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Reading International Business Park

Air Quality Assessment

On behalf of **Arlington Business Parks GP Ltd**

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1 Introduction

1.1 Proposed Development

- 1.1.1 Arlington Business Parks GP Ltd has commissioned PBA, now part of Stantec to undertake an air quality assessment to support a application for employment redevelopment of a site to the north of Reading International Business Park, Reading. The site is located to the west of the A33, north of Junction 11. The proposed development site is located within the administrative boundary of Reading Borough Council (RBC).
- 1.1.2 The site has extant permission for B1a use (09/00685/VARIAT). This application is for the development of commercial units to be used flexibly within B2 and B8 land use class.

1.2 Scope of Assessment

- 1.2.1 This report describes existing air quality within the study area and assesses the impact of the construction and operation of the development on air quality in the surrounding area. The main air pollutants of concern relating to construction are dust and fine particulate matter (PM₁₀), and for road traffic are nitrogen dioxide (NO₂), PM₁₀ and PM_{2.5}.
- 1.2.2 The proposed development will not include an energy centre. Therefore, an assessment of the effect of potential energy centre emissions has been scoped out.
- 1.2.3 The assessment has been prepared taking into account relevant local and national guidance, policy and legislation.

2 Legislation and Policy

2.1 The Air Quality Strategy

- 2.1.1 The Air Quality Strategy (2007) establishes the policy framework for ambient air quality management and assessment in the UK (DETR, 2007). 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, 2016), 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 Clean Air Strategy 2019

- 2.2.1 The Clean Air Strategy aims to lower national emissions of pollutants, thereby reducing background pollution and minimising human exposure to harmful concentrations of pollution. The Strategy will create a stronger and more coherent framework for action to tackle air pollution. It also aims to support the creation of Clean Air Zones in order to reduce emissions from all sources of air pollution (Defra, 2019a).

2.3 EU Limit Values

- 2.3.1 The Air Quality Standards (Amendment) Regulations 2016 amended the Standard Regulations 2010, which implemented the European Union's Directive on ambient air quality and cleaner air for Europe (2008/50/EC), and includes limit values for NO₂ (Statutory Instrument, 2016). 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.
- 2.3.2 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.
- 2.3.3 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.

Air Quality Objectives

Human Health

- 2.3.4 The NAQOs for NO₂ and PM₁₀ set out in the Air Quality Regulations (England) 2000 (Statutory Instrument, 2000) and the Air Quality (England) (Amendment) Regulations 2002 (Statutory Instrument, 2002), are shown in **Table 2.1**.

Table 2.1 NO₂ and PM₁₀ Objectives

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

- 2.3.5 The objectives for NO₂ and PM₁₀ were to have been achieved by 2005 and 2004, respectively, but also 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 60 µg/m³ then the one-hour mean NO₂ objective is unlikely to be exceeded where road transport is the main source of pollution. Therefore, in this assessment this concentration has been used to screen whether the one-hour mean objective is likely to be achieved (Defra, 2016). Similar to NO₂, a PM₁₀ annual mean below 32 µg/m³ is used to screen whether the 24-hour PM₁₀ mean objective is likely to be achieved (Defra, 2016).
- 2.3.6 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 25 µg/m³ by 2020 and an average urban background exposure reduction target of 15% between 2010 and 2020.
- 2.3.7 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 2.2**. The UK Government transposed this new directive into national legislation in June 2010.

Table 2.2 PM_{2.5} Objectives

	Time Period	Objective	To be Achieved by
UK Objectives	Annual mean	25 µg/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 25 $\mu\text{g}/\text{m}^3$	2010
	Annual mean	Limit value of 25 $\mu\text{g}/\text{m}^3$	2015
	Annual mean	Stage 2 indicative Limit value of 20 $\mu\text{g}/\text{m}^3$	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 20 $\mu\text{g}/\text{m}^3$	2015

(a) The 3 year annual or AEI is calculated from the $\text{PM}_{2.5}$ 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.

2.4 Planning Policy

National Policy

- 2.4.1 The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how they are expected to be applied (Ministry of Housing, Communities & Local Government, 2019). In relation to achieving sustainable development, paragraph 8 states that:

"Achieving sustainable development means that the planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives):

...

c) an environmental objective – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy."

- 2.4.2 So that sustainable development is pursued in a positive way, at the heart of the Framework is a presumption in favour of sustainable development. Paragraph 11 states that plans and decisions should apply a presumption in favour of sustainable development, which for decision-taking means:

"... d) where there are no relevant development plan policies, or the policies which are most important for determining the application are out-of-date, granting permission unless:

...

ii. any adverse impacts of doing so would significantly and demonstrably outweigh the benefits, when assessed against the policies in this Framework taken as a whole."

2.4.3 Paragraph 54 on planning conditions and obligations states:

“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.”

2.4.4 Paragraph 102 on promoting sustainable transport states:

“Transport issues should be considered from the earliest stages of plan-making and development proposals, so that:

...

d) the environmental impacts of traffic and transport infrastructure can be identified, assessed and taken into account – including appropriate opportunities for avoiding and mitigating any adverse effects, and for net environmental gains; ...”

2.4.5 Paragraph 103 continues to state:

“Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions, and improve air quality and public health.”

2.4.6 Paragraph 170 on conserving and enhancing the natural environment states:

“Planning policies and decisions should contribute to and enhance the natural and local environment by: ...

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land stability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans, and...”

2.4.7 Paragraph 180 within ground conditions and pollution states:

“Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development.”

2.4.8 Paragraph 181 states that:

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

2.4.9 Paragraph 182 states that:

“Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or ‘agent of change’) should be required to provide suitable mitigation before the development has been completed”.

Planning Practice Guidance

2.4.10 Planning Practice Guidance (PPG) (Planning Practice Guidance, 2014) was first published in March 2014 to support the National Planning Policy Framework.

