

REPORT N° 70019786

52-55 FRIAR STREET & 12 GREYFRIARS ROAD, READING

AIR QUALITY ASSESSMENT REPORT

NOVEMBER 2016

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GREYFRIARS ROAD, READING**
AIR QUALITY ASSESSMENT REPORT
CIP Property (AIPT) Limited

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EXECUTIVE SUMMARY

WSP | Parsons Brinckerhoff has been commissioned by CIP Property (AIP) Limited to undertake an air quality assessment to support the planning application for the proposed development at Friar Street, Reading. The proposals include the demolition of the existing buildings, and construction of a high quality mixed-use development comprising 147 residential dwellings and 627sqm of ground floor retail, leisure and/or office space. The Proposed Development will be supported by cycle parking and a small number of disabled car parking spaces within the basement.

This report presents the findings of the air quality assessment, which addresses the potential air quality impacts during both the construction and operational phases of the Proposed Development. For both phases the type, source and significance of potential impacts have been identified, and measures proposed in order to minimise the impacts. The methodology followed in this study was discussed and agreed with Reading Borough Council's Environmental Health Officer.

The assessment of construction phase impacts associated with fugitive dust and fine particulate matter (PM₁₀ and PM_{2.5}) emissions have been undertaken in line with the relevant Institute of Air Quality Management guidance. This identified that there is a Low Risk of dust soiling impacts and a Low Risk of increases in particulate matter concentrations due to construction activities. Through good site practice and the implementation of suitable mitigation measures, the effect of dust and particulate matter releases would be significantly reduced. The residual effects of the construction phase on air quality are considered to be negligible.

The operation of the Proposed Development is anticipated to lead to a net reduction in total vehicle trips in comparison to the existing land use (food superstore); therefore an assessment of traffic related impacts once the development is operational has been scoped out. In addition, an assessment of the air quality impacts associated with the proposed on-site energy centre has been completed in line with published methodologies and technical guidance. Nitrogen oxides (NO_x) have been considered in this part of the assessment only.

An air quality assessment to consider the potential impacts of NO₂, PM₁₀ and PM_{2.5} at sensitive receptor locations has been undertaken. The results show that the greatest predicted change in NO₂ concentrations at existing receptors as a result of the proposed energy centre is less than 0.04µg/m³. The off-site maximum 1-hour mean NO₂ concentration (as 99.79th percentile) is less than 10% of the AQS objective level of 200µg/m³. The impact is considered to be negligible.

The exposure assessment predicted that in 2021 the future receptors located along Friar Street and Greyfriars Road on the 1st, 2nd and 3rd floor will exceed the annual mean NO₂ AQS objective. Therefore, it is recommended that a mechanical ventilation system with appropriate filtration be installed at these locations to reduce the NO₂ concentrations to below the AQS objective values. All other future receptors modelled predicted NO₂ concentrations below the AQS objective.

Modelled PM₁₀ and PM_{2.5} concentrations for 2021 show concentrations to be below the relevant AQS objectives, and as such, no further mitigation measures are required.

Based on the assessment, it is considered that the development proposals comply with national, regional and local policy for air quality.

1 INTRODUCTION

- 1.1.1 WSP | Parsons Brinckerhoff has been commissioned by CIP Property (AIPT) Limited to carry out an air quality assessment to consider the impacts arising from the Proposed Development at 52-55 Friar Street, Reading, hereafter referred to as the 'Proposed Development' or 'Application Site'.
- 1.1.2 The Application Site lies within the administrative boundary of Reading Borough Council (RBC), and is bordered to the north and east by offices, to the west by Greyfriars Road, and to the south by Friars Street. The proposals include the demolition of the existing buildings, and construction of a high quality mixed-use development comprising 147 residential dwellings and 627sqm of ground floor retail, leisure and/or office space. An on-site energy centre comprising gas-fired boilers and a combined heat and power (CHP) unit is also proposed.
- 1.1.3 The Proposed Development will result in a reduction in total vehicle trips in comparison to the existing land use (food superstore). The assessment focusses on the impacts of emissions from the new energy centre including the new locations with relevant exposure introduced by the Proposed Development.
- 1.1.4 This report considers the relevant legislation policy and guidance; presents the assessment scope and methodology; outlines baseline conditions; gives an assessment of the impacts; and provides recommendations for mitigation.
- 1.1.5 A glossary of terms used in this report is provided in **Appendix A**.

2

LEGISLATION, POLICY & GUIDANCE

2.1 AIR QUALITY LEGISLATION & POLICY

2.1.1 A summary of the relevant air quality legislation and policy is provided below.

UK AIR QUALITY STRATEGY

2.1.2 The Government's policy on air quality within the UK is set out in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland (AQS)¹. The AQS provides a framework for reducing air pollution in the UK with the aim of meeting the requirements of European Union legislation.

2.1.3 The AQS also sets standards and objectives for nine key air pollutants to protect health, vegetation and ecosystems. These are benzene (C₆H₆), 1,3 butadiene (C₄H₆), carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO₂), particulate matter (PM₁₀ and PM_{2.5}), sulphur dioxide (SO₂), ozone (O₃), and polycyclic aromatic hydrocarbons (PAHs). The standards and objectives for the pollutants considered in this assessment are given in **Appendix B**.

2.1.4 The air quality standards are levels recommended by the Expert Panel on Air Quality Standards (EPAQS) and the World Health Organisation (WHO) with regards to current scientific knowledge about the effects of each pollutant on health and the environment.

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

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

2.1.7 The AQS contains a framework for considering the effects of a finer group of particles known as 'PM_{2.5}' as there is increasing evidence that this size of particles can be more closely associated with observed adverse health effects than PM₁₀. Local Authorities are required to work towards reducing emissions/concentrations of particulate matter within their administrative area. However, there is no statutory objective given in the AQS for PM_{2.5} at this time.

¹ Department for Environment, Food and Rural Affairs (DEFRA) and the Devolved Administrations (2007). The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volumes 1 and 2).

AIR QUALITY REGULATIONS

- 2.1.8 Many of the objectives in the AQS have been made statutory in England with the Air Quality (England) Regulations 2000² and the Air Quality (England) (Amendment) Regulations 2002³ for the purpose of Local Air Quality Management (LAQM).
- 2.1.9 These Regulations require that likely exceedances of the AQS objectives are assessed in relation to:

“...the quality of air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present...”

- 2.1.10 The Air Quality Standards Regulations 2010⁴ transpose the European Union Ambient Air Quality Directive (2008/50/EC)⁵ into law in England. This Directive sets legally binding limit values for concentrations in outdoor air of major air pollutants that impact public health such as PM₁₀, PM_{2.5} and NO₂. The limit values for NO₂ and PM₁₀ are the same concentration levels as the relevant AQS objectives and the limit value for PM_{2.5} introduced in this Directive is a concentration of 25µg/m³ to apply from 2015.

ENVIRONMENTAL PROTECTION ACT 1990 - CONTROL OF DUST AND PARTICULATES ASSOCIATED WITH CONSTRUCTION

- 2.1.11 Section 79 of the Environmental Protection Act 1990 gives the following definitions of statutory nuisance relevant to dust and particles:

“Any dust, steam, smell or other effluvia arising from industrial, trade or business premises or smoke, fumes or gases emitted from premises so as to be prejudicial to health or a nuisance”; and

“Any accumulation or deposit which is prejudicial to health or a nuisance”

- 2.1.12 Following this, Section 80 says that where a statutory nuisance is shown to exist, the local authority must serve an abatement notice. Failure to comply with an abatement notice is an offence and if necessary, the local authority may abate the nuisance and recover expenses.
- 2.1.13 There are no statutory limit values for dust deposition above which ‘nuisance’ is deemed to exist. Nuisance is a subjective concept and its perception is highly dependent upon the existing conditions and the change which has occurred.

ENVIRONMENT ACT 1995

- 2.1.14 Under Part IV of the Environment Act 1995, local authorities must review and document local air quality within their area by way of staged appraisals and respond accordingly, with the aim of meeting the air quality objectives defined in the Regulations. Where the objectives are not likely to be achieved, an authority is required to designate an Air Quality Management Area (AQMA). For each AQMA the local authority is required to draw up an Air Quality Action Plan (AQAP) to secure improvements in air quality and show how it intends to work towards achieving air quality

² The Air Quality (England) Regulations 2000 - Statutory Instrument 2000 No.928.

³ The Air Quality (England) (Amendment) Regulations 2002- Statutory Instrument 2002 No.3043.

⁴ The Air Quality Standards Regulations 2010 - Statutory Instrument 2010 No. 1001.

⁵ 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.

standards in the future.

2.2 PLANNING POLICY

- 2.2.1 A summary of the national and local planning policy relevant to the Proposed Development and air quality is provided below.

NATIONAL PLANNING POLICY

NATIONAL PLANNING POLICY FRAMEWORK

- 2.2.2 The Government's overall planning policies for England are described in the National Planning Policy Framework⁶. The core underpinning principle of the Framework is the presumption in favour of sustainable development, defined as:

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs"

- 2.2.3 One of the 12 core planning principles in the NPPF is that planning should 'contribute to conserving and enhancing the natural environment and reducing pollution.'

- 2.2.4 In relation to air quality, the following paragraphs in the document are relevant:

- Paragraph 109, which states *"The planning system should contribute to and enhance the natural and local environment by:...preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water, or noise pollution.."*;
- Paragraph 110, which states *"In preparing plans to meet development needs, the aim should be to minimise pollution and other adverse effects on the local and natural environment. Plans should allocate land with the least environmental or amenity values, where consistent with other policies in this Framework"*;
- Paragraph 122, which states *"...local planning authorities should focus on whether the development itself is an acceptable use of the land, and the impact of the use, rather than the control of processes or emissions themselves where these are subject to approval under pollution control regimes. Local planning authorities should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities"*;
- Paragraph 124, which states *"Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan"*; and
- Paragraph 203, which states *"Local Planning authorities should consider where otherwise unacceptable development could be made acceptable though the use of conditions or planning obligations. Planning Obligations should only be used where it is not possible to address unacceptable impacts through a planning condition"*.

LOCAL PLANNING POLICY

⁶ Department for Communities and Local Government (2012). National Planning Policy Framework.

READING BOROUGH COUNCIL CORE STRATEGY WITH ALTERATION ADOPTED 27TH JANUARY 2015

2.2.5 In this document⁷, Policy CS34 Pollution and Water Resources states that:

- “Development will only be permitted where it would not be damaging to the environment through air, land, noise or light pollution; where it would preserve or ideally enhance ground and surface water quality; and where existing water resources, sewerage and wastewater treatment infrastructure are adequate to support the proposed development”; and
- “Proposals for development that are sensitive to the effects of air, noise or light pollution will only be permitted in areas where they will not be subject to high levels of such pollution, unless adequate mitigation measures are provided to minimise the impact of such pollution.”

2.3 GUIDANCE

2.3.1 A summary of the publications referred to in the undertaking of this assessment is provided below.

LOCAL AIR QUALITY MANAGEMENT REVIEW AND ASSESSMENT TECHNICAL GUIDANCE

2.3.2 The Department for Environment, Food and Rural Affairs (DEFRA) has published technical guidance for use by local authorities in their review and assessment work⁸. This guidance, referred to in this document as LAQM.TG16, has been used where appropriate in the assessment presented herein.

LAND-USE PLANNING & DEVELOPMENT CONTROL: PLANNING FOR AIR QUALITY

2.3.3 In May 2015 Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM) published updated guidance⁹, which offers comprehensive advice on: when an air quality assessment may be required; what should be included in an assessment; how to determine the significance of any air quality impacts associated with a development; and, the possible mitigation measures that may be implemented to minimise these impacts.

GUIDANCE ON THE ASSESSMENT OF DUST FROM DEMOLITION AND CONSTRUCTION

2.3.4 This document¹⁰ published by the IAQM was produced to provide guidance to developers, consultants and environmental health officers on how to assess the impacts arising from construction activities. The emphasis of the methodology is on classifying sites according to the risk of impacts (in terms of dust nuisance, PM₁₀ impacts on public exposure and impact upon sensitive ecological receptors) and to identify mitigation measures appropriate to the level of risk identified.

⁷Reading Borough Council (2015) Core Strategy Adopted 2008 with alteration.

⁸ DEFRA (2016) Part IV The Environment Act 1995 and Environment (Northern Ireland) Order 2002 Part III, Local Air Quality Management Technical Guidance LAQM.TG16.

⁹ Environmental Protection UK and Institute of Air Quality Management (2015). Land Use Planning & Development Control: Planning for Air Quality.

¹⁰ Institute of Air Quality Management (Version 1.1 Updated June 2016). Guidance on the Assessment of Dust from Demolition and Construction.

NATIONAL PLANNING PRACTICE GUIDANCE – AIR QUALITY

2.3.5

This guidance¹¹ provides a number of guiding principles on how the planning process can take into account the impact of new development on air quality, and explains how much detail air quality assessments need to include for proposed developments, and how impacts on air quality can be mitigated. It also provides information on how air quality is taken into account by Local Authorities in both the wider planning context of Local Plans and neighbourhood planning, and in individual cases where air quality is a consideration in a planning decision.

¹¹ Department of Communities and Local Government (DCLG) (March 2014). National Planning Practice Guidance.

3

SCOPE & METHODOLOGY

3.1 SCOPE

3.1.1 The scope of the assessment has been determined in the following way:

- Consultation with the Environmental Health Officer (EHO) at RBC to agree the scope of the assessment and the methodology to be applied; and
- Review of RBC's latest review and assessment reports¹² and air quality data for the area surrounding the Application Site, including data from RBC, DEFRA¹³, the Environment Agency (EA)¹⁴;
- Desk study to confirm the locations of nearby existing receptors that may be sensitive to changes in local air quality, and a review of the masterplan for the Proposed Development to establish the location of new sensitive receptors;
- Review of the traffic data provided by Vectos, the transport consultant; and
- Review of the emission data for the proposed energy centre as supplied by Hurley Palmer Flatt.

3.1.2 The scope of the assessment includes consideration of the potential impacts on local air quality resulting from:

- Dust and particulate matter generated by on-site activities during the construction phase;
- Increases in pollutant concentrations as a result of exhaust emissions arising from construction traffic and plant;
- Increases in pollutant concentrations as a result of emissions to air from the energy centre included within the development proposals.

