



Station Hill, Reading

Air Quality Assessment

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Comments

Comments

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Appendices

- A. Air Quality Assessment Detailed Methodology and Modelled Conditions within the Proposed Development
- B. Cumulative Schemes

Introduction

- 1.1. This report, which was prepared by Waterman Infrastructure & Environment Ltd, presents an assessment of the likely air quality effects of the redevelopment of land to the south of Station Hill, Reading. The redevelopment comprises the demolition of all existing buildings and structures on the site and the construction of a commercial and residential led scheme with ancillary retail and leisure uses, hereafter referred to as the Proposed Development. The Site Location, Site Layout and Proposed Development layout are presented as **Figures 1, 2 and 3**.
- 1.2. The Proposed Development would be constructed in three phases with Plots E and F forming phase 1, Plot G including surrounding public realm forming Phase 2 and Plots A to D forming Phase 3. Plots E and F are also referred to as the South Site and Plots A to D and G (Phases 1 and 2) are referred to as the North Site. Because there is a potential for a pause in the Proposed Development following completion of Phases 1 and 2, the air quality assessment has considered an Interim Development Scenario (following completion of Phases 1 and 2) and a Completed Development Scenario, considering all phases. A Cumulative Development Scenario has also been assessed taking into account a number of consented or reasonably foreseeable schemes as agreed with Reading Borough Council.
- 1.3. Consideration is given in the assessment of pollution effects from changes in road traffic movements as a result of the operation of the Proposed Development, as well as potential effects from dust emissions generated during the site preparation and construction activities.
- 1.4. This report provides a description of the methods used in the assessment. This is followed by a description of the relevant baseline conditions of the Site and surrounding area, together with an assessment of the likely potential effects of the Proposed Development during the Site preparation and construction works and once the Proposed Development is completed and operational. Mitigation measures are identified where appropriate to avoid, reduce or offset any adverse effects identified and / or enhance likely beneficial effects. Taking account of the mitigation measures, the nature and significance of the likely residual effects are described.
- 1.5. The detailed methodology of the air quality assessment is presented in **Appendix A**.

Assessment Methodology and Significance Criteria

Assessment Methodology

- 1.6. This air quality assessment has been undertaken using a variety of information and procedures, and professional judgement. The methodology was as follows:
- Review of Reading Borough Council's (RBC's) air quality review and assessment documents, published as part of the Local Air Quality Management (LAQM) regime, to determine baseline conditions around the Site;
 - A review of the Proposed Development and local area to identify potentially sensitive receptor locations, both existing and proposed, that could be affected by changes in air quality that result from the Proposed Development;
 - Review and use of relevant traffic flow data from the Applicant's transport consultant (PBA part of Stantec (PBA)) which has been provided for the baseline, without and with development scenarios for the future years of 2022, once Phases 1 and 2 are complete and operational (the Interim Development Scenario), and 2026, once all phases have been constructed (the Completed Development Scenario) and a 2026 Cumulative Scenario;
 - Dispersion modelling of pollutant emissions using the ADMS-Roads model¹ to predict the likely pollutant concentrations at the Site and surrounding area; and the likely effect of the complete and operational Development on local air quality in terms of traffic emissions generated. The latest NO₂ from NO_x Calculator available from the LAQM Support website² has been applied to derive the road-related NO₂ concentrations from the modelled NO_x concentrations;
 - Comparison of the predicted air pollutant concentrations with RBC monitored concentrations and adjustment of modelled results where necessary (model verification details are provided in **Appendix A**;
 - Determination of the likely significant effects of Site preparation and construction works and activities, and consideration of the environmental management controls likely to be employed during the construction works;
 - Determination of the likely significant effects of the completed and operational phase of the Development on air quality, based on the application of the Environmental Protection UK (EPUK) and Institute of Air Quality Management (IAQM)³ significance criteria to modelled results; and
 - Identification of mitigation measures, where appropriate.
- 1.7. The UK Air Quality Strategy (AQS) identifies the pollutants associated with road traffic emissions and local air quality as:
- Nitrogen oxides (NO_x);
 - Particulate matter (as PM₁₀ (particles with a diameter up to 10µm) and PM_{2.5} (particles with a diameter up to 2.5µm));
 - Carbon monoxide (CO);
 - 1, 3-butadiene (C₄H₆); and
 - Benzene (C₆H₆).

¹ Cambridge Environmental Research Consultants Ltd, ADMS-Roads, 2018, Version 4.1.1.

² AEA, NO_x to NO₂ Calculator, <http://laqm1.defra.gov.uk/review/tools/monitoring/calculator.php> Version 6.1, 17 October 2017

³ Environmental Protection UK & Institute of Air Quality Management (2017), 'Land-Use Planning & Development Control: Planning for Air Quality', EPUK & IAQM, London.

- 1.8. Emissions of total NO_x from motor vehicle exhausts comprise nitric oxide (NO) and nitrogen dioxide (NO₂). NO oxidises in the atmosphere to form NO₂. The most significant pollutants associated with road traffic emissions, in relation to human health, are NO₂ and particulate matter (PM₁₀ and PM_{2.5}).
- 1.9. If exceedences of any of the pollutants listed above are considered likely, the local authority must declare an Air Quality Management Area (AQMA). RBC has declared an AQMA for annual mean NO₂ attributable to road traffic emissions. This assessment therefore focuses on NO₂ and particulate matter (PM₁₀ and PM_{2.5}).

Construction Assessment Methodology

Dust Emissions

- 1.10. The assessment of the effects of the construction activities in relation to dust has been based on the guidance published by the IAQM⁴ and the following:
 - A consideration of planned construction activities and their phasing; and
 - A review of the sensitive uses in the area immediately surrounding the Site in relation to their distance from the Site.
- 1.11. The IAQM guidance identifies that receptors within 350m of the Site boundary, and within 50m of construction routes would be sensitive to emissions and nuisance dust from construction activities. For clarification, **Figure 4** shows the area surrounding the Site, where sensitive receptors could be affected, considering the IAQM guidance.
- 1.12. Following the IAQM guidance, construction activities can be divided into the following four distinct activities:
 - Demolition – any activity involved in the removal of an existing building;
 - Earthworks – the excavation, haulage, tipping and stockpiling of material, but may also involve levelling the site and landscaping;
 - Construction – any activity involved with the provision of a new structure; and
 - Trackout – the movement of vehicles from unpaved ground on a site, where they can accumulate mud and dirt, onto the public road network where dust might be deposited.
- 1.13. The IAQM guidance considers three separate dust effects, with the proximity of sensitive receptors being taken into consideration. These are:
 - Annoyance due to dust soiling;
 - Potential effects on human health due to significant increase in exposure to PM₁₀; and
 - Harm to ecological receptors.
- 1.14. A summary of the four-step process which has been undertaken for the dust assessment of construction activities, as set out in the IAQM guidance, is presented in Table 1.

Table 1: Summary of the IAQM Guidance for Undertaking a Construction Dust Assessment

Step	Description
1 Screen the Need for a Detailed Assessment	Simple distance based criteria are used to determine the requirement for a detailed dust assessment. An assessment will normally be required where there are 'human receptors' within 350m of the boundary of the site and / or within 50m of the route(s) used by construction vehicles on public highway, up to 500m from the site entrance or 'ecological receptors' within 50m of the

⁴ Institute of Air Quality Management (2014) 'Guidance on the Assessment of dust from demolition and construction.'

Step	Description
	boundary of the site and/or within 50m of the route(s) used by construction vehicles on public highway, up to 500m from the site entrance.
2 Assess the Risk of Dust Effects	The risk of dust arising in sufficient quantities to cause annoyance and/or health or ecological effects should be determined using three risk categories: low, medium and high based on the following factors: - the scale and nature of the demolition and construction works, which determines the risk of dust arising (i.e. the magnitude of potential dust emissions) classed as small, medium or large; and - the sensitivity of the area to dust effects, considered separately for ecological and human receptors (i.e. the potential for effects) defined as low, medium or high.
3 Site Specific Mitigation	Determine the site-specific measures to be adopted at the site based on the risk categories determined in Step 2 for the four activities. For the cases where the risk is 'negligible' no mitigation measures beyond those required by legislation are required. Where a local authority has issued guidance on measures to be adopted these should be taken into account.
4 Determine Significant Effects	Following Steps 2 and 3, the significance of the potential dust effects should be determined, using professional judgement, taking into account the factors that define the sensitivity of the surrounding area and the overall pattern of potential risks.

Construction Vehicle Exhaust and Plant Emissions

1.15. IAQM's construction dust guidance on assessing construction impacts states that

"Experience of assessing the exhaust emissions from on-site plant (also known as non-road mobile machinery or NRM) and site traffic suggests that they are unlikely to make a significant effect on local air quality, and in the vast majority of cases they will not need to be quantitatively assessed. For site plant and on-site traffic, consideration should be given to the number of plant/vehicles and their operating hours and locations to assess whether a significant effect is likely to occur. For site traffic on the public highway, if it cannot be scoped out, then it should be assessed using the same methodology and significance criteria as operational traffic impacts".

1.16. Given the size of the Site (approximately 25,600m²) and the estimated number of constructions related vehicle movements (35 per day), in accordance with IAQM's construction dust guidance, it is considered that a quantitative assessment of the exhaust emissions from construction plant and traffic is not required, and a qualitative assessment is appropriate.

Complete and Operational Development

ADMS Model

1.17. The likely impacts on local air quality from traffic movements generated from the complete and operational Development have been assessed using the atmospheric dispersion model ADMS-Roads.

1.18. Traffic data for the local road network were provided by the project transport consultants, PBA. The baseline year of 2018 was assessed together with the 'without Development' and 'with Development' scenarios for the years 2022 and 2026 which represent the anticipated year of completion of the various phases of the Proposed Development. A Cumulative Development Scenario was also assessed for 2026 assuming the cumulative schemes, as presented in **Appendix B**, were implemented.

- 1.19. The traffic data was used within the ADMS-Roads model to assess the potential for significant impacts from additional traffic movements generated by the Proposed Development on future local air quality at both on and off-site receptor locations.
- 1.20. The ADMS-Roads dispersion model predicts how emissions from roads combine with local background pollution levels, taking account of meteorological conditions, to affect local air quality. The ADMS-Roads model has been run for the completion years, 2022 and 2026, using 2022 and 2026 background data and 2022 and 2026 vehicle emission rates as inputs. For the 2018 verification assessment, 2018 background data and 2018 vehicle emission rates have been used, which would be higher than the 2022 and 2026 data. The model output allows pollution levels to be quantified at specific receptor locations which facilitates the assessment of impacts at potentially sensitive receptor locations.
- 1.21. Full details of the dispersion modelling study, including the road traffic data, verification and background data, are presented within **Appendix A**.

Model Uncertainty

- 1.22. Analyses of historical monitoring data by Defra⁵ have identified a disparity between actual measured NO_x and NO₂ concentrations and the expected decline associated with emission forecasts which form the basis of air quality modelling as described above. The reason is related to the on-road performance of certain vehicles compared to calculations based on Euro emission standards which inform emission forecasts.
- 1.23. The note 'Projecting NO₂ Concentrations'⁶ published by Defra provides alternative approaches that can be followed in air quality assessments in relation to the modelling of future NO₂ concentrations, considering that future NO_x / NO₂ road-traffic emissions and background concentrations may not reduce as previously expected. This includes the use of revised background pollution maps, alternative projection factors and revised vehicle emission factors. However, the Defra note does not form part of statutory guidance and no prescriptive method is recommended for use in an air quality assessment.
- 1.24. Given that the Development is anticipated to be completed in 2026, this air quality assessment has utilised revised emissions data and background concentrations using the Air Quality Consultants Ltd Calculator Using Realistic Emissions for Diesels (CURED) spreadsheet⁷. The spreadsheet has been designed to provide a reasonable worst-case assumption for future vehicle emissions.
- 1.25. The UK government's announcement in July 2017 that no new diesel or petrol sole fuelled vehicles will be sold in the UK from 2040 reflects the national measures being taken to improve background air quality.

Background Pollutant Concentrations

- 1.26. To estimate the total concentrations due to the contribution of any other nearby sources of pollution, background pollutant concentrations need to be added to the modelled concentrations. Full details of the background pollution data used within the air quality assessment are included in **Appendix A**.

⁵ <http://laqm.defra.gov.uk/faqs/faqs.html>.

⁶ Defra, 2012, Local Air Quality Management: Note on Projecting NO₂ Concentrations.

⁷ Air Quality Consultants Ltd (2017) Calculator Using Realistic Emissions for Diesels (CURED) Spreadsheet. CURED V3A December 2017

Model Verification

- 1.27. Model verification is the process of comparing monitored and modelled pollutant concentrations and, if necessary, adjusting the modelled results to reflect actual measured concentrations, to improve the accuracy of the modelling results. The model has been verified by comparing the predicted annual mean NO₂ concentrations for the baseline 2018, with the 2018 results from RBC's diffusion tubes located in the vicinity of the Site and the RBC automatic monitor located on Caversham Road. The verification and adjustment process are described in detail in **Appendix A**.