2.4.11 Paragraph 005, Reference 32-005-20191101 (revision date 01.11.2019), of the PPG provides guidance on how considerations regarding air quality can be relevant to the development management process as follows:

“Whether air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to have an adverse effect on air quality in areas where it is already known to be poor, particularly if it could affect the implementation of air quality strategies and action plans and/or breach legal obligations (including those relating to the conservation of habitats and species). Air quality may also be a material consideration if the proposed development would be particularly sensitive to poor air quality in its vicinity.

Where air quality is a relevant consideration the local planning authority may need to establish:

- *The 'baseline' local air quality, including what would happen to air quality in the absence of the development;*
- *Whether the proposed development could significantly change air quality during the construction and operational phases (and the consequences of this for public health and biodiversity); and*
- *Whether occupiers or users of the development could experience poor living conditions or health due to poor air quality.*

2.4.12 Paragraph 006, Reference 32-006-20191101 (revision date 01.11.2019), of the PPG identifies what specific air quality issues need to be considered in determining a planning application:

“Considerations that may be relevant to determining a planning application include whether the development would:

- *Lead to changes (including any potential reductions) in vehicle-related emissions in the immediate vicinity of the proposed development or further afield. This could be through the provision of electric vehicle charging infrastructure; altering the level of traffic congestion; significantly changing traffic volumes, vehicle speeds or both; and 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; could add to turnover in a large car park; or involve 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; biomass boilers or biomass-fuelled Combined Heat and Power plant; centralised boilers or plant burning other fuels within or close to an air quality management area or introduce relevant combustion within a Smoke Control Area; or extraction systems (including chimneys) which require approval or permits under pollution control legislation;*
- *Expose people to harmful concentrations of air pollutants, including dust. This could be by building new homes, schools, workplaces or other development in places with poor air quality;*
- *Give rise to potentially unacceptable impacts (such as dust) during construction for nearby sensitive locations; and*
- *Have a potential adverse effect on biodiversity, especially where it would affect sites designated for their biodiversity value.”*

2.4.13 Paragraph 007, Reference 32-007-20191101 (revision date 01.11.2019), of the PPG provides guidance on how detailed an assessment needs to be;

“Assessments need to be proportionate to the nature and scale of development proposed and the potential impacts (taking into account existing air quality conditions), and because of this are likely to be locationally specific.”

and

“The following could form part of assessments:

- *A description of baseline conditions and any air quality concerns affecting the area, and how these could change both with and without the proposed development;*
- *Sensitive habitats (including designated sites of importance for biodiversity);*
- *the assessment methods to be adopted and any requirements for the verification of modelling air quality;*
- *The basis for assessing impacts and determining the significance of an impact;*
- *Where relevant, the cumulative or in-combination effects arising from several developments;*
- *Construction phase impacts;*
- *Acceptable mitigation measures to reduce or remove adverse effects; and*
- *Measures that could deliver improved air quality even when legally binding limits for concentrations of major air pollutants are not being breached.”*

2.4.14 Paragraph 008, Reference 32-008-20140306 (revision date 01.11.2019), of the PPG provides guidance on how an impact on air quality can be mitigated;

“Mitigation options will need to be locationally specific, will depend on the proposed development and need to be proportionate to the likely impact. It is important that local planning authorities work with applicants to consider appropriate mitigation so as to ensure new development is appropriate for its location and unacceptable risks are prevented. Planning conditions and obligations can be used to secure mitigation where the relevant tests are met.

Examples of mitigation include:

- *Maintaining adequate separation distances between sources of air pollution and receptors;*
- *Using green infrastructure, trees, where this can create a barrier or maintain separation between sources of pollution and receptors;*
- *Appropriate means of filtration and ventilation;*
- *Including infrastructure to promote modes of transport with a low impact on air quality (such as electric vehicle charging points);*
- *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.”*

Local Policy

Reading New Local Plan

- 2.4.15 RBC has published a new Local Plan on the 4th of November (RBC,2019). Once adopted, the new Local Plan will guide development in the Borough until 2036. The document contains Policy EN15 Air Quality, which states:

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

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 of air quality would be offset by an overall improvement in air quality, for instance through the reduction in the need to travel.*

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.

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

Reading Air Quality Action Plan

- 2.4.16 RBC has declared an AQMA due to exceedances of the annual mean NO₂ objective. The AQMA encompasses all the main arterial routes in and out of Reading and the central area. Due to this declaration, the Council has the responsibility to produce an Air Quality Action Plan (AQAP). The Reading Air Quality Plan Update 2016 (RBC, 2016) aims to improve air quality within the AQMA and wider Reading area. The AQAP contains the following key measures:

- upgrading and expanding local railway services;

- introduction of Mass Rapid Transit (MRT) (southern and eastern MRT) and new park and ride bus routes;
- traffic management to reduce congestion on the A4 and A33;
- cycling network improvements and infrastructure; and
- using the planning process to ensure new developments do not lead to further deterioration in air quality.

3 Methodology

3.1 Study Areas

3.1.1 The study areas adopted for this assessment are:

- For the construction phase assessment, the Study Area is defined as up to 350m from the Project; and,
- For the operational phase assessment, the Study Area is defined as all roads within 250m of the Project and any other roads predicted to experience an increase of greater than 500 vehicles per day or 100 within an AQMA as a result of the proposed development.

3.2 Existing Conditions

3.2.1 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, 2019b).

3.3 Construction Impacts

3.3.1 The Institute of Air Quality Management (IAQM) has issued revised guidance on the assessment of dust from demolition and construction (Holman et al, 2014). Within the IAQM guidance, an 'impact' is described as a change in pollutant concentrations or dust deposition and an 'effect' is described as the consequence of an impact.

3.3.2 During pre-construction 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.

3.3.3 Separation distance is also an important factor. Large dust particles (greater than 30 µm), responsible for most dust annoyance, will largely deposit within 100 m of sources. Intermediate particles (10-30 µm) 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.

