations at the monitoring site. An adjustment factor has therefore been determined as the ratio between the measured road-NO_x contribution and the modelled road-NO_x contribution, forced through zero ($1/0.3285 = 3.04$). This factor has been applied to the modelled road-NO_x concentration for each location to provide an adjusted modelled road-NO_x concentration.

The annual mean road-NO₂ concentration was determined using the DEFRA NO_x:NO₂ spread sheet calculation tool and added to the background NO₂ concentration to produce a total adjusted NO₂ concentration.

Figure C2 shows the adjusted modelled total NO₂ vs monitored NO₂. There is good agreement, but the best fit line forced through zero still has a slight departure from a 1:1 line, thus a secondary adjustment factor, to be applied to the adjusted modelled total NO₂, was calculated ($1/1.0062=0.994$).

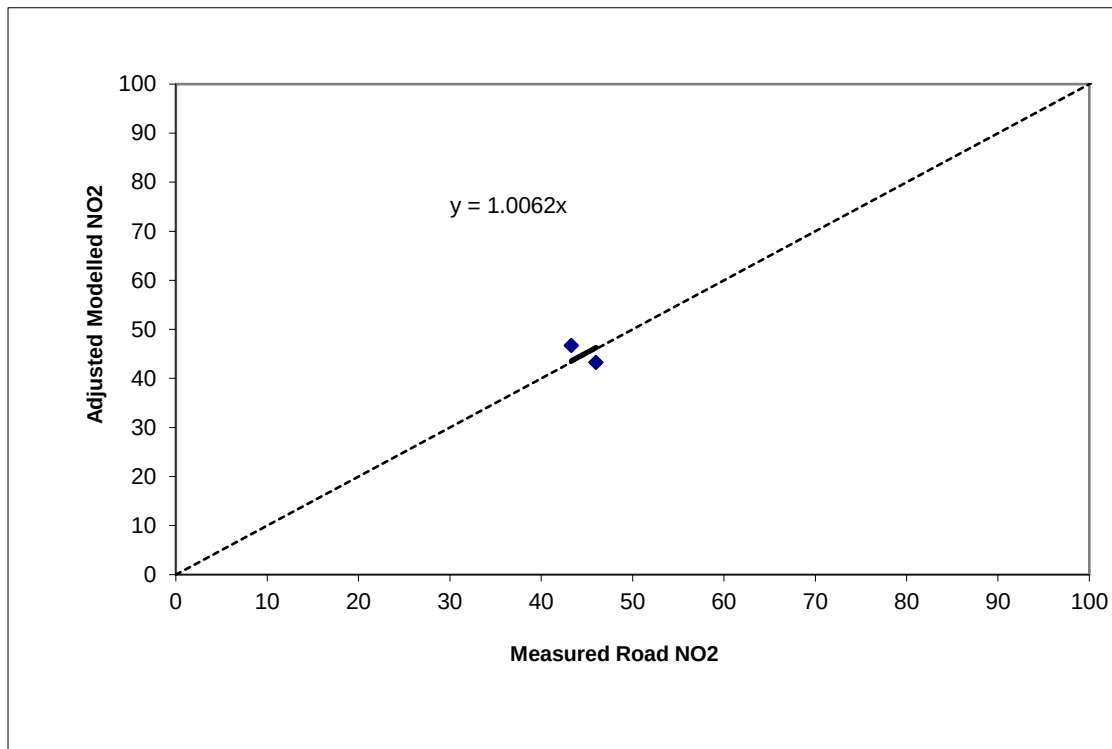


Figure C2: Comparison of Modelled NO₂ with Measured NO_x

After carrying out an initial adjustment there was a need for only a very small secondary adjustment of NO₂. The final adjustment modelled values are shown in Figure C3.

