



Air Quality Assessment

Clitheroe Road, Whalley

Presented to Trafford Housing Trust

Issued: October 2018

Delta-Simons Project No. 18-0886.04






Delta-Simons Environmental Consultants Limited
Head Office: 3 Herley Office Park, Doddington Road, Lincoln, LN6 3QR
Tel: 01522 882555 | www.deltasimons.com



Report Details

Client	Trafford Housing Trust
Report Title	Air Quality Assessment
Site Address	Clitheroe Road, Whalley
Project No.	18-0886.04
Delta-Simons Contact	Gabor Antony

Quality Assurance

Issue No.	Status	Issue Date	Comments	Author	Technical Review	Authorised
1	First Issue	5 th October 2018	-			
				Gabor Antony (MSc MIAQM MEnvSc) Associate Air Quality Consultant	Simon Johnson (MSc URP, AssocRICS, MRTPI) Principal Consultant	Gabor Antony (MSc MIAQM MEnvSc) Associate Air Quality Consultant

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Executive Summary

Site and Report Context	<p>Delta-Simons, was instructed by Trafford Housing Trust (the 'Client') to undertake an Air Quality Assessment in support of a planning application for a proposed residential development (the 'Proposed Development') at land off Clitheroe Road, Whalley (the 'Site').</p> <p>The proposal comprises the construction of 188 residential dwellings with associated infrastructure.</p> <p>The proposal may lead to the exposure of future occupants to poor air quality, as well as adverse air quality impacts at sensitive locations as a result of fugitive dust emissions during construction and road vehicle exhaust emissions during operation. As such, an Air Quality Assessment was required to determine baseline conditions at the Site, consider its suitability for the proposed residential end-use and assess potential impacts associated with the Proposed Development.</p> <p>This report presents the findings of the assessment, which addresses the potential air quality impacts during both the construction and operational phases of the proposed development. For both phases, the type, source and significance of potential impacts were identified, and the measures that should be employed to minimise these proposed.</p>
Summary	<p>The assessment of construction phase impacts associated with fugitive dust and fine Particulate Matter of an aerodynamic diameter of less than 10 and 2.5 microns, respectively (PM₁₀ and PM_{2.5}) emissions has been undertaken in line with the relevant Institute of Air Quality Management (IAQM) guidance. This identified that there is a medium to high risk of dust soiling impacts and a negligible to low risk of increases in particulate matter concentrations due to construction activities. However, through good site practice and the implementation of suitable mitigation measures, the effect of dust and particulate matter releases would be significantly reduced. The residual effects of the construction phase on air quality are considered to be not significant.</p> <p>The results show that the Proposed Development would cause a negligible increase in concentrations of NO₂, PM₁₀ and PM_{2.5}. According to the assessment significance criteria, the residual effects of the Proposed Development are therefore not significant.</p> <p>An assessment of the potential for future users of the Proposed Development to be exposed to poor air quality has also been undertaken. Pollutants considered in this assessment were NO₂, PM₁₀ and PM_{2.5}.</p> <p>The results indicate that concentrations at relevant proposed receptors are likely to meet the annual mean objective for NO₂, PM₁₀ and PM_{2.5} concentrations. The residual effect of air quality on future occupiers of the Proposed Development is judged to be not significant.</p>
Conclusions and Recommendations	<p>Based on the results of the assessment, it is considered that, the Proposed Development complies with national and local planning policies and there are no air quality constraints to development.</p>
<p>This is intended as a summary only. Further detail and limitations of the assessment is provided within the main body of the Report.</p>	

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1 Introduction

1.1 Appointment

- 1.1.1 Delta-Simons Environmental Consultants Limited ('Delta-Simons'), was instructed by Trafford Housing Trust (the 'Client') to undertake an Air Quality Assessment in support of a planning application for a proposed residential development (the 'Proposed Development') at land off Clitheroe Road, Whalley (the 'Site'). Reference should be made to **Figure 1** for a map of the Site and surrounding area.

1.2 Site Location and Context

- 1.2.1 The proposal comprises the construction of 188 residential dwellings with associated infrastructure.
- 1.2.2 The Site is located within the Ribble Valley Borough Council's (RVBC) area of jurisdiction, within the immediate vicinity of the A671, and as such, elevated pollutant concentrations are expected at this location. Consequently, the proposal may lead to the exposure of future occupants to poor air quality, as well as adverse air quality impacts at sensitive locations as a result of fugitive dust emissions during construction and road vehicle exhaust emissions during operation. As such, an Air Quality Assessment was required to determine baseline conditions at the Site, consider its suitability for the proposed end-use and assess potential impacts associated with the Proposed Development.
- 1.2.3 The report presents the findings of an assessment of the potential air quality impacts of the Proposed Development during both the construction and operational phases. For both phases, the type, source and significance of potential impacts are identified, and the measures that should be employed to minimise these described.
- 1.2.4 The standard limitations associated with this assessment are presented in **Appendix A**.
- 1.2.5 A glossary of terms used in this report is provided in **Appendix B**.

2 Legislation and Policy

2.1 Air Quality Legislation & Policy

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

UK Air Quality Strategy

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

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

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

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

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

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

Air Quality Regulations

2.1.8 Many of the objectives in the AQS have been made statutory in England with the Air Quality (England) Regulations 2000² and the Air Quality (England) (Amendment) Regulations 2002³ for the purpose of Local Air Quality Management (LAQM).

2.1.9 These Regulations require that likely exceedances of the AQS objectives are assessed in relation to:

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

2.1.10 The Air Quality Standards (Amendment) Regulations 2016⁴ amends the Air Quality Standards Regulations 2010 that transpose the European Union Ambient Air Quality Directive (2008/50/EC) into law in England. This Directive sets legally binding limit values for concentrations in outdoor air of major air pollutants that impact public health such as PM₁₀, PM_{2.5} and NO₂. The limit values for NO₂ and PM₁₀ are the same concentration levels as the relevant AQS objectives and the limit value for PM_{2.5} is a concentration of 25µg/m³.

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

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

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

⁴ The Air Quality Standards (Amendment) Regulations 2016 - Statutory Instrument 2016 No. 1184

Environmental Protection Act 1990 – Control of Dust and Particulates Associated with Construction

- 2.1.11 Section 79 of the Environmental Protection Act 1990 gives the following definitions of statutory nuisance relevant to dust and particles:
- 'Any dust, steam, smell or other effluvia arising from industrial, trade or business premises or smoke, fumes or gases emitted from premises so as to be prejudicial to health or a nuisance'; and
- 'Any accumulation or deposit which is prejudicial to health or a nuisance'
- 2.1.12 Following this, Section 80 says that where a statutory nuisance is shown to exist, the local authority must serve an abatement notice. Failure to comply with an abatement notice is an offence and if necessary, the local authority may abate the nuisance and recover expenses.
- 2.1.13 There are no statutory limit values for dust deposition above which 'nuisance' is deemed to exist. Nuisance is a subjective concept and its perception is highly dependent upon the existing conditions and the change which has occurred.

Environment Act 1995

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

2.2 Planning Policy

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

National Planning Policy

National Planning Policy Framework

- 2.2.2 The Government's overall planning policies for England are described in the National Planning Policy Framework⁵. The core underpinning principle of the Framework is the presumption in favour of sustainable development, defined as:
- '[...] meeting the needs of the present without compromising the ability of future generations to meet their own needs.'
- 2.2.3 One of the three overarching objectives of the NPPF is that planning should 'to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.'
- 2.2.4 In relation to air quality, the following paragraphs in the document are relevant:
- ▲ Paragraph 54, which states 'Local planning authorities should consider whether otherwise unacceptable development could be made acceptable through the use of conditions or planning obligations. Planning obligations should only be used where it is not possible to address unacceptable impacts through a planning condition.';
 - ▲ Paragraph 103, which states 'Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions, and improve air quality and public health.';
 - ▲ Paragraph 170, which states 'Planning policies and decisions should contribute to and enhance the natural and local environment by: [...] e) preventing new and existing development from

⁵ Ministry of Housing, Communities & Local Government (2018). National Planning Policy Framework.

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

- ▲ Paragraph 180, which states 'Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development.';
- ▲ Paragraph 181, which states 'Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan.'; and
- ▲ Paragraph 183, which states 'The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities.'

Local Planning Policy

Ribble Valley Borough Council - Core Strategy

2.2.5 In this document⁶, POLICY DMG1: GENERAL CONSIDERATIONS states that:

'10.4 in determining planning applications, all development must: [...]

Amenity

[...]

4. Consider air quality and mitigate adverse impacts where possible.'

2.3 Guidance

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

Local Air Quality Management Review and Assessment Technical Guidance

2.3.2 The Department for Environment, Food and Rural Affairs (Defra) has published technical guidance for use by local authorities in their review and assessment work⁷. This guidance, referred to in this document as LAQM.TG16, has been used where appropriate in the assessment presented herein.

⁶ RVBC, (2014). Core Strategy 2008 – 2028 A Local Plan for Ribble Valley Adoption Version

⁷ Defra (2018) Part IV The Environment Act 1995 and Environment (Northern Ireland) Order 2002 Part III, Local Air Quality Management Technical Guidance LAQM.TG16

Land-Use Planning & Development Control: Planning for Air Quality

- 2.3.3 Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM) have published guidance⁸ that offers comprehensive advice on: when an air quality assessment may be required; what should be included in an assessment; how to determine the significance of any air quality impacts associated with a development; and, the possible mitigation measures that may be implemented to minimise these impacts.

Guidance on the Assessment of Dust from Demolition and Construction

- 2.3.4 This document⁹ published by the IAQM was produced to provide guidance to developers, consultants and environmental health officers on how to assess the impacts arising from construction activities. The emphasis of the methodology is on classifying sites according to the risk of impacts (in terms of dust nuisance, PM₁₀ impacts on public exposure and impact upon sensitive ecological receptors) and to identify mitigation measures appropriate to the level of risk identified.

National Planning Practice Guidance – Air Quality

- 2.3.5 This guidance¹⁰ provides a number of guiding principles on how the planning process can take into account the impact of new development on air quality, it explains how much detail air quality assessments need to include for proposed developments, and how impacts on air quality can be mitigated. It also provides information on how air quality is taken into account by local authorities in both the wider planning context of Local Plans and neighbourhood planning, and in individual cases where air quality is a consideration in a planning decision.

⁸ Environmental Protection UK and Institute of Air Quality Management (Version 1.2 Updated January 2017). Land Use Planning & Development Control: Planning for Air Quality

⁹ Institute of Air Quality Management (Version 1.1 Updated June 2016). Guidance on the Assessment of Dust from Demolition and Construction

¹⁰ Department of Communities and Local Government (DCLG) (March 2014). National Planning Practice Guidance

3 Scope & Methodology

3.1 Scope

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

- ▲ Review of RVBC's latest annual status reports¹¹ and air quality data for the area surrounding the Site, including data from RVBC and Defra¹², the Environment Agency (EA)¹³;
- ▲ Preparation of a desk study to confirm the locations of nearby existing receptors that may be sensitive to changes in local air quality, and a review of the masterplan for the Proposed Development to establish the location of new sensitive receptors; and
- ▲ Review of the traffic data provided by the Project Transport Consultant ('PTC').

