FROGHALL ROAD, CHEADLE

Proposed Residential Development

Air Quality Assessment

Prepared for: Bloor Homes North West

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SLR

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1.0 INTRODUCTION

SLR Consulting Ltd (SLR) has been commissioned by Bloor Homes North West to undertake an Air Quality Assessment (AQA) in support of a planning application for Phase 1 of the proposed residential development ('Proposed Development') on land to the east of Froghall Road, Cheadle, Stoke-on-Trent (the 'Site'). The Proposed Development seeks the construction of 228 dwellings (C3 use class), associated infrastructure and landscaping.

The Site is located at the approximate National Grid Reference (NGR): x401250, y344850 and is bounded by:

- agricultural fields in a western, northern and eastern direction;
- existing residential dwellings along the south-western boundary;
- existing residential dwellings bounding the southern boundary; and
- the A521 Froghall Road bounding the north-western boundary.

Vehicular access to the Site will be from the A521 Froghall Road to the west of the Site.

1.1 Scope of Assessment

Consultation with the Environment Health Officer (EHO) at Staffordshire Moorlands District Council (SMDC – the Council)[1] was undertaken to agree upon the extent and methodology of the air quality assessment. The scope of this assessment is as follows, as agreed with SMDC:

- Baseline Evaluation – Assessment of existing air quality in the local area;
- Construction Phase Assessment – Identification and assessment of potential air quality effects associated with the construction phase of the Proposed Development;
- Operational Phase Assessment – Identification of air quality effects and design constraints associated with the operational phase of the Proposed Development; and
- Mitigation Measures – as required.

[1] E-mail communication between SLR Consulting Ltd and Daniel McCrory, Environmental Health Officer within Staffordshire Moorlands District Council, dated 18th June 2021.

2.0 RELEVANT AIR QUALITY LEGISLATION AND GUIDANCE

2.1 Legislative Context

2.1.1 Air Quality Standards

The Air Quality Standards Regulations 2010[2] (AQSR) transpose both the EU Ambient Air Quality Directive (2008/50/EC)[3], and the Fourth Daughter Directive (2004/107/EC)[4] within UK legislation, in order to align and bring together in one statutory instrument the Government's obligations. The AQSR includes Limit Values, Target Values, Objectives, Critical Levels and Exposure Reduction Targets for the protection of human health and the environment. Limit values are legally binding and are considered to apply everywhere with the exception of the carriageway and central reservation of roads and any location where the public do not have access (e.g. industrial sites). Compliance is regulated at a national level (based upon a series of zones and agglomerations).

In the interim period the UK has formally left the EU, however despite this, EU rules and regulations referred above have subsequently been written into UK law and are thus still of relevance.

2.1.2 Air Quality Strategy

Irrespective of the above, the UK Government and the devolved administrations are required under the Environment Act 1995 to produce a national air quality strategy to improve air quality. The latest Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland was published in 2007[5]. The AQS provides the over-arching strategic framework for air quality management in the UK and contains non-statutory national air quality standards and objectives established by the UK Government and Devolved Administrations for the protection of public health and the environment, taking into account epidemiological evidence and international regulations, as well as economic efficiency, practicability and technical feasibility. There is no legal requirement to meet these objectives except where they mirror an equivalent legally binding Limit Value as prescribed within EU legislation, however compliance is regulated at a local level by local planning authorities.

The AQS objectives apply at locations outside buildings or other natural or man-made structures above or below ground, where members of the public are regularly present and might reasonably be expected to be exposed to pollutant concentrations over the relevant averaging period – herein referred to as relevant exposure. Table 2-2 provides an indication of those locations.

The ambient air quality standards of relevance to human receptors in this assessment (collectively termed Air Quality Assessment Levels (AQALs) throughout this report) are provided in Table 2-1.

Table 2-1
Relevant Ambient AQALs

Pollutant	Standard (µg/m^3)	Measured As	Equivalent percentile
Nitrogen Dioxide (NO_2)	40	Annual Mean	-
	200	1-hour Mean	99.79th percentile of 1-hour means (equivalent to 18 1-hour exceedences)
Particulate matter with an aerodynamic diameter of less than 10µm (PM_{10})	40	Annual Mean	-
	50	24-hour mean	90.41th percentile of 24-hour means (equivalent to 35 24-hour exceedences)

[2] The Air Quality Standards Regulations (England) 2010, Statutory Instrument No 1001, The Stationary Office Limited.
[3] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe.
[4] Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004.
[5] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, DEFRA. July 2007.

Pollutant	Standard (µg/m^3)	Measured As	Equivalent percentile
Particulate matter with an aerodynamic diameter of less than 2.5µm ($PM_{2.5}$)	25	Annual Mean	-

Table 2-2
Human Health Relevant Exposure

AQAL Averaging Period	Relevant Locations	AQALs should apply at	AQALs should not apply at
Annual Mean	Where individuals are exposed for a cumulative period of 6-months in a year	Building facades of residential properties, schools, hospitals etc.	Facades of offices Hotels Gardens of residences Kerbside sites
24-hour mean	Where individuals may be exposed for eight hours or more in a day	As above together with hotels and gardens of residential properties	Kerbside sites where public exposure is expected to be short term
1-hour mean	Where individuals might reasonably be expected to spend one hour or longer	As above together with kerbside sites of regular access, car parks, bus stations etc.	Kerbside sites where public would not be expected to have regular access

2.2 Local Air Quality Management

As reinforced within the AQS, Part IV of the Environment Act 1995 induces a statutory duty for local authorities to undergo a process of Local Air Quality Management (LAQM). This requires local authorities to Review and Assess air quality within their boundaries to determinedly the likeliness of compliance, regularly and systematically.

Where any of the prescribed AQS objectives are not likely to be achieved, the authority must designate an Air Quality Management Area (AQMA). For each AQMA, the local authority is required to prepare an Air Quality Action Plan (AQAP), which details measures the authority intends to introduce to deliver improvements in local air quality in pursuit of the objective. AQMAs can give rise to potential constraints to development, or at least a higher degree of scrutiny to air quality assessment work. Local authorities therefore have formal powers to control air quality through a combination of LAQM and through application of wider planning policies.

After a high number of declarations across the UK, it has become standard practice for planning authorities to require an air quality assessment to be carried out as a supporting statement to planning applications.

2.3 Clean Air Strategy

The Clean Air Strategy (CAS)[6], published in 2019, sets out the Government's proposals aimed at delivering cleaner air in England, and also indicates how devolved administrations intend to make emissions reductions. It sets out the comprehensive action that is required from across all parts of government and society to deliver clean air.

2.4 General Nuisance Legislation

Part III of the Environmental Protection Act (EPA) 1990 (as amended) contains the main legislation on Statutory Nuisance and allows local authorities and individuals to take action to prevent a statutory nuisance. Section 79 of

[6] The Clean Air Strategy, DEFRA. January 2019.

the EPA defines, amongst other things, smoke, fumes, dust and smells emitted from industrial, trade or business premises so as to be prejudicial to health or a nuisance, as a potential Statutory Nuisance.

Fractions of dust greater than 10µm (i.e. greater than PM_{10}) in diameter typically relate to nuisance effects as opposed to potential health effects and therefore are not covered within the UK AQS. In legislation there are currently no numerical limits in terms of what level of dust deposition constitutes a nuisance.

2.5 Planning Policy

2.5.1 National Policy

The 2021 update to the National Planning Policy Framework (NPPF) describes the policy context in relation to pollutants including air pollutants:

> *'Para 174: Planning policies and decisions should contribute to and enhance the natural and local environment by:*
>
> *e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of […] air […] pollution […]. Development should, wherever possible, help to improve local environmental conditions such as air […] quality […]'*
>
> *'Para 185: 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.'*

Specifically, in terms of development with regards to air quality:

> *'Para 186: 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.'*

The NPPF is accompanied by web based supporting Planning Practice Guidance (PPG) which includes guiding principles on how planning can take account of the impacts of new development on air quality. In regard to air quality, the PPG states:

> *"Defra carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU Limit Values […] It is important that the potential impact of new development on air quality is taken into account […] where the national assessment indicates that relevant limits have been exceeded or are near the limit."*
>
> *"Whether or not air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to generate air quality impact in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU legislation (including that applicable to wildlife)."*

The PPG sets out the information that may be required within the context of a supporting air quality assessment, stating that "*assessments should be proportional to the nature and scale of development proposed and the level of concern about air quality* […] *Mitigation options where necessary, will depend on the proposed development and should be proportionate to the likely impact*".

The policies within the NPPF and accompanying PPG in relation to air pollution are considered within this air quality assessment.

2.5.2 Local Policy

The Staffordshire Moorlands Local Plan was adopted by SMDC in September 2020 and contains the planning policy used to guide development in the district until 2033. Within the Local Plan, the following policy relates to air quality:

> *"**Policy SD 4 – Pollution and Water Quality***
>
> *The Council will protect people and the environment from unsafe, unhealthy and polluted environments by ensuring proposals avoid potential adverse effects; and only permitting proposals that are deemed (individually or cumulatively) to result in pollution (including air / water / noise / vibration / light / ground contamination) if after mitigation, potential adverse effects are deemed acceptable. This may be achieved by the imposition of planning conditions or through a planning obligation.*
>
> *[…]"*

The above policy has been addressed within this assessment.

2.6 Assessment Guidance

The air quality assessment has been carried out in accordance with the following principles contained within the guidance documents below.

2.6.1 Local Air Quality Management Technical Guidance (2016)

Department of Environment Food and Rural Affairs (DEFRA) Local Air Quality Management Technical Guidance (LAQM.TG(16))[7] was published for use by local authorities in their LAQM review and assessment work. The document provides key guidance in aspects of air quality assessment, including screening, model verification, use of monitoring data, and use of background data that are applicable to all air quality assessments.