Approach to Assessment of the Interim Development Scenario

- 1.28. As part of the Interim Development Scenario a total of 290 car parking spaces are proposed for the future residents within Plots E and F and office workers within Plot G. This is made up of 165 car parking spaces within the car park in Phase 1 (Plots E and F) and 122 car parking spaces within the podium forming part of Phase 2 (Plot G).
- 1.29. As part of Phase 2, the NCP car park and Xafinity House will be demolished. This will result in an immediate loss of public car parking spaces from the NCP car park during construction. At the time of preparing the traffic flows it was envisaged that additional car parking spaces would be delivered temporarily on the area of Phase 3 to be used for public parking (a further 362 spaces were assumed). This is no longer proposed as part of the current applications but may come forward in the future.
- 1.30. The traffic data provided for the air quality assessment of the Interim Development Scenario allocated car parking spaces to the proposed on Site uses. It also accommodated for the re-distribution of the remaining traffic currently using the NCP car park to other surrounding public car parks. The level of re-distributed traffic was based on the existing demand recorded at the NCP car park.
- 1.31. As the level of car parking being proposed in the Interim Development Scenario has reduced since the traffic data was provided there would be an increase in traffic being re-distributed to other surrounding car parks. However, PBA consider that the additional level of re-distributed traffic to other surrounding car parks would not materially alter the daily traffic data provided on which the Air Quality Assessment was undertaken.

Approach to Outline Assessment

- 1.32. As part of Phase 3 of the Proposed Development, up to an additional 713 car parking spaces would be provided in the podium car park including the basement podium which could extend across Phase 2 and Phase 3. In order to provide a worst case assessment, it was assumed that the full amount of car parking was delivered and the associated trip generation of the on Site uses was calculated on this basis. As discussed above the remaining traffic currently using the NCP car park which wasn't assumed to be retained on Site was re-distributed to other local car parks.

Approach to Future Baseline

- 1.33. Traffic anticipated to be generated by the future baseline scheme at the former Coopers BMW site was included within the baseline traffic data provided by PBA. This traffic was added to the baseline traffic flows, which were monitored in 2018 using automatic traffic counts and traffic surveys.

Potentially Sensitive Receptors

- 1.34. The approach adopted by the UK AQS is to focus on locations at, and close to, ground level where members of the public (in a non-workplace area) are likely to be exposed over the averaging time of

the objective in question (i.e. over 1-hour, 24-hour or annual periods). Objective exceedances principally relate to annual mean NO₂ and PM₁₀, and 24-hour mean PM₁₀ concentrations, so that associated potentially sensitive locations relate mainly to residential properties and other sensitive locations (such as schools) where the public may be exposed for prolonged periods.

- 1.35. Table 2 presents existing sensitive receptors likely to be affected by the Proposed Development. These were selected due to their proximity to the road network. Table 2 also presents future sensitive receptor locations which are representative of sensitive uses within the Proposed Development itself. The future sensitive receptor locations represent areas of the Proposed Development exposed to the worst-case air quality conditions, such as closest to roads. The location of the selected existing and future sensitive receptors assessed are presented in **Figure 5**.

Table 2: Selected Receptor Locations

ID	Receptor Location	Receptor Type	OS Grid Reference	Height Above Ground (m)
1	1st Floor Flat, 4 Friar Street	Residential	471634, 173582	3
2	107 Castle Hill	Residential	471041, 173009	0
3	Alms House Castle Street	Residential	471222, 173110	0
4	88 Queens Road	Residential	472250, 173270	0
5	Grantley Heights	Residential	472203, 173315	0
6	90 Kings Road	Residential	472103, 173398	0
7	Forbury Gardens Day Nursery	Nursery	472008, 173642	0
8	119 Caversham Road	Residential	471279, 174212	0
9	20-30 New Bright Street	Residential	471261, 172934	0
10	Blenheim Place, Castle Street	Residential	471061, 173018	0
11	162 Castle Hill	Residential	470835, 172992	0
12	31a Vastern Road	Residential	471416, 174134	0
13	68 George Street	Residential	471913, 174490	0
14	10 Trinity Place	Residential	470738, 173433	0
15	33 Caversham Road	Residential	471123, 173734	0
16	Proposed: Phase 1 Plot E	Residential	471360, 173587	0
17	Proposed: Phase 1 Plot F	Residential	471399, 173690	0
18	Proposed: Phase 3 Plot A	Residential	471282, 173776	0
19	Proposed: Phase 3 Plot B	Residential	471327, 173792	0

Note: Ground floor assumed to be 0m to represent worst-case assessment of exposure as it is the closest location of the receptor to the tailpipe vehicle emissions

Limitations and Assumptions

- 1.36. For the purposes of the assessment of dust nuisance during construction works it has been assumed activities would be carried out at the boundary of the Proposed Development to provide a worst-case assessment.
- 1.37. Currently there is no methodology to assess and determine the impact of a development against the EU Limit Values. In addition, compliance with the EU Limit Values is a UK Government responsibility

given that national measures (such as vehicle scrappage schemes and increased diesel fuel prices) would be required to meet compliance. As such the effect of the Proposed Development has been assessed against the UK AQS objectives rather than the EU Limit Values. To demonstrate that the Proposed Development has a positive influence on air quality a summary of measures which are likely to lead to a benefit to air quality have been outlined.

- 1.38. There is no standard or recognised methodology to predict the reduction in pollutant concentrations from all air quality mitigation measures or measures likely to have a positive impact of local air quality (such as cycle spaces, electric charging points, sustainable transport options, green infrastructure etc) as these measures are either based on holistic behavioural changes and/or there is a lack of real-world quantifiable data (in $\mu\text{g}/\text{m}^3$). However, the mitigation measure and measures that would benefit air quality included as part of the Proposed Development are consistent with those identified by RBC in their Air Quality Action Plan. As such the results presented in the assessment are worst-case.
- 1.39. The limitations with regards to the air quality model are discussed in **Appendix A** and where necessary appropriate model refinement, including a model verification, has been undertaken.

Significance Criteria

Construction

- 1.40. The significance of effects of demolition and construction activities on air quality have been assessed based on professional judgement and with reference to the criteria set out in the IAQM guidance. Appropriate Site-specific mitigation measures that would need to be implemented to minimise adverse effects have also been considered. Details of the assessor's experience and competence to undertake the dust assessment is provided in **Appendix A**.

Dust Emissions

- 1.41. The assessment of the risk of dust effects arising from each of the construction activities, as identified by the IAQM guidance, is based on the magnitude of potential dust emissions and the sensitivity of the area. The risk category matrix for each of the activity types, taken from the IAQM guidance, are presented in Table 3 to Table 6.

Table 3: Risk Category from Demolition Activities

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

Table 4: Risk Category from Earthworks Activities

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

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

Table 5: Risk Category from Construction Activities

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

Table 6: Risk Category from Trackout Activities

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

- 1.42. The risk category determined for each of the construction activity types is used to define the appropriate level of mitigation measures that should be applied. The IAQM guidance recommends that significance is only assigned to the effect after considering mitigation because it assumes that all actions to avoid or reduce the environmental effects are an inherent part of a development, and that, in the case of demolition / construction, mitigation measures (secured through planning conditions, legal requirements or required by regulations) would ensure that likely significant adverse residual effects will not occur.
- 1.43. However, pre-mitigation significance criteria as outlined in Table 7 have been applied which are based on professional judgement.

Table 7: Pre-Mitigation Significance Criteria for Demolition and Construction

Significance Criteria	Definition
Adverse effect of major significance	Receptor is less than 20m from an active construction site.
Adverse effect of moderate significance	Receptor is 20m to 100m from an active construction site.
Adverse effect of minor significance	Receptor is between 100m and 350m from an active construction site.
Negligible effect	Receptor is over 350m from an active construction site.

- 1.44. The IAQM outlines that experience of implementing mitigation measures for construction activities demonstrates that total mitigation is normally possible such that residual effects would not be 'significant'. Therefore, it follows that, within this assessment, no post-mitigation matrix of significance criteria are provided for the likely residual effects of the demolition and construction works.

Construction Vehicle Exhaust and Plant Emissions

- 1.45. The significance of the effects of construction vehicle exhaust emissions on air quality were based on professional judgement.

Complete and Operational Development

- 1.46. The EPUK / IAQM guidance provides an approach to assigning the magnitude of changes as a result of a development as a proportion of a relevant assessment level, followed by examination of this change in the context of the new total concentration and its relationship with the assessment criterion to provide a description of the impact at selected receptor locations.
- 1.47. Table 8 presents the IAQM framework for describing the impacts (the change in concentration of an air pollutant) at individual receptors. The term Air Quality Assessment Level (AQAL) is used to include air quality objectives or limit values, where these exist. The Limit Values and Air Quality Strategy⁸ objectives of air pollutants relevant to this assessment are summarised in Table 9.

Table 8: Impact Descriptors for Individual Receptors

Long term average Concentration at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

Note: AQAL may be an air quality objective, EU limit value, or an Environment Agency 'Environmental Assessment Level (EAL)'

The table is intended to be used by rounding the change in percentage pollutant concentration to whole numbers. Changes of 0% (i.e. less than 0.5%) are described as Negligible.

The table is only to be used with annual mean concentrations

Table 9: National Air Quality Strategy Objectives (England)

Pollutant	Objective		Date by Which Objective is to be Met
	Concentration	Measured as	
Nitrogen dioxide (NO ₂)	200µg/m ³	1-hour mean not to be exceeded more than 18 times per year.	31/12/2005.
	40µg/m ³	Annual mean.	31/12/2005.
Particulate Matter (PM ₁₀) ^(a)	50µg/m ³	24-hour mean not to be exceeded more than 35 times per year.	31/12/2004.
	40µg/m ³	Annual mean.	31/12/2004.
Particulate Matter (PM _{2.5}) ^(b)	Target of 15% reduction in concentrations at urban background locations.	Annual mean.	Between 2010 and 2020.

⁸ Defra, 2007, 'The Air Quality Strategy for England, Scotland, Wales & Northern Ireland'.

Pollutant	Objective		Date by Which Objective is to be Met
	Concentration	Measured as	
	Variable target of up to 20% reduction in concentrations at urban background locations ^(c)	Annual mean.	Between 2010 and 2020.
	25µg/m ³	Annual mean.	01/01/2020.

Notes: (a) Particulate Matter with a mean aerodynamic diameter of less than 10µm (micrometres or microns).
 (b) Particulate Matter with a mean aerodynamic diameter of less than 2.5µm.
 (c) Aim to not exceed 18µg/m³ by 2020.

- 1.48. The approach set out in the EPUK / IAQM guidance provides a method for describing the impact magnitude at individual receptors only. The guidance outlines that this change may have an effect on the receptor depending on the severity of the impact and other factors that may need to be considered. The assessment framework for describing impacts can be used as a starting point to make a judgement on significance of effect. However, whilst there may be 'slight', 'moderate' or 'substantial' impacts described at one or more receptors, the overall effect may not necessarily be judged as being significant in some circumstances.
- 1.49. Following the approach to assessing significance outlined in the EPUK / IAQM guidance, the significance of likely residual effects of the Proposed Development on air quality has been established through professional judgement and the consideration of the following factors:
- The geographical extent (local, district or regional) of effects;
 - Their duration (temporary or long term);
 - Their reversibility (reversible or permanent);
 - The magnitude of changes in pollution concentrations;
 - The exceedance of standards (e.g. AQS objectives); and
 - Changes in pollutant exposure.

Baseline Conditions

Reading Borough Council Review and Assessment Process

- 1.50. On completion of RBC's Stages 1 to 3 Review and Assessment of air quality in 2000, RBC concluded that the air quality objectives would be met for all pollutants and that there would be no requirement to consider the designation of AQMAs.
- 1.51. The RBC Updating and Screening Assessment (USA) published in 2003⁹ concluded that, although it was necessary to undertake further investigation into roadside locations where concentrations of NO₂ were close to objective levels, no further action was required with regard to other pollutants.
- 1.52. The USA 2003 Supplement¹⁰ identified potential 'hot spots' for NO₂ and PM₁₀ which were further examined with the use of the Design Manual for Roads and Bridges (DMRB) air quality screening model. Of relevance to the Site was that Caversham Road (200m west of the Proposed Development) was predicted to have NO₂ levels close to objective levels in 2004. An Air Quality Progress Report published in 2004¹¹ found that there were numerous diffusion tube monitoring locations which recorded levels of NO₂ exceeding the annual mean Air Quality Objectives throughout the Borough.
- 1.53. A Detailed Assessment of Air Quality was completed by RBC in December 2005¹². This included a detailed dispersion modelling assessment that identified twelve areas in the Borough where one or both of the NO₂ air quality objectives were predicted to be exceeded in 2005. As a result of these findings, six AQMAs were declared across the Borough. The nearest AQMA was located approximately 200m west of the Site (Tudor Road and Caversham Road between Tudor and Vachel Roads). The Detailed Assessment predicted NO₂ annual mean concentrations of 37- 40 µg/m³ at the Site (40µg/m³ being the objective level).
- 1.54. Additionally, to these findings, the 2006 USA and the Detailed Assessment in 2008¹³ recommended that an AQMA be declared for NO₂ along Oxford Road, which is likely to extend from 744 Oxford Road (close to the Oxford Road/Beresford Road/Edinburgh Road junction) to the Oxford Road/Chatham Street junction, which at its closest part, is located approximately 220m south-west of the Site.
- 1.55. Following the 2008 Further Assessment¹⁴ RBC declared a new AQMA in 2009 which encompasses the whole town centre and the major roads within the town. The AQMA covers a greater area than the area of known exceedences by covering the major transport routes throughout the district to address the possibility of moving hotspots from one area to another following implementation of the Air Quality Action Plan (AQAP). This AQMA replaces the six previously declared AQMAs.
- 1.56. The Site is located within the Reading AQMA.
- 1.57. The 2009 USA¹⁵, 2010 Progress Report¹⁶ and 2011 Progress Report¹⁷ did not find any significant changes within the Borough to suggest the likelihood of further exceedences outside of the new AQMA declaration.