3.1.3 In addition, potential exposure of future residents of the Development to poor air quality will also be considered.

3.1.4 The following aspects have been scoped out of the assessment:

- The impact of exhaust emission arising from operational phase traffic.

3.1.5 Further detail why this aspect has been scoped out of the assessment is outlined in Section 3.2.7.

3.2 METHODOLOGY

CONSTRUCTION PHASE

3.2.1 Dust comprises particles typically in the size range 1-75 micrometres (µm) in aerodynamic diameter and is created through the action of crushing and abrasive forces on materials. The

¹² Reading Borough Council. Updating and Screening Assessment Report, 2015.

¹³ DEFRA Local Air Quality Management (LAQM) Support Pages. Available at: <http://laqm.defra.gov.uk/>. [Accessed on 14/10/2016].

¹⁴ Environment Agency. http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=airpollution&layerGroups=default&lang=_e&ep=map&scale=1&x=357682.9999999994&y=355133.99999999994. [Accessed on 14/10/2016].

larger dust particles fall out of the atmosphere quickly after initial release and therefore tend to be deposited in close proximity to the source of emission. Dust therefore, is unlikely to cause long-term or widespread changes to local air quality; however, its deposition on property and cars can cause 'soiling' and discolouration. This may result in complaints of nuisance through amenity loss or perceived damage caused, which is usually temporary.

- 3.2.2** The smaller particles of dust (less than 10µm in aerodynamic diameter) are known as particulate matter (PM₁₀) and represent only a small proportion of total dust released; this includes a finer fraction, known as PM_{2.5} (with an aerodynamic diameter less than 2.5µm). As these particles are at the smaller end of the size range of dust particles they remain suspended in the atmosphere for a longer period of time than the larger dust particles, and can therefore be transported by wind over a wider area. PM₁₀ and PM_{2.5} are small enough to be drawn into the lungs during breathing, which in sensitive members of the public could have a potential impact on health.
- 3.2.3** An assessment of the likely significant impacts on local air quality due to the generation and dispersion of dust and PM₁₀ during the construction phase has been undertaken using: the relevant assessment methodology published by the IAQM; the available information for this phase of the Proposed Development provided by the Client and Project Team; and, professional judgement.
- 3.2.4** The IAQM methodology assesses the risk of potential dust and PM₁₀ impacts from the following four sources: demolition; earthworks; general construction activities and track-out. It takes into account the nature and scale of the activities undertaken for each source and the sensitivity of the area to an increase in dust and PM₁₀ levels to assign a level of risk. Risks are described in terms of there being a low, medium or high risk of dust impacts. Once the level of risk has been ascertained, then site specific mitigation proportionate to the level of risk is identified, and the significance of residual effects determined. A summary of the IAQM assessment methodology is provided in **Appendix C**.
- 3.2.5** In addition to impacts on local air quality due to on-site construction activities, exhaust emissions from construction vehicles and plant may have an impact on local air quality adjacent to the routes used by these vehicles to access the Application Site and in the vicinity of the Application Site itself. As information on the number of vehicles and plant associated with the construction phase was not available at the time of writing, a qualitative assessment of their impact on local air quality has been undertaken using professional judgement and by considering the following:
- The number and type of construction traffic and plant likely to be generated by this phase of the Proposed Development;
 - The number and proximity of sensitive receptors to the Application Site and along the likely routes to be used by construction vehicles; and
 - The likely duration of the construction phase and the nature of the construction activities undertaken.

OPERATIONAL PHASE

- 3.2.6** The operational phase will introduce NO_x emissions from a new on-site energy centre. The emissions will be at high level from a stack located on the roof of the new building (the location is shown in **Figure 1**). Emissions from vehicle on local roads could potentially decrease slightly may are likely to
- 3.2.7** Of the pollutants included in the AQS, concentrations of NO₂ and particulate matter (PM₁₀ and PM_{2.5}) have been considered in this assessment. Road traffic is a major source of these pollutants and their concentrations tend to be close to, or in exceedance of, the objectives in urban locations, especially at roadside locations.

- 3.2.8 Following consultation with Vectos it was determined that the Proposed Development would cause a net reduction in total vehicles trips compared to that of the existing land use (supermarket); therefore, an assessment of traffic related air quality impacts at existing receptors has been scoped out. New receptors with relevant exposure will however be introduced and so an assessment of new exposure has been undertaken which accounts for the contributions from road traffic and new on-site energy centre sources.
- 3.2.9 For the prediction of impacts at future receptors due to emissions arising from road traffic, the dispersion model ADMS-Roads (version 4.0.1.0) has been used. This model uses detailed information regarding traffic flows on the local road network, surface roughness, and local meteorological conditions to predict pollutant concentrations at specific receptor locations, as determined by the user.
- 3.2.10 Meteorological data, such as wind speed and direction, is used by the model to determine pollutant transportation and levels of dilution by the wind. Meteorological data used in the model was obtained for observing station at London Heathrow Airport in 2015. This station is considered to provide representative data for the assessment.
- 3.2.11 A summary of the traffic data and pollutant emission factors used in the assessment can be found in **Appendix D**. It includes details of the Annual Average Daily Traffic (AADT) flows, vehicle speeds (kph) and the percentage of Heavy Duty Vehicles (HDVs) for the local road network in all assessment years considered. Traffic speeds were reduced at junctions in line with guidance provided in LAQM.TG16, and using professional judgement.
- 3.2.12 For the assessment, three scenarios were modelled, as follows:
- 2015 – Model Verification and Baseline;
 - 2021 – Future Baseline (Without Development); and
 - 2021 – Future Baseline (Without Development) + Process Contributions from Energy Centre.
- 3.2.13 2015 is the most recent year for which monitoring data and meteorological data are available to enable verification of the model results, and so this year has been used as the baseline year for this assessment. 2021 is the anticipated opening year of the Proposed Development.
- 3.2.14 The modelling scenarios include flows for committed developments in the locality of the Application Site but do not include any contribution to road traffic from the Proposed Development itself.

VEHICLE EMISSION FACTORS

- 3.2.15 Vehicle emission factors for use in the assessment have been obtained using the Emission Factor Toolkit (EFT) version 7.0¹⁵ (published in July 2016) available on the DEFRA website. The EFT allows for the calculation of emission factors arising from road traffic for all years between 2013 and 2030. For the predictions of future year emissions, the toolkit takes into account factors such as anticipated advances in vehicle technology and changes in vehicle fleet composition, such that vehicle emissions are assumed to reduce over time. The emissions data assumed for each scenario are given in **Appendix D**.

¹⁵ Emission Factor Toolkit. Available at <http://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html>

- 3.2.16 PM₁₀ and PM_{2.5} vehicle emission factors used in the assessment have been obtained using DEFRA's EFT to ensure a consistent approach in obtaining emission factors. 2015 emission factors have been used in all modelled scenarios as a worst case assumption.

SELECTION OF BACKGROUND CONCENTRATIONS

- 3.2.17 National maps providing estimated background concentrations at a grid resolution of 1x1km for the whole of the UK for 2013 to 2030 are available from the DEFRA website. The maps assume that background concentrations will improve (i.e. reduce) over time, in line with the predicted reduction in vehicle emissions, as well as reductions in emissions from other sources.
- 3.2.18 These maps have been used to obtain background concentrations for NO_x, NO₂, PM₁₀ and PM_{2.5}. It should be noted that the background maps present both the 'total' estimated background concentrations and the individual contributions from a range of emission sources (for example, motorways, aircraft, domestic heating etc.). When detailed modelling of an individual sector is required as part of an air quality assessment, the respective contribution can be subtracted from the overall background estimate to avoid the potential for 'double-counting'. However, for this assessment, no sector removal has been undertaken, as the model does not include all A roads within the grid square. For this reason, the model outputs presented here can be considered to be a conservative estimate.

MODEL VERIFICATION AND PROCESSING OF RESULTS

- 3.2.19 The ADMS-Roads dispersion model has been widely validated for this type of assessment and is considered to be fit for purpose. Model validation undertaken by the software developer will not have included validation in the vicinity of the Development.
- 3.2.20 To determine the performance of the model at a local level, a comparison of modelled results with the results of monitoring carried out within the study area was undertaken. This process of verification aims to minimise modelling uncertainty and systematic error by correcting modelled results by an adjustment factor to gain greater confidence in the final results, and was carried out following the methodology specified in Chapter 7, Section 4, of LAQM.TG16.
- 3.2.21 Details of the verification factor calculations are presented in **Appendix E**. A factor of 2.0 was obtained during the verification process, which indicated that the model was under-predicting. This factor was applied to the model road-NO_x outputs prior to conversion to annual mean NO₂ concentrations utilising DEFRA's NO_x to NO₂ calculator (version 5.1, released June 2016)¹⁶.
- 3.2.22 As local roadside PM₁₀ or PM_{2.5} monitoring data are not available for the modelled road, PM₁₀ and road-PM_{2.5} components have been adjusted by the verification factor obtained for NO_x before adding to the appropriate background concentration. The number of days with PM₁₀ concentrations greater than 50µg/m³ was then estimated using the relationship with the annual mean concentration, which is described in LAQM.TG16.

ASSESSMENT OF IMPACTS DUE TO EMISSIONS GENERATED BY THE PROPOSED ENERGY CENTRE

- 3.2.23 For the prediction of impacts due to emissions arising from the operation of the proposed energy centre, the air pollutant dispersion model ADMS 5.1 has been used. This model uses detailed information regarding the pollutant releases, local building effects and local meteorological conditions to predict pollution concentrations at specific locations selected by the user. A

¹⁶ Defra NO_x to NO₂ Calculator. Available at: <http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxsector>. [Accessed: 26/07/2016].

summary of the stack parameters and emissions data used in the assessment is provided in **Appendix F**. The pollutant emitted from the proposed energy centre and considered in this assessment is NO_x.

- 3.2.24 Details regarding the selection of plant, flue arrangements and timings of operation for the proposed energy centre were provided by Hurley Palmer Flatt (M & E Consultant) for the project. Full details regarding the operation of the proposed energy centre are provided in **Appendix F**.
- 3.2.25 Both nearby buildings and complex topography can have a significant effect on the dispersion characteristics of the plumes from the energy centre stacks being assessed. ADMS 5.1 has algorithms which attempt to take account of these impacts. Buildings can cause the plume to come to ground much closer to the stack than otherwise expected, causing higher pollutant concentrations. Plumes can also impact on hillsides under certain weather conditions, or within a basin or hollow which may result in pollutants being trapped for low level discharges. A description of the buildings modelled is included in **Appendix F**. Modelled buildings and flue stack locations are illustrated in **Figure 1**.
- 3.2.26 Following Environment Agency guidance¹⁷, the energy centre process contribution to annual mean NO₂ concentrations has been estimated on the basis that - in the long term - 70% of emitted NO_x is converted to NO₂. For short-term (hourly) concentrations the assumption is that 35% of emitted NO_x is converted to NO₂. The estimated statistic for 1-hour mean NO₂ concentrations is the 99.79th percentile which corresponds to the 1-hour mean AQS objective of 200µg/m³.

COMBINING THE ADMS-ROADS AND ADMS 5.1 RESULTS

- 3.2.27 The modelled road contribution to NO_x concentrations were converted to annual mean NO₂ concentrations using the methodology given in LAQM.TG(16), the NO_x to NO₂ calculator and local background concentrations. These were then combined with the predicted contribution to the annual mean NO₂ concentration arising from the proposed energy centre emissions to obtain the total annual mean NO₂ concentrations, in order to assess the long-term impact.
- 3.2.28 Detailed assessment of short term effects is often complex as the maximum contribution from various sources may be separated both temporally and spatially, such that the addition of different 'worst case' concentrations together may not represent a likely event.
- 3.2.29 LAQM.TG(16) advises that exceedence of the 1-hour mean NO₂ objective is unlikely to occur where annual mean concentration is below 60µg/m³.
- 3.2.30 The predicted annual mean PM₁₀ and PM_{2.5} concentration contributions have not been considered in this assessment, as the proposed energy centre is not expected to have any emissions of either of these pollutants, therefore these contributions are not included.
- 3.2.31 Predicted concentrations have been compared against the AQS objectives as set out in **Appendix B**.

3.3 SELECTION OF SENSITIVE RECEPTORS

- 3.3.1 Sensitive locations are places where the public or sensitive ecological habitats may be exposed to pollutants resulting from activities associated with the Proposed Development. These will include locations sensitive to an increase in dust deposition and PM₁₀ exposure as a result of on-site

¹⁷ Environment Agency Air Quality Modelling and Assessment Unit, 'Conversion Ratios for NO_x and NO₂'

construction activities, and locations sensitive to exposure to gaseous pollutants emitted from the proposed energy centre and from road traffic exhaust emissions.

CONSTRUCTION PHASE

- 3.3.2 The IAQM assessment is undertaken where there are: 'human receptors' within 350m of the site boundary, or within 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s); and/or 'ecological receptors' within 50m of the site boundary, or within 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s). It is within these distances that the impacts of dust soiling and increased particulate matter in the ambient air will have the greatest impact on local air quality at sensitive receptors.

OPERATIONAL PHASE

- 3.3.3 In terms of locations that are sensitive to pollutants emitted from engine exhausts and energy centre flues, these will include places where members of the public are likely to be regularly present over the period of time prescribed in the AQS. For instance, on a footpath where exposure will be transient (for the duration of passage along that path) comparison with a short-term standard (i.e. 15 minute mean or 1 hour mean) may be relevant. At a school or adjacent to a private dwelling, where exposure may be for longer periods, comparison with a long-term standard (such as 24 hour mean or annual mean) may be more appropriate. Box 1.1 of LAQM.TG16 provides examples of the locations where the air quality objectives should/should not apply.
- 3.3.4 To complete the assessment of operational phase impacts, a number of 'receptors' representative of locations of relevant public exposure were identified at which pollution concentrations were predicted.
- 3.3.5 To complete the exposure assessment, pollution concentrations were also predicted at a number of locations within the Proposed Development site.
- 3.3.6 The locations receptors used in the assessment are shown on **Figure 2** and listed in **Table 1** below.