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

Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM) have together published guidance[8] to help ensure that air quality is appropriately accounted for in the development control process. The guidance clarifies when an air quality assessment should be undertaken, as well as the likely proportional scope, with reference to indicative screening criteria, and provides a significance criterion for use to evaluate and describe potential developmental impacts and effects.

2.6.3 Construction and Demolition Dust Guidance

Guidance on the assessment of dust from demolition and construction has been published by the IAQM[9]. The guidance provides a series of matrices to determine the risk magnitude of potential dust sources associated with construction activities in order to identify appropriate mitigation measures that are defined within further IAQM guidance.

[7] Local Air Quality Management Technical Guidance 16, Published by DEFRA in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland. April 2021.

[8] Environmental Protection UK and Institute of Air Quality Management, Land-Use Planning and Development Control: Planning for Air Quality', v1.2 2017.

[9] Institute of Air Quality Management (IAQM), Guidance on the assessment dust from demolition and construction (2016).

3.0 ASSESSMENT METHODOLOGY

3.1 Construction Phase

A construction dust assessment has been undertaken with reference to IAQM guidance. The assessment of risk is determined by considering the risk of dust effects arising from four activities in the absence of mitigation:

- demolition;
- earthworks;
- construction; and
- track-out.

The assessment methodology considers three separate dust impacts with account being taken of the sensitivity of the area that may experience these effects:

- annoyance due to dust soiling;
- the risk of health effects due to an increase in exposure to PM_{10}; and
- harm to ecological receptors.

The first stage of the assessment involves a screening to determine if there are sensitive receptors within threshold distances of the site activities associated with the construction phase of the scheme. A detailed assessment is required where a:

- human receptor is located within 350m of the Site, and/or within 50m of routes used by construction vehicles, up to 500m from the site entrance(s); and/or
- ecological receptor is located within 50m of the Site, and/or within 50m of routes used by construction vehicles, up to 500m from the site entrance(s).

The dust emission class (or magnitude) for each activity is determined on the basis of the guidance, indicative thresholds and professional judgement. The risk of dust effects arising is based upon the relationship between the dust emission magnitude and the sensitivity of the area. The risk of impact is then used to determine the appropriate mitigation requirements, whereby through effective application, residual effects are considered to be 'not significant'.

Given the short-term nature of the construction phase and the comparatively low volume of vehicle movements that will likely arise (when compared to the operational phase, for which a full assessment has been undertaken), it is unlikely that significant air quality effects from development related road traffic emissions during the construction phase will arise. Such potential effects have therefore been scoped out from requiring detailed assessment based on their assumed insignificant effect following the EPUK & IAQM guidance outlined in Section 2.6.2.

3.2 Operational Phase

In order to appropriately assess road traffic impacts associated with the operation of the Proposed Development, detailed dispersion modelling has been undertaken using the Cambridge Environmental Research Consultants (CERC) ADMS-Roads v5.0.0.1 dispersion model, focussing on concentrations of NO_2, PM_{10} and $PM_{2.5}$ for the following scenarios:

- 2019 Base Case (2019 BC) – Without development base flows for the year (2019);

- 2023 Do Minimum (2023 DM) – Without development flows for the proposed year of opening (2023), inclusive of any relevant committed development flows; and
- 2023 Do Something (2023 DS) – 'Do Minimum' flows, plus all trips associated with the Proposed Development flows for the proposed year of opening (2023).

For the above future year scenarios (2023), concurrent emission factors and background pollutant concentrations have been used.

Details of model inputs are discussed in turn, below. Advanced inputs are discussed in Appendix A.

3.2.1 Traffic Inputs

The ADMS-Roads assessment incorporates numbers of road traffic vehicles, vehicle speeds on the local roads and the composition of the traffic fleet.

Traffic data was provided by Eddisons (Croft Transport Planning and Design) – the appointed transport consultant. This data has principally informed the spatial extent and inclusion of initial road links within the assessment.

Traffic speeds were modelled at the relevant posted speed limit for each road. However, where appropriate, the speeds have been reduced to simulate queues at junctions, traffic lights and other locations where queues or slower traffic are known to be an issue in accordance with LAQM.TG(16). Traffic speeds have been assumed to be consistent across all the modelled scenarios.

The Emissions Factors Toolkit (EFT) version 10.1 developed by DEFRA[10] has been used to determine vehicle emission factors for input into the ADMS-Roads dispersion model.

Details of the traffic flows used in this assessment are provided in Appendix A, whilst the modelled roads in relation to the Site are presented in Figure 6-1.

Traffic data was provided as 2031 flows with reference to the Cheadle town centre VISSIM modelling undertaken by Amey in support of the Cheadle North Strategic Development Area. The VISSIM model was produced to identify the cumulative effects of the trip generation associated with the future housing and employment developments proposed in the Staffordshire Moorlands Local Plan and, as such, provides a robust and conservative assessment. Emission factors and background pollutant concentrations have utilised development opening year (2023) predictions.

3.2.2 Meteorological Data

To calculate pollutant concentrations at identified sensitive receptor locations the dispersion model uses sequential hourly meteorological data, including wind direction, wind speed, temperature, cloud cover and stability, which exert significant influence over atmospheric dispersion.

The dispersion modelling has been undertaken using 2019 data from the Leek Thorncliffe meteorological station, located approximately 14.5km to the north of the Site – the closest representative meteorological station relative to the Site.

LAQM.TG(16) recommends that meteorological data should have a percentage of usable hours greater than 85%. 2019 meteorological data from Leek Thorncliffe meteorological station includes 8,760 lines of usable hourly data for the year, i.e. 100% usable data. This is therefore suitable for the dispersion modelling exercise.

A windrose is presented in Figure 3-1.

[10] DEFRA, EFT v10.1 (2020). https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html.

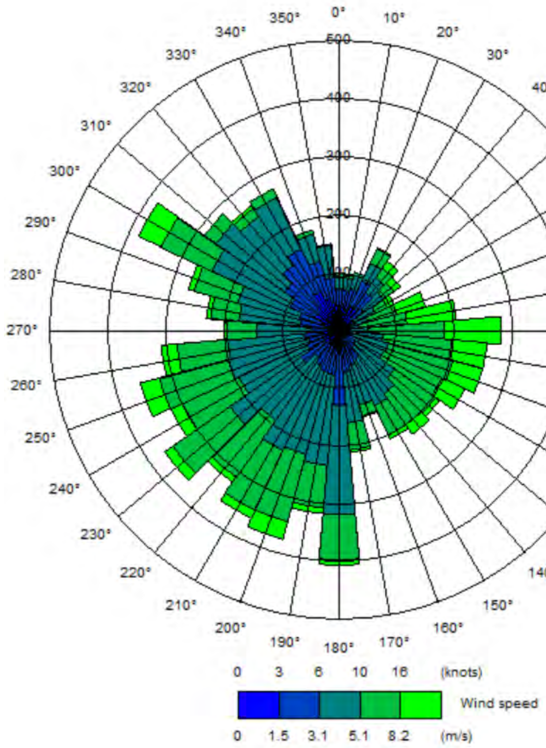

Figure 3-1
Windrose for Leek Thorncliffe Meteorological Station (2019)

3.2.3 Background Concentrations

In the absence of locally representative background monitoring sites, annual mean background concentrations used for the purposes of the assessment have been obtained from the DEFRA supplied background maps (2018 reference year)[11], based on the 1km grid squares which cover the modelled area. Further detail on these datasets can be found in Section 4.1.3.

To avoid double counting of potential source contributions already contained within the ADMS-Roads dispersion model, 'Primary A Road in' was removed from each grid square, as recommended in the DEFRA Background Maps User Guide[12].

As the relationship between NO_2 and oxides of nitrogen (NOx) is not linear, the NO_2 Adjustment for NOx Sector Removal Tool[13] has been used – in accordance with LAQM.TG(16). No adjustment for background concentration variability with height has been made.

3.2.4 Sensitive Receptors

Human receptors considered in the assessment of emissions from road traffic are shown Table 3-1, whilst their locations are illustrated in Figure 3-1.

Receptors R1 – R15 are representative of worst-case exposure locations at existing receptors within the development locale, relative to the affected road network discussed. Diffusion tubes DT29, DT7 and DT30 correspond to existing air quality monitoring undertaken as part of SMDC's commitment to LAQM (see Section 4.1.2 for further information), and represent areas of relevant exposure and these locations have therefore also been assessed.

[11] Defra Background Maps (2018-Reference) http://uk-air.defra.gov.uk/data/laqm-background-home.
[12] Defra Background Concentration Maps User Guide. August 2020.
[13] Defra NO_2 Adjustment for NO_x Sector Removal Tool (v8.0)

All receptors were considered in relation to exposure at breathing height relative to the adjacent modelled road, and were considered in relation to exposure at ground level, i.e. 1.5m height. Receptor locations represent relevant exposure – in accordance with LAQM.TG(16) presented in Table 2-2.

Table 3-1
Receptor Locations Considered

Receptor	X	Y	Height (m)
R1	401773	345942	1.5
R2	401666	345907	1.5
R3	401439	345784	1.5
R4	401117	344838	1.5
R5	401113	344629	1.5
R6	401099	344598	1.5
R7	401071	344512	1.5
R8	401042	344330	1.5
R9	401060	344217	1.5
R10	401002	344114	1.5
R11	400943	343999	1.5
R12	400943	343867	1.5
R13	400925	343781	1.5
R14	400966	343646	1.5
R15	400856	343841	1.5
DT29	400964	343577	2.4
DT7	400966	343564	2.8
DT30	400966	343553	2.9

3.2.5 Model Outputs

The background pollutant values discussed in Section 4.1.3 have been used in conjunction with the concentrations predicted by the ADMS-Roads model to calculate predicted total annual mean concentrations of NO_2, PM_{10} and $PM_{2.5}$ for each respective scenario.