⁹ Reading Borough Council, 2003 Updating and Screening Assessment

¹⁰ Reading Borough Council, 2003 Updating and Screening Assessment Supplement

¹¹ Reading Borough Council, 2004 Progress Report

¹² Reading Borough Council, 2006 Detailed Assessment

¹³ Reading Borough Council, 2008 Detailed Assessment

¹⁴ Reading Borough Council, 2008 Further Assessment

¹⁵ Reading Borough Council, 2009 Updating and Screening Assessment

¹⁶ Reading Borough Council, 2010 Progress Report

¹⁷ Reading Borough Council, 2011 Progress Report

- 1.58. The 2012 USA¹⁸ highlighted a concern over the daily mean PM₁₀ objective in the Caversham Road area, although the data used in the report was still provisional and because of the low data capture rate the data should be used with caution. Additionally, there had been no exceedences in the previous five years and RBC concluded that the nearby work to widen Cow Lane Bridges as part of the Reading Mainline Station expansion work was responsible for the increase in PM₁₀. RBC concluded that it was not necessary to progress immediately to a Detailed Assessment but if the trend was found to continue in 2012 a Detailed Assessment would be completed.
- 1.59. The 2017 Annual Status Report concluded that AQS Objectives for all pollutants would be met, except for NO₂ and that no new areas of exceedence have been identified since the last round of Review and Assessment.

Local Monitoring

- 1.60. RBC conducts an extensive air quality monitoring programme throughout the Borough measuring roadside and background concentrations of PM₁₀ and NO₂. There are four automatic monitoring stations within the Borough as follows:
- Caversham Road Roadside, located 0.7km from the centre of the Site;
 - New Town, AURN, Urban Background, located 2.1km from the centre of the Site;
 - London Road Roadside, located 2.4km from the centre of the Site; and
 - Oxford Road, Roadside, located 2.7km from the centre of the Site.
- 1.61. The results from the most recent PM₁₀ and NO₂ monitoring from the Caversham Roadside monitor are presented in Table 10.

Table 10: Annual Mean NO₂ and PM₁₀ at the Caversham roadside automatic monitor (µg/m³)

Pollutant	Averaging Period	AQS Objective	2015	2016	2017	2018
NO ₂	Annual Mean (µg/m ³)	40µg/m ³	38	39	37	40
	Hourly (No. of Hours)	200µg/m ³ not to be exceeded more than 18 times a year	1	0	0	7
PM ₁₀	Annual Mean (µg/m ³)	40µg/m ³	28	20	22	24
	24 Hour Mean (µg/m ³)	50µg/m ³ not to be exceeded more than 35 times per year	8(41)	5	8	3

Source: 2015-2018 Data taken from RBC's 2019 LAQM Annual Status Report 2019, June 2019

Notes: Exceedances of the objective are shown in **bold**

If the period of valid data is less than 85%, the 90.4th percentile of 24-hour means is provided in brackets.

- 1.62. The results shown in Table 10 indicate that the annual mean NO₂ objective has been close to the objective between 2015 and 2018. There have been no exceedances of the 1-hour mean NO₂ objective or the annual mean and 24-hour mean PM₁₀ objectives.
- 1.63. The 12 RBC diffusion tube monitoring results, closest to the centre of the Site are presented in Table 11.

¹⁸ Reading Borough Council, 2012 Updating and Screening Assessment

Table 11: Measured NO₂ Concentrations at 12 RBC Diffusion Tubes closest to the centre of Site

ID	Site	Classification	Distance to centre of Site (km)	NO ₂ Concentration (µg/m ³)				
				2014	2015	2016	2017	2018
DT41	Station Hill (Near Bus stop WN)	Roadside	0.11	-	-	50	47	35
DT39	Friar St (Nandos)	Roadside	0.14	53	47	52	50	42
DT37	Vachel Rd	Roadside	0.19	38	33	35	34	35
DT36	Sackville Street	Roadside	0.20	43	40	37	37	38
DT42	33 Caversham Rd	Roadside	0.24	51	48	43	45	44
DT43	59A Caversham Rd	Roadside	0.25	47	42	41	43	41
DT40	Station Hill (Near Taxi Station)	Roadside	0.31	-	-	47	49	33
DT35	Picture House, Thorn St	Roadside	0.34	34	30	32	30	31
DT52	31a Vastern Rd	Roadside	0.42	40	36	37	38	33
DT51	108 Caversham Rd	Roadside	0.53	48	41	41	40	42
DT53	131 Caversham Rd	Roadside	0.53	47	40	36	36	35
DT46	Railway Depot	Roadside	0.56	42	39	35	34	27

Note: 2014-2017 Data taken from RBC's 2018 Air Quality Annual Status Report, June 2018
 2018 Data received directly from RBC. 2018 diffusion tube data has not yet been distance corrected
 Exceedences of the objective are presented in **BOLD**

- 1.64 The NO₂ roadside annual mean concentrations in Table 11 indicate that concentrations have been exceeded at all monitoring locations between 2014 and 2018 except Vachel Road (DT37) and Picture House (DT35) which is consistent with the RBC AQMA declared for the whole of the town centre in respect to NO₂. Overall there has been a downward trend in concentrations between 2014 and 2018.

Likely Significant Effects

Demolition and Construction

Nuisance Dust

- 1.65 Construction activities in relation to the Proposed Development have the potential to affect local air quality via Earthworks, Construction and Trackout activities.
- 1.66 As there are existing and proposed receptors within 350m of the boundary of the Site, and within 50m of the routes that would be used by construction vehicles on the public highway, it is considered that a detailed qualitative assessment is required to determine the likely dust effects, as recommended by the IAQM guidance on construction dust. Results of this assessment are provided for each main activity (Demolition, Earthworks, Construction and Trackout).
- 1.67 The sensitivity of the area to each main activity has been assessed based on the number and distance of the nearest sensitive receptors to the activity, and the sensitivity of these receptors to dust soiling, human health and ecological effects. Based on the criteria set out in Table 2 to Table 4 in the IAQM guidance document, Table 12 presents the sensitivity of the area.

Table 12: Summary of the Sensitivity of the Area

Potential Effect	Sensitivity of the Surrounding Area
Dust Soiling.	High
Human Health.	High
Ecological.	Low

Demolition

- 1.68. The estimate for the total volume of buildings to be demolished is greater than 50,000m³. Based on this and considering the IAQM criteria, the potential dust emissions during demolition activities would be of a **large** magnitude.

Earthworks

- 1.69. As noted earlier in this Chapter, considered together the area of the Site is approximately 2.56ha, or 25,600m². Based on this and considering the IAQM criteria, the potential dust emissions during earthworks activities would be of a **large** magnitude.

Construction

- 1.70. The estimate for the total volume of buildings to be constructed (including the basement) is greater than 100,000m³. Based on this and considering the IAQM criteria, the potential dust emissions during construction activities would be of a **large** magnitude.

Trackout

- 1.71. Based on information from the Construction Contractors, it is estimated that the average construction traffic would be 35 vehicles per day. Based on this and considering the IAQM criteria, the potential for dust emissions due to trackout activities would be of a **large** magnitude.

Summary

- 1.72. On the basis of the above, a summary of risk during each stage of the demolition and construction works has been set out in Table 13. This demonstrates that the demolition and construction works are considered to be **high risk**, in particular due to dust soiling and human health effects. Therefore, site-specific mitigation measures (described later in this Chapter) would be required to address these risks.

Table 13: Summary of Risk

Potential Effect	Risk			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	High	High	High	High
Human Health	High	High	High	High
Ecological	Low	Low	Low	Low

Vehicle Emissions

- 1.73. Plant operating on the Site and construction related vehicles entering and egressing the Site from / to the local road network would have the potential to increase local air pollutant concentrations, particularly in respect of NO₂ and particulate matter (both PM₁₀ and PM_{2.5}).
- 1.74. It is estimated that the average construction traffic would be 35 vehicles per day. Therefore, emissions from construction traffic would be relatively small compared to existing road traffic emissions. Further details on existing traffic flows are contained within **Appendix A**. Taking into account the current traffic movements and background pollutant concentrations around the Site it is considered that the likely effect of construction vehicles entering and egressing the Site on air quality would, in the worst-case, give rise to a **temporary, short-term, local** effect of **minor adverse significance**.
- 1.75. Emissions from plant operating on the Site would be very small in comparison to the emissions from traffic movements on the roads adjacent to the Site. It is therefore considered that even in the absence of mitigation, their likely effect on local air quality would be of **negligible significance**.

Interim Development Scenario

- 1.76. Effects on local air quality associated with the Interim Development Scenario would likely result from changes to traffic flows. Table 14 and Table 15 present the concentrations predicted by the ADMS Roads air quality modelling at relevant receptors surrounding the Site, and receptors introduced as part of the Interim Development Scenario. These locations represent the worst-case air quality conditions that would likely result.

Nitrogen Dioxide

Table 14: Results of the Nitrogen Dioxide ADMS-Roads Modelling

ID	2018 Baseline	2022 Without Interim Development	2022 With Interim Development	Change	Impact Descriptor
1	32.7	27.2	27.2	0.0	Negligible
2	34.2	29.2	29.2	0.0	Negligible

ID	2018 Baseline	2022 Without Interim Development	2022 With Interim Development	Change	Impact Descriptor
3	31.0	26.7	26.7	0.0	Negligible
4	50.6	40.9	41.0	0.1	Negligible
5	36.6	30.6	30.6	0.0	Negligible
6	28.9	25.1	25.2	0.1	Negligible
7	33.8	28.7	28.7	0.0	Negligible
8	38.5	32.0	32.0	0.0	Negligible
9	33.3	28.3	28.3	0.0	Negligible
10	35.3	30.0	30.0	0.0	Negligible
11	31.8	27.4	27.4	0.0	Negligible
12	36.9	30.9	31.0	0.1	Negligible
13	34.3	29.3	29.3	0.0	Negligible
14	35.1	29.8	29.8	0.0	Negligible
15	35.2	29.6	29.6	0.0	Negligible
16	-	-	26.9	-	-
17	-	-	25.7	-	-

- 1.77. The results in Table 14 indicate that for 2018, annual mean NO₂ concentrations are predicted to meet the objective at all receptor locations except Receptor 4. As discussed in **Appendix A**, the hourly mean objective for NO₂ is unlikely to be exceeded at a roadside location where the annual-mean NO₂ concentration is less than 60µg/m³ and therefore the 1-hour mean is unlikely to be exceeded at any of the receptor locations.
- 1.78. In 2022 'without' and 'with' the Interim Development Scenario in place concentrations are predicted to meet the NO₂ annual mean objective value of 40µg/m³ at all receptor locations except Receptor 4. Table 14 illustrates that 'without' and 'with' the Interim Development Scenario in place the highest predicted annual mean NO₂ concentration (of 41.0µg/m³ at Receptor 4 'with' the Interim Development Scenario) is much less than 60µg/m³ and as such the hourly objective is likely to be met at all receptors.
- 1.79. Using the magnitude of change descriptors outlined in Table 8, the Interim Development Scenario is predicted to result in an 'negligible' impact on annual mean NO₂ concentrations at all receptor locations. Based on the significance of impact criteria the effect of the Interim Development on NO₂ concentrations is not significant.