Table 1: Receptor Locations Used in the Assessment

RECEPTOR	DESCRIPTION / ADDRESS	GRID REFERENCE		HEIGHT ABOVE GROUND LEVEL (M)
		X	Y	
1	1 st to 4 th Floor - Greyfriars Street	471266	173647	6.8 – 15.8
2	1 st to 7 th Floor - Greyfriars Street	471265	173629	6.8 – 24.8
3	1 st to 7 th Floor - Greyfriars Street	471267	173610	6.8 – 24.8
4	1 st to 5 th Floor - Friars Street	471299	173579	6.8 – 19.1
5	1 st to 5 th Floor - Friars Street	471316	173582	6.8 – 19.1
6	1 st to 7 th Floor - Eastern Façade	471306	173596	6.8 – 24.8
7	Ground to 10 th Floor - Eastern Façade	471299	173636	1.5 – 34.8
8	Ground to 10 th Floor - Eastern Façade	471303	173619	1.5 – 34.8
9	Ground to 10 th Floor - Eastern Façade	471294	173660	1.5 – 34.8

3.4 SIGNIFICANCE CRITERIA

CONSTRUCTION PHASE

- 3.4.1 The IAQM assessment methodology recommends that significance criteria is only assigned to the identified risk of dust impacts occurring from a construction activity with appropriate mitigation measures in place. For almost all construction activities, the application of effective mitigation should prevent any significant effects occurring to sensitive receptors and therefore the residual

effect will normally be negligible.

- 3.4.2 For the assessment of the impact of exhaust emissions from plant used on-site and construction vehicles accessing and leaving the Site on local NO₂ and particulate matter concentrations, the significance of residual effects have been determined using professional judgement and the principles outlined in the EPUK/IAQM guidance, which are described below.

OPERATIONAL PHASE

- 3.4.3 The EPUK/IAQM guidance says that *“the effect on the residents or occupants of any new development where the air quality is such that an air quality objective at the building façade is not met will be judged as significant, unless provision is met to reduce their exposure by some means. For people working at new developments in this situation, the same will not be true as occupational exposure standards are different, although an assessment may wish to draw attention to the undesirability of the exposure.”*

3.5 LIMITATIONS & ASSUMPTIONS

CONSTRUCTION PHASE

- 3.5.1 As suitable information for the construction phase of the Proposed Development was not available professional judgement has been used in the completion of this part of the assessment.
- 3.5.2 General assumptions have been made regarding the material volume and type at each stage of construction based on professional judgement.

OPERATIONAL PHASE

- 3.5.3 It has been assumed that the traffic data provided by the Transport Consultant is accurate and representative of the scenarios that have been modelled.
- 3.5.4 A precautionary approach has been taken relative to the accuracy of future year vehicle emissions and background concentrations, whereby an assumption of no improvement in vehicle emissions or background concentrations has been adopted. This approach is considered to provide a conservative assessment of future air quality within the vicinity of the Application Site.
- 3.5.5 It has been assumed that the energy centre information provided by Hurley Palmer Flatt (M & E Consultants) is accurate.
- 3.5.6 Receptor heights have been assumed 1.5m above the height of the floor at which they are located i.e. ground floor equals 1.5m, 1st floor equals 1.5m plus floor height, and so on.
- 3.5.7 There are uncertainties associated with both measured and predicted concentrations. The model (ADMS-Roads) used in this assessment relies on input data (including predicted traffic flows), which also have uncertainties associated with them. The model itself simplifies complex physical systems including street canyons into a range of algorithms. In addition, local micro-climatic conditions may affect the concentrations of pollutants that the ADMS Roads model will not take into account.
- 3.5.8 In order to reduce the uncertainty associated with predicted concentrations, model verification has been carried out following guidance set out in LAQM.TG16. As the model has been verified against local monitoring data and adjusted accordingly, there can be reasonable confidence in the predicted concentrations.
- 3.5.9 Both nearby buildings and complex topography can have a significant effect on the dispersion characteristics of the plumes from the stacks being assessed. ADMS 5.1 has algorithms which

attempt to take account of these impacts. Buildings can cause the plume to come to ground much closer to the stack than otherwise expected, causing higher pollutant concentrations. Plumes can also impact on hillsides under certain weather conditions, or within a basin or hollow which may result in pollutants being trapped for low level discharges.

3.5.10 The following assumptions in **Table 2** have been made in relation to the ADMS dispersion modelling.

Table 2: Key ADMS Dispersion Modelling Parameters

SITE DATA	SURFACE ROUGHNESS	MINIMUM MONIN-OBUKHOV LENGTH (M)	PRIESTLY-TAYLOR PARAMETER
Dispersion Site	1	30	1
Met. Measurement Site	0.5	30	1

4 BASELINE CONDITIONS

4.1 RBC'S REVIEW & ASSESSMENT OF AIR QUALITY

- 4.1.1 In 2009, RBC designated an AQMA (Reading AQMA) due to exceedances of the annual mean and hourly mean NO₂ AQS objective. The AQMA covers the Oxford Road area, and the major transport routes running through the borough. The Application Site lies within the Reading AQMA.
- 4.1.2 RBC published its Air Quality Action Plan (AQAP) in January 2009. This details a number of measures proposed to reduce NO₂ concentrations within the Reading AQMA as well as across the borough. Transport-related measures within the Local Transport Plan (LTP)¹⁸ include objectives relevant to improving air quality such as the implementation of the cycle strategy scheme, travel plans for schools, car clubs and the introduction of RBC pool cars.

4.2 LOCAL EMISSION SOURCES

- 4.2.1 Source apportionment studies undertaken by RBC have identified road traffic, specifically HGVs, as the major source of the NO₂ hotspots. The Application Site is located in an area where local air quality is mainly influenced by emissions from road transport using Friar Street and Greyfriars Road. The A329 Caversham Road is another potential road source; however this road is located approximately 120m to the west.
- 4.2.2 Reading Railway Station is located approximately 150m north east of the Application Site, and according to LAQM.TG(16), the Paddington to Swansea route, which forms part of the Great Western Mainline is listed as a rail line with heavy traffic of diesel passenger trains. Electrification of the Great Western Mainline is currently being undertaken and it is expected that this work will be complete by the end of 2017. It is expected that electrification of this route will have an impact on local background concentrations, such that in the opening year of the Proposed Development (2021) background concentrations could potentially be lower than in 2015. There is potential that beyond the electrification of the Great Western Railway in 2017, some diesel locomotives would continue to use this route; however, it is likely that the number of movements would be substantially less than what is currently operational, and therefore substantial improvements are still expected.
- 4.2.3 There are no industrial pollution sources in the immediate vicinity of the Application Site that will influence the local air quality.

4.3 BACKGROUND AIR QUALITY DATA

- 4.3.1 **Table 3** gives the background annual mean NO₂, PM₁₀ and PM_{2.5} concentrations in the vicinity of the Application Site. The concentrations are well below the AQS objectives.

¹⁸ Reading Borough Council (2011) Local Transport Plan 3: Strategy 2011-2026

Table 3: DEFRA Background Concentrations ($\mu\text{g}/\text{m}^3$) for 2015

GRID SQUARE (CENTRE ON O.S. GRID REFERENCE)	NO ₂	PM ₁₀	PM _{2.5}
	2015	2015	2015
471500, 173500	31.1	18.2	13.6

4.4 LOCAL AUTHORITY AIR QUALITY MONITORING DATA

4.4.1 NO₂ concentrations measured in the local vicinity of the Application Site (within 300m) by RBC are provided in **Table 4**.

Table 4: Local Authority Air Quality Monitoring Data

SITE NAME	DESCRIPTION	SITE TYPE	DISTANCE TO SITE (M)	ANNUAL MEAN NO ₂ CONCENTRATION ($\mu\text{g}/\text{m}^3$)*				
				2011	2012	2013	2014	2015
DT37	Sackville Street	K	112	39	44	41	42	38
DT38	Vachel Road	R	138	34	39	36	37	31
DT35	Garrard Street	R	148	33	39	36	40	40
FS	Friar Street	R	154	-	52	52	51	45
S2	Station 2 (bus stops w/n sign)	R	194	-	-	-	-	45
DT39	33 Caversham Road	R	196	47	50	49	49	45
S1	Station 1 (nr entrance)	R	196	-	-	-	-	46
DT29	Picture House	R	225	31	34	34	33	28
DT40	59a Caversham Road	R	269	44	47	42	46	40

* RBC 2014 and 2015 monitoring data; RBC 2014 Progress Report

****Bold** indicates exceedance AQS Objective for NO₂

4.4.2 The majority of the sites in **Table 4** are classified as roadside locations, except for Sackville Street, which is classified as kerbside. There are exceedances of the annual mean NO₂ objective at six of the nine monitoring locations in 2015.

4.4.3 The two closest diffusion tubes to the Application Site (DT37 Sackville Street and DT38 Vachel Road located 112m and 138m from the Application Site, respectively) do not exceed the NO₂ AQS objective level of 40 $\mu\text{g}/\text{m}^3$ in 2015. These monitoring sites are shown in relation to the Application Site in **Figure 3**.

4.4.4 Trend analysis of the diffusion tube data gives no clear indication of a general upward or downward trend in annual mean NO₂ concentrations.

4.5 SUMMARY

4.5.1 RBC has recorded exceedances of the AQS objective for annual mean NO₂ at a number of roadside diffusion tube monitoring locations. Trend analysis of the 2011-15 data shows no significant change in NO₂ concentrations over this period.

- 4.5.2 The NO₂ concentrations measured at the diffusion tube monitoring location closest to the Application Site are below the long term (annual mean) AQS objective for in 2015.

5

ASSESSMENT OF IMPACTS

5.1 CONSTRUCTION PHASE

DUST AND PM₁₀ ARISING FROM ON-SITE ACTIVITIES

- 5.1.1 Construction activities that have the potential to generate and/or re-suspend dust and PM₁₀ include:
- Site clearance and preparation including demolition activities;
 - Preparation of temporary access/egress to the Application Site and haulage routes;
 - Earthworks;
 - Materials handling, storage, stockpiling, spillage and disposal;
 - Movement of vehicles and construction traffic within the Application Site (including excavators and dumper trucks);
 - Use of crushing and screening equipment/plant;
 - Exhaust emissions from site plant, especially when used at the extremes of their capacity and during mechanical breakdown;
 - Construction of buildings, roads and areas of hardstanding alongside fabrication processes;
 - Internal and external finishing and refurbishment; and
 - Site landscaping after completion.
- 5.1.2 The majority of the releases are likely to occur during the 'working week'. However, for some potential release sources (e.g. exposed soil produced from significant earthwork activities) in the absence of dust control mitigation measures, dust generation has the potential to occur 24 hours per day over the period during which such activities are to take place.

ASSESSMENT OF POTENTIAL DUST EMISSION MAGNITUDE

- 5.1.3 The IAQM assessment methodology has been used to determine the potential dust emission magnitude for the following four different dust and PM₁₀ sources: demolition; earthworks; construction; and, trackout. The findings of the assessment are presented below.

DEMOLITION

- 5.1.4 Total volume of buildings to be demolished on site is estimated to be between 20,000m³ and 50,000m³, with potentially dusty construction material, and with demolition activities occurring between 10 and 20m above ground level. Therefore, the potential dust emission magnitude is considered to be **medium** for demolition activities.

EARTHWORKS

- 5.1.5 The total area of the Application Site is approximately 3,000m², which falls within the IAQM range for medium sites (2,500 to 10,000m²), the soil type is assumed to be moderately dusty and the total material of material that will be moved is estimated to be between 20,000 and 100,000 tonnes. It is also estimated that between 5 and 10 heavy earth moving vehicles will be active at any one time. Therefore, the potential dust emission magnitude is considered to be **medium** for earthwork activities.

CONSTRUCTION

- 5.1.6 The total volume of buildings to be constructed on the Application Site is estimated to fall between the IAQM range of 25,000m³ and 100,000m³) with potentially dusty construction materials being used. The potential dust emission magnitude is considered to be **medium** for construction activities.

TRACKOUT

- 5.1.7 Information on the number of HDVs associated with this phase of the Proposed Development is not available and therefore professional judgement has been used. It has been assumed that given the size of the development area there are likely to be between 10 and 50 HDV outward movements in any one day, travelling over moderately dusty surface material. As the unpaved road length in the Application Site is likely to be approximately 50m, it is considered that the potential dust emission magnitude of is **medium** for trackout.
- 5.1.8 **Table 5** provides a summary of the potential dust emission magnitude determined for each construction activity considered.

Table 5: Potential Dust Emission Magnitude

ACTIVITY	DUST EMISSION MAGNITUDE
Demolition	Medium
Earthworks	Medium
Construction Activities	Medium
Trackout	Medium

ASSESSMENT OF SENSITIVITY OF THE STUDY AREA

- 5.1.9 A windrose generated using the meteorological data used for the dispersion modelling of operational phases impacts is provided in **Appendix G**. This shows that the prevailing wind direction is from the south west. Therefore, receptors located to north of the Application Site are more likely to be affected by dust and particulate matter emitted and re-suspended during the construction phase.
- 5.1.10 Under low wind speed conditions, it is likely that the majority of dust would be deposited in the area immediately surrounding the source. In the vicinity of the Application Site, there are a number of receptors including existing commercial and office premises to the north, south, east and west. There is a small pocket of existing residential dwellings located along Sackville Street and Vachel Road approximately 100m to the west. The background PM₁₀ concentrations are 18.2µg/m³ (see **Table 3**) which is well below the AQS objective, therefore the area is considered to be of medium sensitivity.
- 5.1.11 Taking the above into account and following the IAQM assessment methodology, the sensitivity of the area to changes in dust and PM₁₀ has been derived for each of the construction activities considered. The results are shown in **Table 6**.

Table 6: Sensitivity of the Study Area

POTENTIAL IMPACT	SENSITIVITY OF THE SURROUNDING AREA			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Low	Low	Low	Low

POTENTIAL IMPACT	SENSITIVITY OF THE SURROUNDING AREA			
Human Health	Low	Low	Low	Low
Ecological	N/A	N/A	N/A	N/A

RISK OF IMPACTS

- 5.1.12 The predicted dust emission magnitude has been combined with the defined sensitivity of the area to determine the risk of impacts during the construction phase, prior to mitigation. **Table 7** below provides a summary of the risk of dust impacts for the Proposed Development. The risk category identified for each construction activity has been used to determine the level of mitigation required.