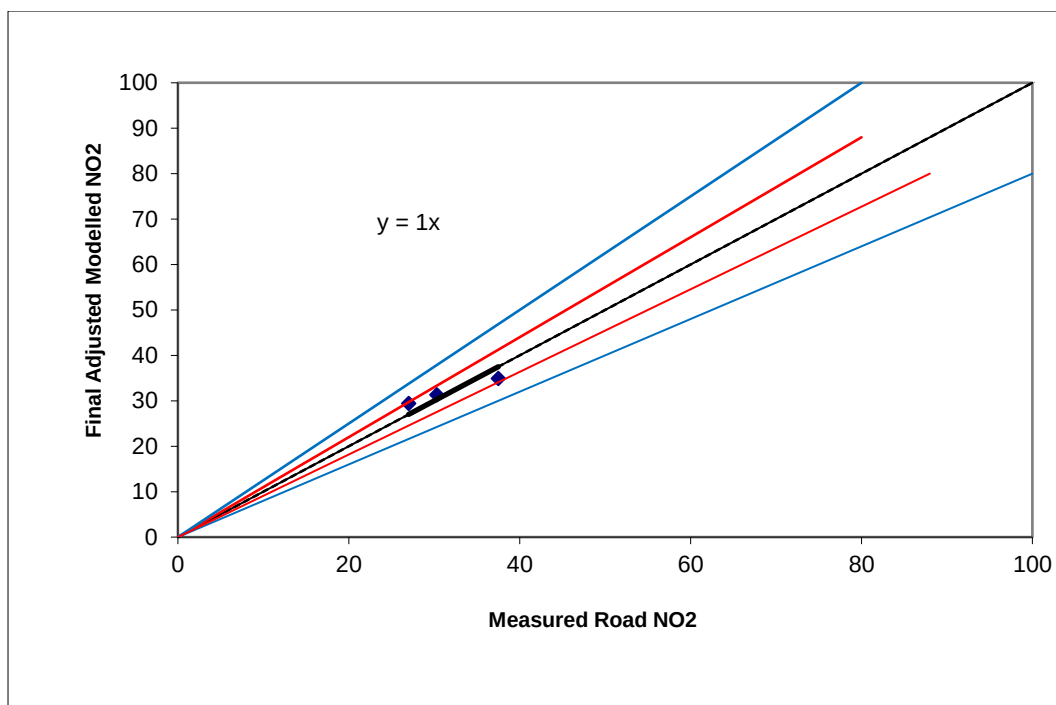


Figure B3: Comparison of Adjusted Modelled NO₂ with Measured NO_x

The adjustment factor of 3.04 has been applied to the modelled NO_x-road concentrations predicted at the selected receptor locations. The predicted NO₂-road concentrations, calculated using the NO_x-NO₂ converter tool, have subsequently been added to background NO₂ and adjusted by 0.994 to provide the final predicted annual mean NO₂ concentrations at each receptor.

These factors have also been used to adjust the predicted PM₁₀ and PM_{2.5} concentration.

Appendix D – Construction Mitigation Measures

It is recommended that the ‘highly recommended’ measures set out below are incorporated into a DMP and approved by MCC prior to commencement of any work on site:

- develop and implement a stakeholder communications plan that includes community engagement before work commences on site;
- display the name and contact details of the person accountable for air quality and dust issues on the site boundary (i.e. the environment manager/engineer or site manager);
- display the head or regional office contact information on the site boundary;
- record all dust and air quality complaints, identify cause, take appropriate measures to reduce emissions in a timely manner and record the measures taken;
- make the complaints log available to the local authority when asked;
- record any exceptional incidents that cause dust and/or air emissions, either on- or off- site and the action taken to resolve the situation in the log book;
- carry out regular site inspections to monitor compliance with the DMP, record inspection results and make inspection log available to MCC when asked;
- increase frequency of site inspection 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 periods of dry or windy conditions;
- plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible;
- erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles;
- fully enclose site or specific operations where there is a high potential for dust production and the activities are being undertaken for an extensive period;
- avoid site runoff of water or mud;
- keep site fencing, barriers and scaffolding clean using wet methods;
- remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If being re-used on site, cover as detailed below;
- cover, seed or fence stockpiles to prevent wind whipping;
- ensure all vehicles switch off engines when stationary - no idling vehicles;
- avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable;
- produce a construction logistic plan to manage the sustainable delivery of goods and materials;
- only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction e.g. suitable local exhaust ventilation systems;
- ensure an adequate water supply on site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate;
- use enclosed chutes and conveyors and covered skips;
- minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate;
- ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods;

- avoid bonfires and burning of waste materials;
- ensure effective water suppression is used during demolition operations;
- avoid blasting, using appropriate manual or mechanical alternatives;
- bag and remove any biological debris or damp down such material before demolition;
- ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out unless this is required for a particular reason;
- use water-assisted dust sweepers on local roads, to remove, as necessary, any material tracked out of the site;
- avoid dry sweeping of large areas;
- ensure haulage vehicles visiting the site are covered to prevent the escape of materials during transport;
- implement a travel plan that supports and encourages sustainable travel.