For the prediction of annual mean NO_2 concentrations for all modelled scenarios at receptor locations, the road NOx contributions (adjusted as per Appendix A) have been converted to total NO_2 following the methodology in LAQM.TG(16) using the latest version of DEFRA's NOx to NO_2 conversion tool (v8.1)[14]. The modelled NO_2 road contribution was then added to the appropriate NO_2 background concentration value to obtain an overall total annual mean NO_2 concentration.

For the prediction of short-term NO_2 impacts, LAQM.TG(16) advises that it is valid to assume that exceedences of the 1-hour mean AQAL for NO_2 are unlikely to occur where the annual mean NO_2 concentration is <60µg/m^3. This approach has thus been adopted for the purposes of this assessment, at relevant receptor locations with an applicable exposure period.

[14] Defra NOx to NO_2 Calculator v8.1 (2020), available at https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc.

For the prediction of short-term PM_{10}, LAQM.TG(16) provides an empirical relationship between the annual mean and the number of exceedences of the 24-hour mean AQAL for PM_{10} that can be calculated as follows:

No. 24-hour mean exceedances = -18.5 + 0.00145 × annual mean^3 + (206/annual mean)

This relationship has thus been adopted to determine whether exceedences of the short-term PM_{10} AQAL are likely in this assessment.

Verification of the ADMS-Roads road traffic emissions assessment has been undertaken, as per Appendix A. All results presented in the assessment are those calculated following the process of model verification, using an adjustment factor of 2.231 for NO_2, PM_{10} and $PM_{2.5}$.

3.2.6 Assessing Significance

Guidance for determining the significance of a development's impact on local air quality is provided by EPUK & IAQM.

When describing the developmental impact at a specific receptor, the resultant total concentration as well as the magnitude of change in relation to respective AQALs are both considered – using the approach detailed in Table 3-2.

Table 3-2
Impact Descriptor Matrix for Receptors

Long Term Average Concentration at Receptor in Assessment Year	Change in Concentration relative to AQAL			
	1% (A)	2-5%	6-10%	>10%
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

Note:
(A) Changes <0.5% will be described as 'Negligible'.

Following derivation of impacts at all receptor locations assessed, the overall significance of the developmental 'effect' is determined based upon consideration, as necessary, of the following factors:

- the existing and future air quality in the absence of the Proposed Development;
- the extent of current and future population exposure to the impacts;
- the worst-case assumptions adopted when undertaking the prediction of impacts; and
- the extent to which the Proposed Development has adopted best practice to eliminate and minimise emissions.

3.2.7 Uncertainty

Dispersion modelling is inherently uncertain and is principally reliant on the accuracy and representativity of its inputs. In acknowledgement of this, the ADMS-Roads dispersion model has been verified with the latest publicly available local monitoring data, as collected by SMDC.

In addition, there is a widely acknowledged disparity between emission factors and ambient monitoring data[15]. To help minimise any associated uncertainty when forming conclusions from the results, this assessment has utilised the latest EFT version 10.1 utilising COPERT 5.3 emission factors, and associated tools / datasets published by DEFRA.

Notwithstanding the above, in consideration of the potential uncertainty in predictions of future year pollutants, as well as the current national and local sensitivities seen in response to elevated roadside NO_2 concentrations, an additional sensitivity assessment has been provided in Appendix B, utilising 2019 as the proposed year of opening for the Proposed Development. This theoretically assumes that there is no improvement in emission factors or background concentrations for the pollutants considered, within SMDC for future years.

These modelled scenarios are likely to represent an overly conservative approach as, despite uncertainty in quantification, it is generally accepted that variables such as background concentrations and/or vehicle emission factors will improve to some degree in future years, with local monitoring trends somewhat supporting this (see Section 4.1).

[15] Carslaw, et al. (2011). Trends in NO_x and NO_2 emissions and ambient measurements in the UK.

4.0 BASELINE ENVIRONMENT

4.1 Baseline Air Quality

4.1.1 LAQM Review and Assessment

SMDC, in fulfilment of statutory requirements, has conducted an on-going exercise to review and assess air quality within their administrative area (Review and Assessment). The latest publicly available LAQM report for SMDC at the time of writing is the 2020 Annual Status Report[16] (ASR). The monitoring data published therein has therefore been used for the purposes of informing this assessment.

Through the annual Review and Assessment process, SMDC has consequently declared two AQMAs within the council's administrative area: AQMA No. 1 in Leek Town Centre and AQMA No. 2 at the Collarhead junction, approximately 11.3km north-north-west and 5.8km west-north-west, respectively. Both AQMAs were declared in 2019 for exceedences of the NO_2 annual mean AQAL at locations of relevant exposure. Due to the separation distance between the Site and these AQMAs, additional vehicular trips associated with the Proposed Development are not considered to have a significant impact upon their declaration. As such, they have not been considered further within this assessment.

4.1.2 Review of Air Quality Monitoring

Automatic Air Quality Monitoring

SMDC do not undertake any automatic monitoring of pollutants.

The closest Automatic Urban and Rural Network (AURN) automatic monitor to the Site is the 'Stoke-on-Trent A50 Roadside' monitor (UKA00610), located approximately 8.8km west-south-west of the Site. The Stoke-on-Trent A50 Roadside monitor is classified as a 'roadside' monitor, defined by LAQM.TG(16) guidance as "a site sampling typically within one to five metres of the kerb of a busy road". Due to the separation distance and difference in classification between this monitor and the Site, comparable pollutant concentrations are not anticipated, and data from this monitor has not been considered within this assessment.

Passive Diffusion Tube Monitoring

Passive NO_2 diffusion tube monitoring is currently undertaken by SMDC within the development locale, at numerous locations, in fulfilment of their statutory LAQM obligations.

The details and results of the monitoring locations of relevance to the Site are presented in Table 4-1 and Table 4-2 respectively, whilst their locations are illustrated in Figure 4-1. All monitoring data presented has been ratified by SMDC.

Table 4-1
Local LAQM NO_2 Passive Diffusion Tube Monitoring Sites: Details

Site ID	Site Type	NGR (m)		Height (m)	Within AQMA	Distance to Site (m)
		X	Y			
29	Roadside (A)	400968	343579	2.4	No	1,080
7	Roadside (A)	400967	343564	2.8	No	1,095
30	Roadside (A)	400967	343548	2.9	No	1,110
45	Roadside (A)	400937	343457	2.6	No	1,205
14	Roadside (A)	400990	343365	2.8	No	1,290

[16] Staffordshire Moorlands District Council, 2020 Air Quality Annual Status Report (2020).

Site ID	Site Type	NGR (m)		Height (m)	Within AQMA	Distance to Site (m)
		X	Y			
52	Roadside (A)	401049	343151	2.6	No	1,500
51	Roadside (A)	401062	343045	2.7	No	1,600
50	Roadside (A)	401043	342917	2.6	No	1,730

Note:
(A) 'Roadside' classification, defined by LAQM.TG(16) guidance as "a site sampling typically within one to five metres of the kerb of a busy road".

Table 4-2
Local LAQM NO_2 Passive Diffusion Tube Monitoring Sites: Results

Site ID	2019 Data Capture %	Annual Mean NO_2 Concentration ($\mu g/m^3$)				
		2015	2016	2017	2018	2019
29	100	30.8	34.6	33.1	36.9	39.7
7	100	37.5	39.1	35.2	38.0	36.2
30	92	36.2	38.7	33.8	33.5	35.5
45	83	30.3	37.0	33.2	34.5	35.3
14	100	27.2	30.0	30.6	32.0	26.6
52	83	-	-	-	37.1	40.1 (A)
51	100	-	-	-	24.6	30.2
50	92	-	-	-	28.6	22.7

Note:
(A) Although the monitored concentration is exceeding the AQAL, Table B.1 of the SMDC 2020 ASR shows the distance corrected concentration to be 32.8µg/m^3 at the nearest relevant exposure.

As shown in Table 4-2, the monitoring locations within the Site locale have all recorded annual mean NO_2 concentrations below the AQAL of 40µg/m^3 across all considered years with the exception of 52 in 2019; however this exceedence is not at a location of relevant exposure and the distance corrected concentration is reported to be 32.8µg/m^3 within the ASR. In 2019, the annual mean NO_2 concentrations ranged from 22.7µg/m^3 to 40.1µg/m^3.

There is no clear trend in concentrations at any of the considered monitoring locations across the five considered years, as concentrations have fluctuated from year to year.

All of the considered monitoring locations are of a 'roadside' classification, demonstrating that road traffic is a key contributor in the local setting.

The empirical relationship given in LAQM.TG(16) states that exceedences of the 1-hour mean AQAL for NO_2 is unlikely to occur where annual mean concentrations are <60µg/m^3. This indicates that an exceedence of the 1-hour mean AQAL is unlikely to have occurred at any of the monitoring sites between 2015 and 2019.

