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FT PATTEN (HOLDINGS)

THE STRAND, LIVERPOOL

AIR QUALITY ASSESSMENT

June 2016

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AIR QUALITY ASSESSMENT

June 2016

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1 INTRODUCTION

1.1.1 Wardell Armstrong LLP has been commissioned to undertake an air quality assessment for a proposed residential development at The Strand, Liverpool.

1.1.2 The proposed development site is located to the west of Liverpool city centre. To the north, the site is bordered by Red Cross Street; with a hotel and office premises beyond. The site is bordered to the east by Liverpool Crown Court, and to the south by existing apartments. To the west lies the A5036 Strand Street; with Canning Dock, the Museum of Liverpool and the River Mersey beyond.

1.1.3 The site currently comprises an existing four storey office building and car park. The proposals are for the demolition of the existing building and erection of a part 16, part 19 storey mixed use development comprising 395 apartments (C3 Use), with associated communal facilities (including residents' gym, cinema, roof terrace), two ground floor commercial units (A1/A2/A3/A4/D1 Use Class) and associated access, servicing, parking and landscaping.

1.1.4 Car parking provision, at basement level, will comprise 48 standard spaces, 2 accessible spaces and 6 car club spaces. In addition, 92 cycle spaces (including 12 cycle club spaces) are proposed. Access to the basement level parking will be from Red Cross Street, to the north.

1.1.5 This report details the results of the air quality assessment undertaken in support of a full planning application for the proposed development. The assessment considers dust and fine particulate matter associated with the construction phase of the proposed development, and road traffic emissions associated with the operational phase. Air pollutant concentrations are considered at proposed receptor locations within the site and the requirement for mitigation is considered.

2 PLANNING POLICY CONTEXT

2.1 Air Quality Legislation and National Air Quality Strategy

2.1.1 The Environment Act 1995 requires the UK government to prepare a National Air Quality Strategy. The UK National Air Quality Strategy (NAQS) was therefore published in March 1997 setting out policies for the management of ambient air quality. The Strategy sets objectives for eight pollutants which may potentially occur in the UK at levels that give cause for concern. These pollutants are: nitrogen dioxide (NO_2), sulphur dioxide, carbon monoxide, lead, fine particulate matter (PM_{10}), benzene, 1, 3–butadiene and ozone.

2.1.2 The Strategy was reviewed and a Review Report[1] and Consultation Document[2] were published by the Department of the Environment, Transport and the Regions in 1999. A revised version (The Air Quality Strategy (AQS) 2000), which supersedes the 1997 Strategy, was published in January 2000. The AQS 2000 strengthened the objectives for a number of pollutants with the exception of that for fine particulate matter, which was replaced with the less stringent EU limit value.

2.1.3 The objectives for the eight pollutants in the Strategy provide the basis of the implementation of Part IV of the Environment Act 1995. The Air Quality Strategy objectives for each pollutant, except ozone, were given statutory status in the Air Quality (England) Regulations, 2000[3] and Air Quality (England) (Amendment) Regulations 2002[4].

2.1.4 In 2007 the Air Quality Strategy was revised. This latest strategy[5] does not remove any of the objectives set out in the previous strategy or its addendum, apart from replacing the provisional 2010 objective for PM_{10} in England, Wales and Northern Ireland with the exposure reduction approach for $PM_{2.5}$. The UK Government and the Devolved Administrations have now therefore set new national air quality objectives for particulate matter smaller than 2.5µm diameter ($PM_{2.5}$).

[1] Department of the Environment, Transport and the Regions, January 1999. Report on the Review of the National Air Quality Strategy, Proposals to amend the Strategy
[2] Department of the Environment, Transport and the Regions 1999, The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. A consultation document
[3] The Air Quality (England) Regulations 2000. SI No 928
[4] The Air Quality (Amendment) Regulations 2002
[5] Department of Environment, Food and Rural Affairs, The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. July 2007

2.1.5 EU Ambient Air Quality Directive 2008/50/EC[6] came into force in June 2008 and was transposed into legislation in England on 11th June 2010 as 'The Air Quality Standards Regulations 2010'[7]. This EU Directive consolidates existing air quality legislation and makes achievement of the objectives a national objective rather than a local one. It also provides a new regulatory framework for $PM_{2.5}$.

2.1.6 The current Air Quality Standards and Objectives, as set out in the Air Quality Standards Regulations 2010, are detailed in Table 1.

Table 1: UK Air Quality Objectives and Pollutants

Pollutant	Objective	Averaging Period	Obligation
Nitrogen Dioxide (NO_2)	200µg/m^3 not to be exceeded more than 18 times a year	1-hour mean	All local authorities
	40µg/m^3	Annual mean	All local authorities
Particulate Matter (PM_{10})	50µg/m^3 not to be exceeded more than 35 times a year	24-hour mean	All local authorities
	50µg/m^3 not to be exceeded more than 7 times a year	24-hour mean	Scotland only
	40µg/m^3	Annual mean	All local authorities
	18µg/m^3	Annual mean	Scotland only
Particulate Matter ($PM_{2.5}$)	25µg/m^3	Annual mean	England only
	10µg/m^3	Annual mean	Scotland only
Sulphur Dioxide (SO_2)	266µg/m^3 not to be exceeded more than 35 times a year	15-minute mean	All local authorities
	350µg/m^3 not to be exceeded more than 24 times a year	1-hour mean	All local authorities
	125µg/m^3 not to be exceeded more than 3 times a year	24-hour mean	All local authorities
Benzene (C_6H_6)	16.25µg/m^3	Running annual mean	All local authorities
	5µg/m^3	Annual mean	England and Wales only
	3.25µg/m^3	Running annual mean	Scotland and Northern Ireland only
1,3-Butadiene (C_4H_6)	2.25µg/m^3	Running annual mean	All local authorities

[6] 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
[7] Statutory Instruments 2010 No. 1001 The Air Quality Standards Regulations 2010

Table 1: UK Air Quality Objectives and Pollutants			
Pollutant	**Objective**	**Averaging Period**	**Obligation**
Carbon Monoxide (CO)	10mg/m^3	Maximum daily running 8-hour mean	England, Wales and Northern Ireland only
	10mg/m^3	Running 8-hour mean	Scotland only
Lead (Pb)	0.5µg/m^3	Annual mean	All local authorities
	0.25µg/m^3	Annual mean	All local authorities

2.2 Legislative Requirement for Local Air Quality Management Guidance

2.2.1 The 2007 Air Quality Strategy for England, Scotland, Wales and Northern Ireland establishes the framework for air quality improvements based on measures agreed at a national and international level. However, despite these measures, it is recognised that areas of poor air quality will remain and these should be dealt with through the Local air Quality Management (LAQM) process using locally implemented measures.

2.2.2 LAQM legislation in the Environment Act 1995 requires local authorities to conduct periodic review and assessments of air quality. These aim to identify all those areas where the air quality objectives are being, or are likely to be, exceeded.

2.2.3 All authorities were required to undertake the first stage of review and assessment which concluded in September 2001. In those areas identified as having the potential to experience elevated levels of pollutants the authority was required to undertake a more detailed second stage review comprising two steps; Updating and Screening Assessments and Detailed Assessments. Where it was predicted that one or more of the air quality objectives would be unlikely to be met by the end of 2005, local authorities were required to proceed to a third stage and, if necessary, declare Air Quality Management Areas (AQMAs) and make action plans for improvements in air quality, in pursuit of the national air quality objectives.

2.2.4 An Evaluation Report, commissioned by the UK Government and Devolved Administrations in 2007, led to the publication of the LAQM Technical Guidance document LAQM.TG(09) in February 2009. This technical guidance was subsequently updated following a consultation process, and in January 2016 the LAQM Technical Guidance document LAQM.TG(16) was published by Defra.

2.2.5 LAQM.TG(16) presents the changes to the LAQM system across the UK. A new streamlined approach has been adopted in England and Scotland; however Wales and Northern Ireland are still considering changes to LAQM and therefore work according to the previous regimes.

2.2.6 The previous structure of Review and Assessment, comprising Updating and Screening Assessments and Detailed Assessments has been replaced by the introduction of an Annual Status Report (ASR) for England and an Annual Progress Report (APR) for Scotland.

2.2.7 The ASR replaces all other reports which previously had to be submitted as part of the LAQM system including review and assessment and action plan progress reports, updating and screening assessments and detailed assessments.

2.2.8 Local authorities now have the option of a fast track AQMA declaration option. This allows more expert judgement to be used and removes the need for a detailed assessment where a local authority is confident of the outcome. Detailed assessments should still be used if there is any doubt.

2.2.9 Examples of where the Air Quality Objectives should/should not apply are also detailed in LAQM.TG(16) and are included in Table 2 below.

Table 2: Examples of Where the Air Quality Objectives Should Apply

Averaging Period	Objectives Should Apply at:	Objectives Should Generally Not Apply at:
Annual mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, car homes, etc.	Building facades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade) or any other location where public exposure is expected to be short term
24-hour mean and 8-hour mean	All locations where the annual mean objectives would apply together with hotels. Gardens of residential properties[a]	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term
1-hour mean	All locations where the annual mean and 24 and 8-hour objectives apply. Kerbside sites (e.g. pavements of busy shopping streets).	Kerbside sites where public would not be expected to have regular access

Table 2: Examples of Where the Air Quality Objectives Should Apply		
Averaging Period	**Objectives Should Apply at:**	**Objectives Should Generally Not Apply at:**
	Those parts of car parks and railway stations etc. which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more. Any outdoor locations to which the public might reasonably be expected to spend one hour or longer	
15-minute mean	All locations where members of the public might reasonably be exposed for a period of 15 minutes or longer	
[a]: Such locations should represent parts of the garden where relevant public exposure is likely, for example where there is seating or play areas. It is unlikely that relevant public exposure to pollutants would occur at the extremities of the garden boundary, or in front gardens, although local judgement should always be applied		

2.3 National Planning Policy and Guidance

2.3.1 The National Planning Policy Framework[8], introduced in March 2012 requires that planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of AQMAs and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in AQMAs is consistent with the local air quality action plan.

2.3.2 The Planning Practice Guidance[9], updated in March 2014, states that whether or not air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to generate air quality impacts in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU legislation (including that applicable to wildlife).

[8] Department for Communities and Local Government, March 2012, National Planning Policy Framework
[9] Department for Communities and Local Government, March 2014, Planning Practice Guidance: Air Quality

2.3.3 Where a proposed development is anticipated to give rise to concerns about air quality an appropriate assessment needs to be carried out. Where the assessment concludes that the proposed development (including mitigation) will not lead to an unacceptable risk from air pollution, prevent sustained compliance with national objectives or fail to comply with the requirements of the Habitats Regulations, then the local authority should proceed to decision with appropriate planning conditions and/or obligations.

2.4 Liverpool City Council – Local Air Quality Management Review and Assessment

2.4.1 Liverpool City Council (LCC) is responsible for the management of local air quality in the vicinity of the proposed development.

2.4.2 The 2015 Updating and Screening Assessment report, the most recent LAQM report available from LCC, provides details of air quality monitoring taking place within the city. There are currently two automatic and seventy three non-automatic monitoring locations in operation within the LCC area.