3.3.4 The IAQM guidance recommends that the risk of dust emission magnitude 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.

3.3.5 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.

3.3.6 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
	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

Dust Emission Magnitude	Activity
	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 PM ₁₀ 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 < 10 dwellings within 20 m Offices/shops/parks within 20 m PM ₁₀ 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 < 10 dwellings within 20 – 350 m Playing fields, parks, farmland, footpaths, short term car parks, roads, shopping streets PM ₁₀ 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

- 3.3.7 Based on the dust emission magnitude and the area sensitivity, the risk of dust impacts is then determined (**Table 3.3**, **Table 3.4** and **Table 3.5**), taking into account professional judgement.

Table 3.3 Risk of Dust Impacts - Demolition

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

Table 3.4 Risk of Dust Impacts - Earthworks and Construction

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

Table 3.5 Risk of Dust Impacts - Trackout

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

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

Significance Criteria

- 3.3.9 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.
- 3.3.10 With appropriate mitigation in place, the residual effect of construction impacts on air quality is assessed as not significant.

3.4 Road Traffic Impacts

Human Health Receptors

- 3.4.1 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.
- 3.4.2 The area assessed also takes into account guidance developed by Environmental Protection UK (EPUK) and the IAQM. The guidance provides indicative criteria for when an air quality assessment is required. Existing receptors have been included in the assessment where they are adjacent to roads with an increase in traffic above the IAQM/EPUK guidance criteria below:
- A change of Light Duty Vehicles (LDVs) flows of more than 100 AADT within or adjacent to an AQMA or more than 500 AADT elsewhere.
 - A change of Heavy Duty Vehicles (HDVs) flows of more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere (Moorcroft and Barrowcliffe *et al*, 2017).
- 3.4.3 Based on the above criteria, five existing properties have been identified as residential receptors for the assessment. The locations of existing residential 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 3.6** and shown in **Figure 1, Appendix G**. Receptors were modelled at a height of 1.5 m representing ground floor exposure.

- 3.4.4 Concentrations have also been predicted at one diffusion tube monitor (DT13) located on 495 Basingstoke Road in order to verify the modelled results (see **Appendix C** for further details on the verification method).

Table 3.6 Receptor Locations Description

Receptor	Location	x	y	Height (m)
R1	51 Kingsley Drive	471585.4165	169046.7933	1.5
R2	52 Kingsley Drive	471591.1315	169079.3371	1.5
R3	53 Kingsley Drive	471610.1816	169045.3646	1.5
R4	43 Kingsley Drive	471604.0697	169142.3412	1.5
R5	44 Kingsley Drive	471599.3072	169109.0036	1.5

Impact Predictions

- 3.4.5 Predictions have been carried out using the ADMS-Roads dispersion model (v4.1.1). 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 2018 meteorological data from the Farnborough meteorological station, which are considered suitable for this area. (**Appendix D** provides further details on the model inputs).
- 3.4.6 AADT flows and the proportions of HDVs, for roads within 250 m of the proposed development site and existing receptors have been provided by the transport team at Peter Brett Associates, now part of Stantec. Traffic data for the monitoring verification site DT13 has been taken from the DfT traffic data. Traffic data used in this assessment are summarised in **Appendix E**.
- 3.4.7 Traffic emissions were calculated using the Emission Factor Toolkit (EFT) v9.0, which utilises NOx emission factors taken from the European Environment Agency COPERT 5 emission tool. The traffic data were entered into the EFT, along with speed data to provide combined emission rates for each of the road links entered into the model.
- 3.4.8 The assessment has been carried out using 2019 emission factors with a transport model year of 2019. An assessment was undertaken via input to the EFT v9.0 of a B2 and a B8 traffic scenario, and B8 had a higher emissions profile. The B8 land use class transport scenario was then therefore used to present a 'worst case' assessment.

Human Health Impacts Significance Criteria

- 3.4.9 The relevant objectives for human health are set out in **Table 2.1** and **Table 2.2**. 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), which considers the change in air quality as a result of a proposed development on existing receptors, has therefore been used (Moorcroft and Barrowcliffe et al., 2017).
- 3.4.10 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.

Table 3.7 Impact Descriptor for individual receptors

Long term average Concentration at receptor in assessment year	% Changes in Concentration with development in relation to Objective / Limit Value			
	1*	2-5	6-10	>10
> 110 % (a)	Moderate	Substantial	Substantial	Substantial
>102% - ≤110% (b)	Moderate	Moderate	Substantial	Substantial
>95% - ≤102% (c)	Slight	Moderate	Moderate	Substantial
>75% - ≤95% (d)	Negligible	Slight	Moderate	Moderate
≤75% (e)	Negligible	Negligible	Slight	Moderate

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

*% change rounded to nearest whole number. Where the % change is 0 (ie. Less than 0.5%) the impact will be Negligible.

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

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

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

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

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

3.4.11 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. **Table 3.7** 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.

3.4.12 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

3.4.13 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.

3.4.14 There has been an acknowledged disparity between national road transport emissions projections and measured annual mean concentrations of nitrogen oxides and NO₂ for many

years; whilst projections suggested that both annual mean nitrogen oxides and NO₂ concentrations from road traffic emissions should have fallen significantly, at many monitoring sites levels had remained relatively stable, or showed a slight increase (Carslaw et al., 2011). Subsequent investigations including the widely publicised 'emissions scandal' has provided further information which, along with a changed emissions testing protocol, has resulted in revisions to the emissions projections. Recent monitoring has shown that reductions in concentrations are now being measured in many parts of the country, however, there is still some uncertainty regarding the rate at which emissions will reduce in the future and therefore some consideration must be given the accuracy of any projection and to appropriately respond to this. Further discussion relating to emissions factors is included in Appendix E .

