

Former Cox & Wyman Site, Reading

Air Quality Assessment

On behalf of **Thames Properties Limited**

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1 Introduction

1.1 Background

- 1.1.1 Peter Brett Associates LLP (PBA) has been commissioned to undertake an air quality assessment to support the planning application for the proposed redevelopment of the former Cox & Wyman site at Cardiff Road, Reading.
- 1.1.2 The proposed development includes the demolition of existing buildings and structures, the erection of a mixed used development comprising approximately 96 residential units with associated car parking, landscaping and access provisions. The development site is located within the boundary of Reading Borough Council (RBC).

1.2 Scope

- 1.2.1 This report describes existing air quality within the study area, considers the suitability of the site for residential development, and assesses the impact of the construction and operational activities on local air quality. The main air pollutants of concern related to construction are dust and fine particulate matter (PM₁₀), whilst for road traffic and railway emission are nitrogen dioxide and fine particulate matter (PM₁₀ and PM_{2.5}).
- 1.2.2 It is understood that the proposed development will not include an energy centre within its premises. Therefore, an assessment of the effect of potential energy centre emissions has been scoped out of the assessment.
- 1.2.3 The development site is located approximately 85 m from the Paddington to Swansea rail line with heavy traffic of diesel passenger trains. RBC confirmed that there are no stationary diesel locomotives or moving trains with potential relevant exposure within 15 m or 30 m, respectively (RBC, 2015). Therefore, the emissions impact of the rail line on the development site have been scoped out of the assessment.
- 1.2.4 The assessment has been prepared taking into account relevant local and national guidance and regulations.

2 Legislation and Policy

2.1 The Air Quality Strategy

- 2.1.1 The Air Quality Strategy (2007) (DETR, 2007) establishes the policy framework for ambient air quality management and assessment in the UK. The primary objective is to ensure that everyone can enjoy a level of ambient air quality which poses no significant risk to health or quality of life. The Strategy sets out the National Air Quality Objectives (NAQOs) and Government policy on achieving these objectives.
- 2.1.2 Part IV of the Environment Act 1995 (Environment Act, 1995) introduced a system of Local Air Quality Management (LAQM). This requires local authorities to regularly and systematically review and assess air quality within their boundary, and appraise development and transport plans against these assessments. The relevant NAQOs for LAQM are prescribed in the Air Quality (England) Regulations 2000 (Statutory Instrument, 2000) and the Air Quality (Amendment) (England) Regulations 2002 (Statutory Instrument, 2002).
- 2.1.3 Where an objective is unlikely to be met, the local authority must designate an Air Quality Management Area (AQMA) and draw up an Air Quality Action Plan (AQAP) setting out the measures it intends to introduce in pursuit of the objectives within its AQMA.
- 2.1.4 The Local Air Quality Management Technical Guidance 2016 (LAQM.TG(16); Defra, 2016a), issued by the Department for Environment, Food and Rural Affairs (Defra) for Local Authorities provides advice as to where the NAQOs apply. These include outdoor locations where members of the public are likely to be regularly present for the averaging period of the objective (which vary from 15 minutes to a year). Thus, for example, annual mean objectives apply at the façades of residential properties, whilst the 24-hour objective (for PM₁₀) would also apply within the garden. They do not apply to occupational, indoor or in-vehicle exposure.

2.2 EU Limit Values

- 2.2.1 The Air Quality Standards Regulations 2010 (Statutory Instrument, 2010) implements the European Union's Directive on ambient air quality and cleaner air for Europe (2008/50/EC), and includes limit values for NO₂. These limit values are numerically the same as the NAQO values but differ in terms of compliance dates, locations where they apply and the legal responsibility for ensuring that they are complied with. The compliance date for the NO₂ EU Limit Value was 1 January 2010, five years later than the date for the NAQO.
- 2.2.2 Directive 2008/50/EC consolidated the previous framework directive on ambient air quality assessment and management and its first three daughter directives. The limit values remained unchanged, but it now allows Member States a time extension for compliance, subject to European Commission (EC) approval.
- 2.2.3 The Directive limit values are applicable at all locations except:
- Where members of the public do not have access and there is no fixed habitation;
 - On factory premises or at industrial installations to which all relevant provisions concerning health and safety at work apply; and
 - On the carriageway of roads; and on the central reservations of roads except where there is normally pedestrian access.

2.3 Planning Policy

National Policy

- 2.3.1 The National Planning Policy Framework (NPPF) was published in March 2012 (Department for Communities and Local Government, 2012). This sets out the Government's planning policies for England and how they are expected to be applied. In relation to conserving and enhancing the natural environment, paragraph 109 states that;

"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 or land instability."

- 2.3.2 Paragraph 124, also states that;

"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."

- 2.3.3 Paragraph 203 goes on to say;

"Local planning authorities should consider whether otherwise unacceptable development could be made acceptable through the use of conditions or planning obligations. Planning obligations should only be used where it is not possible to address unacceptable impacts through a planning condition."

Planning Practice Guidance

- 2.3.4 Planning Practice Guidance (PPG) (Planning Practice Guidance, 2014) was published in March 2014 to support the National Planning Policy Framework. Paragraph 001, Reference 32-001-20140306 of the PPG provides a summary as to why air quality is a consideration for planning;

"... Defra carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU Limit Values. It is important that the potential impact of new development on air quality is taken into account in planning where the national assessment indicates that relevant limits have been exceeded or are near the limit... The local air quality management (LAQM) regime requires every district and unitary authority to regularly review and assess air quality in their area. These reviews identify whether national objectives have been, or will be, achieved at relevant locations, by an applicable date... If national objectives are not met, or at risk of not being met, the local authority concerned must declare an air quality management area and prepare an air quality action plan... Air quality can also affect biodiversity and may therefore impact on our international obligations under the Habitats Directive... Odour and dust can also be a planning concern, for example, because of the effect on local amenity."