2.4.3 The closest monitoring locations to the proposed development are three roadside diffusion tubes located at the junction of Strand Street and Water Street, approximately 0.3km to the north. In 2015, the most recent year for which bias-adjusted data is available, these locations measured annual mean NO_2 concentrations ranging between 64 and 67µg/m^3.

2.4.4 The proposed development is located within the existing AQMA which has been declared for the entire Liverpool city area.

3 ASSESSMENT METHODOLOGY

3.1 Consultation and Scope of Assessment

3.1.1 A written assessment methodology was provided, by email correspondence, to the Environmental Protection Unit at LCC on 6th June 2016. This included the following details:

- An assessment will be undertaken to consider the potential dust and fine particulate matter impacts associated with the construction phase of the proposed development. This will be undertaken in accordance with Institute of Air Quality Management (IAQM) guidance;
- a detailed air quality assessment, using the air dispersion model ADMS-Roads, will be undertaken to consider pollutant concentrations at the proposed development. The assessment will consider NO_2, PM_{10} and $PM_{2.5}$ concentrations at proposed receptor locations;
- although 56 car parking spaces are proposed as part of the development, this represents a reduction from the current uses, as there are currently 65 spaces associated with the existing office building. As a result, it is not necessary to consider the impact of development generated traffic at existing sensitive receptor locations;
- the assessment will consider road traffic along the A5036 Strand Street, as this is the link which is most likely to affect the proposed development;
- meteorological data will be obtained from the Liverpool John Lennon Airport meteorological recording station, as this is considered to be the most representative of the proposed development;
- model verification will be undertaken using a roadside diffusion tube located at the junction of Strand Street and Water Street, approximately 0.3km to the north of the proposed development site. Further details are provided in section 3.3 of this report;
- background NO_2, PM_{10} and $PM_{2.5}$ concentrations will be obtained from the 2011-based Defra default concentration maps, as there are no representative background monitoring locations in the vicinity of the proposed development site; and
- predicted pollutant concentrations will be compared against the relevant air quality objectives, as set out in the Air Quality Standards Regulations 2010. Recommendations for mitigation will be provided, as appropriate.

3.1.2 A return email was received from Mr Paul Farrell, Operations Manager, on 14th June 2016. The assessment methodology was accepted and no further comments were provided.

3.2 Construction Phase Assessment – Dust and Fine Particulate Emissions

3.2.1 To assess the impacts associated with dust and PM_{10} releases, during the construction phase of the development, an assessment has been undertaken in accordance with guidance from the IAQM[10].

Step 1

3.2.2 Step 1 of the assessment is to screen the requirement for a more detailed assessment. The guidance states that an assessment will normally be required where there are existing human sensitive receptors within 350m of the site boundary and/or within 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s).

3.2.3 With regards to ecological receptors, the guidance states that an assessment will normally be required where there are existing ecological receptors within 50m of the site boundary and/or within 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s).

3.2.4 Where there are existing sensitive receptors locations within 350m of the site boundary, it is necessary to proceed to Step 2 of the assessment.

Step 2

3.2.5 Step 2 of the assessment determines the potential risk of dust and PM_{10} arising in sufficient quantities to cause annoyance and/or health and/or ecological impacts. The risk is related to:

- The activities being undertaken (demolition, number of vehicles and plant etc);
- the duration of these activities;
- the size of the site;
- the meteorological conditions (wind speed, direction and rainfall);
- the proximity of receptors to the activity;
- the adequacy of the mitigation measures applied to reduce or eliminate dust; and

[10] Institute of Air Quality Management, Guidance on the Assessment of Dust from Demolition and Construction, February 2014

- the sensitivity of receptors to dust.

3.2.6 The risk of dust and PM_{10} effects is determined using four risk categories: negligible, low, medium and high risk. A site is allocated to a risk category based upon two factors:

- **Step 2A** – the scale and nature of the works which determines the potential dust emission magnitude as small, medium or large; and
- **Step 2B** – the sensitivity of the area to dust impacts which is defined as low, medium or high sensitivity.

3.2.7 These two factors are combined in **Step 2C** to determine the risk of dust impacts with no mitigation applied.

3.2.8 The risk of dust effects is determined for four types of construction phase activities, with each activity being considered separately. If a construction phase activity is not taking place on the site, then it does not need to be assessed. The four types of activities to be considered are:

- Demolition;
- earthworks;
- construction; and
- trackout.

Step 3

3.2.9 Step 3 of the assessment determines the site-specific mitigation required for each of the activities, based on the risk determined in Step 2. Mitigation measures are detailed in guidance published by the Greater London Authority[11], recommended for use outside the capital by LAQM guidance and the IAQM guidance document itself. If the risk is classed as negligible, no mitigation measures beyond those required by legislation will be necessary.

Step 4

3.2.10 Step 4 assesses the residual effect, with mitigation measures in place, to determine whether or not these are significant.

[11] Greater London Authority (2006) The Control of Dust and Emissions from Construction and Demolition: Best Practice Guidance

Existing Sensitive Receptors – Human Receptors

3.2.11 The closest sensitive receptor locations to the proposed development are residential in nature, and are detailed in Table 3.

Table 3: Existing Dust Sensitive Receptors – Human Receptors

Receptor	Direction from the Site	Approximate Distance from the Site Boundary
Liverpool Central Travelodge	North	12m
Existing office premises on Red Cross Street	North/North East	12m at the closest point
Liverpool Crown Court	East	<10m at the closest point
Existing residential apartments within One Park West	South	10m at the closest point
Existing office premises on Strand Street	North West	55m

Existing Sensitive Receptors – Ecological Receptors

3.2.12 There are no designated statutory or non-statutory ecological receptors located within 50m of the site boundary and/or within 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s). Therefore it is not necessary to consider them in this assessment.

3.3 Operational Phase – Road Traffic Emissions

Modelling of Road Traffic Emissions

3.3.1 The air dispersion model ADMS-Roads (CERC, Version 3.4) has been used to assess pollutant concentrations at the proposed development. The air dispersion model has been used to predict NO_2 and fine particulate matter (PM_{10} and $PM_{2.5}$) concentrations, as these are the pollutants considered most likely to exceed the air quality objectives.

3.3.2 Air dispersion modelling has been carried out to estimate pollutant concentrations, due to road traffic emissions, for three assessment years as follows:

- The verification and base year (2015): This is the most recent year for which traffic flow information, local monitored pollution data and meteorological data are available;

- the proposed opening year of the development (2020): This is the first year in which the development is likely to be occupied; and
- a future year (2025): This is five years following the proposed opening year.

3.4 Road Traffic Data

3.4.1 The ADMS-Roads model requires the input of detailed road traffic flow information for those routes which will be affected by the proposed development.

3.4.2 Detailed traffic flow information, for use in the ADMS-Roads air dispersion model, has been obtained from the Department for Transport website[12]. Factors to adjust this data to the correct assessment years have been provided by Curtins Consulting, the appointed transport consultant for the project. The traffic flow information used in the assessment is included in Appendix A.

3.4.3 The traffic flow information has been obtained as 24-hour Annual Average Daily Traffic (AADT) flows, with HGV percentages, for the following links:

- A5036 Strand Street; and
- Water Street.

3.4.4 Air quality modelling has been carried out to predict pollutant concentrations, due to road traffic emissions, for a total of five scenarios:

- Scenario 1: 2015 Verification and Base Year;
- Scenario 2: 2020 Opening Year;
- Scenario 3: 2020 Opening Year – Sensitivity Analysis;
- Scenario 4: 2025 Future Year; and
- Scenario 5: 2025 Future Year – Sensitivity Analysis.

3.5 Meteorological Data

3.5.1 The meteorological data used in the air quality modelling has been obtained from ADM Limited. Meteorological data has been obtained for 2015 from the Liverpool John Lennon Airport recording station, as agreed with LCC.

3.5.2 This is located approximately 11km to the south east of the proposed development and is considered to be the most representative of the conditions at the site.

[12] Department for Transport Traffic Counts website (http://www.dft.gov.uk/traffic-counts/cp.php)

3.5.3 The meteorological data provides hourly wind speed and direction information. The 2015 wind rose for the Liverpool John Lennon Airport meteorological recording station is included in Appendix B.

3.6 Proposed Sensitive Receptor Locations

3.6.1 Five proposed sensitive receptor locations have been selected at locations which are considered to be representative of the proposed residential uses closest to Strand Street. These locations are all on the western façade of the building, facing on to Strand Street, however they take into account the different distances between where residential uses are proposed and the roadside.

3.6.2 Each of the five receptor locations has been modelled at different heights, to take into account the floors on which residential accommodation will be located. These have been chosen based on the elevation plan provided by the client.

3.6.3 The assessment has focused on those façades that are closest to the road with the highest traffic flows (and which are therefore expected to experience the highest pollutant concentrations). Pollutant concentrations have been predicted between Ground Floor Level and Level 08 (i.e. eight floor height); however, it should be noted that no residential uses are proposed on Ground Floor Level. Above Level 08, pollutant concentrations would be not expected to vary significantly from those concentrations predicted at that level. The following heights have been considered:

- Ground Floor Level (1.5m);
- Level 01 (4.8m);
- Level 02 (7.8m);
- Level 03 (10.8m);
- Level 04 (13.6m);
- Level 05 (16.6m);
- Level 06 (19.4m);
- Level 07 (22.4m); and
- Level 08 (25.2m).

3.6.4 Pollutant concentrations at the proposed receptor locations have been predicted for Scenarios 2, 3, 4 and 5 only (as detailed in paragraph 3.4.4). It is not necessary to consider pollutant concentrations in the 2015 Verification and Base Year, as the proposed development has not yet been built.

3.6.5 Details of the proposed sensitive receptor locations are provided in Table 4, and the locations are shown on drawing LE13526-001.

Table 4: Proposed Sensitive Receptor Location			
Receptor Point	**Location**	**Grid Reference**	
		Easting	**Northing**
PR 1	Location on the north western corner of the proposed façade facing onto Strand Street	334182	390118
PR 2	Location on the western proposed façade facing onto Strand Street	334191	390106
PR 3	Location on the western proposed façade, set back from Strand Street	334217	390109
PR 4	Location on the western proposed façade facing onto Strand Street	334206	390085
PR 5	Location on the south western corner of the proposed façade facing onto Strand Street	334215	390073

3.7 Model Verification

3.7.1 Defra Local Air Quality Management Technical Guidance, 2016, (LAQM.TG(16)) recognises that model validation generally refers to detailed studies that have been carried out by the model supplier or a regulatory agency. The ADMS-Roads model has been validated by the supplier CERC.

3.7.2 Model verification is used to check the performance of the model at a local level. The verification of the ADMS-Roads model is achieved by modelling concentration(s) at existing monitoring location(s) in the vicinity of the proposed development and comparing the modelled concentration(s) with the measured concentration(s).

3.7.3 Three co-located roadside diffusion tubes are currently in operation at the junction of Strand Street and Water Street, approximately 0.3km to the north of the proposed development. This has been used for verifying predicted NO_2 concentrations.

3.7.4 There are no PM_{10} or $PM_{2.5}$ monitoring locations along roads for which traffic data is available and therefore adjustment of modelled PM_{10} and $PM_{2.5}$ concentrations has not been possible.