Particulate Matter (PM₁₀ and PM_{2.5})

Table 15: Results of the Particulate Matter ADMS-Roads Modelling

ID	Annual Mean PM ₁₀ (µg/m ³)				24-Hour Mean PM ₁₀ (No. of Days)				Annual Mean PM _{2.5} (µg/m ³)			
	2018 Baseline	2022 Without Development	2022 With Development	Change	2018 Baseline	2022 Without Development	2022 With Development	Change	2018 Baseline	2022 Without Development	2022 With Development	Change
1	16.1	15.4	15.4	0.0	0	0	0	0	10.9	10.2	10.2	0.0
2	18.4	17.8	17.8	0.0	2	1	1	0	16.2	15.4	15.5	0.1
3	16.1	15.4	15.5	0.1	0	0	0	0	14.8	14.1	14.1	0.0
4	26.3	25.6	25.7	0.1	16	14	14	0	21.1	20.0	20.0	0.0
5	18.5	17.8	17.8	0.0	2	1	1	0	16.3	15.5	15.5	0.0
6	14.7	14.1	14.1	0.0	0	0	0	0	14.0	13.3	13.3	0.0
7	18.0	17.5	17.5	0.0	1	1	1	0	16.0	15.3	15.3	0.0
8	20.8	20.3	20.3	0.0	5	4	4	0	17.7	16.8	16.9	0.1
9	17.6	17.0	17.0	0.0	1	1	1	0	15.7	15.0	15.0	0.0
10	19.1	18.5	18.5	0.0	2	2	2	0	16.6	15.8	15.9	0.1
11	16.7	16.2	16.2	0.0	1	0	0	0	15.2	14.5	14.5	0.0
12	19.7	19.2	19.3	0.1	3	3	3	0	17.0	16.3	16.3	0.0
13	18.8	18.2	18.2	0.0	2	2	2	0	16.4	15.6	15.7	0.1
14	18.8	18.2	18.3	0.1	2	2	2	0	16.4	15.7	15.7	0.0
15	18.8	18.2	18.2	0.0	2	2	2	0	16.4	15.6	15.7	0.1
16	-	-	15.3	-	-	-	0	-	-	-	14.0	-
17	-	-	14.4	-	-	-	0	-	-	-	13.5	-

- 1.80. As shown in Table 15, the concentrations of PM₁₀ are predicted to be well below the annual and daily mean objective values in 2018 and in 2022 both 'with' and 'without' the Interim Development Scenario in place at all the receptor locations.
- 1.81. Using the magnitude of change descriptors outlined in Table 8, the Interim Development Scenario is predicted to result in an 'negligible' impact in annual mean PM₁₀ levels at all receptor locations. Based on the significance of impact criteria, the effect of the Interim Development Scenario on annual mean PM₁₀ concentrations is not significant.
- 1.82. There are no significance criteria in relation to daily mean PM₁₀ concentrations (see the Significance Criteria section). However, given the predicted concentrations are well below the daily mean PM₁₀

objective, and no change is predicted at all receptor locations, it is considered that the effect of the Interim Development Scenario on daily mean PM₁₀ levels is not significant.

- 1.83. The results in Table 15 indicate that the annual mean PM_{2.5} objective of 25µg/m³ is predicted to be met in all scenarios modelled, i.e. 2018 and 2022 both 'with' and 'without' the Interim Development Scenario in place. Based on the significance of impact criteria outlined in Table 8, a **negligible** impact is predicted at all receptor locations on annual mean PM_{2.5} levels the effect on annual mean PM_{2.5} concentrations is not significant.

Completed Development Scenario

- 1.84. Effects on local air quality associated with the Completed Development Scenario would likely result from changes to traffic flows. Table 16 and Table 17 present the concentrations predicted by the ADMS Roads air quality modelling at relevant receptors surrounding the Site, and receptors introduced as part of the Proposed Development. These locations represent the worst-case air quality conditions that would likely result.

Nitrogen Dioxide

Table 16: Results of the Nitrogen Dioxide ADMS-Roads Modelling

ID	2026 Without Development	2026 With Development	Change	Impact Descriptor
1	24.8	24.8	0.0	Negligible
2	27.3	27.3	0.0	Negligible
3	24.9	24.9	0.0	Negligible
4	37.3	37.4	0.1	Negligible
5	28.2	28.3	0.1	Negligible
6	23.5	23.5	0.0	Negligible
7	26.6	26.6	0.0	Negligible
8	29.5	29.6	0.1	Negligible
9	26.3	26.4	0.1	Negligible
10	28.0	28.0	0.0	Negligible
11	25.6	25.7	0.1	Negligible
12	28.6	28.7	0.1	Negligible
13	27.4	27.5	0.1	Negligible
14	27.7	27.8	0.1	Negligible
15	27.4	27.4	0.0	Negligible
16	-	24.7	-	-
17	-	24.0	-	-
18	-	27.3	-	-
19	-	23.7	-	-

- 1.85. In 2026 'without' and 'with' the Proposed Development in place concentrations are predicted to meet the NO₂ annual mean objective value of 40µg/m³ at all receptor locations. Table 16 illustrates that

‘without’ and ‘with’ the Proposed Development in place the highest predicted annual mean NO₂ concentration (of 37.4µg/m³ at Receptor 4 ‘with’ the Proposed Development) is much less than 60µg/m³ and as such the hourly objective is likely to be met.

- 1.86. Using the magnitude of change descriptors outlined in Table 8, the Proposed Development is predicted to result in an ‘negligible’ change in annual mean NO₂ concentrations at all receptor locations. Based on the significance of impact criteria outlined in Table 8, the effect of the Proposed Development on NO₂ concentrations is not significant.

Particulate Matter (PM₁₀ and PM_{2.5})

Table 17: Results of the Particulate Matter ADMS-Roads Modelling

ID	Annual Mean PM ₁₀ (µg/m ³)			24-Hour Mean PM ₁₀ (No. of Days)			Annual Mean PM _{2.5} (µg/m ³)		
	2026 Without Development	2026 With Development	Change	2026 Without Development	2026 With Development	Change	2026 Without Development	2026 With Development	Change
1	15.1	15.1	0.0	0	0	0	9.9	9.9	0.0
2	17.6	17.7	0.1	1	1	0	11.3	11.4	0.1
3	15.2	15.3	0.1	0	0	0	10.0	10.0	0.0
4	25.6	25.7	0.1	14	14	0	15.8	15.9	0.1
5	17.6	17.7	0.1	1	1	0	11.3	11.4	0.1
6	13.8	13.8	0.0	0	0	0	9.2	9.2	0.0
7	17.3	17.3	0.0	1	1	0	11.1	11.2	0.1
8	20.2	20.3	0.1	4	4	0	12.7	12.8	0.1
9	16.8	16.9	0.1	1	1	0	10.9	10.9	0.0
10	18.4	18.5	0.1	2	2	0	11.7	11.8	0.1
11	16.0	16.0	0.0	0	0	0	10.4	10.4	0.0
12	19.1	19.2	0.1	2	2	0	12.1	12.2	0.1
13	18.1	18.2	0.1	1	2	1	11.6	11.6	0.0
14	18.1	18.2	0.1	1	2	1	11.6	11.6	0.0
15	18.0	18.1	0.1	1	1	0	11.5	11.6	0.1
16	-	15.0	-	-	0	-	-	9.9	-
17	-	14.2	-	-	0	-	-	9.4	-
18	-	17.5	-	-	1	-	-	11.2	-
19	-	14.0	-	-	0	-	-	9.3	-

- 1.87. As shown in Table 17, the concentrations of PM₁₀ are predicted to be well below the annual and daily mean objective values in 2026 both 'with' and 'without' the Proposed Development in place at all the receptor locations.
- 1.88. Using the magnitude of change descriptors outlined in Table 8, the Proposed Development is predicted to result in a 'negligible' impact on annual mean PM₁₀ levels at all receptor locations. Based on the criteria outlined in Table 8, a **negligible** impact is predicted at all receptor locations on annual mean PM₁₀ levels because of the Proposed Development.
- 1.89. There are no significance criteria in relation to daily mean PM₁₀ concentrations (see the Significance Criteria section). However, given the predicted concentrations are well below the daily mean PM₁₀ objective, and no change is predicted at all receptor locations, it is considered that the effect of the Proposed Development on daily mean PM₁₀ levels is not significant.
- 1.90. The results in Table 17 indicate that the annual mean PM_{2.5} objective of 25µg/m³ is predicted to be met in all scenarios modelled, i.e. 2018 and 2022 both 'with' and 'without' the Proposed Development in place. Based on the criteria outlined in Table 8, a **negligible** impact is predicted at all receptor locations on annual mean PM_{2.5} levels and the effect of the Proposed Development is not significant.

Cumulative Development Scenario

- 1.91. Results of the ADMS modelling of the cumulative schemes is presented in Table 18.

Table 18: ADMS Modelling Results of the Cumulative Schemes

ID	Annual Mean NO ₂ (µg/m ³)			Annual Mean PM ₁₀ (µg/m ³)			24-Hour Mean PM ₁₀ (No. of Days)			Annual Mean PM _{2.5} (µg/m ³)		
	2026 Baseline	2026 With Development and Cumulative Schemes	Change	2026 Baseline	2026 With Development and Cumulative Schemes	Change	2026 Baseline	2026 With Development and Cumulative Schemes	Change	2026 Baseline	2026 With Development and Cumulative Schemes	Change
1	24.8	24.8	0.0	15.1	15.2	0.1	0	0	0	9.9	10.0	0.1
2	27.3	27.3	0.0	17.6	17.7	0.1	1	1	0	11.3	11.4	0.1
3	24.9	24.9	0.0	15.2	15.3	0.1	0	0	0	10.0	10.0	0.0
4	37.3	37.4	0.1	25.6	25.9	0.3	14	15	1	15.8	16.0	0.2
5	28.2	28.3	0.1	17.6	17.7	0.1	1	1	0	11.3	11.4	0.1
6	23.5	23.5	0.0	13.8	13.8	0.0	0	0	0	9.2	9.2	0.0
7	26.6	26.6	0.0	17.3	17.5	0.2	1	1	0	11.1	11.3	0.2
8	29.5	29.6	0.1	20.2	20.3	0.1	4	4	0	12.7	12.8	0.1
9	26.3	26.4	0.1	16.8	16.9	0.1	1	1	0	10.9	10.9	0.0
10	28.0	28.0	0.0	18.4	18.5	0.1	2	2	0	11.7	11.8	0.1
11	25.6	25.7	0.1	16.0	16.0	0.0	0	0	0	10.4	10.4	0.0

ID	Annual Mean NO ₂ (µg/m ³)			Annual Mean PM ₁₀ (µg/m ³)			24-Hour Mean PM ₁₀ (No. of Days)			Annual Mean PM _{2.5} (µg/m ³)		
	2026 Baseline	2026 With Development and Cumulative Schemes	Change	2026 Baseline	2026 With Development and Cumulative Schemes	Change	2026 Baseline	2026 With Development and Cumulative Schemes	Change	2026 Baseline	2026 With Development and Cumulative Schemes	Change
12	28.6	28.7	0.1	19.1	19.4	0.3	2	3	1	12.1	12.3	0.2
13	27.4	27.5	0.1	18.1	18.2	0.1	1	2	1	11.6	11.6	0.0
14	27.7	27.8	0.1	18.1	18.2	0.1	1	2	1	11.6	11.6	0.0
15	27.4	27.4	0.0	18.0	18.2	0.2	1	2	1	11.5	11.6	0.1

Nitrogen Dioxide

- 1.92. In 2026, concentrations are predicted to meet the NO₂ annual mean objective value of 40µg/m³ at all receptor locations. Table 18 illustrates that the highest predicted annual mean NO₂ concentration (of 37.4µg/m³ at Receptor 4 'with' the Proposed Development and cumulative schemes) is much less than 60µg/m³ and as such the hourly objective is likely to be met at all existing receptors.
- 1.93. Using the magnitude of change descriptors outlined in Table 8, the Proposed Development and cumulative schemes are predicted to result in a 'negligible' impact on annual mean NO₂ concentrations at all receptor locations. The cumulative effect on NO₂ concentrations is not significant.

Particulate Matter (PM₁₀ and PM_{2.5})

- 1.94. As shown in Table 18, the concentrations of PM₁₀ are predicted to be well below the annual and daily mean objective values in 2026 at all the receptor locations.
- 1.95. Using the magnitude of change descriptors outlined in Table 8, the Proposed Development and cumulative schemes are predicted to result in a 'negligible' impact on annual mean PM₁₀ levels at all receptor locations and the cumulative effect is not significant.
- 1.96. There are no significance criteria in relation to daily mean PM₁₀ concentrations. However, given the predicted concentrations are well below the daily mean PM₁₀ objective, and no change is predicted at all receptor locations, it is considered that the cumulative effect on daily mean PM₁₀ levels is not significant.
- 1.97. The results in Table 18 indicate that the annual mean PM_{2.5} objective of 25µg/m³ is predicted to be met in all scenarios modelled both 'with' and 'without' the Proposed Development and cumulative schemes. Based on the criteria outlined in Table 8, a **negligible** impact is predicted at all receptor locations on annual mean PM_{2.5} levels and the cumulative effect is not significant.

