23 05 23 CAB AQAP Appendix v

Cheltenham Borough Council

Detailed Modelling Study

August 2022

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Purpose of Assessment

Bureau Veritas has been commissioned by Cheltenham Borough Council (the Council) to complete an updated Air Quality Action Plan (AQAP) for the Council's new Air Quality Management Area (AQMA). Currently there is one AQMA within Cheltenham, declared as a result of exceedances of the 40 µg/m^3 annual mean objective for Nitrogen Dioxide (NO_2). This AQMA encompasses a continuous stretch of road, spanning A4019 Tewkesbury Road, A4019 Poole Way and A4019 Swindon Road – north of the Town Centre. The aim of this Detailed Modelling Study is to increase the Councils' understanding of pollutant concentrations within Cheltenham, in order to provide technical input into the updated AQAP.

This AQMA was declared in September 2020, in response to an assessment undertaken by Bureau Veritas in 2019 which evaluated the monitored NO_2 annual mean exceedances across Cheltenham. This study demonstrated that exceedances had become more localised to an area north of the town centre and, based on these findings, the previous borough-wide AQMA was revoked, and the new AQMA declared in order to provide a focus for the application of a more targeted set of measures.

In order to provide technical input into an updated AQAP that will cover the area within the revised AQMA boundary, the air quality modelling completed for the 2019 detailed assessment (which used 2018 data) has been updated to account for 2019 traffic data, 2019 monitoring data and the latest Local Air Quality Management (LAQM) tools. While data is now available for 2020, a baseline 2019 year has been maintained so as to not take account of any data which may be significantly different from normal traffic years in 2020 as a result of the COVID-19 pandemic.

The updated Detailed Modelling Assessment focusses on the road network across Cheltenham to establish any changes in the spatial extent of NO_2 concentrations in order to identify any areas that are above, or within 10%, of the AQS annual mean objective. The area was modelled using the advanced atmospheric dispersion model ADMS-Roads (Version 5.0.0.1) and latest emissions from the Emissions Factors Toolkit (Version 10.1), with annual mean NO_2 concentration outputs produced at 249 discrete receptor locations, and across a borough-wide receptor grid.

Assessment Findings

Results show that the NO_2 annual mean AQS objective is observed to be exceeded at a total of 14 (5.6%) receptor locations, with 26 (10.4%) further locations within 10% of the objective. As expected, all discrete receptor locations which report annual mean NO_2 concentrations to be above or within 10% of the AQS objective, are located within the existing AQMA, or are limited to roadside locations of junctions where key arterial roads meet.

The highest annual mean concentrations of NO_2 was recorded at Receptor 60 with a concentration of 56.7µg/m^3. Receptor 60 is located within the AQMA, along a façade of a residential property which immediately fronts onto a stretch of the A4019 – High Street, susceptible to congestion due to the convergence of high capacity and town centre roads (M5, A4019 – Tewkesbury Road, A4019 – High Street, A4019 – Swindon Road and High Street). The junction's role as a major strategic connection within the region is believed to be the cause of the elevated NO_2 annual mean concentrations predicted at Receptor 60.

The empirical relationship given in LAQM.TG(16)[1] states that exceedances of the 1-hour mean objective for NO_2 are only likely to occur where annual mean concentrations are 60µg/m^3 or above. The NO_2 annual mean concentrations predicted at all receptors are below this hourly exceedance indicator, suggesting that hourly exceedance of the NO_2 AQS objective is unlikely.

The following areas were identified to report modelled concentrations in exceedance of the annual mean NO_2 AQS objective:

- Within the existing AQMA, the continuous stretch of road spanning A4019 Tewkesbury Road, A4019 Poole Way and A4019 Swindon Road north of the Town Centre; and
- Along stretches of other arterial roads connecting to the Town Centre (A4013 Princess Elizabeth Way, Benhall Roundabout, A46 London Road/Berkley Street intersection, and A46 Shurdington Road).

The following additional areas were identified to report modelled concentrations within 10% of the AQS objective:

- A4019 Fairview Road, A46 Clarence Road and Albion Street;
- A46 London Road;
- Bath Road;
- A40 Lansdowne Road/Suffolk Road intersection;
- A40 Gloucester Road/B4633 Gloucester Road intersection;
- A4013 Princess Elizabeth Way/Marsland Road/Edinburgh Place intersection.

Conclusions and Recommendations

Based on the conclusions of the assessment above, the following recommendations are made:

- Continue to monitor NO_2 across the Borough;
- Deploy and/or relocate existing monitoring within the Borough to the other locations predicted to be in exceedance, or near exceedance, of the NO_2 annual mean AQS objective limit, in order to validate modelled findings; and
- Based on source apportionment results, any future intervention measures should be targeted at reducing vehicle emissions from all vehicle types, notably Cars and LGVs, which are both observed to be the two largest contributors to total vehicle emissions in areas of exceedance.

Following the completion of this modelling exercise, it is hoped that the following topics can be discussed with air quality stakeholders to aid development of the AQAP:

- Possible action plan measures being considered by the Council; and
- Ability to test the effects of these measures using the current dispersion model set up.

1 Introduction

Bureau Veritas has been commissioned by Cheltenham Borough Council (the Council) to complete an updated Air Quality Action Plan (AQAP) for the Council's Air Quality Management Area (AQMA), declared in 2020. Currently there is one AQMA within Cheltenham, declared as a result of exceedances of the 40 µg/m^3 annual mean objective for Nitrogen Dioxide (NO_2). This AQMA encompasses a continuous stretch of road, spanning A4019 Tewkesbury Road, A4019 Poole Way and A4019 Swindon Road – north of the Town Centre.

Prior to this, a whole-borough AQMA had been in place. Cheltenham Whole Borough AQMA was declared on in November 2011 for the exceedance of the Nitrogen Dioxide (NO_2) annual mean UK Air Quality Strategy (AQS) objective of 40µg/m^3. This AQMA was declared in response to an assessment undertaken in 2011 which evaluated the monitored NO_2 annual mean exceedances across Cheltenham. As a result of the findings, an AQAP was published in 2014. Between 2014 and 2018, the Review and Assessment annual reporting process identified that NO_2 annual mean concentrations across the Borough appeared to have stabilised below the AQS objective limit, with exceedances localised to the north of the Town Centre during 2018, specifically along the A4019. This resulted in a detailed modelling assessment being undertaken by Bureau Veritas on behalf of the Council in 2019. Based on this assessment, the whole-borough AQMA was revoked on 15th September 2020 and the new AQMA declared.

In order to provide technical input into an updated AQAP that will cover the area within the revised AQMA boundary, the air quality modelling completed for the 2019 detailed assessment has been updated to account for 2019 traffic data, 2019 monitoring data and the latest Local Air Quality Management (LAQM) tools. This report details the findings of this updated analysis, and provides recommendation on matters related to NO_2 exceedances, in order to inform the update of the AQAP.

1.1 Scope of Assessment

It is the general purpose and intent of this assessment to determine, with reasonable certainty, the magnitude and geographical extent of any exceedances of the AQS objectives for NO_2, enabling the Council to provide for a focused consideration on updating measures as part of the revision of the AQAP.

The following are the objectives of the assessment:

- To assess the air quality at selected locations ("receptors") representative of worst-case exposure relative to the averaging period of focus (i.e. annual objective - façades of the existing residential units), based on modelling of emissions from road traffic on the local road network;
- To establish the spatial extent of any likely exceedances of the UK annual mean NO_2 AQS objective limit, and to identify the spatial extent of any areas within 10%;
- To establish the required reduction in emissions to comply with the UK AQS objectives; and
- To determine the relative contributions of various source types to the overall pollutant concentrations within the new AQMA, through source apportionment, in order to inform an updated AQAP.

The approach adopted in this assessment to assess the impact of road traffic emissions on air quality utilised the atmospheric dispersion model ADMS-Roads version 5.0.0.1, focusing on emissions of oxides of nitrogen (NO_x), which comprise of nitric oxide (NO) and nitrogen dioxide (NO_2). Particulate Matter emissions have also been considered for completeness.

In order to provide consistency with the Council's own work on air quality, the guiding principles for air quality assessments, as set out in the latest guidance provided by Defra for air quality assessment (LAQM.TG(16))[1], have been used.

[1] LAQM Technical Guidance LAQM.TG(22) – August 2022. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.

2 Air Quality – Legislative Context

2.1 Air Quality Strategy

The importance of existing and future pollutant concentrations can be assessed in relation to the national air quality standards and objectives established by Government. The Air Quality Strategy[2] (AQS) provides the over-arching strategic framework for air quality management in the UK and contains national air quality standards and objectives established by the UK Government and Devolved Administrations to protect human health. The air quality objectives incorporated in the AQS and the UK Legislation are derived from Limit Values prescribed in the EU Directives transposed into national legislation by Member States.

The CAFE (Clean Air for Europe) programme was initiated in the late 1990s to draw together previous directives into a single EU Directive on air quality. The CAFE Directive[3] has been adopted and replaces all previous air quality Directives, except the 4th Daughter Directive[4]. The Directive introduces new obligatory standards for $PM_{2.5}$ for Government but places no statutory duty on local government to work towards achievement of these standards.

The Air Quality Standards (England) Regulations[5] 2010 came into force on 11 June 2010 in order to align and bring together in one statutory instrument the Government's obligations to fulfil the requirements of the new CAFE Directive.

The objectives for ten pollutants – benzene (C_6H_6), 1,3-butadiene (C_4H_6), carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), particulate matter (PM_{10} and $PM_{2.5}$), ozone (O_3) and Polycyclic Aromatic Hydrocarbons (PAHs), have been prescribed within the AQS[2].

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. Typically, these include residential properties and schools/care homes for long-term (i.e. annual mean) pollutant objectives and high streets for short-term (i.e. 1-hour) pollutant objectives. Table 2.1 taken from LAQM TG(16)[1] provides an indication of those locations that may or may not be relevant for each averaging period.

This assessment focuses on NO_2 due to the significance this pollutant holds within the Council's administrative area - evidenced by the declared borough-wide AQMA. Moreover, as a result of traffic pollution the UK has failed to meet the EU Limit Values for this pollutant by the 2010 target date. As a result, the Government has had to submit time extension applications for compliance with the EU Limit Values, which has since passed and its continued failure to achieve these limits is currently giving rise to infraction procedures being implemented. The UK is not alone as the challenge of NO_2 compliance at EU level includes many other Member States.

In July 2017, the Government published its plan for tackling roadside NO_2 concentrations[6], to achieve compliance with EU Limit Values. This sets out Government policies for bringing NO_2 concentrations within statutory limits in the shortest time period possible. Furthermore, the Clean Air Strategy was published in 2019, which outlines how the UK will meet international commitments

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[2] Defra (2007), The Air Quality Strategy for England, Scotland, Wales and Northern Ireland.

[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 relating to arsenic, cadmium, mercury, nickel and polycyclic hydrocarbons in ambient air.

[5] The Air Quality Standards Regulations (England) 2010, Statutory Instrument No 1001, The Stationary Office Limited.
[6] Defra, DfT (2017), UK plan for tackling roadside nitrogen dioxide concentrations

to significantly reduce emissions of five damaging air pollutants by 2020 and 2030 under the adopted revised National Emissions Ceiling Directive (NECD).

The AQS objectives for these pollutants are presented in Table 2.2.

Table 2.1 – Examples of where the Air Quality Objectives should apply

Averaging Period	Objectives should apply at:	Objectives should generally not apply at:
Annual mean	All locations where members of the public might be regularly exposed. Building facades of residential properties, schools, hospitals, care homes etc.	Building facades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term
24-hour mean and 8-hour mean	All locations where the annual mean objectives would apply, together with hotels. Gardens or residential properties[1].	Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term.
1-hour mean	All locations where the annual mean and 24 and 8-hour mean objectives would apply. Kerbside sites (e.g. pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where the public might reasonably be expected to spend one hour or more. Any outdoor locations at which the public may be expected to spend one hour or longer.	Kerbside sites where the public would not be expected to have regular access.
15-minute mean	All locations where members of the public might reasonably be expected to spend a period of 15 minutes or longer.	

Note [1] For gardens and playgrounds, such locations should represent parts of the garden where relevant public exposure is likely, for example where there is seating or play areas. It is unlikely that relevant public exposure would occur at the extremities of the garden boundary, or in front gardens, although local judgement should always be applied.

Table 2.2 – Relevant AQS Objectives for the Assessed Pollutants in England

Pollutant	AQS Objective	Concentration Measured as:	Date for Achievement
Nitrogen dioxide (NO_2)	200 µg/m³ not to be exceeded more than 18 times per year	1-hour mean	31st December 2005
	40 µg/m³	Annual mean	31st December 2005
Particles (PM_{10})	50µg/m³ not to be exceeded more than 35 times a year	24-hour mean	31st December 2004
	40µg/m³	Annual Mean	31st December 2004

Particles ($PM_{2.5}$)	25µg/m³	Annual Mean	2020

2.2 Local Air Quality Management (LAQM)

Part IV of the Environment Act 1995[7] places a statutory duty on local authorities to periodically review and assess air quality within their area, and determine whether they are likely to meet the AQS objectives set down by Government for a number of pollutants – a process known as Local Air Quality Management (LAQM). The AQS objectives that apply to LAQM are defined for seven pollutants: benzene, 1,3-butadiene, CO, Pb, NO_2, SO_2 and Particulate Matter.

Local Authorities were formerly required to report on all of these pollutants, but following an update to the regime in 2016, the core of LAQM reporting is now focussed on the objectives of three pollutants; NO_2, PM_{10} and SO_2. Where the results of the Review and Assessment process highlight that problems in the attainment of the health-based objectives pertaining to the above pollutants will arise, the authority is required to declare an AQMA – a geographic area defined by high concentrations of pollution and exceedances of health-based standards.

The areas in which the AQS objectives apply are defined in the AQS as locations outside (i.e. at the façade) of 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 of the AQS objective.

Following any given declaration, the Local Authority is subsequently required to develop an Air Quality Action Plan (AQAP), which will contain measures to address the identified air quality issue and bring the location into compliance with the relevant objective as soon as possible.

One of the objectives of the LAQM regime is for local authorities to enhance integration of air quality into the planning process. Current LAQM Policy Guidance[8] recognises land-use planning as having a significant role in term of reducing population exposure to elevated pollutant concentrations. Generally, the decisions made on land-use allocation can play a major role in improving the health of the population, particularly at sensitive locations – such as schools, hospitals and dense residential areas.

[7] http://www.legislation.gov.uk/ukpga/1995/25/part/IV
[8] Local Air Quality Management Policy Guidance LAQM.PG(16). April 2016. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.

3 Review and Assessment of Air Quality Undertaken by the Council

3.1 Local Air Quality Management

The Council currently has one AQMA (Cheltenham Borough Council AQMA 2020), declared in September 2020 for the exceedance of the NO_2 annual mean UK AQS objective of 40µg/m^3. The AQMA, as shown in Figure 3-1, encompasses a continuous stretch of road (A4019) just north of the Town Centre and was declared in response to a detailed assessment undertaken by Bureau Veritas in 2019 which recommended the previous borough-wide AQMA be amended to cover this more localised area of exceedances.

The Council's 2019 Local Air Quality Management (LAQM) Annual Status Report (ASR) identified the need to review the previous borough-wide AQMA boundary as a result of monitored annual mean NO_2 concentrations over the past several years that demonstrated a localisation of exceedances to the north of the town centre. Bureau Veritas was commissioned to undertake a detailed dispersion modelling assessment in 2019 as the next step in the review process, to understand the full extent of exceedances and support potential amendments to the AQMA boundary. The most recent LAQM report completed by the Council was the 2021 ASR[9].

In order to provide technical input into the updated AQAP, the air quality modelling undertaken in 2019 has been updated to account for updated traffic data, monitoring data and the latest Local Air Quality Management (LAQM) tools. This report details the findings of this updated analysis, and provides recommendation on matters related to NO_2 exceedances, in order to inform a new targeted set of measures within the updated AQAP. This modelling assessment has used a baseline year of 2019 so as not to account for the unusual traffic patterns occurring in 2020 as a result of the COVID-19 pandemic.