3.7.5 NO_2 measurement data, from 2015, has been used for the purposes of verification, as this is the most recent year for which bias-adjusted data is available. The monitoring data that has been used is detailed in Table 5.

Table 5: NO_2 Diffusion Tube Data for 2015 Used for Model Verification			
Location	**Grid Reference**		**2014 Bias Adjusted NO_2 Annual Average Concentration* (µg/m^3)**
	Easting	**Northing**	
T39 – Strand Street/Water Street Jct-Roadsign L2	334277	390231	67
T40 – Strand Street/Water Street Jct-Roadsign L2	334277	390231	64
T41 – Strand Street/Water Street Jct-Roadsign L2	334277	390231	67
**Provided by Environmental Health Department at LCC*			

3.7.6 Further details of the model verification are included in Appendix C.

3.8 Information Sources

3.8.1 The following sources of information have been used in the preparation of this report:

- Liverpool City Council, 2015 Updating and Screening Assessment Report;
- Liverpool City Council, 2015 bias-adjusted monitoring data spreadsheet;
- meteorological data for 2015 from the Liverpool John Lennon Airport recording station, obtained from ADM Limited; and
- traffic flow information, obtained from the Department for Transport and adjusted using factors provided by Curtins Consulting.

3.9 Assumptions and Limitations

3.9.1 Given the scale of the proposed development, it has been assumed that the number of vehicles generated by the construction phase will not be significant. Therefore, the impact on air quality during the construction phase has not been assessed.

4 SIGNIFICANCE CRITERIA

4.1 Construction Phase Assessment – Dust and Fine Particulate Emissions

4.1.1 The IAQM guidance details criteria for assessing the sensitivity of an area to dust soiling and health effects of PM_{10}, as summarised in Tables 6 to 8 below.

4.1.2 The guidance then goes on to provide significance criteria for the classification of dust soiling and human health effects from demolition, earthworks, construction activities and trackout, as summarised in Tables 9 to 11 below.

Sensitivity of the Area – Human Receptors

4.1.3 The sensitivity categories for different types of receptors, to both dust soiling effects and the health effects of PM_{10}, are described in Table 6.

Table 6: Sensitivity Categories for Human Receptors

Sensitivity Category	Dust Soiling Effects	Health effects of PM_{10}
High	Users can reasonably expect to enjoy a high level of amenity; Appearance, aesthetics or value of a property would be diminished; Examples include dwellings, museums and other culturally important collections, medium and long term car parks and car show rooms.	Locations where members of the public are exposed over a period of time relevant to the air quality objective for PM_{10}; Examples include residential properties, hospitals, schools, and residential care homes.
Medium	Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; The appearance, aesthetics or value of their property could be diminished; People or property wouldn't reasonably be expected to be continuously present or regularly for extended periods of time; Examples include parks and places of work.	Locations where people are exposed as workers and exposure is over a period of time relevant to the air quality objective for PM_{10}; Examples include office and shop workers but will generally not include workers occupationally exposed to PM_{10}.
Low	Enjoyment of amenity would not reasonably be expected; Property would not be diminished in appearance, aesthetics or value; People or property would expected to be present only for limited periods of time; Examples include playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.	Locations where human exposure is transient; Examples include public footpaths, playing fields, parks and shopping streets.

4.1.4 Based upon the category of receptor sensitivity, the sensitivity of the area to dust soiling effects is determined using the criteria detailed in Table 7.

Table 7: Sensitivity of the Area to Dust Soiling Effects on People and Property

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

4.1.5 Based upon the category of receptor sensitivity, the sensitivity of the area to the health effects of PM_{10} is determined using the criteria detailed in Table 8.

Table 8: Sensitivity of the Area to Human Health Impacts

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

Risk of Dust Impacts

4.1.6 The risk of dust being generated by demolition activities at the site is determined using the criteria in Table 9.

Table 9: Risk of Dust Impacts - Demolition			
Sensitivity of Area	**Dust Emission Magnitude**		
	Large	**Medium**	**Small**
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

4.1.7 The risk of dust being generated by earthworks and construction activities at the site is determined using the criteria in Table 10.

Table 10: Risk of Dust Impacts – Earthworks and Construction			
Sensitivity of Area	**Dust Emission Magnitude**		
	Large	**Medium**	**Small**
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

4.1.8 The risk of dust being generated by trackout from the site is determined using the criteria in Table 11.

Table 11: Risk of Dust Impacts – Trackout			
Sensitivity of Area	**Dust Emission Magnitude**		
	Large	**Medium**	**Small**
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

5 BASELINE SITUATION

5.1 Background Air Pollutant Concentrations

5.1.1 The ADMS assessment needs to take into account background concentrations upon which the local, traffic derived pollution is superimposed. The data may be derived through long term ambient measurements at background sites, remote from immediate sources of air pollution, or alternatively from the default concentration maps which have been provided for use by Defra with the LAQM.TG(16) guidance.

5.1.2 There are no background monitoring locations which are considered to be representative of the proposed development site. As a result, background pollutant concentrations for use in the assessment have been obtained from the default concentration maps, which can be accessed through the Defra website[13].

5.1.3 Current evidence suggests that background NO_2 concentrations are not decreasing in accordance with expected reductions. A sensitivity analysis has therefore been carried out whereby 2015 background concentrations and vehicle emission factors have been applied to the 2020 Opening Year and 2025 Future Year scenarios. This is considered to be a conservative approach, as it is likely that there will be some improvement in background air quality, and emission factors, before 2025.

5.1.4 The background pollutant concentrations used in the assessment are detailed in Table 12.

Table 12: Background Pollutant Concentrations Obtained from the Defra Default Background Concentration Maps (Grid Square: 334500, 390500)

Pollutant	Pollutant Concentrations (µg/m^3)		
	2015	2020	2025
Oxides of Nitrogen (NO_x)	45.38	39.36	37.54
Nitrogen Dioxide (NO_2)	29.32	25.95	24.83
Fine Particulate Matter (PM_{10})	16.74	15.85	15.63
Fine Particulate Matter ($PM_{2.5}$)	11.26	10.42	10.16

[13] Defra Local Air Quality Management webpage (http://uk-air.defra.gov.uk/data/laqm-background-maps?year=2011)

6 IMPACT ASSESSMENT

6.1 Construction Phase Assessment – Dust and Fine Particulate Emissions

6.1.1 The main activities involved with the construction phase of works are as follows:

- **Demolition** of existing buildings within the proposed development area;
- **Earthworks** which may be required prior to the construction phase of works. Sources of dust can include:
  - Cleaning the site;
  - Stripping and stockpiling of topsoil and subsoil;
  - Ground excavation;
  - Bringing in, tipping and spreading materials on site;
  - Stockpiling materials;
  - Levelling ground;
  - Trenching;
  - Road construction;
  - Vehicle movements on site roads; and
  - Windblown materials from site.
- **Construction** which will involve the construction of individual building access roads, the car parking areas and the buildings themselves; and
- **Trackout** which is the transport of dust and dirt by vehicles travelling from a construction site on to the public road network. This may occur through the spillage of dusty materials onto road surfaces or through the transportation of dirt by vehicles that have travelled over muddy ground on the site. This dust and dirt can then be deposited and re-suspended by other vehicles.

Step 2A

6.1.2 Step 2A of the construction phase dust assessment has defined the potential dust emission magnitude from demolition, earthworks, construction and trackout in the absence of site specific mitigation. Examples of the criteria for the dust emission classes are detailed in the IAQM guidance.

Step 2B

6.1.3 Step 2B of the construction phase dust assessment has defined the sensitivity of the area, taking into account the significance criteria detailed in Tables 6 to 8, for demolition, earthworks, construction and trackout. The sensitivity of the area to each activity is assessed for potential dust soiling and human health effects.

6.1.4 For demolition, earthworks and construction there are in excess of 100 residential receptor locations within 50m of where these activities may take place.

6.1.5 For trackout, there are between 10 and 100 residential receptor locations within 20m of where trackout may occur, for a distance of up to 500m from the site access.

Step 2C

6.1.6 Step 2C of the construction phase dust assessment has defined the risk of impacts from each activity. The dust emission magnitude is combined with the sensitivity of the surrounding area. The risk of dust impacts from each activity, with no mitigation in place, has been assessed in accordance with the criteria detailed in Tables 9 to 11.

Summary

6.1.7 Table 13 details the results of Step 2 of the construction phase assessment for human receptors.

Table 13: Construction Phase Dust Assessment (Step 2) – Human Receptors

	Activity			
	Demolition	**Earthworks**	**Construction**	**Trackout**
Step 2A				
Dust Emission Magnitude	Medium[a]	Medium[b]	Large[c]	Medium[d]
Step 2B				
Sensitivity of Closest Receptors	High	High	High	High
Sensitivity of Area to Dust Soiling Effects	High	High	High	High
Sensitivity of Area to Human Health Effects	Low[e]	Low[e]	Low[e]	Low[e]
Step 2C				
Dust Risk: Dust Soiling	Medium Risk	Medium Risk	High Risk	Medium Risk
Dust Risk: Human Health	Low Risk	Low Risk	Low Risk	Low Risk

Table 13: Construction Phase Dust Assessment (Step 2) – Human Receptors				
	Activity			
	Demolition	Earthworks	Construction	Trackout
a. Total building volume estimated to be <20,000m^3, but potentially dusty materials and demolition may take place at a height of 10-20m above ground *b. Total site area estimated to be between 2,500m^2 and 10,000m^2* *c. Total building volume estimated to be more than 100,000m^3* *d. HGV movements estimated to be between 10 and 50 per day* *e. Background annual mean PM_{10} concentration less than 24µg/m^3 (based on data obtained from the LAQM Defra default concentration maps, for the appropriate grid squares, as detailed in Table 12)*				

6.2 Operational Phase Assessment – Road Traffic Emissions

Proposed Sensitive Receptor Locations

6.2.1 Air pollutant concentrations have been modelled for five proposed receptor locations, for the 2020 Opening Year and 2025 Future Year scenarios. As discussed previously, the assessment has considered pollutant concentrations at a number of heights which correspond to the storeys of the proposed building.

NO_2 Concentrations

6.2.2 The predicted NO_2 concentrations for the five receptor locations considered are detailed in Table 14 and are also included in Appendix D.