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

- ▲ Dust and particulate matter generated by on-site activities during the construction phase;
- ▲ Increases in pollutant concentrations as a result of exhaust emissions arising from construction traffic and plant;
- ▲ Increases in pollutant concentrations as a result of exhaust emissions arising from traffic generated by the Proposed Development once operational; and
- ▲ Exposure of future occupants to poor air quality should elevated pollution levels be experienced at the Site.

3.2 Methodology

Construction Phase

- 3.2.1 Dust comprises particles typically in the size range 1-75 micrometres (μm) in aerodynamic diameter and is created through the action of crushing and abrasive forces on materials. The larger dust particles fall out of the atmosphere quickly after initial release and therefore tend to be deposited in close proximity to the source of emission. Dust therefore, is unlikely to cause long-term or widespread changes to local air quality; however, its deposition on property and cars can cause 'soiling' and discolouration. This may result in complaints of nuisance through amenity loss or perceived damage caused, which is usually temporary.
- 3.2.2 The smaller particles of dust, are known as particulate matter (PM), with less than $10\mu\text{m}$ in aerodynamic diameter (PM_{10}) representing only a small proportion of total dust released; this includes a finer fraction, known as $\text{PM}_{2.5}$ (with an aerodynamic diameter less than $2.5\mu\text{m}$). As these particles are at the smaller end of the size range of dust particles they remain suspended in the atmosphere for a longer period of time than the larger dust particles, they can therefore be transported by wind over a wider area. PM_{10} and $\text{PM}_{2.5}$ are small enough to be drawn into the lungs during breathing, which in sensitive members of the public could have a potential impact on health. However, it is worth noting that, according to the IAQM guidance, the majority of fugitive particulate emissions arising from construction sites are expected to relate to the coarser fractions (i.e. $\text{PM}_{2.5-10}$) with just 10-15% expected to comprise $\text{PM}_{2.5}$. The IAQM guidance therefore focusses on PM_{10} for the purposes of assessment.
- 3.2.3 An assessment of the likely significant impacts on local air quality due to the generation and dispersion of dust and PM_{10} during the construction phase has been undertaken using: the relevant assessment methodology published by the IAQM; the available information for this phase of the Proposed Development provided by the Client and Project Team; and, professional judgement.

¹¹ RVBC (2017) 2017 Air Quality Annual Status Report

¹² Defra Local Air Quality Management (LAQM) Support Pages. Available at: <http://laqm.defra.gov.uk/> Accessed on (10/09/2018)

¹³ <https://data.gov.uk/dataset/cfd94301-a2f2-48a2-9915-e477ca6d8b7e/pollution-inventory> Accessed on (11/09/2018)

3.2.4 The IAQM methodology assesses the risk of potential dust and PM₁₀ impacts from the following four sources: demolition; earthworks; general construction activities and track-out. It takes into account the nature and scale of the activities undertaken for each source and the sensitivity of the area to an increase in dust and PM₁₀ levels to assign a level of risk. Risks are described in terms of there being a low, medium or high risk of dust impacts. Once the level of risk has been ascertained, then site specific mitigation proportionate to the level of risk is identified, and the significance of residual effects determined. A summary of the IAQM assessment methodology is provided in **Appendix D**.

3.2.5 In addition to impacts on local air quality due to on-site construction activities, exhaust emissions from construction vehicles and plant may have an impact on local air quality adjacent to the routes used by these vehicles to access the application Site and in the vicinity of the Application Site itself. As information on the number of vehicles and plant associated with the construction phase was not available at the time of writing, a qualitative assessment of their impact on local air quality has been undertaken using professional judgement and by considering the following:

- ▲ The number and type of construction traffic and plant likely to be generated by this phase of the Development;
- ▲ The number and proximity of sensitive receptors to the application Site and along the likely routes to be used by construction vehicles; and
- ▲ The likely duration of the construction phase and the nature of the construction activities undertaken.

Operational Phase Assessment

3.2.6 Of the pollutants included in the AQS, concentrations of NO₂ and particulate matter (PM₁₀ and PM_{2.5}) have been considered in this assessment as road traffic is a major source of these pollutants and their concentrations tend to be close to, or in exceedance of, the objectives in urban locations.

3.2.7 In order to predict NO₂ and PM concentrations across the Application Site, the advanced dispersion model ADMS-Roads (version 4.1.1.0) has been used. This model uses detailed information regarding traffic flows on the local road network, surface roughness and local meteorological conditions to predict pollutant concentrations. Details of the model input parameters are presented in **Appendix E**.

Meteorological Data

3.2.8 Meteorological data, such as wind speed and direction, is used by the model to determine pollutant transportation and levels of dilution by the wind. Meteorological data used in the model was obtained from the observing station at Bingley in 2016. This station is considered to provide representative data for the assessment. A wind rose generated from the meteorological data used for the dispersion modelling of operational phase impacts is provided in **Appendix F**.

Traffic Data

Traffic Flows

3.2.9 A summary of traffic data and pollutant emission factors used in the assessment can be found in **Appendix E**. It includes details of the Annual Average Daily Traffic (AADT) flows, vehicle speeds (km/h) and the percentage of Heavy Duty Vehicles (HDVs) for the local road network in all assessment years considered. Traffic speeds were reduced at junctions in line with guidance provided in LAQM.TG16, and using professional judgement.

3.2.10 For the assessment, three scenarios were modelled, as follows:

- ▲ 2016 - Model Verification and Baseline;
- ▲ 2025 - Opening Year without Development; and
- ▲ 2025 - Opening Year with Development.

3.2.11 Reference should be made to **Figure 1** for a graphical representation of the modelled road link locations.

Vehicle Emission Factors

- 3.2.12 Emission factors for each link were calculated using the relevant traffic flows and the Emissions Factor Toolkit (EFT) (version 8.0.1). This has been produced by DEFRA and incorporates COPERT 5 vehicle emission factors and fleet information.
- 3.2.13 There is current uncertainty over NO₂ concentrations within the UK, with the implementation of new vehicle emission standards not resulting in the previously expected reduction in roadside levels. Therefore, 2016 emission factors were utilised in preference to the Site development year in order to provide robust concentration predictions. As predictions for 2016 were verified, it is considered results are an indication of worst case concentrations during the operation of the proposal.

Selection of Background Concentrations

- 3.2.14 Background pollutant data for the operational phase assessment have been taken from the national maps provided on the Defra website¹⁴, where background concentrations of those pollutants included within the AQS have been mapped at a grid resolution of 1x1km for the whole of the UK. Estimated background concentrations are available for all years between 2015 and 2030. The maps assume that background concentrations will improve (i.e. reduce) over time, in line with the predicted reduction in vehicle emissions, and emissions from other sources. Due to the uncertainty discussed above, and in line with the findings of many local authorities that measured concentrations have not reduced as anticipated, 2016 background concentrations for NO_x, NO₂, PM₁₀ and PM_{2.5} have been utilised in this assessment for 2016. This provided a robust assessment and is likely to overestimate pollutant concentrations during the operation of the proposal.

Model Verification and Result Processing

- 3.2.15 The ADMS Roads dispersion model has been widely validated for this type of assessment and is considered to be fit for purpose. Model validation undertaken by the software developer will not have included validation in the vicinity of the Proposed Development.
- 3.2.16 To determine the performance of the model at a local level, a comparison of modelled results with the results of monitoring carried out within the study area was undertaken. This process of verification aims to minimise modelling uncertainty and systematic error by correcting modelled results by an adjustment factor to gain greater confidence in the final results, and was carried out following the methodology specified in Chapter 7, Section 4, of LAQM.TG16.
- 3.2.17 Details of the verification factor calculations are presented in **Appendix E**. A factor of **3.02** was obtained during the verification process, which indicated that the model was under-predicting. This factor was applied to the model road-NO_x (oxides of nitrogen) outputs prior to conversion to annual mean NO₂ concentrations utilising the NO_x to NO₂ calculator (version 6.1, 17 October 2017) provided by Defra¹⁵. The NO₂ diffusion tube monitoring results provided by RVBC were subsequently used to derive an indicative baseline annual mean NO₂ concentration for each site in the vicinity of the Proposed Development. Reference should be made to **Figure 1**, which shows the diffusion tube monitoring locations within the assessment extents.
- 3.2.18 As local roadside monitoring data within the assessment extents are not available for PM₁₀ or PM_{2.5}, the modelled road-PM₁₀ and road-PM_{2.5} components have been adjusted by the verification factor obtained for NO_x before adding to the appropriate background concentration. The number of days with PM₁₀ concentrations greater than 50µg/m³ was then estimated using the relationship with the annual mean concentration described in LAQM.TG16.
- 3.2.19 Once processed, the predicted concentrations were compared against the relevant AQS objective levels for NO₂, PM₁₀ and PM_{2.5} set out in **Appendix C**.

¹⁴ Defra, 2017. Background Concentrations. [Online]
<Available at <https://uk-air.defra.gov.uk/data/laqm-background-home>> [Accessed on 11/09/2018].

¹⁵ Defra NO_x to NO₂ Calculator. 17/10/2017.
<Available at https://laqm.defra.gov.uk/documents/NOx_to_NO2_Calculator_v6.1.xls> [Accessed on 14/09/2018].

- 3.2.20 The air quality modelling generates pollutant estimates of road source contributed NO_x, PM₁₀ and PM_{2.5} and energy centre NO_x contributions at specified receptors. To permit comparison with the relevant air quality objectives for NO₂, PM₁₀ and PM_{2.5} it has been necessary to combine the model outputs data with the background concentrations.
- 3.2.21 To consider compliance with the 1-hour mean air quality objective for NO₂, Defra's guidance suggests that in locations where the annual mean NO₂ concentration exceeds 60µg/m³ then the 1-hour mean objective may be exceeded. Where annual mean concentrations are less than 60µg/m³ then exceedance of the 1-hour mean objective is considered unlikely. The risk of non-compliance with the 1-hour mean objective, where up to 18 exceedances of a 1-hour mean concentration of 200µg/m³ are allowed in a calendar year, is therefore considered likely when the annual mean concentration is greater than 60µg/m³ but unlikely when not. This approach has been adopted for this assessment.
- 3.2.22 To estimate total annual mean concentrations for PM₁₀ and PM_{2.5}, for comparison with the annual mean air quality objectives (40 and 25 µg/m³ respectively) the model output concentrations are simply added to the background concentrations for these pollutants.
- 3.2.23 To consider compliance with the 24-hour mean air quality objective for PM₁₀, Defra's guidance gives the following equation that relates the annual mean concentration to the number of exceedances of the 24-hour mean concentration of 50µg/m³, where up to 35 exceedances are allowed:
- ▲ No. 24-hour mean exceedances = -18.5 + 0.00145 x annual mean³ + (206/annual mean)
- 3.2.24 This approach has been adopted for 24-hour mean PM₁₀ for this assessment.

