Great George Street Developments Ltd

# Phase 2 and 3 Great George Street, Liverpool

## Air Quality Assessment

Issue | 5 October 2018

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 260088

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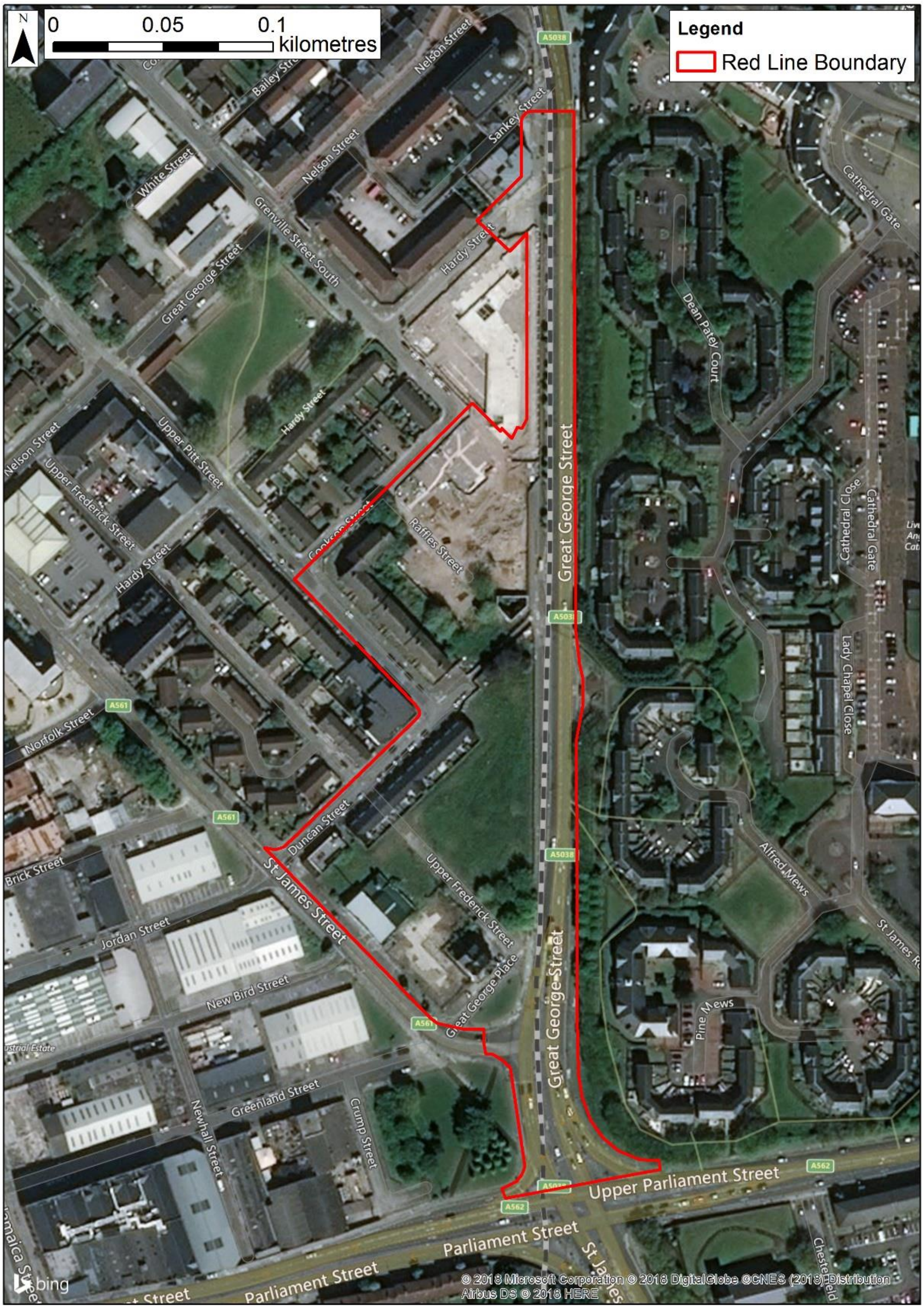
# 1 Introduction

Ove Arup and Partners (Arup) has been commissioned to undertake an air quality assessment of Phase 2 and 3 of the proposed Great George Street development in Liverpool.

Air quality studies are concerned with the presence of airborne pollutants in the atmosphere. This report assesses the potential impact of the proposed phase masterplan development on air quality in the vicinity of the development. This report outlines relevant air quality management policy and legislation and describes the existing air quality conditions in the vicinity of the site, before assessing the impact of the proposed development, its significance and any mitigation required.

The proposed development is located west of Great George Street. Residential areas are located to the west of the site and to the east, across Great George Street. There are commercial and retail areas to the north and south of the site.

Figure 1: Site location



# 2 Legislation

## 2.1 European Air Quality Management

In May 2008 the Directive 2008/50/EC[1] on ambient air quality and cleaner air for Europe came into force. This Directive consolidates earlier directives (except the 4th Daughter Directive, which will be brought into the new Directive at a later date), providing EU limit values for specified pollutants and provides a new regulatory framework for fine particulate matter ($PM_{2.5}$). The European Directive has been transposed into national legislation in England in the Air Quality Standards 2010[2]. The Secretary of State for the Environment has the duty of ensuring compliance with the air quality limit values.

## 2.2 Air Quality Objectives and Limit Values

Air quality limit values and objectives are quality standards for clean air. Some pollutants have standards expressed as annual average (long-term) concentrations due to the chronic way in which they affect health or the natural environment (i.e. effects occur after a prolonged period of exposure to elevated concentrations) and others have standards expressed as 24-hour, 1-hour or 15-minute average (short-term) concentrations due to the acute way in which they affect health or the natural environment (i.e. after a relatively short period of exposure). Some pollutants have standards expressed in terms of both long-term and short-term concentrations. Table 1 sets out these EU air quality limit values and national air quality objectives for the pollutants of greatest concern in the UK ($NO_2$ and particulate matter).

Table 1: Air quality standards

| Pollutant | Averaging period | Limit value / Objective |
|---|---|---|
| **Nitrogen Dioxide ($NO_2$)** | Annual mean | 40µg/m$^3$ |
| | 1-hour mean | 200µg/m$^3$ not to be exceeded more than 18 times a year (99.8th percentile) |
| **Fine Particulate Matter ($PM_{10}$)** | Annual mean | 40µg/m$^3$ |
| | 24-hour mean | 50µg/m$^3$ not to be exceeded more than 35 times a year (90.41st percentile) |
| **Very Fine Particulate Matter ($PM_{2.5}$)** | Annual mean | 25µg/m$^3$ |

[1] 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
[2] HMSO, Air Quality Standards Regulations 2010 SI No. 1001

## 2.3 Environment Act 1995

Part IV of the Environment Act 1995[3] places a duty on the Secretary of State for the Environment to develop, implement and maintain an Air Quality Strategy with the aim of reducing atmospheric emissions and improving air quality. The Air Quality Strategy[4] for England, Scotland, Wales and Northern Ireland provides the national air quality objectives and a framework for ensuring compliance with these values based on a combination of international, national and local measures to reduce emissions and improve air quality. This includes the statutory duty, also under Part IV of the Environment Act 1995, for local authorities to undergo a process of local air quality management and declare Air Quality Management Areas (AQMA) where pollutant concentrations exceed the national air quality objectives.  Where an AQMA is declared the local authority would also need to produce an Air Quality Action Plan (AQAP) which outlines the strategy for improving air quality in these areas.

## 2.4 Dust Nuisance

Dust is the generic term used in the British Standard document BS 6069 (Part Two) to describe particulate matter in the size range 1–75µm in diameter. Dust nuisance is the result of the perception of the soiling of surfaces by excessive rates of dust deposition. Under provisions in the Environmental Protection Act 1990[5], dust nuisance is defined as a statutory nuisance.

There are currently no standards or guidelines for dust nuisance in the UK, nor are formal dust deposition standards specified. This reflects the uncertainties in dust monitoring technology and the highly subjective relationship between deposition events, surface soiling and the perception of such events as a nuisance. In law, complaints about excessive dust deposition would have to be investigated by the local authority and any complaint upheld for a statutory nuisance to occur. However, dust deposition is generally managed by suitable on-site practices and mitigation rather than by the determination of statutory nuisance and/or prosecution or enforcement notice(s).

3 Environment Act 1995, Chapter 25, Part IV Air Quality
4 Defra (2007) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, Volume 1, July 2007
[5]Environmental Protection Act 1990, Chapter 43, Part III Statutory Nuisances and Clean Air

# 3 Planning Policy and Guidance

## 3.1 National Planning Policy Framework

The National Planning Policy Framework[6] (NPPF) was published in July 2018 with the purpose of planning to achieve sustainable development. Paragraph 181 of the NPPF on air quality 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.*"

In addition, paragraph 103 states that:

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

Paragraph 170 discusses how planning policies and decisions should contribute to and enhance the natural and local environment. In relation to air quality, NPPF notes that this can be achieved 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*"

[6] Department for Communities and Local Government (2018) National Planning Policy Framework

### 3.1.1 Planning Practice Guidance (2014)

Planning Practice Guidance[7] (PPG) on various topics was published, including air quality, to supplement the NPPF. However, the PPG in relation to air quality has not yet been updated to reflect the changes in the latest NPPF published in July 2018 as outlined above. The current version of the guidance refers to the significance of air quality assessments to determine the impacts of proposed developments in the area and describes the role of local and neighbourhood plans with regard to air quality. It also provides a flowchart method to assist local authorities to determine how considerations of air quality fit into the development management process.

## 3.2 Local Planning Policies

Liverpool City Council (LCC) is in the process of producing a Local Plan for Liverpool which was published for consultation in January 2018. In the pre-submission draft of the local plan[8], policy STP2 (Sustainable Growth Principles and Managing Environmental Impacts) refers to air quality:

> "*1. New development should seek to avoid negative impacts on the environment through adoption of best practice. Where a negative effect is identified this should be mitigated by appropriate measures. Specifically, to ensure the sustainable growth of the City, new development should:*
>
> …
>
> *m. Minimise adverse impacts on, and include measures to improve air quality within the City;"*

Policy R1 (Air, Light and Noise Pollution) also states:

> "*1. Development proposals which are likely to have a pollution impact should demonstrate that:*
>
> *a. Appropriate measures are incorporated to avoid pollution to air, water and soil;*
>
> …
>
> *c. The proposal will not undermine the achievement of Air Quality Management Area (AQMA) objectives; and*
>
> *d. It will not lead to a significant decline in air quality"*

LCC was preparing the Core Strategy before the Local plan. The Draft Core Strategy[9] includes Strategic Policy 33: Environmental Impacts which states that:

[7] Department for Communities and Local Government (2014) Planning Practice Guidance: Air Quality
[8] Liverpool City Council, Liverpool Local Plan 2013-2033, Pre-submission draft, January 2018
[9] Liverpool City Council, Submission Draft, Liverpool Core Strategy, 2012

*"1. New development should seek to avoid negative impacts on the environment through adoption of best practice. Where a negative effect is identified this should be mitigated by appropriate measures. Specifically, development proposals should:*

*a. Minimise adverse impacts on, and include measures to improve, air quality within the city.*

*…*

*While this policy seeks to ensure that development contributes to improving air quality in Liverpool, the Core Strategy more generally seeks to achieve this by reducing the need to travel, and encouraging increased use of sustainable transport modes, including walking and cycling."*

## 3.3 Local Air Quality Management Policy Guidance (2016)

The 2016 policy guidance note from Defra, LAQM (PG16)[10], provides additional guidance on the links between transport and air quality. LAQM (PG16) describes how road transport contributes to local air pollution and how transport measures may bring improvements in air quality. Key transport-related Government initiatives are set out, including regulatory measures and standards to reduce vehicle emissions and improve fuels, tax-based measures and the development of an integrated transport strategy.

LAQM (PG16) also provides guidance on the links between air quality and the land-use planning system. The guidance advises that air quality considerations should be integrated into the planning process at the earliest stage and is intended to aid local authorities in developing action plans to deal with specific air quality problems and create strategies to improve air quality. It summarises the main ways in which the land use planning system can help deliver compliance with the air quality objectives.

Technical Guidance (TG16)[11] is designed to support local authorities in carrying out their duties to review and assess air quality in their area.

## 3.4 IAQM Guidance on the Assessment of Dust from Demolition and Construction (2014)

The 2014 Institute of Air Quality Management (IAQM) guidance[12] provides guidance to development consultants and environmental health officers on how to assess air quality impacts from construction. The IAQM guidance provides a method for classifying the significance of effect from construction activities based on the 'dust magnitude' (high, medium or low) and proximity of the site to the closest receptors. The guidance recommends that once the significance of effect from construction is identified, the appropriate mitigation measures are

[10] Defra (2016) Local Air Quality Management Policy Guidance, PG16
[11] Defra (2016) Local Air Quality Management Technical Guidance, TG16
[12] IAQM (2014) Guidance on the Assessment of Dust from Demolition and Construction

implemented. Experience has shown that once the appropriate mitigation measures are applied in most cases the resulting dust impacts can be reduced to negligible levels.

## 3.5 EPUK/IAQM Land-Use Planning & Development Control (2017)

The 2017 Land-Use Planning & Development Control guidance document[13] provides a framework for professionals operating in the planning system to provide a means of reaching sound decisions, having regard to the air quality implications of development proposals.

The document provides guidance on when air quality assessments are required by providing screening criteria regarding the size of a development, changes to traffic flows/composition energy facilities or combustion processes associated with the development.

[13] Environmental Protection UK (EPUK), Institute of Air Quality Management (IAQM) (2017) Land-Use Planning & Development Control: Planning For Air Quality

# 4 Methodology

The overall approach to the air quality assessment comprises:

- A review of the existing air quality conditions at and in the vicinity of the proposed development sites;
- An assessment of the potential changes in air quality, and their significance, arising from the construction and operation of the proposed development;
- Formulation of mitigation measures, where necessary, to ensure any adverse effects on air quality are minimised.

The methodology for this assessment was discussed and agreed with the Environmental Health Officer at Liverpool City Council (CCC).