Table 7: Summary Dust Risk Table to Define Site Specific Mitigation

POTENTIAL IMPACT	RISK			
	DEMOLITION	EARTHWORKS	CONSTRUCTION	TRACKOUT
Dust Soiling	Medium Risk	Medium Risk	Medium Risk	Low Risk
Human Health	Medium Risk	Medium Risk	Medium Risk	Low Risk
Ecological	N/A	N/A	N/A	N/A

CONSTRUCTION VEHICLES & PLANT

- 5.1.13 The greatest impact on air quality due to emissions from vehicles and plant associated with the construction phase will be in the areas immediately adjacent to the site access. It is anticipated that construction traffic will access the site via Friars Street and Greyfriars Road.
- 5.1.14 Final details of the exact plant and equipment likely to be used on Site will be determined by the appointed contractor, it is considered likely to comprise dump trucks, tracked excavators, diesel generators, asphalt spreaders, rollers, compressors and trucks. The number of plant and their location within the Site are likely to be variable over the construction period.
- 5.1.15 Based on the current local air quality in the area, the proximity of sensitive receptors to the roads likely to be used by construction vehicles, and the likely numbers of construction vehicles and plant that will be used, the impacts are considered to be slight adverse according to the significance criteria published by EPUK/IAQM (May 2015), prior to the implantation of mitigation.

5.2 OPERATIONAL PHASE

- 5.2.1 Full results of the dispersion modelling are presented in **Appendix H** and a summary is provided below.

NO₂ CONCENTRATIONS

- 5.2.2 The AQS objective for annual mean NO₂ concentrations is 40µg/m³. The AQS objective for 1-hour mean concentrations is 200µg/m³ not to be exceeded more than 18 times a year (or the 99.79th percentile concentration).

- 5.2.3** **Figure 4** and **Figure 5** illustrate the process contributions in terms of annual mean and 99.79th percentile NO₂ concentrations in the vicinity of the Proposed Development. Annual mean concentrations predicted for new receptor locations introduced as part of the Proposed Development are given in **Appendix H**.
- 5.2.4** The nearest existing residential receptors are located to the west along Sackville Street and Vachel Road, where the impact of the proposed energy centre on annual mean concentrations is predicted to be less than 0.04µg/m³. Taking into account the existing NO₂ background concentration (31.1µg/m³) the impact of the proposed energy centre will be negligible. The maximum process contribution to annual mean concentrations beyond the Application Site boundary occurs to the north east in the vicinity of a car park on Garrard Street where there is no relevant exposure to annual mean concentrations. The off-site maximum 1-hour mean concentration (as 99.79th percentile) is less than 10% of the AQS objective level of 200µg/m³. On the basis of these results the energy emissions have negligible impact on ambient NO₂ concentrations in the area surrounding the Application Site.
- 5.2.5** The highest predicted annual mean concentration at new receptor locations is 48.2µg/m³ at Receptor N4_1 (1st floor receptor facing onto Friar Street). The annual mean AQS objective will be exceeded at 9 of the 70 new receptor locations. The location of the exceedances is along Friar Street and Greyfriars Road at 1st, 2nd and 3rd floor levels. The exceedances are largely associated with the road traffic contributions along these roads.
- 5.2.6** The greatest predicted process contribution from the proposed onsite energy centre is 0.5µg/m³ at Receptor N9_10 (10th floor receptor located closest to the flue stack). The total predicted annual mean concentration at this new receptor is 32.4µg/m³ which is well below the annual mean AQS objective.

PM₁₀ CONCENTRATIONS

- 5.2.7** The annual mean PM₁₀ AQS objective is 40µg/m³. The highest predicted concentration is 18.6µg/m³. Annual mean PM₁₀ is therefore not considered to be a constraint to the Proposed Development.
- 5.2.8** The daily mean PM₁₀ AQS objective is 50µg/m³ to be exceeded no more than 35 times a year. The assessment indicates that new receptors will not be exposed to daily mean PM₁₀ concentrations that are in breach of the objective with a maximum number of 2 days exceeding the 50µg/m³ threshold.

ANNUAL MEAN PM_{2.5} CONCENTRATIONS

- 5.2.9** The annual mean PM_{2.5} AQS objective is 25µg/m³. The highest predicted concentration in 2021 will be 13.8µg/m³, which is well below the objective.

6

MITIGATION & RESIDUAL EFFECTS

6.1 CONSTRUCTION PHASE

6.1.1 Based on the assessment results, mitigation will be required. Recommended mitigation measures are given below.

GENERAL COMMUNICATION

- A stakeholder communications plan that includes community engagement before work commences on site should be developed and implemented.
- The name and contact details of person(s) accountable for air quality and dust issues should be displayed on the site boundary. This may be the environment manager/engineer or the site manager. The head or regional office contact information should also be displayed.

GENERAL DUST MANAGEMENT

- A Dust Management Plan (DMP), which may include measures to control other emissions, in addition to the dust and PM₁₀ mitigation measures given in this report, should be developed and implemented, and approved by the Local Authority. The DMP may include a requirement for monitoring of dust deposition, dust flux, real-time PM₁₀ continuous monitoring and/or visual inspections.

SITE MANAGEMENT

- All dust and air quality complaints should be recorded and causes identified. Appropriate remedial action should be taken in a timely manner with a record kept of actions taken including of any additional measures put in-place to avoid reoccurrence.
- The complaints log should be made available to the local authority on request.
- Any exceptional incidents that cause dust and/or air emissions, either on- or offsite should be recorded, and then the action taken to resolve the situation recorded in the log book.
- Regular liaison meetings with other high risk construction sites within 500m of the site boundary should be held, 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

- Daily on-site and off-site inspections should be undertaken, where receptors (including roads) are nearby to monitor dust. The inspection results should be recorded and made available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of site boundary, with cleaning to be provided if necessary.
- Regular site inspections to monitor compliance with the DMP should be carried out, inspection results recorded, and an inspection log made available to the local authority when asked.
- The frequency of site inspections should be increased when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
- Dust deposition, dust flux, or real-time PM₁₀ continuous monitoring locations should be agreed with the Local Authority. Where possible baseline monitoring should start at least three months before work commences on site or, if it a large site, before work on a phase commences.

PREPARING AND MAINTAINING THE SITE

- Plan the site layout so that machinery and dust causing activities are located away from receptors, as far as is practicable.
- Where practicable, erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
- Where practicable, 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. If they are being re-used on-site cover appropriately.
- Where practicable, cover, seed or fence stockpiles to prevent wind whipping.

OPERATING VEHICLE/MACHINERY AND SUSTAINABLE TRAVEL

- Ensure all vehicle operators 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.
- A maximum-speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas should be imposed (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate).
- A Construction Logistics Plan should be produced to manage the sustainable delivery of goods and materials.
- A Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing) should be considered.

OPERATIONS

- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
- Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
- Use enclosed chutes and conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
- Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.

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 tackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.
- Where practicable, only remove the cover in small areas during work and not all at once.
- Stockpile surface areas should be minimised (subject to health and safety and visual constraints regarding slope gradients and visual intrusion) to reduce area of surfaces exposed to wind pick-up.
- Where practicable, windbreak netting/screening should be positioned around material stockpiles and vehicle loading/unloading areas, as well as exposed excavation and material handling operations, to provide a physical barrier between the Application Site and the surroundings.
- Where practicable, stockpiles of soils and materials should be located as far as possible from sensitive properties, taking account of the prevailing wind direction.
- During dry or windy weather, material stockpiles and exposed surfaces should be dampened down using a water spray to minimise the potential for wind pick-up.

MEASURES SPECIFIC TO CONSTRUCTION

- Avoid scabbling (roughening of concrete surfaces) if possible.
- 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.
- For smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust.
- All construction plant and equipment should be maintained in good working order and not left running when not in use.

MEASURES SPECIFIC TO TRACKOUT

- 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 in frequent 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.
- Record all inspections of haul routes and any subsequent action in a site log book.

- Where practicable, hard surfaced haul routes should be installed, 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.

RESIDUAL EFFECTS

- 6.1.2 The residual effects of dust and PM₁₀ generated by construction activities following the application of the mitigation measures described above and good site practice are not significant.
- 6.1.3 The residual effects of emissions to air from construction vehicles and plant on local air quality are not significant.

6.2 OPERATIONAL PHASE

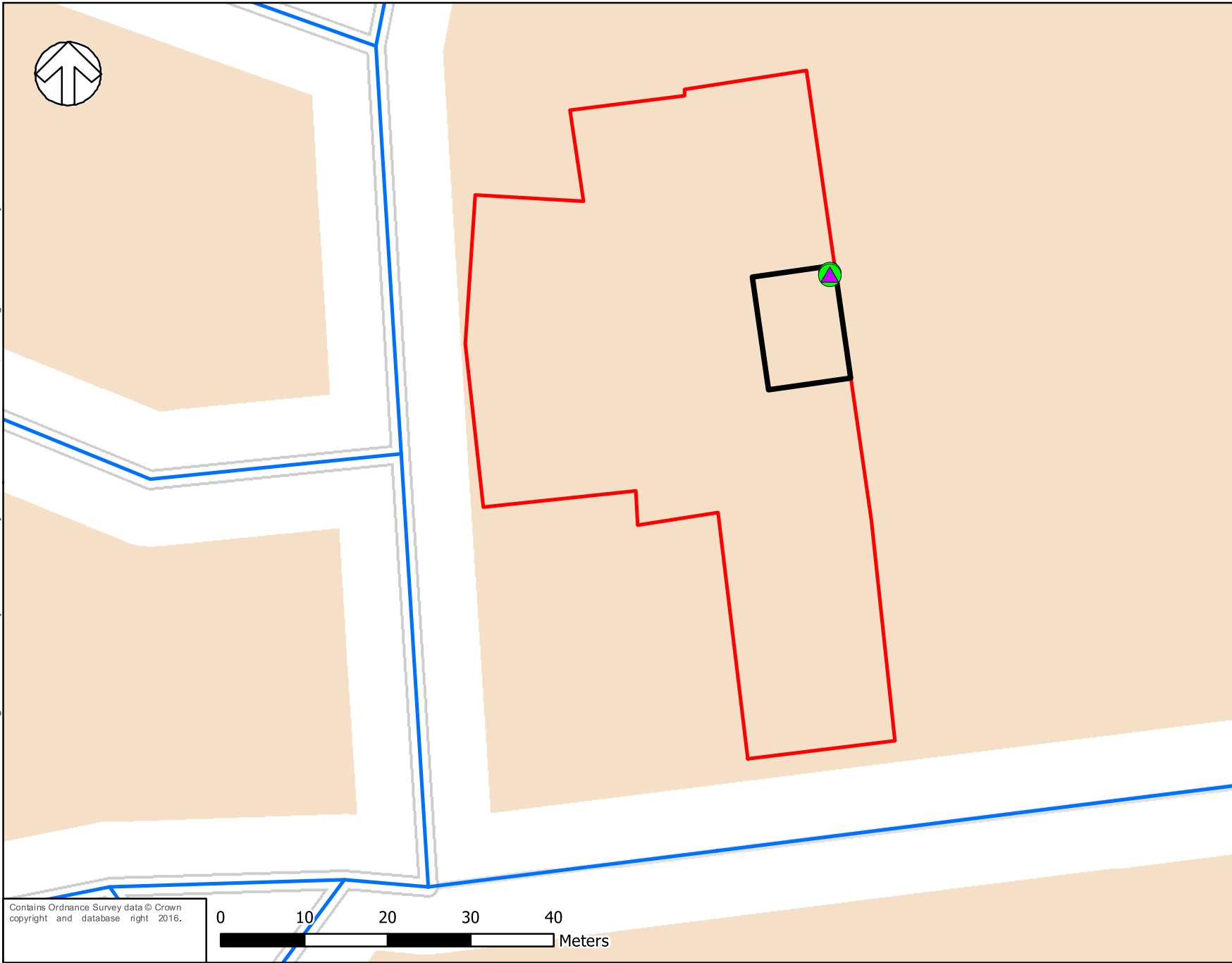
MITIGATION

- 6.2.1 The majority of the future receptors modelled predicted concentrations of NO₂, PM₁₀ and PM_{2.5} which are below the relevant annual mean AQS objectives. However, there are a small number of predicted exceedances of the annual mean NO₂ AQS objective at some of the future receptors located on the 1st, 2nd and 3rd floors along Friar Street and Greyfriars Road. In order to mitigate the impact of these exceedances, mechanical ventilation should be considered. The ventilation strategy should introduce a suitable filtration system to reduce NO₂ concentrations drawn into the ventilation system intakes to below statutory limit values.

7 CONCLUSIONS

- 7.1.1 A qualitative assessment of the potential impacts on local air quality from construction activities has been carried out for this phase of the Proposed Development using the IAQM methodology. This identified that there is a Low Risk of dust soiling impacts and a Low Risk of increases in particulate matter concentrations due to construction activities. Through good site practice and the implementation of suitable mitigation measures, the effect of dust and PM₁₀ releases would be significantly reduced. The residual effects of dust and PM₁₀ generated by construction activities on air quality are therefore not significant. The residual effects of emissions to air from construction vehicles and plant on local air quality are not significant.
- 7.1.2 An air quality assessment to consider the potential impacts of NO₂, PM₁₀ and PM_{2.5} at sensitive receptor locations has been undertaken. The results show that the greatest predicted change in NO₂ concentrations at existing receptors as a result of the proposed energy centre is less than 0.04µg/m³. The off-site maximum 1-hour mean NO₂ concentration (as 99.79th percentile) is less than 10% of the AQS objective level of 200µg/m³. The impact is considered to be negligible.
- 7.1.3 The assessment of new exposure indicates that annual mean NO₂ concentrations at new receptors located at the 1st, 2nd and 3rd floors along Friar Street and Greyfriars will exceed the AQS objective. Consequently, it is recommended that a mechanical ventilation system with appropriate filtration be installed at these locations to reduce the NO₂ concentrations below the objective level. Annual mean NO₂ concentrations at the new receptors located on or above the 4th floor will be below the AQS objective. The on-site energy centre will make nominal contributions to annual mean NO₂ at new receptors of less than 0.04µg/m³.
- 7.1.4 Modelled PM₁₀ and PM_{2.5} concentrations at the new receptors are predicted to be below the relevant AQS objectives, and do not require further consideration.