3.2 Review of Air Quality Monitoring

3.2.1 Local Automatic Air Quality Monitoring

During 2019, the Council undertook automatic (continuous) monitoring at one site within Cheltenham (CM1). CM1 is located north of the Town Centre along the A4019 – Swindon Road, adjacent to the St George's Street intersection within the AQMA. CM1 solely monitors NO_2 via a chemiluminescent analyser.

Details of CM1 are provided in Table 3.1 and 2019 monitoring results are presented in Table 3.1, whilst the location of the monitoring site is illustrated in Figure 3-2.

Table 3.1 – Automatic Monitor CM1

Site ID	Site Location	Site Type	OS Grid Ref (E, N)	In AQMA	Pollutants Monitored	Inlet Height (m)
CM1	St Georges Street	Kerbside	394760, 222878	Yes	NO_2	1.3

[9] Cheltenham Borough Council (2020), 2020 Annual Status Report

Table 3.2 – Automatic Monitor CM1: NO_2 Annual Mean Concentrations

Site ID	Valid Data Capture for 2019 (%)	NO_2 Annual Mean Concentration (µg/m³)				
		2015	2016	2017	2018	2019
CM1	97.3%	35.0	34.0	36.0	32.7	36.0

Table 3.3 – Automatic Monitor CM1: Number of NO_2 Hourly Means Exceedances

Site ID	Valid Data Capture for 2018 (%)	Hourly Means in Excess of the 1-hour Objective (200 µg/m³)				
		2015	2016	2017	2018	2019
CM1	97.3	0	0	0	0	0

Whilst there were no recorded exceedances of either the annual mean or short term AQS objectives for NO_2 at CM1 between 2015 and 2019, annual mean NO_2 concentrations have been within 10% of the AQS objective limit in both 2017 and 2019. Hourly mean NO_2 concentrations recorded at CM1 have not reported an exceedance of 200µg/m³ within the past five years.

3.2.2 Local Non-Automatic Air Quality Monitoring

During 2019, the Council's non-automatic monitoring programme consisted of recording NO_2 concentrations using a network of 29 passive diffusion tubes – comprising 27 sites (with the provision of a triplicate co-location site). 25 of these locations are roadside sites and the remaining 2 are kerbside sites. Monitoring at Clarence Parade has been removed since 2018 and a new diffusion tube site installed (site 30) across the road on the same street, due to the diffusion tube often going missing at the original location.

The details of the diffusion tube monitoring within Cheltenham for 2019 are shown in Table 3.4, whereas results are presented in Table 3.4.

Table 3.4 – Cheltenham Borough Council LAQM Diffusion Tube Monitoring

Site ID	Site Location	Site Type	In AQMA	OS Grid Ref (X, Y)
1	Municipal Offices (Front)	R	Y	394757, 222320
2	Municipal Offices (Back)	R	Y	394724, 222320
3	Ladies College	R	Y	394621, 222215
4	2 Gloucester Road	R	Y	394237, 223006
5	422 High St	R	Y	394350, 222923
6	New Rutland	R	Y	394738, 222888
7,8,9	CM1 Co-location Study	R	Y	394760, 222878
10	2 Swindon Road	K	Y	394830, 222845
11	Portland Street	R	Y	395110, 222670
12	Winchcombe/Fairview	R	Y	395210, 222618
13	Albion Street (outside no. 54)	K	Y	395207, 222465
14	2 London Road	R	Y	395362, 222000
15	YMCA - High St	R	Y	395182, 222183
16	8a Bath Road	R	Y	395146, 222149
18	81 London Road	R	Y	395660, 221670

Site ID	Site Location	Site Type	In AQMA	OS Grid Ref (X, Y)
19	264 Gloucester Road	R	Y	393296, 222170
20	340 Gloucester Road	R	Y	392912, 221862
21	14 Imperial Square	R	Y	394809, 222060
22	Hatherley Lane	R	Y	391179, 221640
23	St James Square	R	Y	394577, 222424
24	St Gregory's Church	R	Y	394566, 222600
25	St Georges Street	R	Y	394708, 222763
26	St Pauls Road	R	Y	394902, 223004
27	St Luke's College Road	R	Y	395156, 221866
28	Princess Elizabeth Way North	R	Y	393081, 223643
29	Princess Elizabeth Way South	R	Y	392066, 222540
30	Clarence Parade Alternative Location	R	Y	394810, 222439

Table 3.5 – Cheltenham Borough Council LAQM Diffusion Tube Monitoring

Site ID	Valid Data Capture for 2019 (%)	Annual Mean NO_2 Concentration (µg/m^3)				
		2015	2016	2017	2018	2019
1	100.0	-	-	26.4	22.9	23.8
2	100.0	-	-	32.9	28.0	27.6
3	100.0	36.6	33.8	32.8	27.5	29.6
4	100.0	**46.5**	**43.2**	**45.4**	**41.2**	**43.1**
5	100.0	**47.3**	**45.5**	**49.9**	**45.2**	**46.5**
6	100.0	**42.4**	**40.8**	**41.6**	37.9	**40.3**
7,8,9	91.7	34.6	33.3	36.4	32.9	35.1
10	100.0	37.9	38.2	39.4	35.6	39.2
11	100.0	36.8	35.7	35.9	32.6	34.1
12	91.7	33.0	32.2	32.8	31.8	34.4
13	100.0	-	-	34.8	31.3	30.4
14	100.0	**40.0**	38.0	37.1	37.4	37.4
15	100.0	34.5	32.9	31.9	29.1	28.5
16	100.0	**41.1**	38.4	38.0	34.5	34.4
18	91.7	**41.4**	39.6	38.4	37.3	37.6
19	83.3	36.7	32.2	34.4	30.6	33.4
20	100.0	38.7	35.9	38.6	35.3	36.2
21	100.0	-	-	-	23.4	23.9
22	75.0	-	-	-	34.9	33.4
23	100.0	-	-	-	30.9	32.6
24	91.7	-	-	-	27.9	25.1
25	100.0	-	-	-	31.9	31.6
26	100.0	-	-	-	29.0	31.3
27	91.7	-	-	-	24.8	27.6
28	100.0	-	-	-	38.4	38.2

Site ID	Valid Data Capture for 2019 (%)	Annual Mean NO_2 Concentration (µg/m^3)				
		2015	2016	2017	2018	2019
29	100.0	-	-	-	31.2	33.7
30*	58.3	-	-	-	-	31.6

Notes
* Annualisation performed due to data capture <75%
All values reported are bias adjusted as required and represent the monitoring location (i.e. absence of distance correction calculations)

Three monitoring locations (Sites 4, 5 and 6) reported annual mean NO_2 concentrations exceeding 40µg/m^3 in 2019. Sites 4 and 5 have consecutively reported annual mean NO_2 concentrations to be above 40µg/m^3 for the previous four years (2015 – 2018), whilst Site 6 reported exceedances in all but 2018, in which concentrations were within 10% of the AQS Objective. All three sites are located immediately north of Cheltenham Town Centre, along stretches of the A4019 – (Tewkesbury Road, High Street and Swindon Road) which connects to form a key arterial route to the M5 within the AQMA.

Site 5, within the AQMA, reported the highest annual mean NO_2 concentration within Cheltenham for 2019 (46.5µg/m^3) – a trend consistent since 2015, with concentrations peaking at 49.9µg/m^3 in 2017. Site 5 is situated along a façade of a residential property which immediately fronts onto a stretch of the A4019 (High Street), susceptible to congestion due to the convergence of high capacity and town centre roads (M5, A4019 – Tewkesbury Road, A4019 – High Street, A4019 – Swindon Road and High Street).

The empirical relationship given in LAQM.TG(16)[1] states that exceedances of the 1-hour mean objective for NO_2 is only likely to occur where annual mean concentrations are 60µg/m^3 or above at a location of relevant exposure (Table 2.1). This indicates that an exceedance of the 1-hour mean objective is unlikely to have occurred at these sites between 2015 and 2019.

Five monitoring locations (Site 10, 14, 18, 20 and 28) report annual mean NO_2 concentrations to be within 10% of the AQS objective limit for 2019. All five diffusion tubes are located adjacent to stretches of Cheltenham's main arterial road network.

The results from the Council's 2019 monitoring programme demonstrate NO_2 annual mean concentrations across the borough to have stabilised below the AQS objective limit, with exceedances localised to areas of the main arterial road network, specifically the A4019 north of the town centre, London Road (A49), Princess Elizabeth Way (A4013) and the junction of Gloucester Road (B4633) with Lansdown Road (A40). This reaffirmed the need for revocation of the previous borough-wide AQMA and declaration of the current, more focused AQMA boundary in September 2020.

Cheltenham Borough Council AQMA boundary and all 2019 council-operated monitoring locations are presented in Figure 3-1 and Figure 3-2, respectively.

Figure 3-1 - Cheltenham Borough Council AQMA Boundary

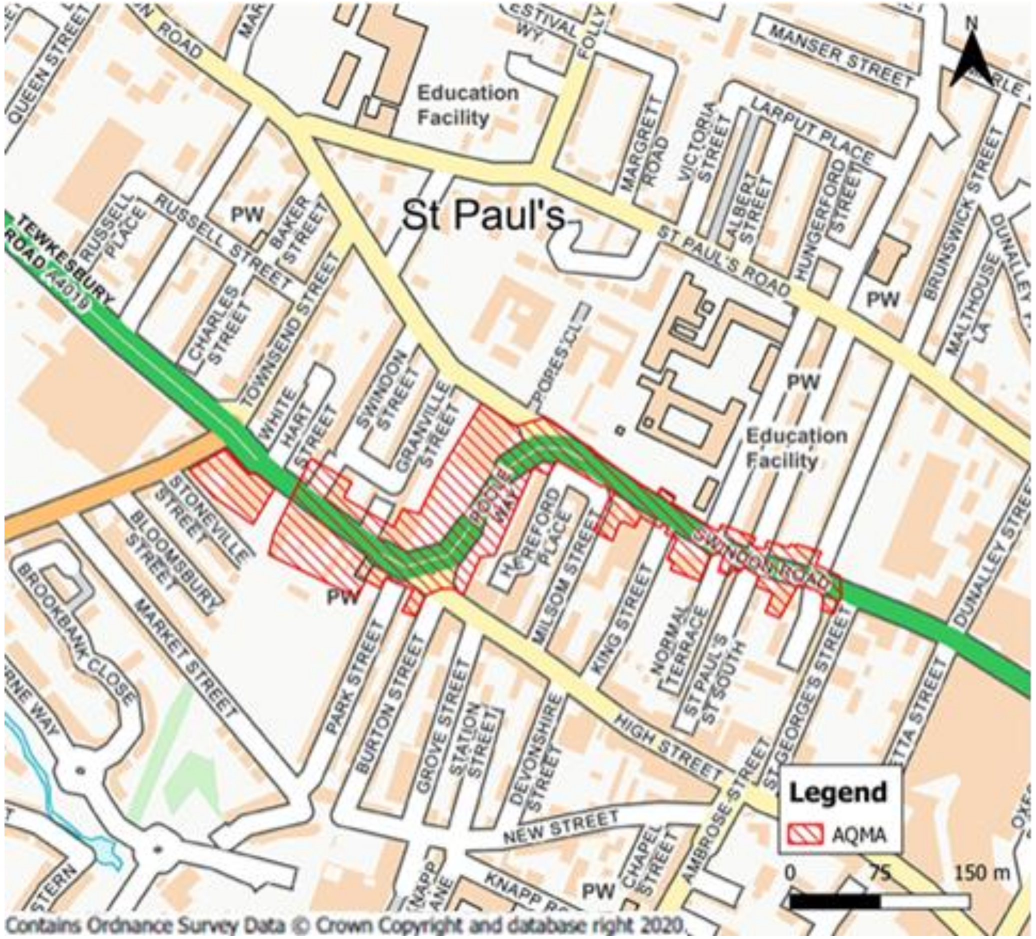
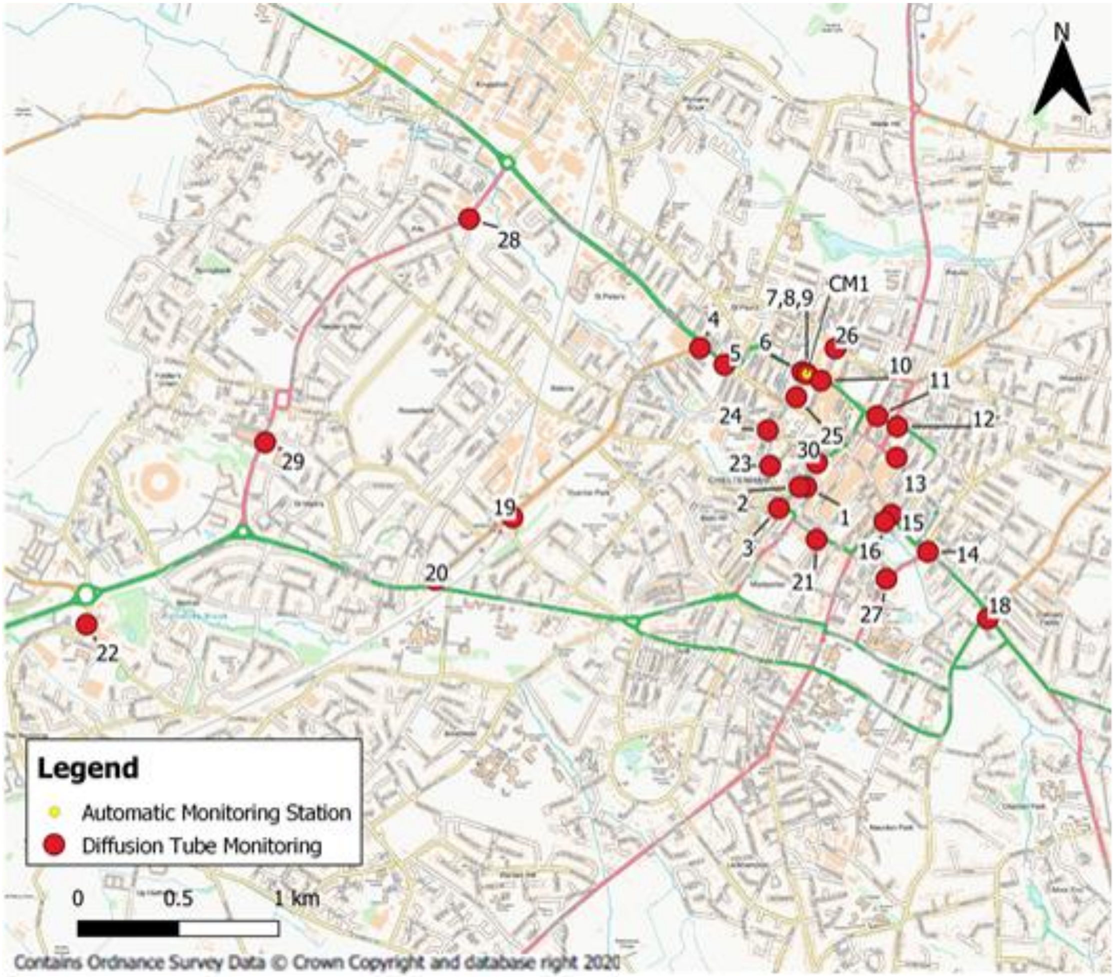


Figure 3-2 – Local Monitoring Locations



3.3 Defra Background Concentration Estimates

Defra maintains a nationwide model of existing and future background air pollutant concentrations at a 1km x 1km grid square resolution. This data includes annual average concentration for NO_x, 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)[10]. The model used to determine the background pollutant levels is semi-empirical in nature: it uses the National Atmospheric Emissions Inventory (NAEI) emissions to model the concentrations of pollutants at the centroid of each 1km grid square, but then calibrates these concentrations in relation to actual monitoring data.

Due to the absence of local background monitoring within Cheltenham, pollutant background concentrations used for the purposes of this assessment have been obtained from the Defra supplied background maps for the relevant 1km x 1km grid squares covering the modelled domain for the year 2019. The relevant annual mean background concentration will be added to the predicted annual mean road contributions in order to predict the total pollutant concentration at each receptor location. The total pollutant concentration can then be compared against the relevant AQS objective to determine the event of an exceedance.

The Defra mapped background concentrations for base year of 2019, which cover the modelled domain, are presented in Table B.1 of the Appendices. All of the mapped background concentrations presented are well below the respective annual mean AQS objectives.