## 4.1 Methodology for Establishing Baseline Conditions

The baseline ambient air quality in this assessment refers to the concentration of relevant substances that are already present in the environment. These are present from various sources, such as industrial processes, commercial and domestic activities, traffic and natural sources.

The following data sources have been used to determine the baseline and future conditions of air quality in the study area:

- The LCC review and assessment report and local air quality monitoring data;
- The Defra Local Air Quality Management website[14];
- The Environment Agency website[15].

Sensitive receptors are defined as those properties/schools/hospitals that are likely to experience a change in pollutant concentrations and/or dust nuisance due to the construction of the proposed development.

## 4.2 Methodology for Assessment of Effects from Construction

The effects from demolition and construction have been assessed using the qualitative approach described in the latest guidance[9] by the Institute of Air Quality Management (IAQM).

An 'impact' is described as a change in pollutant concentrations or dust deposition, while an 'effect' is described as the consequence of an impact. The

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[14] Defra Local Air Quality Management website; http://laqm.defra.gov.uk/; [Accessed: September 2018]
[15] Environment Agency website; https://environment.data.gov.uk/public-register/view/search-industrial-installations; [Accessed: September 2018]

main impacts that may arise during demolition and construction of the proposed development are:

- Dust deposition, resulting in the soiling of surfaces;
- Visible dust plumes;
- Elevated $PM_{10}$ concentrations as a result of dust generating activities on site; and
- An increase in $NO_2$ and $PM_{10}$ concentrations due to exhaust emissions from non-road mobile machinery and vehicles accessing the site.

The IAQM guidance considers the potential for dust emissions from activities such as demolition of existing structures, earthworks, construction of new structures and trackout. Earthworks refer to the processes of soil stripping, ground levelling, excavation and land capping, while trackout is the transport of dust and dirt from the site onto the public road network where it may be deposited and then re-suspended by vehicles using the network. This arises when vehicles leave the site with dust materials, which may then spill onto the road, or when they travel over muddy ground on site and then transfer dust and dirt onto the road network.

For each of these dust-generating activities, the guidance considers three separate effects: annoyance due to dust soiling; harm to ecological receptors; and the risk of health effects due to a significant increase in $PM_{10}$ exposure. The receptors can be human or ecological and are chosen based on their sensitivity to dust soiling and $PM_{10}$ exposure.

The methodology takes into account the scale to which the above effects are likely to be generated (classed as small, medium or large), along with the levels of background $PM_{10}$ concentrations and the distance to the closest receptor, in order to determine the sensitivity of the area. This is then taken into consideration when deriving the overall risk for the site. Suitable mitigation measures are also proposed to reduce the risk of the site.

There are five steps in the assessment process described in the IAQM guidance. These are summarised in Figure 2 and a further description is provided in the following paragraphs.

**Step 1: Need for assessment**

The first step is the initial screening for the need for a detailed assessment. According to the IAQM guidance, an assessment is required where there are sensitive receptors within 350m of the site boundary (for ecological receptors that is 50m) and/or within 50m of the route(s) used by the construction vehicles on the public highway and up to 500m from the site entrance(s).

**Step 2: Assess the risk of dust impacts**

This step is split into three sections as follows:

- 2A. Define the potential dust emission magnitude;
- 2B. Define the sensitivity of the area; and
- 2C. Define the risk of impacts.

Each of the dust-generating activities is given a dust emission magnitude depending on the scale and nature of the works (step 2A) based on the criteria shown in Table B.1 (Appendix B).

The sensitivity of the surrounding area is then determined (step 2B) for each dust effect from the above dust-generating activities, based on the proximity and number of receptors, their sensitivity to dust, the local $PM_{10}$ background concentrations and any other site-specific factors. Tables B.2 to B.4 (Appendix B) show the criteria for defining the sensitivity of the area to different dust effects.

The overall risk of the impacts for each activity is then determined (step 2C) prior to the application of any mitigation measures (Table B.5, Appendix B) and an overall risk for the site derived.

**Step 3: Determine the site-specific mitigation**

Once each of the activities is assigned a risk rating, appropriate mitigation measures are identified. Where the risk is negligible, no mitigation measures beyond those required by legislation are necessary.

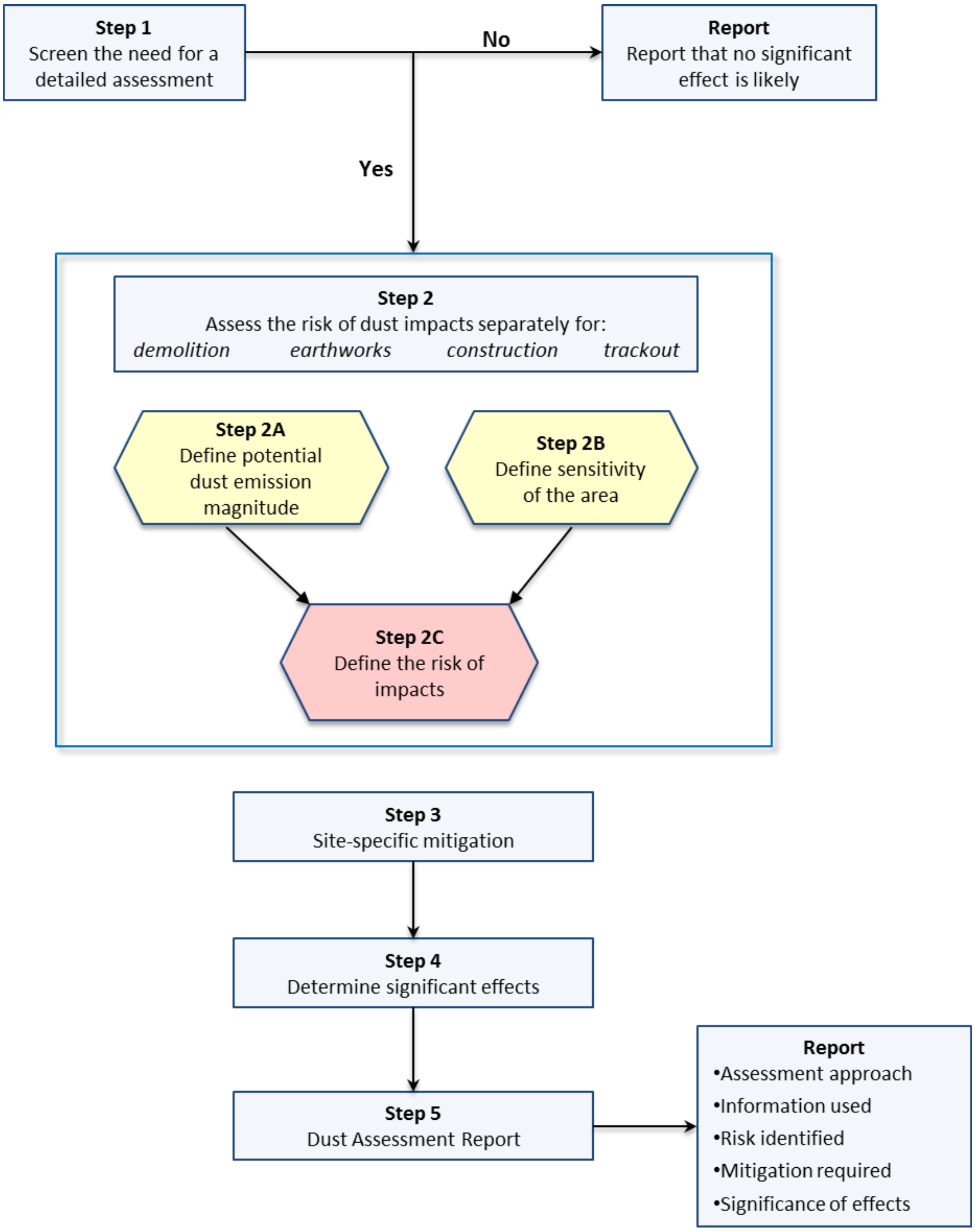
**Step 4: Determine any significant residual effects**

Once the risk of dust impacts has been determined and the appropriate dust mitigation measures identified, the final step is to determine whether there are any residual significant effects. The IAQM guidance notes that it is anticipated that with the implementation of effective site-specific mitigation measures, the environmental effect will not be significant in most cases.

**Step 5: Prepare a dust assessment report**

The last step of the assessment is the preparation of a Dust Assessment Report, if required. Mitigation relating to construction dust is listed in section 7.1.

Figure 2: IAQM dust assessment methodology



### 4.2.1 Construction Traffic

At this early stage, no forecast of construction vehicle traffic is available. Consequently, the effects from construction traffic accessing the site have not been assessed. While effects associated with construction traffic would be temporary they should be screened against the EPUK criteria to confirm whether a detailed assessment is required. A detailed assessment would be required if there are more than 25 HGV AADT movements. With this said, the construction traffic is not expected to exceed the screening criteria.

## 4.3 Methodology for Assessment of Effects from Operation

### 4.3.1 Car park ventilation

There is expected to be mechanical ventilation serving the basement car park. However, the ventilation has not yet been designed. The design should consider locating the ventilation extract for the car park more than 20m from sensitive receptors. This is because EPUK/IAQM guidance[13] indicates that if a ventilation extract for a car park that is underground, is located more than 20m from sensitive receptors, a detailed assessment is not required. Therefore, it is not considered to impact the air quality at sensitive receptors.

### 4.3.2 Road Traffic Emissions

The proposed development has the potential to impact existing air quality because of road traffic exhaust emissions, such as $NO_2$, $PM_{10}$ and $PM_{2.5}$, associated with vehicles travelling to and from the site. A screening assessment was therefore undertaken using the criteria contained within the EPUK/IAQM land-use guidance document[10] to determine potential local air quality effects associated with the significant potential trip generation because of the proposed development.

As the proposed development is located within the LCC AQMA, the EPUK/IAQM guidance document states the following criteria to help establish when an air quality assessment is likely to be considered necessary:

- A change of Light Duty Vehicle flows of more than 100 Annual Average Daily Traffic (AADT) movements; and
- A change of Heavy Duty Vehicle flows of more than 25 AADT movements.

In accordance with EPUK/IAQM[16], as change in traffic flows would be in excess of 100 movements per day, an air quality assessment is required.

Effects of traffic generated by the Proposed Development have been assessed using the ADMS-Roads atmospheric dispersion model. The assessment follows

[16] Environmental Protection UK (EPUK), Institute of Air Quality Management (IAQM) (2017) Land-Use Planning & Development Control: Planning For Air Quality

the methodology set out in Defra's LAQM Technical Guidance (LAQM TG16)[11], and the inputs and processes used are detailed in the following sections.

### 4.3.3 Traffic Data

Traffic data was obtained from the transport planners (Arup) for the Proposed Development for the major roads surrounding the site.

The assessment scenarios are summarised as follows:

- 2017 baseline scenario;
- 2023 opening year Do-Minimum (DM) scenario; and,
- 2023 opening year Do-Something (DS) scenario.

The latest full year of ratified monitoring data available at the time of writing was 2017. To enable validation with local monitoring data, 2017 was therefore modelled as the baseline year. Traffic data was provided for 2017 by Arup.

The 2023 DM scenario represents the opening year scenario without the proposed developments but includes traffic associated with Phase 1 of the Great George Street development, which is a committed development that will be operational by 2023. The 2023 DS scenario represents the opening year scenario with traffic associated with both the Phase 1 committed development and the proposed Phase 2 and 3 developments in full operation.

The data consists of 24-hour Annual Average Daily Traffic (AADT) flows, average speeds and percentages of heavy goods vehicles (HGVs) for each of the road links for the Do-something (DS) 2023 and Do-minimum (DM) 2023, i.e. with and without the scheme, respectively.

Data was screened in accordance with the relevant EPUK/IAQM criteria listed in section 4.3.1, which confirmed the need for a detailed modelling assessment. Traffic data for the model road network are given in Appendix C and the location of these roads shown in Figure 3.

Emission rates for all road sources were calculated using the UK Defra Emissions Factor Toolkit (EFT) v8.0.1[17]. A reduced speed of 20 kilometres per hour (kph) was applied to junction from a distance of 25m to 50m, following the LAQM TG16 guidance[11], with the exception of the A5038, A562 and A561 junction where the speed was applied to a length of up to 100m from the junction. This is because this junction is quite large and vehicles could be expected to start slowing down earlier.