3.3 Selection of Sensitive Receptors

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

Construction Phase

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

Operational Phase

- 3.3.3 In terms of locations that are sensitive to pollutants emitted from engine exhausts, these will include places where members of the public are likely to be regularly present over the period of time prescribed in the AQS. For instance, on a footpath where exposure will be transient (for the duration of passage along that path) comparison with a short-term standard (i.e. 15-minute mean or 1-hour mean) may be relevant. At a school or adjacent to a private dwelling, where exposure may be for longer periods, comparison with a long-term standard (such as 24-hour mean or annual mean) may be more appropriate. Box 1.1 of LAQM.TG16 provides examples of the locations where the air quality objectives should/should not apply.
- 3.3.4 To complete the assessment of operational phase impacts, a number of 'receptors' representative of locations of relevant public exposure were identified at which pollution concentrations were predicted. Receptors have been located adjacent to the roads that are likely to experience the greatest change in traffic flows or composition, and therefore NO₂ and particulate matter concentrations, as a result of the Proposed Development.
- 3.3.5 The locations of the assessment receptors are shown on **Figure 1** and listed in **Table 1** below.

Table 1 - Receptor Locations Used in the Assessment

Receptor	Description / Address	Grid Reference		Height above Ground Level (m)
		X (m)	Y (m)	
R1	29 Springwood Drive	373683.1	436504.8	1.5
R2	21 Springwood Drive	373642.5	436555.6	1.5
R3	19 Springwood Drive	373638.1	436570.1	1.5
R4	1 Springwood Drive	373537.8	436669.0	1.5
R5	36 Clitheroe Road	373512.3	436658.0	1.5
R6	The Cottage	373588.2	436779.2	1.5
R7	29 Clitheroe Road	373494.2	436696.5	1.5
R8	33 Clitheroe Road	373527.6	436778.4	1.5
R9	6 Forge Corner	373353.0	436451.0	1.5
PR1	Proposed Residential Receptor	373846.2	436624.4	1.5
PR2	Proposed Residential Receptor	373849.5	436574.0	1.5
PR3	Proposed Residential Receptor	373869.8	436532.9	1.5
PR4	Proposed Residential Receptor	373901.1	436457.1	1.5
PR5	Proposed Residential Receptor	373879.9	436383.1	1.5
PR6	Proposed Residential Receptor	373722.6	436330.3	1.5
PR7	Proposed Residential Receptor	373698.0	436218.1	1.5
PR8	Proposed Residential Receptor	373588.4	436229.2	1.5
PR9	Proposed Residential Receptor	373604.8	436374.9	1.5
PR10	Proposed Residential Receptor	373700.7	436491.2	1.5
PR11	Proposed Residential Receptor	373717.1	436539.6	1.5
PR12	Proposed Residential Receptor	373730.4	436559.9	1.5
PR13	Proposed Residential Receptor	373766.9	436650.0	1.5

3.4 Significance criteria

Construction Phase

- 3.4.1 The IAQM assessment methodology recommends that significance criteria is only assigned to the identified risk of dust impacts occurring from a construction activity with appropriate mitigation measures in place. For almost all construction activities, the application of effective mitigation should prevent any significant effects occurring to sensitive receptors and therefore the residual effect will normally be negligible.
- 3.4.2 For the assessment of the impact of exhaust emissions from plant used on-site and construction vehicles accessing and leaving the Site on local concentrations of NO₂ and particulate matter, the significance of residual effects has been determined using professional judgement and the principles outlined in the EPUK/IAQM guidance, which are described below.

Operational Phase

- 3.4.3 The approach provided in the EPUK/IAQM guidance has been used within this assessment to assist in describing the air quality effects of additional emissions from traffic generated by the Proposed Development once operational.
- 3.4.4 This guidance recommends that the degree of an impact is described by expressing the magnitude of incremental change in pollution concentration as a proportion of the relevant assessment level and examining this change in the context of the new total concentration and its relationship with the assessment criterion, as summarised in **Table 2**.

Table 2 - Road Vehicle Exhaust Emissions - Significance of Impact

Long Term Average Concentration at Receptors in Assessment Year	% Change In Concentration Relative to air quality assessment Level (AQAL)			
	1	2 - 5	6 - 10	> 10
75% or less of AQO	Negligible	Negligible	Slight	Moderate
76 - 94% of AQO	Negligible	Slight	Moderate	Moderate
95 - 102% of AQO	Slight	Moderate	Moderate	Substantial
103 - 109% of AQO	Moderate	Moderate	Substantial	Substantial
110% or more of AQO	Moderate	Substantial	Substantial	Substantial

Notes

AQAL = air quality assessment Level, which for this assessment related to the UK Air Quality Strategy objectives.

Where the %change in concentrations is <0.5%, the change is described as 'Negligible' regardless of the concentration.

When defining the concentration as a percentage of the AQAL, 'without scheme' concentration should be used where there is a decrease in pollutant concentration and the 'with scheme;' concentration where there is an increase.

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

- 3.4.5 The matrix shown in **Table 2** is intended to be used by rounding the change in percentage pollutant concentration to whole numbers, which makes it clearer which cell the impact falls within. It should be noted that changes of 0%, i.e. less than 0.5%, are described as negligible.
- 3.4.6 Following the prediction of impacts at discrete receptor locations, the EPUK/IAQM document provides guidance on determining the overall air quality impact significance of the operation of a development. The following factors are identified for consideration by the assessor:
- ▲ The existing and future air quality in the absence of the development;
 - ▲ The extent of current and future population exposure to the impacts; and,
 - ▲ The influence and validity of any assumptions adopted when undertaking the prediction of impacts.

- 3.4.7 The EPUK/IAQM guidance states that for most road transport related emissions, long-term average concentrations are the most useful for evaluating the impacts. The guidance does not include criteria for determining the significance of the effect on hourly mean NO₂ concentrations or daily mean PM₁₀ concentrations. The significance of effects of hourly mean NO₂ and daily mean PM₁₀ concentrations arising from the operational phase have therefore been determined qualitatively using professional judgement and the principles described above.
- 3.4.8 The EPUK/IAQM guidance says that 'Where the air quality is such that an air quality objective at the building facade is not met, the effect on residents or occupants will be judged as significant, unless provision is made to reduce their exposure by some means. For people working at new developments in this situation, the same will not be true as occupational exposure standards are different, although any assessment may wish to draw attention to the undesirability of the exposure.'
- 3.4.9 The EPUK/IAQM guidance states that an assessment must reach a conclusion on the likely significance of the predicted impact. It should be noted that this is a binary judgement of either it is significant, or it is not significant.

Future Exposure

- 3.4.10 The Proposed Development has the potential to expose future users of the Site to poor air quality. Pollutant concentrations were therefore quantified across the Site using dispersion modelling as detailed previously. The results were subsequently compared with the relevant AQOs to determine the potential for any exceedance.

4 Baseline

4.1 Introduction

- 4.1.1 Existing air quality conditions in the vicinity of the Site were identified in order to provide a baseline for consideration. These are detailed in the following sections.

4.2 Local Air Quality Management

- 4.2.1 According to their latest Air Quality Annual Status Report from RVBC, the air quality objectives are met throughout the Borough, apart from exceedances of the annual mean NO₂ objective in Clitheroe. As a result of these exceedances RVBC designated an AQMA in 2010. The Proposed Development lies approximately 4.5km to the south of the AQMA. Reference should be made to **Figure 1** for a graphical representation of the location of the AQMA.
- 4.2.2 RVBC has concluded that concentrations of all other pollutants considered within the AQS are currently below the relevant AQOs. As such, no further AQMAs have been designated.

4.3 Local Emission Sources

- 4.3.1 The Site is located in an area where air quality is mainly influenced by emissions from road transport using the A671 and the A59.
- 4.3.2 There are no industrial pollution sources identified within the immediate vicinity of the Site that will influence the local air quality.

4.4 Air Quality Monitoring

- 4.4.1 Monitoring of pollutant concentrations is undertaken by RVBC throughout their area of jurisdiction. Recent results recorded in the vicinity of the development are shown in **Table 3**.

Table 3 - Monitoring Results

Monitoring Site		Monitored NO ₂ Concentration (µg/m ³)		
Location	Type	2014	2015	2016
Whittle Close	Urban Background	12.5	11.8	12.9
Royal British Legion (Triplicate Tubes)	Roadside	36.9	33.3	39.9
57 Whalley Road	Roadside	36.7	32.8	36.6
Greenacre Street	Roadside	26.9	24.3	28.7
85 Whalley Road	Roadside	24.6	26.3	32.1

- 4.4.2 As shown in **Table 3**, annual mean NO₂ concentrations were below the relevant AQO at all monitoring locations during 2014 to 2016. Reference should be made to **Figure 1** for a map of the survey positions.
- 4.4.3 RVBC do not undertake PM₁₀ monitoring within the vicinity of the Site.

4.5 Background Pollutant Concentrations

- 4.5.1 Predictions of background pollutant concentrations on a 1 km by 1 km grid basis have been produced by DEFRA for the entire of the UK to assist LAs in their Review and Assessment of air quality. The Site is located in grid square NGR: 373500, 436500. Data for this location was downloaded from the DEFRA website¹⁶ for the purpose of the project. This data is summarised in **Table 4** below.

Table 4 - Predicted Background Pollutant Concentrations

Location	NO ₂	NO _x	PM ₁₀	PM _{2.5}
The Site	8.9	11.7	10.5	7.3
Verification Location	11.4	15.3	-	-

- 4.5.2 As shown in **Table 4**, predicted background NO₂, PM₁₀ and PM_{2.5} concentrations are below the relevant AQOs at the Site.

¹⁶ <http://uk-air.defra.gov.uk/data/laqm-background-maps?year=2015>.

5 Assessment

5.1 Introduction

- 5.1.1 There is the potential for air quality impacts as a result of the construction and operation of the Proposed Development. These are assessed in the following sections.

5.2 Construction Phase Assessment

Dust and PM₁₀ Arising from On-Site Activities

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

Assessment of Potential Dust Emission Magnitude

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

Demolition

- 5.2.4 Total volume of buildings to be demolished on site is assumed to be below 20,000m³, with potentially dusty construction material, and with demolition activities anticipated to occur below 10m above ground level. Therefore, the potential dust emission magnitude is considered to be **small** for demolition activities.

Earthworks

- 5.2.5 The total area of the Site is greater than 10,000m², the soil type is assumed to be potentially dusty. Therefore, the potential dust emission magnitude is considered to be **large** for earthwork activities

Construction

- 5.2.6 The total volume of buildings to be constructed on the Site is assumed to be more than 100,000m³ with earthworks anticipated to be undertaken during wetter months. Therefore, the potential dust emission magnitude is considered to be **large** for construction activities.