[10] Defra Background Maps (2019), available at https://uk-air.defra.gov.uk/data/laqm-background-home

4 Assessment Methodology

To predict pollutant concentrations of road traffic emissions the atmospheric model ADMS Roads version 5.0.0.1 was used to model a 2019 baseline scenario. The guiding principles for air quality assessments as set out in the latest guidance and tools provided by Defra for air quality assessment (LAQM.TG(16)[1] have been used.

The approach used in this assessment has been based on the following:

- Prediction of NO_2 concentrations to which existing receptors may be exposed and comparison with the relevant AQS objectives;

- Quantification of relative NO_2 contribution of sources to overall NO_2 pollutant concentration; and

- Determination of the geographical extent of any potential exceedances in regard to the existing AQMA boundary.

4.1 Traffic Inputs

Traffic flows and vehicle class compositions for the 2019 baseline scenario were taken from the Gloucestershire County Council (GCC) roads traffic database and the Department for Transport (DfT) traffic count point database. The GCC monitoring programme comprises both permanent Automatic Traffic Count (ATC) and temporary survey points. Whilst data from the permanent count points was provided as annual average daily traffic, data for the temporary survey points was provided as average daily traffic. The Transport Officer at GCC advised it would be suitable to consider the average daily traffic data representative of typical flows.

On modelled road links where neither DfT nor GCC 2019 data was available, the 2017 traffic flows provided by GCC for the Detailed Assessment undertaken by Bureau Veritas in 2019 were used. A factor derived from the Government software TEMPro[11] was applied to predict 2019 concentrations from 2017 and it was assumed that the percentage of heavy goods vehicles in 2019 remained the same as those recorded in 2017.

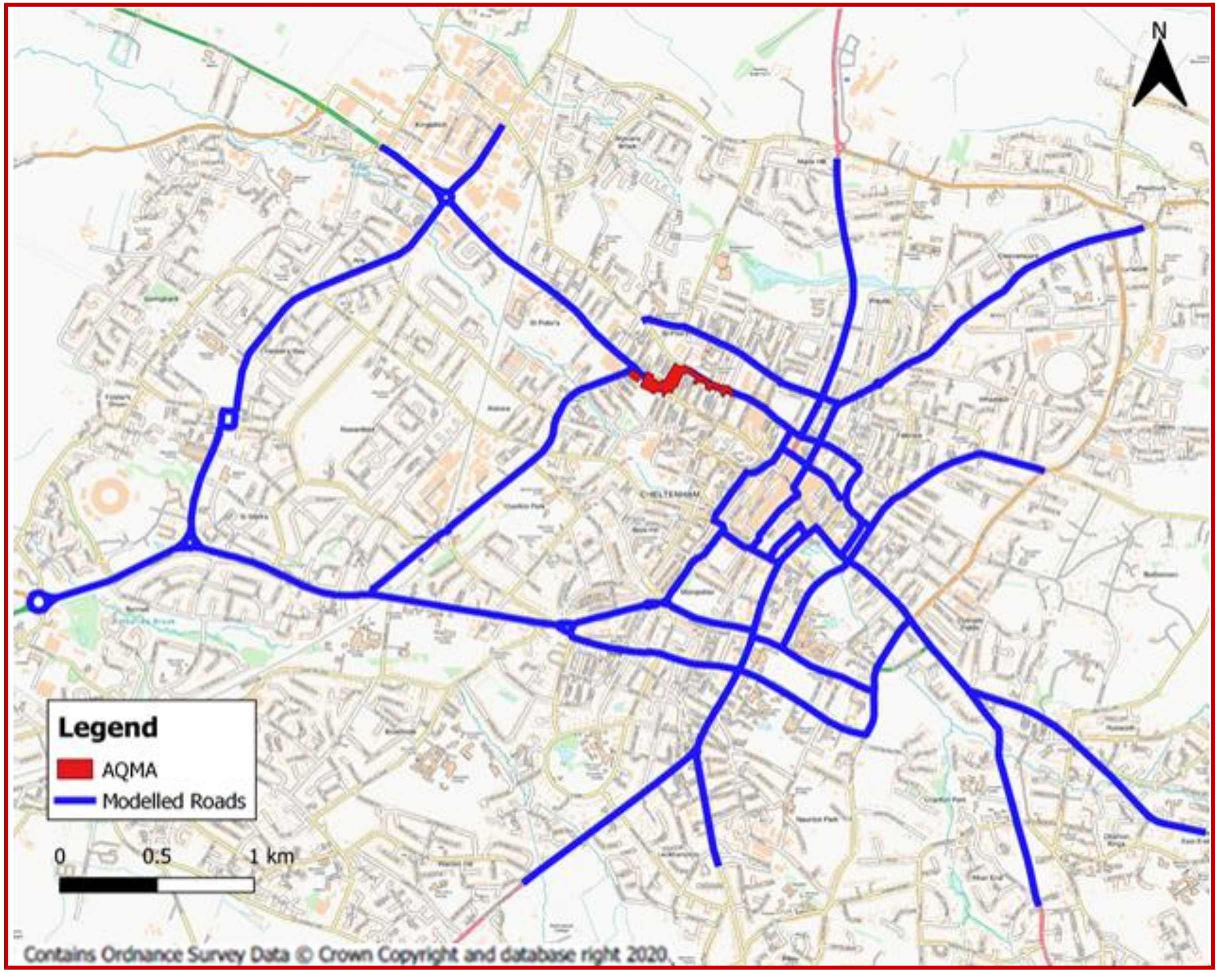
Traffic speeds were modelled at either the relevant speed limit for each road or, where available, monitored vehicle speeds provided by GCC. Where appropriate, vehicle speeds have been reduced in accordance with LAQM TG(16)[1] to simulate queues at junctions, traffic lights and other locations where queues or slower traffic are known to be an issue. Consultation with the Council has been undertaken throughout this process to identify areas where congestion is considered to be prevalent.

The Emissions Factors Toolkit (EFT) version 10.1 developed by Defra[12] has been used to determine vehicle emission factors for input into the ADMS-Roads model, based upon the traffic data inputs.

Details of the traffic flows used in this assessment are provided in Table C. 1 of the Appendices. The entire modelled road network across Cheltenham is presented in Figure 4-1.

[11] Department for Transport, TEMPro, available at: https://www.gov.uk/government/publications/tempro-downloads
[12] Defra, Emissions Factors Toolkit. https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

Figure 4-1 – City Wide Modelled Road Network



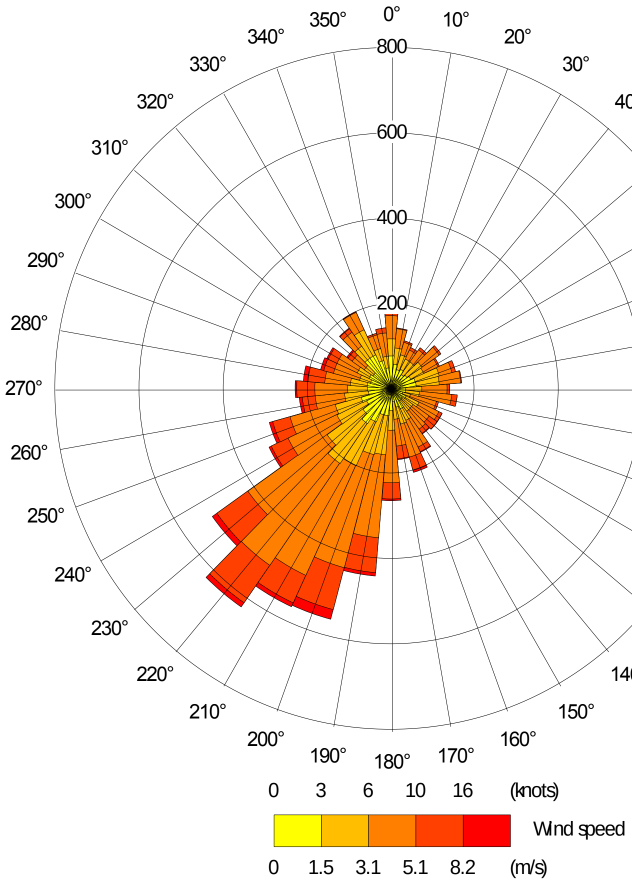
4.2 General Model Inputs

A site surface roughness value of 1 m was entered into the ADMS-roads model, consistent with the built-up nature of the modelled domain. In accordance with CERC's ADMS Roads User Guide[13], a minimum Monin-Obukhov length of 30 m was used for the ADMS Road model to reflect the urban topography of the model domain.

One year of hourly sequential meteorological data from a representative synoptic station is required by the dispersion model. 2019 meteorological data from Gloucestershire weather station has been used in this assessment. The station is located approximately 6.5 km west of Cheltenham town centre and is considered representative of the meteorological conditions experienced throughout the borough. A surface roughness value of 0.5 m was used for the area surrounding the meteorological station, more representative of the Gloucestershire airfield location.

A wind rose for this site for the year 2019 is shown in Figure 4-2.

Figure 4-2 – Wind rose for Gloucestershire Data 2019



Most dispersion models do not use meteorological data if they relate to calm winds conditions, as dispersion of air pollutants is more difficult to calculate in these circumstances. ADMS-Roads treats calm wind conditions by setting the minimum wind speed to 0.75m/s. It is recommended in LAQM.TG(16)[1] that the meteorological data file be tested within a dispersion model and the relevant output log file checked, to confirm the number of missing hours and calm hours that cannot be used

[13] CERC (2020), ADMS-Roads User Guide Version 5

by the dispersion model. This is important when considering predictions of high percentiles and the number of exceedances. LAQM.TG(16)[1] recommends that meteorological data should have a percentage of usable hours greater than 85%. If the data capture is less than 85% short-term concentration predictions should be expressed as percentiles rather than as numbers of exceedances. The 2019 meteorological data from Gloucestershire includes 8,666 lines of usable hourly data out of the total 8,760 for the year, i.e. 98.9% usable data. This is therefore suitable for the dispersion modelling exercise.

4.3 Sensitive Receptors

A total of 249 discrete receptors were included within the assessment to represent locations of relevant exposure. Details of the receptors are presented within Table D.1 of the Appendices and their locations are illustrated in Figure 4-3.

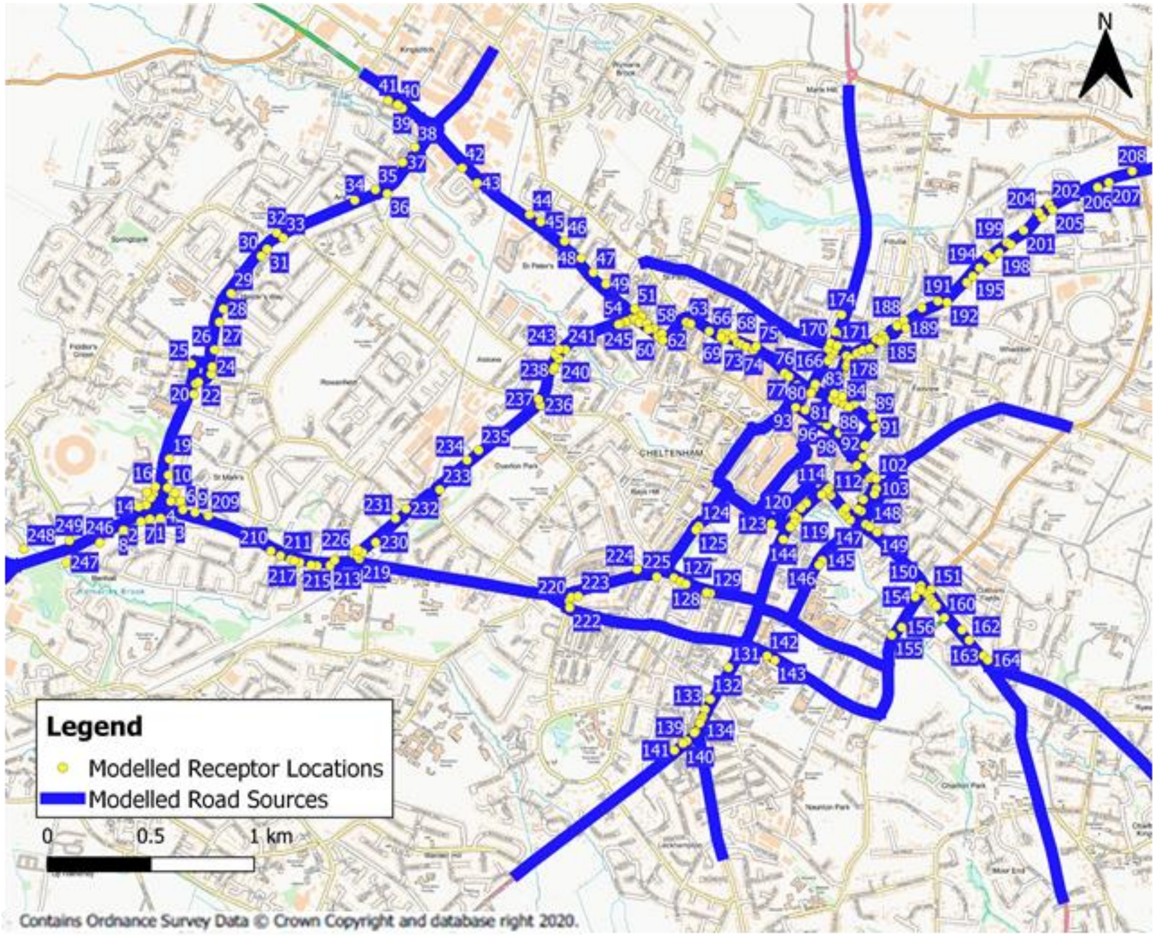
The majority of the receptors (169) were included at a height of 1.5 m to represent ground level exposure, whereas the remainder were included at various heights to represent relevant exposure relative to the adjacent modelled road link, e.g. where there is no residential use at ground level (Table 4.1).

Concentrations were also modelled across a regular gridded area, at a standardised height of 1.5m, covering the full extent of the model domain. The intelligent gridding option was applied to the ADMS-roads model meaning additional points were added at locations close to the roads for greater output resolution.

Table 4.1 – Number of Receptors Included at Various Heights

Height (m)	Number of Receptors
0.0	53
1.0	1
1.5	169
3.5	20
4.0	6

Figure 4-3 – Receptor Locations Considered in the Assessment



4.4 Model Outputs

The background pollutant values discussed in Section 3.3 have been used in conjunction with the concentrations predicted by the ADMS-Roads model to calculate predicted total annual mean concentrations of NO_x.

For the prediction of annual mean NO_2 concentrations for the modelled scenarios, the output of the ADMS-Roads model for road NO_x contributions has been converted to total NO_2 following the methodology in LAQM.TG(16)[1], using the NO_x to NO_2 conversion tool developed on behalf of Defra. This tool also uses the total background NO_x and NO_2 concentrations. This assessment has used version 8.1 (August 2020) of the NO_x to NO_2 conversion tool[14]. The road contribution is then added to the appropriate NO_2 background concentration value to obtain an overall total NO_2 concentration.

For the prediction of short term NO_2 impacts, LAQM.TG(16)[1] advises that it is valid to assume that exceedances of the 1-hour mean AQS objective for NO_2 are only likely to occur where the annual mean NO_2 concentration is 60µg/m^3 or greater. This approach has thus been adopted for the purposes of this assessment.

In addition to annual mean concentrations, NO_x source apportionment was carried out for the following vehicle classes:

- Cars;
- Light-Goods Vehicles (LGVs);
- Heavy-Goods Vehicles (HGVs);
- Bus and Coaches; and
- Motorcycles.

Verification of the ADMS-Roads assessment has been undertaken using a number of local authority diffusion tube monitoring locations. All NO_2 results presented in the assessment are those calculated following the process of model verification. Full details of the verification process are provided in Appendix A – ADMS Model Verification.

4.5 Uncertainty

Due to the number of inputs that are associated with the modelling of the study area there is a level of uncertainty that has to be taken into account when drawing conclusions from the predicted concentrations of NO_2. The predicted concentrations are based upon the inputs of traffic data, background concentrations, emission factors, street canyon calculations, meteorological data, modelling terrain limitations and the availability of monitoring data from the assessment area(s).