Modelling has been carried out using 2023 background concentrations and 2023 vehicle emissions from the EFT. This is predicted to be the optimistic scenario in terms of air quality impact. Vehicle emissions and background air quality are predicted to improve over time due to the introduction of cleaner vehicles into the vehicle fleet. However, there is uncertainty as to how effective the introduction of new vehicle emissions limits will be. To account for this uncertainty, a sensitivity

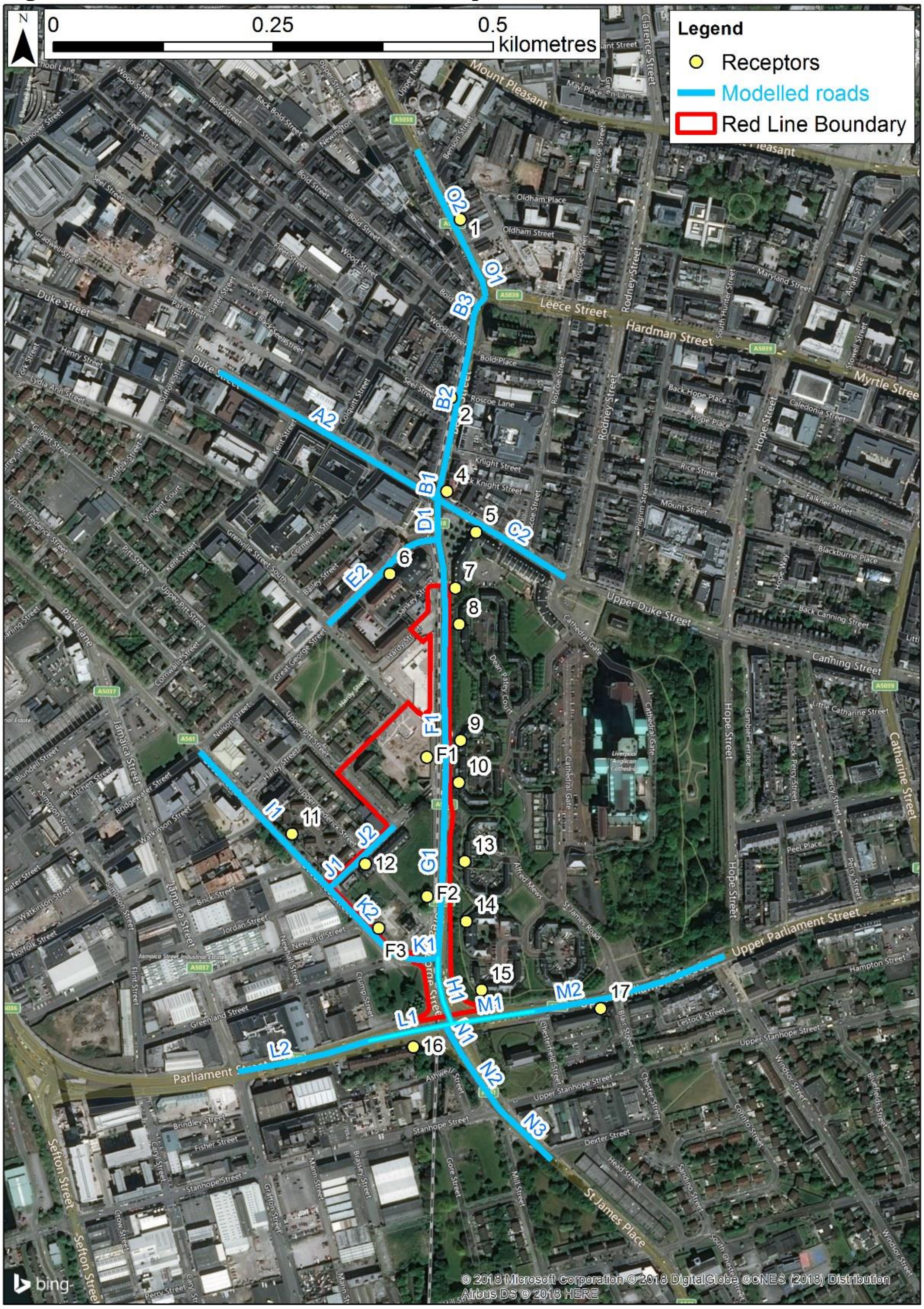
[17] Defra, Emissions Factor Toolkit 2017, Available from: https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html [Accessed: June 2018]

test has been carried out assuming no improvement in vehicle emissions or background concentrations between 2017 and 2023.

#### 4.3.3.1 Sensitivity Test

Vehicle emissions from the EFT and background concentrations for the 2017 baseline have been used in the future year scenarios for the sensitivity test. This represents a pessimistic scenario, as some reductions in vehicle emissions are likely by 2023. Modelling has therefore also been carried out using 2017 background concentrations and vehicle emissions.

Figure 3: Modelled road network and receptors



### 4.3.4 Sensitive Receptors

Pollutant concentrations have been forecast at existing and future sensitive receptors. Sensitive receptors, such as those close to junctions and closest to the road have been selected as representative receptors for this assessment.

Details of the assessed receptors are given in Table 2 and their locations are shown in Figures 3. A height of 1.5m corresponds to human exposure at ground level. It has been assumed that each floor is 3m, therefore first floor receptors are at 4.5m. The future receptors are located at the façade of the proposed buildings that face the surrounding road network. The residential receptors at these façades are only present at the 2$^{nd}$ floor, at an assumed height of 7.5m.

Table 2: Assessed receptors for operational traffic emissions

| ID | Receptor | National Grid Reference | | Height (m) |
|---|---|---|---|---|
| | | X | Y | |
| **Existing receptors** | | | | |
| 1a | Renshaw Street (retail) | 335205 | 390007 | 1.5 |
| 1b | Renshaw Street (residential) | 335205 | 390007 | 4.5 |
| 2a | Berry Street (retail) | 335194 | 389805 | 1.5 |
| 2b | Berry Street (residential) | 335194 | 389805 | 4.5 |
| 3a | Duke Street (restaurant) | 335170 | 389705 | 1.5 |
| 3b | Duke Street (residential) | 335170 | 389705 | 4.5 |
| 4a | Upper Duke Street (restaurant) | 335190 | 389698 | 1.5 |
| 4b | Upper Duke Street (residential) | 335190 | 389698 | 4.5 |
| 5 | Upper Duke Street (residential) | 335223 | 389652 | 1.5 |
| 6a | Nelson Street (retail) | 335125 | 389604 | 1.5 |
| 6b | Nelson Street (residential) | 335125 | 389604 | 4.5 |
| 7 | Great George Street (residential) | 335199 | 389588 | 1.5 |
| 8 | Great George Street (residential) | 335204 | 389547 | 1.5 |
| 9 | Great George Street (residential) | 335205 | 389415 | 1.5 |
| 10 | Great George Street (residential) | 335204 | 389367 | 1.5 |
| 11 | St James Street (residential) | 335014 | 389309 | 1.5 |
| 12 | Duncan Street (residential) | 335097 | 389274 | 1.5 |
| 13 | Great George Street (residential) | 335210 | 389277 | 1.5 |
| 14 | Great George Street (residential) | 335212 | 389209 | 1.5 |
| 15 | Upper Parliament Street (residential) | 335229 | 389131 | 1.5 |
| 16 | Parliament Street (residential) | 335152 | 389067 | 1.5 |
| 17 | Upper Parliament Street (residential) | 335365 | 389110 | 1.5 |
| **Future receptors** | | | | |

| ID | Receptor | National Grid Reference | | Height (m) |
|---|---|---|---|---|
| | | X | Y | |
| F1a | Great George Street (commercial) | 335167 | 389396 | 1.5 |
| F1b | Great George Street (residential) | 335167 | 389396 | 7.5 |
| F2a | Great George Street (commercial) | 335167 | 389238 | 1.5 |
| F2b | Great George Street (residential) | 335167 | 389238 | 7.5 |
| F3a | St James Street (commercial) | 335113 | 389202 | 1.5 |
| F3b | St James Street (residential) | 335113 | 389202 | 7.5 |

### 4.3.5 Dispersion Model

Detailed dispersion modelling of $NO_x$, $PM_{10}$ and $PM_{2.5}$ emissions was undertaken using ADMS-Roads (version 4.1) atmospheric dispersion model from Cambridge Environmental Research Consultants (CERC). Predicted $NO_x$ concentrations have been processed to determine annual mean $NO_2$ concentrations for comparison with the annual mean $NO_2$ objectives.

The ADMS suite of models has been widely validated for road sources. It is regularly tested against other dispersion models by the EA's Air Quality Modelling and Assessment Unit (AQMAU) and is suitable for EIAs. The model incorporates the latest understanding of boundary layer meteorology and dispersion.

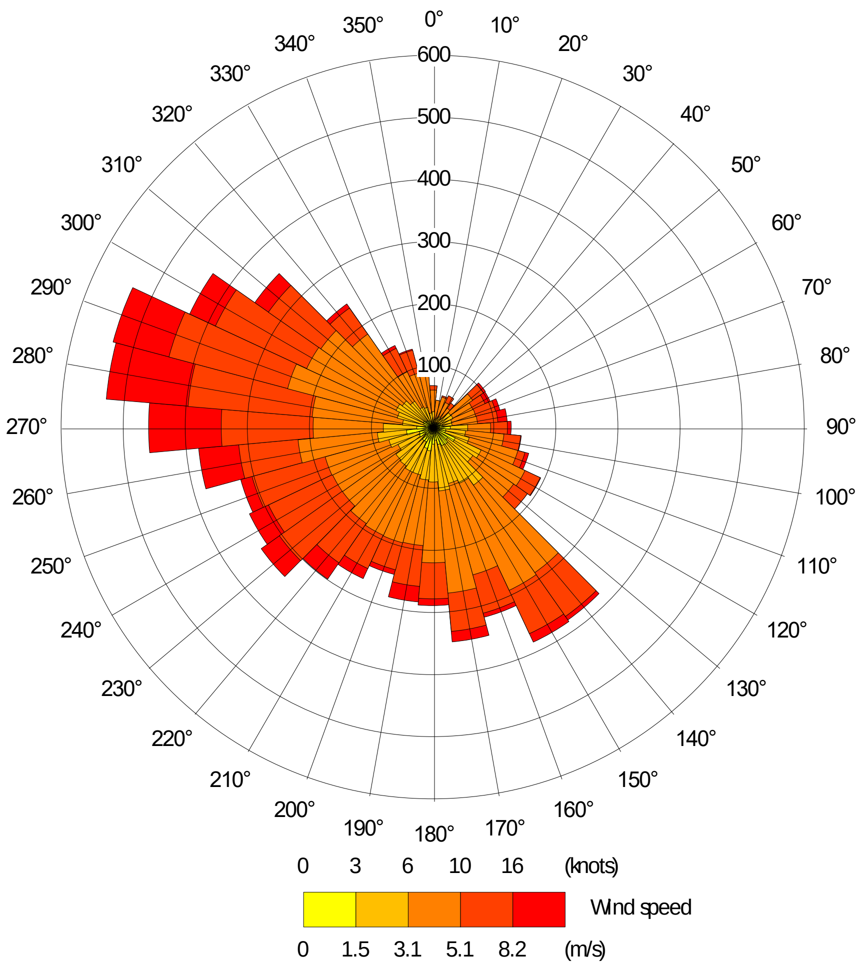
### 4.3.6 Meteorological Data

Meteorological data used in this assessment was measured at Liverpool John Lennon Airport meteorological station for 2017. Liverpool Airport is located approximately 11km to the south-east of Great George Street, and due to its location, is considered to be the most representative meteorological station. Figure 4 shows the data as wind roses for 2017. The predominant wind direction is north north-westerly.

In order for the modelling exercise to be representative of local conditions and to predict long-term averages, the dispersion model requires representative meteorological data. Most dispersion models for roads do not use meteorological data if they relate to calm winds conditions, as dispersion in calm conditions is difficult to calculate in Gaussian or advanced Gaussian models. ADMS-Roads treats calm wind conditions by setting the minimum wind speed to 0.75m/s. Defra's LAQM.TG16[11] guidance recommends that the meteorological data file is tested within a dispersion model and the relevant output log file checked to confirm the number of missing hours and calm hours that cannot be used by the dispersion model. This is important when considering predictions of high percentiles and the number of exceedances. The guidance recommends that meteorological data should only be used if the percentage of usable hours is greater than 75% and preferably 90%.

The datasets used includes 8,707 lines of usable hourly data (about 99% of the hours in a year), well above the 90% threshold; therefore, the data meets the requirements of the Defra guidance and is adequate for the dispersion modelling.

Figure 4: Wind rose for Liverpool Airport (2017)




## 4.3.7 Other Model Parameters

The extent of mechanical turbulence (and hence, mixing) in the atmosphere is affected by the roughness of the surface/ground over which the air is passing. Typical surface roughness values range from 1.5m (for cities, forests and industrial areas) to 0.0001m (for water or sandy deserts).

Due to the number of buildings, the land around the proposed development can be best described as 'cities, woodlands' with a corresponding surface roughness of 1m. Due to the location of Liverpool Airport met station outside of the city, the site can be best described as 'parklands, open surburbia' with a corresponding surface roughness of 0.5m.

The minimum Monin-Obukhov length is a model parameter which describes the extent to which the urban heat island effect limits stable atmospheric conditions. For this model, a length of 30m was used corresponding to "cities and large towns", to represent the city of Liverpool.

### 4.3.8 Model Verification

Model verification refers to the comparison of modelled and measured pollutant concentrations at the same points to determine the performance of the model. Should the model results for $NO_2$ be mostly within ±25% of the measured values and there is no systematic over or under-prediction of concentrations, then the LAQM.TG16[11] guidance advises that no adjustment is necessary. If this is not the case, modelled concentrations are adjusted based on the observed relationship between modelled and measured $NO_2$ concentrations to provide a better agreement.

The modelled road network was extended to be close to diffusion tube locations included in the monitoring undertaken by LCC. There are two diffusion tubes located on the model road network, the details of which are given in Table 3. Although the monitoring sites are located roadside to the modelled network, they are also near a junction with Leece Street (A5039) (see Figure 5). Traffic data was not available for Leece Street and there was no count point data from the Department for Transport (DfT) that could be appropriately used to calculate the traffic on the road.