- 2.3.5 Paragraph 002, Reference 32-002-20140306, of the PPG concerns the role of Local Plans with regard to air quality;

"... Drawing on the review of air quality carried out for the local air quality management regime, the Local Plan may need to consider;

- *the potential cumulative impact of a number of smaller developments on air quality as well as the effect of more substantial developments;*
- *the impact of point sources of air pollution ...; and*

- *ways in which new development would be appropriate in locations where air quality is or likely to be a concern and not give rise to unacceptable risks from pollution. This could be through, for example, identifying measures for offsetting the impact on air quality arising from new development including supporting measures in an air quality action plan or low emissions strategy where applicable."*

2.3.6 Paragraph 005, Reference 32-005-20140306, of the PPG identifies when air quality could be relevant for a planning decision;

"... When deciding whether air quality is relevant to a planning application, considerations could include whether the development would;

- *Significantly affect traffic in the immediate vicinity of the proposed development site or further afield. This could be by generating or increasing traffic congestion; significantly changing traffic volumes, vehicle speed or both; or significantly altering the traffic composition on local roads. Other matters to consider include whether the proposal involves the development of a bus station, coach or lorry park; adds to turnover in a large car park; or result in construction sites that would generate large Heavy Goods Vehicle flows over a period of a year or more;*
- *Introduce new point sources of air pollution. This could include furnaces which require prior notification to local authorities; or extraction systems (including chimneys) which require approval under pollution control legislation or biomass boilers or biomass-fuelled CHP plant; centralised boilers or CHP plant burning other fuels within or close to an air quality management area or introduce relevant combustion within a Smoke Control Area; ...*
- *Expose people to existing sources of air pollutants. This could be by building new homes, workplaces or other development in places with poor air quality;*
- *Give rise to potentially unacceptable impact (such as dust) during construction for nearby sensitive locations; and*
- *Affect biodiversity. In particular, is it likely to result in deposition or concentration of pollutants that significantly affect a European-designated wildlife site, and is not directly connected with or necessary to the management of the site, or does it otherwise affect biodiversity, particularly designated wildlife sites."*

2.3.7 Paragraph 007, Reference 32-007-20140306, of the PPG provides guidance on how detailed an assessment needs to be;

"Assessments should be proportionate to the nature and scale of development proposed and the level of concern about air quality, and because of this are likely to be locationally specific."

2.3.8 Paragraph 008, Reference 32-008-20140306, of the PPG provides guidance on how an impact on air quality can be mitigated;

"Mitigation options where necessary will be locationally specific, will depend on the proposed development and should be proportionate to the likely impact... Examples of mitigation include;

- *the design and layout of development to increase separation distances from sources of air pollution;*
- *using green infrastructure, in particular trees, to absorb dust and other pollutants;*
- *means of ventilation;*
- *promoting infrastructure to promote modes of transport with low impact on air quality;*

- *controlling dust and emissions from construction, operation and demolition; and*
- *contributing funding to measures, including those identified in air quality action plans and low emission strategies, designed to offset the impact on air quality arising from new development."*

2.3.9 Paragraph 009, Reference 32-009-20140306, of the PPG provides guidance on how considerations about air quality fit into the development management process by means of a flowchart. The final two stages in the process deal with the results of the assessment;

"Will the proposed development (including mitigation) lead to an unacceptable risk from air pollution, prevent sustained compliance with EU limit values or national objectives for pollutants or fail to comply with the requirements of the Habitats Regulations." If Yes:

"Consider how the proposal could be amended to make it acceptable or, where not practicable, consider whether planning permission should be refused."

Local Policy

2.3.10 The 'Reading Borough Local Development Framework: Core Strategy adopted in January 2008 as amended in January 2015', sets out how planning and development will achieve the Reading 2020 vision for the town (RBC, 2015). Policy CS34 on 'Pollution and Water Resources' relates to air quality and states:

"Development will only be permitted where it would not be damaging to the environment through air, land, noise or light pollution; ...

"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."

2.3.11 RBC draft local plan will replace the current development plans, such as the Core Strategy, with a new plan setting out how Reading will develop up to 2036 (RBC, 2017). Policy EN15 on Air Quality states:

"Development should have regard to the need to improve air quality and reduce the effects of poor air quality.

i. Development that would detrimentally affect air quality will not be permitted unless the effect is to be mitigated. The following criteria should be taken into account:

- *Whether the proposal, including when combined with the cumulative effect of other developments already permitted, would significantly worsen air quality;*
- *Whether the development is within, or accessed via, an Air Quality Management Area; and*
- *Whether it can be demonstrated that a local worsening in air quality would be offset by an overall improvement in air quality, for instance through reduction in the need to travel.*

ii. Where a development would introduce sensitive uses (such as residential, schools and nurseries, hospitals, care facilities) into, or intensify such uses within, an Air Quality Management Area, detrimental effects on that use will be mitigated. Mitigation measures should be detailed in any planning application. If there are significant detrimental effects that cannot be mitigated, the application should be refused.

iii. Where required, planning obligations will be used to secure contributions to measures to tackle poor air quality or for air quality monitoring."

Reading Borough Council Air Quality Action Plan

2.3.12 The RBC Air Quality Action Plan sets out current and new policies and measures to address air quality issues in order to work toward meeting the air quality objectives for NO₂ (RBC, 2009). The measures are broken down into 'Air Pollution Transport Measures', 'Air Pollution Other Sources', 'Air Pollution Development Control and Air Pollution Other Measures'. Measures within the action plan include:

- Continue to implement "Quality Travel for Reading" including a new cycling strategy;
- Continue to work with Reading buses to reduce air quality impacts and greenhouse gas emissions per passenger kilometre from the Reading bus fleet, setting targets for emissions reductions;
- Investigate mechanisms to reduce the impact of Heavy Goods Vehicles (HGVs) on local air quality in Reading; and
- Ensure through the planning process that future development does not result in any future deterioration of air quality where possible.

3 Methodology

3.1 Existing Conditions

- 3.1.1 Information on existing air quality has been obtained by collating the results of monitoring carried out by RBC. Background concentrations for the site have been defined using the national pollution maps published by Defra. These cover the whole country on a 1x1 km grid (Defra, 2016b).

3.2 Construction Impacts

- 3.2.1 During demolition and construction the main potential effects are dust annoyance and locally elevated concentrations of PM₁₀. The suspension of particles in the air is dependent on surface characteristics, weather conditions and on-site activities. Impacts have the potential to occur when dust generating activities coincide with dry, windy conditions, and where sensitive receptors are located downwind of the dust source.
- 3.2.2 Separation distance is also an important factor. Large dust particles (greater than 30µm), responsible for most dust annoyance, will largely deposit within 100 m of sources. Intermediate particles (10-30µm) can travel 200-500 m. Consequently, significant dust annoyance is usually limited to within a few hundred metres of its source. Smaller particles (less than 10µm) are deposited slowly and may travel up to 1 km; however, the impact on the short-term concentrations of PM₁₀ occurs over a shorter distance. This is due to the rapid decrease in concentrations with distance from the source due to dispersion.
- 3.2.3 The Institute of Air Quality Management (IAQM) has issued revised guidance on the assessment of dust from demolition and construction (Holman et al, 2014). The IAQM guidance recommends that the risk of dust generation is combined with the sensitivity of the area surrounding the site to determine the risk of dust impacts from construction and demolition activities. Depending on the level of risk (high, medium, low or negligible) for each activity, appropriate mitigation is selected.
- 3.2.4 In accordance with the IAQM, the dust emission magnitude is defined as either large, medium or small (**Table 3.1**) taking into account the general activity descriptors on site and professional judgement.
- 3.2.5 The sensitivity of the study area to construction dust impacts is defined based on the examples provided within the IAQM 2014 guidance (**Table 3.2**), taking into account professional judgement.