Trackout

- 5.2.7 Information on the number of HDVs associated with this phase of the Proposed Development is not available and therefore professional judgement has been used. It has been assumed that given the size of the development area there are likely to be 10 to 50 HDV outward movements in any one day. As the unpaved road length in the Site is likely to be more than 100m, it is considered that the potential dust emission magnitude of is **large** for trackout.
- 5.2.8 **Table 5** provides a summary of the potential dust emission magnitude determined for each construction activity considered.

Table 5 - Potential Dust Emission Magnitude

Activity	Dust Emission Magnitude
Demolition	Small
Earthworks	Large
Construction Activities	Large
Trackout	Large

Assessment of Sensitivity of the Study Area

- 5.2.9 A windrose generated using the meteorological data used for the dispersion modelling of operational phase impacts is provided in **Appendix F**. This shows that the prevailing wind direction is mainly from the south-west and from the west. Therefore, receptors located to the east and north-east of the Site are more likely to be affected by dust and particulate matter emitted and re-suspended during the construction phase.
- 5.2.10 Under low wind speed conditions, it is likely that the majority of dust would be deposited in the area immediately surrounding the source. There are no sensitive receptors north and east of the Site. It has been assumed that the construction traffic will access the site through existing access roads. The majority of construction traffic will travel through Springwood Drive and access the Clitheroe Road.
- 5.2.11 There are no ecological receptors within the vicinity of the Site considered to be sensitive to dust or PM, and as such these effects are not considered further within this assessment.
- 5.2.12 Taking the above into account and following the IAQM assessment methodology, the sensitivity of the area to changes in dust and PM₁₀ has been derived for each of the construction activities considered. The results are shown in **Table 6**.

Table 6 - Sensitivity of the Study Area

Potential Impact	Sensitivity of the Surrounding Area			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	High	High	High	High
Human Health	Low	Low	Low	Low

Risk of Impacts

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

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

Potential Impact	Risk			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Medium	High	High	High
Human Health	Negligible	Low	Low	Low

Construction Vehicles & Plant

- 5.2.14 The greatest impact on air quality due to emissions from vehicles and plant associated with the construction phase will be in the areas immediately adjacent to the site accesses. Construction traffic will access the Site via Springwood Drive and access the Clitheroe Road. Due to the size of the Site, it is considered likely that the construction traffic will be low in comparison to the existing traffic flows on these roads.
- 5.2.15 Final details of the exact plant and equipment likely to be used on Site will be determined by the appointed contractor, it is considered likely to comprise dump trucks, tracked excavators, diesel generators, asphalt spreaders, rollers, compressors and trucks. The number of plant and their location within the Site are likely to be variable over the construction period.
- 5.2.16 Based on the current local air quality in the area, the proximity of sensitive receptors to the roads likely to be used by construction vehicles, and the likely numbers of construction vehicles and plant that will be used, the impacts are therefore considered to be **negligible** according to the assessment significance criteria.

5.3 Operational Phase Assessment

- 5.3.1 Vehicle movements associated with the operation of the proposal will generate exhaust emissions on the local and regional road networks. An assessment was therefore undertaken using dispersion modelling in order to quantify potential changes in pollutant concentrations at sensitive locations in the vicinity of the Site, as well as consider potential exposure of future occupants to AQO exceedances.
- 5.3.2 The assessment considered the following scenarios:
- ▲ 2016 - Verification;
 - ▲ 2025 - Without Development; and
 - ▲ 2025 - With Development.
- 5.3.3 The 2025 - 'with development' scenario included anticipated baseline traffic data, inclusive of anticipated growth for the relevant assessment year, in addition to predicted vehicle trips associated with the operation of the proposals.
- 5.3.4 For the purpose of the assessment traffic data for 2025 was utilised as the development opening year. Air quality is predicted to improve in the future. However, in order to provide a robust assessment, emission factors and background concentrations for 2016 were utilised within the dispersion model. The use of 2025 traffic data and 2016 emission factors and background concentrations is considered to provide a worst-case scenario and therefore a sufficient level of confidence can be placed within the predicted pollution concentrations.

Road Vehicle Exhaust Emission Impacts

5.3.5 Full results of the dispersion modelling are presented in **Appendix G** and a summary is provided below.

Nitrogen Dioxide

Annual Mean

5.3.6 The AQS objective for annual mean NO₂ concentrations is 40µg/m³. By 2025, the opening year of the Proposed Development, the highest concentrations are predicted at receptor R5, 36 Clitheroe Road, 20.5µg/m³ in both the 'Without Development' and 'With Development' scenarios, resulting in a **negligible** impact from the additional traffic associated with the operation of the Proposed Development.

5.3.7 There are no new exceedances of the AQS objective as a result of the proposed development.

5.3.8 The predicted changes in annual mean NO₂ concentrations are all <5% of the relevant AQS objective. Therefore, in accordance with the EPUK/IAQM guidance, the impact of the increased emissions associated with the Proposed Development on annual mean NO₂ concentrations is considered to be **negligible**.

1-hour Mean

5.3.9 The annual mean NO₂ concentrations predicted by the model were all below 60µg/m³, and therefore hourly mean NO₂ concentrations are unlikely to cause a breach of the hourly mean AQS objective. The impact of the Proposed Development on hourly mean NO₂ concentrations at existing sensitive receptors is considered to be **negligible**.

Particulate Matter (PM₁₀)

Annual Mean

5.3.10 The AQS objective for annual mean PM₁₀ concentrations is 40µg/m³. Predicted concentrations of PM₁₀ are well below the annual mean objective at all receptors in each of the modelled 2025 scenarios. The highest concentration is predicted at receptor R5, where a concentration of 12.3µg/m³ in the 'With Development' scenario.

5.3.11 The predicted changes in annual mean PM₁₀ concentrations are all <1% of the relevant AQS objective. Based on the EPUK/IAQM guidance, the impact of the increased emissions associated with the Proposed Development on annual mean PM₁₀ concentrations is considered to be **negligible**.

24-hour Mean

5.3.12 The AQS objective for daily mean PM₁₀ concentrations is 50µg/m³ to be exceeded no more than 35 times a year. The results of the dispersion modelling indicate that the highest number of predicted exceedances during 2025 was below 1 at receptor R5, without the risk of exceeding the AQS objective.

5.3.13 There has been no predicted increase in the number of days exceeding the daily PM₁₀ limit in the 'With Development' scenario.

5.3.14 As such, the impacts of increased emissions associated with the operational phase of the Proposed Development are **negligible**.

Particulate Matter (PM_{2.5})

5.3.15 Predicted annual mean concentrations of PM_{2.5} in 2025 are all well below the AQS objective of 25µg/m³ in all modelled scenarios. The highest modelled concentration is 8.3µg/m³, which is predicted at receptor R5 in the 'With Development' scenario.

5.3.16 All changes in PM_{2.5} as a result of increased traffic associated with the Proposed Development are <0.5% of the relevant AQS objective and therefore, based on the EPUK/IAQM guidance, the Proposed Development is considered to have a **negligible** impact on annual mean PM_{2.5} concentrations.

Future Exposure

- 5.3.17 The Proposed Development has the potential to expose future residents to elevated air pollutant levels. Dispersion modelling was therefore undertaken with the inputs described in **Section 3.2** and **Appendix E** to quantify air quality conditions at the Site. This included consideration of vehicle exhaust emissions on the local road network, as well as other background sources. Reference should be made to **Appendix G** for Full results of the dispersion modelling.
- 5.3.18 It should be noted that all presented results have been verified in accordance with the methodology outlined within **Appendix E**.
- 5.3.19 Predicted concentrations of NO₂, PM₁₀ and PM_{2.5} are all below the relevant objectives at proposed receptor locations within the Site boundary.
- 5.3.20 The highest predicted annual mean concentration for NO₂ at relevant proposed receptors is 13.9µg/m³ at proposed receptors PR4. The highest predicted annual mean PM₁₀ concentration is 11.1µg/m³ at PR4,. The highest predicted PM_{2.5} concentration is 7.6µg/m³ at proposed receptors PR3 – PR5 and PR10.
- 5.3.21 No exceedances of the relevant AQS objectives are predicted at the Proposed Development locations.

Summary

- 5.3.22 Based on the assessment results, the Site is considered suitable for residential development without the implementation of mitigation measures.

6 Mitigation and Residual Effects

6.1 Construction Phase

Mitigation

- 6.1.1 Based on the assessment results, mitigation will be required during the construction phase of the Proposed Development. Recommended mitigation measures are given below.

General Communication

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

Site Management

- ▲ All dust and air quality complaints should be recorded and causes identified. Appropriate remedial action should be taken in a timely manner with a record kept of actions taken including of any additional measures put in-place to avoid reoccurrence.
- ▲ The complaints log should be made available to the Local Authority on request.
- ▲ Any exceptional incidents that cause dust and/or air emissions, either on or off site should be recorded, and then the action taken to resolve the situation recorded in the log book

Monitoring

- ▲ Daily on-Site and off-Site inspections should be undertaken, where receptors (including roads) are nearby to monitor dust. The inspection results should be recorded and made available to the Local Authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of the Site boundary, with cleaning to be provided if necessary.
- ▲ The frequency of Site inspections should be increased when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.

Preparing and maintaining the Site

- ▲ Plan the Site layout so that machinery and dust causing activities are located away from receptors, as far as is practicable.
- ▲ Where practicable, erect solid screens or barriers around dusty activities or the Site boundary that are at least as high as any stockpiles on Site.
- ▲ Where practicable, fully enclose site or specific operations where there is a high potential for dust production and the Site is active for an extensive period.
- ▲ Avoid Site runoff of water or mud.
- ▲ Keep Site fencing, barriers and scaffolding clean using wet methods.
- ▲ Remove materials that have a potential to produce dust from Site as soon as possible, unless being re-used on Site. If they are being re-used on-Site cover appropriately.

Operating vehicle/machinery and sustainable travel

- ▲ Ensure all vehicle operators switch off engines when stationary - no idling vehicles.
- ▲ Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.
- ▲ A Construction Logistics Plan should be produced to manage the sustainable delivery of goods and materials.

Operations

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

Waste management

- ▲ Avoid bonfires and burning of waste materials.

Measures Specific to Demolition

- ▲ Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.
- ▲ Avoid explosive blasting, using appropriate manual or mechanical alternatives.
- ▲ Bag and remove any biological debris or damp down such material before demolition.

Measures Specific to Earthworks

- ▲ Stockpile surface areas should be minimised (subject to health and safety and visual constraints regarding slope gradients and visual intrusion) to reduce area of surfaces exposed to wind pick-up.
- ▲ Where practicable, windbreak netting/screening should be positioned around material stockpiles and vehicle loading/unloading areas, as well as exposed excavation and material handling operations, to provide a physical barrier between the Site and the surroundings.
- ▲ Where practicable, stockpiles of soils and materials should be located as far as possible from sensitive properties, taking account of the prevailing wind direction.
- ▲ During dry or windy weather, material stockpiles and exposed surfaces should be dampened down using a water spray to minimise the potential for wind pick-up.