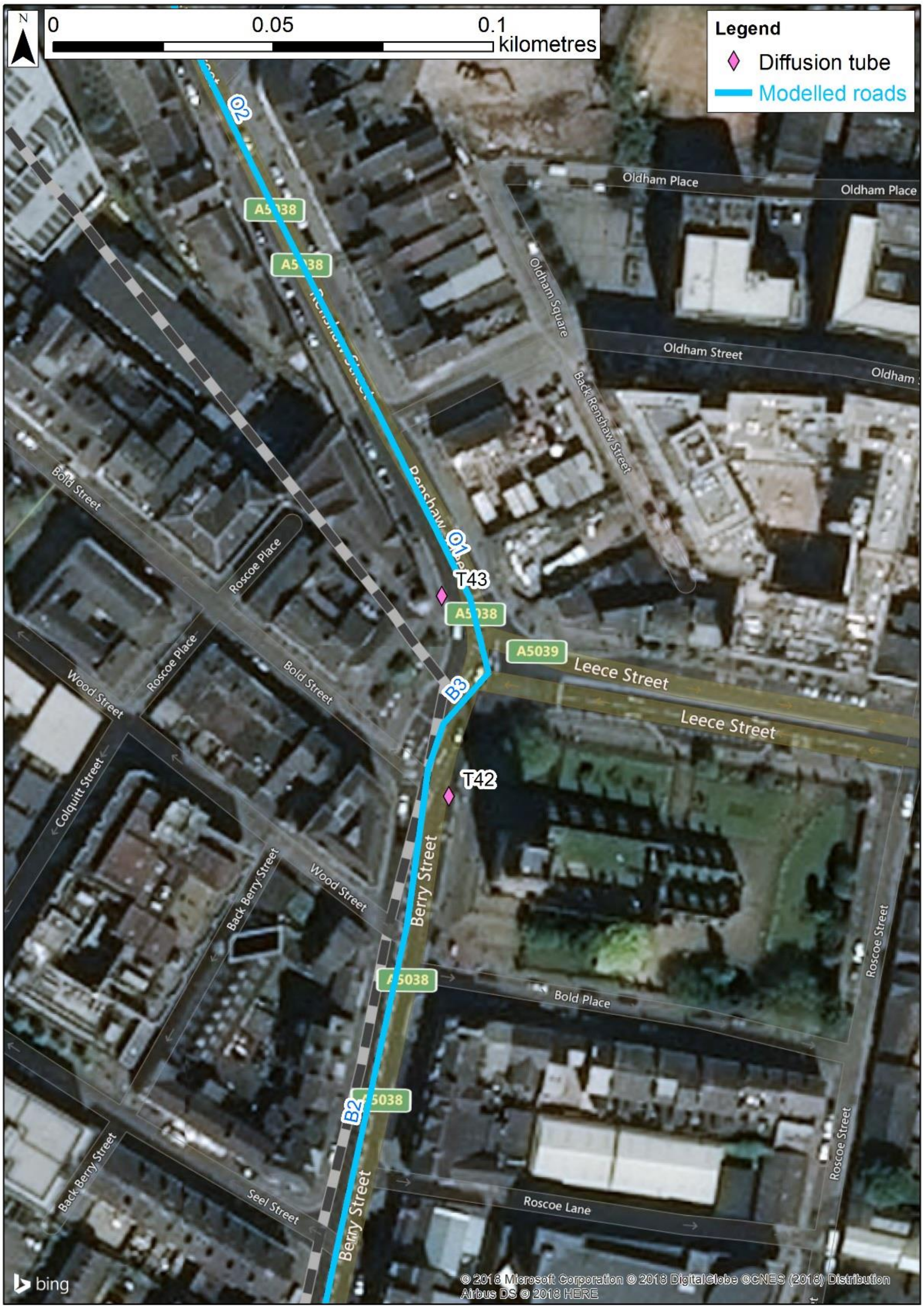
Monitoring results for these locations were obtained from the latest Annual Status Reports from LCC, detailed in section 5.2. The modelled road contribution to the total $NO_x$ concentration calculated was used in the verification process.

The results of the verification process are included in the assessment of air quality impacts during operation (section 6.3.1).

Table 3: $NO_2$ verification sites

| Monitoring Location | Comments |
|---|---|
| T42 | This site is located beside a bus stop. It is also located near Leece Street, which was not modelled. The location is assumed to be on the lamp post at a height of 3m. |
| T43 | This site is located near Leece Street, which was not modelled. The location is assumed to be on a sign post at a height of 3m. |

Figure 5: Verification sites and Leece Street



## 4.3.9 Results Processing

### 4.3.9.1 $NO_x$ to $NO_2$ Conversion

The model predicts NOx concentrations which comprise nitric oxide (NO) and nitrogen dioxide ($NO_2$). NOx is emitted from combustion processes, i.e. combustion plant and vehicles, primarily as NO with a small percentage (usually <5%) of $NO_2$. The emitted NO reacts with oxidants in the air (mainly ozone) to form $NO_2$ and this oxidation occurs at a rate determined by a variety of factors including the concentration of oxidants in the air, wind speed and temperature. The concentration of $NO_2$ at any one point in the plume will depend on these factors as well as the time since the pollutants were emitted.

$NO_2$ is associated with effects on human health and therefore the air quality standards for the protection of human health are based on $NO_2$ rather than total NOx or NO. A suitable NOx:$NO_2$ conversion has been derived and applied to the modelled NOx concentrations, in order to determine the impact of the NOx emissions on ambient concentrations of $NO_2$.

LAQM.TG16[11] details an approach for calculating the roadside conversion of $NO_x$ to $NO_2$, which takes into account the difference between ambient $NO_x$ concentrations with and without the Proposed Development, the concentration of ozone and the different proportions of primary $NO_2$ emissions in different years. This approach is available as a spreadsheet calculator, with the most up to date version having been released in October 2017 (v6.1)[18].

### 4.3.9.2 Short term $NO_2$ 1-hour mean objective

Research carried out on behalf of Defra identified that the exceedances of the $NO_2$ hourly objective is unlikely to occur where the annual mean is below 60µg/m$^3$. This assumption is referred to in the LAQM.TG16[11] and is used in the results.

### 4.3.9.3 Short term $PM_{10}$ daily mean objective

The $PM_{10}$ daily mean objective of 50µg/m$^3$ is not to be exceeded more than 35 times a year. This equates to the 90.41$^{st}$ percentile. The 90.41$^{st}$ percentile of 24-hour average results have been modelled to assess against this objective. In order to predict the total short-term $PM_{10}$ concentration, the short-term background must also be added. Following LAQM.TG16[11], twice the $PM_{10}$ annual mean background can be used to do this.

## 4.3.10 Significance Criteria

The 2017 EPUK/IAQM guidance note ‘Land-Use Planning & Development Control[16]’ provides an approach to determining the air quality impacts resulting

[18] Defra, 2017. $NO_x$ to $NO_2$ calculator. http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc

from a proposed development and the overall significance of local air quality effects arising from a proposed development.

Firstly, impact descriptors are determined based on the magnitude of incremental change as a proportion of the relevant assessment level, in this instance the annual mean $NO_2$ objectives. The change is then examined in relation to the predicted total pollutant concentrations in the assessment year and its relationship with the annual mean $NO_2$ objectives.

The assessment framework for determining impact descriptors at each of the assessed receptors is shown in Table 4. These annual mean descriptors are only relevant for receptor locations where the public could be expected to reside for a year (i.e. residential receptors).

Table 4: Impact descriptors

| **Annual Average Concentrations at Receptor in the Assessment Year** | **% Change in Concentrations Relative to Annual Mean Objectives** | | | |
|---|---|---|---|---|
| | **1** | **2-5** | **6-10** | **>10** |
| 75% or less of objective | Negligible | Negligible | Slight | Moderate |
| 76-94% of objective | Negligible | Slight | Moderate | Moderate |
| 95-102% of objective | Slight | Moderate | Moderate | Substantial |
| 103-109% of objective | Moderate | Moderate | Substantial | Substantial |
| 110% of more of objective | Moderate | Substantial | Substantial | Substantial |

Note: Changes in pollutant concentrations of 0% i.e. <0.5% would be described as negligible

The impact descriptors at each of the assessed receptors can be used as a starting point for making judgements on the effect of the proposed development. However, other considerations need to be accounted for, such as:

- The existing and future air quality in the absence of the development;
- The extent of current and future population exposure to the impacts; and
- The influence and validity of any assumptions adopted when undertaking the prediction of impacts.

Professional judgement should be used to determine the overall effect of the proposed development, however in circumstances where the proposed development can be judged in isolation, it is likely that a ‘moderate’ or ‘substantial’ impact will give rise to a significant effect and a ‘negligible’ or ‘slight’ impact will not result in a significant effect.

# 5 Baseline Conditions

## 5.1 Sources of Air Pollution

### 5.1.1 Industrial Processes

Industrial air pollution sources are regulated through a system of operating permits or authorisations, requiring stringent emission limits to be met and ensuring that any releases to the environment are minimised or rendered harmless. Regulated (or prescribed) industrial processes are classified as Part A or Part B processes, regulated through the Pollution Prevention and Control (PPC) system[19,20]. The larger more polluting processes are regulated by the Environment Agency (EA) and the smaller less polluting ones by the local authorities.

There are no relevant processes, regulated for emissions to air, listed on the EA website within 2km of the proposed development.

Part B processes are regulated and reviewed by LCC and, given the nature of these processes, are unlikely to significantly affect ambient air quality in the vicinity of the proposed development.

The impact of Part A and Part B processes is assumed to be included in the background monitoring and Defra background concentrations.

## 5.2 Local Air Quality

The Environment Act 1995, as described in section 2.3, requires local authorities to review and assess air quality with respect to the objectives for seven pollutants specified in the National Air Quality Strategy. Local authorities have been required to carry out an Updating and Screening Assessment of their area every three years. If this assessment identifies potential hotspot areas likely to exceed air quality objectives, then a further Detailed Assessment of those areas is required. Where objectives are not predicted to be met, local authorities must declare the area as an AQMA. In addition, local authorities are required to produce an Air Quality Action Plan which includes measures to improve air quality within the AQMA.

To fulfil their Local Air Quality Management duties, LCC produced their latest Air Quality Annual Status Reports (ASR)[21] in 2017. This document includes a summary of the previous rounds of review and assessment.

LCC declared a city-wide AQMA for Liverpool in 2009 due to exceedances of the annual mean objective for $NO_2$ at various locations across the city. The location of

[19] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)
[20] The Environmental Permitting (England and Wales) (Amendment) Regulations 2013, SI 2013/390
[21] Liverpool City Council, 2017 Air Quality Annual Status Report (ASR), August 2017

the proposed development with respect to the Liverpool AQMA is shown in Figure 6.

The latest monitoring reports from LCC[21] shows that there are no automatic monitoring sites within 2km. LCC operate two automatic monitoring sites, an urban background, approximately 10.5km to the south-east, and an urban roadside, approximately 5.5km to the north-east. The details of these monitoring sites are included in Table 5 and their location is shown on Figure 6.

Table 5: LCC automatic monitoring sites

| LCC ID | Site | Location | Site type | Pollutants monitored | Distance (m) and direction from site (m) |
|---|---|---|---|---|---|
| AM1 | Speke | 343884, 383601 | Urban background | $NO_2$, $NO_x$ $SO_2$, $PM_{2.5}$ $PM_{10}$,PAH | 10.5km to the south-east |
| AM2 | Queens Drive, Walton | 336164, 394906 | Urban roadside | $NO_2$, $NO_x$ | 5.5km to the north-east |

Figure 6: Liverpool AQMA and automatic monitors

Table 6: Results of automatic monitoring

| Site | Annual mean $NO_2$ concentrations (µg/m³) | | | Number of hourly mean $NO_2$ concentrations >200µg/m³ | | | Valid data capture for 2015 - $NO_2$ | Annual mean $PM_{10}$ concentrations (µg/m³) | | | Valid data capture for 2016 - $PM_{10}$ | Number of hourly mean $PM_{10}$ concentrations >50µg/m³ | | | Annual mean $PM_{2.5}$ concentrations (µg/m³) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2014 | 2015 | 2016 | 2014 | 2015 | 2016 | | 2014 | 2015 | 2016 | | 2014 | 2015 | 2016 | 2014 | 2015 | 2016 |
| AM1 | 25 | 22 | 23 | 0 | 0 | 0 | 97.2% | 14 | 14 | 15 | 91.1 | 2 | 1 | 0 | 11 | 9 | 10 |
| AM2 | 35 | 34 | 32 | 0 | 0 | 0 | 95.8% | - | - | - | - | - | - | - | - | - | - |
| Air quality objective | 40 µg/m³ | | | 200µg/m³, not to be exceeded more than 18 times a year | | | | 40 µg/m³ | | | | 50µg/m³, not to be exceeded more than 35 times a year | | | 25 µg/m³ | | |

- no data, pollutant not monitored at that location

The latest monitoring reports from LCC[21] shows that there are 24 monitoring sites located within 2km of the proposed development. These are all urban roadside diffusion tube sites. Details of these diffusion monitoring points within 2km of the proposed developments are included in Table 7 and the latest results are listed in Table 8.

Table 7: LCC monitoring sites within 2km

| LCC ID | Site | X | Y | Type |
|---|---|---|---|---|
| B1 | Prescot St/ RLUH Taxi Rank Lamp L7 | 335961 | 390845 | Urban Roadside |
| B2 | Prescot St/ RLUH Taxi Rank Lamp L7 | 335961 | 390845 | Urban Roadside |
| B3 | Prescot St/ RLUH Taxi Rank Lamp L7 | 335961 | 390845 | Urban Roadside |
| S46 | Edge Lane/Jubilee Dr LHS Junct nr C2414 | 336642 | 390484 | Urban Roadside |
| T26 | Smithdown Road Info sign by Howard Jenkins funerals nr jct with lodge lane | 337003 | 389459 | Urban Roadside |
| T27 | Islington AQ Station Traffic Lights | 335394 | 390956 | Urban Roadside |
| T28 | Islington AQ Station Traffic Lights | 335394 | 390956 | Urban Roadside |
| T29 | Islington AQ Station Traffic Lights | 335394 | 390956 | Urban Roadside |
| T30 | Leeds Street/Pall Mall Road Sign | 334057 | 391098 | Urban Roadside |
| T31 | Leeds Street/Pall Mall Road Sign | 334057 | 391098 | Urban Roadside |
| T32 | Leeds Street/Pall Mall Road Sign | 334057 | 391098 | Urban Roadside |
| T33 | Crosshall Street Downpipe 2nd Alng from Dale St. | 334585 | 390677 | Urban Roadside |
| T34 | Crosshall Street Downpipe 2nd Alng from Dale St. | 334585 | 390677 | Urban Roadside |
| T35 | Crosshall Street Downpipe 2nd Alng from Dale St. | 334585 | 390677 | Urban Roadside |
| T36 | Lpool Centre Old Haymarket | 334762 | 390686 | Urban Roadside |
| T37 | Lpool Centre Old Haymarket | 334762 | 390686 | Urban Roadside |
| T38 | Lpool Centre Old Haymarket | 334762 | 390686 | Urban Roadside |

| LCC ID | Site | X | Y | Type |
|---|---|---|---|---|
| T39 | Covent Garden/Dale St Lamp Post RH side | 334086 | 390425 | Urban Roadside |
| T40 | Strand Street/Water Street Jct-Roadsign L2 | 334277 | 390231 | Urban Roadside |
| T41 | Strand Street/Water Street Jct-Roadsign L2 | 334277 | 390231 | Urban Roadside |
| T42 | Strand Street/Water Street Jct-Roadsign L2 | 334277 | 390231 | Urban Roadside |
| T43 | Berry St o/s St Lukes Ch Pedestrian Lights | 335221 | 389886 | Urban Roadside |
| T44 | Renshaw St/Bold St J cor Lamp Post Rapid | 335222 | 389937 | Urban Roadside |
| T45 | Clarence St/Mount Pleasant J LP o/s JMU | 335432 | 390107 | Urban Roadside |