Table 3.1: Criteria for Dust Emission Magnitude

Dust Emission Magnitude	Activity
Large	Demolition >50,000 m ³ building demolished, dusty material (e.g. concrete), on-site crushing/screening, demolition >20 m above ground level
	Earthworks >10,000 m ² site area, dusty soil type (e.g. clay), >10 earth moving vehicles active simultaneously, >8 m high bunds formed, >100,000 tonnes material moved

Dust Emission Magnitude	Activity
	Construction >100,000 m ³ building volume, on site concrete batching, sandblasting
	Trackout >50 HDVs out / day, dusty soil type (e.g. clay), >100 m unpaved roads
Medium	Demolition 20,000 - 50,000 m ³ building demolished, dusty material (e.g. concrete) 10-20 m above ground level
	Earthworks 2,500 - 10,000 m ² site area, moderately dusty soil (e.g. silt), 5-10 earth moving vehicles active simultaneously, 4 m – 8 m high bunds, 20,000 - 100,000 tonnes material moved
	Construction 25,000 - 100,000 m ³ building volume, on site concrete batching
	Trackout 10 - 50 HDVs out / day, moderately dusty surface material, 50 -100 m unpaved roads
Small	Demolition <20,000 m ³ building demolished, non-dusty material, <10 m above ground level, work in winter
	Earthworks <2,500 m ² site area, non-dusty soil, <5 earth moving vehicles active simultaneously, <4 m high bunds, <20,000 tonnes material moved
	Construction <25,000 m ³ , non-dusty material
	Trackout <10 HDVs out / day, non-dusty soil, < 50 m unpaved roads

Table 3.2: Area Sensitivity Definitions

Area Sensitivity	People and Property Receptors	Ecological Receptors
High	>100 dwellings, hospitals, schools, care homes within 50 m 10 – 100 dwellings within 20 m Museums, car parks, car showrooms within 50 m PM₁₀ concentrations approach or are above the daily mean objective.	National or Internationally designated site within 20 m with dust sensitive features / species present
Medium	>100 dwellings, hospitals, schools, care homes within 100 m 10 – 100 dwellings within 50 m Less than 10 dwellings within 20 m Offices/shops/parks within 20 m PM₁₀ concentrations below the daily mean objective.	National or Internationally designated site within 50 m with dust sensitive features / species present Nationally designated site or particularly important plant species within 20 m
Low	>100 dwellings, hospitals, schools, care homes 100 - 350m away 10 – 100 dwellings within 50 – 350 m Less than 10 dwellings within 20 – 350 m Playing fields, parks, farmland, footpaths, short term car parks, roads, shopping streets PM₁₀ concentrations well below the daily mean objective.	Nationally designated site or particularly important plant species 20 – 50 m Locally designated site with dust sensitive features within 50 m

3.2.6 Based on the dust emission magnitude and the area sensitivity, the risk of dust impacts is then determined (**Table 3.3**), taking into account professional judgement.

Table 3.3: Risk of Dust Impacts

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High	Medium	Low
Medium	Medium	Medium	Low
Low	Low	Low	Negligible

3.2.7 Based on the risk of dust impacts, appropriate mitigation is selected from the IAQM guidance using professional judgement.

Significance Criteria

3.2.8 The construction impact significance criteria are based on the IAQM guidance. The guidance recommends that no assessment of the significance of effects is made without mitigation in place, as mitigation is assumed to be secured by planning conditions, legal requirements or required by regulations.

- 3.2.9 With appropriate mitigation in place, the residual effect of construction impacts on air quality is assessed as not significant.

3.3 Road Traffic Impacts

Sensitive Locations

- 3.3.1 Relevant sensitive locations are places where members of the public might be expected to be regularly present over the averaging period of the objectives. For the annual mean and daily mean objectives that are the focus of this assessment, sensitive receptors will generally be residential properties, schools, nursing homes, etc. When identifying these receptors, particular attention has been paid to assessing impacts close to junctions, where traffic may become congested, and where there is a combined effect of several road links.
- 3.3.2 Based on the above criteria, seven existing properties have been identified as relevant sensitive receptors for the assessment. The locations of existing receptors were chosen to represent locations where impacts from road traffic related to the proposed development are likely to be the greatest, i.e. as a result of development traffic at junctions. These locations are described in **Table 3.4.** and shown in Figure 1. Receptors were modelled at a height of 1.5 m representing floor exposure.
- 3.3.3 In addition, five receptors within the Site have been chosen as future residential receptors (PR1 – PR5), such proposed receptors were modelled at a height of 1.5 m representing ground floor exposure.
- 3.3.4 Concentrations have also been predicted at three monitoring locations in order to verify the modelled results (see **Appendix C** for further details on the verification method).

Table 3.4: Receptor Locations Description

Receptor	Location	Height (m)
R1	40 Cardiff Road	1.5
R2	22 Cardiff Road	1.5
R3	8 Addison Road	1.5
R4	66 Addison Road	1.5
R5	EP Collier Primary School	1.5
R6	7 Swansea Road	1.5
R7	217 Caversham Road	1.5
PR1	Meadow Road	1.5
PR2	Cardiff Road	1.5
PR3	Cardiff Road	1.5
PR4	Cardiff Road	1.5
PR5	Milford Road	1.5

Impact Predictions

- 3.3.5 Predictions have been carried out using the ADMS-Roads dispersion model (v4.1). The model requires the user to provide various input data, including the Annual Average Daily Traffic (AADT) flow, the proportion of Heavy Duty Vehicles (HDVs), road characteristics (including road width and street canyon height, where applicable), and the vehicle speed. It also requires

meteorological data. The model has been run using 2015 meteorological data from the Heathrow Airport meteorological station, which is considered suitable for this area.