- 3.4.15 The development modelling has been based on 2019 emission factors and background concentrations, whilst utilising traffic flows for 2019. The model has been verified against 2018 monitoring data.

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. Reading AQMA covers the majority of the town centre and the road network including Junction 11 of the M4.

4.2 Monitoring

Nitrogen Dioxide

- 4.2.1 RBC carries out monitoring at three automatic monitoring stations, with an additional automatic monitoring location operated by Defra. There is no automatic monitoring in close proximity to the site. In 2018, the Council undertook passive (diffusion tube) monitoring at 56 locations. The closest and most representative monitoring locations are described in **Table 4.1** below.

Table 4.1 Measured NO₂ Concentrations

Site ID	Site Type	Within AQMA	Annual Mean (µg/m³)				
			2014	2015	2016	2017	2018
Diffusion Tubes							
*DT13–495 Basingstoke Road	Roadside	Y	34	31	33	34	28
DT11 – Shinfield Road	Roadside	Y	33	30	34	31	31
DT12 – Shinfield Road	Roadside	Y	43	39	42	38	34
Objective		40					

Exceedances of the objective highlighted in bold.

2013 – 2018 data taken from the 2019 Air Quality Annual Status Report (RBC, 2019b)

*Used for model verification

- 4.2.2 Measured concentrations at the closest monitoring location to the development site, DT13 at 495 Basingstoke Road (circa 1.1 km away) have been below the annual mean objective between 2014 and 2018. Conditions at the site are not expected to be comparable to those at this monitoring location, development concentrations are likely to be higher due to higher traffic and associated emissions. Measured concentrations at the remaining monitoring locations shown in **Table 4.1** have also been below the objective, except for DT12 on Shinfield Road, where the objective was exceeded in 2014 and 2016.

PM₁₀

- 4.2.3 There is no PM₁₀ monitoring undertaken in close proximity to the proposed development site.

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, 2019b). The mapped background concentrations were calibrated against background concentrations measured at the Reading AURN automatic monitoring site (see **Appendix B** for more details). The calibrated Defra background concentrations for the site and modelled area are provided in **Table 4.2**.

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

Table 4.2: Estimated Annual Mean Background Concentrations

Year	Location	Annual Mean ($\mu\text{g}/\text{m}^3$)			
		NO _x	NO ₂	PM ₁₀	PM _{2.5}
2018	471_169	26.3	20.6	12.6	8.3
2019	471_169	25.1	19.9	12.4	8.2
Objectives		-	40	40	25

4.4 Predicted Baseline Concentrations

Human Health Receptors

4.4.1 The ADMS-Roads model has been run to predict baseline NO₂, PM₁₀ and PM_{2.5} concentrations at each of the existing receptor locations identified in **Table 3.6**. The results for the baseline scenarios are presented in **Table 4.3** below.

Table 4.3 Predicted Baseline Concentrations of NO₂, PM₁₀ and PM_{2.5} in 2018 and 2019

Receptor	Annual Mean ($\mu\text{g}/\text{m}^3$)					
	NO ₂		PM ₁₀		PM _{2.5}	
	2018	2019	2018	2019	2018	2019
R1	26.2	25.3	13.8	13.6	9.0	8.9
R2	25.0	24.2	13.5	13.4	8.9	8.7
R3	24.1	23.3	13.3	13.2	8.7	8.6
R4	24.4	23.8	13.4	13.2	8.8	8.6
R5	24.3	23.7	13.4	13.2	8.8	8.6
Objectives	40		40		25	

4.4.2 The annual mean NO₂, PM₁₀ and PM_{2.5} objectives are not predicted to be exceeded at any of the existing receptor locations in 2018 and 2019.

5 Impact Assessment

5.1 Construction Dust 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. There is no significant demolition expected during this development.
- 5.1.3 Based on the IAQM guidance criteria (**Table 3.1**), the potential dust emission magnitude for the phases of construction are as follows:
- for earthworks, the emissions magnitude is classified as 'large' given the >34,000 sqm size of the site, levelling activities involved and loamy intermediate character soil types;
 - for construction activities, the dust emission magnitude is considered to be 'large' due to the total building volume and construction materials; and
 - For trackout, the dust emission magnitude is considered to be 'medium' due to the potential length of onsite haul roads and there are anticipated to be up to 10 - 25 HDV movements per day.
- 5.1.4 The study area is considered to be of 'low' sensitivity to potential dust impacts (**Table 3.2**), due to the close proximity of commercial premises to the site and residential receptors to the north of the site.
- 5.1.5 The study area is considered to be of 'low' sensitivity to potential PM₁₀ impacts (**Table 3.2**), due to the baseline PM₁₀ concentrations and distance to of sensitive receptors.
- 5.1.6 There are no sensitive ecological receptors within 50m of the site and therefore the study area is not considered to be sensitive to potential dust or PM₁₀ impacts on ecological receptors.
- 5.1.7 The overall risk of dust impacts for earthworks, construction and trackout are classified as 'low'.
- 5.1.8 Overall, appropriate mitigation measures corresponding to a 'low risk' site are therefore required during the construction phase of the development (see **paragraph 6.1.1**).

5.2 Road Traffic Impacts

Operation

Human Health Receptors

- 5.2.1 Predicted concentrations of NO₂, PM₁₀ and PM_{2.5} at existing receptors, both without and with the proposed development in place are presented in Error! Reference source not found., Error! Reference source not found. and Error! Reference source not found. below.