4.6 Uncertainty in NO_x and NO_2 Trends

Recent studies have identified historical monitoring data within the UK that shows a disparity between measured concentration data and the projected decline in concentrations associated with emission forecasts for future years[15]. Ambient concentrations of NO_x and NO_2 have shown two distinct trends over the past twenty-five years: (1) a decrease in concentrations from around 1996

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

[15] Carslaw, D, Beevers, S, Westmoreland, E, Williams, M, Tate, J, Murrells, T, Steadman, J, Li, Y, Grice, S, Kent, Aand Tsagatakis, I. 2011, Trends in NO_x and NO_2 emissions and ambient measurements in the UK, prepared for Defra, July 2011.

to 2002/04, followed by (2) a period of more stable concentrations from 2002/04 rather than the further decline in concentrations that was expected due to the improvements in vehicle emissions standards.

The reason for this disparity is related to the actual on-road performance of vehicles, in particular diesel cars and vans, when compared with calculations based on the Euro emission standards. Preliminary studies suggest the following:

- NO_x emissions from petrol vehicles appear to be in line with current projections and have decreased by 96% since the introduction of 3-way catalysts in 1993;
- NO_x emissions from diesel cars, under urban driving conditions, do not appear to have declined substantially, up to and including Euro 5. There is limited evidence that the same pattern may occur for motorway driving conditions; and
- NO_x emissions from HDVs equipped with Selective Catalytic Reduction (SCR) are much higher than expected when driving at low speeds.

This disparity in the historical national data highlights the uncertainty of future year projections of both NO_x and NO_2.

Defra and the Devolved Administrations have investigated these issues and have since published updated versions of the EFT that utilise COPERT 5 emission factors, which may go some way to addressing this disparity, but it is considered likely that a gap still remains. This assessment has utilised the latest EFT version 10.1 and associated tools published by Defra to help minimise any associated uncertainty when forming conclusions from the results.

5 Results

5.1 Modelled Concentrations

5.1.1 Baseline 2019 NO_2 Concentrations

The assessment has considered emissions of NO_2 from road traffic at 249 existing receptor locations representing locations of relevant exposure, and across a generic output grid covering the modelled area.

Table 5.1 provides a summary of the modelled receptors split into groups based on the predicted annual mean NO_2 concentration. It can be seen that of the 249 discrete receptors, 14 (5.6%) are predicted to be above the NO_2 annual mean AQS objective limit, with a further 26 (10.4%) within 10%.

Table 5.1 – Summary of 2019 Modelled Receptor Results NO_2

Modelled NO_2 Concentration (µg/m^3)	Number of Receptors	Reference to the AQS Objective	Number of Receptors	% of Receptors
>44	8	**Above 40µg/m^3 AQS Objective**	**14**	**5.6%**
40 - 44	6			
36 - 40	26	Within 10% of AQS Objective	26	10.4%
32 - 36	58	Below 36µg/m^3 AQS Objective	209	83.9%
<32	151			

The highest annual mean NO_2 concentration was recorded at Receptor 60 with a concentration of 56.7µg/m^3. Receptor 60 is located along a façade of a residential property within the AQMA which immediately fronts onto a stretch of the A4019 – High Street, susceptible to congestion due to the convergence of high capacity and town centre roads (M5, A4019 – Tewkesbury Road, A4019 – High Street, A4019 – Swindon Road and High Street). The junction's role as a major strategic connection within the region is believed to be the cause of the elevated NO_2 annual mean concentrations predicted at Receptor 60.

The empirical relationship given in LAQM.TG(16)[1] states that exceedance of the 1-hour mean objective for NO_2 is only likely to occur where annual mean concentrations are 60 µg/m^3 or above. Given the NO_2 annual mean concentration recorded at Receptor 60 is below the hourly exceedance indicator (60µg/m^3), an exceedance of the hourly NO_2 AQS objective is unlikely at this location. In addition, on review of the annual mean NO_2 concentration isopleth presented in Figure 5-2 covering the modelled domain, there are no relevant locations with a modelled annual mean NO_2 concentration above 60µg/m^3, which suggests that an exceedance of the hourly NO_2 AQS objective is unlikely across the modelled area.

Figure 5-1 shows the locations of those receptors which are exceeding the 40µg/m^3 annual mean AQS objective and those receptors which are within 10% of the annual mean AQS objective (36 to 40µg/m^3). Based on these results, the following observations were made:

- Areas of exceedance or near exceedance of the annual mean NO_2 AQS objective were concentrated to roadside locations near junctions where key arterial roads meet, confirming vehicular traffic to be the main contributor to elevated levels of NO_2 concentrations within Cheltenham. Notable roads include: A4013 Princess Elizabeth Way, A4019 Tewkesbury Road, A4019 Swindon Road, A46 Berkeley Street, A46 Bath Road, and A46 London Road.

The following areas were identified to report modelled concentrations in exceedance of the annual mean NO_2 AQS objective:

- Within the existing AQMA, the continuous stretch of road spanning A4019 Tewkesbury Road, A4019 Poole Way and A4019 Swindon Road north of the Town Centre; and
- Along stretches of other arterial roads connecting to the Town Centre (A4013 Princess Elizabeth Way, Benhall Roundabout, A46 London Road/Berkley Street intersection, and A46 Shurdington Road).

The following additional areas were identified to report modelled concentrations within 10% of the AQS objective:

- A4019 Fairview Road, A46 Clarence Road and Albion Street;
- A46 London Road;
- Bath Road;
- A40 Lansdowne Road/Suffolk Road intersection;
- A40 Gloucester Road/B4633 Gloucester Road intersection;
- A4013 Princess Elizabeth Way/Marsland Road/Edinburgh Place intersection.

An expansion of the Council's monitoring network is recommended so as to include those locations outside of the AQMA that have been identified to have a modelled exceedance and/or near exceedance, in order to validate the modelled findings.

Monitoring sites within and/or adjacent to the locations identified to have a modelled exceedance and/or near exceedance outside of the declared AQMA area should be reviewed in order to validate predicted model findings.

A full set of concentration results for the discrete receptors used within the assessment is provided in Table D.1 of the Appendices. To provide further detail on the AQMA area, annual mean NO_2 concentrations were also predicted at generic gridded receptor locations (Figure 5-3).

Figure 5-1 – Location of Discrete Receptors Predicted to be within 10% or Above the NO_2 Annual Mean AQS Objective

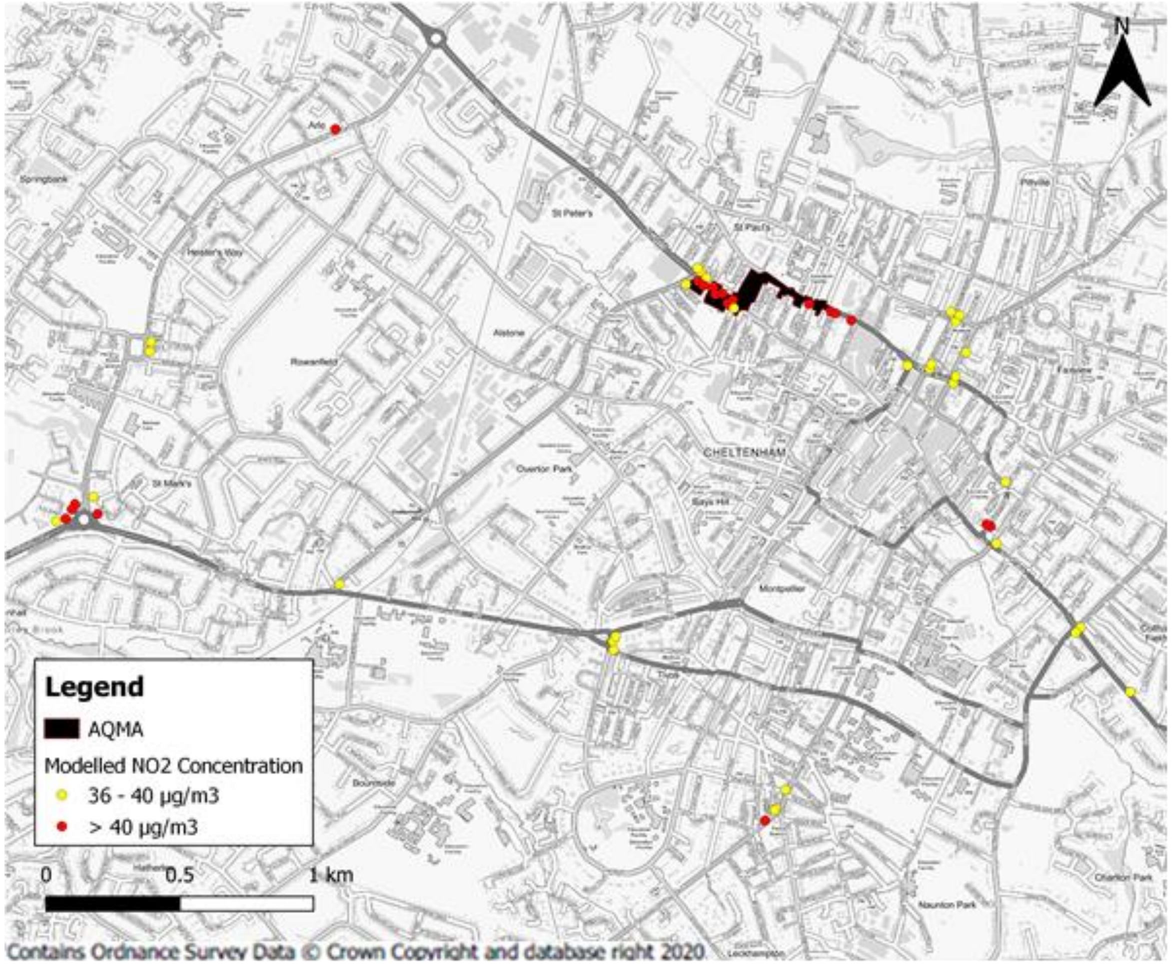


Figure 5-2 – Annual Mean NO_2 Concentration Isopleths: Cheltenham

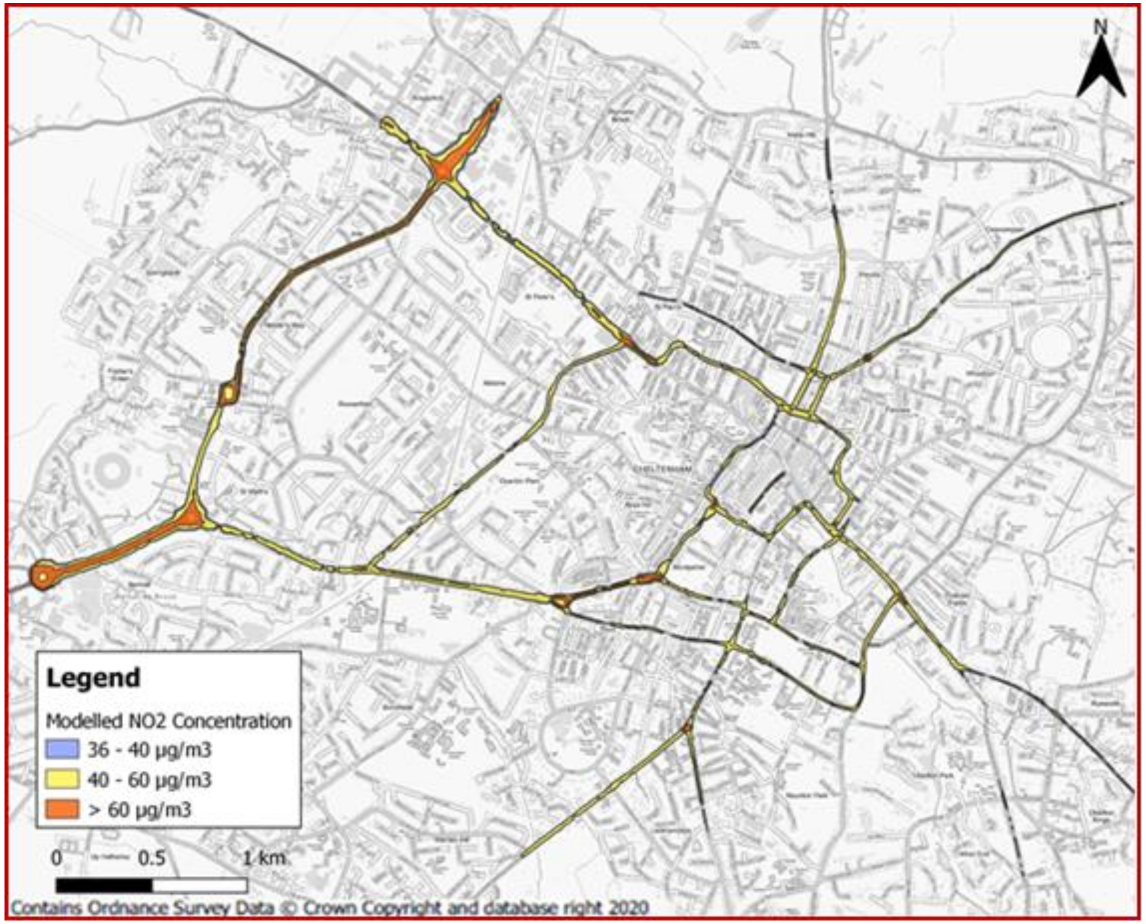
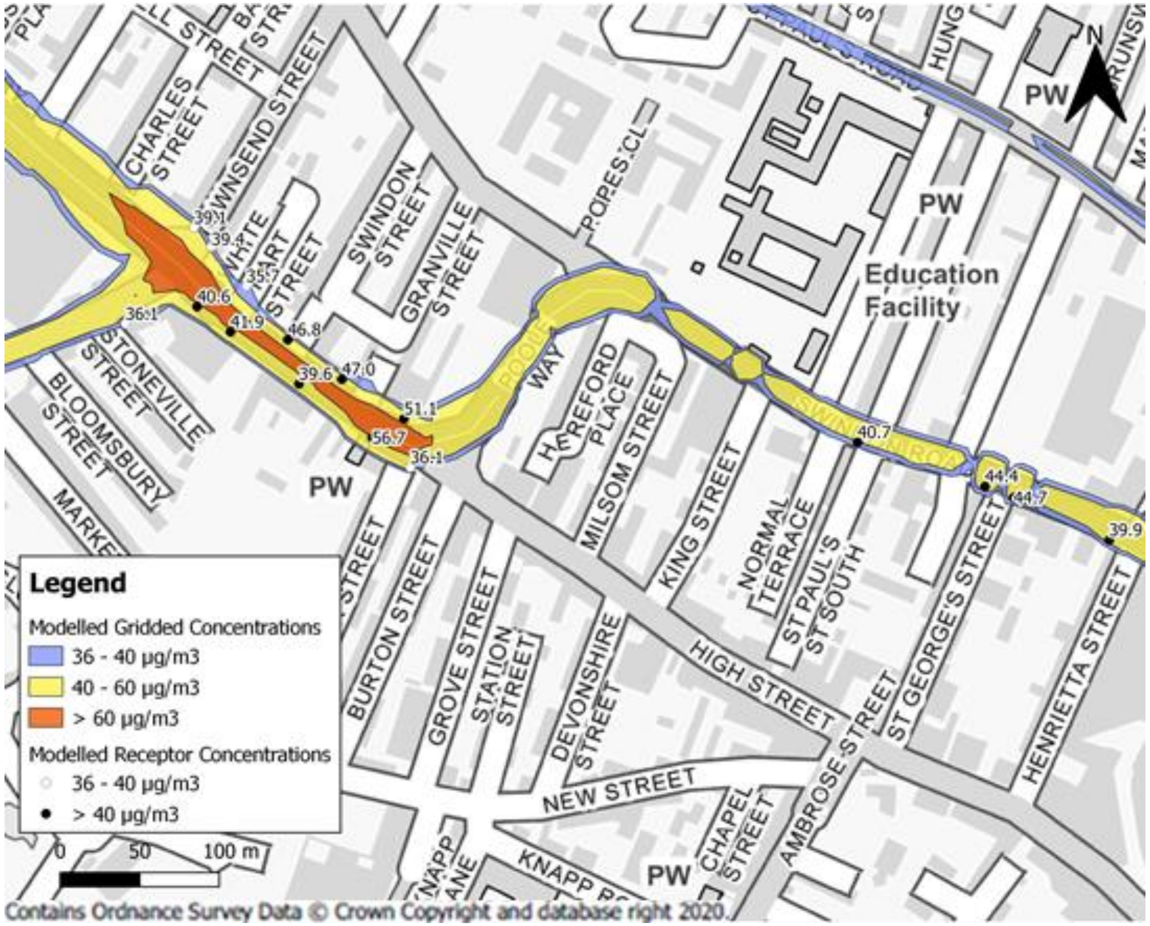


Figure 5-3 – Annual Mean NO_2 Concentration Isopleths and Model Predictions at Discrete Receptor Locations within Declared AQMA



5.2 Estimated Year of Compliance

Following the identification of exceedances of the AQS objectives, it is useful to provide an estimate of the year by which concentrations at the identified locations of exceedances will become compliant with the relevant AQS objective. This is initially provided below assuming only the trends for future air quality, as currently predicted by Defra, are realised. The implementation of specific intervention measures to mitigate the local air quality issues, as are currently being developed by the Council within a revised AQAP, would then be considered most likely to bring forwards the estimated date of compliance.