Table 14: Predicted NO_2 Concentrations at Proposed Sensitive Receptor Locations for 2020 Opening Year and 2025 Future Year Scenarios

Proposed Receptor Location	Height	Calculated Annual Mean Concentration (µg/m^3)			
		2020 Opening Year (2020 Backgrounds and Emission Factors)	2020 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)	2025 Future Year (2025 Backgrounds and Emission Factors)	2025 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)
PR 1	Ground Floor Level – 1.5m	48.17	62.70	45.00	71.34
	Level 01 – 4.8m	38.88	49.17	36.60	54.78
	Level 02 – 7.8m	33.74	41.47	31.93	45.13
	Level 03 – 10.8m	30.71	36.82	29.17	39.16
	Level 04 – 13.6m	29.05	34.23	27.65	35.79
	Level 05 – 16.6m	27.99	32.57	26.69	33.62

Table 14: Predicted NO_2 Concentrations at Proposed Sensitive Receptor Locations for 2020 Opening Year and 2025 Future Year Scenarios

Proposed Receptor Location	Height	Calculated Annual Mean Concentration (µg/m³)			
		2020 Opening Year (2020 Backgrounds and Emission Factors)	2020 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)	2025 Future Year (2025 Backgrounds and Emission Factors)	2025 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)
	Level 06 – 19.4m	27.39	31.62	26.15	32.37
	Level 07 – 22.4m	26.98	30.96	25.77	31.49
	Level 08 – 25.2m	26.72	30.54	25.53	30.94
PR 2	Ground Floor Level – 1.5m	48.34	62.99	45.15	71.68
	Level 01 – 4.8m	38.78	49.05	36.50	54.61
	Level 02 – 7.8m	33.69	41.39	31.87	45.02
	Level 03 – 10.8m	30.68	36.78	29.14	39.11
	Level 04 – 13.6m	29.03	34.20	27.64	35.75
	Level 05 – 16.6m	27.98	32.54	26.68	33.59
	Level 06 – 19.4m	27.38	31.60	26.14	32.34
	Level 07 – 22.4m	26.97	30.94	25.76	31.47
	Level 08 – 25.2m	26.71	30.52	25.52	30.92
PR 3	Ground Floor Level – 1.5m	35.34	43.92	33.41	48.29
	Level 01 – 4.8m	33.94	41.80	32.13	45.59
	Level 02 – 7.8m	32.11	38.98	30.45	41.98
	Level 03 – 10.8m	30.38	36.31	28.87	38.52
	Level 04 – 13.6m	29.12	34.34	27.72	35.94
	Level 05 – 16.6m	28.15	32.81	26.84	33.94
	Level 06 – 19.4m	27.52	31.82	26.27	32.64
	Level 07 – 22.4m	27.07	31.10	25.85	31.69
	Level 08 – 25.2m	26.78	30.64	25.59	31.07

Table 14: Predicted NO_2 Concentrations at Proposed Sensitive Receptor Locations for 2020 Opening Year and 2025 Future Year Scenarios

Proposed Receptor Location	Height	Calculated Annual Mean Concentration (µg/m³)			
		2020 Opening Year (2020 Backgrounds and Emission Factors)	2020 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)	2025 Future Year (2025 Backgrounds and Emission Factors)	2025 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)
PR 4	Ground Floor Level – 1.5m	<u>48.50</u>	<u>63.26</u>	<u>45.29</u>	<u>72.01</u>
	Level 01 – 4.8m	38.52	<u>48.70</u>	36.26	<u>54.17</u>
	Level 02 – 7.8m	33.43	<u>41.03</u>	31.64	<u>44.55</u>
	Level 03 – 10.8m	30.56	36.59	29.02	38.85
	Level 04 – 13.6m	28.97	34.11	27.58	35.63
	Level 05 – 16.6m	27.95	32.49	26.65	33.52
	Level 06 – 19.4m	27.35	31.55	26.11	32.28
	Level 07 – 22.4m	26.94	30.89	25.74	31.41
	Level 08 – 25.2m	26.68	30.48	25.50	30.87
PR 5	Ground Floor Level – 1.5m	<u>48.61</u>	<u>63.45</u>	<u>45.39</u>	<u>72.23</u>
	Level 01 – 4.8m	38.44	<u>48.59</u>	36.18	<u>54.03</u>
	Level 02 – 7.8m	33.36	<u>40.92</u>	31.57	<u>44.40</u>
	Level 03 – 10.8m	30.49	36.49	28.96	38.73
	Level 04 – 13.6m	28.93	34.03	27.54	35.53
	Level 05 – 16.6m	27.92	32.44	26.62	33.45
	Level 06 – 19.4m	27.33	31.51	26.09	32.23
	Level 07 – 22.4m	26.92	30.86	25.72	31.37
	Level 08 – 25.2m	26.67	30.46	25.49	30.83

<u>Underlined</u> concentrations represent an exceedance of the annual mean objective of 40µg/m³

6.2.3 When the use of 2020 and 2025 background concentrations and vehicle emission factors are used in the 2020 Opening Year and 2025 Future Year scenarios, respectively (i.e. assuming improvements in air quality by 2025), exceedance of the annual mean NO_2 objective is predicted at Ground Floor Level, for those receptors located closest to Strand Street (i.e. PR 1, 2, 4 and 5). However, no residential uses are proposed at this level. Elevated concentrations are predicted at Level 01 (i.e. first floor height), which is the lowest storey at which residential uses are proposed.

6.2.4 This is considered to be an optimistic approach, as current evidence suggests that background NO_2 concentrations are not decreasing in accordance with expected reductions. These results are therefore considered to present a 'best' case scenario.

6.2.5 As a result, an alternative approach has also been adopted (i.e. a sensitivity analysis), in which 2015 background concentrations and 2015 vehicle emission factors are used in the 2020 Opening Year and 2025 Future Year scenarios. This presents a robust approach as it has been assumed that there will be no improvement in air quality before 2025.

6.2.6 The results of the sensitivity analysis predict exceedances of the annual mean NO_2 objective at all five proposed sensitive receptor locations considered. These exceedances are predicted at Ground Floor Level (i.e. at a height of 1.5m), Level 01 (i.e. at a height of 4.8m) and at Level 02 (i.e. at a height of 7.8m) at those receptors located closest to Strand Street (i.e. PR 1, 2, 4 and 5). Exceedance is only predicted at Level 01 at PR 3, which is located further away from Strand Street.

6.2.7 Elevated NO_2 concentrations are also predicted at Level 03 (i.e. at a height of 10.8m) for those receptors located closest to Strand Street (i.e. PR 1, 2, 4 and 5).

6.2.8 No residential uses are proposed at the Ground Floor Level. Residential uses are proposed at Level 01 and upwards.

6.2.9 It should be noted that ground level background concentrations have been used throughout the assessment, in the prediction of pollutant concentrations at receptor locations on all floors of the proposed development. In reality, background concentrations would be expected to decrease with height, and therefore this assessment adopts a robust approach.

PM_{10} Concentrations

6.2.10 The predicted PM_{10} concentrations for the five receptor locations considered are detailed in Table 15 and are also included in Appendix E.

Table 15: Predicted PM_{10} Concentrations at Proposed Sensitive Receptor Locations for 2020 Opening Year and 2025 Future Year Scenarios

Proposed Receptor Location	Height	Calculated Annual Mean Concentration (µg/m³)			
		2020 Opening Year (2020 Backgrounds and Emission Factors)	2020 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)	2025 Future Year (2025 Backgrounds and Emission Factors)	2025 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)
PR 1	Ground Floor Level – 1.5m	17.09	18.12	17.23	18.59
	Level 01 – 4.8m	16.50	17.47	16.48	17.72
	Level 02 – 7.8m	16.23	17.17	16.13	17.31
	Level 03 – 10.8m	16.08	17.00	15.93	17.09
	Level 04 – 13.6m	16.00	16.91	15.83	16.97
	Level 05 – 16.6m	15.95	16.86	15.76	16.89
	Level 06 – 19.4m	15.92	16.82	15.72	16.85
	Level 07 – 22.4m	15.90	16.80	15.70	16.82
	Level 08 – 25.2m	15.88	16.79	15.68	16.80
PR 2	Ground Floor Level – 1.5m	16.33	17.28	17.29	18.64
	Level 01 – 4.8m	16.51	17.48	16.49	17.73
	Level 02 – 7.8m	16.23	17.17	16.13	17.31
	Level 03 – 10.8m	16.08	17.00	15.93	17.09
	Level 04 – 13.6m	16.00	16.91	15.82	16.97
	Level 05 – 16.6m	15.95	16.85	15.76	16.89
	Level 06 – 19.4m	15.92	16.82	15.72	16.85
	Level 07 – 22.4m	15.90	16.80	15.69	16.82
	Level 08 – 25.2m	15.88	16.79	15.68	16.80
PR 3	Ground Floor Level – 1.5m	16.33	17.28	16.25	17.46
	Level 01 – 4.8m	16.25	17.19	16.15	17.35
	Level 02 – 7.8m	16.15	17.08	16.03	17.20

Table 15: Predicted PM_{10} Concentrations at Proposed Sensitive Receptor Locations for 2020 Opening Year and 2025 Future Year Scenarios

Proposed Receptor Location	Height	Calculated Annual Mean Concentration (µg/m³)			
		2020 Opening Year (2020 Backgrounds and Emission Factors)	2020 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)	2025 Future Year (2025 Backgrounds and Emission Factors)	2025 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)
	Level 03 – 10.8m	16.07	16.99	15.91	17.07
	Level 04 – 13.6m	16.00	16.92	15.83	16.97
	Level 05 – 16.6m	15.95	16.86	15.77	16.90
	Level 06 – 19.4m	15.92	16.83	15.73	16.86
	Level 07 – 22.4m	15.90	16.80	15.70	16.82
	Level 08 – 25.2m	15.89	16.79	15.68	16.80
PR 4	Ground Floor Level – 1.5m	17.17	18.21	17.35	18.70
	Level 01 – 4.8m	16.52	17.49	16.49	17.73
	Level 02 – 7.8m	16.23	17.16	16.12	17.30
	Level 03 – 10.8m	16.07	17.00	15.92	17.08
	Level 04 – 13.6m	15.99	16.91	15.82	16.96
	Level 05 – 16.6m	15.94	16.85	15.75	16.89
	Level 06 – 19.4m	15.91	16.82	15.72	16.84
	Level 07 – 22.4m	15.89	16.80	15.69	16.82
	Level 08 – 25.2m	15.88	16.78	15.68	16.80
PR 5	Ground Floor Level – 1.5m	17.20	18.24	17.38	18.73
	Level 01 – 4.8m	16.52	17.49	16.50	17.74
	Level 02 – 7.8m	16.23	17.16	16.12	17.30
	Level 03 – 10.8m	16.07	16.99	15.92	17.08
	Level 04 – 13.6m	15.99	16.90	15.82	16.96
	Level 05 – 16.6m	15.94	16.85	15.75	16.88

Table 15: Predicted PM_{10} Concentrations at Proposed Sensitive Receptor Locations for 2020 Opening Year and 2025 Future Year Scenarios					
Proposed Receptor Location	**Height**	**Calculated Annual Mean Concentration (µg/m³)**			
		2020 Opening Year (2020 Backgrounds and Emission Factors)	**2020 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)**	**2025 Future Year (2025 Backgrounds and Emission Factors)**	**2025 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)**
	Level 06 – 19.4m	15.91	16.82	15.72	16.84
	Level 07 – 22.4m	15.89	16.80	15.69	16.81
	Level 08 – 25.2m	15.88	16.78	15.67	16.80
Underlined concentrations represent an exceedance of the annual mean objective of 40µg/m³					

6.2.11 No exceedances of the annual mean PM_{10} objective are predicted at any of the five proposed sensitive receptor locations considered.

$PM_{2.5}$ Concentrations

6.2.12 The predicted $PM_{2.5}$ concentrations for the five receptor locations considered are detailed in Table 16 and are also included in Appendix F.