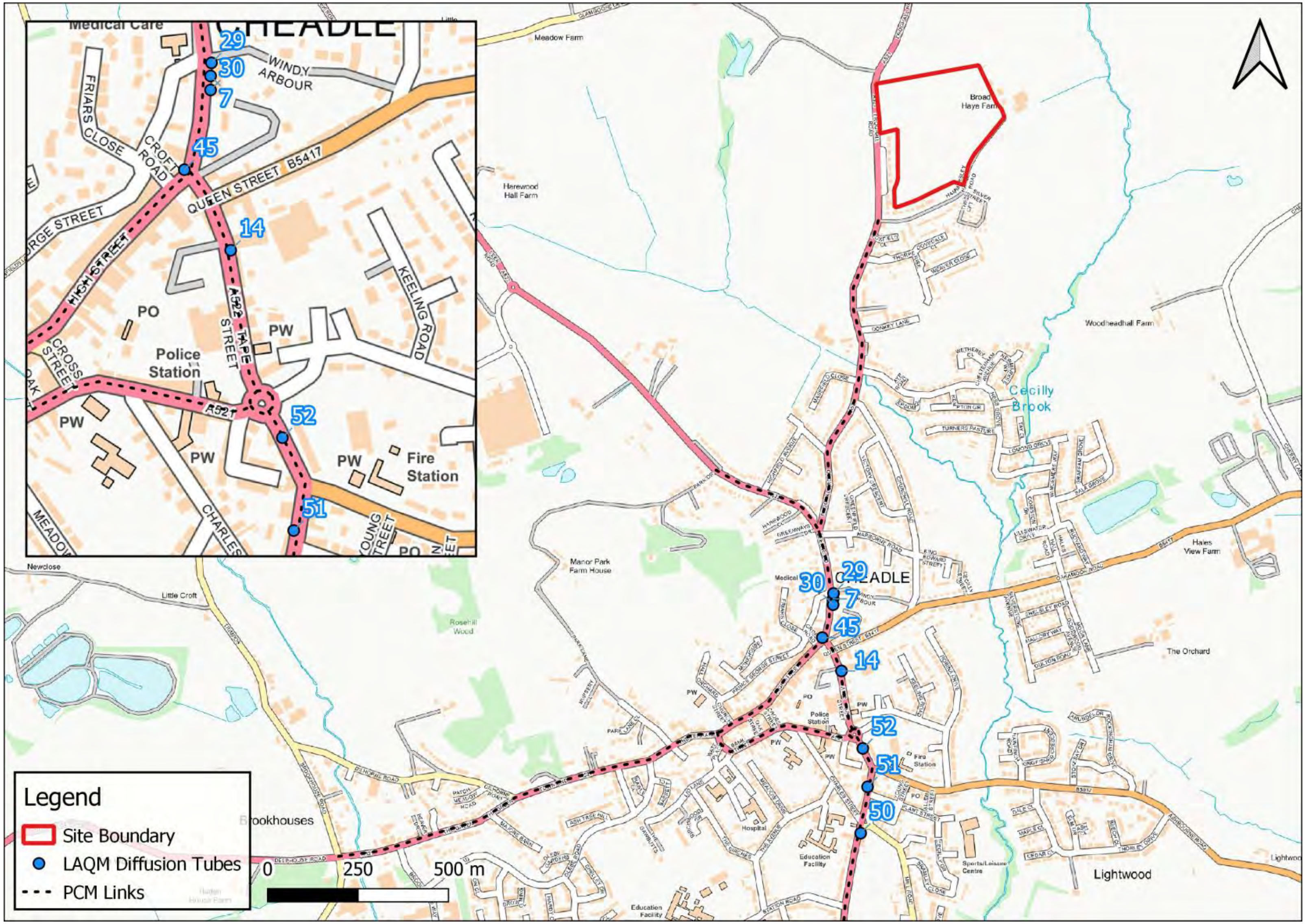

Figure 4-1
Site Setting and Local Monitoring Locations

4.1.3 DEFRA Mapped Background Concentrations

DEFRA maintains a nationwide model of existing and future background air quality concentrations at a 1km grid square resolution which is routinely used to support LAQM requirements and air quality assessments. The data sets include annual average concentration estimates for NOx, NO_2, PM_{10} and $PM_{2.5}$ using a base year of 2018 (the year in which comparisons between modelled and monitoring are made).

Annual mean background concentrations of NOx, NO_2, PM_{10} and $PM_{2.5}$ have been obtained from the DEFRA published background maps (2018 base year), based on the 1km grid squares which cover the modelled domain. The DEFRA mapped background concentrations for base year of 2019 and the predicted opening year of the development (2023) are presented in Table 4-3.

All of the mapped background concentrations presented are well below the respective annual mean AQALs.

Table 4-3
DEFRA Mapped Background Pollutant Concentrations

Grid Square (X, Y)	Year	Annual Mean Background Concentration (µg/m^3)			
		NOx	NO_2	PM_{10}	$PM_{2.5}$
x401500, y344500	2019	10.1	7.8	10.3	6.9
	2023	8.7	6.8	9.7	6.5
x401500, y345500	2019	9.2	7.2	10.2	6.6
	2023	8.0	6.3	9.7	6.2
x400500, y343500	2019	12.4	9.5	10.7	7.2
	2023	10.7	8.3	10.2	6.8
AQAL		***-***	***40***	***40***	***25***

4.1.4 Defra's Pollutant Climate Mapping Model

DEFRA's Pollutant Climate Mapping (PCM) model is a collection of models designed to fulfil part of the UK's AQSR requirements to report on the concentrations of particular pollutions in the atmosphere. The latest PCM model data, released by Defra in 2020, has modelled concentrations incorporating Defra's 2018 action plan (2018 reference year), up until 2030 taking into account the anticipated uptake of cleaner vehicles, along with other policy interventions.

The nearest PCM link to the Site (Census ID 802026168) is located approximately 60m south-west of the Site along A521 Froghall Road (see Figure 4-1). The 2019 roadside annual mean NO_2 concentration reported in relation to this PCM link is 11.4µg/m^3, and 9.1µg/m^3 in 2023 (the predicted opening year of development) – both 'well below' the AQAL (40µg/m^3). Concentrations reported by the PCM assume roadside locations, typically at a 4m separation distance. Proposed residential dwellings are expected to be set at a greater separation distance in comparison, resulting in lower concentrations experienced by future occupants (with distance from road).

5.0 CONSTRUCTION PHASE ASSESSMENT

This section presents the potential air quality impacts and effects associated with the construction of the Proposed Development.

5.1 Construction Dust Assessment

Where figures relating to area and volume of the Site, approximate number of construction vehicles or distances to receptors are given, these relate to thresholds as defined in the IAQM guidance to guide the assessor to define the dust emissions magnitude and sensitivity of the area.

5.1.1 Assessment Screening

There are 'human receptors' within 350m of the Site but no designated habitat sites within 50m of the Site boundary or up to 500m of the Site entrance(s) / 50m of the roads anticipated to witness construction traffic movements. Therefore, an assessment of construction dust on human receptors, only, is required.

5.1.2 Potential Dust Emissions Magnitude

Demolition

The Site is currently vacant agricultural land with no buildings or structures that require demolition. As such, impacts associated with demolition have been screened out of this assessment.

Earthworks

The proposals comprise the construction of 228 residential units. However, in recognition of the phased construction of residential schemes, Site earthworks are not believed to be required over an area >10,000m^2 at any one given time. As such, the dust emission magnitude for earthworks is therefore initially considered to be 'medium'.

Construction

The total building volume associated with the Proposed Development is predicted to be >25,000m^3. However, in recognition of the phased construction of residential schemes, the total building volume associated with the Proposed Development is predicted to be <100,000m^3 at any one given time. As such, the dust emission magnitude for construction is therefore initially considered to be 'medium'.

Trackout

Construction vehicles are expected to access the Site off Froghall Road. No details are available at the time of assessment on the number of additional HDV movements associated with construction works. However, given the scale and nature of works required, it is considered unlikely that >50 HDV outward movements will occur in any worst-case day. In addition, the unpaved road length is likely to be <100m at any one given time as a result of phasing. The dust emission magnitude for trackout is therefore initially considered to be 'medium'.

Table 5-1
Potential Dust Emission Magnitude

Activity	Dust Emission Magnitude
Demolition	N/A
Earthworks	Medium
Construction	Medium
Trackout	Medium

5.1.3 Sensitivity of the Area

Dust Soiling Impacts

Overall, there are anticipated to be 10-100 existing residential properties (highly sensitive receptors) within 20m of the Site. In addition, there are believed to be 10-100 residential receptors within 50m of sections of Site accesses within 200m (commensurate of a medium site[17]) of the Site entrance – assuming construction traffic travels both north / south along Froghall Road.

The sensitivity of the area with respect to dust soiling effects on people and property in relation to demolition, earthworks, construction is therefore considered to be 'high' and trackout activities considered to be 'medium'.

Human Health Impacts

The maximum 2019 mapped background PM_{10} concentration (2018 base year) for the 1km^2 grid square centred on the Site is estimated to be 10.3µg/m^3 (i.e. falls into the <24µg/m^3 class). As discussed in Section 4.1.3, no local background PM_{10} monitoring exists within the development locale.

Given the above information regarding the number of residential receptors within 20m of the Site and within 200m from the Site entrance on access roads, the sensitivity of the area with respect to human health impacts in relation to earthworks, construction and trackout is therefore considered to be 'low'.

Table 5-2
Sensitivity of the Area

Potential Impact	Sensitivity of Surrounding Area		
	Earthworks	Construction	Trackout
Dust Soiling Impacts	High	High	Medium
Human Health Impacts	Low	Low	Low

5.1.4 Risk of Impacts (Unmitigated)

The outcome of the assessment of the potential 'magnitude of dust emissions', and the 'sensitivity of the area' are combined in Table 5-3 below to determine the risk of impact which is used to inform the selection of appropriate mitigation.