Figure 7: LCC diffusion tube monitoring sites within 2km

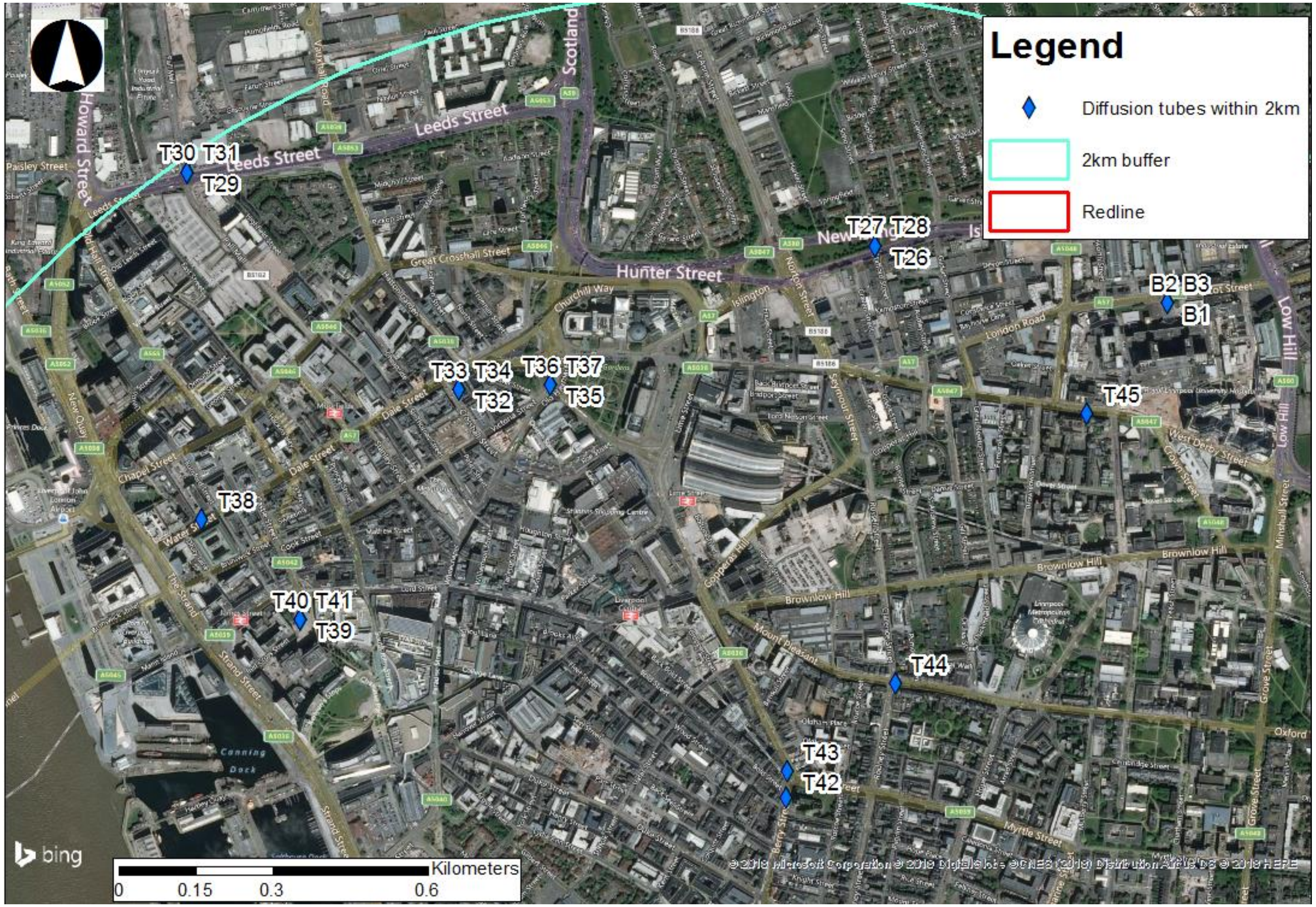

Legend
Diffusion tubes within 2km
2km buffer
Redline
T30 T31
T29
T27 T28
T26
B2 B3
B1
T33 T34
T32
T36 T37
T35
T45
T38
T40 T41
T39
T44
T43
T42
Kilometers
0
0.15
0.3
0.6
Leeds Street
Hunter Street
Howard Street
Scotland
Brownlow Hill
Low Hill
bing

Table 8: Results of LCC diffusion tube monitoring within 2km

| LCC ID | Site type | 2015 | 2016 | 2017 | 2017 data capture (%) |
|---|---|---|---|---|---|
| | | Annual mean $NO_2$ concentrations ($\mu g/m^3$) | | | |
| B1 | Urban roadside | **61** | **57** | **44** | 100 |
| B2 | Urban roadside | **62** | **56** | **43** | 100 |
| B3 | Urban roadside | **62** | **56** | **44** | 100 |
| S46 | Urban roadside | **53** | **54** | 38 | 83 |
| T26 | Urban roadside | **46** | **50** | 35 | 92 |
| T27 | Urban roadside | **46** | **46** | 34 | 92 |
| T28 | Urban roadside | **47** | **50** | 35 | 83 |
| T29 | Urban roadside | **50** | **43** | 30 | 100 |
| T30 | Urban roadside | **51** | **41** | 31 | 100 |
| T31 | Urban roadside | **52** | **43** | 30 | 100 |
| T32 | Urban roadside | **69** | **70** | **47** | 100 |
| T33 | Urban roadside | **69** | **73** | **46** | 92 |
| T34 | Urban roadside | **67** | **80** | **44** | 92 |
| T35 | Urban roadside | **56** | **59** | **41** | 100 |
| T36 | Urban roadside | **59** | **56** | **42** | 100 |
| T37 | Urban roadside | **55** | **58** | **41** | 100 |
| T38 | Urban roadside | **46** | **48** | 36 | 92 |
| T39 | Urban roadside | **68** | **67** | **50** | 75 |
| T40 | Urban roadside | **67** | **64** | **45** | 67 |
| T41 | Urban roadside | **68** | **67** | **49** | 100 |
| T42 | Urban roadside | **52** | **51** | 38 | 100 |
| T43 | Urban roadside | **60** | **64** | **46** | 100 |
| T44 | Urban roadside | **50** | **48** | 37 | 100 |
| T45 | Urban roadside | **54** | **51** | 36 | 92 |
| Air quality objective | | 40 $\mu g/m^3$ | | | |

Data obtained from LCC; has been bias corrected, annualised (where necessary) and corrected to the nearest façade.

Exceedances of the annual mean objective (40$\mu g/m^3$) are highlighted in bold

LCC diffusion tube monitoring of roadside sites within 2km of the proposed developments shows that the annual mean $NO_2$ objective (40$\mu g/m^3$) was exceeded at all locations during 2015 and 2016. However, 2017 results show some significant reduction in concentrations at all locations, with the annual mean objective only exceeded at 12 of the 24 locations.

## 5.3 Background Concentrations

Background pollutant concentrations are available on the Defra air quality website[22] for every 1km x 1km grid square across the UK. Background pollutant concentrations for the base year (2017) have been obtained for the grid squares in which the proposed development and the modelled receptors at located. These are shown in Table 9. Defra background pollutant concentrations for 2017 are well below the relevant air quality objectives.

In the absence of appropriate urban background monitoring near the proposed development, the Defra background concentrations have been used in the results processing.

Table 9: Defra background pollutant concentrations for 2017 (µg/m$^3$)

| OS Grid Square (X, Y) | | Annual Mean Concentration (µg/m$^3$) | | | |
|---|---|---|---|---|---|
| **X** | **Y** | **NOx** | **$NO_2$** | **$PM_{10}$** | **$PM_{2.5}$** |
| **2017** | | | | | |
| 335500 | 389500 | 30.3 | 20.9 | 12.7 | 8.0 |
| 335500 | 390500 | 43.2 | 28.1 | 14.1 | 8.8 |
| **2023** | | | | | |
| 335500 | 389500 | 21.2 | 15.3 | 12.3 | 7.6 |
| 335500 | 390500 | 30.1 | 20.7 | 13.6 | 8.3 |

[22] Background Pollutant Concentrations, Defra Air Quality Website, https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html [Accessed June 2018]

# 6 Assessment

## 6.1 Assessment of Effects from Construction

As discussed above, the IAQM guidance takes into consideration four dust-generating activities: demolition, earthworks, construction and trackout. The site of the proposed development covers an area of approximately 1.5 hectares.

## 6.2 Sensitive Receptors and Area Sensitivity

Sensitive receptors are defined as those properties/schools/hospitals that are likely to experience a change in pollutant concentrations and/or dust nuisance due to the construction of the proposed development.

The sensitivity of the area to dust soiling and human health effects during the construction phase has been determined by considering the number, location and sensitivity of the receptors.

There are no sensitive ecological receptors (designated either internationally or nationally and potentially affected by the proposed development) which are sensitive to dust within 50m of the site boundary.

There are approximately 50 sensitive receptors within 20m of the proposed development boundary, and more than 100 receptors within 50m of the proposed development, including student accommodation, primary school, places of worship (Liverpool Cathedral) and residential properties.

The sensitivity of nearby receptors to dust soiling has been classified as high, according to the IAQM guidance, and the sensitivity to human health has been classified as low according, because the annual mean concentration of $PM_{10}$ in the area is considered to be below 24µg/$m^3$.

Table 10: Sensitivity of the area

| Activity | Sensitivity of the Surrounding Area |
|---|---|
| Dust Soiling | High |
| Human Health | Low |

### 6.2.1 Dust Emission Magnitude

Each dust generating activity has been assigned a dust emission magnitude as shown in Table 13.

Table 11: Dust emission magnitude for dust generating activities

| Activity | Dust Emission Magnitude | Reasoning |
|---|---|---|
| Demolition | Small | Total building volume <20,000m$^3$ (Total building volume is estimated < 20,000m$^3$) |
| Earthworks | Large | Total site area is >10,000m$^2$ (Total site area is estimated to be >10,000 m$^2$) |
| Construction | Large | Total building volume >100,000 m$^3$ (Volume of the proposed development is estimated to be >100,000m$^3$)<br>Potentially dusty construction material (e.g. concrete) |
| Trackout | Large | Estimated to be >50 HDV (>3.5t) as earthworks and constructions are considered to be large |

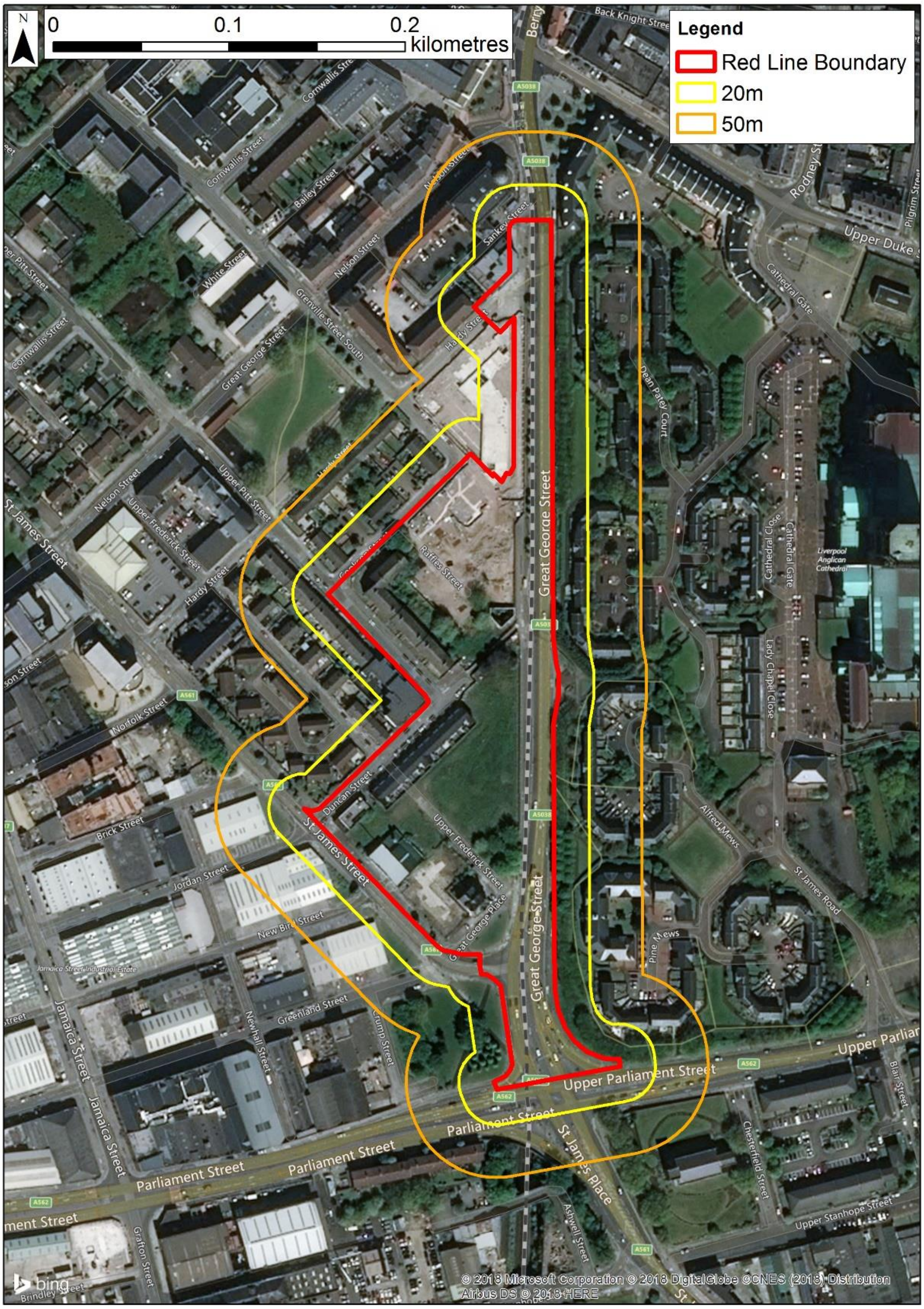
### 6.2.2 Risk of Impacts

Taking into consideration the dust emission magnitude and the sensitivity of the area, dust soiling impacts are classified as medium risk and the human health impacts are classified as low (see Table 12). Specific mitigation to minimise the risk of dust soiling and human health impacts is described in Section 7.1.