Table 5.1 Predicted Concentrations of NO₂ (µg/m³), % Change and Impact at each Receptor

Receptor	2019 Without Development	2019 With Development	Change (%)	Impact
R1	25.3	25.3	0.02%	Negligible
R2	24.2	24.2	0.02%	Negligible
R3	23.3	23.3	0.03%	Negligible
R4	23.8	23.8	0.02%	Negligible
R5	23.6	23.7	0.03%	Negligible
Objectives	40		-	

Table 5.2 Predicted Concentrations of PM₁₀ (µg/m³), % Change and Impact at each Receptor

Receptor	2019 Without Development	2019 With Development	Change (%)	Impact
R1	13.6	13.6	0.01%	Negligible
R2	13.4	13.4	0.01%	Negligible
R3	13.2	13.2	0.01%	Negligible
R4	13.2	13.2	0.00%	Negligible
R5	13.2	13.2	0.01%	Negligible
Objectives	40		-	

Table 5.3 Predicted Concentrations of PM_{2.5} (µg/m³), % Change and Impact at each Receptor.

Receptor	2019 Without Development	2019 With Development	Change (%)	Impact
R1	8.9	8.9	0.01%	Negligible
R2	8.7	8.7	0.01%	Negligible
R3	8.6	8.6	0.01%	Negligible

Receptor	2019 Without Development	2019 With Development	Change (%)	Impact
R4	8.6	8.6	0.00%	Negligible
R5	8.6	8.6	0.00%	Negligible
Objectives	40		-	

- 5.2.2 The predicted NO₂, PM₁₀ and PM_{2.5} concentrations in 2019 without and with the proposed development in place are below the relevant objectives at all existing receptor locations.
- 5.2.3 None of the predicted annual mean NO₂ concentrations exceed 60 µg/m³ and therefore exceedance of the 1-hour mean NO₂ objective is unlikely.
- 5.2.4 None of the predicted annual mean PM₁₀ concentrations exceed 32 µg/m³ and therefore the 24-hour mean PM₁₀ objective is not predicted to be exceeded.
- 5.2.5 Changes are below 0.04% occur at all receptors for NO₂. The changes in PM₁₀ and PM_{2.5} concentrations are all below 0.01%.
- 5.2.6 Using the criteria set out in **Table 3.7** the impact on annual mean NO₂ concentrations is described as negligible at all receptor locations. The impact on PM₁₀ concentrations is described as negligible, and the annual mean of 32µg/m³ equating to 35 days above 50µg/m³ for PM₁₀ is described as negligible at all receptor locations.

Impact Significance

- 5.2.7 Overall, considering the conservative nature of the assessment, and the criteria set out in **paragraph 3.4.10**, the air quality effects of road traffic generated by the proposed development is 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 (refer to **Table 3.6**).

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

- 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 comply with the London Low Emission Zone and the NRMM standards, where applicable.
- Ensure all vehicles switch off engines when stationary.
- Avoid the use of diesel or petrol powered generators where possible.
- 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.

Construction

- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless required for a particular process.

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.

6.2 Operation

- 6.2.1 The effects of development traffic on existing human health receptors are judged to be not significant as the predicted pollutants concentrations are well below the relevant air quality objectives. No additional mitigation is therefore required against the direct effects of the traffic.
- 6.2.2 To further reduce the impacts of traffic associated with the development a Travel Plan has been developed, which seeks to reduce the number of employee vehicle movements associated with the development and subsequent emissions by encouraging sustainable transport. Several mitigation measures are included within the documents, together with management, implementation and monitoring of such measures.

7 Conclusions

- 7.1.1 The air quality impacts associated with the proposed redevelopment of the site at Reading International Business Park, located within the administrative boundary of Reading Borough Council have been assessed.
- 7.1.2 To date, RBC has declared one AQMA due to exceedances of the annual mean NO₂ objective. This entails an area covering Reading Town Centre, areas along the major radial road routes into Reading (including J11 of the M4). The proposed site is not located within this AQMA, however the modelled road network is.
- 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 Concentrations of NO₂, PM₁₀ and PM_{2.5} have been predicted for a number of worst case locations representing existing properties adjacent to the road network. Predicted concentrations are well below the relevant objectives at all of the existing receptor locations.
- 7.1.5 Mitigation measures to reduce the impacts of the development on air quality concentrations are not required, but additional transport related mitigation measures within the travel plan will be employed to reduce emissions from the development.
- 7.1.6 The operational effects of the proposed development are judged to be not significant.
- 7.1.7 Overall, it is concluded that there are no air quality constraints to the proposed development.

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Appendix A Glossary

Abbreviations	Meaning
AADT	Annual Average Daily Traffic
ADMS	Air Dispersion Modelling System
APIS	Air Pollution Information System
AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network
CEMP	Construction Environmental Management Plan
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
Diffusion Tube	A passive sampler used for collecting NO ₂ in the air
EA	Environmental Agency
EFT	Emission Factor Toolkit
EHO	Environmental Health Officer
EPUK	Environmental Protection UK
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
NPPF	National Planning Policy Framework
RBC	Reading Borough Council.
PBA	Peter Brett Associates, now Part
PM ₁₀ /PM _{2.5}	Small airborne particles less than 10/2.5 µm in diameter
PPG	Planning Practice Guidance
Receptor	A location where the effects of pollution may occur
SSSI	Site of Special Scientific Interest
SPG	Supplementary Planning Guidance
TEA	Triethanolamine
UNECE	United Nations Economic Commission for Europe
TEMPO	Trip End Model Presentation Programme

Appendix B 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 2018 annual mean road- NO_x contribution at a monitoring location (identified in **RBC carries** out monitoring at three automatic monitoring stations, with an additional automatic monitoring location operated by Defra. There is no automatic monitoring in close proximity to the site. In 2018, the Council undertook passive (diffusion tube) monitoring at 56 locations. The closest and most representative monitoring locations are described in **Table 4.1** below.

Table 4.1). Concentrations have been modelled at a height of 2.5 m.

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. 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.

The following primary adjustment factor has been applied to all modelled nitrogen dioxide data:

Primary adjustment factor: 1.463

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.

Particulates (PM_{10} and $\text{PM}_{2.5}$)

There is no PM_{10} or $\text{PM}_{2.5}$ monitoring in close proximity to the proposed development site. Therefore, the primary adjustment factor calculated for NO_2 concentrations has been applied to the modelled road-particulates concentrations.