Mitigation Measures and Likely Residual Effects

Demolition and Construction

Nuisance Dust

- 1.98. A range of environmental management controls would be developed with reference to the IAQM guidance. These would be detailed in a Construction Environmental Management Plan (CEMP) with the objective to prevent the release of dust entering the atmosphere and/or being deposited on nearby receptors. Such measures, which would be adopted and secured through planning obligations and/or appropriate planning conditions, would include:
- Damping down surfaces during dry weather;
 - Erecting appropriate hoarding and/or fencing to reduce dust dispersion and restrict public access;
 - Sheeting of chutes, skips and vehicles removing construction wastes;
 - Appropriate handling and storage of materials, especially stockpiled materials;
 - Restricting drop heights onto lorries and other equipment;
 - Effective vehicle washing facilities to be provided for vehicles leaving the Site;
 - Fitting all equipment (e.g. for cutting, grinding, crushing) with dust control measures such as water sprays wherever possible;
 - Prevention of dust-contaminated run-off water from the Site;
 - Using gas powered generators rather than diesel if possible (these are also quieter) and ensuring that all plant and vehicles are well maintained so that exhaust emissions do not breach statutory emission limits;
 - Prohibiting fires on the construction site; and
 - Ensuring that cleaning equipment is available to clean mud from hard standing roads and footpaths.
- 1.99. Particular attention would be paid to operations that would take place close to the Site boundary due to their proximity to surrounding properties.

Vehicle Emissions

- 1.100. Construction traffic logistics would be agreed with RBC in advance of the works commencing. In determining construction traffic routing, consideration has been, and would be, given to the location of sensitive routes (i.e. residential roads etc.). Where practicable, use of roads during peak hours will be limited. Where possible, construction vehicles with low diesel emissions (i.e. the latest Euro Emission standards) would be used. It is anticipated that with appropriate construction logistics, the likely residual effect of emissions from construction vehicles entering and egressing the Site is not significant and no further mitigation is required.

Construction Plant Emissions

- 1.101. No mitigation measures are required as no significant adverse impacts from construction plant are predicted.

Interim Development and Completed Development Scenarios

1.102. As identified above, the Interim, Completed and Cumulative Development Scenarios are predicted to have a negligible impact on local air quality and therefore the effect would be not significant. However, a Travel Plan would be prepared to encourage car sharing and reduce the number of car trips associated with the Proposed Development and encourage walking and cycling and use of public transport, which would also reduce emissions to air. The Proposed Development will also include the provision of electric vehicle charging points which will also have a benefit to air quality by encouraging the switch to low emission vehicles. These would be secured by means of a planning condition on any future planning consent.

Summary

Table 18: Summary of Effects

Issue	Likely Significant Effect	Mitigation Measures	Likely Residual Effect
Demolition and Construction			
Dust emissions from construction activities	Temporary, local and of minor adverse significance	CEMP	Negligible
Emissions from construction plant	Negligible	None required	Negligible
Emissions from construction vehicles	Temporary local minor adverse	Traffic Logistics Plan	Negligible
Interim Development Scenario			
NO ₂ , PM ₁₀ and PM _{2.5} emissions from traffic associated with the completed Interim Development	Negligible	Travel Plan Electric vehicle charge points	Negligible
Completed Development			
NO ₂ , PM ₁₀ and PM _{2.5} emissions from traffic associated with the Completed Development	Negligible	Travel Plan Electric vehicle charge points	Negligible
Cumulative Development			
NO ₂ , PM ₁₀ and PM _{2.5} emissions from traffic associated with the Cumulative Development Scenario	Negligible	Travel Plan Electric vehicle charge points	Negligible

Figures

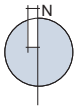
Figure 1: Site Location Plan

Figure 2: Site Layout

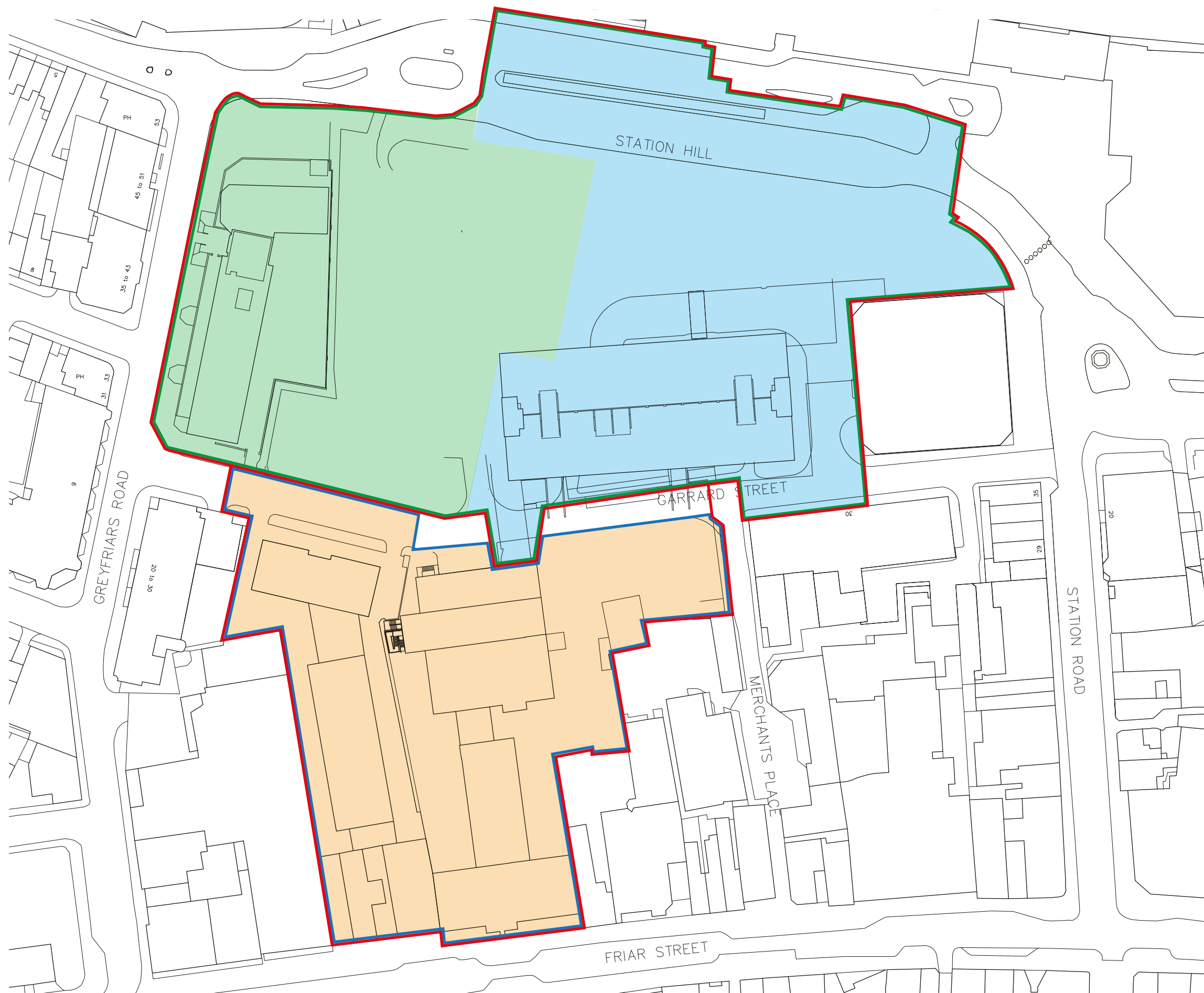
Figure 3: Proposed Development Layout

Figure 4: Construction Phase Assessment Plan

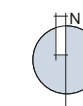
Figure 5: Site Plan and Receptor Locations



Project Details	WIE14788-100: Station Hill, Reading
Figure Title	Figure 1: Site Location
Figure Ref	WIE14788-100_GR_ES_1A
Date	2020
File Location	\\s-Incs\\wie\\projects\\wie14788\\100\\graphics\\aqa\\issued figures



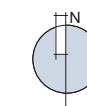
- Site Boundary
- North Site Boundary
- South Site Boundary
- Phase 1
- Phase 2
- Phase 3



Project Details	WIE14788-100: Station Hill, Reading
Figure Title	Figure 2: Phasing Plan
Figure Ref	WIE14788-100_GR_AQA_2A
Date	2020
File Location	\\s-incs\wie\projects\wie14788\100\graphics\aqal\issued figures

Note:

The proposals for Phase 3 are illustrative



Project Details

WIE14788-100: Station Hill, Reading

Figure Title

Figure 3: Proposed Development Layout

Figure Ref
Date

WIE14788-100_GR_AQA_3A
2020

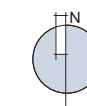
File Location

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www.watermangroup.com



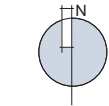
- Site Boundary
- 20m from Site Boundary
- 50m from Site Boundary
- 100m from Site Boundary
- 200m from Site Boundary
- 350m from Site Boundary



Project Details	WIE14788-100: Station Hill, Reading
Figure Title	Figure 4: Construction Phase Assessment Bands
Figure Ref	WIE14788-108_GR_AQA_4A
Date	2020
File Location	\\s-incs\wie\projects\wie14788\100\graphics\aqalissued figures



- Site Boundary
- Receptor Locations



Project Details	WIE14788-100: Station Hill, Reading
Figure Title	Figure 5: Site Plan and Receptor Locations
Figure Ref	WIE14788-100_GR_AQA_5A
Date	2020
File Location	\\s-Incs\wie\projects\wie14788\100\graphics\aqalissued figures

APPENDICES

A. Air Quality Assessment Detailed Methodology and Modelled Conditions within the Proposed Development

This appendix presents the technical information and data upon which the air quality assessment is based.

Operational Development Assessment

ADMS-Roads

In urban areas, pollutant concentrations are primarily determined by the balance between pollutant emissions that increase concentrations, and the ability of the atmosphere to reduce and remove pollutants by dispersion, advection, reaction and deposition. An atmospheric dispersion model is used as a practical way to simulate these complex processes; which requires a range of input data, which can include pollutant emissions rates, meteorological data and local topographical information.

The potential effects of the Proposed Development on local air quality was assessed using the advanced atmospheric dispersion model ADMS-Roads, considering the contribution of emissions from forecast road-traffic on the local road network for the assessment years (taken to be 2022 and 2026).

The ADMS-Roads model is a comprehensive tool for investigating air pollution in relation to road networks. On review of the Site, and its surroundings, ADMS-Roads was considered appropriate for the assessment of the potential long and short term effects of the Proposed Development on air quality. The model uses advanced algorithms for the height-dependence of wind speed, turbulence and stability to produce improved predictions of air pollutant concentrations. It can predict long-term and short-term concentrations, including percentile concentrations.

ADMS-Roads model is a formally validated model, developed in the United Kingdom (UK) by CERC (Cambridge Environmental Research Consultants). This includes comparisons with data from the UK's air quality Automatic Urban and Rural Network (AURN) and specific verification exercises using standard field, laboratory and numerical data sets. CERC is also involved in European programmes on model harmonisation and their models have been compared favourably against other E.U and U.S. EPA systems. Further information in relation to this is available from the CERC website at www.cerc.co.uk.

Model Scenarios

To assess future air quality conditions at the Site once the Proposed Development is complete and operational the future years of 2022, once Phases 1 and 2 are complete and operational (the Interim Development Scenario), and 2026, once all phases have been constructed (the Completed Development Scenario) were assessed. A 2026 Cumulative Scenario has also been modelled.

The year 2018 was also modelled to establish the existing baseline situation because it is the latest full year of existing monitoring data from Reading Borough Council (RBC) surrounding the Site against which the air quality model is verified (discussed further below). Base year traffic data for 2018 and meteorological data for 2018 were also used to be consistent with the verification year.

Considering recent analyses by Defra¹⁹ showing that historical NO_x and NO₂ concentrations are not declining in line with emission forecasts, the assessment has used revised emissions data and background concentrations using the Air Quality Consultants Ltd Calculator Using Realistic Emissions for Diesels (CURED) spreadsheet²⁰. The spreadsheet has been designed to provide a reasonable worst-case assumption for future vehicle emissions.

Traffic Data

Traffic flow data comprising Annual Average Daily Traffic (AADT) flows, traffic composition (% Heavy-Duty Vehicles (HDVs)) were used in the model as provided by the project transport consultants (PBA part of Stantec) for the surrounding road network, inclusive of traffic flows for committed developments near the Site. **Table A1** presents the traffic data used within the Air Quality Assessment.

19 <http://laqm.defra.gov.uk/faqs/faqs.html>: Measured nitrogen oxides (NO_x) and/or nitrogen dioxide (NO₂) concentrations in my local authority area do not appear to be declining in line with national forecasts.