Table 16: Predicted $PM_{2.5}$ Concentrations at Proposed Sensitive Receptor Locations for 2020 Opening Year and 2025 Future Year Scenarios					
Proposed Receptor Location	**Height**	**Calculated Annual Mean Concentration (µg/m³)**			
		2020 Opening Year (2020 Backgrounds and Emission Factors)	**2020 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)**	**2025 Future Year (2025 Backgrounds and Emission Factors)**	**2025 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)**
PR 1	Ground Floor Level – 1.5m	11.11	12.08	11.02	12.36
	Level 01 – 4.8m	10.79	11.70	10.62	11.84
	Level 02 – 7.8m	10.63	11.51	10.43	11.60
	Level 03 – 10.8m	10.55	11.41	10.32	11.46
	Level 04 – 13.6m	10.50	11.36	10.27	11.39
	Level 05 – 16.6m	10.48	11.32	10.23	11.35

Table 16: Predicted $PM_{2.5}$ Concentrations at Proposed Sensitive Receptor Locations for 2020 Opening Year and 2025 Future Year Scenarios

Proposed Receptor Location	Height	Calculated Annual Mean Concentration (µg/m³)			
		2020 Opening Year (2020 Backgrounds and Emission Factors)	2020 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)	2025 Future Year (2025 Backgrounds and Emission Factors)	2025 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)
	Level 06 – 19.4m	10.46	11.30	10.21	11.32
	Level 07 – 22.4m	10.45	11.29	10.20	11.30
	Level 08 – 25.2m	10.44	11.28	10.19	11.29
PR 2	Ground Floor Level – 1.5m	11.13	12.11	11.05	12.39
	Level 01 – 4.8m	10.79	11.70	10.62	11.85
	Level 02 – 7.8m	10.63	11.51	10.43	11.60
	Level 03 – 10.8m	10.55	11.41	10.32	11.46
	Level 04 – 13.6m	10.50	11.36	10.27	11.39
	Level 05 – 16.6m	10.47	11.32	10.23	11.34
	Level 06 – 19.4m	10.46	11.30	10.21	11.32
	Level 07 – 22.4m	10.45	11.29	10.20	11.30
	Level 08 – 25.2m	10.44	11.28	10.19	11.29
PR 3	Ground Floor Level – 1.5m	10.69	11.58	10.50	11.69
	Level 01 – 4.8m	10.64	11.53	10.44	11.62
	Level 02 – 7.8m	10.59	11.46	10.37	11.53
	Level 03 – 10.8m	10.54	11.40	10.31	11.45
	Level 04 – 13.6m	10.51	11.36	10.27	11.39
	Level 05 – 16.6m	10.48	11.33	10.24	11.35
	Level 06 – 19.4m	10.46	11.31	10.21	11.32
	Level 07 – 22.4m	10.45	11.29	10.20	11.30
	Level 08 – 25.2m	10.44	11.28	10.19	11.29

Table 16: Predicted $PM_{2.5}$ Concentrations at Proposed Sensitive Receptor Locations for 2020 Opening Year and 2025 Future Year Scenarios

Proposed Receptor Location	Height	Calculated Annual Mean Concentration (µg/m³)			
		2020 Opening Year (2020 Backgrounds and Emission Factors)	2020 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)	2025 Future Year (2025 Backgrounds and Emission Factors)	2025 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)
PR 4	Ground Floor Level – 1.5m	11.16	12.13	11.08	12.43
	Level 01 – 4.8m	10.79	11.70	10.63	11.85
	Level 02 – 7.8m	10.63	11.51	10.42	11.59
	Level 03 – 10.8m	10.55	11.41	10.32	11.46
	Level 04 – 13.6m	10.50	11.35	10.26	11.39
	Level 05 – 16.6m	10.47	11.32	10.23	11.34
	Level 06 – 19.4m	10.46	11.30	10.21	11.32
	Level 07 – 22.4m	10.45	11.29	10.19	11.30
	Level 08 – 25.2m	10.44	11.28	10.19	11.29
PR 5	Ground Floor Level – 1.5m	11.17	12.15	11.10	12.45
	Level 01 – 4.8m	10.79	11.70	10.63	11.85
	Level 02 – 7.8m	10.63	11.51	10.42	11.59
	Level 03 – 10.8m	10.54	11.41	10.32	11.46
	Level 04 – 13.6m	10.50	11.35	10.26	11.38
	Level 05 – 16.6m	10.47	11.32	10.23	11.34
	Level 06 – 19.4m	10.46	11.30	10.21	11.32
	Level 07 – 22.4m	10.45	11.29	10.19	11.30
	Level 08 – 25.2m	10.44	11.28	10.18	11.29

Underlined concentrations represent an exceedance of the annual mean objective of 25µg/m³

6.2.13 No exceedances of the annual mean $PM_{2.5}$ objective are predicted at any of the five proposed sensitive receptor locations considered.

7 MITIGATION MEASURES

7.1 Construction Phase Assessment – Dust and Fine Particulate Emissions

Step 3

7.1.1 During the construction phase the implementation of effective mitigation measures will substantially reduce the potential for nuisance dust and PM_{10} to be generated.

7.1.2 Step 2C of the construction phase assessment identified that:

- The risk of dust soiling effects is classed as medium for demolition, earthworks and trackout, and high for construction; and
- The risk of human health effects is classed as low for demolition, earthworks, construction and trackout.

7.1.3 This assumes that no mitigation measures are applied, except those required by legislation. Site specific mitigation measures do not need to be recommended if the risk category is negligible.

7.1.4 The risk of dust soiling and human health effects is not negligible for any of the activities considered and therefore site specific mitigation will need to be implemented to ensure dust effects from these activities will be 'not significant'.

7.1.5 A best practice dust mitigation plan will be written and implemented for the site. This will set out the practical measures that could be incorporated as part of a best working practice scheme. This will take into account the recommendations included within the IAQM guidance, which may include:

- 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;
- Re-vegetate earthworks and exposed areas/ soil stockpiles to stabilise surfaces as soon as practicable;
- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place;
- 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;

- Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use; and
- Ensure vehicles entering and leaving the sites are covered to prevent escape of materials during transport.

7.1.6 It is recognised that the final design solutions will be developed with the input of the Contractor to maximise construction efficiencies, to use modern construction techniques and sustainable materials, and to incorporate the particular skills and experience offered by the successful contractor.

Step 4

7.1.7 Step 4 of the construction phase dust assessment has been undertaken to determine the significance of the dust effects arising from demolition, earthworks, construction and trackout associated with the proposed development.

7.1.8 The implementation of effective mitigation measures during the construction phase, such as those detailed in Step 3, will substantially reduce the potential for nuisance dust and PM_{10} to be generated and any residual impact should not be significant.

7.2 Operational Phase Assessment – Road Traffic Emissions

Proposed Sensitive Receptor Locations

7.2.1 The air quality assessment and sensitivity analysis have predicted pollutant concentrations at five proposed receptor locations, taking into account various heights relating to the storeys of the building where residential uses are proposed. The main focus is on the western façade, which faces onto Strand Street.

7.2.2 The results of the air dispersion modelling suggest that there is a possibility of exceedance of the annual mean NO_2 objective at Ground Floor Level (i.e. at a height of 1.5m), at Level 01 (i.e. at a height of 4.8m) and at Level 02 (i.e. at a height of 7.8m), for receptors located along the western façade facing onto Strand Street. There are no residential uses proposed at Ground Floor Level. Residential uses are proposed at Level 01 and above.

7.2.3 Exceedance of the annual mean PM_{10} and $PM_{2.5}$ objectives is considered very unlikely at any of the proposed sensitive receptors considered.

7.2.4 As there is a potential for exceedance of the NO_2 annual mean objective, where residential uses are proposed, it is recommended that suitable mitigation be put in

place to safeguard future residents who may occupy apartments on Level 01 (i.e. first floor level) and Level 02 (i.e. second floor level), located along the western façade facing onto Strand Street. This could include the installation of a mechanical or passive ventilation system, to draw in air from a higher level or a façade further away from Strand Street.

8 CONCLUSIONS

8.1 Construction Phase Assessment – Dust and Fine Particulate Emissions

8.1.1 The construction phase assessment has been undertaken to determine the risk and significance of dust effects from demolition, earthworks, construction and trackout from the proposed development. The assessment has been undertaken in accordance with the guidance on assessing the impacts of construction phase dust published by the IAQM.

8.1.2 The risk of dust soiling effects is considered to be medium for demolition, earthworks and trackout, and high for construction. The risk of human health effects is classed as low for demolition, earthworks, construction and trackout. Site specific mitigation measures will therefore need to be implemented at the site.

8.1.3 With site specific mitigation measures in place, as detailed in Section 7 of this report, the significance of dust effects for demolition, earthworks, construction and trackout are considered to be not significant.

8.2 Operational Phase Assessment – Road Traffic Emissions

Proposed Sensitive Receptor Locations

8.2.1 The air quality assessment and sensitivity analysis have predicted pollutant concentrations at five proposed receptor locations, taking into account various heights relating to the storeys of the building where residential uses are proposed. The main focus is on the western façade which faces onto Strand Street.

8.2.2 Where residential uses are proposed, the sensitivity analysis predicts exceedances of the NO_2 objective for proposed receptors located at Level 01 and Level 02.

8.2.3 Exceedance of the annual mean PM_{10} and $PM_{2.5}$ objective is considered very unlikely at any of the proposed sensitive receptors considered.

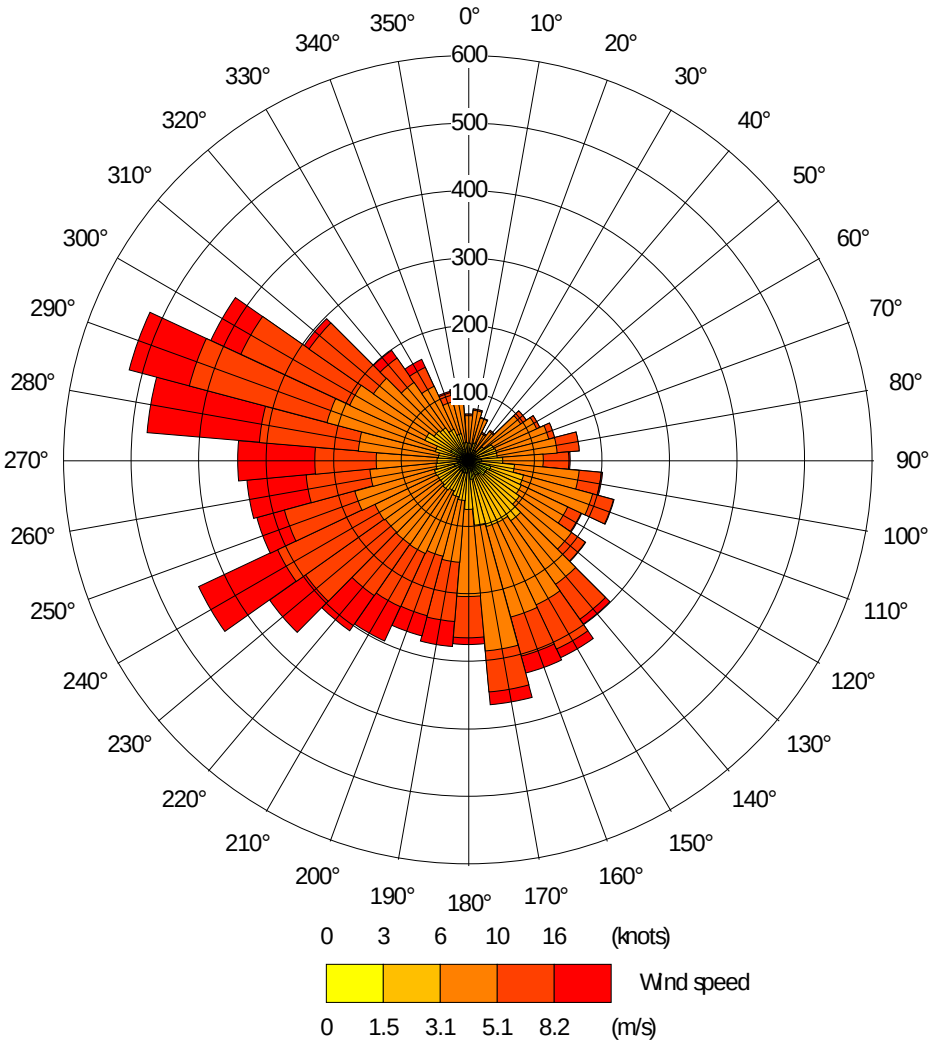
8.2.4 As there is a potential for exceedance of the NO_2 annual mean objective, it is recommended that suitable mitigation be put in place to safeguard future residents who may occupy first floor and second floor apartments, along the western façade facing onto Strand Street. This could include the installation of a mechanical or passive ventilation system, to draw in air from a higher level or a façade further away from Strand Street.