Appendix C Model Inputs and Results Processing Tools

Meteorological Data	2018 Hourly meteorological data from Farnborough Station has been used in the model. The wind rose is shown in figure C1.
ADMS	Version 4.1.1
Time Varying Emission Factors	Based on Department for Transport statistics. Table TRA0307. Motor vehicle traffic distribution by time of day and day of the week on all roads, Great Britain: 2018.
Latitude	51°
Surface Roughness	A value of 0.5 for Parkland and Open Suburbia was used to represent the modelled area. A value of 0.3 for agricultural areas was used to represent the meteorological station site
Minimum Monin-Obukhov length	A value of 30 for Cities and large towns was used to represent the modelled area. A value of 10 for small towns was used to represent the meteorological station site.
Emission Factor Toolkit (EFT)	V9.0 , April 2019.
NO _x to NO ₂ Conversion	NO _x to NO ₂ calculator version 7.1, April 2019
Background Maps	2017 reference year background maps

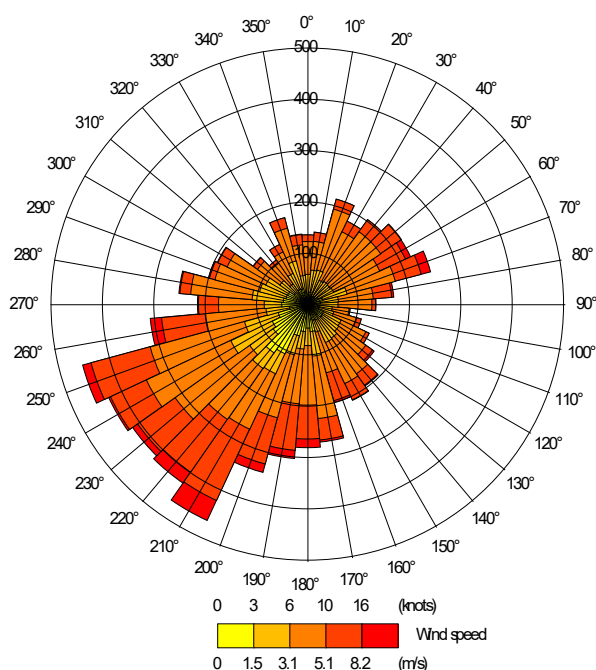


Figure C.1: 2018 Farnborough Wind rose

Appendix D Traffic Data and Road Network

Location	Speed (kph)	2018 Baseline		2019 Without Development		2019 With Development	
		AADT	HDV (%)	AADT	HDV (%)	AADT	HDV (%)
A33 north of Imperial Way Roundabout	64	47,273	7.2	48,020	7.2	48,244	7.2
A33 between RIBP north and Imperial Way Roundabout	48	48,777	9.8	49,548	9.8	49,767	9.8
A33 between RIBP south and north accesses (southbound)	48	21,323	9.2	21,660	9.2	21,743	9.2
A33 between RIBP south and north accesses (northbound)	48	25,978	9.3	26,388	9.3	26,543	9.3
Imperial Way	64	13,817	6.2	14,035	6.2	14,078	6.2
B3031	64	8,525	8.4	8,660	8.4	8,668	8.4

Appendix E Future Year Modelling – Road Transport Emissions Factors

Introduction

Atmospheric dispersion modelling is used to determine the effect of future development traffic on local air quality. The modelling utilises predictions of the composition and emissions profile of the vehicle fleet which are produced by Defra in the emissions factor toolkit (EFT) with the fleet composition and emissions profiles provided on a year by year basis; the most recent update is V9.0 and includes data from 2017 to 2030.

The modelling of future traffic impacts requires consideration of uncertainty as to the accuracy of the emission factors, as well as uncertainty introduced by the modelling process and the traffic data on which the predictions are based. This has become more important in recent years as it has been realised that previous versions of the EFT were likely to have significantly underestimated the real-world NO_x emissions of the vehicle fleet primarily resulting from diesel vehicles.

This note sets out PBAs approach to the choice of vehicle emission factors for future year assessments.

Modelling Methodology

As a prelude to the discussion of emission factors, it is useful to recap on the general methodology that is used for dispersion modelling of road traffic emissions:

- Traffic data is entered into the dispersion model to represent the baseline situation and the model is used to predict how NO_x emissions are dispersed in the environment.
- The dispersion modelling predictions are compared to monitoring data to obtain a verification factor; the factor by which the predicted road traffic concentration must be multiplied by to agree with the monitored concentration.
- The modelling is repeated for the future year situation; with traffic data representing the situation without the development in place (the 'without' scheme scenario) and with the development in place ('with' scheme). In both cases, the verification factor obtained from the baseline modelling is used to multiply the model results by, in essence assuming that the model is equally as accurate in the future as it was for the baseline scenario.

The verification factor is one of the key elements in the discussion regarding vehicle emission factors. One element of uncertainty in the modelling is the degree to which the emission factors in the EFT are different to actual emissions of the vehicle fleet on the local road network. The use of the verification factor for the future year predictions essentially assumes that the difference between the EFT emission factors and real world emissions is the same in the future as it was in the baseline year. In other words, unless there is some reason to believe that the future year emission factors are less accurate than the baseline year emission factors, the degree to which the EFT emission factors and real world emission factors differ is taken into account in the modelling by the use of the verification factor. This is discussed further in the following sections.

Emission Factor Toolkit

The EFT contains estimates of the future composition of the vehicle fleet in terms of the age and type of vehicles. The composition of the vehicle fleet is primarily related to the age of the vehicles (in terms of their emissions class) and the fuel that they use (i.e. petrol, diesel or electric). In general terms, as new vehicles replace older vehicles, and as the emissions performance of vehicles is generally taken to improve over time, both current and historical versions of the EFT predict very large reductions in NO_x emissions in the future. It is also obvious that the further one looks into the future, the more uncertain the predictions become as they depend on the rate of vehicle renewal and the size and fuel mix of the vehicles bought; which are all estimates.