Following the methodology outlined in LAQM.TG(16)[1] paragraph 7.70 onward, the year by which concentrations at the identified locations of exceedances will become compliant with the NO_2 annual mean AQS objective has been estimated. This has been completed using the predicted modelled NO_2 concentrations from the 2019 Base scenario.

As a worst-case approach, the projection is based upon the receptor predicted as having the maximum annual mean NO_2 concentration, which in this case is Receptor 60. The appropriate roadside NO_2 projection factors, as provided on the LAQM Support website[16], are then applied to this concentration value to ascertain the estimated NO_2 annual mean reduction per annum, and hence the anticipated year of compliance. In this case, roadside projection factors for 'Rest of UK (HDV <10%)' have been applied, consistent with the worst-case receptor location.

The projected NO_2 annual mean concentrations following the above approach are presented in Table 5.2.

Table 5.2 – Projected Annual Mean NO_2 Concentrations

Receptor 60									
2019 Annual Mean Concentration (µg/m³)	Predicted Annual Mean Concentration (µg/m³)								
	2020	2021	2022	2023	2024	2025	2026	2027	2028
56.7	**53.9**	**50.9**	**48.0**	**45.5**	**43.1**	**40.8**	38.8	37.0	35.4
In **bold**, exceedance of the NO_2 annual mean AQS objective of 40µg/m³ Vehicle Adjustment Factor = Rest of UK (HDV <10%)									

Table 5.2 indicates that the first year by which Receptor 60 will be exposed to a concentration below the annual mean NO_2 AQS objective will be 2026. Additionally, it is expected that concentrations are expected to drop below 10% of the annual mean NO_2 AQS objective by 2028. 2026 is therefore considered the predicted year of compliance for those receptors used within the model, which are believed to represent worst case exposure within Cheltenham, in the absence of the implementation of any specific intervention measures to further bring forward local air quality improvements in the area.

5.3 Source Apportionment

To help inform the development of measures as part of the action plan stage of the project, a NO_x source apportionment exercise was undertaken for the following vehicle classes:

[16] https://laqm.defra.gov.uk/tools-monitoring-data/roadside-no2-projection-factor.html

- Cars;
- Light-Goods Vehicles (LGVs);
- Heavy-Goods Vehicles (HGVs);
- Bus and Coaches; and
- Motorcycles.

This will provide vehicle emission proportions of NO_x that will allow the Council to design specific AQAP measures targeting a reduction in emissions from specific vehicle types.

It should be noted that emission sources of NO_2 are dominated by a combination of direct NO_2 (f-NO_2) and oxides of nitrogen (NO_x), the latter of which is chemically unstable and rapidly oxidised upon release to form NO_2. Reducing levels of NO_x emissions therefore reduces levels of NO_2. As a consequence, the source apportionment study has considered the emissions of NO_x which are assumed to be representative of the main sources of NO_2.

Table 5.3 and Table 5.4 detail the source apportionment results for NOx concentrations at modelled receptors for three scenarios:

- The average NO_x contributions across all modelled receptors. This provides useful information when considering possible action measures to test and adopt. It will however understate road NO_x concentrations in problem areas;
- The average NO_x contributions within the AQMA. This will inform potential prominent NO_x contributors present within the identified area of exceedance and therefore be useful when testing and adopting action measures; and
- The location where the maximum road NO_x concentration has been predicted within the AQMA. This is likely to be in the area of most concern within the proposed AQMA and so a good place to test and adopt action measures. Any gains predicted by action measures are however likely to be greatest at this location and so would not represent gains across the whole modelled area.

When considering the average NO_x concentration across all modelled receptor locations, the following observations were found:

- Road traffic accounts for 35.4µg/m^3 (65.9%) of total NO_x (53.7µg/m^3), with background accounting for 18.3µg/m^3 (34.1%);
- Of the total road NO_x, Cars are highest contributing vehicle class accounting for 56.2% (19.9µg/m^3);
- LGVs are found to be the second highest contributing vehicle class accounting for 27.4% (9.7µg/m^3);
- HGVs and Buses account for similar total road NO_x (HGVs – 7.7% (2.7µg/m^3) and Buses 8.6% (3.0µg/m^3)); whereas
- Motorcycles are found to contribute <1%.

When considering the average NO_x concentration at modelled receptor locations within the AQMA, the following observations were found:

- The predicted road traffic NO_x percentage contribution is similar in comparison to all receptor locations, accounting for 70.4% (48µg/m^3) of the total NO_x (68.3µg/m^3), with the background component percentage contribution 29.6% (20.2µg/m^3);

- Of the total road NO_x, Cars account for a similar contribution in comparison to contributions modelled at all receptor locations, and are still found to be the highest contributing vehicle class accounting for 56.0% (26.9µg/m^3);

- LGVs are similarly found to be the second highest contributing vehicle class, with a consistent percentage weighting observed (28.6% (13.7µg/m^3));

- Percentage contributions from HGVs were also found to be similar in comparison to contributions modelled for all receptor locations, and remain third in terms of overall ranking (8.1% (3.9µg/m^3)) - suggesting a marginal influence of HGVs in exceedance areas across the modelled domain; and

- Percentage contributions from Buses and Motorcycles remain stable in comparison to contributions modelled at all receptor locations (Buses – 7.2% (3.4µg/m^3) and Motorcycles <1%).

When considering the modelled receptor location at which the maximum road NO_x concentration has been predicted:

- Road traffic accounts for 81.3% (91.5µg/m^3) of the total averaged NO_x (112.6µg/m^3) – highlighting contributions from road traffic to be the core component in areas of exceedance;

- Of the total road NO_x, Cars are found to be the highest contributing vehicle class accounting for 54.3% (49.7µg/m^3). However, in comparison to contributions within the AQMA as a whole and across the whole domain, this percentage is slightly lower, suggesting influence from other vehicle classes in this location;

- LGVs are found to be the second highest contributing vehicle class accounting for 28.5% (26.1µg/m^3). This observed percentage contribution is consistent with observations found across the whole domain and within the AQMA;

- HGVs account for 8.2% (7.5µg/m^3) of the total road NO_x. This is an increase in comparison to the contribution observed across the whole domain and suggests an influence on exceedance within the AQMA;

- Buses account for 8.8% (8.1µg/m^3) of the total road NO_x – a slight increase in percentage contribution in comparison to the wider domain - suggesting an influence on exceedance within the AQMA; and

- Motorcycles are similarly found to contribute <1%.

The NO_x source apportionment exercise demonstrates a largely consistent ranking of contributing vehicle classes exhibited throughout all scenarios (Cars, LGVs, HGVs, Buses and Coaches, and Motorcycles), where Cars primarily (alongside LGVs) are found to be the main contributors to total road NO_x concentrations across Cheltenham.

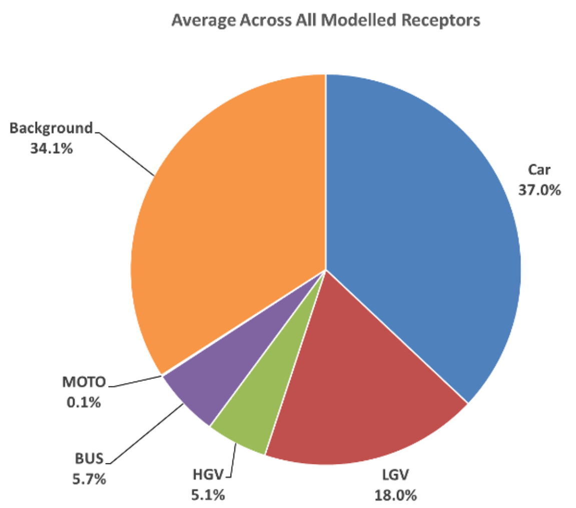
Whilst comparing modelled contributions at identified receptor locations within the AQMA against the wider modelled domain, Cars were observed to employ a slightly reduced influence on total road NO_x concentrations within the AQMA. Slight increases to total road NO_x contributions from both LGVs and HGVs were observed, demonstrating a larger degree of influence. Increases to both LGV and HGV total road NO_x contributions within the AQMA is owed to the strategic road network the area of exceedance is centred on (i.e. the A4019 – Tewkesbury Road, A4019 – High Street, A4019 – Swindon Road and High Street) – which connects the M5 (among other high capacity roads) to the Town Centre.

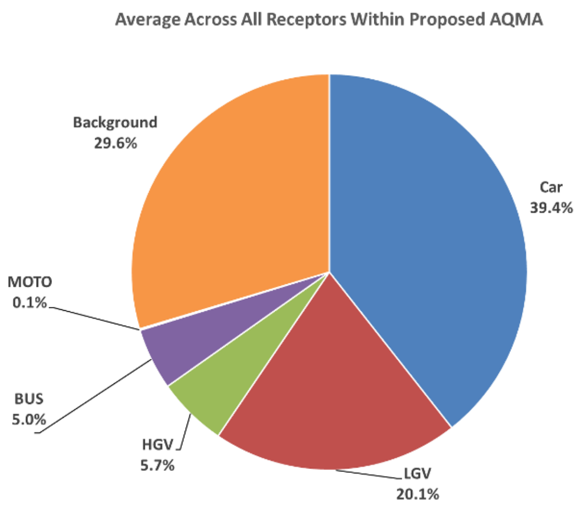
However, whilst taking the above into consideration, the observed variance in percentage contributions between vehicle classes largely didn't disrupt the observed ranking of contributing vehicle class exhibited throughout all scenarios. This suggests volume of traffic is considered to be the key contributor to elevated levels of NO_2 annual mean concentrations within the AQMA.

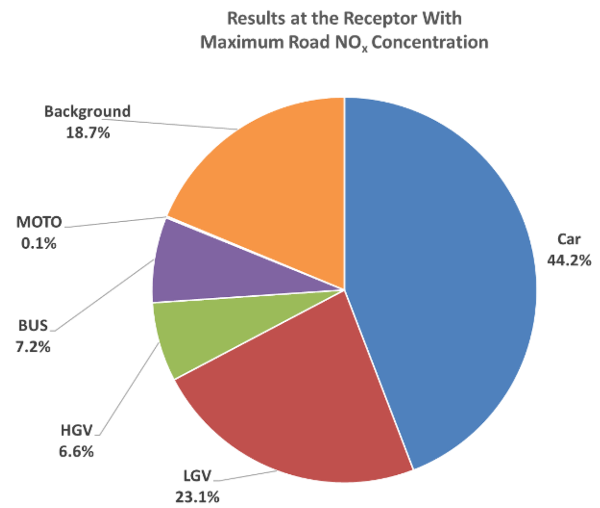
Table 5.3 – Detailed Source Apportionment of NO_x Concentrations

Results	All Vehicles	Cars	LGV	HGV	Bus & Coach	Motorcycle	Background
Average Across all Modelled Receptors							
NO_x Concentration (µg/m^3)	35.4	19.9	9.7	2.7	3.0	0.1	18.3
Percentage of total NO_x (%)	65.9	37.0	18.0	5.1	5.7	0.1	34.1
Percentage Road Contribution to total NO_x (%)	100.0	56.2	27.4	7.7	8.6	0.2	-
Average Across all Receptors within AQMA							
NO_x Concentration (µg/m^3)	48.0	26.9	13.7	3.9	3.4	0.1	20.2
Percentage of total NO_x (µg/m^3)	70.4	39.4	20.1	5.7	5.0	0.1	29.6
Percentage Road Contribution to total NO_x (µg/m^3)	100.0	56.0	28.6	8.1	7.2	0.2	-
At Receptor with Maximum Road NO_x Concentration							
NO_x Concentration (µg/m^3)	91.5	49.7	26.1	7.5	8.1	0.2	21.1
Percentage of total NO_x (µg/m^3)	81.3	44.2	23.1	6.6	7.2	0.1	18.7
Percentage Road Contribution to total NO_x (µg/m^3)	100.0	54.3	28.5	8.2	8.8	0.2	-

Table 5.4 – Detailed Source Apportionment of NO_x Concentrations






Results at the Receptor With
Maximum Road NO_x Concentration
Background
18.7%
MOTO
0.1%
BUS
7.2%
HGV
6.6%
LGV
23.1%
Car
44.2%

6 Conclusions and Recommendations

The dispersion modelling exercise undertaken has provided the following updated perspective on NO_2 challenges within Cheltenham Town Centre and its associated strategic roads.

6.1 Predicted Concentrations

The model suggests that the 40µg/m^3 NO_2 annual mean AQS objective is exceeded at a total of 14 (5.6 %) receptor locations, with 26 (10.4 %) further locations within 10 % of the objective.

All of receptors reporting NO_2 annual mean concentrations to be above or within 10 % of the AQS objective limit are either located within the existing AQMA or are concentrated to roadside locations of junctions where key arterial roads meet and form the main transportation network within the region.

The highest annual mean concentration of NO_2 was recorded at Receptor 60 with a concentration of 56.7µg/m^3. Receptor 60 is located along a façade of a residential property which immediately fronts onto a stretch of the A4019 – High Street. This location is susceptible to congestion due to the convergence of high capacity and town centre roads (M5, A4019 – Tewkesbury Road, A4019 – High Street, A4019 – Swindon Road and High Street).

The empirical relationship given in LAQM.TG(16)[1] states that exceedances of the 1-hour mean objective for NO_2 is only likely to occur where annual mean concentrations are 60µg/m^3 or above at a location of relevant exposure (Table 2.1). Given the NO_2 annual mean concentration recorded at all receptors is below 60µg/m^3, exceedances of the hourly NO_2 AQS objective are unlikely.

The following areas were identified to report modelled concentrations in exceedance of the annual mean NO_2 AQS objective:

- Within the existing AQMA, the continuous stretch of road spanning A4019 Tewkesbury Road, A4019 Poole Way and A4019 Swindon Road north of the Town Centre; and
- Along stretches of other arterial roads connecting to the Town Centre (A4013 Princess Elizabeth Way, Benhall Roundabout, A46 London Road/Berkley Street intersection, and A46 Shurdington Road).

The following additional areas were identified to report modelled concentrations within 10% of the AQS objective:

- A4019 Fairview Road, A46 Clarence Road and Albion Street;
- A46 London Road;
- Bath Road;
- A40 Lansdowne Road/Suffolk Road intersection;
- A40 Gloucester Road/B4633 Gloucester Road intersection;
- A4013 Princess Elizabeth Way/Marsland Road/Edinburgh Place intersection.

An expansion of the Council's monitoring network is intended so as to include those locations outside of the AQMA that have been identified to have a modelled exceedance and/or near exceedance, in order to validate the modelled findings.

PM_{10} and $PM_{2.5}$ concentrations have also been predicted as part of the modelling assessment. No modelled receptors recorded concentrations in exceedance of either of the annual mean objectives for these pollutants. The highest modelled PM_{10} concentration was 22.1µg/m³ at R60. The highest modelled $PM_{2.5}$ concentration was 14.3µg/m³ at R60.

6.2 Source Apportionment

To help inform the development of measures as part of a future AQAP, a NO_x source apportionment exercise was undertaken to provide an understanding of any potential similarities in vehicle emission contributors within the AQMA.