Table 12: Summary dust risk table prior to mitigation

| Activity | Dust soiling | Human health |
|---|---|---|
| Demolition | Medium Risk | Negligible |
| Earthworks | High Risk | Low risk |
| Construction | High Risk | Low risk |
| Trackout | High Risk | Low risk |

Figure 8: Construction dust buffer



## 6.3 Assessment of Effects from Operation

To assess the operational impact of road traffic emissions, dispersion modelling was undertaken following the methodology outlined in section 0.

### 6.3.1 Model Verification

Model verification can be undertaken for road sources as this requires comparison of modelled concentrations against monitored concentrations. A comparison of the monitored and modelled data is shown in Table 13Table 13.

Table 13: Comparison of modelled and monitored annual mean $NO_2$ for 2017

| Site name | Monitoring pollutant | Monitored concentration ($\mu g/m^3$) | Modelled concentration ($\mu g/m^3$) | Difference of modelled vs monitored (%) |
|---|---|---|---|---|
| T42 | $NO_2$ | 37.8 | 25.7 | -32.0% |
| T43 | $NO_2$ | 46.1 | 27.0 | -41.4% |

The verification process of the monitoring sites showed that the model was under-predicting $NO_2$ at T42 and T43 by 32% and 41% respectively. The difference between modelled and monitored was >±25% at both sites. The monitored and modelled $NO_2$ road contribution concentrations, were plotted and the equation of the trend line based on linear regression through zero calculated. This showed that a verification factor of 4.26 could be applied to all modelled NOx results from road traffic. The use of the factor produced the results in Table 14

Table 14: Comparison of adjusted modelled and monitored annual mean for 2017

| Site name | Monitoring pollutant | Monitored concentration ($\mu g/m^3$) | Adjusted modelled concentration ($\mu g/m^3$) | Difference of modelled vs monitored (%) |
|---|---|---|---|---|
| T42 | $NO_2$ | 37.8 | 39.8 | 5.4% |
| T43 | $NO_2$ | 46.1 | 44.6 | -3.2% |

The under-predicting and high verification factor is attributed to Leece Street (where the monitoring takes place) not having been modelled (as traffic data are not available). Therefore, applying the derived factor across the road network will not accurately represent the baseline, however it will create a pessimistic scenario, because it will assume higher contributions of $NO_2$ from road emissions across the whole network.

No adjustment of $PM_{10}$ or $PM_{2.5}$ concentrations has been undertaken as there is no monitoring data for $PM_{10}$ or $PM_{2.5}$ close to the modelled road network to enable comparison.

### 6.3.2 Predicted $NO_2$ Concentrations

Pollutant concentrations have been predicted at each of the modelled receptors. Some receptors would not be present in the DM scenario (they are part of the proposed development) and therefore it is not relevant to assess the impact at these locations.

Table 15 presents the predicted concentrations of $NO_2$. The table shows that the maximum predicted change in annual mean $NO_2$ is 0.9µg/m$^3$ at receptor 12 (Duncan Street). All the predicted concentrations in the DS scenario are below the $NO_2$ annual mean objective (40µg/m$^3$).

The annual mean is not relevant to retail, restaurant and commercial uses, because these receptors are not expected to be present for a whole year. Therefore, the impact descriptors have not been defined at these receptors. However, the 1-hour $NO_2$ objective is relevant at the retail, restaurant and commercial uses. The predicted results show that they are unlikely to exceed the 1-hour $NO_2$ objective, because they are all below 60µg/m$^3$. The impact descriptor for annual mean $NO_2$ concentrations is predicted to be negligible at all modelled sensitive receptors.

Table 15: Predicted annual mean $NO_2$ concentrations (µg/m$^3$)

| **Receptor** | | **DM 2023 (µg/m$^3$)** | **DS 2023 (µg/m$^3$)** | **Change (µg/m$^3$)** | **Impact** |
|---|---|---|---|---|---|
| 1a | Renshaw Street (retail) | 31.5 | 31.7 | n/a | n/a |
| 1b | Renshaw Street (residential) | 27.1 | 27.2 | 0.1 | Negligible |
| 2a | Berry Street (retail) | 23.5 | 23.7 | n/a | n/a |
| 2b | Berry Street (residential) | 20.5 | 20.6 | 0.1 | Negligible |
| 3a | Duke Street (restaurant) | 33.9 | 34.2 | n/a | n/a |
| 3b | Duke Street (residential) | 26.4 | 26.6 | 0.3 | Negligible |
| 4a | Upper Duke Street (restaurant) | 35.0 | 35.5 | n/a | n/a |
| 4b | Upper Duke Street (residential) | 27.1 | 27.4 | 0.3 | Negligible |
| 5 | Upper Duke Street (residential) | 23.8 | 24.1 | 0.2 | Negligible |
| 6a | Nelson Street (retail) | 19.6 | 19.7 | n/a | n/a |
| 6b | Nelson Street (residential) | 19.3 | 19.5 | 0.1 | Negligible |
| 7 | Great George Street (residential) | 24.2 | 24.5 | 0.3 | Negligible |
| 8 | Great George Street (residential) | 22.3 | 22.6 | 0.3 | Negligible |
| 9 | Great George Street (residential) | 22.3 | 22.6 | 0.3 | Negligible |
| 10 | Great George Street (residential) | 22.9 | 23.1 | 0.3 | Negligible |
| 11 | St James Street (residential) | 22.4 | 22.7 | 0.2 | Negligible |
| 12 | Duncan Street (residential) | 20.5 | 21.4 | 0.9 | Negligible |
| 13 | Great George Street (residential) | 22.1 | 22.4 | 0.2 | Negligible |
| 14 | Great George Street (residential) | 23.9 | 24.1 | 0.3 | Negligible |
| 15 | Upper Parliament Street (residential) | 32.6 | 32.9 | 0.3 | Negligible |
| 16 | Parliament Street (residential) | 34.8 | 34.9 | 0.1 | Negligible |
| 17 | Upper Parliament Street (residential) | 30.6 | 30.8 | 0.2 | Negligible |

| Receptor | | DM 2023 ($\mu g/m^3$) | DS 2023 ($\mu g/m^3$) | Change ($\mu g/m^3$) | Impact |
|---|---|---|---|---|---|
| F1a | Great George Street (commercial) | n/a | 20.6 | n/a | n/a |
| F1b | Great George Street (residential) | n/a | 18.6 | n/a | n/a |
| F2a | Great George Street (commercial) | n/a | 24.4 | n/a | n/a |
| F2b | Great George Street (residential) | n/a | 21.0 | n/a | n/a |
| F3a | St James Street (commercial) | n/a | 28.2 | n/a | n/a |
| F3b | St James Street (residential) | n/a | 21.6 | n/a | n/a |

### 6.3.3 Predicted $PM_{10}$ Concentrations

Annual mean $PM_{10}$ concentrations were predicted at the receptor locations for each scenario and the magnitude of change of annual mean $PM_{10}$ concentrations from the DM to DS scenario and impact descriptor at each of the receptor locations were determined. The results are presented in Table 16.

Table 16 shows that $PM_{10}$ concentrations were predicted to achieve the annual mean $PM_{10}$ objective ($40\mu g/m^3$) at all receptors in all scenarios. The table also shows that the 24-hour 9.41st percentile does not exceed the $PM_{10}$ daily objective ($50\mu g/m^3$). The impact descriptor for annual mean $PM_{10}$ concentrations is predicted to be negligible at all modelled locations.

Table 16: Predicted annual mean $PM_{10}$ concentrations

| Receptor | DM 2023 ($\mu g/m^3$) | DS 2023 ($\mu g/m^3$) | Change ($\mu g/m^3$) | Impact | DS 2023 24hr 90.41st percentile |
|---|---|---|---|---|---|
| 1a | 14.4 | 14.4 | n/a | n/a | 28.6 |
| 1b | 14.0 | 14.0 | <0.1 | Negligible | 28.0 |
| 2a | 12.8 | 12.8 | n/a | n/a | 25.7 |
| 2b | 12.6 | 12.6 | <0.1 | Negligible | 25.2 |
| 3a | 13.3 | 13.3 | n/a | n/a | 26.4 |
| 3b | 12.9 | 12.9 | <0.1 | Negligible | 25.7 |
| 4a | 13.3 | 13.4 | n/a | n/a | 26.4 |
| 4b | 12.9 | 12.9 | <0.1 | Negligible | 25.7 |
| 5 | 12.8 | 12.8 | <0.1 | Negligible | 25.5 |
| 6a | 12.6 | 12.6 | n/a | n/a | 25.1 |
| 6b | 12.5 | 12.6 | <0.1 | Negligible | 25.1 |
| 7 | 12.9 | 12.9 | <0.1 | Negligible | 25.7 |
| 8 | 12.7 | 12.8 | <0.1 | Negligible | 25.5 |
| 9 | 12.7 | 12.8 | <0.1 | Negligible | 25.4 |
| 10 | 12.8 | 12.8 | <0.1 | Negligible | 25.5 |
| 11 | 12.8 | 12.8 | <0.1 | Negligible | 25.4 |

| Receptor | DM 2023 ($\mu g/m^3$) | DS 2023 ($\mu g/m^3$) | Change ($\mu g/m^3$) | Impact | DS 2023 24hr 90.41st percentile |
|---|---|---|---|---|---|
| 12 | 12.6 | 12.6 | <0.1 | Negligible | 25.2 |
| 13 | 12.7 | 12.7 | <0.1 | Negligible | 25.4 |
| 14 | 12.8 | 12.8 | <0.1 | Negligible | 25.5 |
| 15 | 13.2 | 13.2 | <0.1 | Negligible | 26.2 |
| 16 | 13.3 | 13.3 | <0.1 | Negligible | 26.8 |
| 17 | 13.3 | 13.3 | <0.1 | Negligible | 26.6 |
| F1a | n/a | 12.6 | n/a | n/a | 25.3 |
| F1b | n/a | 12.5 | n/a | n/a | 25.0 |
| F2a | n/a | 12.8 | n/a | n/a | 25.7 |
| F2b | n/a | 12.6 | n/a | n/a | 25.2 |
| F3a | n/a | 13.1 | n/a | n/a | 25.9 |
| F3b | n/a | 12.6 | n/a | n/a | 25.2 |

### 6.3.4 Predicted $PM_{2.5}$ Concentrations

Annual mean $PM_{2.5}$ concentrations were predicted at the receptor locations for each scenario and the magnitude of change of annual mean $PM_{2.5}$ concentrations from the DM to DS scenario and impact descriptor at each of the receptor locations were determined. The results are presented in Table 17.

Table 17 shows that $PM_{2.5}$ concentrations were predicted to achieve the annual mean $PM_{2.5}$ objective (25µg/m$^3$) at all receptors in all scenarios. The impact descriptor for annual mean $PM_{2.5}$ concentrations is predicted to be negligible at all modelled locations.

Table 17: Predicted annual mean $PM_{2.5}$ concentrations

| Receptor | DM 2023 ($\mu g/m^3$) | DS 2023 ($\mu g/m^3$) | Change ($\mu g/m^3$) | Impact |
|---|---|---|---|---|
| 1a | 8.7 | 8.7 | n/a | n/a |
| 1b | 8.5 | 8.5 | <0.1 | Negligible |
| 2a | 7.9 | 7.9 | n/a | n/a |
| 2b | 7.8 | 7.8 | <0.1 | Negligible |
| 3a | 8.1 | 8.1 | n/a | n/a |
| 3b | 7.9 | 7.9 | <0.1 | Negligible |
| 4a | 8.2 | 8.2 | n/a | n/a |
| 4b | 7.9 | 7.9 | <0.1 | Negligible |
| 5 | 7.9 | 7.9 | <0.1 | Negligible |
| 6a | 7.7 | 7.7 | n/a | n/a |
| 6b | 7.7 | 7.7 | <0.1 | Negligible |

| Receptor | DM 2023 ($\mu g/m^3$) | DS 2023 ($\mu g/m^3$) | Change ($\mu g/m^3$) | Impact |
|---|---|---|---|---|
| 7 | 7.9 | 7.9 | <0.1 | Negligible |
| 8 | 7.8 | 7.8 | <0.1 | Negligible |
| 9 | 7.8 | 7.8 | <0.1 | Negligible |
| 10 | 7.9 | 7.9 | <0.1 | Negligible |
| 11 | 7.8 | 7.8 | <0.1 | Negligible |
| 12 | 7.8 | 7.8 | <0.1 | Negligible |
| 13 | 7.8 | 7.8 | <0.1 | Negligible |
| 14 | 7.9 | 7.9 | <0.1 | Negligible |
| 15 | 8.1 | 8.1 | <0.1 | Negligible |
| 16 | 8.2 | 8.2 | <0.1 | Negligible |
| 17 | 8.1 | 8.1 | <0.1 | Negligible |
| F1a | n/a | 7.8 | n/a | n/a |
| F1b | n/a | 7.7 | n/a | n/a |
| F2a | n/a | 7.9 | n/a | n/a |
| F2b | n/a | 7.8 | n/a | n/a |
| F3a | n/a | 8.0 | n/a | n/a |
| F3b | n/a | 7.8 | n/a | n/a |

### 6.3.5 Sensitivity Test

The results of the sensitivity test are presented in Appendix D. The sensitivity test used 2017 EFTs in the future DM and DS scenarios for the road traffic emissions and 2017 background concentrations from Defra were used in the processing of results. This represents a pessimistic scenario because vehicle emissions and background concentrations are expected to improve in the future.

For $PM_{10}$ and $PM_{2.5}$ the concentrations are below the relevant objectives and all of the impacts are described as negligible.

The verification factor has been applied to the $NO_2$ results in the sensitivity test. The results in Appendix D show that all the predicted results are below 60$\mu g/m^3$ and therefore are unlikely to exceed the 1-hour $NO_2$ mean objective.

The $NO_2$ annual mean concentrations exceed that objective at nine receptors. However, the proposed development is not predicted to create a new exceedance. All of the exceedances are in both the DM and DS scenarios.

The $NO_2$ results also predict three moderate adverse impacts (receptors 15, 16 and 17) at receptors sensitive to the annual mean objective. However, the maximum annual mean is 53.6 $\mu g/m^3$ and therefore is unlikely to exceed the $NO_2$ short-term objective at any receptor.