The emissions performance of the vehicles in the EFT is classified in terms of Euro type approval testing; Euro 1 to 6 concerning light duty vehicles and Euro I to VI heavy duty vehicles. Whilst the introduction of each Euro class has generally seen a tightening of emission standards, the standards up until 2017 were based on laboratory testing of vehicles. The emissions performance of the vehicles in real world driving conditions has been higher than the laboratory testing results, especially for diesel vehicles. This factor was not recognised in earlier versions of the EFT, and combined with the fact that diesel vehicles have much higher NO_x emissions than petrol vehicles and there has been a very large increase in the number of diesel vehicles on the road, has meant that the NO_x emissions and NO₂ concentrations did not reduce as was anticipated.

The trends in NO_x emissions in the vehicle fleet, especially diesel vehicles and the accuracy of the current version of the EFT, is therefore critical in terms of the choice of emission factors in modelling.

Trends in NO_x emissions

For light duty vehicles, the latest Euro standard is Euro 6, which was introduced from September 2015 (with a derogation in the UK for the registration of new vehicles until September 2016).

The emissions standards previously related to a laboratory test whereby the average emission rate is calculated over an idealised drive cycle. The cycle used was the New European Drive Cycle (NEDC) and there was extensive criticism that the drive cycle did not represent real world driving conditions. A new drive cycle was therefore introduced, the World Light-duty Test Cycle (WLDTc), as well as an on-road test termed Real Driving Emissions (RDE) from September 2017.

Up until September 2017, Euro 6 vehicles were only tested in the laboratory against the NEDC, and these vehicles are termed Euro 6ab. However, from September 2017, new models are tested against the WLDTc and also have a RDE test. The initial introduction of the RDE test allowed vehicles to have average RDE test emissions of 2.1 times the WLDTc test standard (termed Euro 6c vehicles). The 2.1 factor is termed the conformity factor and applies to new vehicle models from September 2017 and all new vehicles from September 2019. From January 2020, the conformity factor will reduce to 1.5 for new vehicle models (January 2021 for all new vehicles) and these are termed Euro 6d vehicles.

Air Quality Consultants undertook some research into the performance of diesel vehicles to support a methodology that they adopted for undertaking air quality assessments¹. As part of the analysis, they compared the real word test results of current Euro 6ab diesel vehicles and calculated an average conformity factor of 3.9 from the tests that were assessed. This work led to AQC publishing the CURED v2A calculator which attempted to take account of the real world emissions performance of diesel vehicles. The approach using CURED v2A was generally accepted to be conservative when considering developments a long time in the future.

Subsequently, the Department for Transport have undertaken testing of Euro 5 and 6ab diesel vehicles and found that the average NO_x emissions were 1135 mg/km for Euro 5 vehicles and 500 mg/km for Euro 6ab vehicles². These work out to be a conformity factor of 6.30 and 6.25 for Euro 5 and Euro 6ab respectively. Adding in the DfTr results to the AQC results gives an overall average conformity factor for Euro 6ab vehicles tested of 4.1.

A paper presented by Dr Marc Stettler at the 2016 Westminster Energy, Environment & Transport Forum³ included results of RDE testing of existing Euro 6ab vehicles. Whilst there was wide range in the results, a number of the vehicles tested did already comply with the Euro 6c standard.

¹ Emissions of Nitrogen Oxides from Modern Diesel Vehicles. AQC January 2016

² Vehicle Emissions Testing Programme DfTr Cm 9259 April 2016

³ Priorities for reducing air quality impacts of road vehicles. Dr Marc Stettler 17th May 2016

Similar results have been reported in a study led by Rosalind O'Driscoll of Imperial College⁴. This showed that the average NO_x emissions were 4.5 times higher than the Euro 6 limit, with an average NO₂ percentage of 44%.

From the emissions testing work undertaken to date on Euro 6ab vehicles it is clear that the NO_x emissions performance of Euro 6ab vehicles is significantly better than Euro 5 vehicles, although not in line with the laboratory standards. The introduction of Euro 6 should therefore see a significant reduction in NO_x emissions in the future, as outlined in the following table.

Emission Standard	Real Driving Emissions NO _x mg/km
Euro 5, DfTr testing	1135
Euro 6ab, DfTr testing	500
Euro 6c, September 2017 models	168
Euro 6d, January 2020 models	120

Further testing of vehicles is ongoing, with Emissions Analytics regularly publishing the results of real world emissions testing on vehicles⁵. Also, in the November 2017 budget, the government announced a one-off tax on new diesel cars not meeting Euro 6c standards. Both of these factors should help put pressure on vehicle manufacturers to meet the RDE standards. In the longer term, there is also the move to electric vehicles which will gather pace. Recent evidence in terms of vehicle procurement also suggests a decline in diesel vehicle sales due to negative publicity. These factors may mean that the vehicle fleet predictions in the EFT v9.0 are pessimistic with regard to vehicle NO_x emissions.

Emissions in the EFT

As noted in Section 3, the EFT contains estimates of vehicle emissions by Euro Class. The database was updated in May 2019 to v9.0. It now uses NO_x emissions factors for the vehicles taken from the European Environment Agency's COPERT 5 database and the 2019 update included changes to the fleet mix due largely to the London Low Emissions Zone.

The EFT now takes account of the real-world performance of Euro 6ab diesel cars, applying a high conformity factor to these vehicles. For Euro 6c and Euro 6d vehicles, it assumes that the RDE is effective in bringing down vehicle emissions, but does not assume that vehicle emissions will be as low as the conformity factors in the RDE testing. The EFT therefore incorporates an assumption that diesel car NO_x emissions will be higher in real world driving conditions than the testing standards allow.