Appendix A:
Traffic Flow Information
Used in the Air Quality Assessment

24 Hour Annual Average Daily Traffic (AADT) Flows

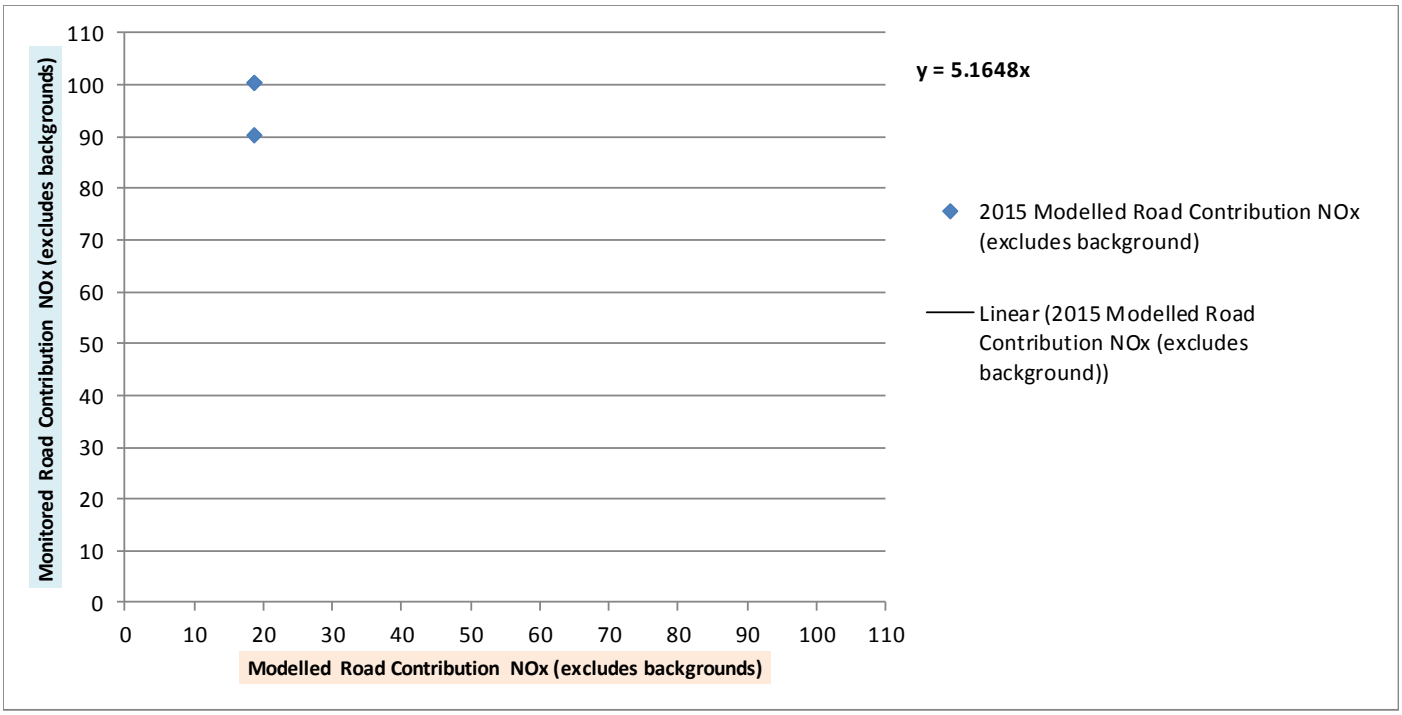
Link	Link Name	Direction	Speed Limit (kph)	Scenario 1: 2015 Verification and Base Year		Scenario 2 and 3: 2020 Opening Year		Scenarios 4 and 5: 2025 Future Year	
				LGV	HGV	LGV	HGV	LGV	HGV
1	A5036 Strand Street, South of Salthouse Quay	NB	48	21320	492	22897	528	30700	708
		SB	48	21320	492	22897	528	30700	708
2	A5036 Strand Street, South of Red Cross Street	NB	48	21320	492	22897	528	30700	708
		SB	48	21320	492	22897	528	30700	708
3	A5036 Strand Street, South of Water Street	NB	48	22138	468	23776	502	31879	673
		SB	48	22138	468	23776	502	31879	673
4	A5036 Strand Street, North of Water Street	NB	48	22138	468	23776	502	31879	673
		SB	48	22138	468	23776	502	31879	673
5	Water Street	-	48	3280	77	3522	83	4722	111
**Slow down sections modelled at 25kph*									

Appendix B:
2015 Wind Rose for Liverpool John Lennon Airport Meteorological Recording Station

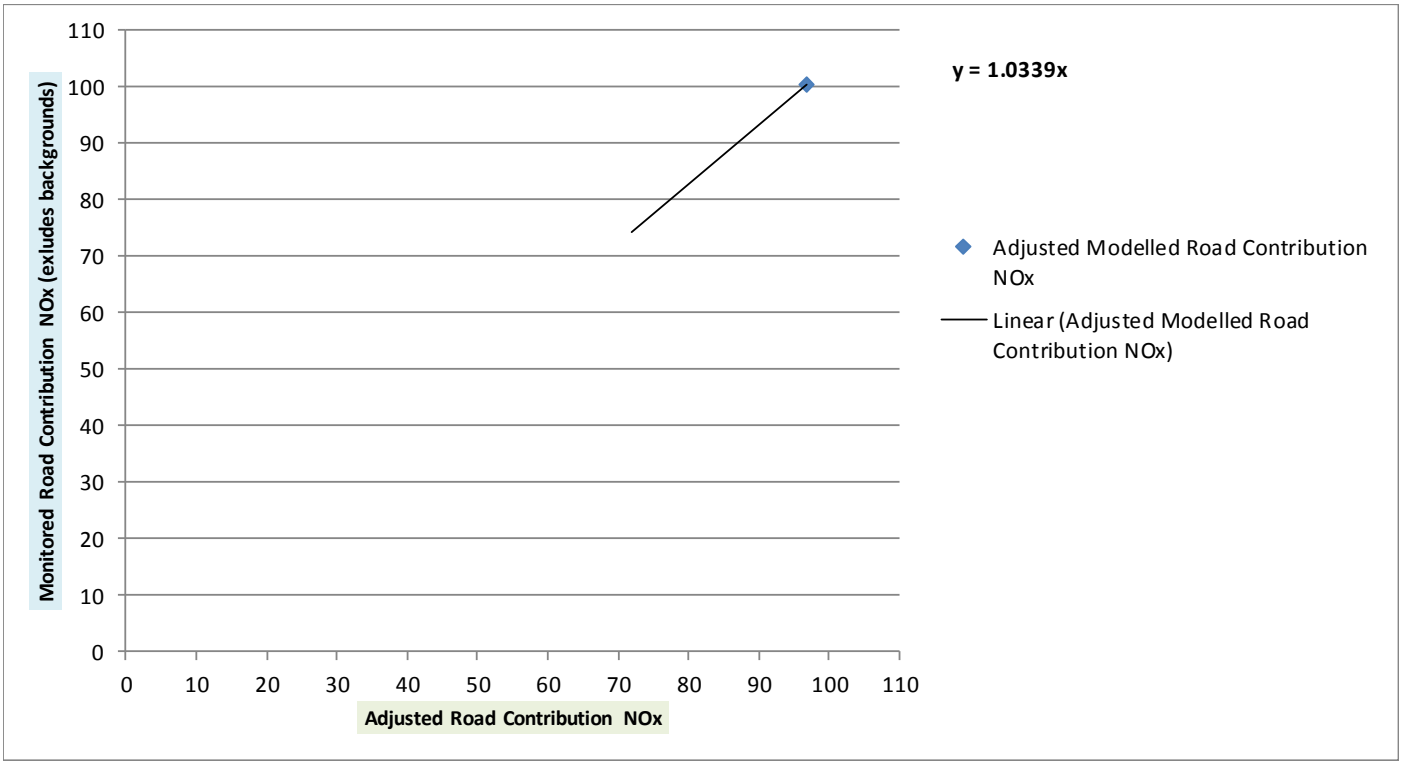

0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100°
110°
120°
130°
140°
150°
160°
170°
180°
190°
200°
210°
220°
230°
240°
250°
260°
270°
280°
290°
300°
310°
320°
330°
340°
350°
600
500
400
300
200
100
0 3 6 10 16 (knots)
Wind speed
0 1.5 3.1 5.1 8.2 (m/s)

Appendix C:
Model Verification Procedure

Address	2015 Monitored Total NO2	2015 Monitored Total NOx	2015 Background NO2	2015 Background NOx	Monitored Road Contribution NO2 (total - background)	Monitored Road Contribution NOx (excludes background)	Modelled Road Contribution NOx (excludes background)
Strand Street/Water Street Junction 1	67.00	145.56	29.32	45.38	37.68	100.18	18.76
Strand Street/Water Street Junction 2	64.00	135.71	29.32	45.38	34.68	90.33	18.76
Strand Street/Water Street Junction 3	67.00	145.56	29.32	45.38	37.68	100.18	18.76