### 6.3.6 Assessment of Significance

The predicted concentrations at existing receptors have been used to assess the significance of the impact of emissions from the road vehicle emissions, following the guidance outlined in the EPUK/IAQM land-use planning guidance. The impact descriptor for each existing receptor for annual mean concentrations is predicted to be negligible.

In the $NO_2$ sensitivity test, moderate adverse impacts were predicted. However, the true future scenario $NO_2$ concentrations are likely to lie somewhere between the assessed scenario (optimistic) and the sensitivity test scenario (pessimistic case). The use of the verification factor (4.26) also provides a pessimistic case to both scenarios as explained in section 6.3.1.

Following the guidance outlined in the EPUK/IAQM land-use planning guidance, and considering the mentioned factors, the impact of the proposed development is considered to be not significant on local air quality.

# 7 Mitigation Measures

## 7.1 Construction

The dust emitting activities assessed above can be greatly reduced or eliminated by applying the site-specific mitigation measures for medium risk sites according to IAQM guidance[12]. The following measures from the guidance are relevant and should be included in the Construction Environmental Management Plan for the site.

**General**

- Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.
- Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.
- Display the Head or Regional office contact information.
- Develop and implement a Dust Management Plan, which will include measures to control other emissions, approved by the Local Authority.

**Site management**

- Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner and record the measures taken.
- Make the complaints log available to the local authority when asked.
- Record any exceptional incidents that cause dust and/or air emissions, either on- or off-site or the action taken to resolve the situation in the log book.
- Hold regular liaison meetings with other high-risk construction sites within 500m 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.

**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.
- Carry out regular site inspections to monitor compliance with the Dust Management Plan, record inspection results and make an inspection log available to the local authority, when asked.
- 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.
- 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 is a

large site, before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction.

**Site maintenance**

- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as possible.
- Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
- Fully enclose site or specific operations where there is a high potential for dust production and the site is active 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.
- Cover, seed or fence stockpiles to prevent wind whipping.

**Operating vehicle/machinery and sustainable travel**

- 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.
- Impose and signpost a maximum speed limit of 15mph on surfaced and 10mph on un-surfaced haul roads and work areas.
- Implement a Travel Plan than supports and encourages sustainable travel (public transport, cycling, walking and car-sharing).
- Ensure vehicles entering and leaving the site are covered to prevent escape of materials during transport.
- Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.

**Operations**

- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques, such as water sprays or local extraction.
- Ensure an adequate water supply on the 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 the fine water sprays on such equipment wherever appropriate.
- Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.

**Waste management**

- Avoid bonfires and burning of waste materials.

**Measures Specific to Demolition**

- Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).
- Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.
- Avoid explosive blasting, using appropriate manual or mechanical alternatives.
- Bag and remove any biological debris or damp down such material before demolition.

**Measures Specific to Earthworks**

- 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.

**Measures Specific to Construction**

- Avoid scabbling (roughening of concrete surfaces) if possible.
- Ensure sand and other aggregates are stored in bundled 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.
- 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.

**Measures Specific to Trackout**

- Use water-assisted dust sweepers 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.
- Avoid dry sweeping of large areas.
- Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
- Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable. Records inspections of haul routes.
- Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.
- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
- Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.

- Access gates to be located at least 10m from receptors where possible.

## 7.2 Operation

The assessment has predicted the impact from the proposed development will not be significant. Therefore, no additional mitigation is required.

However, the proposed development has included embedded mitigation within the design. The design does not locate residential units at ground level facing the road network. This locates sensitive receptors away from the road traffic emissions.

There is expected to be mechanical ventilation serving the basement car park. However, the ventilation has not yet been designed. The design should consider locating the ventilation extract for the car park more than 20m from sensitive receptors. This is following EPUK/IAQM guidance[13] that indicates if the extract is located at this distance, a detailed assessment is not required, indicating that impacts would be negligible at this distance.

# 8 Conclusion

An air quality assessment has been prepared to accompany a planning application for the proposed development of a mix of residential, commercial and retail use on Great George Street in Liverpool. The proposed development has the potential to cause air quality impacts during the construction and operational phases, particularly from proposed traffic generated by the development.

The site of the proposed development is located within the city-side AQMA declared for exceedances of the annual mean $NO_2$ objective. The proposed development lies adjacent to Great George Street, a trafficked road and main A road in Liverpool. Roadside air quality monitoring undertaken by the local authority north of the proposed development shows that there have been exceedances of the annual mean $NO_2$ objective.

Construction effects have been assessed using the qualitative approach described in the latest IAQM guidance and it was concluded that with the appropriate best practice mitigation measures in place, there is likely to be a negligible effect from the dust-generating activities on site.

The assessment used an optimistic scenario, using the predicted 2023 vehicle emissions and background concentrations from Defra. A pessimistic case (sensitivity test) was also carried out with 2017 emissions and background concentrations used in the future scenarios.

The assessment of the optimistic scenario predicted that the impacts on the annual mean and $NO_2$, $PM_{10}$ and $PM_{2.5}$ concentrations would be negligible at all receptors, and pollutant concentrations at existing receptors and at the façade of the proposed development are predicted to be below the respective air quality objectives.

The assessment of the pessimistic case scenario predicted negligible impacts at all receptors for $PM_{10}$ and $PM_{2.5}$. With regards to $NO_2$, moderate adverse impacts and one substantial adverse impact was predicted at a receptor. However, the annual mean objective is not considered to be relevant to the ground floor receptor (4a) receiving the substantial impact.

The verification factor of 4.26 was used in both the optimistic and pessimistic cases and therefore the modelling is likely to over-predict the $NO_2$ contributions from the road vehicle emissions. This is due to the modelled road network excluding Leece Street (traffic data were unavailable) which has resulted in a factor which is conservative to compensate for the exclusion of the $NO_2$ contribution from Leece Street.

The most likely future scenario for $NO_2$ concentrations is likely to lie somewhere between the optimistic and pessimistic cases. Considering this and the use of the conservative verification factor, the impact of the proposed development is considered to be not significant on local air quality.

# Appendix A

Consultation with Liverpool City Council

[redacted]

**From:** [redacted]
**Sent:** 17 August 2018 12:06
**To:** [redacted]
**Cc:**
**Subject:** [External] RE: AQ enquiry
**Attachments:** ASR Liverpool 2017v1.pdf; PDT Annual mean results 2017.xls

**Follow Up Flag:** Follow up
**Flag Status:** Flagged

[redacted]

Many thanks for your email.

Your proposed methodology looks fine. By all means come back to me re: modelling of moist sensitive receptors.

Attached are the 2017 ASR containing the 2016 ratified data and I also attach the 2017 ratified data.

Many Thanks

[redacted]

**From:** [redacted]
**Sent:** 15 August 2018 17:01
**To:** [redacted]
**Cc:** [redacted]
**Subject:** RE: AQ enquiry

[redacted]

Thank you for your email.

Our air quality assessment is to inform proposals for Stage 2 and 3 of redevelopment of a site on Great George Street. Approximate grid reference is 335160, 389315. I have attached a location plan.

Please can we make a request to receive the Defra Annual Status Report (ASR) for 2017 and the 2017 ratified data, as you mentioned. The P.O number is 260088

The scope of works for our air quality assessment will comprise:

- A review of legislation and planning policy relating to air quality would be undertaken, on a national and local level;
- A baseline assessment to determine existing air quality in the area using the latest report/monitoring data from Liverpool City Council (LCC) and data available from the Defra Local Air Quality Management Website;
- An assessment of dust and emissions during the construction phase of the development will be undertaken. The Institute of Air Quality Management (IAQM) guidance for the assessment of dust from demolition and construction will be followed;
- An assessment of operational traffic impacts resulting from the proposed development would be carried out via dispersion modelling. Pollutant concentrations at sensitive receptors will be calculated for a baseline scenario, to enable the model to be verified against monitored data. Existing and future sensitive receptors will be considered.

1

Pollutant concentrations will also be predicted for the first fully operational year, with and without the development, at sensitive receptors on and off-site, to enable the significance of the changes in local air quality to be determined;

- The quantitative assessment would be undertaken using dispersion modelling (ADMS-Roads). Meteorological data will be obtained for input to the ADMS-Roads model;
- An assessment of significance of the operational impacts of the proposed development will be undertaken following guidance set out by Environmental Protection UK (EPUK)/ IAQM in the Land-Use Planning and Development Control: Planning for Air Quality document; and
- Mitigation measures will be recommended for both the construction and operational phase should this be required, the residual effect of the proposed development with appropriate mitigation in place will also be assessed.

We have not yet determined which sensitive receptors we will be modelling. We can consult with you on this to confirm locations.

Please let us know if you have any comments regarding the methodology.

We look forward to hearing from you again.

Kind regards

[redacted]

**Arup**
The Arup Campus Blythe Valley Business Park
Solihull West Midlands B90 8AE
[redacted]
www.arup.com

---

**From:** [redacted]
**Sent:** 15 August 2018 16:34
**To:** [redacted]
**Subject:** [External] AQ enquiry

[redacted]

In relation to your enquiry, please submit your proposed methodology by email in brief and I will review.

In addition we can provide you with the latest approved Defra Annual Status Report (ASR) for 2017 which includes 2016 AQ data. In addition I can provide you with 2017 ratified data, the ASR is still to be approved by Defra so that cannot be shared.

This information would be provided under 2015 ROPSI regulations and there is a fee to be paid of £160. If you decide to proceed then please provide a P.O. to invoice against and I will provide the information electronically.

You will ned to provide me with the site details as the data is to be sued only for the site in question.

Kind Regards

2

[redacted]
Environmental Protection & Public Protection Enforcement

[redacted]

Correspondence Address

Liverpool City Council
Cunard Building
Water Street
Liverpool
L3 1AH

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# Appendix B

Construction Dust Methodology

Table B.1: Dust emission magnitude

| Dust Emission Magnitude | | |
|---|---|---|
| **Small** | **Medium** | **Large** |
| **Demolition** | | |
| • total building volume <20,000m$^3$<br>• construction material with low potential for dust release (e.g. metal cladding or timber)<br>• demolition activities <10m above ground<br>• demolition during wetter months | • total building volume 20,000 - 50,000m$^3$<br>• potentially dusty construction material<br>• demolition activities 10 - 20m above ground level | • total building volume >50,000m$^3$<br>• potentially dusty construction material (e.g. concrete)<br>• on-site crushing and screening<br>• demolition activities >20m above ground level |
| **Earthworks** | | |
| • total site area <2,500m$^2$<br>• soil type with large grain size (e.g. sand)<br>• <5 heavy earth moving vehicles active at any one time<br>• formation of bunds <4m in height<br>• total material moved <10,000 tonnes<br>• earthworks during wetter months | • total site area 2,500m$^2$ - 10,000m$^2$<br>• moderately dusty soil type (e.g. silt)<br>• 5 – 10 heavy earth moving vehicles active at any one time<br>• formation of bunds 4 - 8m in height<br>• total material moved 20,000 - 100,000 tonnes | • total site area >10,000m$^2$<br>• potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size)<br>• >10 heavy earth moving vehicles active at any one time<br>• formation of bunds >8m in height<br>• total material moved >100,000 tonnes |
| **Construction** | | |
| • total building volume <25,000 m$^3$<br>• construction material with low potential for dust release (e.g. metal cladding or timber) | • total building volume 25,000 - 100,000m$^3$<br>• potentially dusty construction material (e.g. concrete)<br>• on-site concrete batching | • total building volume >100,000m$^3$<br>• on-site concrete batching<br>• sandblasting |
| **Trackout** | | |
| • <10 HDV (>3.5t) outward movements in any one day<br>• surface material with low potential for dust release<br>• unpaved road length <50m | • 10 – 50 HDV (>3.5t) outward movements in any one day<br>• moderately dusty surface material (e.g. high clay content)<br>• unpaved road length 50 – 100m; | • >50 HDV (>3.5t) outward movements in any one day<br>• potentially dusty surface material (e.g. high clay content)<br>• unpaved road length >100m |

Table B.2: Sensitivity of the area to dust soiling effects

| 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 |
| | < 10 | Medium | Low | Low | Low |
| Medium | > 1 | Medium | Low | Low | Low |
| Low | > 1 | Low | Low | Low | Low |

Table B.3: Sensitivity of the area to human health impacts

<table>
<tr><th rowspan="2">Background PM$_{10}$ concentrations (annual mean)</th><th rowspan="2">Number of receptors</th><th colspan="5">Distance from the source (m)</th></tr>
<tr><th>< 20</th><th>< 50</th><th>< 100</th><th>< 200</th><th>< 350</th></tr>
<tr><td colspan="7">High receptor sensitivity</td></tr>
<tr><td rowspan="3">> 32µg/m$^3$</td><td>> 100</td><td rowspan="3">High</td><td rowspan="2">High</td><td>High</td><td>Medium</td><td rowspan="3">Low</td></tr>
<tr><td>10 – 100</td><td>Medium</td><td rowspan="2">Low</td></tr>
<tr><td>< 10</td><td>Medium</td><td>Low</td></tr>
<tr><td rowspan="3">28 – 32µg/m$^3$</td><td>> 100</td><td rowspan="3">High</td><td>High</td><td>Medium</td><td rowspan="3">Low</td><td rowspan="3">Low</td></tr>
<tr><td>10 – 100</td><td rowspan="2">Medium</td><td rowspan="2">Low</td></tr>
<tr><td>< 10</td></tr>
<tr><td rowspan="3">24 – 28µg/m$^3$</td><td>> 100</td><td rowspan="2">High</td><td rowspan="2">Medium</td><td rowspan="3">Low</td><td rowspan="3">Low</td><td rowspan="3">Low</td></tr>
<tr><td>10 – 100</td></tr>
<tr><td>< 10</td><td>Medium</td><td>Low</td></tr>
<tr><td rowspan="3">< 24µg/m$^3$</td><td>> 100</td><td>Medium</td><td rowspan="3">Low</td><td rowspan="3">Low</td><td rowspan="3">Low</td><td rowspan="3">Low</td></tr>
<tr><td>10 – 100</td><td rowspan="2">Low</td></tr>
<tr><td>< 10</td></tr>
<tr><td colspan="7">Medium receptor sensitivity</td></tr>
<tr><td rowspan="2">> 32µg/m$^3$</td><td>> 10</td><td>High</td><td>Medium</td><td rowspan="2">Low</td><td rowspan="2">Low</td><td rowspan="2">Low</td></tr>
<tr><td>< 10</td><td>Medium</td><td>Low</td></tr>
<tr><td rowspan="2">28 – 32µg/m$^3$</td><td>> 10</td><td>Medium</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td></tr>
<tr><td>< 10</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td></tr>
<tr><td rowspan="2">24 – 28µg/m$^3$</td><td>> 10</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td></tr>
<tr><td>< 10</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td></tr>
<tr><td rowspan="2">< 24µg/m$^3$</td><td>> 10</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td></tr>
<tr><td>< 10</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td></tr>
<tr><td colspan="7">Low receptor sensitivity</td></tr>
<tr><td>–</td><td>> 1</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td><td>Low</td></tr>
</table>