Table 5-3
Risk of Dust Impacts

Potential Impact	Earthworks	Construction	Trackout
Dust Soiling Impacts	Medium Risk	Medium Risk	Low Risk
Human Health Impacts	Low Risk	Low Risk	Low Risk

5.1.5 Mitigation

Following the construction dust assessment, the Site is found to be at worst 'Medium Risk' in relation to dust soiling effects on people and property and 'Low Risk' in relation to human health impacts (Table 5-3). However, potential dust effects during the construction phase are considered to be temporary in nature and may only arise at particular times (i.e. certain activities and/or meteorological conditions).

[17] As per the IAQM's 'Guidance on the Assessment of Dust from Demolition and Construction', without site-specific mitigation, trackout may occur along the public highway up to 500m from large sites, 200m from medium sites and 50m from small sites (determined by the calculated trackout dust emission magnitude), as measured from the site exit.

Nonetheless, commensurate with the above designation of dust risk, mitigation measures, as identified by IAQM guidance are required to ensure that any potential impacts arising from the construction phase of the Proposed Development are reduced and, where possible, completely removed. In accordance with IAQM guidance, providing effective mitigation measures are implemented, such as those outlined in Section 7.0, construction dust effects are considered to be 'not significant'.

Figure 5-1
Construction Dust Assessment Buffers

6.0 OPERATIONAL PHASE ASSESSMENT

This section presents the potential air quality impacts and effects associated with the operation of the Proposed Development.

Traffic data used for the purposes of the assessment was provided by Eddisons (Croft Transport Planning and Design). The Transport Assessment (TA) predicted a total 24-hour annual average daily traffic (AADT) of 1,185AADT, based upon 250 dwellings. The TA further provides trip distribution on the wider highway network. The trip distribution suggests that development flows on Froghall Road (north and south bound from the Site entrance) are above the EPUK & IAQM *'indicative criterion for assessment'* (i.e. >500 Light Duty Vehicles (LDV) as an AADT or >100 Heavy Duty Vehicles (HDV) as an AADT (for locations outside of an AQMA)). Beyond this link, development flows fall below the EPUK & IAQM *'indicative criterion for assessment'* and, as such, the assessment focusses on air quality impacts and effects on and adjacent to Froghall Road, with other links 'screened' in accordance with EPUK & IAQM guidance. At receptor locations adjacent to road links whereby change in development trips has been screened out from further assessment by reference to the *'indicative criterion for assessment'*, effects on air quality would be 'insignificant' in accordance with the EPUK & IAQM guidance.

It is important to note that the following scenarios utilise 2031 traffic flow data, as provided by the appointed transport consultants and discussed in Section 3.2.1. The assessment is therefore considered precautionary as these flows are not predicted to materialise in their entirety in 2023 (the Proposed Development opening year).

Figure 6-1 shows the modelled road links and sensitive receptor locations.

6.1 NO_2 Modelling Results

Table 6-1 presents the annual mean NO_2 concentrations predicted at all assessed receptor locations for the 2019 BC, 2023 DM and 2023 DS scenarios.

Table 6-1
Predicted Annual Mean NO_2 Concentrations – 2023 Development Opening Year

Receptor	Predicted Annual Mean NO_2 Concentration (µg/m^3)			% Change of AQAL	% of 2023 DS Relative to AQAL	EPUK & IAQM Impact Descriptor
	2019 BC	2023 DM	2023 DS			
R1	10.4	9.8	10.0	+0.5	25.0	Negligible
R2	10.9	10.3	10.5	+0.6	26.3	Negligible
R3	11.6	10.9	11.2	+0.6	28.0	Negligible
R4	10.6	9.9	10.1	+0.5	25.3	Negligible
R5	11.4	10.7	10.9	+0.6	27.3	Negligible
R6	13.9	13.5	13.9	+1.0	34.8	Negligible
R7	12.9	12.4	12.8	+0.8	32.0	Negligible
R8	13.6	13.1	13.5	+0.9	33.8	Negligible
R9	12.4	11.7	12.0	+0.7	30.0	Negligible
R10	10.8	9.6	9.8	+0.4	24.5	Negligible
R11	12.2	10.7	10.9	+0.4	27.3	Negligible
R12	15.0	13.0	13.3	+0.7	33.3	Negligible
R13	21.3	17.7	18.0	+0.8	45.0	Negligible
R14	22.0	18.0	18.2	+0.5	45.5	Negligible

Receptor	Predicted Annual Mean NO_2 Concentration ($\mu g/m^3$)			% Change of AQAL	% of 2023 DS Relative to AQAL	EPUK & IAQM Impact Descriptor
	2019 BC	2023 DM	2023 DS			
R15	17.3	14.1	14.2	+0.3	35.5	Negligible
DT29	41.8	34.0	34.4	+1.1	86.0	Negligible
DT7	38.4	31.2	31.6	+1.0	79.0	Negligible
DT30	37.3	30.1	30.5	+1.0	76.3	Negligible

The maximum predicted annual mean NO_2 concentration at all receptors during the 2019 BC scenario was at receptor R14 with a predicted concentration of 22.0$\mu g/m^3$; representing 55% of the AQAL. Receptor R14 is located at the façade of a residential property along the A522 Leek Road. Diffusion tube 29 represents the highest overall predicted annual mean NO_2 concentration during the 2019 BC scenario with a predicted concentration of 41.8$\mu g/m^3$. Diffusion tube 29 is deployed at a location of relevant exposure (on the façade of a residential property along the A522 Leek Road), but placed higher than 1.5m above ground level. Diffusion tube DT29 is located within a street canyon and on a gradient, resulting in higher emission rates and reduced dispersion, resulting in the higher predicted concentrations. However, an analysis of the monitoring data at the DT29 diffusion location (as presented in Table 4-2) indicates 2019 monitored annual mean NO_2 concentrations are lower than the AQAL (monitored concentration of 39.7$\mu g/m^3$) and therefore the dispersion model is overpredicting concentrations at this location in the 2019 BC scenario.

The maximum predicted annual mean NO_2 concentration at all receptors with the development in place (2023 DS) was at R14 with a predicted concentration of 18.2$\mu g/m^3$, representing 45.5% of the AQAL, considered to be 'well below' the annual mean AQAL. The change in the annual mean NO_2 concentration at this location, due to the Proposed Development (i.e. 2023 DS vs. 2023 DM) relative to the AQAL was 0.5% (i.e. +0.2$\mu g/m^3$). However, the receptor with the greatest predicted change in concentration is R6; a residential property on Froghall Road (south of the Site entrance) (i.e. +0.4$\mu g/m^3$). Again, the overall highest predicted concentration and greatest predicted change in concentration is found at diffusion tube DT29 with a 2023 DS concentration of 34.4$\mu g/m^3$ (i.e. 86% of the AQAL) and a change in concentration of 1.1% relative to the AQAL.

In accordance with EPUK & IAQM guidance, the impact of the development on annual mean NO_2 concentrations at all assessed existing receptors is considered to be 'negligible'. Given the marginal increase in annual mean NO_2 concentrations associated with the Proposed Development, and that there are no predicted exceedences of the annual mean NO_2 AQAL in 2023 Proposed Development opening year, unmitigated effects associated with annual mean NO_2 concentrations at all assessed receptor locations are therefore considered to be 'not significant'.

The empirical relationship given in LAQM.TG(16) states that exceedences of the 1-hour mean NO_2 AQAL are unlikely to occur where annual mean concentrations are <60$\mu g/m^3$. Annual mean NO_2 concentrations predicted at all receptor locations are well below this limit. Therefore, it is unlikely that an exceedance of the 1-hour mean AQAL will occur. Effects associated with likely 1-hour mean NO_2 concentrations at all assessed receptor locations (including those on Site) are therefore considered to be 'not significant'.

6.2 PM_{10} Modelling Results

Table 6-2 presents the annual mean PM_{10} concentrations predicted at all assessed receptor locations of relevant exposure for the 2019 BC, 2023 DM and 2023 DS scenarios.

Table 6-2
Predicted Annual Mean PM_{10} Concentrations – 2023 Development Opening Year

Receptor	Predicted Annual Mean PM_{10} Concentration ($\mu g/m^3$)			% Change of AQAL	% of 2023 DS Relative to AQAL	EPUK & IAQM Impact Descriptor
	2019 BC	2023 DM	2023 DS			
R1	10.9	10.7	10.8	+0.1	27.0	Negligible
R2	11.0	10.9	11.0	+0.2	27.5	Negligible
R3	11.0	11.0	11.1	+0.2	27.8	Negligible
R4	10.8	10.6	10.7	+0.1	26.8	Negligible
R5	11.0	10.8	10.9	+0.2	27.3	Negligible
R6	11.5	11.6	11.7	+0.3	29.3	Negligible
R7	11.3	11.3	11.4	+0.2	28.5	Negligible
R8	11.4	11.5	11.6	+0.3	29.0	Negligible
R9	11.2	11.1	11.2	+0.2	28.0	Negligible
R10	10.9	10.5	10.6	+0.1	26.5	Negligible
R11	11.4	11.0	11.0	+0.1	27.5	Negligible
R12	11.9	11.6	11.7	+0.2	29.3	Negligible
R13	13.1	12.9	13.0	+0.2	32.5	Negligible
R14	13.3	13.0	13.1	+0.1	32.8	Negligible
R15	12.4	12.0	12.0	+<0.1	30.0	Negligible

The maximum predicted annual mean PM_{10} concentration at all receptors during the 2019 BC scenario was at Receptor R14 with a predicted concentration of 13.3$\mu g/m^3$, representing 33.3% of the AQAL and therefore considered to be 'well-below'.