FIGURES & APPENDICES



KEY:

-  Site Boundary
-  Modelled Roads
-  CHP Flue Stack
-  Boiler Flue Stacks
-  Main Building

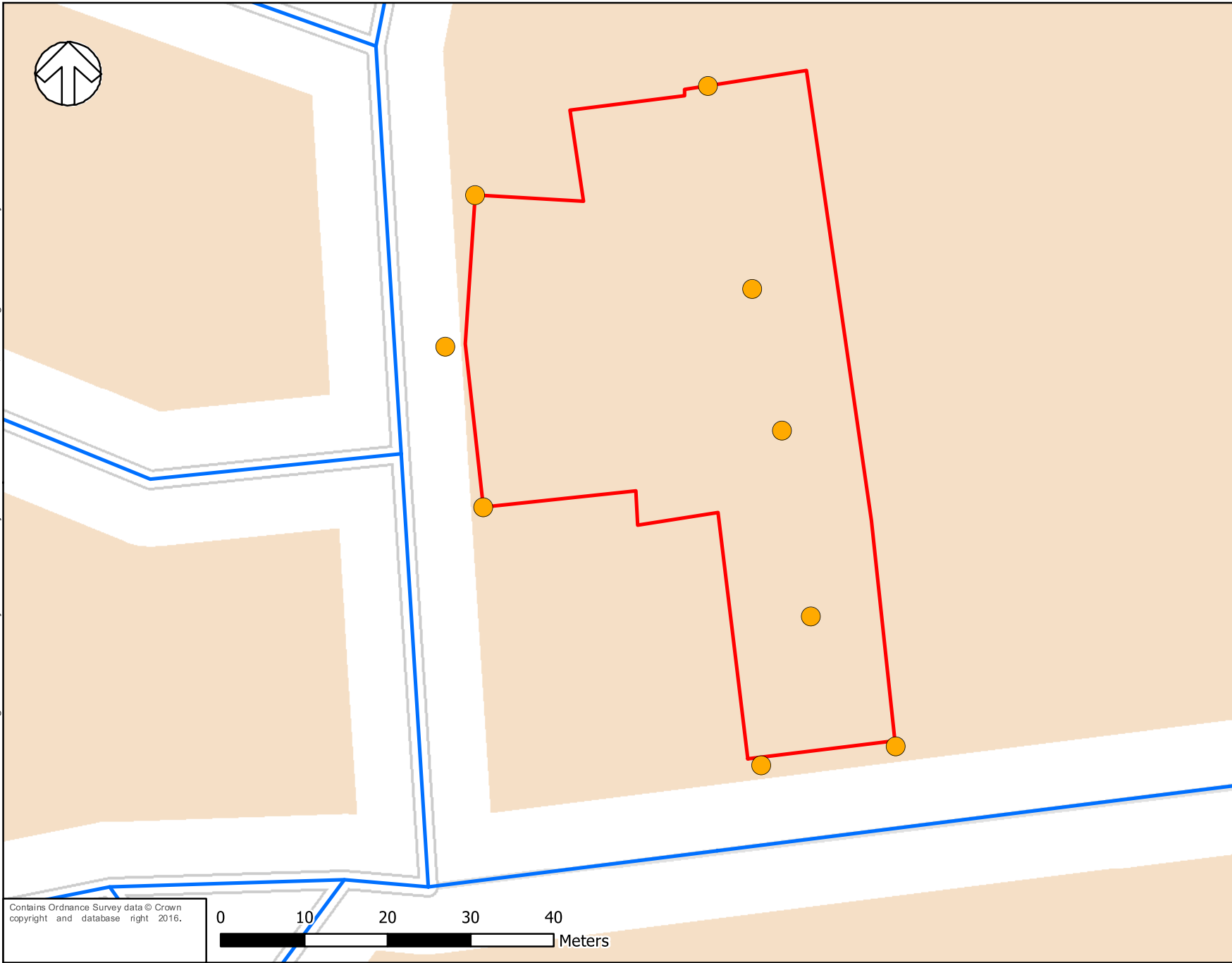


TITLE:
52-55 FRIAR STREET
& 12 GREYFRIARS
ROAD, READING

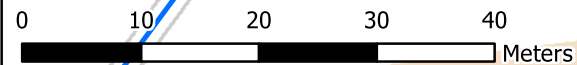
FIGURE No:
FIGURE 1 - MODELLED
BUILDINGS & FLUE STACK
LOCATIONS

Contains Ordnance Survey data © Crown
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0 10 20 30 40
Meters



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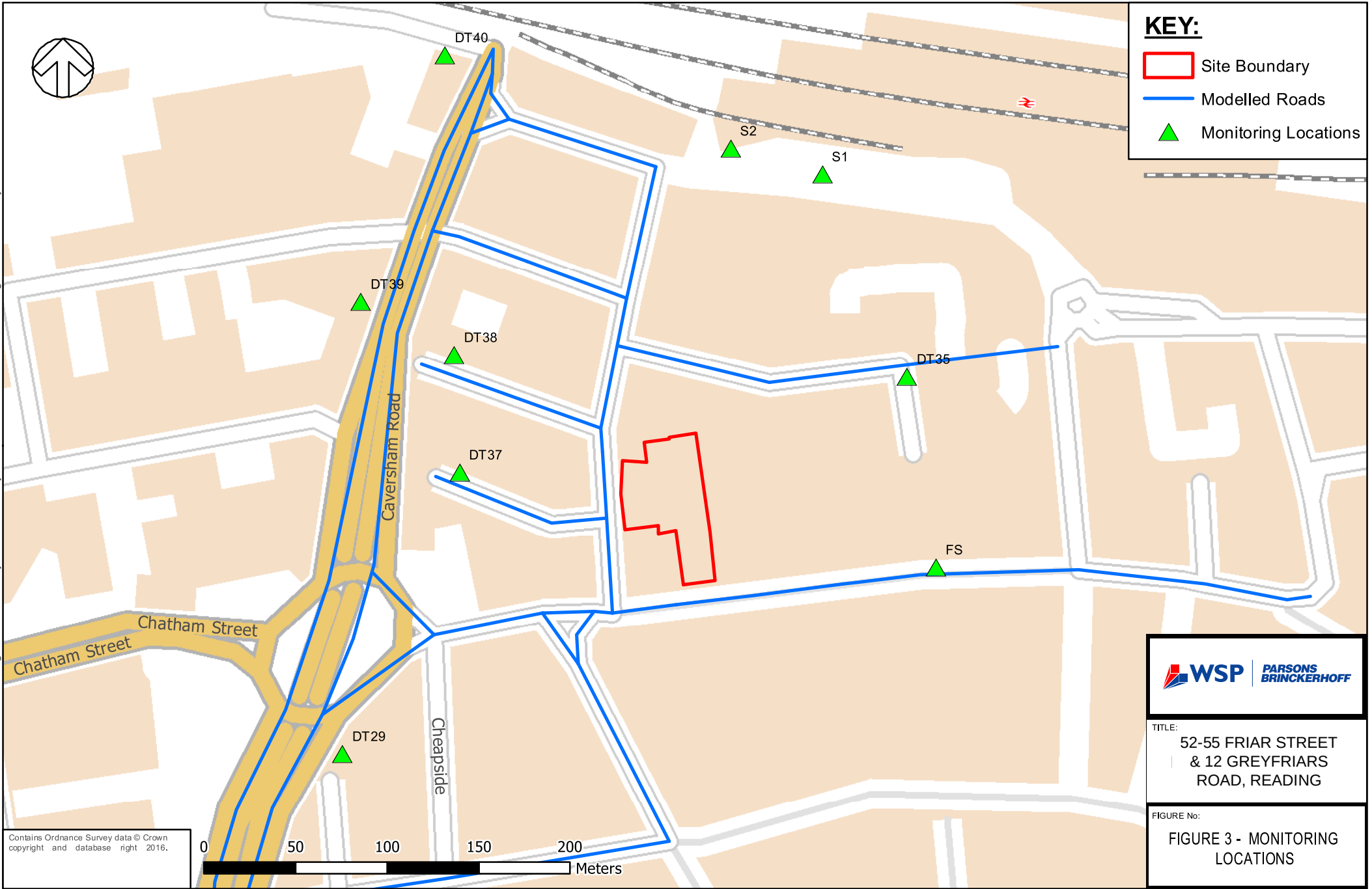
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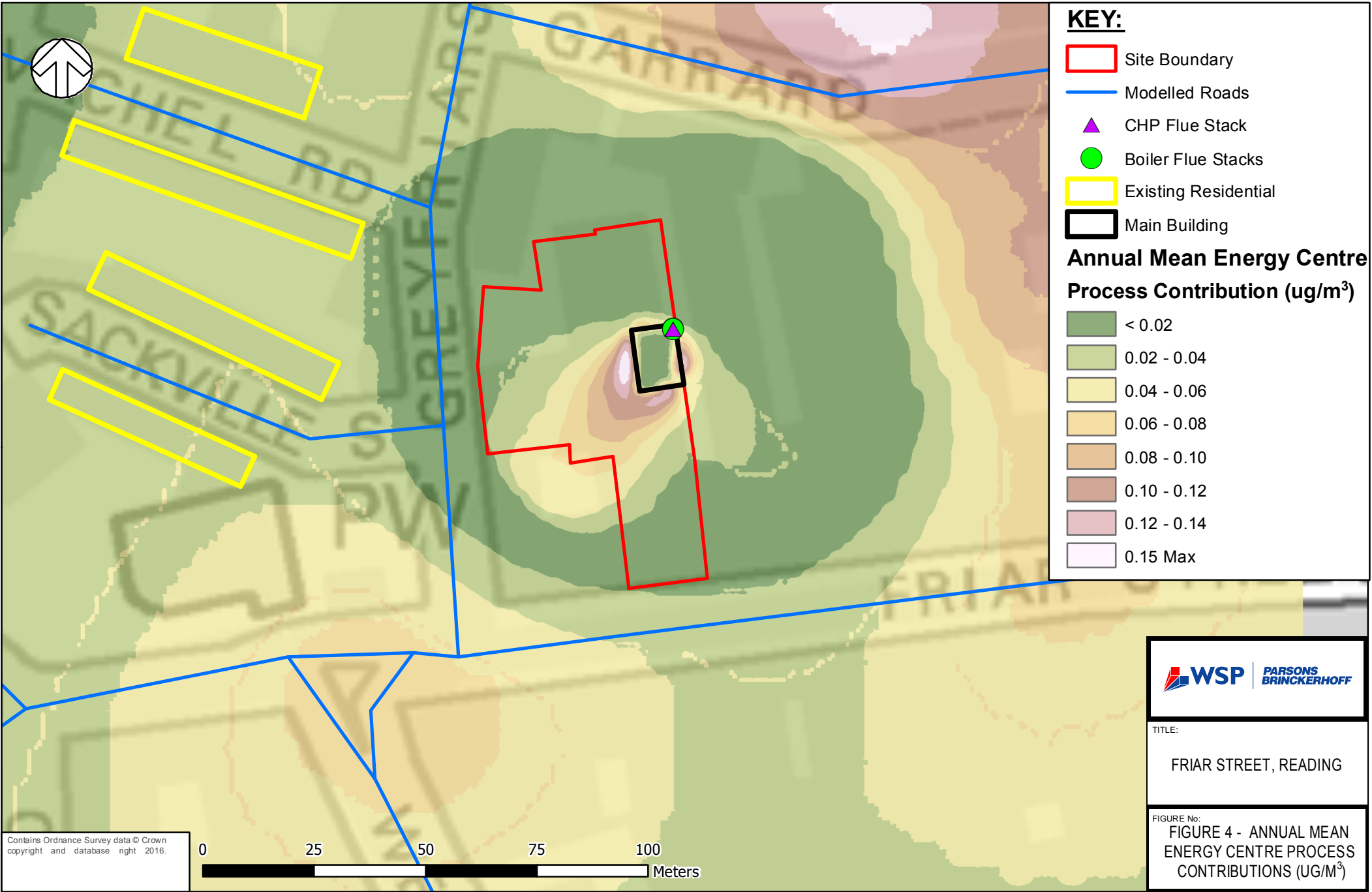
- Site Boundary
- Modelled Roads
- Future Receptors