Measures Specific to Construction

- ▲ Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
- ▲ For smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust.
- ▲ All construction plant and equipment should be maintained in good working order and not left running when not in use.

Measures Specific to Trackout

- ▲ Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
- ▲ Record all inspections of haul routes and any subsequent action in a site log book.

- 6.1.2 Detailed mitigation measures to control construction traffic should be discussed with the Local Authority to establish the most suitable access and haul routes for the site traffic. The most effective mitigation will be achieved by ensuring that construction traffic does not pass along sensitive roads (residential roads, congested roads, via unsuitable junctions, etc.) where possible, and that vehicles are kept clean (through the use of wheel washers, etc.) and sheeted when on public highways. Timing of large-scale vehicle movements to avoid peak hours on the local road network will also be beneficial.

Residual Effects

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

6.2 Operational Phase

Mitigation

- 6.2.1 The change in pollutant concentrations attributable to traffic emissions associated with the operation phase of the Proposed Development (i.e. impacts on local air quality) are **negligible** and therefore no mitigation is needed.

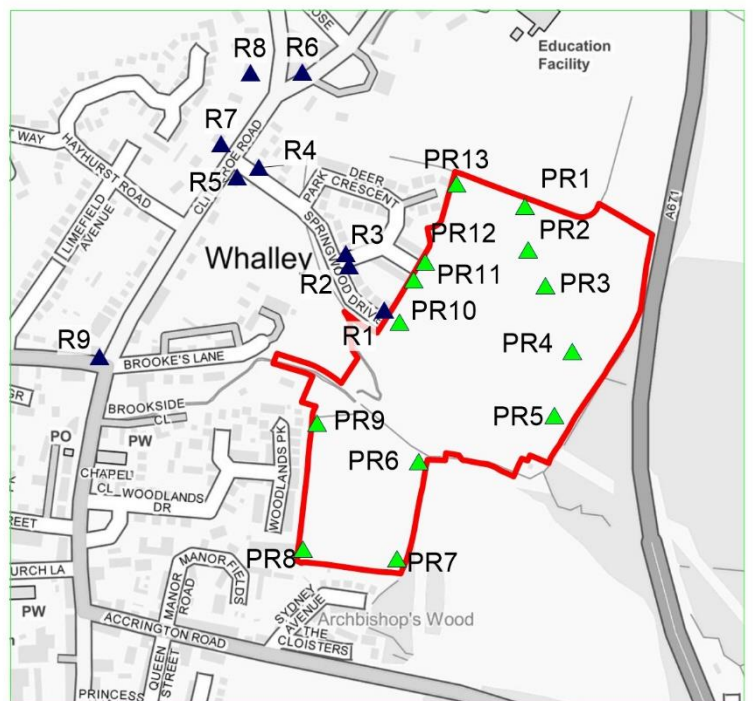
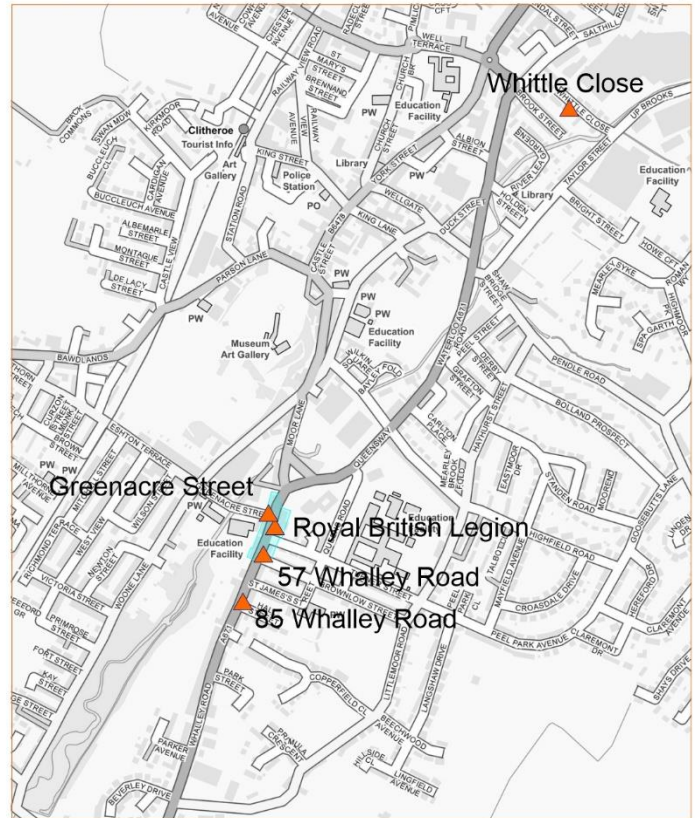
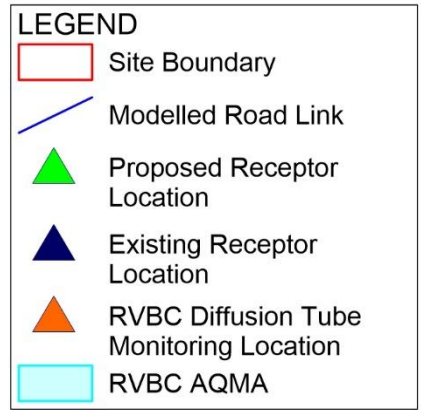
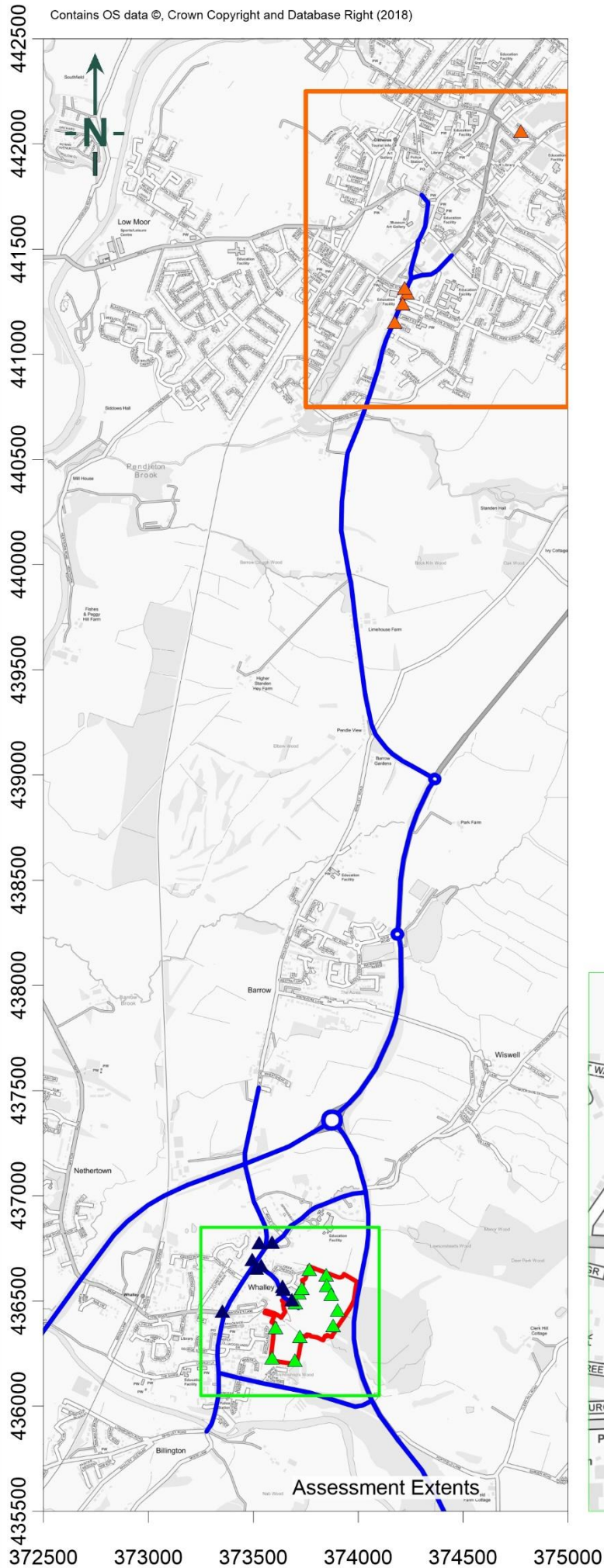
Residual Effects

- 6.2.2 The Proposed Development is predicted to cause a **negligible** increase in NO₂ and PM₁₀ and PM_{2.5} concentrations.
- 6.2.3 Concentrations are predicted to meet the statutory objectives both without and with the Proposed Development, within the assessment extents.
- 6.2.4 The residual effects of the Proposed Development on air quality is **not significant** for NO₂, PM₁₀ and PM_{2.5} according to the EPUK/IAQM assessment criteria.

7 Summary and Conclusions

- 7.1.1 Delta-Simons, has been appointed to prepare this Air Quality Assessment in support of the planning application for a residential development on land off Clitheroe Road, Whalley.
- 7.1.2 A qualitative assessment of the potential impacts on local air quality from construction activities has been carried out for this phase of the Proposed Development using the IAQM methodology. This identified that there is a **medium to high risk** of dust soiling impacts and a **negligible to low risk** of increases in particulate matter concentrations due to unmitigated construction activities. However, through good site practice and the implementation of suitable mitigation measures, the effect of dust and PM₁₀ releases would be significantly reduced. The residual effects of dust and PM₁₀ generated by construction activities on air quality are therefore considered to be **not significant**. The residual effects of emissions to air from construction vehicles and plant on local air quality is considered to be **not significant**.
- 7.1.3 The Proposed Development is expected to result in a **negligible** impact associated with the operational phase traffic on nearby receptors and the residual effects are considered to be **not significant**.
- 7.1.4 An assessment of the potential for future users/residents of the Proposed Development to be exposed to poor air quality has been undertaken. The Site lies within an area where air quality is mainly influenced by emissions associated with traffic along the local road network. Pollutants considered in this assessment were NO₂ and Particulate Matter (PM₁₀ and PM_{2.5}).
- 7.1.5 The results indicate that concentrations at the Site meet the annual mean objective for NO₂, PM₁₀ and PM_{2.5} concentrations. The residual effect of air quality on future occupiers of the Proposed Development is judged to be **not significant**.
- 7.1.6 Based on the assessment significance criteria, the residual effects of the Proposed Development are considered to be **not significant** for all pollutants assessed.
- 7.1.7 Furthermore, it is considered that the Proposed Development complies with national and local policy for air quality.
- 7.1.8 Based on the assessment results, air quality issues are not considered a constraint to planning consent.

Figures



Appendix A - Limitations

Limitations

The recommendations contained in this Report represent Delta-Simons professional opinions, based upon the information listed in the Report, exercising the duty of care required of an experienced Environmental Consultant. Delta-Simons does not warrant or guarantee that the Site is free of hazardous or potentially hazardous materials or conditions.