Address	Ratio of Monitored Road Contribution NOx / Modelled Road Contribution NOx	Adjustment Factor for Modelled Road Contribution	Adjusted Modelled Road Contribution NOx	Adjusted Modelled Total NOx (including background NOx)	Modelled Total NO2 (based on empirical NOx / NO2 relationship)	Monitored Total NO2	% Difference [(modelled - monitored) / monitored] x 100
Strand Street/Water Street Junction 1	5.34		96.90	142.28	66.01	67.00	-1.48
Strand Street/Water Street Junction 2	4.81		96.90	142.28	66.01	64.00	3.14
Strand Street/Water Street Junction 3	5.34		96.90	142.28	66.01	67.00	-1.48
		5.1648					


y = 1.0339x
Monitored Road Contribution NOx (exludes backgrounds)
Adjusted Road Contribution NOx
Adjusted Modelled Road Contribution NOx
Linear (Adjusted Modelled Road Contribution NOx)
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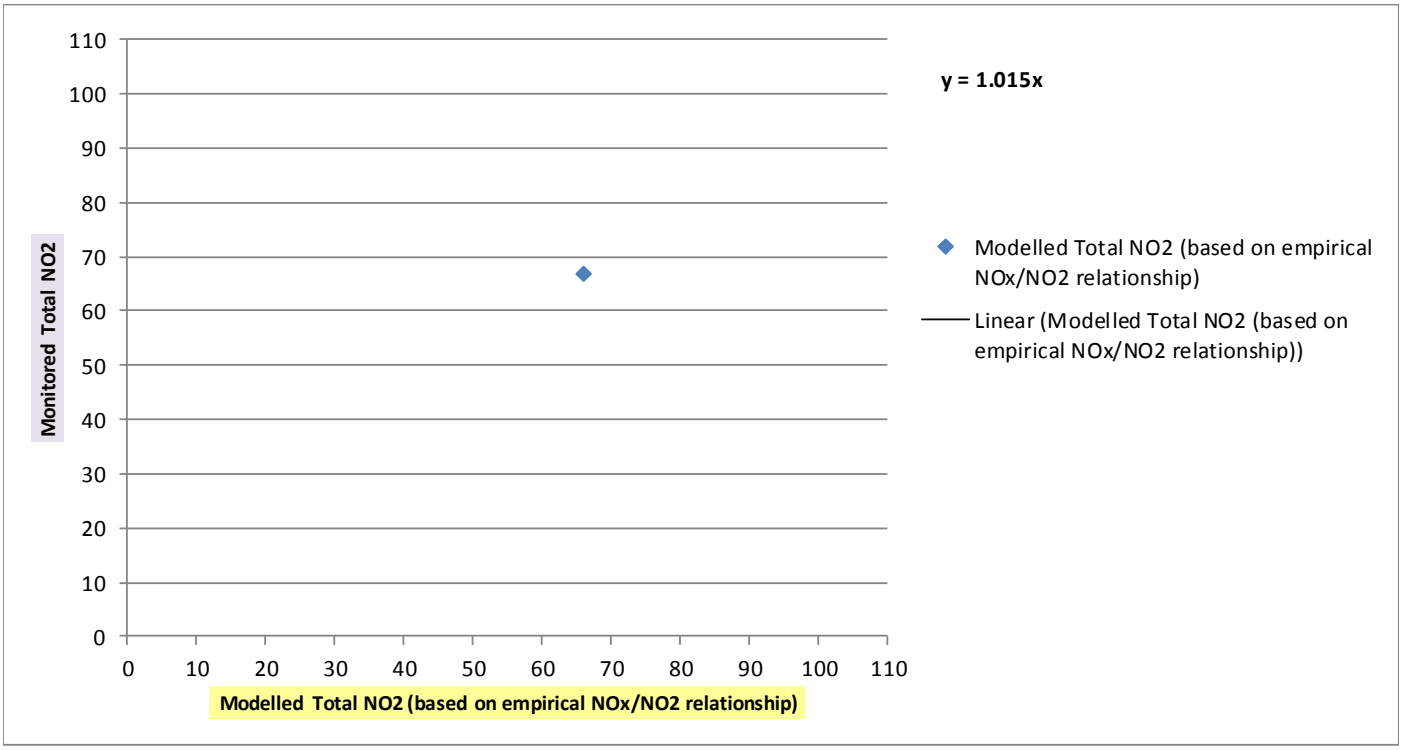
10
20
30
40
50
60
70
80
90
100
110


y = 1.015x
Monitored Total NO2
Modelled Total NO2 (based on empirical NOx/NO2 relationship)
Modelled Total NO2 (based on empirical NOx/NO2 relationship)
Linear (Modelled Total NO2 (based on empirical NOx/NO2 relationship))
0
10
20
30
40
50
60
70
80
90
100
110

Appendix D:
Modelling Results –
Annual Mean NO_2 Concentrations

Proposed Receptor Location	Height	Calculated Annual Mean Concentration (µg/m^3)			
		2020 Opening Year (2020 Backgrounds and Emission Factors)	2020 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)	2025 Future Year (2025 Backgrounds and Emission Factors)	2025 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)
PR 1	Ground Floor Level – 1.5m	48.17	62.70	45.00	71.34
	Level 01 – 4.8m	38.88	49.17	36.60	54.78
	Level 02 – 7.8m	33.74	41.47	31.93	45.13
	Level 03 – 10.8m	30.71	36.82	29.17	39.16
	Level 04 – 13.6m	29.05	34.23	27.65	35.79
	Level 05 – 16.6m	27.99	32.57	26.69	33.62
	Level 06 – 19.4m	27.39	31.62	26.15	32.37
	Level 07 – 22.4m	26.98	30.96	25.77	31.49
	Level 08 – 25.2m	26.72	30.54	25.53	30.94
PR 2	Ground Floor Level – 1.5m	48.34	62.99	45.15	71.68
	Level 01 – 4.8m	38.78	49.05	36.50	54.61
	Level 02 – 7.8m	33.69	41.39	31.87	45.02
	Level 03 – 10.8m	30.68	36.78	29.14	39.11
	Level 04 – 13.6m	29.03	34.20	27.64	35.75
	Level 05 – 16.6m	27.98	32.54	26.68	33.59
	Level 06 – 19.4m	27.38	31.60	26.14	32.34
	Level 07 – 22.4m	26.97	30.94	25.76	31.47
	Level 08 – 25.2m	26.71	30.52	25.52	30.92
PR 3	Ground Floor Level – 1.5m	35.34	43.92	33.41	48.29
	Level 01 – 4.8m	33.94	41.80	32.13	45.59
	Level 02 – 7.8m	32.11	38.98	30.45	41.98
	Level 03 – 10.8m	30.38	36.31	28.87	38.52

Proposed Receptor Location	Height	Calculated Annual Mean Concentration (µg/m^3)			
		2020 Opening Year (2020 Backgrounds and Emission Factors)	2020 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)	2025 Future Year (2025 Backgrounds and Emission Factors)	2025 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)
	Level 04 – 13.6m	29.12	34.34	27.72	35.94
	Level 05 – 16.6m	28.15	32.81	26.84	33.94
	Level 06 – 19.4m	27.52	31.82	26.27	32.64
	Level 07 – 22.4m	27.07	31.10	25.85	31.69
	Level 08 – 25.2m	26.78	30.64	25.59	31.07
PR 4	Ground Floor Level – 1.5m	48.50	63.26	45.29	72.01
	Level 01 – 4.8m	38.52	48.70	36.26	54.17
	Level 02 – 7.8m	33.43	41.03	31.64	44.55
	Level 03 – 10.8m	30.56	36.59	29.02	38.85
	Level 04 – 13.6m	28.97	34.11	27.58	35.63
	Level 05 – 16.6m	27.95	32.49	26.65	33.52
	Level 06 – 19.4m	27.35	31.55	26.11	32.28
	Level 07 – 22.4m	26.94	30.89	25.74	31.41
	Level 08 – 25.2m	26.68	30.48	25.50	30.87
PR 5	Ground Floor Level – 1.5m	48.61	63.45	45.39	72.23
	Level 01 – 4.8m	38.44	48.59	36.18	54.03
	Level 02 – 7.8m	33.36	40.92	31.57	44.40
	Level 03 – 10.8m	30.49	36.49	28.96	38.73
	Level 04 – 13.6m	28.93	34.03	27.54	35.53
	Level 05 – 16.6m	27.92	32.44	26.62	33.45
	Level 06 – 19.4m	27.33	31.51	26.09	32.23
	Level 07 – 22.4m	26.92	30.86	25.72	31.37
	Level 08 – 25.2m	26.67	30.46	25.49	30.83

Proposed Receptor Location	Height	Calculated Annual Mean Concentration (µg/m^3)			
		2020 Opening Year (2020 Backgrounds and Emission Factors)	2020 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)	2025 Future Year (2025 Backgrounds and Emission Factors)	2025 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)
Underlined concentrations represent an exceedance of the annual mean objective of 40µg/m^3					

Appendix E:
Modelling Results –
Annual Mean PM_{10} Concentrations

Proposed Receptor Location	Height	Calculated Annual Mean Concentration (µg/m^3)			
		2020 Opening Year (2020 Backgrounds and Emission Factors)	2020 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)	2025 Future Year (2025 Backgrounds and Emission Factors)	2025 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)
PR 1	Ground Floor Level – 1.5m	17.09	18.12	17.23	18.59
	Level 01 – 4.8m	16.50	17.47	16.48	17.72
	Level 02 – 7.8m	16.23	17.17	16.13	17.31
	Level 03 – 10.8m	16.08	17.00	15.93	17.09
	Level 04 – 13.6m	16.00	16.91	15.83	16.97
	Level 05 – 16.6m	15.95	16.86	15.76	16.89
	Level 06 – 19.4m	15.92	16.82	15.72	16.85
	Level 07 – 22.4m	15.90	16.80	15.70	16.82
	Level 08 – 25.2m	15.88	16.79	15.68	16.80
PR 2	Ground Floor Level – 1.5m	16.33	17.28	17.29	18.64
	Level 01 – 4.8m	16.51	17.48	16.49	17.73
	Level 02 – 7.8m	16.23	17.17	16.13	17.31
	Level 03 – 10.8m	16.08	17.00	15.93	17.09
	Level 04 – 13.6m	16.00	16.91	15.82	16.97
	Level 05 – 16.6m	15.95	16.85	15.76	16.89
	Level 06 – 19.4m	15.92	16.82	15.72	16.85
	Level 07 – 22.4m	15.90	16.80	15.69	16.82
	Level 08 – 25.2m	15.88	16.79	15.68	16.80
PR 3	Ground Floor Level – 1.5m	16.33	17.28	16.25	17.46
	Level 01 – 4.8m	16.25	17.19	16.15	17.35
	Level 02 – 7.8m	16.15	17.08	16.03	17.20
	Level 03 – 10.8m	16.07	16.99	15.91	17.07
	Level 04 – 13.6m	16.00	16.92	15.83	16.97