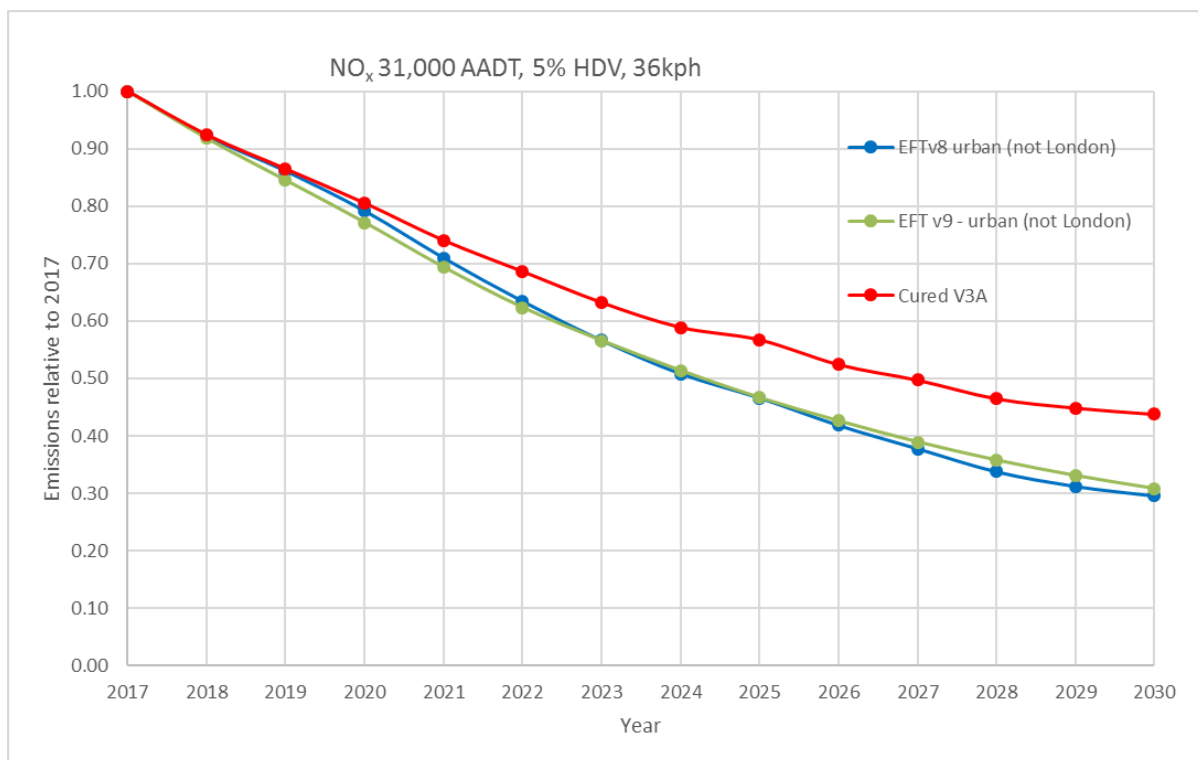
AQC reviewed their approach to vehicle emissions⁶ following publication of EFT v8.0. CURED v3A was formulated assuming that light duty vehicle emissions are as per EFT v8.0 up until Euro 6c. Euro 6d vehicles are assumed to have the same emissions as Euro 6c. Emissions from HDVs are assumed to be as per the EFT v8.0. Vehicle emissions using CURED v3A can be considered to be a worst-case sensitivity test post 2020. CURED v3A has not been revised following the publication of EFT v9.0.

The following graph shows the relative decline in vehicle NO_x emissions predicted for an urban road (outside London) with 5% Heavy Duty Vehicle traffic, travelling at 36kph. As air quality models are verified against historic data, the relative decline in emissions is shown.

⁴ A Portable Emissions Measurement System (PEMS) study of NO_x and primary NO₂ emissions from Euro 6 diesel passenger cars and comparison with COPERT emission factors. Rosalind O'Driscoll. September 2016

⁵ <http://equaindex.com/equa-air-quality-index/>

⁶ Development of the CURED V3A Emissions Model



For emission years prior to 2021, the CURED v3A methodology is likely to give similar results to using the EFT v9.0 data. Post 2021, when the introduction of Euro 6d begins to take effect, then CURED v3A and the EFT v9.0 begin to diverge. By 2030, CURED v3A emissions are approximately equivalent to EFT v9.0 for 2025.

Appendix F Background Concentrations

Introduction

Defra publish details of estimated background concentrations of pollutants for each 1km grid square across the country. Reading Borough Council run a urban background monitoring AURN site approximately 4.5km north of the development site. In order to more accurately reflect background concentrations across the study area, defra mapped background concentrations at this site have been compared against concentrations measured at the site in 2018 to produce a calibration factor which is applied to background concentrations across the study area.

Nitrogen Dioxide

Defra mapped $\text{NO}_2 = 23.5 \mu\text{g}/\text{m}^3$
Measured $\text{NO}_2 = 25.86 \mu\text{g}/\text{m}^3$
Calibration factor = $25.86 / 23.5 = 1.102$

This factor has been applied to the mapped background for both baseline and future year scenarios across the study area.

PM₁₀

Defra mapped $\text{PM}_{10} = 16.6 \mu\text{g}/\text{m}^3$
Measured $\text{PM}_{10} = 13.354 \mu\text{g}/\text{m}^3$
Calibration factor = $16.6 / 13.354 = 0.803$

This factor has been applied to the mapped background for both baseline and future year scenarios across the study area.

PM_{2.5}

Defra mapped $\text{PM}_{2.5} = 11.6 \mu\text{g}/\text{m}^3$
Measured $\text{PM}_{2.5} = 9.115 \mu\text{g}/\text{m}^3$
Calibration factor = $11.6 / 9.115 = 0.785$

Appendix G Figures