Delta-Simons obtained, reviewed and evaluated information in preparing this Report from the Client and others. Delta-Simons conclusions, opinions and recommendations has been determined using this information. Delta-Simons does not warrant the accuracy of the information provided to it and will not be responsible for any opinions which Delta-Simons has expressed, or conclusions which it has reached in reliance upon information which is subsequently proven to be inaccurate.

This Report was prepared by Delta-Simons for the sole and exclusive use of the Client and for the specific purpose for which Delta-Simons was instructed. Nothing contained in this Report shall be construed to give any rights or benefits to anyone other than the Client and Delta-Simons, and all duties and responsibilities undertaken are for the sole and exclusive benefit of the Client and not for the benefit of any other party. In particular, Delta-Simons does not intend, without its written consent, for this Report to be disseminated to anyone other than the Client or to be used or relied upon by anyone other than the Client. Use of the Report by any other person is unauthorised and such use is at the sole risk of the user. Anyone using or relying upon this Report, other than the Client, agrees by virtue of its use to indemnify and hold harmless Delta-Simons from and against all claims, losses and damages (of whatsoever nature and howsoever or whensoever arising), arising out of or resulting from the performance of the work by the Consultant.

Appendix B - Glossary

Glossary

Term	Definition
AADT Annual Average Daily Traffic	A daily total traffic flow (24hrs), expressed as a mean daily flow across all 365 days of the year.
Adjustment	Application of a correction factor to modelled results to account for uncertainties in the model
Accuracy	A measure of how well a set of data fits the true value.
Air quality objective	Policy target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedances within a specific timescale (see also air quality standard).
Air quality standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive sub groups (see also air quality objective).
Ambient air	Outdoor air in the troposphere, excluding workplace air.
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year.
AQMA	Air Quality Management Area.
AQO	Air Quality Objective
AURN	Automatic Urban and Rural (air quality monitoring) Network, managed by contractors on behalf of Defra
Conservative	Tending to over-predict the impact rather than under-predict.
Data capture	The percentage of all the possible measurements for a given period that were validly measured.
Defra	Department for Environment, Food and Rural Affairs.
DfT	Department for Transport.
EFT	Emissions Factor Toolkit
Emission rate	The quantity of a pollutant released from a source over a given period of time.
EPUK	Environmental Protection (UK)
Exceedance	A period of time where the concentrations of a pollutant is greater than the appropriate air quality standard.
HDV/HGV	Heavy Duty Vehicle/Heavy Goods Vehicle.
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management.
Model adjustment	Following model verification, the process by which modelled results are amended. This corrects for systematic error.
NO ₂	Nitrogen dioxide.
NO _x	Nitrogen oxides.

Term	Definition
PM ₁₀	Particulate matter with an aerodynamic diameter of less than 10 micrometres.
PM _{2.5}	Particulate matter with an aerodynamic diameter of less than 2.5 micrometres.
RVBC	Ribble Valley Borough Council
Road link	A length of road which is considered to have the same flow of traffic along it. Usually, a link is the road from one junction to the next.
µg/m ³ microgrammes per cubic metre	A measure of concentration in terms of mass per unit volume. A concentration of 1µg/m ³ means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.
Uncertainty	A measure, associated with the result of a measurement, which characterizes the range of values within which the true value is expected to lie. Uncertainty is usually expressed as the range within which the true value is expected to lie with a 95% probability, where standard statistical and other procedures have been used to evaluate this figure. Uncertainty is more clearly defined than the closely related parameter 'accuracy', and has replaced it on recent European legislation.
Validation (modelling)	Refers to the general comparison of modelled results against monitoring data carried out by model developers.
Verification (modelling)	Comparison of modelled results versus any local monitoring data at relevant locations.

Appendix C - Relevant UK Air Quality Strategy Objectives

Relevant UK Air Quality Strategy Objectives

National Air Quality Objectives and European Directive Limit Values for the Protection of Human Health						
Pollutant	Applies To	Objective	Measured As	Date to be achieved by and maintained thereafter	European Obligations	Date to be achieved by and maintained thereafter
Nitrogen dioxide (NO ₂)	UK	40µg/m ³	annual mean	31.12.2005	40µg/m ³	01.01.2010
	UK	200µg/m ³ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005	200µg/m ³ not to be exceeded more than 18 times a year	01.01.2010
Particulate Matter (PM ₁₀) (gravimetric) ^A	UK	40µg/m ³	annual mean	31.12.2005	40µg/m ³	01.01.2010
	UK (except Scotland)	40µg/m ³	annual mean	31.12.2004	40µg/m ³	01.01.2005
Particulate Matter (PM _{2.5})	UK (except Scotland)	50µg/m ³ not to be exceeded more than 35 times a year	24-hour mean	31.12.2004	50µg/m ³ not to be exceeded more than 35 times a year	01.01.2005
	UK (except Scotland)	25µg/m ³	annual mean	2020	Target value 25µg/m ³	2010

^A Measured using the European gravimetric transfer sampler or equivalent

µg/m³ = microgram per cubic metre

Appendix D - IAQM Construction Assessment Methodology

IAQM Construction Assessment Methodology

Step 1 - Screening the Need for a detailed assessment

An assessment will normally be required where there are:

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

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

Step 2a - define the potential dust emission magnitude

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

Table D1 - Examples of Human Receptor Sensitivity to Construction Phase Impacts

Magnitude	Activity	Criteria
Large	Demolition	>50,000m ³ building demolished, dusty material (e.g. concrete), on-site crushing/screening, demolition >20m above ground level
	Earthworks	Total site area greater than 10,000m ² Potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size) More than 10 heavy earth moving vehicles active at any one time Formation of bunds greater than 8m in height More than 100,000 tonnes of material moved
	Construction	Total building volume greater than 100,000m ³ On site concrete batching Sandblasting
	Trackout	More than 50 Heavy Duty Vehicle (HDV) trips per day Potentially dusty surface material (e.g. high clay content) Unpaved road length greater than 100m
Medium	Demolition	20,000 - 50,000m ³ building demolished, dusty material (e.g. concrete) 10-20m above ground level
	Earthworks	Total site area 2,500m ² to 10,000m ² ; Moderately dusty soil type (e.g. silt) 5 to 10 heavy earth moving vehicles active at any one times Formation of bunds 4m to 8m in height Total material moved 20,000 tonnes to 100,000 tonnes
	Construction	Total building volume 25,000m ³ to 100,000m ³ Potentially dusty construction material (e.g. concrete) On site concrete batching
	Trackout	10 to 50 HDV trips per day Moderately dusty surface material (e.g. high clay content) Unpaved road length 50m to 100m

Magnitude	Activity	Criteria
Small	Demolition	<20,000m ³ building demolished, non-dusty material (e.g metal cladding), <10m above ground level, work during wetter months
	Earthworks	Total site area less than 2,500m ² ; Soil type with large grain size (e.g. sand) Less than 5 heavy earth moving vehicles active at any one time Formation of bunds less than 4m in height Total material moved less than 20,000 tonnes Earthworks during wetter months
	Construction	Total building volume less than 25,000m ³ Construction material with low potential for dust release (e.g. metal cladding or timber)
	Trackout	Less than 10 HDV trips per day Surface material with low potential for dust release Unpaved road length less than 50m

Step 2b - Define the Sensitivity of the Area

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

Table D2- Sensitivity of the Area to Dust Soiling Effects

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

Table D3 - Sensitivity of the Area to Human Health Impacts

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

Table D4 - Sensitivity of the Area to Ecological Impacts

Receptor Sensitivity	Distance from The Sources (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Step 2c - Define the Risk of Impacts

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

Table D5 - Risk of Dust Impacts

Sensitivity of Surrounding Area	Dust Emission Magnitude		
	Large	Medium	Small
Demolition			
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible
Earthworks and Construction			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible
Trackout			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Step 3 - Site Specific Mitigation

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

Step 4 - Determine Significant Effects

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

Appendix E - Dispersion Model Details

Model Input Parameters

Traffic Flow Data

2016 is the most recent year for which monitoring data and meteorological data are available to enable verification of the model results, and so this year has been used as the baseline year for this assessment. 2019 is the anticipated opening year of the Proposed Development.

Baseline traffic data for use in the assessment, including 24-hour Annual Average Daily Traffic (AADT) flows and fleet composition as HDV proportion, was obtained from the Department for Transport (DfT)¹⁷. The DfT web tool enables the user to view and download available traffic flows on every link of the 'A' road and motorway network, as well as selected minor roads, in Great Britain for the years 1999 to 2017. It should be noted that the DfT web tool is referenced in DEFRA's LAQM.TG16 guidance as being a suitable source of data for air quality assessments and it is therefore considered to provide a reasonable estimate of traffic flows in the vicinity of the Site.

The baseline traffic data was converted to the anticipated operational year utilising a factor obtained from TEMPro (version 7.2). This software package has been developed by the DfT to calculate future traffic growth throughout the UK.

Table E1 - 2017 Verification/Baseline Traffic Data

Road Link	Name	AADT (Total vehicles)	%HDV	Speed (km/h)	NO _x Emission Factor (g/km/s)
01	Whalley Road South of Moor Lane Junction Approach	17,672	3.22	10	0.178953
02	Whalley Road North of Brownlow Street	17,672	3.22	25	0.119860
03	Whalley Road South of Brownlow Street	17,672	3.22	48	0.088684
04	Whalley Road South of Primrose Road	17,672	3.22	60	0.085852
05	A671 West of A59	15,227	2.38	48	0.077295
06	A671 and A59 Roundabout	27,398	5.68	10	0.340255
07	A59 South of A671	27,398	5.68	70	0.139324
08	A59 North of Holm Road R't Junction Approach	27,398	5.68	10	0.340255
09	A59 - Holm Road Roundabout	27,398	5.68	10	0.340255
10	A59 South of Holm Road R't	27,398	5.68	70	0.139324
11	A59 North of A671 R't Junction Approach	27,398	5.68	10	0.340255
12	A59 and A671 Roundabout	27,398	5.68	10	0.340255
13	A671 South of A59 R't Junction Approach	16,585	4.77	10	0.193461
14	A671 South of A59 Roundabout	16,585	4.77	10	0.193461
15	A671 North of Springwood	16,585	4.77	70	0.082239
16	A671 North of Springwood Junction Approach	16,585	4.77	10	0.193461
17	A671 South of Springwood Junction Approach	23,311	4.11	10	0.259167
18	A671 South of Springwood	23,311	4.11	70	0.113451
19	Queensway	11,292	1.18	20	0.071746
20	Moor Lane	7,270	0.00	30	0.035973
21	A59 South of A671 R't Junction Approach	18,786	6.14	10	0.240465
22	A59 South of A671 R't	18,786	6.14	70	0.096732

¹⁷ <https://roadtraffic.dft.gov.uk/manualcountpoints>.