- 3.3.6 AADT flows and the proportions of HDVs, for roads within 250 m of the proposed development site and air quality monitoring stations have been provided by TTP Consulting. Traffic counts from the Department of Transport were used for A4155 and A329 Caversham Road (DfT, 2017). Traffic data used in this assessment is summarised in **Appendix D**.
- 3.3.7 Traffic emissions were calculated using the Emission Factor Toolkit (EFT) v7.0. The traffic data were entered into ADMS-Roads, along with speed data to provide combined emission rates for each of the road links entered into the model. In order to take account of uncertainties relating to future year vehicle emissions, an assessment has been carried out utilising 2015 emission factors and background concentrations, this is considered a conservative assumption of emissions in the future.

Assessment Criteria

- 3.3.8 The NAQOs for NO₂ and PM₁₀ set out in the Air Quality Regulations (England) 2000 and the Air Quality (England) (Amendment) Regulations 2002, are shown in **Table 3.5**.

Table 3.5: NO₂ and PM₁₀ Objectives

Pollutant	Time Period	Objective
Nitrogen dioxide (NO ₂)	1-hour mean	200µg/m ³ not to be exceeded more than 18 times a year
	Annual mean	40µg/m ³
Particulate matter (PM ₁₀)	24-hour mean	50µg/m ³ not to be exceeded more than 35 times a year
	Annual mean	40µg/m ³

- 3.3.9 The objectives for NO₂ and PM₁₀ were to have been achieved by 2005 and 2004, respectively, and continue to apply in all future years thereafter. Analysis of long term monitoring data suggests that if the annual mean NO₂ concentration is less than 60µg/m³ then the one-hour mean NO₂ objective is unlikely to be exceeded where road transport is the main source of pollution. This concentration has been used to screen whether the one-hour mean objective is likely to be achieved (Carslaw *et al*, 2011).
- 3.3.10 The Air Quality Strategy 2007 (DETR, 2007) includes an exposure reduction target for smaller particles known as PM_{2.5}. These are an annual mean target of 25µg/m³ by 2020 and an average urban background exposure reduction target of 15% between 2010 and 2020.
- 3.3.11 The ambient air quality and cleaner air for Europe directive (2008/50/EC) was adopted in May 2008, and includes a national exposure reduction target, a target value and a limit value for PM_{2.5}, shown in **Table 3.6**. The UK Government transposed this new directive into national legislation in June 2010.

Table 3.6: PM_{2.5} Objectives

	Time Period	Objective	To be Achieved by
UK Objectives	Annual mean	25µg/m ³	2020
	3 year running annual mean	15% reduction in concentrations measured at urban background Sites	Between 2010 and 2020

	Time Period	Objective	To be Achieved by
European Obligations	Annual mean	Target value of 25µg/m ³	2010
	Annual mean	Limit value of 25µg/m ³	2015
	Annual mean	Stage 2 indicative Limit value of 20µg/m ³	2020
	3 year Average Exposure Indicator (AEI) (a)	Exposure reduction target relative to the AEI depending on the 2010 value of the 3 year AEI (ranging from a 0% to a 20% reduction)	2020
	3 year Average Exposure Indicator (AEI)	Exposure concentration obligation of 20µg/m ³	2015

Note: (a) The 3 year annual or AEI is calculated from the PM_{2.5} concentration averaged across all urban background monitoring locations in the UK e.g. the AEI for 2010 is the mean concentration measured over 2008, 2009 and 2010.

Significance

- 3.3.12 There is no official guidance in the UK on how to assess the significance of air quality impacts of a new development. The approach developed by the IAQM and Environmental Protection UK (EPUK) has therefore been used (Moorcroft and Barrowcliffe *et al*, 2015).
- 3.3.13 The guidance sets out three stages: determining the magnitude of change at each receptor, describing the impact, and assessing the overall significance. Impact magnitude relates to the change in pollutant concentration; the impact description relates this change to the air quality objective.
- 3.3.14 **Table 3.7** sets out the impact magnitude descriptors, whilst **Table 3.8** sets out the impact descriptors.

Table 3.7: Impact Magnitude for Changes in Ambient Pollutant Concentrations

Magnitude (% Change in Concentration)	Annual Mean NO ₂ and PM ₁₀ (40 µg/m ³)	Annual Mean PM _{2.5} (25 µg/m ³)	Annual Mean of 32 µg/m ³ equating to 35 days above 50 µg/m ³ for PM ₁₀
Very Large (>9.5%)	≥3.8 µg/m ³	≥2.375 µg/m ³	≥3.04 µg/m ³
Large (>5.5% - ≤9.5%)	>2.2 – ≤3.8 µg/m ³	>1.375 – ≤2.375 µg/m ³	>1.76 - ≤3.04 µg/m ³
Medium (>1.5% - ≤5.5%)	>0.6 – ≤2.2 µg/m ³	>0.375 – ≤1.375 µg/m ³	>0.48 - ≤1.76 µg/m ³
Small (>0.5% - ≤1.5%)	>0.2 – ≤0.6 µg/m ³	>0.125 – ≤0.375 µg/m ³	>0.16 - ≤0.48 µg/m ³
Imperceptible (≤0.5%)	≤0.2 µg/m ³	≤0.125 µg/m ³	≤0.16 µg/m ³

Table 3.8: Impact Descriptor for Changes in Concentration at a Receptor

Concentration with development in place in relation to Objective / Limit Value	Emission Magnitude				
	Imperceptible	Small	Medium	Large	Very Large
> 109.5 % (a)	Negligible	Moderate	Substantial	Substantial	Substantial
>102.5% - ≤109.5% (b)	Negligible	Moderate	Moderate	Substantial	Substantial
>94.5% - ≤102.5% (c)	Negligible	Slight	Moderate	Moderate	Substantial
>75.5% - ≤94.5% (d)	Negligible	Negligible	Slight	Moderate	Moderate
≤75.5% (e)	Negligible	Negligible	Negligible	Slight	Moderate

Where concentrations increase the impact is described as adverse and where it decreases as beneficial.