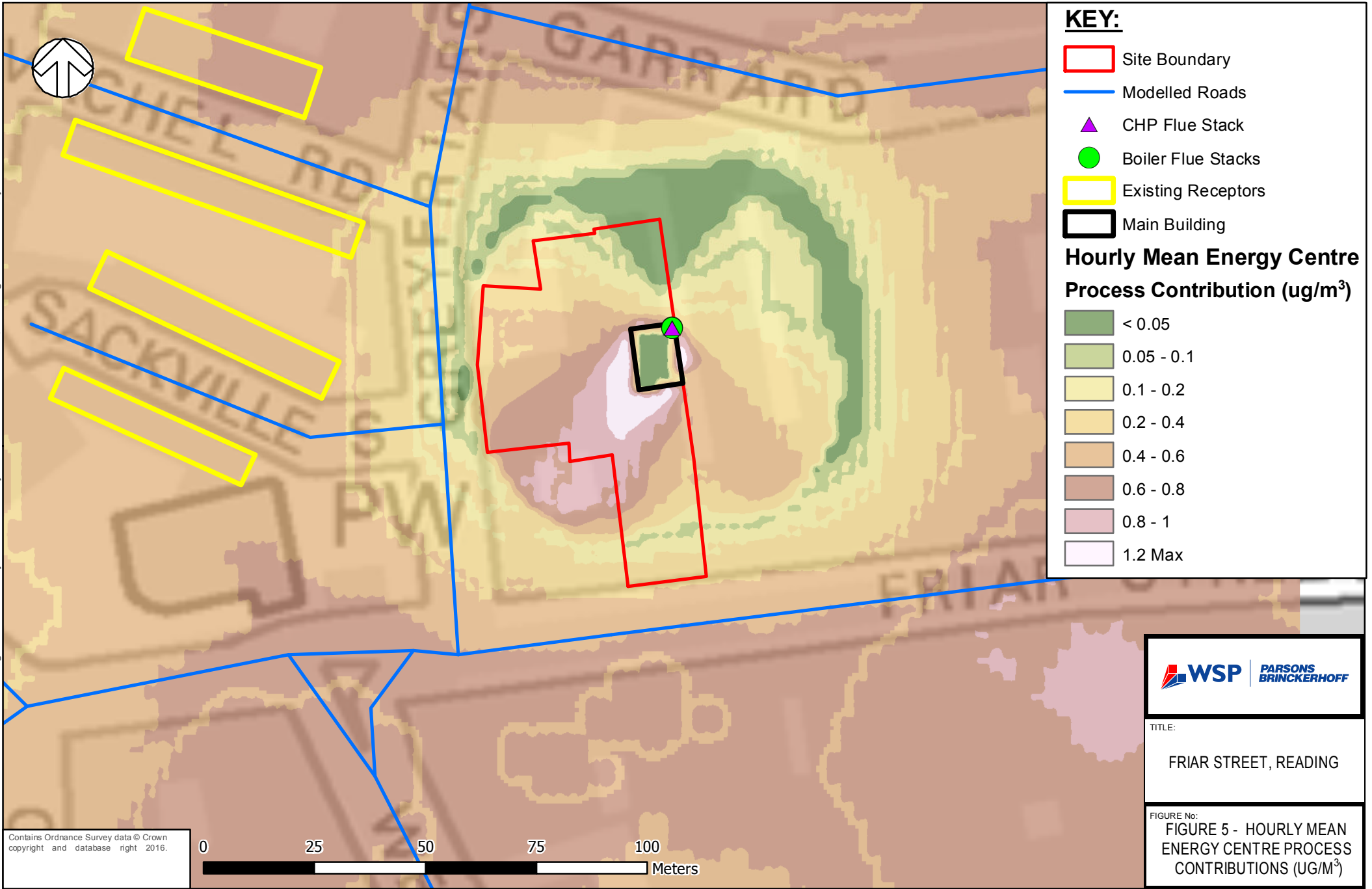


TITLE:
52-55 FRIAR STREET
& 12 GREYFRIARS
ROAD, READING

FIGURE No:
FIGURE 2 - FUTURE
RECEPTOR LOCATIONS







Appendix A

GLOSSARY

TERM	DEFINITION
AADT Annual Average Daily Traffic	A daily total traffic flow (24 hrs), expressed as a mean daily flow across all 365 days of the year.
Adjustment	Application of a correction factor to modeled results to account for uncertainties in the model
Accuracy	A measure of how well a set of data fits the true value.
Air quality objective	Policy target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedances within a specific timescale (see also air quality standard).
Air quality standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive sub groups (see also air quality objective).
Ambient air	Outdoor air in the troposphere, excluding workplace air.
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year.
AQMA	Air Quality Management Area.
AURN	Automatic Urban and Rural (air quality monitoring) Network, managed by contractors on behalf of DEFRA
Conservative	Tending to over-predict the impact rather than under-predict.
Data capture	The percentage of all the possible measurements for a given period that were validly measured.
DEFRA	Department for Environment, Food and Rural Affairs.
Dust	Dust comprises particles typically in the size range 1-75 micrometres (μm) in aerodynamic diameter and is created through the action of crushing and abrasive forces on materials
Emission rate	The quantity of a pollutant released from a source over a given period of time.
Exceedance	A period of time where the concentrations of a pollutant is greater than the appropriate air quality standard.
Fugitive emissions	Emissions arising from the passage of vehicles that do not arise from the exhaust system.
HDV/HGV	Heavy Duty Vehicle/Heavy Goods Vehicle.
LAQM	Local Air Quality Management.
Model adjustment	Following model verification, the process by which modelled results are amended. This corrects for systematic error.
NO ₂	Nitrogen dioxide.
NO _x	Nitrogen oxides.
PM ₁₀	Particulate matter with an aerodynamic diameter of less than 10 micrometres.
PM _{2.5}	Particulate matter with an aerodynamic diameter of less than 2.5 micrometres.
Trackout	The transport of dust and dirt from the construction / demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network. This arises when heavy duty vehicles (HDVs) leave the construction / demolition site with dusty materials, which may then spill onto the road, and/or when HDVs transfer dust and dirt onto the road having travelled over muddy ground on site.
$\mu\text{g}/\text{m}^3$ microgrammes per cubic metre	A measure of concentration in terms of mass per unit volume. A concentration of $1\mu\text{g}/\text{m}^3$ means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.
Uncertainty	A measure, associated with the result of a measurement, which characterizes the range of values within which the true value is expected to lie. Uncertainty is usually expressed as the range within which the true value is expected to lie with a 95% probability, where standard statistical and other procedures have been used to evaluate this figure. Uncertainty is more clearly defined than the closely related parameter 'accuracy', and has replaced it on recent European legislation.
Validation (modelling)	Refers to the general comparison of modelled results against monitoring data carried out by model developers.
Verification (modelling)	Comparison of modelled results versus any local monitoring data at relevant locations.

Appendix B

RELEVANT UK AIR QUALITY STRATEGY OBJECTIVES

NATIONAL AIR QUALITY OBJECTIVES AND EUROPEAN DIRECTIVE LIMIT VALUES FOR THE PROTECTION OF HUMAN HEALTH						
POLLUTANT	APPLIES TO	OBJECTIVE	MEASURED AS	DATE TO BE ACHIEVED BY AND MAINTAINED THEREAFTER	EUROPEAN OBLIGATIONS	DATE TO BE ACHIEVED BY AND MAINTAINED THEREAFTER
Nitrogen dioxide (NO ₂)	UK	200µg/m ³ not to be exceeded more than 18 times a year	1 hour mean	31.12.2005	200µg/m ³ not to be exceeded more than 18 times a year	01.01.2010
	UK	40µg/m ³	annual mean	31.12.2005	40µg/m ³	01.01.2010
Particulate Matter (PM ₁₀) (gravimetric) ^A	UK (except Scotland)	40µg/m ³	annual mean	31.12.2004	40µg/m ³	01.01.2005
	UK (except Scotland)	50µg/m ³ not to be exceeded more than 35 times a year	24 hour mean	31.12.2004	50µg/m ³ not to be exceeded more than 35 times a year	01.01.2005
Particulate Matter (PM _{2.5})	UK (except Scotland)	25µg/m ³	annual mean	2020	Target value 25µg/m ³	2010

^A Measured using the European gravimetric transfer sampler or equivalent
µg/m³ = microgram per cubic metre

Appendix C

IAQM CONSTRUCTION ASSESSMENT METHODOLOGY

STEP 1 – SCREENING THE NEED FOR A DETAILED ASSESSMENT

An assessment will normally be required where there are:

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

Where the need for a more detailed assessment is screened out, it can be concluded that the level of risk is "negligible".

STEP 2A – DEFINE THE POTENTIAL DUST EMISSION MAGNITUDE

The following are examples of how the potential dust emission magnitude for different activities can be defined. (Note that not all the criteria need to be met for a particular class). Other criteria may be used if justified in the assessment.

Table 2A: Examples of Human Receptor Sensitivity to Construction Phase Impacts

DUST EMISSION MAGNITUDE	ACTIVITY
Large	Demolition >50,000m ³ building demolished, dusty material (e.g. concrete), on-site crushing/screening, demolition >20m above ground level
	Earthworks >10,000m ² site area, dusty soil type (e.g. clay), >10 earth moving vehicles active simultaneously, >8m high bunds formed, >100,000 tonnes material moved
	Construction >100,000m ³ building volume, on site concrete batching, sandblasting
	Trackout >50 HDVs out / day, dusty surface material (e.g. clay), >100m unpaved roads
Medium	Demolition 20,000 - 50,000m ³ building demolished, dusty material (e.g. concrete) 10-20m above ground level
	Earthworks 2,500 - 10,000m ² site area, moderately dusty soil (e.g. silt), 5-10 earth moving vehicles active simultaneously, 4m - 8m high bunds, 20,000 -100,000 tonnes material moved
	Construction 25,000 - 100,000m ³ building volume, dusty material e.g. concrete, on site concrete batching
	Trackout 10 - 50 HDVs out / day, moderately dusty surface material (e.g. clay), 50 -100m unpaved roads
Small	Demolition <20,000m ³ building demolished, non-dusty material (e.g metal cladding), <10m above ground level,

DUST EMISSION MAGNITUDE	ACTIVITY
	work during wetter months
	Earthworks <2,500m ² site area, soil with large grain size (e.g. sand), <5 earth moving vehicles active simultaneously, <4m high bunds, <20,000 tonnes material moved, earthworks during wetter months
	Construction <25,000m ³ , non-dusty material (e.g. metal cladding or timber)
	Trackout <10 HDVs out / day, non-dusty soil, < 50m unpaved roads

STEP 2B – DEFINE THE SENSITIVITY OF THE AREA

The tables below present the IAQM assessment methodology to determine the sensitivity of the area to dust soiling, human health and ecological impacts respectively. The IAQM guidance provides guidance to allow the sensitivity of individual receptors to dust soiling and health effects to assist in the assessment of the overall sensitivity of the study area.

Table 2Ba: 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
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 2Bb: Sensitivity of the Area to Human Health Impacts

RECEPTOR SENSITIVITY	ANNUAL MEAN PM ₁₀ CONCENTRATION (µg/m ³)	NUMBER OF RECEPTORS	DISTANCE FROM THE SOURCE (m)				
			<20	<50	<100	<200	<350
High	>32	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>32	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
		>10	Medium	Low	Low	Low	Low
	28-32	1-10	Low	Low	Low	Low	Low
		>10	Low	Low	Low	Low	Low
	24-28	1-10	Low	Low	Low	Low	Low
		>10	Low	Low	Low	Low	Low
	<24	1-10	Low	Low	Low	Low	Low
		>10	Low	Low	Low	Low	Low
	<24	>1	Low	Low	Low	Low	Low

Table 2Bc: Sensitivity of the Area to Ecological Impacts

RECEPTOR SENSITIVITY	DISTANCE FROM THE SOURCES (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

STEP 2C – DEFINE THE RISK OF IMPACTS

The dust emissions magnitude determined at Step 2A should be combined with the sensitivity of the area determined at Step 2B to determine the risk of impacts without mitigation applied. For those cases where the risk category is 'negligible' no mitigation measures beyond those required by legislation will be required.

Table 2C: Risk of Dust Impacts

SENSITIVITY OF SURROUNDING AREA	DUST EMISSION MAGNITUDE		
	LARGE	MEDIUM	SMALL
Demolition			
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible
Earthworks and Construction			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible
Trackout			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

STEP 3 –SITE SPECIFIC MITIGATION

Having determined the risk categories for each of the four activities it is possible to determine the site-specific measures to be adopted. These measures will be related to whether the site is considered to be a low, medium or high risk site. The IAQM guidance details the mitigation measures required for high, medium and low risk sites as determined in Step 2C.

STEP 4 – DETERMINE SIGNIFICANT EFFECTS

Once the risk of dust impacts has been determined in Step 2C and the appropriate dust mitigation measures identified in Step 3, the final step is to determine whether there are significant effects arising from the construction phase. For almost all construction activities, the application of effective mitigation should prevent any significant effects occurring to sensitive receptors and therefore the residual effect will normally be negligible.

Appendix D

TRAFFIC AND EMISSIONS DATA

2015 BASELINE

ROAD LINK ID	ROAD LINK NAME	CANYON HEIGHT	SPEED (kph)	AADT	% HDV	NO _x EMISSION RATE (g/km/s)	PM ₁₀ EMISSION RATE (g/km/s)	PM _{2.5} EMISSION RATE (g/km/s)
1	Tudor Road	0	45	3698	3	0.0173	0.0016	0.0010
2	Tudor Road	0	16	3698	3	0.0279	0.0018	0.0011
3	Tudor Road	0	16	3698	3	0.0279	0.0018	0.0011
4	Greyfriars Road	0	47	5272	2	0.0230	0.0022	0.0013
5	Friar Street West of Greyfriars Rd	0	35	4726	8	0.0346	0.0025	0.0015
6	Friar Street West of Greyfriars Rd	0	16	4726	8	0.0543	0.0027	0.0018
7	Friar Street West of Greyfriars Rd	0	16	4726	8	0.0543	0.0027	0.0018
8	Sackville Street	0	20	310	0	0.0017	0.0001	0.0001
9	Vachel Road	0	22	351	1	0.0020	0.0002	0.0001
10	Stanshave Road	0	32	393	7	0.0029	0.0002	0.0001
11	Garrard Street	0	37	2614	2	0.0129	0.0011	0.0007
12	Friar Street East of Greyfriars Rd	0	40	4577	36	0.0772	0.0042	0.0027
13	West Street	0	35	3186	22	0.0410	0.0023	0.0015
14	West Street	0	16	3186	22	0.0708	0.0027	0.0018
15	West Street	0	16	3186	22	0.0708	0.0027	0.0018
16	Oxford Road	0	36	5866	6	0.0389	0.0029	0.0018
17	Caversham Road Southbound	0	64	48528	3	0.2022	0.0210	0.0125
18	Caversham Road Northbound	0	64	34951	4	0.1601	0.0159	0.0095
19	Greyfriars Road	0	16	5272	2	0.0367	0.0025	0.0015
20	Greyfriars Road	0	16	5272	2	0.0367	0.0025	0.0015
21	Stanshave Road	0	16	393	7	0.0044	0.0002	0.0001
22	Garrard Street	0	16	2614	2	0.0188	0.0012	0.0008
23	West Street	0	16	3186	22	0.0708	0.0027	0.0018
24	Friar Street East of Greyfriars Rd	10	40	4577	36	0.0772	0.0042	0.0027
25	Friar Street East of Greyfriars Rd	0	16	4577	36	0.1520	0.0051	0.0034
26	Greyfriars Road	0	47	5272	2	0.0230	0.0022	0.0013