The maximum predicted annual mean PM_{10} concentration at existing receptors with the development in place (2023 DS) was at Receptor R14 with a predicted concentration of 13.1$\mu g/m^3$; this represents 32.8% of the AQAL. The change in the annual mean PM_{10} concentration at this location, due to the Proposed Development (2023 DS vs. 2023 DM) relative to the AQAL was 0.1% (i.e. +0.1$\mu g/m^3$). However, the receptors with the greatest predicted change in concentration are R6 and R8 (R8 being a residential property on Froghall Road south of the Site entrance (i.e. 0.3% relative to the AQAL) at both receptors.

In accordance with EPUK & IAQM guidance, the impact of the development on annual mean PM_{10} concentrations at all assessed existing receptors is considered to be 'negligible'. Given the marginal increase in annual mean PM_{10} concentrations associated with the Proposed Development, and that there are no predicted exceedences of the annual mean PM_{10} AQAL, unmitigated effects associated with annual mean PM_{10} concentrations at all assessed receptor locations are therefore considered to be 'not significant'.

Based upon the maximum predicted annual mean PM_{10} concentrations at all existing receptors, there are predicted to be no days where 24-hour mean PM_{10} concentrations are predicted to be greater than 50$\mu g/m^3$. Effects associated with likely 24-hour mean PM_{10} concentrations at all assessed receptor locations are therefore considered to be 'not significant'.

6.3 $PM_{2.5}$ Modelling Results

Table 6-3 presents the annual mean $PM_{2.5}$ concentrations predicted at all assessed receptor locations of relevant exposure for the 2019 BC, 2023 DM and 2023 DS scenarios.

Table 6-3
Predicted Annual Mean $PM_{2.5}$ Concentrations – 2023 Development Opening Year

Receptor	Predicted Annual Mean $PM_{2.5}$ Concentration ($\mu g/m^3$)			% Change of AQAL	% of 2023 DS Relative to AQAL	EPUK & IAQM Impact Descriptor
	2019 BC	2023 DM	2023 DS			
R1	7.0	6.8	6.9	+0.1	27.6	Negligible
R2	7.1	6.9	7.0	+0.2	28.0	Negligible
R3	7.1	7.0	7.0	+0.2	28.0	Negligible
R4	7.2	7.0	7.0	+0.1	28.0	Negligible
R5	7.3	7.1	7.1	+0.1	28.4	Negligible
R6	7.6	7.5	7.6	+0.2	30.4	Negligible
R7	7.5	7.3	7.4	+0.2	29.6	Negligible
R8	7.5	7.4	7.5	+0.2	30.0	Negligible
R9	7.4	7.2	7.3	+0.2	29.2	Negligible
R10	7.2	6.9	6.9	+0.1	27.6	Negligible
R11	7.6	7.2	7.3	+0.1	29.2	Negligible
R12	7.9	7.6	7.6	+0.2	30.4	Negligible
R13	8.6	8.3	8.4	+0.2	33.6	Negligible
R14	8.7	8.4	8.4	+0.1	33.6	Negligible
R15	8.2	7.8	7.8	+<0.1	31.2	Negligible

The maximum predicted annual mean $PM_{2.5}$ concentration at all receptors during the 2019 BC scenario was at Receptor R14 with a predicted concentration of 8.7$\mu g/m^3$, representing 34.8% of the AQAL.

The maximum predicted annual mean $PM_{2.5}$ concentration at existing receptors with the development in place (2023 DS) was at Receptor R13 and R14 with a predicted concentration of 8.4$\mu g/m^3$ at both; representing 33.6% of the AQAL. The change in the annual mean $PM_{2.5}$ concentration at R13, due to the Proposed Development (2023 DS vs. 2023 DM) relative to the AQAL was 0.2% (i.e. +0.1$\mu g/m^3$).

In accordance with EPUK & IAQM guidance, the impact of the development on annual mean $PM_{2.5}$ concentrations at all assessed existing receptors is considered to be 'negligible'. Given the marginal increase in annual mean $PM_{2.5}$ concentrations associated with the Proposed Development, and that there are no predicted exceedences of the annual mean $PM_{2.5}$ AQAL, unmitigated effects associated with annual mean $PM_{2.5}$ concentrations at all assessed receptor locations are therefore considered to be a 'not significant' effect.

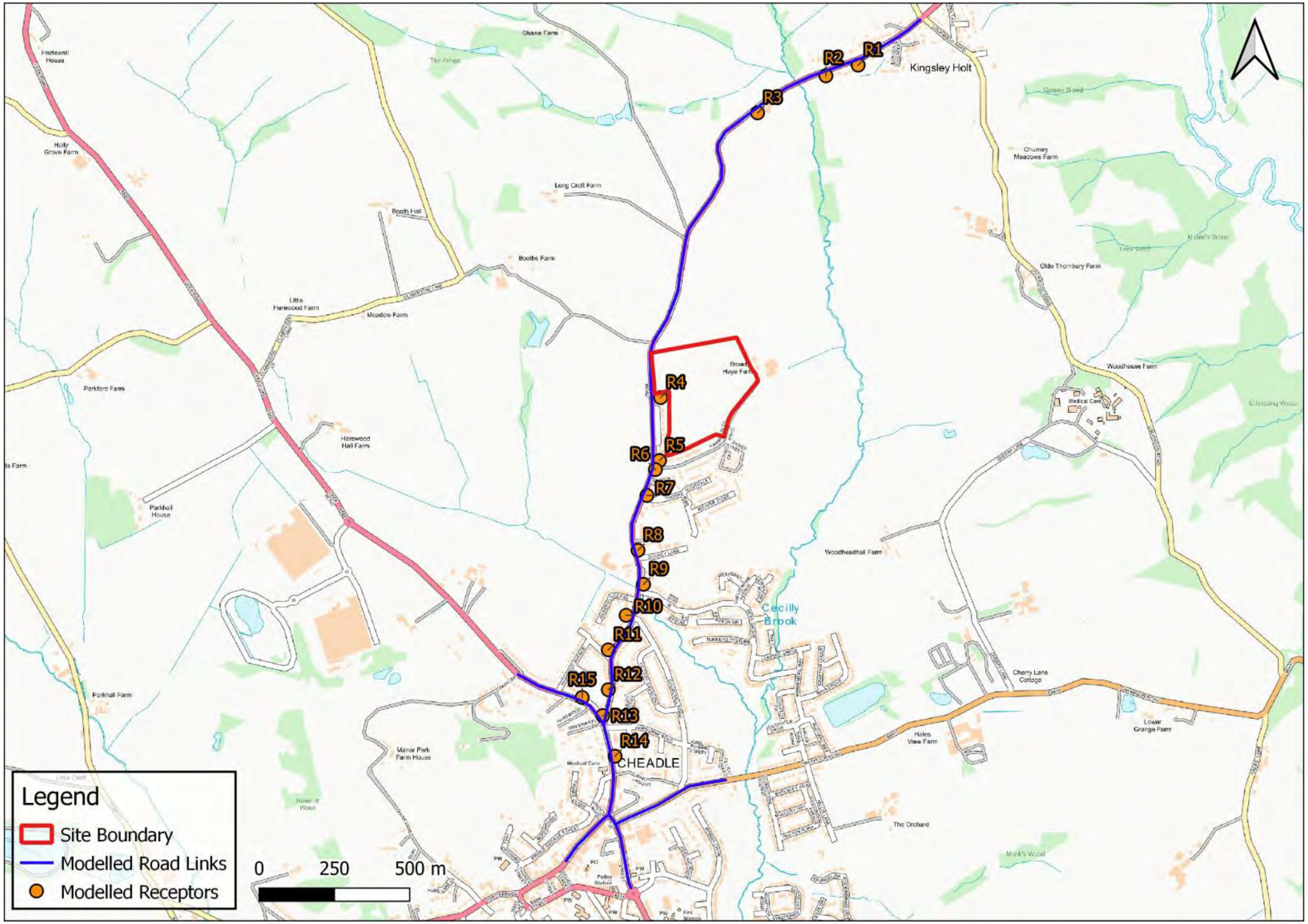

Figure 6-1
Modelled Road Links and Receptor Locations

7.0 MITIGATION MEASURES

This section presents any proportionate mitigation measures required during the construction and operational phases of the Proposed Development.

7.1 Construction Dust

As discussed in Section 5.0, construction impacts associated to the Proposed Development would result in the generation of dust and PM_{10}.

IAQM guidance outlines a number of Site-specific mitigation measures based on the assessed risk. The measures are grouped into those which are highly recommended and those which are desirable. With the effective application of the dust mitigation measures, as detailed in Table 7-1, residual effects will be 'not significant'. Mitigation measures can be secured by planning condition.

Table 7-1
Construction Dust Mitigation Measures

Site Application	Mitigation Measures
Highly Recommended	
Communications	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.
	Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.
	Display the head or regional office contact information.
	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The level of detail will depend on the risk, and should include as a minimum the highly recommended measures in this document. The desirable measures should be included as appropriate for the site.
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.
Monitoring	Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked.
	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
	Agree dust deposition, dust flux, or real-time PM_{10} continuous monitoring locations with the Local Authority. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction.
Operating Vehicle/Machinery	Ensure all vehicles 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.

Site Application	Mitigation Measures
and Sustainable Travel	Produce a Construction Logistics Plan 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.
Preparing and Maintaining the Site	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.
	Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.
	Avoid site 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 as described below.
	Cover, seed or fence stockpiles to prevent wind whipping.
Site Management	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
	Make the complaints log available to the local authority when asked.
	Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the logbook.
	Hold regular liaison meetings with other high risk construction sites within 500m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport deliveries which might be using the same strategic road network routes.
Waste Management	Avoid bonfires and burning of waste materials.
Desirable	
Construction	Avoid scabbling (roughening of concrete surfaces) if possible.
	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.