(a) NO₂ or PM₁₀: > 44µg/m³ annual mean; PM_{2.5} >27.5 µg/m³ annual mean; PM₁₀ >35.2 µg/m³ annual mean (days)

(b) NO₂ or PM₁₀: > 40.8 – ≤ 44µg/m³ annual mean; PM_{2.5} > 25.5 – ≤27.5 µg/m³ annual mean; PM₁₀ >32.64 – ≤35.2 µg/m³ annual mean (days)

(c) NO₂ or PM₁₀: > 38 – ≤40.8 µg/m³ annual mean; PM_{2.5} >23.75 – ≤25.5 µg/m³ of annual mean; PM₁₀ >30.4 – ≤32.64µg/m³ annual mean (days)

(d) NO₂ or PM₁₀: >30 - ≤38 µg/m³ annual mean; PM_{2.5} >18.75 - ≤23.75 µg/m³ annual mean; PM₁₀ <24 - ≤ 30.4 µg/m³ annual mean (days)

(e) NO₂ or PM₁₀: ≤30 µg/m³ annual mean; PM_{2.5} ≤18.75 µg/m³; annual mean; PM₁₀ ≤24 µg/m³ annual mean (days)

3.3.15 The guidance states that the assessment of significance should be based on professional judgement, taking into account factors including:

- the number of properties affected by slight, moderate or substantial air quality impacts and a judgement on the overall balance;
- the magnitude of the changes and the descriptions of the impacts at the receptors i.e. **Tables 3.7** and **3.8** findings;
- whether or not an exceedance of an objective or limit value is predicted to arise in the operational study area (where there are significant changes in traffic) where none existed before or an exceedance area is substantially increased;
- the uncertainty, comprising the extent to which worst-case assumptions have been made; and
- the extent to which an objective or limit value is exceeded.

3.3.16 Where impacts can be considered in isolation at an individual receptor, moderate or substantial impacts (i.e. per **Table 3.7**) may be considered to be a significant environmental effect, whereas negligible or slight impacts would not be considered significant. The overall effect however, needs to be considered in the round taking into account the changes at all of the modelled receptor locations, with a judgement made as to whether the overall air quality effect of the development is significant or not.

Assumptions and Limitations

3.3.17 There are many components that contribute to the uncertainty in predicted concentrations. The model used in this assessment is dependent upon the traffic data that have been input which will have inherent uncertainties associated with them. There is then additional uncertainty as the model is required to simplify real-world conditions into a series of algorithms.

- 3.3.18 A disparity between national road transport emissions projections and measured annual mean concentrations of nitrogen oxides and NO₂ has been identified in recent years. Whilst projections suggest that both annual mean nitrogen oxides and NO₂ concentrations from road traffic emissions should have fallen significantly over the past 6 – 8 years, at many monitoring sites levels have remained relatively stable, or have shown a slight increase.
- 3.3.19 The complete development modelling has been based on 2015 emission factors and background concentrations. The model has been verified against 2015 monitoring data. This is considered to provide an appropriately conservative assessment taking into account the uncertainties regarding future vehicle emission factors.

4 Baseline Conditions

4.1 LAQM

- 4.1.1 RBC has investigated air quality within its area as part of its responsibilities under the LAQM regime. An Air Quality Management Area (AQMA) has been declared due to exceedances of the annual NO₂ objectives. The AQMA comprises Reading city centre and extends out along major roads including the A33 and A327.

4.2 Monitoring

Nitrogen Dioxide

- 4.2.1 RBC carries out monitoring of NO₂ concentrations at a number of locations across the borough. The closest and most representative locations are described in **Table 5.1** and shown in **Figure 1**.

Table 5.1: Measured NO₂ Concentrations, (2011-2015)

ID	Site Type	Within AQMA	Annual Mean (µg/m³)				
			2011	2012	2013	2014	2015
Automatic Site							
Caversham Road* (RD1)	R	Y	46	47	43	41	38
Diffusion Tubes							
197 Caversham Road*	R	Y	40	44	42.2	43.4	37
108 Caversham Road	R	Y	39	42	43.9	47.7	39
131 Caversham Road	R	Y	49 (50)	44	43.4	46.9	38
50 Cardiff Road*	R	Y	-	-	38.4	35.6	31
125 Cardiff Road	R	Y	-	-	-	32	31
Railway Depot	R	Y	-	-	-	40	37
Objective		40					

R= Roadside

2011-2014 data taken from the RBC Updating and Screening Assessment 2015; 2015 data taken from the RBC Annual Status Report 2016.

*Used for model verification

() annualised data.

- 4.2.2 Measured concentrations at monitoring locations along Caversham Road have generally been above the objective over the 2011 – 2014 period, but decreased in 2015 to below the objective. There is no clear trend in concentrations between 2011-2014 period.
- 4.2.3 Concentrations at the closest monitoring point to the development site, Cardiff Road, are below the objective. However, concentrations at Cardiff Road were higher than would be anticipated

from the level of traffic on the road, especially as the road is blocked in the middle and restricts the traffic movements in the area. It was therefore likely that measured concentrations were being influenced by emissions from the railway lines to the south of the monitoring point. Reading station underwent improvement works in 2014. In conjunction with the station redevelopment a train depot has been relocated to sidings backing onto Cardiff Road (RBC, 2015). Diesel trains idle on the depot tracks for periods of the day and night, however the nearest track is 25 m away from the nearest location where there may be relevant exposure. The measured concentration at 50 Cardiff Road reduced in 2015 which may be partly due to the rail improvements works.

Particles (PM₁₀ and PM_{2.5})

- 4.2.4 PM₁₀ and PM_{2.5} monitoring is carried out using three monitors within the Borough. The closest and most representative location is along Caversham Road. Data for this site is presented in **Table 5.2**.

Table 5.2: Measured PM₁₀ and PM_{2.5} Concentrations, (2011-2015)

Site Site ID	Site Type	2011	2012	2013	2014	2015
PM ₁₀ Annual Mean (µg/m³)						
RD1	R	46	47	29	33	28
Objective		40				
PM ₁₀ Number of days > 50µg/m³						
RD1	R	30	32	24	31	8
Objective		35				
PM _{2.5} Annual Mean (µg/m³)						
RD1	R	10	9	8	8	6
Objective		25				

Data taken from the RBC Annual Status Report 2016

- 4.2.5 PM₁₀ and PM_{2.5} measured concentrations have been below the objective.

4.3 Background Concentrations

- 4.3.1 In addition to these measured concentrations, estimated background concentrations for the site have been obtained from the national maps provided by Defra (Defra, 2016a) (shown in **Table 5.3**). Defra background concentrations were adjusted based on the Reading New Town local background Automatic Urban and Rural Network station (AURN) (see **Appendix C** for further details).