2021 BASELINE (WITHOUT DEVELOPMENT)

ROAD LINK ID	ROAD LINK NAME	CANYON HEIGHT	SPEED (kph)	AADT	% HDV	NO _x EMISSION RATE (g/km/s)	PM ₁₀ EMISSION RATE (g/km/s)	PM _{2.5} EMISSION RATE (g/km/s)
1	Tudor Road	0	45	4095	3	0.0191	0.0018	0.0011
2	Tudor Road	0	16	4095	3	0.0309	0.0020	0.0012
3	Tudor Road	0	16	4095	3	0.0309	0.0020	0.0012
4	Greyfriars Road	0	47	5837	2	0.0254	0.0025	0.0015
5	Friar Street West of Greyfriars Rd	0	35	5233	8	0.0384	0.0027	0.0017
6	Friar Street West of Greyfriars Rd	0	16	5233	8	0.0601	0.0030	0.0019
7	Friar Street West of Greyfriars Rd	0	16	5233	8	0.0601	0.0030	0.0019
8	Sackville Street	0	20	343	0	0.0018	0.0001	0.0001
9	Vachel Road	0	22	389	1	0.0022	0.0002	0.0001
10	Stanshave Road	0	32	435	7	0.0032	0.0002	0.0001
11	Garrard Street	0	37	2894	2	0.0142	0.0013	0.0008
12	Friar Street East of Greyfriars Rd	0	40	5067	36	0.0854	0.0047	0.0029
13	West Street	0	35	3527	22	0.0454	0.0026	0.0016
14	West Street	0	16	3527	22	0.0784	0.0030	0.0020
15	West Street	0	16	3527	22	0.0784	0.0030	0.0020
16	Oxford Road	0	36	6494	6	0.0430	0.0032	0.0020
17	Caversham Road Southbound	0	64	52803	3	0.2200	0.0229	0.0136
18	Caversham Road Northbound	0	64	38030	4	0.1742	0.0173	0.0103
19	Greyfriars Road	0	16	5837	2	0.0405	0.0027	0.0017
20	Greyfriars Road	0	16	5837	2	0.0405	0.0027	0.0017
21	Stanshave Road	0	16	435	7	0.0047	0.0002	0.0002
22	Garrard Street	0	16	2894	2	0.0207	0.0014	0.0009
23	West Street	0	16	3527	22	0.0784	0.0030	0.0020
24	Friar Street East of Greyfriars Rd	10	40	5067	36	0.0854	0.0047	0.0029
25	Friar Street East of Greyfriars Rd	0	16	5067	36	0.1682	0.0056	0.0038
26	Greyfriars Road	0	47	5837	2	0.0254	0.0025	0.0015

2021 WITH DEVELOPMENT

ROAD LINK ID	ROAD LINK NAME	CANYON HEIGHT	SPEED (kph)	AADT	% HDV	NO _x EMISSION RATE (g/km/s)	PM ₁₀ EMISSION RATE (g/km/s)	PM _{2.5} EMISSION RATE (g/km/s)
1	Tudor Road	0	45	4095	3	0.0191	0.0018	0.0011
2	Tudor Road	0	16	4095	3	0.0309	0.0020	0.0012
3	Tudor Road	0	16	4095	3	0.0309	0.0020	0.0012
4	Greyfriars Road	0	47	5837	2	0.0254	0.0025	0.0015
5	Friar Street West of Greyfriars Rd	0	35	5233	8	0.0384	0.0027	0.0017
6	Friar Street West of Greyfriars Rd	0	16	5233	8	0.0601	0.0030	0.0019
7	Friar Street West of Greyfriars Rd	0	16	5233	8	0.0601	0.0030	0.0019
8	Sackville Street	0	20	343	0	0.0018	0.0001	0.0001
9	Vachel Road	0	22	389	1	0.0022	0.0002	0.0001
10	Stanshave Road	0	32	435	7	0.0032	0.0002	0.0001
11	Garrard Street	0	37	2894	2	0.0142	0.0013	0.0008
12	Friar Street East of Greyfriars Rd	0	40	5067	36	0.0854	0.0047	0.0029
13	West Street	0	35	3527	22	0.0454	0.0026	0.0016
14	West Street	0	16	3527	22	0.0784	0.0030	0.0020
15	West Street	0	16	3527	22	0.0784	0.0030	0.0020
16	Oxford Road	0	36	6494	6	0.0430	0.0032	0.0020
17	Caversham Road Southbound	0	64	52803	3	0.2200	0.0229	0.0136
18	Caversham Road Northbound	0	64	38030	4	0.1742	0.0173	0.0103
19	Greyfriars Road	0	16	5837	2	0.0405	0.0027	0.0017
20	Greyfriars Road	0	16	5837	2	0.0405	0.0027	0.0017
21	Stanshave Road	0	16	435	7	0.0047	0.0002	0.0002
22	Garrard Street	0	16	2894	2	0.0207	0.0014	0.0009
23	West Street	0	16	3527	22	0.0784	0.0030	0.0020
24	Friar Street East of Greyfriars Rd	15	40	5067	36	0.0854	0.0047	0.0029
25	Friar Street East of Greyfriars Rd	0	16	5067	36	0.1682	0.0056	0.0038
26	Greyfriars Road	16.5	47	5837	2	0.0254	0.0025	0.0015

Appendix E

ADMS-ROADS MODEL VERIFICATION

The comparison of modelled concentrations with local monitored concentrations is a process termed 'verification'. Model verification investigates the discrepancies between modelled and measured concentrations, which can arise due to the presence of inaccuracies and/or uncertainties in model input data, modelling and monitoring data assumptions. The following are examples of potential causes of such discrepancy:

- estimates of background pollutant concentrations;
- meteorological data uncertainties;
- traffic data uncertainties;
- model input parameters, such as 'roughness length'; and
- overall limitations of the dispersion model.

NITROGEN DIOXIDE

Most nitrogen dioxide is produced in the atmosphere by the reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of the primary pollutant emissions of nitrogen oxides ($\text{NO}_x = \text{NO} + \text{NO}_2$), in line with the guidance provided within LAQM.TG16.

The model has been run to predict the 2015 annual mean road- NO_x contribution at two roadside diffusion tubes within the modelled road network. The modelled road- NO_x have been compared with the 'measured' road- NO_x , which was determined from the NO_2 concentrations measured using diffusion tubes at the monitoring locations. These were then converted to NO_x concentrations using DEFRA's NO_x from NO_2 calculator and the NO_2 background concentration taken from the background map. As discussed in the methodology section, the most recent suitable data available for model verification purposes is 2015 data. It has been assumed that there has been no improvement in concentrations between 2015 and 2021. This approach was agreed with RBC and is judged to be appropriately conservative.

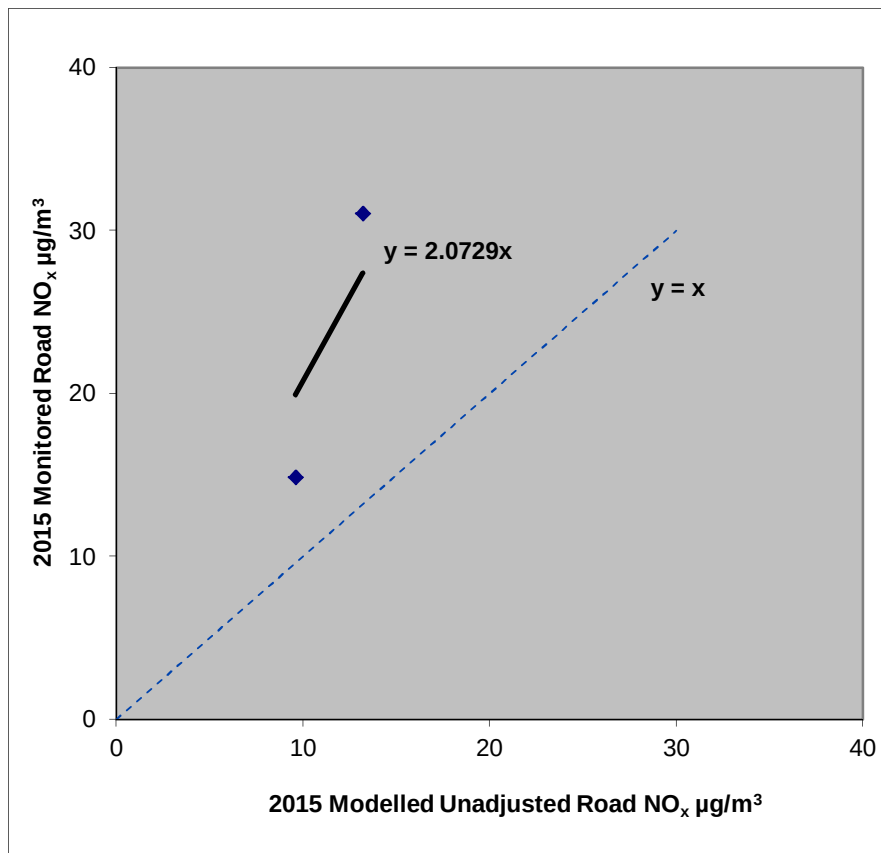
Table E1 and **Figure E1** below present the data used in the verification.

Table E1 – Data used in the roadside NO_2 model verification

MONITORING SITE	MEASURED ANNUAL MEAN NO_2 CONCENTRATION ($\mu\text{g}/\text{m}^3$)	BACKGROUND NO_2 ($\mu\text{g}/\text{m}^3$)	MEASURED ROAD- NO_x ($\mu\text{g}/\text{m}^3$) (FROM NO_x TO NO_2 CALCULATOR)	MODELLED ROAD- NO_x ($\mu\text{g}/\text{m}^3$)	% DIFFERENCE (MODELLED / MONITORED)
Sackville Street	38	31.1	14.9	9.6	6
Friar Street	45	31.1	31.1	13.2	-3

The road- NO_x adjustment factor was determined as the slope of the best fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (**Figure E1**). This factor was then applied to the modelled road- NO_x concentration for each monitoring site to provide adjusted modelled road- NO_x concentrations. The total nitrogen dioxide concentrations were then determined by inputting the adjusted modelled road- NO_x concentrations and the background NO_2 concentration into the NO_x to NO_2 calculator.

Figure E1: Comparison of Measured Road-NO_x with Unadjusted Modelled Road-NO_x



PM₁₀ AND PM_{2.5}

There are no local PM₁₀ or PM_{2.5} monitoring data against which the model could be verified. Consequently, the verification factor determined above for adjusting the road-NO_x contribution has been applied to the predicted road-PM₁₀ and road-PM_{2.5} contributions, consistent with guidance set out in LAQM.TG16.

Appendix F

ENERGY CENTRE INPUTS & MODELLED BUILDINGS

BUILDINGS AND TOPOGRAPHY

Both nearby buildings and complex topography can have a significant effect on the dispersion of exhaust plumes from the stacks being assessed. ADMS 5.1 incorporates algorithms which attempt to take account of these effects. Buildings can cause the plume to come to ground much closer to the stack than otherwise expected, causing higher pollutant concentrations at ground level.

The dimensions of the proposed buildings have been taken from the final application and parameter plans provided by the project Architects. Due to the complexity of the buildings surrounding the Application Site only the main building where the flue stack is located has been included in the model. Details of the buildings included in the model can be seen in **Table F1** below.

Table F1 - Modelled Building Parameters

BUILDING NUMBER	X	Y	HEIGHT (M)	LENGTH (M)	WIDTH (M)	ORIENTATION (°)
Building 1 (Main)	471305	173631	34.8	9.9	13.6	82

ENERGY CENTRE DETAILS

The energy centre modelled in this assessment is proposed to be made up of 1 Ener-G 50kW CHP Unit and 2 Elco R607 gas-fired boilers. The CHP is estimated to run at 22 hours per day (a total of approximately 7953 hours per year), and the gas boilers are estimated to run for 12 hours per day (a total of approximately 4380 hours per year).

STACK PARAMETERS

The atmospheric dispersion of pollutants is affected by the efflux velocity at the stack exit point, which determines plume momentum, and the temperature of the gases, which determines plume buoyancy. Both momentum and buoyancy contribute to plume rise. The atmospheric conditions then govern the degree of turbulent mixing of the plume, allowing for dilution and dispersion of pollutants.

The model input data for the energy centres used in both planning applications are summarised in **Table F2**.

Table F2 - Modelled Stack and Emissions Parameters for the Proposed Energy Centre

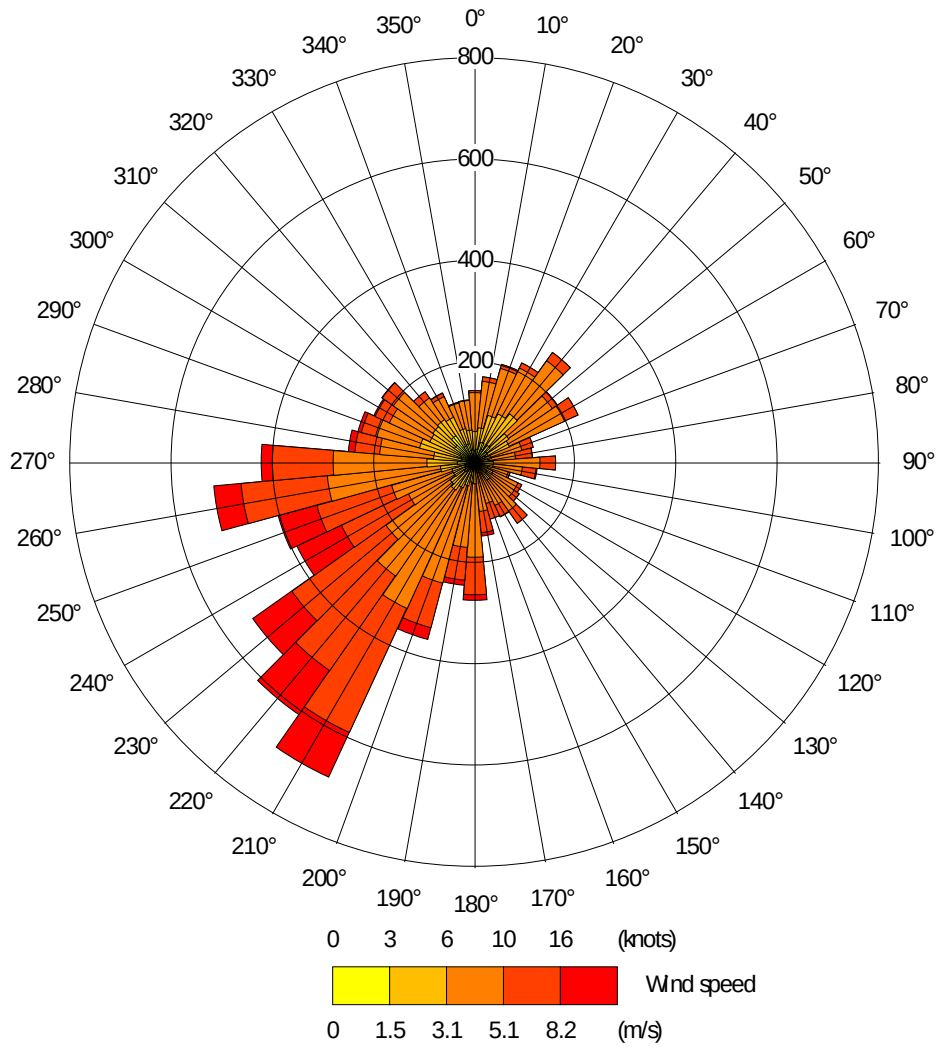
PARAMETERS	BOILERS*	CHP
Number of Units	2	1
Stack Height (above ground level, m)	37.8	37.8
Internal Diameter (m)	0.35	0.3
Exhaust Gas Temperature (°C)	80	120
Exhaust Gas Velocity (m/s)	2.6	1
NOx Emission Rate, g/s	0.00672	0.00631

*Note: Each gas boiler has an individual flue stack; therefore the information detailed in **Table F2** is per flue stack.