Site Application	Mitigation Measures
	For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust.
Earthworks	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.
	Use Hessian, mulches or tackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable
	Only remove the cover in small areas during work and not all at once.
Monitoring	Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and windowsills within 100m of site boundary, with cleaning to be provided if necessary.
	With respect to operating vehicle/machinery and sustainable travel:
	Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate).
	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).
Trackout	Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.
	Avoid dry sweeping of large areas.
	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 logbook.
	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).

7.2 Construction Phase Plant Emissions

During the construction phase Non-road Mobile Machinery (NRMM) and plant shall be well maintained; if any emissions of dark smoke occur then the relevant machinery should stop immediately and any problem rectified. In addition, the following controls should apply to NRMM:

- all NRMM should use fuel equivalent to ultralow sulphur diesel;
- all NRMM should comply with either the current or previous EU Directive Staged Emission Standards;
- all NRMM should be fitted with Diesel Particulate Filters (DPF) conforming to defined and demonstrated filtration efficiency (load/duty cycle permitting);
- the on-going conformity of plant retrofitted with DPF, to a defined performance standard; and

- implementation of fuel conservation measures including instructions to throttle down or switch off idle construction equipment; switch off the engines of trucks while they are waiting to access the site and while they are being loaded or unloaded, ensure equipment is properly maintained to ensure efficient fuel consumption.

Successful implementation of the above relevant mitigation measures would ensure that emissions from the construction phase and NRMM used during construction phase result in a 'not significant' effect on air quality.

7.3 Construction Phase – Vehicular Pollutants

Information on traffic movements anticipated during construction works was unavailable for the completion of the Air Quality Assessment. However, the development quantum is not anticipated to result in a significant increase in movements above the EPUK & IAQM criterion and the duration of movements will be short-term in nature. Therefore, in accordance with the criterion presented within EPUK & IAQM guidance, additional road vehicle trips during the construction phase '*can be considered to have insignificant effects*' on air quality.

7.4 Operational Phase Road Traffic Emissions

An assessment of vehicle emissions associated with the operation of the scheme predicted the unmitigated impact on annual mean NO_2 and PM_{10} concentrations to be 'negligible' at all considered receptors resulting in an overall 'not significant' effect on air quality.

The appointed transport consultants for the Proposed Development have created a Travel Plan Framework[18], within which contains a number of mitigation measures which would help to improve air quality in the locale by reducing reliance upon car movements to and from the Site. These measures include:

- a Travel Plan Co-ordinator (TPC) – an appointed individual and/or entity to manage the day to day running of the Travel Plan and to organise residents travel surveys, as well as the promotion of sustainable transport options available to residents including public transport, cycling, walking and car sharing schemes;
- residents Travel Plan 'Welcome Pack' – to encourage the use of sustainable modes of transport from the inception of the development;
- travel awareness and information – all residents to be made aware of the Travel Plan and the sustainable modes of transport within;
- promotion of car sharing scheme - the TPC will promote the use of car sharing and encourage residents to register on the Car Share website;
- encouraging walking/cycling – residents will be provided with information and advice concerning safe pedestrian and cycle routes to the site through the provision of the Resident's Travel Pack; and
- establish a Bike Users Club (BUC) – the Travel Pack will include information on any cycle user groups operating in the vicinity of the site as well as information on cycle routes and facilities in the area

[18] Eddisons (Croft Transport Planning and Design), Proposed Residential Development, Land off Froghall Road, Cheadle – Travel Plan Framework, July 2021

8.0 CONCLUSIONS

SLR Consulting has been commissioned to undertake an assessment of potential air quality impacts of a proposed residential development on land to the east of Froghall Road, Cheadle, Stoke-on-Trent, comprising 250 residential units.

8.1 Construction Phase

A qualitative assessment of the potential dust impacts during the construction of the Proposed Development has been undertaken following IAQM guidance.

Following the construction dust assessment, the Site is found to be at worst 'Medium Risk' in relation to dust soiling effects on people and property, and 'Low Risk' human health impacts. Providing effective mitigation measures are implemented, such as those outlined in Section 7.1 of this report, residual impacts from dust emissions during the construction phase would be 'not significant'.

Given the short-term nature of the construction phase and the comparatively low volume of vehicle movements that will likely arise (when compared to the operational phase, for which a full assessment has been undertaken), there is predicted to be an insignificant effect on air quality from construction-generated vehicle emissions.

8.2 Operational Phase

The assessment of operational phase effects considered impacts on all relevant receptors from road traffic emissions associated with the Proposed Development.

The ADMS-Roads dispersion model was used to determine the likely NO_2, PM_{10} and $PM_{2.5}$ concentrations at all assessed receptor locations for a series of scenarios, in accordance with technical guidance presented in LAQM.TG(16). Predicted pollutant concentration changes relevant receptor locations as a result of the Proposed Development were assessed using the EPUK & IAQM significance criteria.

In accordance with EPUK & IAQM guidance, the impacts of the Proposed Development on NO_2, PM_{10} and $PM_{2.5}$ concentrations at all assessed receptor locations are considered to be 'negligible'. Unmitigated effects associated with NO_2, PM_{10} and $PM_{2.5}$ concentrations at all assessed receptor locations are therefore considered 'not significant'.

APPENDIX A – Advanced Model Input and Verification

Advanced Model Input Summary

Advanced modelling input parameters used (not previously disclosed) are summarised in Table A-1.

Table A-1
Advanced Modelling Inputs

Parameter	Input Variable
Surface Roughness	A roughness length z0 of 0.5m was used to represent the surface roughness of the principal study area – i.e. open suburbia.
	A roughness length z0 of 0.2m was used to represent the surface roughness of the meteorological site – i.e. agricultural areas (min).
Urban Canyons	Urban canyons included along: • A522 – Leek Road; and • Highstreet.

Traffic Data

Table A-2 details the traffic data used within the assessment. It is important to note that the traffic flows provided by the appointed transport consultants represented 2031 flows to align with the Cheadle town centre VISSIM modelling undertaken by Amey in support of the Cheadle North Strategic Development Area application to the south. The VISSIM model was produced to identify the cumulative effects of the trip generation associated with the future housing and employment developments proposed in the Staffordshire Moorlands Local Plan. As such, utilising 2031 traffic flows is considered highly conservative for a 2023 operational year.

Table A-2
Traffic Data Used Within the Assessment

Link		2019 BC		2023DM		2023DS		Speed (kph) [(A)]
ID	Description	AADT	% HDV	AADT	% HDV	AADT	% HDV	
L1	Froghall Road – South of Site entrance	6,620	3	9,995	6	10,611	6	48
L1a	Froghall Road – South of Churchill Road, North of Froghall Road/Leek Road junction	6,620	3	8,795	3	9,385	3	48
L2	Froghall Road – North of Site entrance	6,620	3	9,995	6	10,564	6	96/64
L3	Leek Road West – North of Froghall Road/Leek Road junction	10,418	6	11,827	6	11,998	6	48

Link		2019 BC		2023DM		2023DS		Speed (kph) (A)
ID	Description	AADT	% HDV	AADT	% HDV	AADT	% HDV	
L4	Leek Road East – South of Froghall Road/Leek Road junction	16,318	6	18,906	6	19,344	6	48
L5	Highstreet	4,202	5	7957	2	8,046	2	20
L6a	Tape Street – Between Leek Road/Tape Street/High Street roundabout and Tape Street/Queen Street junction	12,914	4	16,733	0	17,083	0	48
L6b	Tape Street – Between Leek Street/Queen Street Junction and Tape Street/Chapel Street/Well Street roundabout	12,914	4	19,241	1	19,591	1	48
L7	Queen Street	5,317	3	3002	2	3002	2	48
RNDBT	Leek Road/Tape Street/Highstreet roundabout	16,717	5	21,798	3	22,236	3	20
Note: (A) Speeds based upon National Speed Limits. Traffic speeds have been adjusted to take into account queues and congestion in accordance with LAQM.TG(16).								

Model Verification

The ADMS-Roads dispersion model has been widely validated for this type of assessment and is specifically listed in the DEFRA's LAQM.TG(16) guidance as an accepted dispersion model.

Model validation undertaken by the software developer (CERC) will not have included validation in the vicinity of the Site. It is therefore necessary to perform a comparison of modelled results with local monitoring data at relevant locations. This process of verification attempts to minimise modelling uncertainty and systematic error by correcting modelled results by an adjustment factor to gain greater confidence in the final results.

Prior to undertaking model verification, model setup parameters and input data were reviewed to maximise the performance of the dispersion model in relation to the real-world conditions.

NOx / NO_2 Verification

NOx / NO_2 verification, relates to the comparison and adjustment of modelled road-NOx (as output from the ADMS-Roads dispersion model), relative to monitored road-NO_x.

For NOx / NO_2 model verification, 2019 LAQM SMDC monitoring data has been used (Table A-3). These locations are situated along the A522 and are the closest roadside monitors with sufficient traffic data relative to the Site.

Table A-3
Local Monitoring Data Available for Model Verification

Site ID	X	Y	2019 Monitored NO_2 Concentration ($\mu g/m^3$)	2019 Data Capture (%)
DT29	400968	343579	39.7	100%
DT7	400967	343564	36.2	100%
DT30	400967	343548	35.5	92%
DT45	400937	343457	35.3	83%
DT14	400990	343365	26.6	100%

As NO_2 concentrations are solely reported using diffusion tubes, NOx was back calculated using the latest version of DEFRA's NOx to NO_2 Calculator (v8.1). The NOx to NO_2 Calculator was also used to facilitate the conversion of modelled road-NOx (as output from the ADMS-Roads dispersion model) into road-NO_2.

Verification was completed using the 2019 DEFRA background mapped concentrations (2018 base year) for the relevant 1km x 1km grid squares (i.e. those within which the model verification locations are located).