20 <http://www.aqconsultants.co.uk/News/January-2018/UPDATED-CURED-TO-V3A.aspx>

Table A1: 24-hour AADT Data Used within the Assessment

Ref.	Link Name	Speed (kph)	2018		2022				2026					
			Baseline		Baseline		Interim Development Scenario		Baseline		Completed Development Scenario		Cumulative Scenario	
			AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV	AADT	%HDV
1	Castle Street west of IDR	39	26582	5.32	28611	5.31	28682	5.39	30356	5.31	30602	5.41	30602	5.41
2	Castle Street east of IDR	33	6316	8.38	6759	8.37	6853	8.26	7173	8.37	7378	8.14	7436	8.08
3	Queens Road	38	25366	8.27	27140	8.28	27278	8.34	28805	8.28	29182	8.29	29182	8.29
4	Forbury Road	43	22902	9.47	25171	9.47	25171	9.47	26674	9.47	26674	9.47	27913	9.12
5	Blagrove Road	21	6185	22.44	6615	22.44	6615	22.44	7021	22.44	7021	22.44	7021	22.44
6	Friar Street	26	4493	34.90	4805	34.89	4805	34.89	5100	34.89	5100	34.89	5195	34.48
7	Caversham Road under Railway bridge	39	32456	9.79	35099	9.80	35152	9.92	37230	9.80	37514	9.93	37906	9.85
8	Vastern Road	40	23905	8.43	26144	8.42	26205	8.47	27713	8.42	27912	8.47	29456	8.15
9	George Street	45	19137	5.77	20497	5.77	20679	5.81	21754	5.77	22215	5.79	22215	5.79
10	Station Road	17	4092	9.78	4377	9.77	4377	9.77	4646	9.77	4646	9.77	4646	9.77
11	Oxford Road	37	18625	6.91	20048	6.91	20168	6.96	21271	6.91	21594	6.94	21594	6.94
12	Wokingham Road	41	14900	6.09	16164	6.10	16299	6.13	17142	6.10	17483	6.10	17483	6.10
13	A4 London Road	40	31594	7.22	34251	7.22	34414	7.28	36325	7.22	36785	7.27	36785	7.27
14	Caversham Road north of IDR	39	30635	9.46	33150	9.46	33262	9.51	35162	9.46	35510	9.50	35597	9.48
15	Greyfriars Road	30	5955	7.94	6331	7.94	6338	10.30	6665	7.94	7204	10.64	7377	10.62
16	Garrard Street	26	3068	6.55	3262	6.56	3270	11.13	3434	6.56	3974	11.63	3974	12.36

Vehicle Speeds

To take into account the presence of slow moving traffic along the links in the area, the speed at the junctions were reduced to 20kph in accordance with the following criteria recommended within LAQM.TG(16)²¹:

- Traffic on the carriageway approaching the lights when red, e.g. 5-20 kph, depending on the time of day and level of congestion at the junction;
- Traffic approaching the lights when green, e.g. 20-50 kph; and
- Traffic on the carriageway approaching the lights when red, e.g. 5-20 kph, depending on the time of day and how congested the junction is.

Diurnal Profile

The ADMS-Roads model uses an hourly traffic flow based on the daily (AADT) flows. Traffic flows follow a diurnal variation throughout the day and week. Therefore, a diurnal profile was used in the model to replicate how the average hourly traffic flow would vary throughout the day and the week. This was based on data (the latest available at the time of the assessment) collated by Waterman from the Department for Transport (DfT) statistics Table TRA0307: 'Traffic Distribution by Time of Day on all roads in Great Britain', 2018²². **Figure A1** presents the diurnal variation in traffic flows which has been used within the model.

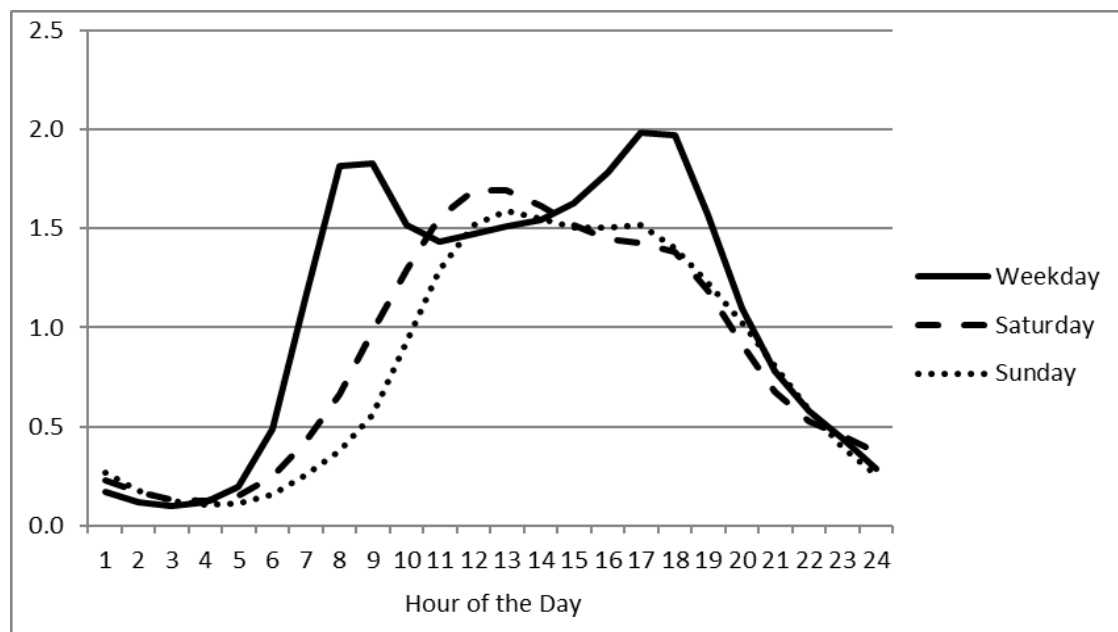


Figure A1: Department for Transport Diurnal Traffic Variation

Street Canyon Effect

Narrow streets with tall buildings on either side have the potential to create a confined space, which can interfere with the dispersion of traffic pollutants and may result in pollutant emissions accumulating in these streets. In an air quality model, these narrow streets are described as street canyons.

²¹ Defra, 2016, London Local Air Quality Management Technical Guidance LAQM.TG (16)

²² Department for Transport (DfT) Statistics, www.dft.gov.uk/statistics/series/traffic

ADMS-Roads includes a street canyon model to take account of the additional turbulent flow patterns occurring inside such a narrow street with relatively tall buildings on both sides. LAQM.TG(16) identifies a street canyon “*as narrow streets where the height of buildings on both sides of the road is greater than the road width.*”

Following a review of the road network to be included within the model, the roads within the network to be modelled are relatively wide and existing buildings are not considered to be tall. The proposed buildings within the Proposed Development Site, while being tall, do not cause any new canyons to be created with the existing buildings on the opposite side of Station Hill, Greyfriars Road, Garrard Street or Friar Street. Therefore, no canyons were included within the model for the existing or with Development scenarios.

Road Traffic Emission Factors

The latest version of the ADMS-Roads model (version 4.1.1.0) was used for the assessment. At the time of the assessment this includes the latest vehicle emission factors published by Defra in the Emission Factors Toolkit (EFT) (version 9.0, published in May 2019).

The EFT uses several parameters (traffic flow, percentage of HDV, speed and road type) to calculate road traffic emissions for the selected pollutants.

As stated previously, for the future year assessment revised NO_x and NO₂ emissions data using the CURED spreadsheet have been inputted into the model.

Emissions from Diesel Trains

LAQM.TG(16) provides guidance on assessing NO_x emissions from railways. The guidance states that there is only a requirement to “*assess railway lines with a high usage of diesel locomotives*” and where “*there is potential for long term exposure within 30m of the edge of the tracks*”. Table 7.2 of LAQM.TG(16) lists the lines with a heavy traffic of diesel passenger trains. The lines travelling through Reading Station are included within Table 7.2 of LAQM.TG(16) (Paddington to Swansea). However, there is no exposure in the Proposed Development within 30m of the edge of the tracks. As such, NO_x emissions from diesel trains have not been considered further within this assessment.

Background Pollutant Concentrations

The ADMS-Roads model requires background pollutant concentration data (i.e. concentrations not including local pollutant sources such as roads or stacks), that correspond to the year of assessment, to which the model adds contributions from the road sources.

RBC undertake background air pollutant monitoring at one automatic monitor within their administrative boundary. Table A2 shows the monitoring results for the automatic analyser located at New Town approximately 2km from the Site.

Table A2: Measured Concentrations at the RBC Urban Background Monitor (µg/m³)

Pollutant	Averaging Period	AQS Objective	2016	2017	2018
NO _x	Annual Mean (µg/m ³)	-	-	-	35
NO ₂	Annual Mean (µg/m ³)	40µg/m ³	34	29	26

Pollutant	Averaging Period	AQS Objective	2016	2017	2018
PM ₁₀	1-Hour Mean (No. of Hours)	200µg/m ³ not to be exceeded more than 18 times a year	4	0	0
	Annual Mean (µg/m ³)	40µg/m ³	13	12	13
	24-Hour Mean (No. of Days)	50µg/m ³ not to be exceeded more than 35 times a year	3	3	1
PM _{2.5}	Annual Mean (µg/m ³)	25µg/m ³	9	10	7

Notes: Data obtained from [RBC 2019 Annual Status Report](#)

In addition to the background monitoring undertaken by RBC, background concentrations of NO_x, NO₂, PM₁₀ and PM_{2.5} are available from the Defra Local Air Quality Management website²³ for 1x1km grid squares, for years 2017 to 2030. **Table A3** presents the Defra mapped NO₂ background concentrations for the grid square the Site is located within (473500, 173500;) for 2018 to compare against the RBC New Town automatic monitor.

Table A3: Defra background maps in 2017 for the grid square at the Site

Pollutant	Annual Mean Concentration (µg/m ³)
	2018
NO _x	37.0
NO ₂	23.5
PM ₁₀	16.6
PM _{2.5}	11.6

Tables A2 and A3 show that in 2018 monitored urban background NO₂ concentration at the New Town automatic monitor (26µg/m³) is slightly higher than the Defra map (23.5µg/m³). The 2018 monitored concentrations of PM₁₀ (13µg/m³) and PM_{2.5} (7µg/m³) are slightly lower than the Defra maps (PM₁₀: 16.6µg/m³ and PM_{2.5}: 11.6µg/m³). Concentrations have been obtained from the New Town monitored data rather than the estimated Defra maps.

Table A4 presents the background concentrations used within the air quality assessment. The future year NO₂ concentrations were calculated using the CURED methodology.

Table A4: Background concentrations used in the assessment (µg/m³)

Pollutant	2018	2022	2026
NO _x	35.0	30.0	27.9
NO ₂	26.0	23.1	21.7
PM ₁₀	13.0	12.4	12.0
PM _{2.5}	9.0	8.5	8.2

Meteorological Data

Local meteorological conditions strongly influence the dispersal of pollutants. Key meteorological data for dispersion modelling include hourly sequential data including wind direction, wind speed, temperature, precipitation and the extent of cloud cover for each hour of a given year. As a minimum ADMS-Roads requires wind speed, wind direction, and cloud cover.

²³ <http://uk-air.defra.gov.uk/>

Meteorological data to input into the model were obtained from the Farnborough Airport Meteorological Station, which is the closest to the Site and considered to be the most representative. The 2018 data were used to be consistent with the base traffic year and model verification year. It was also used for the 2022 and 2024 scenarios for the air quality assessment. **Figure A2** presents the wind-rose for the meteorological data.

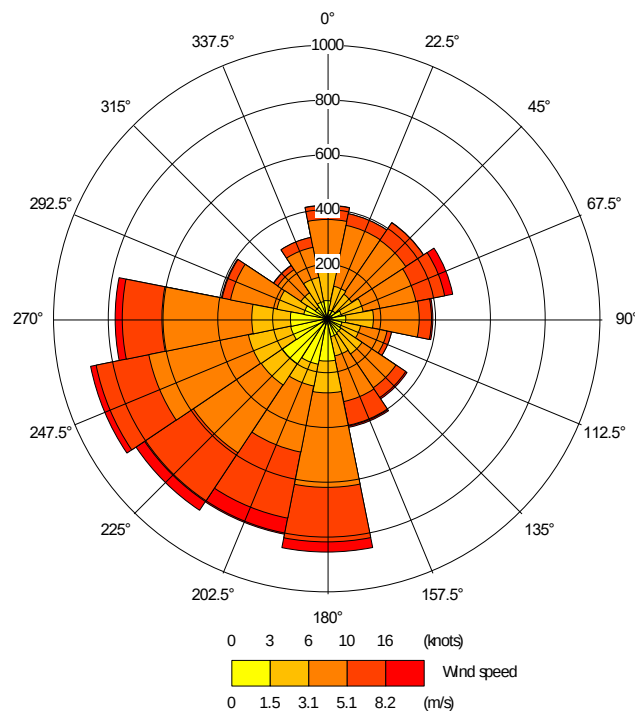


Figure A2: 2018 Wind Rose for the Farnborough Airport Meteorological Site

Most dispersion models do not use meteorological data if they relate to calm winds conditions, as dispersion of air pollutants is more difficult to calculate in these circumstances. ADMS-Roads treats calm wind conditions by setting the minimum wind speed to 0.75 m/s. It is recommended in LAQM.TG(16) that the meteorological data file be tested within a dispersion model and the relevant output log file checked, to confirm the number of missing hours and calm hours that cannot be used by the dispersion model. This is important when considering predictions of high percentiles and the number of exceedances. LAQM.TG(16) recommends that meteorological data should only be used if the percentage of usable hours is greater than 85%. 2018 meteorological data from Farnborough Airport includes 8,197 lines of usable hourly data out of the total 8,760 for the year, i.e. 93.6% of usable data. This is above the 85% threshold and is therefore adequate for the dispersion modelling.

A value of 0.5 was used for the Farnborough Airport Meteorological Station, which is representative of parkland and open suburbia, and is considered appropriate following a review of the local area surrounding the Meteorological Station.