Table E2 - 2025 Without Development Traffic Data

Road Link	Name	AADT (Total vehicles)	%HDV	Speed (km/h)	NO _x Emission Factor (g/km/s)	PM ₁₀ Emission Factor (g/km/s)	PM _{2.5} Emission Factor (g/km/s)
01	Whalley Road South of Moor Lane Junction Approach	19,593	3.22	10	0.198406	0.006256	0.009823
02	Whalley Road North of Brownlow Street	19,593	3.22	25	0.132889	0.005513	0.009040
03	Whalley Road South of Brownlow Street	19,593	3.22	48	0.098324	0.005065	0.008569
04	Whalley Road South of Primrose Road	19,593	3.22	60	0.095184	0.004073	0.006468
05	A671 West of A59	16,882	2.38	48	0.085696	0.003481	0.005494
06	A671 and A59 Roundabout	30,376	5.68	10	0.377239	0.009249	0.013380
07	A59 South of A671	30,376	5.68	70	0.154468	0.006822	0.010825
08	A59 North of Holm Road R't Junction Approach	30,376	5.68	10	0.377239	0.009249	0.013380
09	A59 - Holm Road Roundabout	30,376	5.68	10	0.377239	0.009249	0.013380
10	A59 South of Holm Road R't	30,376	5.68	70	0.154468	0.006822	0.010825
11	A59 North of A671 R't Junction Approach	30,376	5.68	10	0.377239	0.009249	0.013380
12	A59 and A671 Roundabout	30,376	5.68	10	0.377239	0.009249	0.013380
13	A671 South of A59 R't Junction Approach	18,388	4.77	10	0.214492	0.005392	0.007822
14	A671 South of A59 Roundabout	18,388	4.77	10	0.214492	0.005392	0.007822
15	A671 North of Springwood	18,388	4.77	70	0.091179	0.004020	0.006378
16	A671 North of Springwood Junction Approach	18,388	4.77	10	0.214492	0.005392	0.007822
17	A671 South of Springwood Junction Approach	25,845	4.11	10	0.287340	0.007367	0.010712
18	A671 South of Springwood	25,845	4.11	70	0.125783	0.005538	0.008788
19	Queensway	12,519	1.18	20	0.079542	0.003351	0.005477
20	Moor Lane	8,060	0.00	30	0.039882	0.001957	0.003272
21	A59 South of A671 R't Junction Approach	20,828	6.14	10	0.266603	0.006461	0.009333
22	A59 South of A671 R't	20,828	6.14	70	0.107247	0.004741	0.007522
23	Clitheroe Road North of Wiswell Lane	8,176	4.33	48	0.043386	0.002190	0.003698
24	Wiswell Lane	2,954	0.98	48	0.013106	0.000708	0.001202
25	Clitheroe Road North of Springwood Drive	9,524	3.71	48	0.049004	0.002501	0.004228
26	Springwood Drive	0	3.71	30	0.000000	0.000000	0.000000
27	Clitheroe Road South of Springwood Drive	9,524	3.71	48	0.049004	0.002501	0.004228
28	King Street North of Accrington Road	13,075	2.47	48	0.063068	0.003297	0.005585

Road Link	Name	AADT (Total vehicles)	%HDV	Speed (km/h)	NO _x Emission Factor (g/km/s)	PM ₁₀ Emission Factor (g/km/s)	PM _{2.5} Emission Factor (g/km/s)
29	Accrington Road	8,504	2.18	48	0.040381	0.002123	0.003600
30	King Street South of Accrington Road	13,337	1.74	48	0.061805	0.003281	0.005566

Table E3 - 2025 With Development Traffic Data

Road Link	Name	AADT (Total vehicles)	%HDV	Speed (km/h)	NO _x Emission Factor (g/km/s)	PM ₁₀ Emission Factor (g/km/s)	PM _{2.5} Emission Factor (g/km/s)
01	Whalley Road South of Moor Lane Junction Approach	19,593	3.22	10	0.198406	0.006256	0.009823
02	Whalley Road North of Brownlow Street	19,593	3.22	25	0.132889	0.005513	0.009040
03	Whalley Road South of Brownlow Street	19,593	3.22	48	0.098324	0.005065	0.008569
04	Whalley Road South of Primrose Road	19,593	3.22	60	0.095184	0.004073	0.006468
05	A671 West of A59	16,882	2.38	48	0.085696	0.003481	0.005494
06	A671 and A59 Roundabout	30,376	5.68	10	0.377239	0.009249	0.013380
07	A59 South of A671	30,376	5.68	70	0.154468	0.006822	0.010825
08	A59 North of Holm Road R'bt Junction Approach	30,376	5.68	10	0.377239	0.009249	0.013380
09	A59 - Holm Road Roundabout	30,376	5.68	10	0.377239	0.009249	0.013380
10	A59 South of Holm Road R'bt	30,376	5.68	70	0.154468	0.006822	0.010825
11	A59 North of A671 R'bt Junction Approach	30,376	5.68	10	0.377239	0.009249	0.013380
12	A59 and A671 Roundabout	30,376	5.68	10	0.377239	0.009249	0.013380
13	A671 South of A59 R'bt Junction Approach	18,388	4.77	10	0.214492	0.005392	0.007822
14	A671 South of A59 Roundabout	18,388	4.77	10	0.214492	0.005392	0.007822
15	A671 North of Springwood	18,388	4.77	70	0.091179	0.004020	0.006378
16	A671 North of Springwood Junction Approach	18,388	4.77	10	0.214492	0.005392	0.007822
17	A671 South of Springwood Junction Approach	25,845	4.11	10	0.287340	0.007367	0.010712
18	A671 South of Springwood	25,845	4.11	70	0.125783	0.005538	0.008788
19	Queensway	12,519	1.18	20	0.079542	0.003351	0.005477
20	Moor Lane	8,060	0.00	30	0.039882	0.001957	0.003272
21	A59 South of A671 R'bt Junction Approach	20,828	6.14	10	0.266603	0.006461	0.009333
22	A59 South of A671 R'bt	20,828	6.14	70	0.107247	0.004741	0.007522
23	Clitheroe Road North of Wiswell Lane	8,964	4.33	48	0.047569	0.002401	0.004055

Road Link	Name	AADT (Total vehicles)	%HDV	Speed (km/h)	NO _x Emission Factor (g/km/s)	PM ₁₀ Emission Factor (g/km/s)	PM _{2.5} Emission Factor (g/km/s)
24	Wiswell Lane	2,954	0.98	48	0.013106	0.000708	0.001202
25	Clitheroe Road North of Springwood Drive	10,312	3.71	48	0.053060	0.002708	0.004578
26	Springwood Drive	788	3.71	30	0.005063	0.000220	0.000363
27	Clitheroe Road South of Springwood Drive	10,312	3.71	48	0.053060	0.002708	0.004578
28	King Street North of Accrington Road	13,487	2.47	48	0.065053	0.003401	0.005761
29	Accrington Road	8,504	2.18	48	0.040381	0.002123	0.003600
30	King Street South of Accrington Road	13,749	1.74	48	0.063713	0.003382	0.005738

Roughness Length

The roughness length (z_0) is a modelling parameter applied to allow consideration of surface height roughness elements. A z_0 of 1m was used to describe the modelling extents at the proposed development site, the verification site and for the meteorological site. The values of z_0 is considered appropriate for the morphology of the area and are suggested within ADMS-Roads as being suitable for 'Cities woodlands'.

Monin-Obukhov Length

The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 10m was used to describe the modelling extents and meteorological site. This value is considered appropriate for the nature of both areas and is suggested within ADMS-Roads as being suitable for 'small towns'.

Model Verification

Introduction

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

- ▲ Estimates of background pollutant concentrations;
- ▲ Meteorological data uncertainties;
- ▲ Traffic data uncertainties;
- ▲ Model input parameters, such as 'roughness length'; and,
- ▲ Overall limitations of the dispersion model.

Nitrogen Dioxide

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

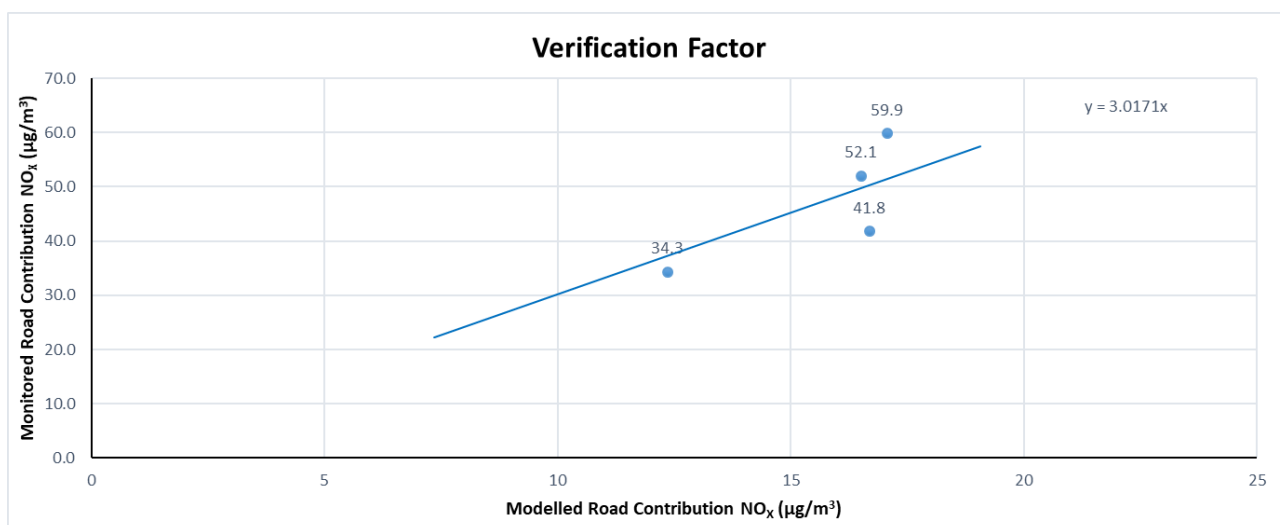
The model has been run to predict the 2016 annual mean road- NO_x contribution at a number of roadside diffusion tubes within the modelled road network at the verification location. The model outputs of road- NO_x have been compared with the 'measured' road- NO_x , which was determined from the NO_2 concentrations measured using diffusion tubes at the monitoring locations, utilising the NO_x from NO_2 calculator provided by Defra and the NO_2 background concentration (from the Defra background map). As discussed in the methodology section, the most recent suitable data available for model verification purposes is 2016 data.

Table E3 - Model Verification

Site ID	2016 Monitored Total NO ₂ (µg/m ³)	2016 Background NO ₂ (µg/m ³)	2016 Monitored Road Contribution NO _x (µg/m ³)	2016 Modelled Contribution NO _x (µg/m ³)	Ratio
Royal British Legion	39.9	11.4	59.9	17.1	3.509
57 Whalley Road	36.6	11.4	52.1	16.5	3.152
Greenacre Street	28.7	11.4	34.3	12.4	2.777
85 Whalley Road	32.1	11.4	41.8	16.7	2.503

The road-NO_x adjustment factor was determined as the slope of the best fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (**Figure E1**). This resulted in a factor of **3.02**, indicating that the model was under-predicting. This road-NO_x adjustment factor was applied to the modelled road-NO_x concentration for each monitoring site to provide adjusted modelled road-NO_x concentrations. The total nitrogen dioxide concentrations were then determined by inputting the adjusted modelled road-NO_x concentrations and the background NO₂ concentration into the NO_x to NO₂ calculator.