Comparison of the modelled vs. monitored road NOx contribution at the relevant verification locations is provided in Table A-4. An adjustment factor of 2.231 has been derived, based on a linear regression forced through zero, as shown in Figure A-1. No further improvement to the ADMS-Roads dispersion model could be achieved.

Table A-4
NOx / NO_2 Model Verification (2.231)

Site ID	Ratio (Monitored vs. Modelled Road NO_x)	Adjustment Factor	Adjusted Modelled Total NO_2 ($\mu g/m^3$)	Monitored Total NO_2 ($\mu g/m^3$)	% Difference (Adjusted Modelled NO_2 vs Monitored NO_2)
DT29	2.1	2.231	41.8	39.7	+5.2
DT7	2.1		37.3	35.5	+5.2
DT30	2.0		38.4	36.2	+6.0
DT45	3.4		27.0	35.3	-23.7
DT14	3.1		21.9	26.6	-17.7

LAQM.TG(16) states that:

> "*In order to provide more confidence in the model predictions and the decisions based on these, the majority of results should be within 25% of the monitored concentrations as a minimum, preferably within 10%*".

As noted in Table A-4, the difference between the adjusted modelled NO_2 and monitored NO_2 is within ±25% at all verification locations and therefore within LAQM.TG(16) prescribed limit. In addition, a verification factor of 2.231 reduces the Root Mean Square Error (RMSE) from a value of 14.4$\mu g/m^3$ to 4.6$\mu g/m^3$ (11.4% of the annual mean AQAL) – within the ideal LAQM.TG(16) prescribed limit. On this basis, the derived verification factor (2.231) was considered acceptable and was subsequently applied to all road-NOx concentrations predicted (as output of the ADMS Roads dispersion model).

PM_{10} / $PM_{2.5}$ Verification

The calculated NOx adjustment factor of 2.231 was also applied to road-PM_{10} and $PM_{2.5}$ concentrations (as output of the ADMS Roads dispersion model), following the recommendations of LAQM.TG(16) guidance, in the absence of local particulate monitoring.

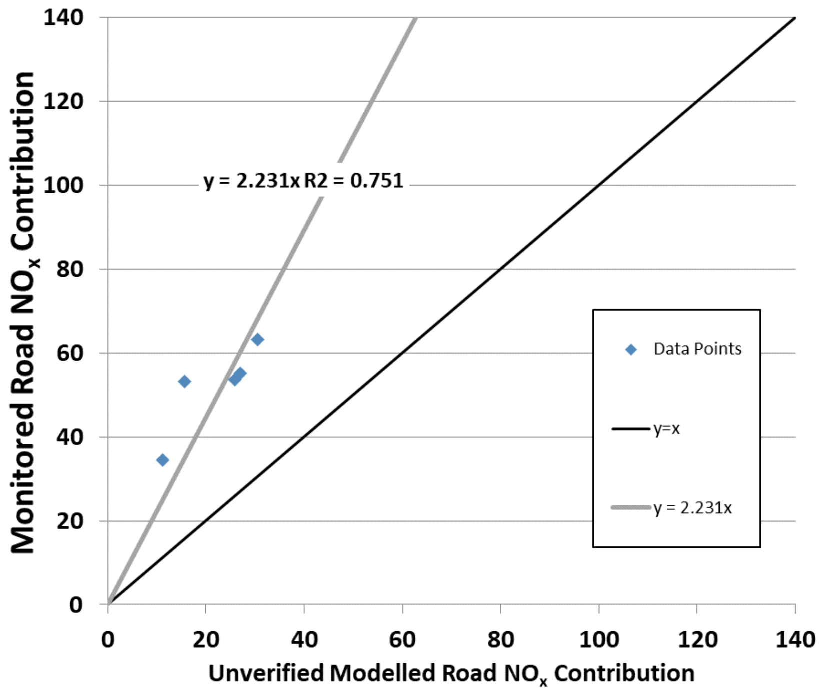

Figure A-1
Comparison of Modelled vs. Monitored Road NO_x Contribution (2.231)

APPENDIX B – Sensitivity Analysis

In consideration of the potential uncertainty in predictions of future year pollutants, as well as the current national and local sensitivities seen in response to elevated roadside NO_2 concentrations, an additional scenario has been assessed (as described in Section 3.2.7) which considers:

- 2019 NOx / NO_2, background concentrations (2018 reference year); and
- 2019 NOx emission factors obtained from EFT v10.1.

Use of these variables therefore assumes that there is no improvement in either emission factors and / or background concentrations within SMDC for future years, relative to 2019. These modelled scenarios are likely to represent an overly conservative approach as, despite uncertainty in quantification, it is generally accepted that variables such as background concentrations and / or vehicle emission factors will improve to some degree in future years, with local monitoring trends somewhat supporting this (see Section 4.1.1).

The results of this sensitivity assessment with respect to annual mean NO_2 concentrations are presented in Table B-1 below. Any exceedences are displayed in bold text.

Table B-1
Predicted Annual Mean NO_2 Concentrations: Sensitivity Test

Receptor	Predicted Annual Mean NO_2 Concentration (µg/m³)			% Change of AQAL	% of 2019 DS Relative to AQAL	EPUK & IAQM Impact Descriptor
	2019 BC	2019 DM	2019 DS			
R1	10.4	12.6	12.9	+0.8	32.3	Negligible
R2	10.9	13.4	13.7	+0.9	34.3	Negligible
R3	11.6	14.2	14.6	+1.0	36.5	Negligible
R4	10.6	12.5	12.8	+0.7	32.0	Negligible
R5	11.4	13.7	14.1	+0.9	35.3	Negligible
R6	13.9	17.8	18.3	+1.4	45.8	Negligible
R7	12.9	16.2	16.7	+1.3	41.8	Negligible
R8	13.6	17.2	17.7	+1.4	44.3	Negligible
R9	12.4	15.2	15.6	+1.1	39.0	Negligible
R10	10.8	12.1	12.3	+0.6	30.8	Negligible
R11	12.2	13.3	13.6	+0.6	34.0	Negligible
R12	15.0	16.7	17.1	+1.0	42.8	Negligible
R13	21.3	23.7	24.1	+1.2	60.3	Negligible
R14	22.0	24.0	24.3	+0.7	60.8	Negligible
R15	17.3	18.6	18.8	+0.4	47.0	Negligible
DT29	**41.8**	**46.1**	**46.7**	+1.4	116.8	Moderate (A)
DT7	37.3	**41.2**	**41.7**	+1.2	104.3	Moderate (A)
DT30	38.4	**42.3**	**42.8**	+1.3	107.0	Moderate (A)

The maximum predicted annual mean NO_2 concentration at all receptors with the development in place (2019 DS) was at Receptor R14 (residential property on A522 Leek Road) with a predicted concentration of 24.3µg/m³, representing 60.8% of the AQAL. The change in the annual mean NO_2 concentrations at this location, due to the Proposed Development (2019 DS vs. 2019 DM) relative to the AQAL was 0.7% (i.e. +0.3µg/m³).

The greatest predicted increase in annual mean NO_2 concentrations due to the Proposed Development (2019 DS vs. 2019 DM) relative to the AQAL was 1.4% at receptors R6 and R8.

The greatest overall predicted concentration (2019 DS) was at diffusion tube DT29 with a concentration of 46.7µg/m^3, representing 116.8% of the AQAL.

In accordance with EPUK & IAQM guidance, the impact of the development on annual mean NO_2 concentrations at all assessed existing receptors is considered to be 'negligible', with the exception of the diffusion tubes included within the assessment and which are of relevant exposure where the impact is considered to be 'moderate, adverse'. Given the overly-conservative methodology applied within the sensitivity assessment (i.e. 2031 traffic flows with no improvement in background concentrations or emission factors from 2019), unmitigated effects associated with case sensitivity annual mean NO_2 concentrations at all assessed receptor locations are therefore still considered to be 'not significant'.

The empirical relationship given in LAQM.TG(16) states that exceedences of the 1-hour mean AQAL for NO_2 are only likely to occur where annual mean concentrations are 60µg/m^3 or above. Annual mean NO_2 concentrations predicted at all receptor locations are well below this limit, despite the overly worst-case nature of the sensitivity assessment approach. Effects associated with case sensitivity 1-hour mean NO_2 concentrations at all assessed receptor locations are therefore considered to be 'not significant'.

EUROPEAN OFFICES

United Kingdom

AYLESBURY
T: +44 (0)1844 337380

BELFAST
belfast@slrconsulting.com

BRADFORD-ON-AVON
T: +44 (0)1225 309400

BRISTOL
T: +44 (0)117 906 4280

CARDIFF
T: +44 (0)29 2049 1010

CHELMSFORD
T: +44 (0)1245 392170

EDINBURGH
T: +44 (0)131 335 6830

EXETER
T: + 44 (0)1392 490152

GLASGOW
T: +44 (0)141 353 5037

GUILDFORD
T: +44 (0)1483 889800

LONDON
T: +44 (0)203 805 6418

MAIDSTONE
T: +44 (0)1622 609242

MANCHESTER (Media City)
T: +44 (0)161 872 7564

NEWCASTLE UPON TYNE
T: +44 (0)191 261 1966

NOTTINGHAM
T: +44 (0)115 964 7280

SHEFFIELD
T: +44 (0)114 245 5153

SHREWSBURY
T: +44 (0)1743 23 9250

STIRLING
T: +44 (0)1786 239900

WORCESTER
T: +44 (0)1905 751310

Ireland

DUBLIN
T: + 353 (0)1 296 4667

France

GRENOBLE
T: +33 (0)6 23 37 14 14