Model Data Processing

The modelling results were processed to calculate the averaging periods required for comparison with the Air Quality Strategy Objectives.

NO_x emissions from combustion sources (including vehicle exhausts) comprise principally nitric oxide (NO) and NO₂. The emitted NO reacts with oxidants in the air (mainly ozone) to form more NO₂. Since only NO₂ is associated with impacts on human health, the air quality standards for the protection of human health are based on NO₂ and not total NO_x or NO.

The ADMS-Roads model was run without the Chemistry Reaction option to allow verification (see below). Therefore, a suitable NO_x:NO₂ conversion was applied to the modelled NO_x concentrations. There are a variety of different approaches to dealing with NO_x:NO₂ relationships, a number of which are widely recognised as being acceptable. However, the current approach was developed for roadside sites, and is detailed within the Technical Guidance LAQM.TG(16).

The LAQM Support website provides a spreadsheet calculator²⁴ to allow the calculation of NO₂ from NO_x concentrations, accounting for the difference between primary emissions of NO_x and background NO_x, the concentration of O₃, and the different proportions of primary NO₂ emissions, in different years. This approach is only applicable to annual mean concentrations.

Research²⁵ undertaken in support of LAQM.TG(16) has indicated that the hourly mean limit value and objective for NO₂ is unlikely to be exceeded at a roadside location where the annual-mean NO₂ concentration is less than 60µg/m³. The hourly objective is, therefore, not considered further within this assessment where the annual-mean NO₂ concentration is predicted to be less than 60µg/m³.

To calculate the number of daily exceedances of 50µg/m³ PM₁₀, the relationship between the number of 24-hour exceedances of 50µg/m³ and the annual mean PM₁₀ concentration from LAQM.TG (16) was applied as follows:

$$\text{Number of Exceedances} = -18.5 + 0.00145 \times \text{annual mean}^3 + (206/\text{annual mean})$$

Other Model Parameters

There are other parameters that are used within the ADMS-Roads model, which are described for completeness and transparency:

- The model requires a surface roughness value to be inputted. A value of 0.5 was used for the Site and Meteorological Station, which is representative of parkland and open suburbia; and
- The model requires the Monin-Obukhov length (a measure of the stability of the atmosphere) to be inputted. A value of 30m (representative of A value of 30m (representative of large cities and towns, such as Reading) was used for the modelling ng; and
- The model requires the Road Type to be inputted. 'Urban [Not London]' was selected and used for the modelling of the road links.

Model Verification

Model verification is the process of comparing monitored and modelled pollutant concentrations for the same year, at the same locations, and adjusting modelled concentrations if necessary, to be consistent with monitoring data. This increases the robustness of modelling results.

²⁴ AEA, NO_x to NO₂ Calculator, <http://laqm1.defra.gov.uk/review/tools/monitoring/calculator.php> Version 7.1, 15 April 2019

²⁵ Defra (2016), 'Local Air Quality Management Policy guidance PG(16)', DEFRA, London

Discrepancies between modelled and measured concentrations can arise for several reasons, for example:

- Traffic data uncertainties;
- Background concentration estimates;
- Meteorological data uncertainties;
- Sources not explicitly included within the model (e.g. car parks and bus stops);
- Overall model limitations (e.g. treatment of roughness and meteorological data, treatment of speeds); and
- Uncertainty in monitoring data, particularly diffusion tubes.

Verification is the process by which uncertainties such as those described above are investigated and minimised. Disparities between modelling and monitoring results are likely to arise as result of a combination of these aspects.

Nitrogen Dioxide

The ADMS-Roads model was run to predict annual mean NO_x concentrations at 22 diffusion tube locations within Reading Town Centre and the Caversham Road automatic monitor. These locations were chosen as the most representative of roadside locations within the Town Centre within the road study network with good data capture.

Box 7.15 in LAQM.TG(16) indicates a method based on comparison of the road NO_x contributions and calculating an adjustment factor. This requires the roadside NO_x contribution to be calculated. In addition, monitored NO_x concentrations are required, which were calculated from the annual mean NO₂ concentration at the diffusion tube site using the NO_x to NO₂ spreadsheet calculator as described above. The steps involved in the adjustment process are presented in **Table A5**. The background data for 2018, as presented in **Table A4**.

Table A23: Model Verification Result for Unadjusted NO_x Emissions (µg/m³)

Site ID	Monitored NO ₂	Monitored NO _x	Monitored Road NO ₂	Monitored Road NO _x	Modelled Road NO _x
DT1	32.0	47.2	6.0	12.2	15.4
DT7	40.0	64.7	14.0	29.7	15.6
DT9	30.0	43.1	4.0	8.1	4.6
DT18	35.0	53.6	9.0	18.6	11.0
DT19	42.0	69.3	16.0	34.3	22.8
DT20	37.0	58.0	11.0	23.0	17.8
DT30	39.0	62.5	13.0	27.5	7.9
DT31	34.0	51.5	8.0	16.5	15.4
DT32	42.0	69.3	16.0	34.3	9.0

Site ID	Monitored NO ₂	Monitored NO _x	Monitored Road NO ₂	Monitored Road NO _x	Modelled Road NO _x
DT34	42.0	69.3	16.0	34.3	8.7
DT35	32.0	47.2	6.0	12.2	11.4
DT36	31.0	45.2	5.0	10.2	10.7
DT37	38.0	60.2	12.0	25.2	7.9
DT39	35.0	53.6	9.0	18.6	9.6
DT42	42.0	69.3	16.0	34.3	10.4
DT43	44.0	74.0	18.0	39.0	18.6
DT47	41.0	67.0	15.0	32.0	17.3
DT48	34.0	51.5	8.0	16.5	12.8
DT51	37.0	58.0	11.0	23.0	24.3
DT52	42.0	69.3	16.0	34.3	21.0
DT53	33.0	49.4	7.0	14.4	18.5
RD1	35.0	53.6	9.0	18.6	14.0

Figure A3 shows the mathematical relationship between modelled and monitored roadside NO_x (i.e. total NO_x minus background NO_x) in a scatter graph (data taken from **Table A6**), with a trendline passing through zero and its derived equation.

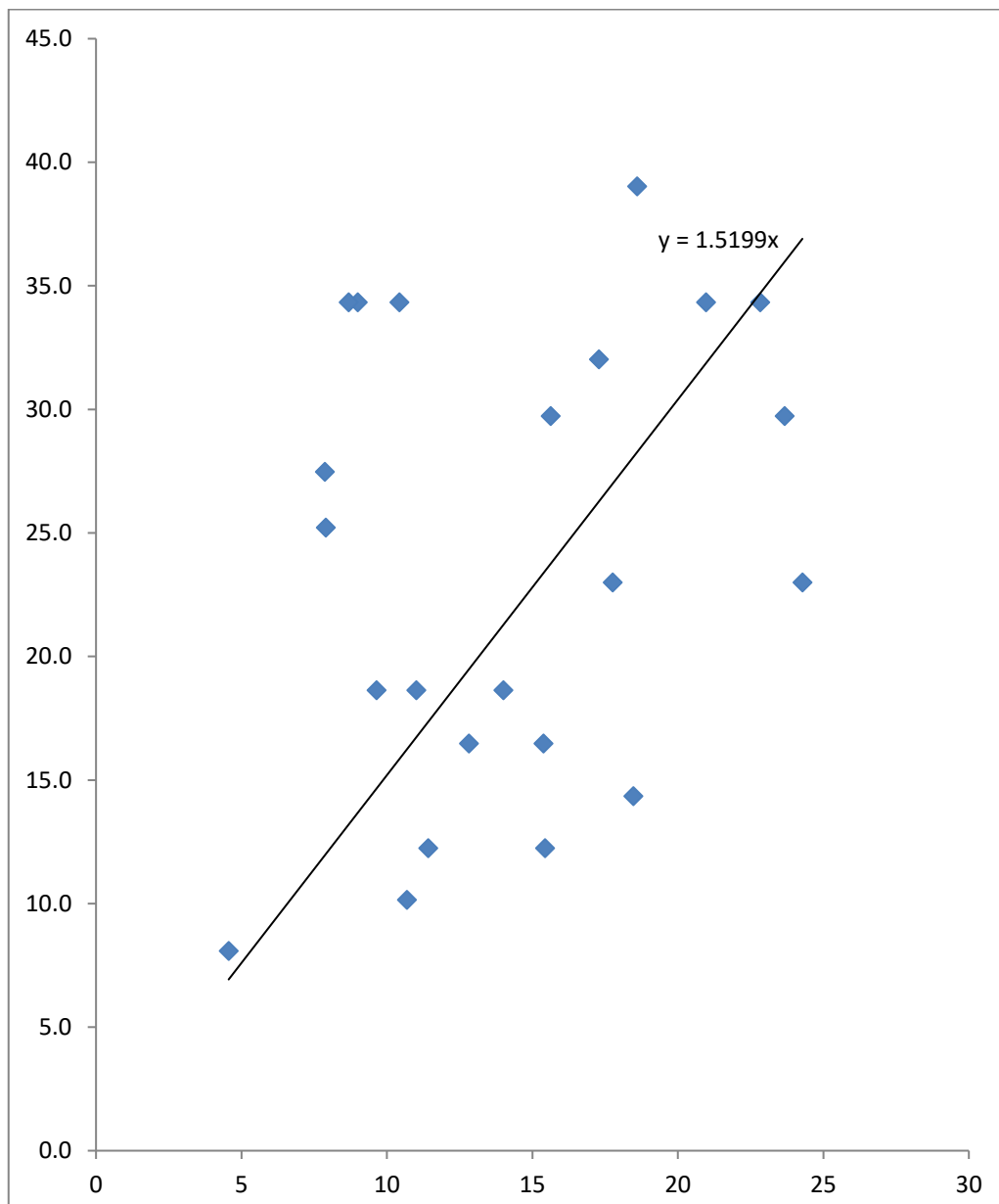


Figure A3: Unadjusted Modelled versus Monitored Annual Mean Roadside NO_x at the Monitoring Sites (µg/m³)

Consequently, in **Table A6** the adjustment factor (1.5199) obtained from **Figure A3** is applied to the modelled NO_x Roadside concentrations to obtain improved agreement between monitored and modelled annual mean NO_x. This has been converted to annual mean NO₂ using the NO_x:NO₂ spreadsheet calculator.

Table A24: Model Verification Result for Adjustment NO_x Emissions (µg/m³)

Site ID	Adjusted Modelled Road NO _x	Adjusted Modelled Total NO _x	Modelled Total NO ₂	Monitored Total NO ₂	% Difference
DT1	23.5	58.5	37.2	32.0	16.3
DT7	23.8	58.8	37.3	40.0	-6.6
DT9	6.9	41.9	29.4	30.0	-1.9
DT18	16.7	51.7	34.1	35.0	-2.5
DT19	34.7	69.7	42.2	42.0	0.4
DT20	27.0	62.0	38.8	37.0	4.8
DT30	12.0	47.0	31.9	39.0	-18.3
DT31	23.4	58.4	37.2	34.0	9.3
DT32	13.7	48.7	32.7	42.0	-22.2
DT34	13.2	48.2	32.5	42.0	-22.7
DT35	17.4	52.4	34.4	32.0	7.5
DT36	16.2	51.2	33.9	31.0	9.3
DT37	12.0	47.0	31.9	38.0	-16.1
DT39	14.6	49.6	33.1	35.0	-5.3
DT42	15.9	50.9	33.7	42.0	-19.7
DT43	28.3	63.3	39.4	44.0	-10.6
DT47	26.3	61.3	38.5	41.0	-6.2
DT48	19.5	54.5	35.4	34.0	4.1
DT51	36.9	71.9	43.1	37.0	16.5
DT52	31.9	66.9	40.9	42.0	-2.5
DT53	28.1	63.1	39.3	33.0	19.0
RD1	21.3	56.3	36.2	35.0	3.5

The results of **Table A6** indicates a better agreement between monitored and modelled annual mean NO₂ results compared to the unadjusted/unverified model shown in **Table A5**.

Based on the results from **Table A5** and **Table A6**, the NO_x adjustment process was subsequently applied to all roadside NO_x modelling for the 2018, 2022 and 2026 scenarios, at the specific receptors locations assessed, before the predicted concentrations were converted to NO₂.

Particulate Matter (PM₁₀ and PM_{2.5})

PM₁₀ monitoring is also undertaken at the automatic monitoring site at Caversham Road, and therefore, a similar process to that above has been applied to PM₁₀. The steps involved in the adjustment process are presented in **Table A7**.

Table A25: Model Verification Result for Annual Mean PM₁₀ in 2018 at Caversham Road Automatic Monitor

Site ID	Monitored PM ₁₀	Background PM ₁₀	Monitored Road PM ₁₀ Contribution	Modelled Road PM ₁₀ Contribution	Ratio
Caversham Road	24.0	13.0	11.0	1.96	5.61

The adjustment factor (5.61) obtained in **Table A7** is applied to the modelled PM₁₀ Roadside concentrations, prior to the addition of the background concentrations and before the number of daily PM₁₀ exceedences was calculated, to obtain improved agreement between monitored and modelled annual mean PM₁₀.