Table 5.3: Estimated Annual Mean Background Concentrations

Year	Grid reference	Annual Mean (µg/m ³)		
		NO ₂	PM ₁₀	PM _{2.5}
2015	471_174	22.2	12.7	7.5
	470_174 (Cardiff Road)	20.4	11.8	7.1
Objective		40	40	25

- 4.3.2 The background concentrations are all well below the relevant objectives.

5 Impact Assessment

5.1 Construction Impacts

5.1.1 The main potential effects during construction are dust deposition and elevated PM₁₀ concentrations. The following activities have the potential to cause emissions of dust:

- Site preparation including delivery of construction material, erection of fences and barriers;
- Demolition of existing buildings on Site;
- Earthworks including digging foundations and landscaping;
- Materials handling such as storage of material in stockpiles and spillage;
- Construction and fabrication of units; and
- Disposal of waste materials off-site.

5.1.2 Typically the main cause of unmitigated dust generation on construction sites is from demolition and vehicles using unpaved haul roads, and off-site from the suspension of dust from mud deposited on local roads by construction traffic. The main determinants of unmitigated dust annoyance are the weather and the distance to the nearest receptor.

5.1.3 Based on the IAQM criteria (**Table 3.1**), the dust emissions magnitude is considered to be medium. The study area is considered to be of high sensitivity, as there are 10-100 dwellings within 20 m of the site boundary (**Table 3.2**). Appropriate mitigation corresponding to a medium risk site is therefore required during the construction phase (**Table 3.3**). With appropriate mitigation in place the construction impacts are described as not significant.

5.2 Road Traffic Impacts

5.2.1 Predicted concentrations of NO₂, PM₁₀ and PM_{2.5} at existing receptors in 2015, both without and with the proposed development in place are presented in **Table 5.1** below.

Table 5.1: Predicted Concentrations of NO₂, PM₁₀ and PM_{2.5} at Existing Receptors

Receptor	2015 Without Development			2015 With Development		
	Annual Mean (µg/m³)					
	NO ₂	PM ₁₀	PM _{2.5}	NO ₂	PM ₁₀	PM _{2.5}
R1	26.6	15.6	9.4	22.1	12.5	7.5
R2	29.7	17.1	10.3	27.7	16.6	9.9
R3	24.8	13.8	8.2	24.4	13.7	8.2
R4	24.8	13.8	8.2	24.5	13.8	8.2
R5	28.6	17.5	10.4	28.8	17.7	10.6
R6	26.8	15.8	9.4	26.9	15.9	9.5
R7	28.3	16.3	9.8	28.0	16.3	9.8
Objectives	40	40	25	40	40	25

5.2.3 The predicted NO₂, PM₁₀ and PM_{2.5} concentrations in 2015 without and with the proposed development in place are well below the relevant objectives at all existing receptor locations.

- 5.2.4 The changes in annual mean concentrations of NO₂, PM₁₀ and PM_{2.5} are presented in **Table 5.2** below.

Table 5.2: Change in Predicted Concentrations brought about by the Development

Receptor	Annual Mean (µg/m ³)		
	NO ₂	PM ₁₀	PM _{2.5}
R1	-4.56	-3.12	-1.93
R2	-1.99	-0.52	-0.36
R3	-0.40	-0.07	-0.05
R4	-0.27	-0.02	-0.02
R5	0.23	0.23	0.14
R6	0.11	0.12	0.07
R7	-0.31	0.03	0.01

Based on unrounded numbers

- 5.2.5 Based on the impact magnitude descriptors presented in **Table 3.7**, the positive changes in annual mean NO₂, PM₁₀ and PM_{2.5} concentrations are all imperceptible at R5 and, small at R6.
- 5.2.6 The negative change in predicted concentrations are related with the changes in the access routes brought about by the Development. The commercial use routes will be restricted to the industrial areas north and west of the proposed Site. Meadow Road connection to Addison Road will be blocked and the Cardiff Road blockage will move further west to the junction with Weighbridge Row. The new commercial use routes together with the width restriction control measures will limit the traffic route to residential use (car passengers and light duty vehicles) in Addison Road and Cardiff road adjacent to the development.
- 5.2.7 Using the criteria set out in **Table 3.8**, the impact on annual mean NO₂, PM₁₀ and PM_{2.5} concentrations is described as negligible at all receptor locations, except at receptor R1 where it is described as moderate beneficial.

Proposed Receptors

- 5.2.8 Predicted concentrations of NO₂, PM₁₀ and PM_{2.5} at proposed receptors within the proposed development site are presented in **Table 5.3**.

Table 5.3: Predicted Concentrations of NO₂, PM₁₀ and PM_{2.5} at Proposed Receptors within Site

Receptor	Annual Mean (µg/m ³)		
	NO ₂	PM ₁₀	PM _{2.5}
PR1	23.8	13.2	7.9
PR2	24.3	13.7	8.1
PR3	22.5	12.8	7.7
PR4	25.8	15.7	9.4
PR5	22.0	12.4	7.4
Objectives	40	40	25

- 5.2.9 Predicted concentrations of NO₂, PM₁₀ and PM_{2.5} are all well below the relevant objectives and therefore the site is suitable for residential development.

Impact Significance

- 5.2.10 Overall, considering the conservative nature of the assessment, and the criteria set out in **Section 3.3.13**, the air quality effects of road traffic generated by the proposed development are considered to be not significant as there are no predicted exceedances of the relevant air quality strategy objectives at any of the existing receptor locations. All concentrations at existing residential receptor locations will be well below the relevant objectives.

6 Mitigation

6.1 Construction

- 6.1.1 The following standard low risk mitigation measures from the IAQM 2014 guidance are recommended. These should be included within a Construction Environmental Management Plan and agreed with the Local Authority.

Communication

- Develop and implement a stakeholder communications plan.
- Display the name and contact details of persons accountable on the site boundary.
- Display the head or regional office information on the site boundary.

Management

- Develop and implement a dust management plan.
- Record all dust and air quality complaints, identify causes and take measures to reduce emissions.
- Record exceptional incidents and action taken to resolve the situation.
- Carry out regular site inspections to monitor compliance with the dust management plan and record results.
- Increase site inspection frequency during prolonged dry or windy conditions and when activities with high dust potential are being undertaken.
- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as possible.
- Erect solid screens or barriers around dusty activities or the site boundary at least as high as any stockpile on site.
- Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.
- Avoid site run off of water or mud.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove potentially dusty materials from site as soon as possible.
- Cover, seed or fence stockpiles to prevent wind whipping.
- Ensure all vehicles switch off engines when stationary.
- Avoid the use of diesel or petrol powered generators where possible.
- Produce a Construction Logistics Plan to manage the delivery of goods and materials.
- Only use cutting, grinding and sawing equipment with dust suppression equipment.