The following 'desirable' measures should also be considered for inclusion within the DMP:

- undertake daily on-site and off-site inspection, where receptors area nearby, to monitor, 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 the site boundary, with cleaning provided if necessary;
- re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable;
- use hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable;
- only remove the cover in small areas during work and not all at once;
- avoid scabbling (roughening of concrete surfaces) if possible;
- ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery;
- for smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust;
- soft strip inside buildings before demolition.

Appendix E – Dispersion Modelling Results

Table E1: Predicted Annual Mean NO ₂ Concentrations (µg/m ³)		
Receptor	Floor	NO ₂ Concentration
1	Ground floor	40.1
1a	1 st floor	36.0
	2 nd floor	34.2
	3 rd floor	33.7
	4 th floor	33.4
	5 th floor	33.2
	6 th floor	33.1
	7 th floor	33.0
	8 th floor	33.0
2	Ground floor	38.9
2a	1 st floor	36.1
	2 nd floor	34.4
	3 rd floor	33.8
	4 th floor	33.4
	5 th floor	33.2
	6 th floor	33.1
	7 th floor	33.0
	8 th floor	33.0
3	Ground floor	41.1
	1 st floor	35.9
	2 nd floor	34.2
	3 rd floor	33.6
	4 th floor	33.4
	5 th floor	33.2
	6 th floor	33.1
	7 th floor	33.0
	8 th floor	33.0
4	Ground floor	39.2
	1 st floor	35.5
	2 nd floor	34.1

Table E1: Predicted Annual Mean NO₂ Concentrations (µg/m³)

Receptor	Floor	NO ₂ Concentration
	3 rd floor	33.6
	4 th floor	33.3
	5 th floor	33.2
	6 th floor	33.1
	7 th floor	33.0
	8 th floor	33.0
5	Ground floor	37.0
	1 st floor	35.3
	2 nd floor	34.1
	3 rd floor	33.6
	4 th floor	33.3
	5 th floor	33.2
	6 th floor	33.1
	7 th floor	33.0
	8 th floor	33.0
6	Ground floor	35.8
	1 st floor	34.9
	2 nd floor	34.1
	3 rd floor	33.7
	4 th floor	33.4
	5 th floor	33.2
	6 th floor	33.1
	7 th floor	33.0
	8 th floor	33.0
7	Ground floor	35.8
	1 st floor	34.9
	2 nd floor	34.1
	3 rd floor	33.7
	4 th floor	33.4
	5 th floor	33.2
	6 th floor	33.1
	7 th floor	33.0

Table E1: Predicted Annual Mean NO₂ Concentrations (µg/m³)

Receptor	Floor	NO ₂ Concentration
	8 th floor	33.0
8	Ground floor	37.6
	1 st floor	35.6
	2 nd floor	34.3
	3 rd floor	33.7
	4 th floor	33.4
	5 th floor	33.2
	6 th floor	33.1
	7 th floor	33.0
	8 th floor	33.0

Table E2: Predicted Annual Mean PM₁₀ Concentrations (µg/m³)

Receptor	Floor	PM ₁₀ Concentration
1	Ground floor	13.7
1a	1 st floor	12.9
	2 nd floor	12.5
	3 rd floor	12.4
	4 th floor	12.3
	5 th floor	12.3
	6 th floor	12.3
	7 th floor	12.3
	8 th floor	12.3
2	Ground floor	13.4
2a	1 st floor	12.8
	2 nd floor	12.5
	3 rd floor	12.4
	4 th floor	12.3
	5 th floor	12.3
	6 th floor	12.3
	7 th floor	12.3
	8 th floor	12.3
3	Ground floor	13.9

Table E2: Predicted Annual Mean PM₁₀ Concentrations (µg/m³)