The NO_x source apportionment exercise demonstrates a largely consistent ranking of contributing vehicle class exhibited throughout all scenarios (Cars, LGVs, HGVs, Buses and Coaches and Motorcycles), where Cars and LGVs are found to be the main contributors to total road NO_x concentrations across Cheltenham.

Whilst comparing modelled contributions at the identified worst-case receptor location within the AQMA (Receptor 60) against the wider modelled domain, cars were observed to employ a slightly reduced influence total road NO_x concentrations within the AQMA. Whilst increases to total road NO_x contributions from LGVs, HGVs and buses were observed. The increase in contributions from these vehicle types to total road NO_x within the AQMA is owed to the arterial network the area of exceedance is centred on (i.e. the A4019 – Tewkesbury Road, A4019 – High Street, A4019 – Swindon Road and High Street) – which connects the M5 (among other high capacity roads) to the Town Centre.

6.3 Future Recommendations

Following the completion of the detailed modelling assessment, the following recommendations are made:

- Continue to monitor NO_2 across the Borough;
- Deploy and/or relocate existing monitoring within the Borough to the other locations predicted to be in exceedance, or near exceedance, of the NO_2 annual mean AQS objective limit, in order to validate modelled findings; and
- Based on source apportionment results, any future intervention measures should be targeted at reducing vehicle emissions from all vehicle types, notably Cars and LGVs, which are both observed to be the two largest contributors to total vehicle emissions in areas of exceedance.

Following the modelling exercise, it is hoped that the following topics can be discussed with air quality stakeholders to aid development of the AQAP:

- Possible action plan measures being considered by the Council; and
- Ability to test the effects of these measures using the current dispersion model set up.

Appendices

Appendix A – ADMS 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)[1] guidance as an accepted dispersion model.

Model validation undertaken by the software developer (CERC) will not have included validation in the vicinity of the proposed development 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.

The predicted results from a dispersion model may differ from measured concentrations for a large number of reasons, including uncertainties associated with:

- Background concentration estimates;
- Source activity data such as traffic flows and emissions factors;
- Monitoring data, including locations; and
- Overall model limitations.

Model verification is the process by which these and other uncertainties are investigated and where possible minimised. In reality, the differences between modelled and monitored results are likely to be a combination of all of these aspects.

Model setup parameters and input data were checked prior to running the models in order to reduce these uncertainties. The following were checked to the extent possible to ensure accuracy:

- Traffic data;
- Distance between sources and monitoring as represented in the model;
- Speed estimates on roads;
- Background monitoring and background estimates; and
- Monitoring data.

The traffic data for this assessment has been collated using a combination of data provided by the highways department at GCC and DfT traffic count data, as outlined in Section 4.1.

During 2019, concentrations of NO_2 were monitored at 27 sites across Cheltenham, comprising 29 diffusion tubes and one continuous monitor (CM1), with the provision of a triplicate colocation study (Table A.1) – all undertaken at roadside/kerbside locations. The following six passive monitoring locations tubes were sited outside of the modelled road network so were therefore removed from the verification:

- Site 1;
- Site 3;
- Site 22;

- Site 23;
- Site 24; and
- Site 25.

The details of the LAQM monitoring sites considered for the purposes of model verification are presented in Table A.1 below.

Table A.1 – Local Monitoring Data Available for Model Verification

Site ID	OS Grid Reference		2019 Annual Mean NO_2 Concentration ($\mu g/m^3$)	2019 Data Capture (%)
	X	Y		
2	394724	222320	27.6	100
4	394237	223006	43.1	100
5	394350	222923	46.5	100
6	394738	222888	40.3	100
7,8,9	394760	222878	35.1	91.7
10	394830	222845	39.2	100
11	395110	222670	34.1	100
12	395210	222618	34.4	91.7
13	395207	222465	30.4	100
14	395362	222000	37.4	100
15	395182	222183	28.5	100
16	395146	222149	34.4	100
18	395660	221670	37.6	91.7
19	393296	222170	33.4	83.3
20	392912	221862	36.2	100
21	394809	222060	23.9	100
26	394902	223004	31.3	100
27	395156	221866	27.6	91.7
28	393081	223643	38.2	100
29	392066	222540	33.7	100
30	394810	222439	31.6*	58.3
CM1	394760	222878	36.0	97.3

*Annualised concentration.

NO_2 Verification Calculations

The verification of the modelling output was performed in accordance with the methodology provided in Chapter 7 of LAQM.TG(16)[1].

For the verification and adjustment of NO_x/NO_2, the 2019 monitoring data presented in Table A.1 was used. One passive monitoring location (Site 30) reported data capture to be below 75% for the duration of 2019, with annualisation subsequently performed to derive the reported NO_2 annual mean concentration.

Site 19 was removed from the verification process as the results presented were anomalous and it was not possible to confirm the location of the monitoring following a desktop review. In addition, passive monitoring location 7,8,9 has also been removed from the verification process due to being co-located with continuous monitor CM1. As a bias adjustment factor derived from CM1 was used to adjust all diffusion tubes in 2019, it is considered that the NO_2 concentration recorded by CM1 is more representative of the location than that at 7,8,9 and the automatic monitoring is generally considered more reliable than diffusion tube monitoring.

Verification was completed using the 2019 (2018 reference year) Defra background mapped concentrations for the relevant 1km x 1km grid squares within Cheltenham (i.e. those within which the model verification locations are located), as displayed in Table B.1 of the Appendices.

Table A.2 below shows an initial comparison of the monitored and unverified modelled NO_2 results for the year 2019, in order to determine if verification and adjustment was required.

Table A.2 – Comparison of Unverified Modelled and Monitored NO_2 Concentrations

Site ID	Background NO_2	Monitored total NO_2 (µg/m^3)	Unverified Modelled total NO_2 (µg/m^3)	Difference (modelled vs. monitored) (%)
CM1	15.3	36.0	20.8	-42.2
2	15.3	27.6	18.5	-32.9
4	12.1	43.1	20.6	-52.3
5	15.3	46.5	23.0	-50.7
6	15.3	40.3	21.3	-47.0
10	15.3	39.2	20.7	-47.3
11	14.2	34.1	21.3	-37.8
12	14.2	34.4	19.1	-44.4
13	14.2	30.4	17.3	-43.2
14	12.9	37.4	21.5	-42.5
15	14.2	28.5	20.1	-29.4
16	14.2	34.4	21.6	-37.2
18	12.9	37.6	22.8	-39.5
20	12.6	36.2	18.9	-47.9
21	15.3	23.9	19.5	-18.5
26	12.1	31.3	15.5	-50.5
27	12.9	27.6	18.2	-33.9
28	14.3	38.2	20.0	-47.7
29	12.6	33.7	17.5	-48.0
30	15.3	31.6	18.6	-41.3

The data in the table above shows that the model was under predicting at all verification points, with the highest under prediction between the modelled and monitored concentrations observed at Site 4 (-52.3 %). At this stage all model inputs were checked to ensure their accuracy, this includes road and monitoring sire geometry, traffic data, link emission rates, 2019 monitoring results, background concentrations and modelling features such as street canyons. Following a level of QA/QC completed upon the model, no further improvement of the modelled results could be obtained on this occasion. The difference between modelled and monitored concentrations was greater than -25% at the majority of locations, therefore adjustment of the results was necessary. The relevant data was then gathered to allow the adjustment factor to be calculated.

It was also decided that, for the purpose of verification, the model domain would be split into two distinct areas, in order to improve the robustness of the verification factors output and provide a more location specific factor for the AQMA. They are shown in

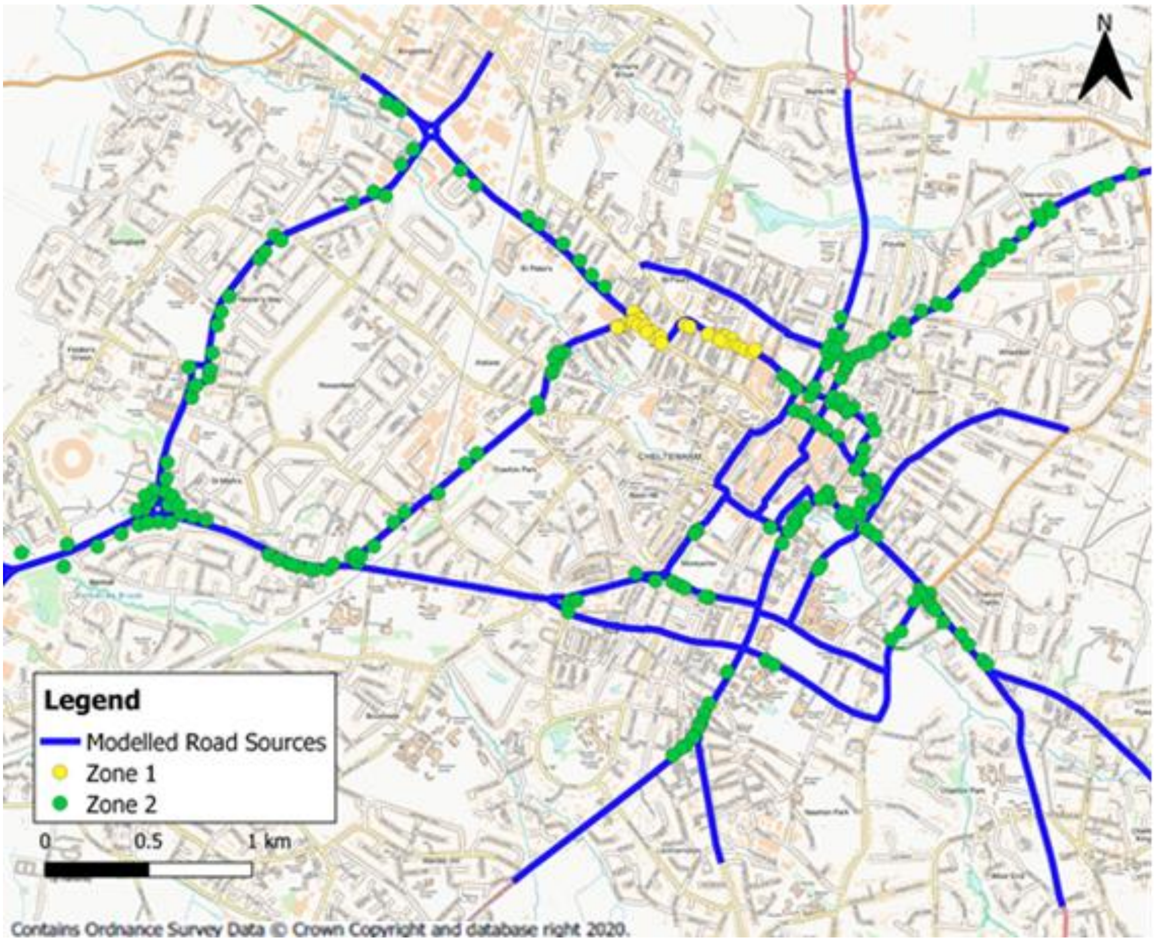
Figure A.1, and are listed as follows:

- Zone 1 – Areas within and surrounding the AQMA; and
- Zone 2 – All other areas within the model domain.

Model adjustment needs to be undertaken based on NO_x and not NO_2. For the Council operated monitoring results used in the calculation of the model adjustment, NO_x was derived from NO_2; these calculations were undertaken using a spreadsheet tool available from the LAQM website[17].

[17] http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOxNO2calc

Figure A.1 – Verification Zones



Zone 1 Verification (AQMA)

Table A.3 provides the relevant data required for Zone 1 to calculate the model adjustment based on regression of the modelled and monitored road source contribution to NO_x.

Figure A.2 provides a comparison of the Modelled Road Contribution NO_x versus Monitored Road Contribution NO_x, and the equation of the trend line based on linear regression through zero. The Total Monitored NO_x concentration has been derived by back-calculating NO_x from the NO_x/NO_2 empirical relationship using the spreadsheet tool available from Defra's website. The equation of the trend lines presented in Figure A.2 gives an adjustment factor for the modelled results of 4.588.

Table A.3 – Data Required for Adjustment Factor Calculation – Zone 1

Site ID	Monitored total NO_2 (µg/m³)	Monitored total NO_x (µg/m³)	Background NO_2 (µg/m³)	Background NO_x (µg/m³)	Monitored road contribution NO_2 (total - background) (µg/m³)	Monitored road contribution NO_x (total - background) (µg/m³)	Modelled road contribution NO_x (excludes background) (µg/m³)
CM1	36.0	62.5	15.3	21.1	20.7	41.4	10.3
DT4	43.1	80.3	12.1	16.2	30.9	64.0	13.0
DT5	46.5	86.8	15.3	21.1	31.2	65.7	14.4
DT6	40.3	72.0	15.3	21.1	25.0	50.9	11.3
DT10	39.2	69.7	15.3	21.1	23.9	48.6	10.1

Figure A.2 – Zone 1 Comparison of the Modelled Road Contribution NO_x versus Monitored Road Contribution NO_x

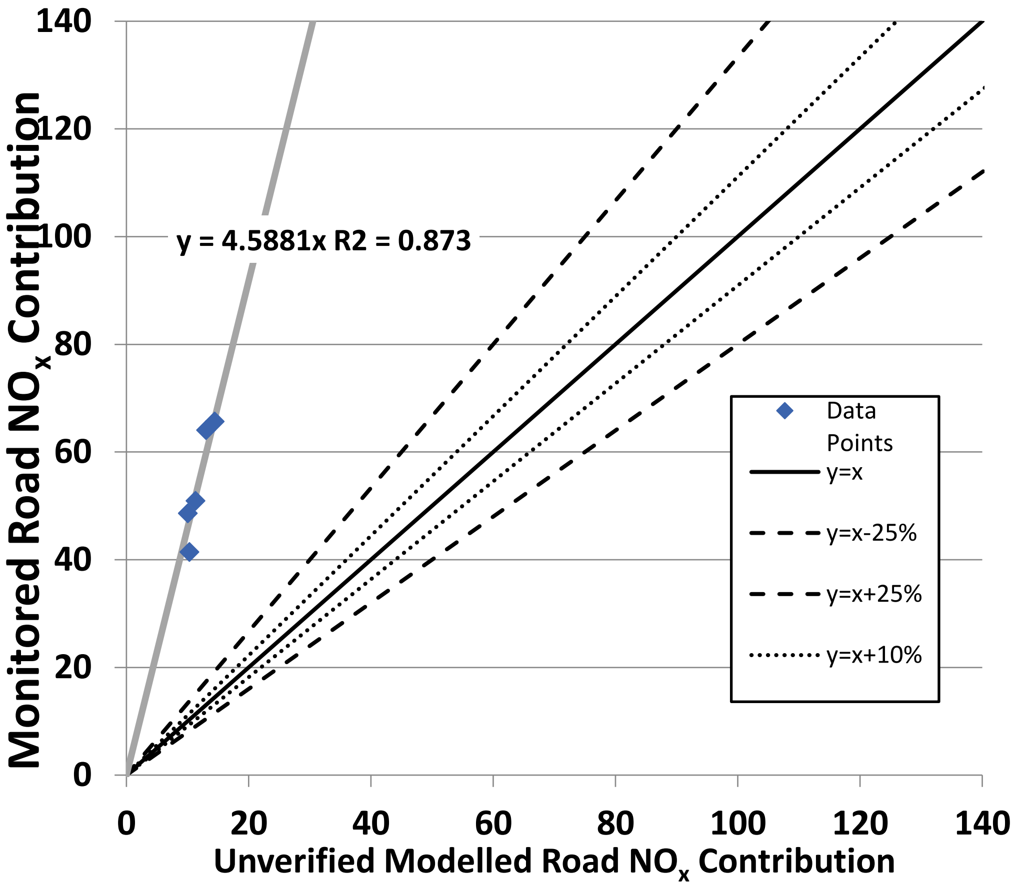


Table A.4 – Zone 1 Adjustment Factor and Comparison of Verified Results against Monitoring Results