Table B.4: Sensitivity of the area for ecological impacts

| **Receptor sensitivity** | **Distance from the source (m)** | |
|---|---|---|
| | **< 20** | **< 50** |
| High | High | Medium |
| Medium | Medium | Low |
| Low | Low | Low |

Table B.5: Risk of dust impacts

| Sensitivity of area | Dust emission magnitude | | |
|---|---|---|---|
| | **Large** | **Medium** | **Small** |
| ***Demolition*** | | | |
| High | High risk site | Medium risk site | Medium risk site |
| Medium | High risk site | Medium risk site | Low risk site |
| Low | Medium risk site | Low risk site | Negligible |
| ***Earthworks*** | | | |
| High | High risk site | Medium risk site | Low risk site |
| Medium | Medium risk site | Medium risk site | Low risk site |
| Low | Low risk site | Low risk site | Negligible |
| ***Construction*** | | | |
| High | High risk site | Medium risk site | Low risk site |
| Medium | Medium risk site | Medium risk site | Low risk site |
| Low | Low risk site | Low risk site | Negligible |
| ***Trackout*** | | | |
| High | High risk site | Medium risk site | Low risk site |
| Medium | Medium risk site | Low risk site | Negligible |
| Low | Low risk site | Low risk site | Negligible |

# Appendix C

Traffic Data

Table C1: Traffic data

| ID | Road Name | Speed (km/h) | Base | | DM 2023 | | DS 2023 | |
|---|---|---|---|---|---|---|---|---|
| | | | 24hr AADT | %HGV | 24hr AADT | %HGV | 24hr AADT | %HGV |
| A1 | Duke Street | 20.0 | 10,248 | 2.2 | 11,274 | 2.2 | 11,397 | 2.2 |
| A2 | Duke Street | 48.3 | 10,248 | 2.2 | 11,274 | 2.2 | 11,397 | 2.2 |
| B1 | Berry Street | 20.0 | 11,015 | 5.6 | 12,121 | 5.6 | 12,416 | 5.6 |
| B2 | Berry Street | 48.3 | 11,015 | 5.6 | 12,121 | 5.6 | 12,416 | 5.6 |
| B3 | Berry Street | 20.0 | 11,015 | 5.6 | 12,121 | 5.6 | 12,416 | 5.6 |
| C1 | Upper Duke Street | 20.0 | 11,030 | 1.1 | 12,141 | 1.1 | 12,368 | 1.1 |
| C2 | Upper Duke Street | 48.3 | 11,030 | 1.1 | 12,141 | 1.1 | 12,368 | 1.1 |
| D1 | Nelson Street | 20.0 | 13,119 | 4.4 | 14,481 | 4.4 | 15,131 | 4.4 |
| E1 | Nelson Street | 20.0 | 1,256 | 3.2 | 1,416 | 3.2 | 1,485 | 3.0 |
| E2 | Nelson Street | 48.3 | 1,256 | 3.2 | 1,416 | 3.2 | 1,485 | 3.0 |
| F1 | Great George Street | 48.3 | 12,860 | 4.5 | 14,160 | 4.5 | 14,742 | 4.5 |
| G1 | Great George Street | 48.3 | 12,860 | 4.5 | 14,160 | 4.5 | 14,650 | 4.5 |
| H1 | Great George Street | 20.0 | 20,144 | 5.3 | 22,237 | 5.3 | 23,270 | 5.1 |
| I1 | St James Street | 48.3 | 8,332 | 6.3 | 9,184 | 6.3 | 9,400 | 6.1 |
| J1 | Duncan Street | 20.0 | 887 | 0.7 | 1,161 | 0.5 | 2,565 | 0.2 |

| ID | Road Name | Speed (km/h) | Base | | DM 2023 | | DS 2023 | |
|---|---|---|---|---|---|---|---|---|
| | | | 24hr AADT | %HGV | 24hr AADT | %HGV | 24hr AADT | %HGV |
| J2 | Duncan Street | 32.2 | 887 | 0.7 | 1,161 | 0.5 | 2,565 | 0.2 |
| K1 | St James Street | 20.0 | 9,309 | 5.7 | 10,376 | 5.6 | 11,606 | 5.0 |
| K2 | St James Street | 48.3 | 9,309 | 5.7 | 10,376 | 5.6 | 11,606 | 5.0 |
| L1 | Parliament Street | 20.0 | 38,494 | 2.5 | 42,304 | 2.5 | 42,543 | 2.4 |
| L2 | Parliament Street | 48.3 | 38,494 | 2.5 | 42,304 | 2.5 | 42,543 | 2.4 |
| M1 | Upper Parliament Street | 20.0 | 30,749 | 1.7 | 33,834 | 1.7 | 34,333 | 1.7 |
| M2 | Upper Parliament Street | 48.3 | 30,749 | 1.7 | 33,834 | 1.7 | 34,333 | 1.7 |
| N1 | St James Place | 20.0 | 26,540 | 5.1 | 29,165 | 5.1 | 29,469 | 5.1 |
| N2 | St James Place | 48.3 | 26,540 | 5.1 | 29,165 | 5.1 | 29,469 | 5.1 |
| N3 | St James Place | 48.3 | 26,540 | 5.1 | 29,165 | 5.1 | 29,469 | 5.1 |
| O1 | Renshaw St | 20.0 | 10,798 | 17.0 | 11,883 | 17.0 | 12,178 | 16.7 |
| O2 | Renshaw St | 48.3 | 10,798 | 17.0 | 11,883 | 17.0 | 12,178 | 16.7 |

# Appendix D

Sensitivity Test

Table 18: Sensitivity test – predicted annual mean $NO_2$ concentrations ($\mu g/m^3$)

| Receptor | | DM 2023 ($\mu g/m^3$) | DM 2023 ($\mu g/m^3$) | Change ($\mu g/m^3$) | Impact |
|---|---|---|---|---|---|
| 1a | Renshaw Street (retail) | 49.4 | 49.8 | n/a | n/a |
| 1b | Renshaw Street (residential) | 40.8 | 41.0 | 0.2 | Slight adverse |
| 2a | Berry Street (retail) | 35.0 | 35.3 | n/a | n/a |
| 2b | Berry Street (residential) | 29.8 | 30.0 | 0.2 | Negligible |
| 3a | Duke Street (restaurant) | 50.8 | 51.4 | n/a | n/a |
| 3b | Duke Street (residential) | 39.1 | 39.5 | 0.4 | Slight adverse |
| 4a | Upper Duke Street (restaurant) | 52.9 | 53.6 | n/a | n/a |
| 4b | Upper Duke Street (residential) | 40.3 | 40.8 | 0.5 | Slight adverse |
| 5 | Upper Duke Street (residential) | 34.8 | 35.1 | 0.4 | Negligible |
| 6a | Nelson Street (retail) | 28.1 | 28.4 | n/a | n/a |
| 6b | Nelson Street (residential) | 27.7 | 28.0 | 0.3 | Negligible |
| 7 | Great George Street (residential) | 35.8 | 36.3 | 0.5 | Negligible |
| 8 | Great George Street (residential) | 32.8 | 33.2 | 0.5 | Negligible |
| 9 | Great George Street (residential) | 32.8 | 33.3 | 0.4 | Negligible |
| 10 | Great George Street (residential) | 33.7 | 34.1 | 0.4 | Negligible |
| 11 | St James Street (residential) | 33.3 | 33.6 | 0.3 | Negligible |
| 12 | Duncan Street (residential) | 29.8 | 31.1 | 1.4 | Slight adverse |
| 13 | Great George Street (residential) | 32.5 | 32.9 | 0.4 | Negligible |
| 14 | Great George Street (residential) | 35.4 | 35.8 | 0.4 | Negligible |
| 15 | Upper Parliament Street (residential) | 48.9 | 49.3 | 0.5 | **Moderate adverse** |
| 16 | Parliament Street (residential) | 52.0 | 52.2 | 0.2 | **Moderate adverse** |
| 17 | Upper Parliament Street (residential) | 44.7 | 45.0 | 0.3 | **Moderate adverse** |
| F1a | Great George Street (commercial) | n/a | 29.9 | n/a | n/a |
| F1b | Great George Street (residential) | n/a | 26.5 | n/a | n/a |
| F2a | Great George Street (commercial) | n/a | 36.2 | n/a | n/a |
| F2b | Great George Street (residential) | n/a | 30.6 | n/a | n/a |
| F3a | St James Street (commercial) | n/a | 42.3 | n/a | n/a |
| F3b | St James Street (residential) | n/a | 31.7 | n/a | n/a |

Table 19: Sensitivity test – predicted annual mean $PM_{10}$ concentrations

| **Receptor** | **DM 2023 (µg/m$^3$)** | **DS 2023 (µg/m$^3$)** | **Change (µg/m$^3$)** | **Impact** | **DS 2023 24hr 90.41$^{st}$ percentile** |
|---|---|---|---|---|---|
| 1a | 14.9 | 15.0 | n/a | n/a | 29.7 |
| 1b | 14.6 | 14.6 | <0.1 | Negligible | 29.1 |
| 2a | 13.3 | 13.3 | n/a | n/a | 26.6 |
| 2b | 13.1 | 13.1 | <0.1 | Negligible | 26.1 |
| 3a | 13.8 | 13.8 | n/a | n/a | 27.4 |
| 3b | 13.3 | 13.4 | <0.1 | Negligible | 26.6 |
| 4a | 13.9 | 13.9 | n/a | n/a | 27.5 |
| 4b | 13.4 | 13.4 | <0.1 | Negligible | 26.6 |
| 5 | 13.3 | 13.3 | <0.1 | Negligible | 26.4 |
| 6a | 13.0 | 13.0 | n/a | n/a | 26.0 |
| 6b | 13.0 | 13.0 | <0.1 | Negligible | 25.9 |
| 7 | 13.3 | 13.3 | <0.1 | Negligible | 26.6 |
| 8 | 13.2 | 13.2 | <0.1 | Negligible | 26.3 |
| 9 | 13.2 | 13.2 | <0.1 | Negligible | 26.3 |
| 10 | 13.2 | 13.2 | <0.1 | Negligible | 26.4 |
| 11 | 13.2 | 13.2 | <0.1 | Negligible | 26.2 |
| 12 | 13.0 | 13.1 | <0.1 | Negligible | 26.0 |
| 13 | 13.2 | 13.2 | <0.1 | Negligible | 26.3 |
| 14 | 13.2 | 13.3 | <0.1 | Negligible | 26.4 |
| 15 | 13.7 | 13.7 | <0.1 | Negligible | 27.2 |
| 16 | 13.8 | 13.9 | <0.1 | Negligible | 27.8 |
| 17 | 13.8 | 13.8 | <0.1 | Negligible | 27.6 |
| F1a | n/a | 13.1 | n/a | n/a | 26.2 |
| F1b | n/a | 12.9 | n/a | n/a | 25.8 |
| F2a | n/a | 13.3 | n/a | n/a | 26.6 |
| F2b | n/a | 13.1 | n/a | n/a | 26.1 |
| F3a | n/a | 13.6 | n/a | n/a | 26.8 |
| F3b | n/a | 13.1 | n/a | n/a | 26.1 |

Table 20: Sensitivity test – predicted annual mean $PM_{2.5}$ concentrations

| **Receptor** | **DM 2023 (μg/m$^3$)** | **DS 2023 (μg/m$^3$)** | **Change (μg/m$^3$)** | **Impact** |
|---|---|---|---|---|
| 1a | 9.3 | 9.3 | n/a | n/a |
| 1b | 9.1 | 9.1 | <0.1 | Negligible |
| 2a | 8.4 | 8.4 | n/a | n/a |
| 2b | 8.2 | 8.3 | <0.1 | Negligible |
| 3a | 8.7 | 8.7 | n/a | n/a |
| 3b | 8.4 | 8.4 | <0.1 | Negligible |
| 4a | 8.7 | 8.8 | n/a | n/a |
| 4b | 8.4 | 8.5 | <0.1 | Negligible |
| 5 | 8.4 | 8.4 | <0.1 | Negligible |
| 6a | 8.2 | 8.2 | n/a | n/a |
| 6b | 8.2 | 8.2 | <0.1 | Negligible |
| 7 | 8.4 | 8.4 | <0.1 | Negligible |
| 8 | 8.3 | 8.3 | <0.1 | Negligible |
| 9 | 8.3 | 8.3 | <0.1 | Negligible |
| 10 | 8.3 | 8.4 | <0.1 | Negligible |
| 11 | 8.3 | 8.3 | <0.1 | Negligible |
| 12 | 8.2 | 8.3 | <0.1 | Negligible |
| 13 | 8.3 | 8.3 | <0.1 | Negligible |
| 14 | 8.4 | 8.4 | <0.1 | Negligible |
| 15 | 8.6 | 8.7 | <0.1 | Negligible |
| 16 | 8.7 | 8.7 | <0.1 | Negligible |
| 17 | 8.7 | 8.7 | <0.1 | Negligible |
| F1a | n/a | 8.3 | n/a | n/a |
| F1b | n/a | 8.2 | n/a | n/a |
| F2a | n/a | 8.4 | n/a | n/a |
| F2b | n/a | 8.3 | n/a | n/a |
| F3a | n/a | 8.5 | n/a | n/a |
| F3b | n/a | 8.3 | n/a | n/a |