- Ensure an adequate supply of water on site for dust suppressant.
- Use enclosed chutes and conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use water sprays on such equipment where appropriate.
- Ensure equipment is readily available on site to clean up spillages of dry materials.
- No on-site bonfires and burning of waste materials on site.

Earthworks

- Re-vegetate earthworks and exposed areas /soil stockpiles to stabilise surfaces as soon as practicable.
- Only remove the cover in small areas during work and not all at once.

Demolition

- Incorporate 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 water suppression is used during demolition operation.
- Avoid explosive blasting, using appropriate manual and mechanical alternatives.
- Bag and remove any biological debris or damp down such material before demolition.

Construction

- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless required for a particular process.
- Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored silos with suitable emissions control systems.

Trackout

- Use water assisted dust sweepers on the site access and local roads.
- Avoid dry sweeping of large areas.
- Ensure vehicles entering and leaving the site are covered to prevent escape of materials.
- Record inspection of on-site haul routes and any subsequent action, repairing as soon as reasonably practicable.
- Install hard surfaced haul routes which are regularly damped down.
- Install a wheel wash with a hard-surfaced road to the site exit where site layout permits.
- The site access gate to be located at least 10m from receptors where possible.

6.2 Operation

- 6.2.1 The effects of development traffic on local air quality are judged to be not significant. No additional traffic mitigation is therefore required to reduce the direct effects of the development on local air quality.

7 Conclusions

- 7.1.1 The air quality impacts associated with the proposed redevelopment of the Former Cox & Wyman Site, located within the boundary of RBC, have been assessed.
- 7.1.2 An AQMA has been declared in Reading due to exceedances of the annual mean and daily mean NO₂ objectives. The proposed site is located within the AQMA which encompasses the centre of Reading and the major arterial roads into and out of the town.
- 7.1.3 The construction works have the potential to create dust. During construction it is recommended that a package of mitigation measures is put in place to minimise the risk of elevated PM₁₀ concentrations and dust nuisance in the surrounding area. With mitigation in place the construction impacts are judged as not significant.
- 7.1.4 Predicted NO₂, PM₁₀ and PM_{2.5} concentrations are well below air quality strategy objectives at all of the existing receptor locations in close proximity to the site. The proposed development improves concentrations at a number of receptor locations due to the changes in the site access arrangements. Taking into account the predicted concentrations, the overall air quality effect of the development is considered to be not significant.
- 7.1.5 There are no predicted exceedances of the air quality strategy objectives at any of the proposed receptor locations. The site is considered suitable for residential development without the need for additional mitigation.
- 7.1.6 Overall, it is concluded that there are no air quality constraints to the proposed development.

Appendix A Glossary

AADT	Annual Average Daily Traffic
AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network
Defra	Department of the Environment, Food and Rural Affairs
Diffusion Tube	A passive sampler used for collecting NO ₂ in the air
EFT	Emission Factor Toolkit
HDV	Heavy Duty Vehicle; a vehicle with a gross vehicle weight greater than 3.5 tonnes Includes Heavy Goods Vehicles and buses
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
NAQO	National Air Quality Objective as set out in the Air Quality Strategy and the Air Quality Regulations
NO ₂	Nitrogen Dioxide
NO _x	Nitrogen oxides, generally considered to be nitric oxide and NO ₂ . Its main source is from combustion of fossil fuels, including petrol and diesel used in road vehicles
PM ₁₀	Small airborne particles less than 10µm in diameter
PBA	Peter Brett Associates LLP
PPG	Planning Practice Guidance
RBC	Reading Borough Council
Receptor	A location where the effects of pollution may occur

Appendix B References

Carslaw, D., Beevers, S., Westmoreland, E. and Williams, M. (2011). 'Trends in NO_x and NO₂ emissions and ambient measurements in the UK'. Available: http://uk-air.defra.gov.uk/library/reports?report_id=645.

Department of the Environment, Food and Rural Affairs (Defra) in partnership with the Scottish Executive, The National Assembly for Wales and the Department of the Environment for Northern Ireland (2016a). '*Local Air Quality Management Technical Guidance, LAQM.TG(16)*'. HMSO, London.

Department of the Environment, Food and Rural Affairs (Defra) (2016b). '*2013 Based Background Maps for NO_x, NO₂, PM₁₀ and PM_{2.5}*'. Available: <https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2013>.

Department of the Environment, Transport and the Regions (DETR, 2007) in Partnership with the Welsh Office, Scottish Office and Department of the Environment for Northern Ireland (2007). '*The Air Quality Strategy for England, Scotland, Wales, Northern Ireland*' HMSO, London.

Environmental Act 1995, Part IV.

Holman *et al.* (2014). '*Assessment of dust from demolition and construction*', IAQM, London

Moorcroft and Barrowcliffe *et al.* (2017). '*Land-use Planning & Development Control: Planning for Air Quality*'. V1.2., London

Planning Practice Guidance (2014). '*Air Quality*'.
Available at: <http://planningguidance.planningportal.gov.uk/blog/guidance/air-quality/>

Reading Borough Council (2015) '*Reading Borough Local Development Framework: Core Strategy*'. Available at: <http://beta.reading.gov.uk/media/1046/Core-Strategy-Adopted-January-2008/pdf/Core-Strategy-Adopted-Jan08-Altered-Jan15.pdf>

Reading Borough Council (2017) 'DRAFT READING BOROUGH LOCAL PLAN'. Available at: <http://www.reading.gov.uk/newlocalplan>

Reading Borough Council (2009) '*Air Quality Action Plan*'.
Available at: <http://beta.reading.gov.uk/media/1262/Air-Quality-Action-Plan/pdf/AIR-QUALITY-ACTION-PLAN.pdf>

Statutory Instrument 2000, No 921, '*The Air Quality (England) Regulations 2000*' HMSO, London.

Statutory Instrument 2002, No 3034, '*The Air Quality (England) (Amendment) Regulations 2002*' HMSO, London.

Statutory Instrument 2010, No. 1001, '*The Air Quality Standards Regulations 2010*' HMSO, London

Appendix C Model Verification

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 primary pollutant emission of nitrogen oxides ($\text{NO}_x = \text{NO} + \text{NO}_2$). The model has been run to predict the 2015 annual mean road- NO_x contribution at three monitoring locations (identified in [Table 5.1](#)). Concentrations have been modelled at a height of 2.5 m for 197 Caversham Road, 2.5 m for 50 Cardiff Road and 1.5 m for Reading Caversham RD1.