Site ID	Ratio of monitored road contribution NO_x / modelled road contribution NOx	Adjustment factor for modelled road contribution NO_x	Adjusted modelled road contribution NO_x (µg/m³)	Adjusted modelled total NO_x (including background NO_x) (µg/m³)	Modelled total NO_2 (based upon empirical NO_x / NO_2 relationship) (µg/m³)	Monitored total NO_2 (µg/m³)	Difference (adjusted modelled NO_2 vs. monitored NO_2) (%)
CM1	4.0	4.588	47.3	68.4	38.7	36.0	7.4
DT4	4.6		59.8	76.0	41.3	43.1	-4.2
DT5	4.6		66.3	87.4	46.8	46.5	0.5
DT6	4.5		51.9	73.0	40.7	40.3	1.1
DT10	4.6		46.1	67.2	38.1	39.2	-2.8

Figure A.3 – Zone 1 Comparison of the Verified Modelled Total NO_2 versus Monitored NO_2

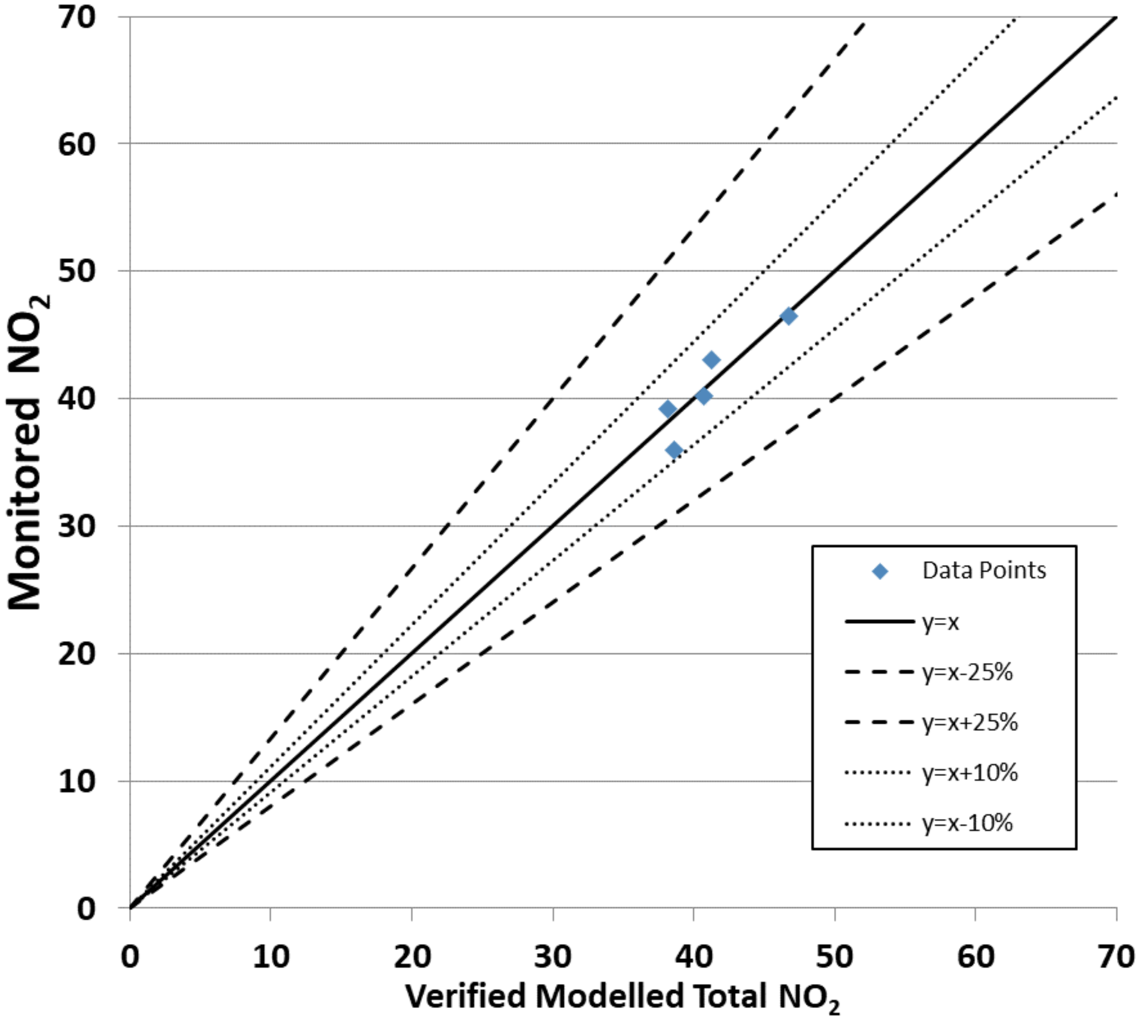


Table A.4 and Figure A.3 show the ratios between monitored and modelled NO_2 for each monitoring location after using the calculated adjustment factor. LAQM.TG(16)[1] states that:

"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, ideally within 10%."

The sites show good agreement between the ratios of monitored and modelled NO_2, It can be seen that all of the verification points lie within the ±10% tolerance as detailed in LAQM.TG(16).

A factor of 4.588 reduces the Root Mean Square Error (RMSE) from a value of 20.0 to 1.5, which is in line with the guidance value of 4 µg/m^3 as stated within LAQM.TG(16).

The 4.588 Zone 1 adjustment factor was applied to the road contribution NO_x concentrations predicted by the model to arrive at the final NO_2 concentrations in and around the AQMA (Figure A.1).

Zone 2 Verification (All Other Areas)

Table A.5 provides the relevant data required for Zone 2 to calculate the model adjustment based on regression of the modelled and monitored road source contribution to NO_x.

Figure A.4 provides a comparison of the Modelled Road Contribution NO_x versus Monitored Road Contribution NO_x, and the equation of the trend line based on linear regression through zero. The Total Monitored NO_x concentration has been derived by back-calculating NO_x from the NO_x/NO_2 empirical relationship using the spreadsheet tool available from Defra's website. The equation of the trend lines presented in Figure A.4 gives an adjustment factor for the modelled results of 3.725.

Table A.5 – Data Required for Adjustment Factor Calculation – Zone 2

Site ID	Monitored total NO_2 (µg/m³)	Monitored total NO_x (µg/m³)	Background NO_2 (µg/m³)	Background NO_x (µg/m³)	Monitored road contribution NO_2 (total - background) (µg/m³)	Monitored road contribution NO_x (total - background) (µg/m³)	Modelled road contribution NO_x (excludes background) (µg/m³)
CM1	36.0	62.5	15.3	21.1	20.7	41.4	10.3
DT2	27.6	44.9	15.3	21.1	12.3	23.8	6.1
DT4	43.1	80.3	12.1	16.2	30.9	64.0	13.0
DT5	46.5	86.8	15.3	21.1	31.2	65.7	14.4
DT6	40.3	72.0	15.3	21.1	25.0	50.9	11.3
DT10	39.2	69.7	15.3	21.1	23.9	48.6	10.1
DT11	34.1	59.0	14.2	19.3	20.0	39.7	13.4
DT12	34.4	59.4	14.2	19.3	20.2	40.2	9.4
DT13	30.4	51.0	14.2	19.3	16.3	31.8	5.7
DT14	37.4	66.7	12.9	17.4	24.5	49.3	16.1
DT15	28.5	47.0	14.2	19.3	14.3	27.8	11.1
DT16	34.4	59.5	14.2	19.3	20.2	40.2	14.0
DT18	37.6	67.3	12.9	17.4	24.7	49.9	18.6
DT20	36.2	64.2	12.6	16.9	23.6	47.4	11.7
DT21	23.9	37.4	15.3	21.1	8.6	16.3	6.1
DT26	31.3	53.7	12.1	16.2	19.1	37.5	6.1
DT27	27.6	45.6	12.9	17.4	14.6	28.2	9.8
DT28	38.2	67.9	14.3	19.5	23.9	48.3	10.1
DT29	33.7	58.8	12.6	16.8	21.2	42.0	9.0
DT30	31.6	53.1	15.3	21.1	16.3	32.0	6.2

Figure A.4 – Zone 2 Comparison of the Modelled Road Contribution NO_x versus Monitored Road Contribution NO_x

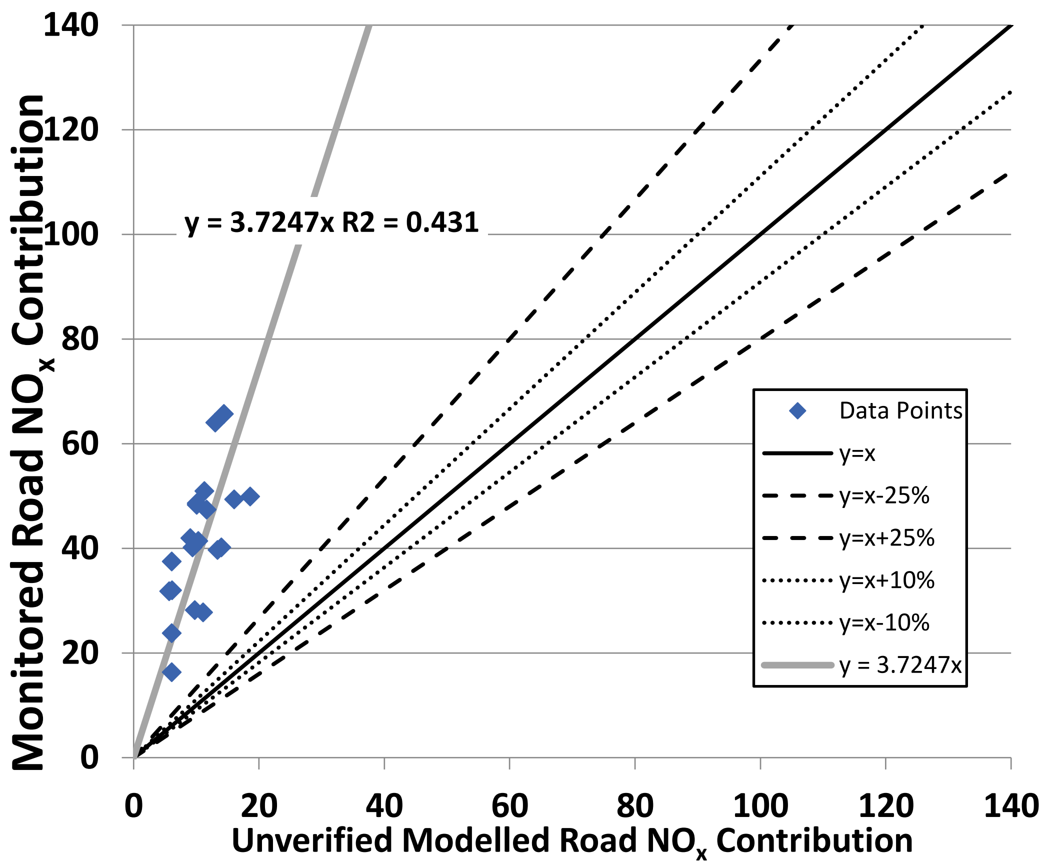
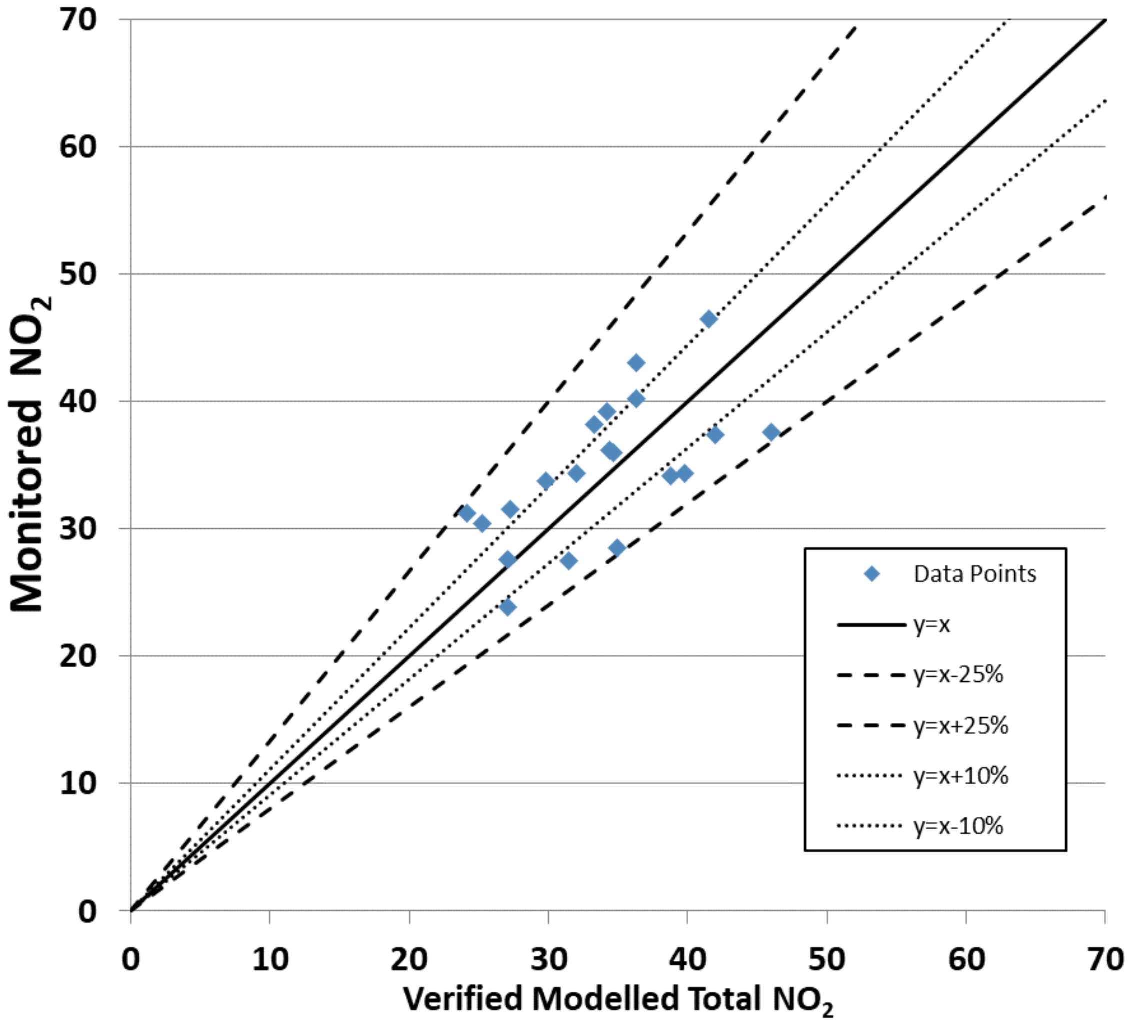


Table A.6 – Zone 2 Adjustment Factor and Comparison of Verified Results against Monitoring Results

Site ID	Ratio of monitored road contribution NO_x / modelled road contribution NOx	Adjustment factor for modelled road contribution NO_x	Adjusted modelled road contribution NO_x (µg/m³)	Adjusted modelled total NO_x (including background NO_x) (µg/m³)	Modelled total NO_2 (based upon empirical NO_x / NO_2 relationship) (µg/m³)	Monitored total NO_2 (µg/m³)	Difference (adjusted modelled NO_2 vs. monitored NO_2) (%)
CM1	4.0	3.725	38.4	59.5	34.6	36.0	-3.8
DT2	4.0		22.7	43.8	27.1	27.6	-1.9
DT4	4.5		48.5	64.8	36.3	43.1	-15.6
DT5	4.5		53.8	74.9	41.5	46.5	-10.8
DT6	4.5		42.2	63.3	36.3	40.3	-9.8
DT10	4.6		37.5	58.6	34.2	39.2	-12.9
DT11	4.2		49.9	69.1	38.7	34.1	13.4
DT12	4.2		35.2	54.4	32.0	34.4	-6.8
DT13	4.3		21.2	40.5	25.3	30.4	-17.0
DT14	4.0		59.8	77.2	42.0	37.4	12.2
DT15	3.9		41.4	60.7	34.9	28.5	22.6
DT16	3.8		52.2	71.4	39.8	34.4	15.6
DT18	3.6		69.3	86.7	46.0	37.6	22.1
DT20	3.6		43.4	60.3	34.4	36.2	-4.9

Site ID	Ratio of monitored road contribution NO_x / modelled road contribution NOx	Adjustment factor for modelled road contribution NO_x	Adjusted modelled road contribution NO_x (µg/m³)	Adjusted modelled total NO_x (including background NO_x) (µg/m³)	Modelled total NO_2 (based upon empirical NO_x / NO_2 relationship) (µg/m³)	Monitored total NO_2 (µg/m³)	Difference (adjusted modelled NO_2 vs. monitored NO_2) (%)
DT21	3.6		22.6	43.7	27.1	23.9	13.3
DT26	3.7		22.8	39.0	24.1	31.3	-22.9
DT27	3.6		36.4	53.8	31.5	27.6	14.3
DT28	3.7		37.6	57.1	33.3	38.2	-12.8
DT29	3.7		33.7	50.5	29.9	33.7	-11.5
DT30	3.7		23.0	44.1	27.2	31.6	-13.8

Figure A.5 – Zone 2 Comparison of the Verified Modelled Total NO_2 versus Monitored NO_2



A factor of 3.725 reduces the Root Mean Square Error (RMSE) from a value of 15.5 to 4.8. Ideally, as stated in LAQM.TG(16), an RMSE value of 4 µg/m³ (±10% tolerance) or less would be achieved; however, it can be seen that all of the verification points lie within the ±25% tolerance (10 µg/m³).