Receptor	Floor	PM ₁₀ Concentration
	1 st floor	12.8
	2 nd floor	12.5
	3 rd floor	12.4
	4 th floor	12.3
	5 th floor	12.3
	6 th floor	12.3
	7 th floor	12.3
	8 th floor	12.3
4	Ground floor	13.5
	1 st floor	12.7
	2 nd floor	12.5
	3 rd floor	12.4
	4 th floor	12.3
	5 th floor	12.3
	6 th floor	12.3
	7 th floor	12.3
	8 th floor	12.3
5	Ground floor	13.1
	1 st floor	12.7
	2 nd floor	12.5
	3 rd floor	12.4
	4 th floor	12.3
	5 th floor	12.3
	6 th floor	12.3
	7 th floor	12.3
	8 th floor	12.3
6	Ground floor	12.8
	1 st floor	12.6
	2 nd floor	12.5
	3 rd floor	12.4
	4 th floor	12.3
	5 th floor	12.3

Table E2: Predicted Annual Mean PM ₁₀ Concentrations (µg/m ³)		
Receptor	Floor	PM ₁₀ Concentration
	6 th floor	12.3
	7 th floor	12.3
	8 th floor	12.3
7	Ground floor	12.8
	1 st floor	12.6
	2 nd floor	12.5
	3 rd floor	12.4
	4 th floor	12.3
	5 th floor	12.3
	6 th floor	12.3
	7 th floor	12.3
	8 th floor	12.3
8	Ground floor	13.1
	1 st floor	12.7
	2 nd floor	12.5
	3 rd floor	12.4
	4 th floor	12.3
	5 th floor	12.3
	6 th floor	12.3
	7 th floor	12.3
	8 th floor	12.3

Table E3: Predicted Annual Mean PM _{2.5} Concentrations (µg/m ³)		
Receptor	Floor	PM _{2.5} Concentration
1	Ground floor	8.9
1a	1 st floor	8.4
	2 nd floor	8.2
	3 rd floor	8.1
	4 th floor	8.1
	5 th floor	8.1
	6 th floor	8.1
	7 th floor	8.1

Table E3: Predicted Annual Mean PM_{2.5} Concentrations (µg/m³)

Receptor	Floor	PM _{2.5} Concentration
	8 th floor	8.1
2	Ground floor	8.7
2a	1 st floor	8.4
	2 nd floor	8.2
	3 rd floor	8.2
	4 th floor	8.1
	5 th floor	8.1
	6 th floor	8.1
	7 th floor	8.1
	8 th floor	8.1
3	Ground floor	9.0
	1 st floor	8.4
	2 nd floor	8.2
	3 rd floor	8.1
	4 th floor	8.1
	5 th floor	8.1
	6 th floor	8.1
	7 th floor	8.1
	8 th floor	8.1
4	Ground floor	8.8
	1 st floor	8.4
	2 nd floor	8.2
	3 rd floor	8.1
	4 th floor	8.1
	5 th floor	8.1
	6 th floor	8.1
	7 th floor	8.1
	8 th floor	8.1
5	Ground floor	8.5
	1 st floor	8.3
	2 nd floor	8.2
	3 rd floor	8.1

Table E3: Predicted Annual Mean PM_{2.5} Concentrations (µg/m³)

Receptor	Floor	PM _{2.5} Concentration
	4 th floor	8.1
	5 th floor	8.1
	6 th floor	8.1
	7 th floor	8.1
	8 th floor	8.1
6	Ground floor	8.4
	1 st floor	8.3
	2 nd floor	8.2
	3 rd floor	8.2
	4 th floor	8.1
	5 th floor	8.1
	6 th floor	8.1
	7 th floor	8.1
	8 th floor	8.1
7	Ground floor	8.4
	1 st floor	8.3
	2 nd floor	8.2
	3 rd floor	8.2
	4 th floor	8.1
	5 th floor	8.1
	6 th floor	8.1
	7 th floor	8.1
	8 th floor	8.1
8	Ground floor	8.6
	1 st floor	8.4
	2 nd floor	8.2
	3 rd floor	8.2
	4 th floor	8.1
	5 th floor	8.1
	6 th floor	8.1
	7 th floor	8.1
	8 th floor	8.1