Proposed Receptor Location	Height	Calculated Annual Mean Concentration (µg/m^3)			
		2020 Opening Year (2020 Backgrounds and Emission Factors)	2020 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)	2025 Future Year (2025 Backgrounds and Emission Factors)	2025 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)
	Level 05 – 16.6m	15.95	16.86	15.77	16.90
	Level 06 – 19.4m	15.92	16.83	15.73	16.86
	Level 07 – 22.4m	15.90	16.80	15.70	16.82
	Level 08 – 25.2m	15.89	16.79	15.68	16.80
PR 4	Ground Floor Level – 1.5m	17.17	18.21	17.35	18.70
	Level 01 – 4.8m	16.52	17.49	16.49	17.73
	Level 02 – 7.8m	16.23	17.16	16.12	17.30
	Level 03 – 10.8m	16.07	17.00	15.92	17.08
	Level 04 – 13.6m	15.99	16.91	15.82	16.96
	Level 05 – 16.6m	15.94	16.85	15.75	16.89
	Level 06 – 19.4m	15.91	16.82	15.72	16.84
	Level 07 – 22.4m	15.89	16.80	15.69	16.82
	Level 08 – 25.2m	15.88	16.78	15.68	16.80
PR 5	Ground Floor Level – 1.5m	17.20	18.24	17.38	18.73
	Level 01 – 4.8m	16.52	17.49	16.50	17.74
	Level 02 – 7.8m	16.23	17.16	16.12	17.30
	Level 03 – 10.8m	16.07	16.99	15.92	17.08
	Level 04 – 13.6m	15.99	16.90	15.82	16.96
	Level 05 – 16.6m	15.94	16.85	15.75	16.88
	Level 06 – 19.4m	15.91	16.82	15.72	16.84
	Level 07 – 22.4m	15.89	16.80	15.69	16.81
	Level 08 – 25.2m	15.88	16.78	15.67	16.80
Underlined concentrations represent an exceedance of the annual mean objective of 40µg/m^3					

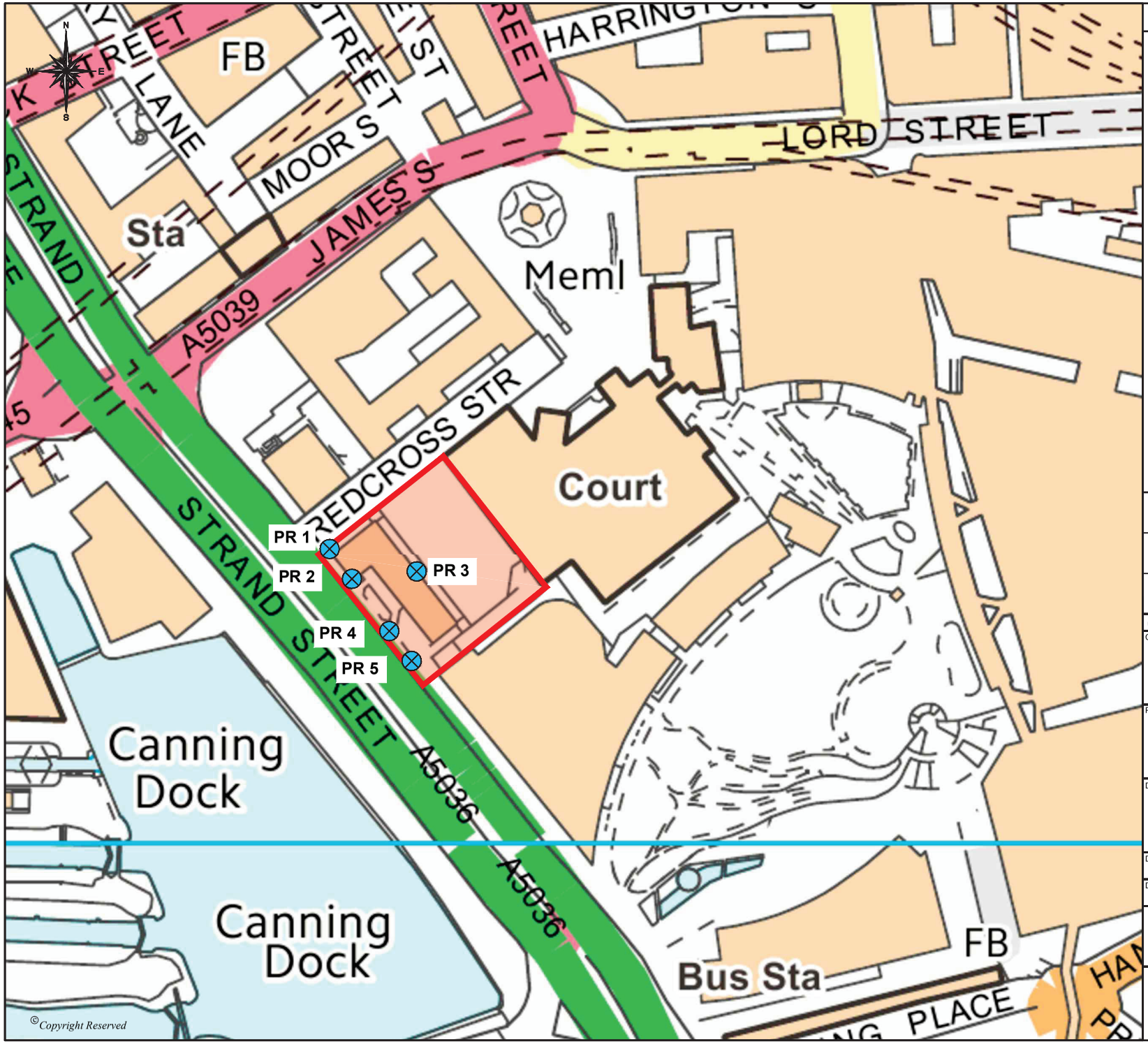
Appendix E:
Modelling Results –
Annual Mean $PM_{2.5}$ Concentrations

Table 16: Predicted $PM_{2.5}$ Concentrations at Proposed Sensitive Receptor Locations for 2020 Opening Year and 2025 Future Year Scenarios					
Proposed Receptor Location	**Height**	**Calculated Annual Mean Concentration (µg/m³)**			
		2020 Opening Year (2020 Backgrounds and Emission Factors)	**2020 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)**	**2025 Future Year (2025 Backgrounds and Emission Factors)**	**2025 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)**
PR 1	Ground Floor Level – 1.5m	11.11	12.08	11.02	12.36
	Level 01 – 4.8m	10.79	11.70	10.62	11.84
	Level 02 – 7.8m	10.63	11.51	10.43	11.60
	Level 03 – 10.8m	10.55	11.41	10.32	11.46
	Level 04 – 13.6m	10.50	11.36	10.27	11.39
	Level 05 – 16.6m	10.48	11.32	10.23	11.35
	Level 06 – 19.4m	10.46	11.30	10.21	11.32
	Level 07 – 22.4m	10.45	11.29	10.20	11.30
	Level 08 – 25.2m	10.44	11.28	10.19	11.29
PR 2	Ground Floor Level – 1.5m	11.13	12.11	11.05	12.39
	Level 01 – 4.8m	10.79	11.70	10.62	11.85
	Level 02 – 7.8m	10.63	11.51	10.43	11.60
	Level 03 – 10.8m	10.55	11.41	10.32	11.46
	Level 04 – 13.6m	10.50	11.36	10.27	11.39
	Level 05 – 16.6m	10.47	11.32	10.23	11.34
	Level 06 – 19.4m	10.46	11.30	10.21	11.32
	Level 07 – 22.4m	10.45	11.29	10.20	11.30
	Level 08 – 25.2m	10.44	11.28	10.19	11.29
PR 3	Ground Floor Level – 1.5m	10.69	11.58	10.50	11.69
	Level 01 – 4.8m	10.64	11.53	10.44	11.62
	Level 02 – 7.8m	10.59	11.46	10.37	11.53
	Level 03 – 10.8m	10.54	11.40	10.31	11.45

Table 16: Predicted $PM_{2.5}$ Concentrations at Proposed Sensitive Receptor Locations for 2020 Opening Year and 2025 Future Year Scenarios					
Proposed Receptor Location	**Height**	**Calculated Annual Mean Concentration (µg/m³)**			
		2020 Opening Year (2020 Backgrounds and Emission Factors)	**2020 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)**	**2025 Future Year (2025 Backgrounds and Emission Factors)**	**2025 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)**
	Level 04 – 13.6m	10.51	11.36	10.27	11.39
	Level 05 – 16.6m	10.48	11.33	10.24	11.35
	Level 06 – 19.4m	10.46	11.31	10.21	11.32
	Level 07 – 22.4m	10.45	11.29	10.20	11.30
	Level 08 – 25.2m	10.44	11.28	10.19	11.29
PR 4	Ground Floor Level – 1.5m	11.16	12.13	11.08	12.43
	Level 01 – 4.8m	10.79	11.70	10.63	11.85
	Level 02 – 7.8m	10.63	11.51	10.42	11.59
	Level 03 – 10.8m	10.55	11.41	10.32	11.46
	Level 04 – 13.6m	10.50	11.35	10.26	11.39
	Level 05 – 16.6m	10.47	11.32	10.23	11.34
	Level 06 – 19.4m	10.46	11.30	10.21	11.32
	Level 07 – 22.4m	10.45	11.29	10.19	11.30
	Level 08 – 25.2m	10.44	11.28	10.19	11.29
PR 5	Ground Floor Level – 1.5m	11.17	12.15	11.10	12.45
	Level 01 – 4.8m	10.79	11.70	10.63	11.85
	Level 02 – 7.8m	10.63	11.51	10.42	11.59
	Level 03 – 10.8m	10.54	11.41	10.32	11.46
	Level 04 – 13.6m	10.50	11.35	10.26	11.38
	Level 05 – 16.6m	10.47	11.32	10.23	11.34
	Level 06 – 19.4m	10.46	11.30	10.21	11.32
	Level 07 – 22.4m	10.45	11.29	10.19	11.30

Table 16: Predicted $PM_{2.5}$ Concentrations at Proposed Sensitive Receptor Locations for 2020 Opening Year and 2025 Future Year Scenarios					
Proposed Receptor Location	**Height**	**Calculated Annual Mean Concentration (µg/m³)**			
		2020 Opening Year (2020 Backgrounds and Emission Factors)	**2020 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)**	**2025 Future Year (2025 Backgrounds and Emission Factors)**	**2025 Opening Year – Sensitivity Analysis (2015 Backgrounds and Emission Factors)**
	Level 08 – 25.2m	10.44	11.28	10.18	11.29
Underlined concentrations represent an exceedance of the annual mean objective of 25µg/m³					

Drawing



DO NOT SCALE FROM THIS DRAWING | A3

REFERENCE

SITE BOUNDARY

PROPOSED SENSITIVE RECEPTOR LOCATION

REVISION	DETAILS	DATE	DRAWN	CHK'D	APP'D
A	First Issue	29/06/16	PG	RF	CMD

CLIENT

FT (Patten) Holdings

PROJECT

The Strand,
Liverpool

DRAWING TITLE

Proposed Sensitive Receptor Locations

DRG No.	SCALE	DATE
LE13526-001	1:1500	29/06/16

DRAWN BY	CHECKED BY	APPROVED BY
PG	RF	CMD

☐ STOKE-ON-TRENT (HEAD OFFICE)	TEL 0845 111 7777	☐ CARDIFF	TEL 029 2072 9191
		■ LEIGH	TEL 01942 260101
☐ NEWCASTLE UPON TYNE	TEL 0191 232 0943	☐ SHEFFIELD	TEL 0114 245 6244
☐ WEST BROMWICH	TEL 0121 580 0909	☐ EDINBURGH	TEL 0131 555 3311
☐ LONDON	TEL 020 7287 2872	☐ LIVERPOOL	TEL 0151 494 5431

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