Appendix G

WINDROSE

WIND ROSE FOR LONDON HEATHROW AIRPORT (2015)



Appendix H

ASSESSMENT RESULTS

ANNUAL MEAN NO₂ CONCENTRATIONS

RECEPTOR ID	RECEPTOR LOCATION	ANNUAL MEAN NO ₂ CONCENTRATION (µg/m ³)		
		2021 With Development	Energy Centre Process Contribution	Mitigation Required (Y/N)
N1_1	New Receptor Greyfriars Street (1 st to 4 th Floor)	35.6	0.0	N
N1_2		34.8	0.0	N
N1_3		34.1	0.0	N
N1_4		33.6	0.0	N
N2_1	New Receptor Greyfriars Street (1 st to 7 th Floor)	41.5	0.0	Y
N2_2		40.8	0.0	Y
N2_3		40.1	0.0	Y
N2_4		39.6	0.0	N
N2_5		33.1	0.0	N
N2_6		32.7	0.0	N
N2_7		32.4	0.0	N
N3_1	New Receptor Greyfriars Street (1 st to 7 th Floor)	36.2	0.0	N
N3_2		35.0	0.0	N
N3_3		34.2	0.0	N
N3_4		33.5	0.0	N
N3_5		33.0	0.0	N
N3_6		32.7	0.0	N
N3_7		32.4	0.1	N
N4_1	New Receptor Friar Street (1 st to 5 th Floor)	48.2	0.0	Y
N4_2		46.8	0.0	Y
N4_3		46.0	0.0	Y
N4_4		33.3	0.0	N
N4_5		32.8	0.1	N
N5_1	New Receptor Friar Street (1 st to 5 th Floor)	47.5	0.0	Y
N5_2		46.6	0.0	Y
N5_3		46.0	0.0	Y
N5_4		33.2	0.0	N
N5_5		32.7	0.0	N
N6_1	New Receptor Eastern Façade (1 st to 7 th Floor)	36.0	0.0	N
N6_2		34.8	0.0	N
N6_3		33.9	0.0	N
N6_4		33.3	0.0	N
N6_5		32.8	0.0	N
N6_6		32.5	0.0	N
N6_7		32.2	0.0	N
N7_GF	New Receptor Eastern Façade (1 st to 10 th Floor)	35.8	0.1	N
N7_ML		35.5	0.1	N
N7_1		35.0	0.1	N
N7_2		34.5	0.1	N
N7_3		33.9	0.1	N
N7_4		33.4	0.1	N
N7_5		33.0	0.1	N
N7_6		32.6	0.1	N
N7_7		32.3	0.1	N
N7_8		32.1	0.1	N
N7_9		31.9	0.1	N
N7_10		32.0	0.4	N
N8_GF	New Receptor Eastern Façade (1 st to 9 th Floor)	36.3	0.1	N
N8_ML		35.9	0.1	N
N8_1		35.2	0.1	N
N8_2		34.5	0.1	N
N8_3		33.9	0.1	N
N8_4		33.3	0.1	N
N8_5		32.9	0.1	N
N8_6		32.5	0.1	N

RECEPTOR ID	RECEPTOR LOCATION	ANNUAL MEAN NO ₂ CONCENTRATION (µg/m ³)		
N8_7	New Receptor Eastern Façade (1 st to 10 th Floor)	32.3	0.1	N
N8_8		32.1	0.1	N
N8_9		31.9	0.1	N
N9_GF		35.6	0.0	N
N9_ML		35.3	0.0	N
N9_1		34.8	0.0	N
N9_2		34.3	0.0	N
N9_3		33.7	0.0	N
N9_4		33.3	0.0	N
N9_5		32.9	0.0	N
N9_6		32.5	0.0	N
N9_7		32.3	0.0	N
N9_8		32.1	0.0	N
N9_9		32.0	0.1	N
N9_10		32.2	0.5	N

Results rounded to 1 decimal place

ANNUAL MEAN PM₁₀ CONCENTRATIONS

RECEPTOR ID	RECEPTOR LOCATION	ANNUAL MEAN PM ₁₀ CONCENTRATION (µg/m ³)		
		2021 With Development	Energy Centre Process Contribution	Mitigation Required (Y/N)
N1_1	New Receptor Greyfriars Street (1 st to 4 th Floor)	18.6	-	N
N1_2		18.5	-	N
N1_3		18.5	-	N
N1_4		18.4	-	N
N2_1	New Receptor Greyfriars Street (1 st to 7 th Floor)	18.6	-	N
N2_2		18.5	-	N
N2_3		18.5	-	N
N2_4		18.4	-	N
N2_5		18.4	-	N
N2_6		18.3	-	N
N2_7		18.3	-	N
N3_1	New Receptor Greyfriars Street (1 st to 7 th Floor)	18.6	-	N
N3_2		18.5	-	N
N3_3		18.5	-	N
N3_4		18.4	-	N
N3_5		18.4	-	N
N3_6		18.3	-	N
N3_7		18.3	-	N
N4_1	New Receptor Friar Street (1 st to 5 th Floor)	18.6	-	N
N4_2		18.5	-	N
N4_3		18.4	-	N
N4_4		18.4	-	N
N4_5		18.3	-	N
N5_1	New Receptor Friar Street (1 st to 5 th Floor)	18.5	-	N
N5_2		18.4	-	N
N5_3		18.4	-	N
N5_4		18.4	-	N
N5_5		18.3	-	N
N6_1	New Receptor Eastern Façade (1 st to 7 th Floor)	18.5	-	N
N6_2		18.5	-	N
N6_3		18.4	-	N
N6_4		18.4	-	N
N6_5		18.3	-	N
N6_6		18.3	-	N
N6_7		18.3	-	N
N7_GF	New Receptor Eastern Façade (1 st to 10 th Floor)	18.6	-	N
N7_ML		18.5	-	N
N7_1		18.5	-	N
N7_2		18.5	-	N
N7_3		18.4	-	N
N7_4		18.4	-	N
N7_5		18.3	-	N
N7_6		18.3	-	N
N7_7		18.3	-	N
N7_8		18.3	-	N
N7_9		18.3	-	N
N7_10		18.2	-	N
N8_GF	New Receptor Eastern Façade (1 st to 9 th Floor)	18.6	-	N
N8_ML		18.5	-	N
N8_1		18.5	-	N
N8_2		18.5	-	N
N8_3		18.4	-	N
N8_4		18.4	-	N
N8_5		18.3	-	N
N8_6		18.3	-	N

RECEPTOR ID	RECEPTOR LOCATION	ANNUAL MEAN PM ₁₀ CONCENTRATION (µg/m ³)		
N8_7	New Receptor Eastern Façade (1 st to 10 th Floor)	18.3	-	N
N8_8		18.3	-	N
N8_9		18.3	-	N
N9_GF		18.6	-	N
N9_ML		18.5	-	N
N9_1		18.5	-	N
N9_2		18.5	-	N
N9_3		18.4	-	N
N9_4		18.4	-	N
N9_5		18.3	-	N
N9_6		18.3	-	N
N9_7		18.3	-	N
N9_8		18.3	-	N
N9_9		18.3	-	N
N9_10		18.2	-	N

Results rounded to 1 decimal place

DAILY MEAN PM₁₀ (no. of days exceeding 50µg/m³)

RECEPTOR ID	RECEPTOR LOCATION	DAYS OF EXCEEDANCE – DAILY PM ₁₀		
		2021 With Development	Energy Centre Process Contribution	Mitigation Required (Y/N)
N1_1	New Receptor Greyfriars Street (1 st to 4 th Floor)	2	-	-
N1_2		2	-	-
N1_3		2	-	-
N1_4		2	-	-
N2_1	New Receptor Greyfriars Street (1 st to 7 th Floor)	2	-	-
N2_2		2	-	-
N2_3		2	-	-
N2_4		2	-	-
N2_5		2	-	-
N2_6		2	-	-
N2_7		2	-	-
N3_1	New Receptor Greyfriars Street (1 st to 7 th Floor)	2	-	-
N3_2		2	-	-
N3_3		2	-	-
N3_4		2	-	-
N3_5		2	-	-
N3_6		2	-	-
N3_7		2	-	-
N4_1	New Receptor Friar Street (1 st to 5 th Floor)	2	-	-
N4_2		2	-	-
N4_3		2	-	-
N4_4		2	-	-
N4_5		2	-	-
N5_1	New Receptor Friar Street (1 st to 5 th Floor)	2	-	-
N5_2		2	-	-
N5_3		2	-	-
N5_4		2	-	-
N5_5		2	-	-
N6_1	New Receptor Eastern Façade (1 st to 7 th Floor)	2	-	-
N6_2		2	-	-
N6_3		2	-	-
N6_4		2	-	-
N6_5		2	-	-
N6_6		2	-	-
N6_7		2	-	-
N7_GF	New Receptor Eastern Façade (1 st to 10 th Floor)	2	-	-
N7_ML		2	-	-
N7_1		2	-	-
N7_2		2	-	-
N7_3		2	-	-
N7_4		2	-	-
N7_5		2	-	-
N7_6		2	-	-
N7_7		2	-	-
N7_8		2	-	-
N7_9		2	-	-
N7_10		2	-	-
N8_GF	New Receptor Eastern Façade (1 st to 9 th Floor)	2	-	-
N8_ML		2	-	-
N8_1		2	-	-
N8_2		2	-	-
N8_3		2	-	-
N8_4		2	-	-
N8_5		2	-	-
N8_6		2	-	-

RECEPTOR ID	RECEPTOR LOCATION	DAYS OF EXCEEDANCE – DAILY PM ₁₀		
N8_7		2	-	-
N8_8		2	-	-
N8_9		2	-	-
N9_GF	New Receptor Eastern Façade (1 st to 10 th Floor)	2	-	-
N9_ML		2	-	-
N9_1		2	-	-
N9_2		2	-	-
N9_3		2	-	-
N9_4		2	-	-
N9_5		2	-	-
N9_6		2	-	-
N9_7		2	-	-
N9_8		2	-	-
N9_9		2	-	-
N9_10		2	-	-

ANNUAL MEAN PM_{2.5} CONCENTRATIONS

RECEPTOR ID	RECEPTOR LOCATION	ANNUAL MEAN PM _{2.5} CONCENTRATIONS (µg/m ³)		
		2021 With Development	Energy Centre Process Contribution	Mitigation Required (Y/N)
N1_1	New Receptor Greyfriars Street (1 st to 4 th Floor)	13.8	-	N
N1_2		13.8	-	N
N1_3		13.7	-	N
N1_4		13.7	-	N
N2_1	New Receptor Greyfriars Street (1 st to 7 th Floor)	13.8	-	N
N2_2		13.8	-	N
N2_3		13.7	-	N
N2_4		13.7	-	N
N2_5		13.7	-	N
N2_6		13.7	-	N
N2_7		13.7	-	N
N3_1	New Receptor Greyfriars Street (1 st to 7 th Floor)	13.8	-	N
N3_2		13.8	-	N
N3_3		13.7	-	N
N3_4		13.7	-	N
N3_5		13.7	-	N
N3_6		13.7	-	N
N3_7		13.7	-	N
N4_1	New Receptor Friar Street (1 st to 5 th Floor)	13.8	-	N
N4_2		13.8	-	N
N4_3		13.7	-	N
N4_4		13.7	-	N
N4_5		13.7	-	N
N5_1	New Receptor Friar Street (1 st to 5 th Floor)	13.8	-	N
N5_2		13.7	-	N
N5_3		13.7	-	N
N5_4		13.7	-	N
N5_5		13.7	-	N
N6_1	New Receptor Eastern Façade (1 st to 7 th Floor)	13.8	-	N
N6_2		13.8	-	N
N6_3		13.7	-	N
N6_4		13.7	-	N
N6_5		13.7	-	N
N6_6		13.7	-	N
N6_7		13.6	-	N
N7_GF	New Receptor Eastern Façade (1 st to 10 th Floor)	13.8	-	N
N7_ML		13.8	-	N
N7_1		13.8	-	N
N7_2		13.7	-	N
N7_3		13.7	-	N
N7_4		13.7	-	N
N7_5		13.7	-	N
N7_6		13.7	-	N
N7_7		13.6	-	N
N7_8		13.6	-	N
N7_9		13.6	-	N
N7_10		13.6	-	N
N8_GF	New Receptor Eastern Façade (1 st to 9 th Floor)	13.8	-	N
N8_ML		13.8	-	N
N8_1		13.8	-	N
N8_2		13.7	-	N
N8_3		13.7	-	N
N8_4		13.7	-	N
N8_5		13.7	-	N
N8_6		13.7	-	N

RECEPTOR ID	RECEPTOR LOCATION	ANNUAL MEAN PM _{2.5} CONCENTRATIONS (µg/m ³)		
N8_7	New Receptor Eastern Façade (1 st to 10 th Floor)	13.6	-	N
N8_8		13.6	-	N
N8_9		13.6	-	N
N9_GF		13.8	-	N
N9_ML		13.8	-	N
N9_1		13.8	-	N
N9_2		13.8	-	N
N9_3		13.7	-	N
N9_4		13.7	-	N
N9_5		13.7	-	N
N9_6		13.7	-	N
N9_7		13.6	-	N
N9_8		13.6	-	N
N9_9		13.6	-	N
N9_10		13.6	-	N

Results rounded to 1 decimal place