The model output of road- NO_x has been compared with the 'measured' road- NO_x , which was calculated from the measured NO_2 concentrations and the adjusted background NO_2 concentrations within the NO_x from NO_2 calculator.

A primary 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 C.1](#)). 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 combining the adjusted modelled road- NO_x concentrations with the predicted background NO_2 concentration within the NO_x from NO_2 calculator. A secondary adjustment factor was finally calculated as the slope of the best fit line applied to the adjusted data and forced through zero ([Figure C.2](#)).

The following primary and secondary adjustment factors have been applied to all modelled nitrogen dioxide data:

Primary adjustment factor: 1.3272

Secondary adjustment factor: 1.0452

The results imply that overall, the model was under-predicting the road- NO_x contribution. This is a common experience with this and most other models. The final NO_2 adjustment is minor.

[Figure C.3](#) compares final adjusted modelled total NO_2 at each of the monitoring sites, to measured total NO_2 , and shows the 1:1 relationship, as well as $\pm 10\%$ and $\pm 25\%$ of the 1:1 line.

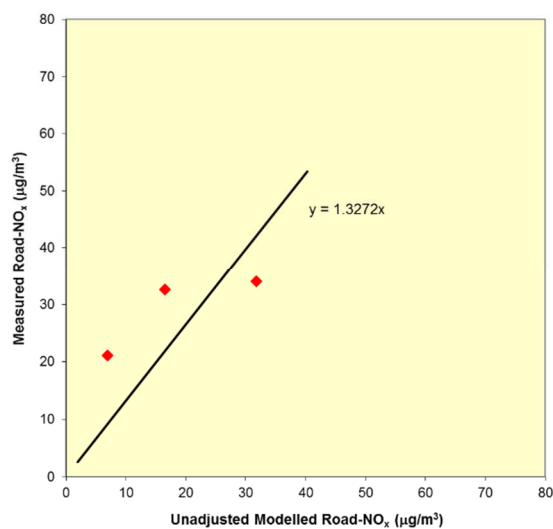


Figure C.1: Comparison of Measured Road-NO_x with Unadjusted Modelled Road-NO_x Concentrations

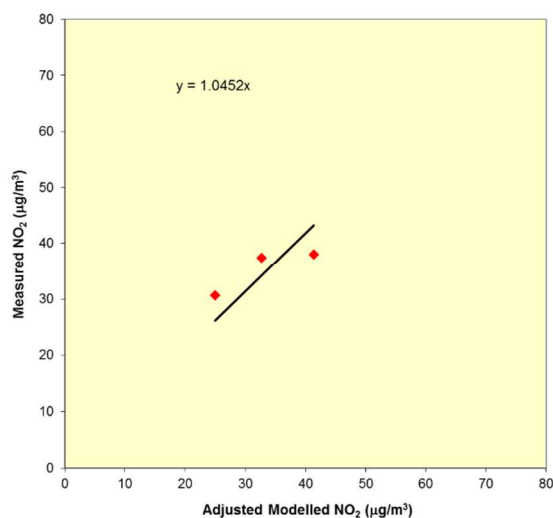


Figure C.2: Comparison of Measured NO₂ with Primary Adjusted Modelled NO₂ Concentrations

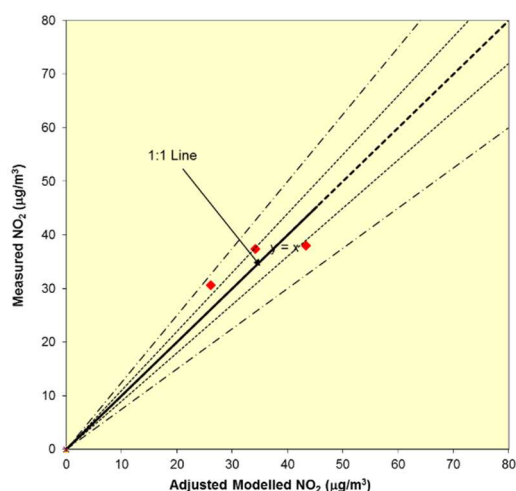


Figure C.3: Comparison of Measured NO₂ with Fully Adjusted Modelled NO₂ Concentrations

Particles (PM₁₀ and PM_{2.5})

PM₁₀ monitoring is carried out at the Reading Caversham automatic monitoring station. The following adjustment factor for PM₁₀ has been calculated and applied to the modelled road-PM₁₀ concentrations data:

Measured PM ₁₀ :	28.0 µg/m ³
Background PM ₁₀ :	12.7 µg/m ³
Measured Road PM ₁₀ :	15.3 µg/m ³
Modelled Road PM ₁₀ :	2.19 µg/m ³
Adjustment Factor:	6.99

PM_{2.5} measured concentration for 2015 was 6 µg/m³, while the Defra background was 7.5 µg/m³. This would result in a negative adjustment factor. Therefore, the PM₁₀ adjustment factor was applied to the modelled road-PM_{2.5} concentrations as worst case.

Background adjustment factor

Reading New Town AURN urban background station was used to adjust the Defra backgrounds.

	Measured Background AURN (µg/m ³)	Defra background (µg/m ³)	Factor
NO ₂	22.2	25.9	0.86
PM ₁₀	12.5	17.3	0.72
PM _{2.5}	7.4	12.8	0.58

Appendix D Traffic Data

Location	2015 Baseline Without Development		2015 Baseline With Development	
	AADT	HDV (%)	AADT	HDV (%)
Bridge Road	29634	4.4	29,949	4.4
Caversham Road (A4155)	28,263	4.1	28,578	4.1
Richfield Avenue	18,355	4.7	18,670	4.7
Caversham Road (A329)	37,044	3.2	37,359	3.2
Vastern Road	21,322	6.8	21,637	6.8
Cardiff Road (industrial)	5,250	5.00	5,250	5.0
Cardiff Road (residential adjacent site)	5,250	5.0	315	0.0
Cardiff Road (residential)	5,250	5.0	5,565	0.0
Swansea Road	5,250	5.0	5,565	5.0
Milford Road (industrial)	823	16.0	823	16.0
Addison Road	817	10.0	1,132	0.0
Site Access	-	-	315	0

HDV% traffic flows include buses

Appendix E Figures