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



PM₁₀ and PM_{2.5}

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

Model Uncertainty

An evaluation of model performance has been undertaken to establish confidence in model results. LAQM.TG16 identifies a number of statistical procedures that are appropriate to evaluate model performance and assess the uncertainty. These include:

- Root mean square error (RMSE);
- Fractional bias (FB); and
- Correlation coefficient (CC).

These parameters estimate how the model results agree or diverge from the observations. These calculations can be carried out prior to, and after adjustment, or based on different options for adjustment, and can provide useful information on model improvement. Further details can be found in Box 7.17 of LAQM.TG16.

Table E4 - Methods for describing model uncertainty

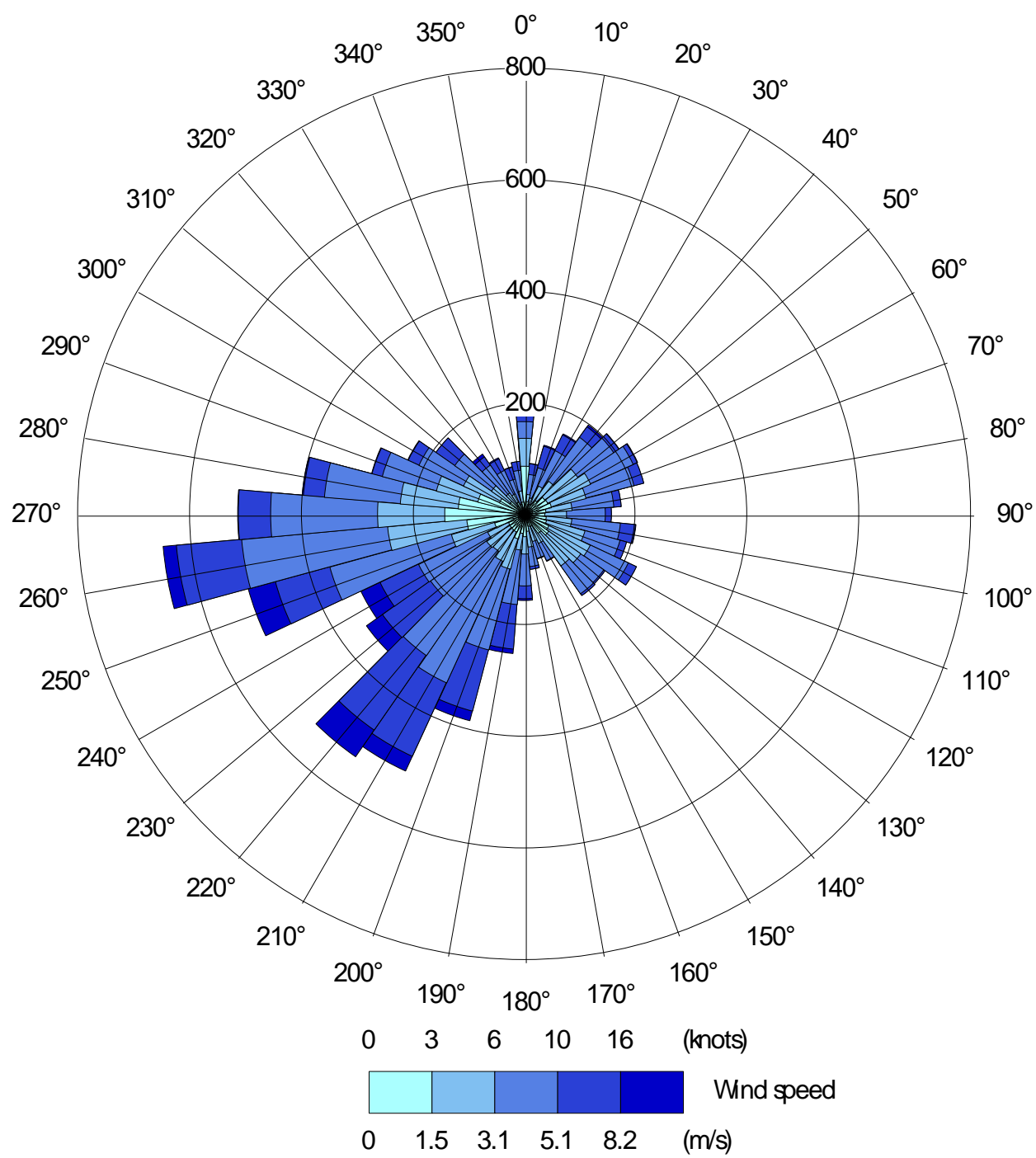
Statistical Parameter	Comments
RMSE	<p>RMSE is used to define the average error or uncertainty of the model. The units of RMSE are the same as the quantities compared.</p> <p>If the RMSE values are higher than 25% of the objective being assessed, it is recommended that the model inputs and verification should be revisited in order to make improvements.</p> <p>For example, if the model predictions are for the annual mean NO₂ objective of 40 µg/m³, if an RMSE of 10µg/m³ or above is determined for a model it is advised to revisit the model parameters and model verification.</p> <p>Ideally an RMSE within 10% of the air quality objective would be derived, which equates to 4µg/m³ for the annual mean NO₂ objective.</p>
Fractional Bias	<p>It is used to identify if the model shows a systematic tendency to over or under predict.</p> <p>FB values vary between +2 and -2 and has an ideal value of zero. Negative values suggest a model over-prediction and positive values suggest a model under-prediction.</p>
Correlation Coefficient	<p>It is used to measure the linear relationship between predicted and observed data. A value of zero means no relationship and a value of 1 means absolute relationship.</p> <p>This statistic can be particularly useful when comparing a large number of model and observed data points.</p>

To assess the uncertainty of a model, the RMSE is the simplest parameter to calculate providing an estimate of the average error of the model in the same units as the modelled predictions. It is also often easier to interpret the RMSE than the other statistical parameters and therefore it has been calculated in this assessment to understand the model uncertainty.

The overall weighted RMSE value calculated after verification was 2.72 and therefore the final predictions are considered to be robust.

Appendix F - Wind Rose for Bingley (2016)

Wind Rose for Bingley (2016)



Appendix G - Dispersion Modelling Results

Table G1 - Annual Mean NO₂ Concentration

Receptor	Future Without Dev.(µg/m ³)	Future With Dev. (µg/m ³)	% of AQAL	Change (µg/m ³)	% of AQO	Impact
R1	12.1	13.1	32.7	1.0	3.0	Negligible
R2	12.2	13.2	33.1	1.0	3.0	Negligible
R3	12.3	13.2	33.1	1.0	2.0	Negligible
R4	16.2	17.6	43.9	1.4	4.0	Negligible
R5	19.3	20.5	51.1	1.1	3.0	Negligible
R6	18.8	19.3	48.2	0.5	1.0	Negligible
R7	16.4	17.0	42.4	0.6	1.0	Negligible
R8	15.3	15.7	39.3	0.4	1.0	Negligible
R9	18.3	18.8	46.9	0.5	1.0	Negligible
PR1	-	12.8	32.0	-	-	-
PR2	-	12.8	32.0	-	-	-
PR3	-	13.1	32.7	-	-	-
PR4	-	13.9	34.8	-	-	-
PR5	-	13.6	34.0	-	-	-
PR6	-	12.3	30.7	-	-	-
PR7	-	12.6	31.5	-	-	-
PR8	-	12.5	31.3	-	-	-
PR9	-	12.2	30.4	-	-	-
PR10	-	13.1	32.7	-	-	-
PR11	-	12.4	31.0	-	-	-
PR12	-	12.4	31.0	-	-	-
PR13	-	12.5	31.3	-	-	-

Table G2 - Annual Mean PM₁₀ Concentration

Receptor	Future Without Dev.(µg/m ³)	Future With Dev. (µg/m ³)	% of AQAL	Change (µg/m ³)	% of AQO	Impact
R1	10.9	11.0	27.5	0.1	<0.1	Negligible
R2	10.9	11.0	27.6	0.1	<0.1	Negligible
R3	10.9	11.0	27.6	0.1	<0.1	Negligible
R4	11.6	11.8	29.4	0.2	1.0	Negligible
R5	12.1	12.3	30.7	0.2	<0.1	Negligible
R6	12.0	12.1	30.2	0.1	<0.1	Negligible
R7	11.6	11.7	29.2	0.1	<0.1	Negligible
R8	11.4	11.5	28.6	0.1	<0.1	Negligible
R9	11.9	12.0	30.1	0.1	<0.1	Negligible
PR1	-	10.9	27.3	-	-	-
PR2	-	10.9	27.3	-	-	-
PR3	-	11.0	27.4	-	-	-
PR4	-	11.1	27.7	-	-	-
PR5	-	11.0	27.6	-	-	-
PR6	-	10.9	27.2	-	-	-
PR7	-	10.9	27.3	-	-	-
PR8	-	11.0	27.4	-	-	-
PR9	-	10.9	27.2	-	-	-
PR10	-	11.0	27.5	-	-	-
PR11	-	10.9	27.3	-	-	-
PR12	-	10.9	27.3	-	-	-
PR13	-	10.9	27.3	-	-	-

Table G3 - Annual Mean PM_{2.5} Concentration

Receptor	Future Without Dev.(µg/m ³)	Future With Dev. (µg/m ³)	% of AQAL	Change (µg/m ³)	% of AQO	Impact
R1	7.5	7.6	30.3	0.1	<0.1	Negligible
R2	7.5	7.6	30.4	0.1	<0.1	Negligible
R3	7.5	7.6	30.4	0.1	<0.1	Negligible
R4	7.9	8.0	32.1	0.1	<0.1	Negligible
R5	8.2	8.3	33.3	0.1	<0.1	Negligible
R6	8.2	8.2	32.8	<0.1	<0.1	Negligible
R7	7.9	8.0	31.9	0.1	<0.1	Negligible
R8	7.8	7.8	31.4	<0.1	<0.1	Negligible
R9	8.1	8.2	32.7	<0.1	<0.1	Negligible
PR1	-	7.5	30.2	-	-	-
PR2	-	7.5	30.2	-	-	-
PR3	-	7.6	30.3	-	-	-
PR4	-	7.6	30.5	-	-	-
PR5	-	7.6	30.4	-	-	-
PR6	-	7.5	30.0	-	-	-
PR7	-	7.5	30.1	-	-	-
PR8	-	7.5	30.2	-	-	-
PR9	-	7.5	30.0	-	-	-
PR10	-	7.6	30.3	-	-	-
PR11	-	7.5	30.1	-	-	-
PR12	-	7.5	30.1	-	-	-
PR13	-	7.5	30.1	-	-	-