No roadside PM_{2.5} monitoring data is undertaken to compare to the model output. Therefore, the adjustment factor (of 5.61) calculated in **Table A7** for the adjustment of PM₁₀ has been applied to all the roadside PM_{2.5} modelling results inside of the street canyon, before the addition of the appropriate background concentrations.

Verification Summary

Any atmospheric dispersion model study will always have a degree of inaccuracy due to a variety of factors. These include uncertainties in traffic emissions data, the differences between available meteorological data and the specific microclimate at each receptor location, and simplifications made in the model algorithms that describe the atmospheric dispersion and chemical processes. There will also be uncertainty in the comparison of predicted concentrations with monitored data, given the potential for errors and uncertainty in sampling methodology (technique, location, handling, and analysis) as well as processing of any monitoring data.

Whilst systematic under or over prediction can be taken in to account through the model verification / adjustment process, random errors will inevitably occur and a level of uncertainty will still exist in corrected / adjusted data.

Model uncertainties arise because of limited scientific knowledge, limited ability to assess the uncertainty of model inputs, for example, emissions from vehicles, poor understanding of the interaction between model and / or emissions inventory parameters, sampling and measurement error associated with monitoring sites and whether the model itself completely describes all the necessary atmospheric processes.

Overall, it was concluded that with the adjustment factors applied to the ADMS-Roads model, it is performing well, and modelled results are suitable to determine the potential effects of the Development on local air quality.

Assessor Experience

Name: Christopher Brownlie

Years of Experience: 11

Qualifications:

- BSc (Hons)
- MSc
- MIAQM (Member of the Institute of Air Quality Management)

Chris has over eleven years of experience in the assessment of air quality and odour for a variety of environmental impact assessment projects. Chris has knowledge and extensive experience of designing and undertaking ambient air quality monitoring programmes using real time equipment and passive diffusion tubes. This includes devising monitoring programs for dust deposition, typically to monitor levels of dust generated during construction activities in populated areas where there is the potential for nuisance to be caused.

Chris has been responsible for the technical delivery of a wide range of air quality projects for a variety of clients in both the public and private sector. These projects include consideration of emissions from both transportation and industrial sources, through both monitoring and modelling, and therefore he has an in depth understanding of the regulatory requirements for these sources and the published technical guidance for their assessment.

Conditions within the Development

Table A26: 2026 Annual Mean NO₂ Concentrations (µg/m³)

Floor	A	B	C	D	E	F	G
G	27.3	23.7	23.4	25.4	24.7	24.0	24.7
1	25.4	23.7	23.4	24.6	23.6	23.4	24.2
2	24.0	23.5	23.3	23.8	23.2	23.2	23.5
3	23.5	23.4	23.2	23.4	22.9	23.0	23.2
4	23.3	23.2	23.1	23.2	22.8	22.9	23.0
5	23.0	23.0	22.9	23.0	22.7	22.7	22.9
6	22.9	22.8	22.8	22.8	22.6	22.6	22.7
7	22.7	22.7	22.7	22.7	22.5	22.5	22.6
8	22.6	22.6	22.6	22.5	22.4	22.4	22.5
9	22.4	22.5	22.5	22.4	22.3	22.3	22.4
10	22.4	22.4	22.4	22.4	22.3	22.3	22.4
11	22.3	22.3	22.3	22.3	22.2	22.2	22.3
12	22.2	22.2	22.2	22.2	22.1	22.2	22.2
13	22.1	22.2	22.2	22.2	22.1	22.1	
14	22.1	22.1	22.1	22.1	22.1	22.1	
15	22.1	22.1	22.1	22.1			
16	22.0	22.0	22.0	22.0			
17		22.0	22.0	22.0			
18		22.0	22.0	22.0			
19		21.9	21.9	21.9			
20		21.9	21.9	21.9			
21		21.9	21.9	21.9			
22		21.8	21.8				
23		21.8	21.8				
24		21.8	21.8				

Floor	A	B	C	D	E	F	G
25		21.8	21.8				
26		21.8	21.8				
27			21.8				

Table A27: 2026 Annual Mean PM₁₀ Concentrations (µg/m³)

Floor	A	B	C	D	E	F	G
G	17.5	14.0	13.8	15.5	15.0	14.2	14.9
1	15.6	14.0	13.7	14.9	13.9	13.7	14.4
2	14.3	13.9	13.6	14.1	13.5	13.5	13.8
3	13.9	13.7	13.5	13.8	13.3	13.3	13.5
4	13.6	13.5	13.4	13.5	13.1	13.2	13.3
5	13.4	13.3	13.3	13.3	13.0	13.0	13.2
6	13.2	13.2	13.1	13.1	12.9	12.9	13.1
7	13	13.0	13	13.0	12.8	12.8	13.0
8	12.9	12.9	12.9	12.9	12.7	12.8	12.9
9	12.8	12.8	12.8	12.8	12.7	12.7	12.8
10	12.7	12.7	12.7	12.7	12.6	12.6	12.7
11	12.6	12.6	12.6	12.6	12.5	12.5	12.6
12	12.5	12.5	12.6	12.5	12.5	12.5	12.5
13	12.5	12.5	12.5	12.5	12.4	12.4	
14	12.4	12.4	12.4	12.4	12.4	12.4	
15	12.4	12.4	12.4	12.4			
16	12.4	12.4	12.4	12.4			
17		12.3	12.3	12.3			
18		12.3	12.3	12.3			
19		12.3	12.3	12.3			
20		12.3	12.3	12.3			
21		12.2	12.2	12.2			

Floor	A	B	C	D	E	F	G
22		12.2	12.2				
23		12.2	12.2				
24		12.2	12.2				
25		12.1	12.1				
26		12.1	12.1				
27			12.1				

Table A28: Daily Mean PM_{2.5} Concentrations >50µg/m³ (No. of Days)

Floor	A	B	C	D	E	F	G
G	1	0	0	0	0	0	0
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	1	1	0
6	0	0	0	0	1	1	0
7	1	1	1	1	1	1	1
8	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1
13	1	1	1	1	1	1	
14	1	1	1	1	1	1	
15	1	1	1	1			
16	1	1	1	1			
17		1	1	1			
18		1	1	1			

Floor	A	B	C	D	E	F	G
19		1	1	1			
20		1	1	1			
21		1	1	1			
22		1	1				
23		1	1				
24		1	1				
25		1	1				
26		1	1				
27			1				

Table A29: 2026 Annual Mean PM_{2.5} Concentrations (µg/m³)

Floor	A	B	C	D	E	F	G
G	11.2	9.3	9.2	10.1	9.9	9.4	9.8
1	10.2	9.3	9.2	9.8	9.3	9.1	9.5
2	9.5	9.2	9.1	9.4	9.0	9.0	9.2
3	9.2	9.1	9.1	9.2	8.9	8.9	9.0
4	9.1	9.0	9.0	9.0	8.8	8.9	8.9
5	9.0	8.9	8.9	8.9	8.8	8.8	8.9
6	8.9	8.8	8.8	8.8	8.7	8.7	8.8
7	8.8	8.8	8.8	8.8	8.7	8.7	8.7
8	8.7	8.7	8.7	8.7	8.6	8.6	8.7
9	8.6	8.6	8.6	8.6	8.6	8.6	8.6
10	8.6	8.6	8.6	8.6	8.5	8.5	8.6
11	8.5	8.5	8.5	8.5	8.5	8.5	8.5
12	8.5	8.5	8.5	8.5	8.5	8.5	8.5
13	8.5	8.5	8.5	8.5	8.4	8.5	
14	8.4	8.4	8.5	8.4	8.4	8.4	
15	8.4	8.4	8.4	8.4			

Floor	A	B	C	D	E	F	G
16	8.4	8.4	8.4	8.4			
17		8.4	8.4	8.4			
18		8.4	8.4	8.4			
19		8.4	8.4	8.4			
20		8.3	8.3	8.3			
21		8.3	8.3	8.3			
22		8.3	8.3				
23		8.3	8.3				
24		8.3	8.3				
25		8.3	8.3				
26		8.3	8.3				
27			8.3				

B. Cumulative Schemes

No	Site	Application Reference	Proposals	Decision/Date	Distance and direction from the Site (at its closest point)
1.	80 Caversham Road	182252 / OUT	Outline application considering access, landscaping, layout and scale involving the demolition of all existing buildings and structures (Classes B1a & B2) and erection of new buildings ranging between basement and 2 – 25 storeys in height, providing 658 (79 x studio, 227x1, 335x2 & 17x3-bed) residential units, office accommodation (Class B1a), flexible ground floor Class A1-3 uses, a community centre(Class D1), health centre uses (Class D1) and various works including car parking, servicing, public and private open space, landscaping, highways, pedestrian and vehicular access and associated works.	Decision Pending	150m north
2.	29-35 Station Road, Reading, RG1 1LG	181930	Demolition of existing building and the erection of a 22 storey building (at 121m AOD) for hotel accommodation, office accommodation and ground floor retail uses. No parking is proposed on site although servicing will be provided for to the rear of the site accessed from Garrard Street.	Decision Pending	45m south-east
3.	52 to 55 Friar Street and 12 Greyfriars Road, Reading RG1 1DX	162210	Demolition of existing building and structures (Class A1) and erection of 3 new buildings ranging between 6 - 12 (and basement) storeys in height to provide 135 (1xstudio, 54x1, 73x2 & 7x3-bed) residential units (Class C3), a flexible Class A1-A5 use at ground floor level fronting onto Friar St, a flexible Class A1-5, B1(a) or D2 (gym only) use at ground floor level fronting onto Greyfriars Rd, with associated access, parking, servicing, landscaping and engineering works (amended description).	Approved 20/03/18	Immediately adjacent to the west of the Site.

Appendices

No	Site	Application Reference	Proposals	Decision/Date	Distance and direction from the Site (at its closest point)
4.	Bristol and West Arcade, Market Place	180358	Demolition of vacant former Bristol & West Arcade (173 – 175 Friar Street) and erection of an eight storey mixed-use building (plus basement) to provide 35 residential units, 4,212 sqm of B1 office floorspace, and 5 retail units (A1/A2/A3), demolition of rear parts of 29 – 31 and 32 Market Place, the change of use of the retained units at 27 – 28, 29 - 31 Market Place at first, second and third floors to provide 8 residential units, change of use at ground and basement level of 32 Market Place from A2 to flexible retail use (A1/A2/A3), retention of 260.4 sqm of A4 use at ground and basement at 29-31 Market Place, change of use at ground and basement of 27 - 28 Market Place to flexible retail use (A1/A2/A3), and associated internal and external works to the Listed Buildings, landscaping, refuse, plant, cycle stores and substation at basement level.	Approved 09/01/19	300m to the east.
5.	Land between Weldale Street and Chatham Street	170326	Demolition of all existing buildings (including 3 retail units) and structures, and erection of new buildings ranging between lower ground & 4 storeys to lower ground & 11 storeys in height, providing 427 (233x1, 182x2 & 12x3-bed) residential units (Class C3) and 1 flexible ground floor retail shop (Class A1) or restaurant and café (Class A3) unit, together with new public realm, landscaping, accesses, parking and associated works (amended description).	Approved 15 March 2018	180m to the west of the Site.

Appendices

No	Site	Application Reference	Proposals	Decision/Date	Distance and direction from the Site (at its closest point)
6.	Kenavon Drive	170509	Demolition of the two existing retail (Homebase and former Toys R Us) structures and the erection of new buildings ranging between 2 and 11 storeys in height, providing 765 (18 x studio, 302x1, 409x2 and 36x3- bed) residential units (Class C3), 5 commercial units (1x flexible Class A1-A4, B1 or D1-D2, 1x flexible D1 or D2, 1x flexible Class A1- A5, 1x flexible Class A3 or A4, 1x flexible A1-A5 or D1-D2 uses), various works to the public realm, including a new riverside square, landscaping, accesses, parking and associated works	Approved October 2018	700m east
7.	Former Scottish and Southern Electricity Site, North of Vastern Road	No application submitted to date – anticipated in June 2019. Public consultation only.	Residential development in five buildings of up to 11 storeys. No further details such as unit numbers are currently available.	N/A – application not yet submitted	300m north
8.	Broad Street, Reading	182137	Construction of three residential buildings (Use Class C3) ranging in height from 5 to 22 storeys (Site E to provide 52 units , Site B to provide 139 Units and Site A to provide 172 units) above Broad Street Mall and provision of a podium level amenity area; Construction of an 18 storey building on South Court comprising ground and first floor retail (Use Class A1/A2/A3) and residential over upper floors (Use Class C3, Site C to provide 99 units); Change of use and extension of Quadrant House to form a 3 storey residential building (Use Class C3, Site D to provide 31 units); Creation of three ground floor retail units (Use Class A1/A2/A3) fronting Dusseldorf Way and Queens Walk	N/A – currently pending a decision	160m south west

Appendices

Station Hill, Reading

WIE14788-100-R-24.1.2-AQ

UK and Ireland Office Locations