There is therefore considered to be an acceptable level of agreement between the ratios of monitored and modelled NO_2, given the area over which the borough-wide factor applies.

The 3.725 Zone 2 adjustment factor was applied to the road contribution NO_x concentrations predicted by the model outside of the AQMA area (see Figure A.1) to arrive at the final NO_x concentrations. .

Appendix B – Background Concentrations Used

Table B.1 – Defra Background Pollutant Concentrations Covering the Modelled Domain

Grid Square (E,N)	2019 Annual Mean Background Concentration (µg/m^3) [1]			
	Total Background NO_x	Total Background NO_2	Total Background PM_{10}	Total Background $PM_{2.5}$
391500, 224500	13.6	10.4	13.5	8.9
392500, 224500	14.8	11.2	13.8	9.2
393500, 224500	19.9	14.5	14.3	9.5
394500, 224500	14.2	10.7	14.5	9.4
395500, 224500	13.8	10.4	13.8	9.0
396500, 224500	12.0	9.2	13.1	8.8
391500, 223500	13.7	10.4	13.9	9.4
392500, 223500	16.3	12.2	14.4	9.9
393500, 223500	19.5	14.3	14.5	9.9
394500, 223500	16.2	12.1	14.4	9.9
395500, 223500	15.5	11.6	13.8	9.4
396500, 223500	17.0	12.6	14.1	9.7
391500, 222500	17.0	12.7	13.9	9.4
392500, 222500	16.8	12.6	14.5	9.8
393500, 222500	18.2	13.4	14.3	9.9
394500, 222500	21.1	15.3	14.6	9.9
395500, 222500	19.3	14.2	14.9	10.1
396500, 222500	14.5	10.9	13.9	9.6
391500, 221500	19.1	14.1	14.6	9.7
392500, 221500	16.9	12.6	14.2	9.8
393500, 221500	16.1	12.1	13.9	9.5
394500, 221500	18.9	14.0	14.2	9.7
395500, 221500	17.4	12.9	14.1	9.6
396500, 221500	14.5	11.0	13.4	9.1
391500, 220500	14.6	11.0	13.8	9.2
392500, 220500	13.8	10.5	13.9	9.5
393500, 220500	13.7	10.4	13.8	9.3
394500, 220500	13.9	10.5	13.7	9.5
395500, 220500	12.3	9.4	13.1	9.0
396500, 220500	12.4	9.5	13.2	9.0

Note:
[1] Values obtained from the 2019 Defra Mapped Background estimates for the relevant 1km x 1km grid squares covering the modelled domain

Appendix C – Traffic Inputs

Table C. 1 – Traffic Data used in the Detailed Assessment

Source	Traffic Point	Modelled Road Link	AADT	HGV (%)	Average Speed (kph)
DFT Traffic Data 2019	8569	WnchmbeSt_JctN_A4019	7459	7.0	20.0
DFT Traffic Data 2019	8569	WnchmbeSt_Rd_1	7459	7.0	17.0
DFT Traffic Data 2019	8569	WnchmbeSt_Rd_2	7459	7.0	48.3
DFT Traffic Data 2019	47170	Cirences_Rd_1	8713	1.9	48.3
DFT Traffic Data 2019	47170	Cirences_Rd_2	8713	1.9	48.3
DFT Traffic Data 2019	47170	Cirences_JctN_A40	8713	1.9	20.0
DFT Traffic Data 2019	47170	Cirences_JctS_Lyefld	8713	1.9	20.0
DFT Traffic Data 2019	47170	Cirences_Rd_4	8713	1.9	26.6
DFT Traffic Data 2019	47170	Cirences_Rd_3	8713	1.9	48.3
DFT Traffic Data 2019	47170	Cirences_JctN_Lyefld	8713	1.9	20.0
DFT Traffic Data 2019	48071	SflkRd_JctW_ThirleRd	10235	1.9	20.0
DFT Traffic Data 2019	48071	SflkRd_Rd_1	10235	1.9	48.3
DFT Traffic Data 2019	48071	SflkRd_JctE_ParkPlc	10235	1.9	20.0
DFT Traffic Data 2019	26442	SflkRd_JctW_ParkPlc	10235	1.6	20.0
DFT Traffic Data 2019	26442	SflkRd_Rd_2_Xin	10235	1.6	20.0
DFT Traffic Data 2019	26442	SflkRd_Rd_3	10235	1.6	48.3
DFT Traffic Data 2019	26442	SflkRd_Rd_4	10235	1.6	28.9
DFT Traffic Data 2019	17981	A16_Jct_2	14470	2.3	34.6
DFT Traffic Data 2019	17981	HighSt_Rd_1_Xin	14470	2.3	34.6
DFT Traffic Data 2019	17981	A16_Jct_1	14470	2.3	34.6
DFT Traffic Data 2019	17981	HighSt_Rd_2	14470	2.3	34.6
DFT Traffic Data 2019	17981	A435_JctW_HewlettRd	14470	2.3	34.6
DFT Traffic Data 2019	99377	EveshamRd_JctN_Welli	11679	4.7	20.0
DFT Traffic Data 2019	99377	EveshamRd_Rd_2	11679	4.7	26.9
DFT Traffic Data 2019	99377	EveshamRd_Rd_3	11679	4.7	48.3
DFT Traffic Data 2019	48072	A46_BathRd_Jct_N_A46	12337	1.4	20.0
DFT Traffic Data 2019	48072	A46_BathRd_Rd_6	12337	1.4	48.3
DFT Traffic Data 2019	48072	A46_BathRd_Rd_7_Xin	12337	1.4	20.0
DFT Traffic Data 2019	48072	A46_BathRd_JctS_Sflk	12337	1.4	20.0
DFT Traffic Data 2019	48072	A46_BathRd_Rd_5	12337	1.4	48.3
DFT Traffic Data 2019	18552	Tew_Rd_17_Jct	24066	2.9	20.0
DFT Traffic Data 2019	18552	Tew_Rd_8_Jct	24066	2.9	57.9
DFT Traffic Data 2019	18552	Tew_Rd_13_Jct	24066	2.9	57.9
DFT Traffic Data 2019	18552	Tew_Rd_14_Jct	24066	2.9	20.0
DFT Traffic Data 2019	18552	Tew_Rd_11_Jct	24066	2.9	57.9
DFT Traffic Data 2019	18552	Tew_Rd_12	24066	2.9	64.4
DFT Traffic Data 2019	18552	Tew_Rd_15	24066	2.9	48.3
DFT Traffic Data 2019	18552	Tew_Rd_16_2Jct	24066	2.9	24.1
DFT Traffic Data 2019	18552	Tew_Rd_5	24066	2.9	64.4
DFT Traffic Data 2019	18552	Tew_Rd_6	24066	2.9	64.4
DFT Traffic Data 2019	18552	Tew_Rd_MJct	24066	2.9	10.0

Source	Traffic Point	Modelled Road Link	AADT	HGV (%)	Average Speed (kph)
DFT Traffic Data 2019	18552	Tew_Rd_9	24066	2.9	64.4
DFT Traffic Data 2019	18552	Tew_Rd_10_Jct	24066	2.9	57.9
DFT Traffic Data 2019	18552	Tew_Rd_7_Jct	24066	2.9	57.9
DFT Traffic Data 2019	27679	Tewke_Rd_MJct	26028	2.5	10.0
DFT Traffic Data 2019	27679	Tew_Rd_2	26028	2.5	33.0
DFT Traffic Data 2019	27679	Tew_Rd_3_Split2_MJct	26028	2.5	33.0
DFT Traffic Data 2019	27679	Tew_Rd	26028	2.5	64.4
DFT Traffic Data 2019	27679	Tew_Rd_1	26028	2.5	64.4
DFT Traffic Data 2019	27679	Tew_Rd_4_Split2_MJct	26028	2.5	33.0
DFT Traffic Data 2019	28699	A4013_Jct	26222	2.3	41.0
DFT Traffic Data 2019	28699	A4013_4	26222	2.3	41.0
DFT Traffic Data 2019	28699	A4013_5	26222	2.3	41.0
DFT Traffic Data 2019	28699	A4013_2	26222	2.3	41.0
DFT Traffic Data 2019	28699	A4013_3	26222	2.3	41.0
DFT Traffic Data 2019	99604	CollegeRd_JctS_A435	9608	1.6	20.0
DFT Traffic Data 2019	99604	CollegeRd_Rd_1	9608	1.6	19.8
DFT Traffic Data 2019	99604	CollegeRd_JctN_Sandf	9608	1.6	20.0
DFT Traffic Data 2019	99377	EveshamRd_JctN_Clare	12401	4.7	20.0
DFT Traffic Data 2019	99377	EveshamRd_Rd_1	12401	4.7	48.3
DFT Traffic Data 2019	99377	EveshamRd_JctS_Welli	12401	4.7	20.0
DFT Traffic Data 2019	77984	Shurdgtn_Rd_2	17386	2.0	48.3
DFT Traffic Data 2019	77984	Shurdgtn_JctE_Mooren	17386	2.0	20.0
DFT Traffic Data 2019	77984	Shurdgtn_Rd_JctW_A46	17386	2.0	20.0
DFT Traffic Data 2019	77984	Shurdgtn_Rd_1	17386	2.0	48.3
DFT Traffic Data 2019	77984	Shurdgtn_JctW_Mooren	17386	2.0	57.9
DFT Traffic Data 2019	77984	Shurdgtn_Rd_3	17386	2.0	33.9
DFT Traffic Data 2019	77983	A40_LndRd_Rd_5	11370	2.1	64.4
DFT Traffic Data 2019	77983	A40_LndRd_Rd_6_Xin	11370	2.1	57.9
DFT Traffic Data 2019	77983	A40_JctW_Greenway Ln	11370	2.1	20.0
DFT Traffic Data 2019	77983	A40_JctE_Greenway Ln	11370	2.1	20.0
DFT Traffic Data 2019	77983	A40_LndRd_Rd_7	11370	2.1	64.4
DFT Traffic Data 2019	77983	A40_LndRd_Rd_8	11370	2.1	35.5
DFT Traffic Data 2019	77983	A40_LndRd_Rd_3_Xin	11370	2.1	20.0
DFT Traffic Data 2019	77983	A40_LndRd_Rd_4	11370	2.1	48.3
DFT Traffic Data 2019	77983	A40_JctE_A435/Haywar	11370	2.1	20.0
DFT Traffic Data 2019	77983	A40_LndRd_Rd_3	11370	2.1	48.3
DFT Traffic Data 2019	70126	A46_Fairvw_JctW_Winc	12310	2.5	17.4
DFT Traffic Data 2019	70126	A46_Fairvw_JctE_Prtl	12310	2.5	17.4

Source	Traffic Point	Modelled Road Link	AADT	HGV (%)	Average Speed (kph)
DFT Traffic Data 2019	70122	NStreet_JctS_A4019	5410	3.6	20.0
DFT Traffic Data 2019	70122	NStreet_JctM_AlbnSt	5410	3.6	20.0
DFT Traffic Data 2019	58258	A40_6	24356	3.6	64.4
DFT Traffic Data 2019	58258	A40_7	24356	3.6	64.4
DFT Traffic Data 2019	58258	Glcster_Jct_Split	24356	3.6	57.9
DFT Traffic Data 2019	58258	Glcster_2Jct_Split	24356	3.6	32.2
DFT Traffic Data 2019	58258	A40_8	24356	3.6	64.4
DFT Traffic Data 2019	58258	A40_9_2Jct	24356	3.6	32.2
DFT Traffic Data 2019	5048	AlbionSt_Rd_3_Xin	4871	3.6	48.3
DFT Traffic Data 2019	5048	AlbionSt_Rd_1	4871	3.6	48.3
DFT Traffic Data 2019	5048	AlbionSt_Rd_2	4871	3.6	48.3
DFT Traffic Data 2019	5048	AlbionSt_Rd_4	4871	3.6	48.3
DFT Traffic Data 2019	5030	A46_BathRd_Rd_1	14470	3.6	34.6
DFT Traffic Data 2019	48637	A46_BathRd_Rd_2	14381	1.9	48.3
DFT Traffic Data 2019	48637	A46_BathRd_JctE_Bath	14381	1.9	20.0
DFT Traffic Data 2019	48637	A46_BathRd_JctW_Bath	14381	1.9	20.0
DFT Traffic Data 2019	48072	A46_BathRd_Rd_4	10873	1.4	48.3
DFT Traffic Data 2019	48072	A46_BathRd_JctN_Sflk	10873	1.4	20.0
DFT Traffic Data 2019	48071	OldBathRd_JctS_Sandf	11292	1.9	20.0
DFT Traffic Data 2019	48071	OldBathRd_Rd_4	11292	1.9	48.3
DFT Traffic Data 2019	48071	ThirleRd_Rd_1	11292	1.9	26.5
DFT Traffic Data 2019	48071	ThirleRd_JctE_SflkRd	11292	1.9	20.0
DFT Traffic Data 2019	48071	OldBathRd_JctN_Thirl	11292	1.9	20.0
DFT Traffic Data 2019	48071	ThirleRd_JctW_OldBat	11292	1.9	20.0
DFT Traffic Data 2019	38657	Promenade_Jct_A46	11465	6.2	20.0
DFT Traffic Data 2019	38657	Promenade_Rd_1	11465	6.2	48.3
DFT Traffic Data 2019	38657	MntPelWalk_Rd_2	11465	6.2	48.3
DFT Traffic Data 2019	38657	MntPelWalk_JctN_Land	11465	6.2	21.7
DFT Traffic Data 2019	38657	Promenade_Rd_2	11465	6.2	48.3
DFT Traffic Data 2019	38657	MntPelWalk_Rd_1	11465	6.2	48.3
DFT Traffic Data 2019	38656	A46_Fairvw_JctE_Winc	12310	2.5	20.0
DFT Traffic Data 2019	38656	A46_Fairvw_Rd_3	12310	2.5	48.3
DFT Traffic Data 2019	38656	A46_Fairvw_JctW_AlbS	12310	2.5	20.0
DFT Traffic Data 2019	38656	A46_Fairvw_Rd_1	12310	2.5	48.3
DFT Traffic Data 2019	38656	A46_Fairvw_Rd_2	12310	2.5	48.3
DFT Traffic Data 2019	99605	A16_Jct	14029	2.7	20.0
DFT Traffic Data 2019	99605	A46_AlbionSt_Rd_2	14029	2.7	48.3
DFT Traffic Data 2019	99605	A46_Fairvw_JctE_AlbS	14029	2.7	20.0
DFT Traffic Data 2019	99605	A46_AlbionSt_Rd_1	14029	2.7	48.3
DFT Traffic Data 2019	99605	A46_AlbS_JctW_StJame	14029	2.7	20.0
DFT Traffic Data 2019	28700	A46_BathRd_Rd_3	6509	1.5	48.3

Source	Traffic Point	Modelled Road Link	AADT	HGV (%)	Average Speed (kph)
DFT Traffic Data 2019	26442	A40_2Jct_1	12023	1.6	16.6
DFT Traffic Data 2019	26442	SflkRd_Rd_6	12023	1.6	48.3
DFT Traffic Data 2019	26442	SflkRd_Rd_5_Xin	12023	1.6	20.0
DFT Traffic Data 2019	26442	A40_1	12023	1.6	48.3
DFT Traffic Data 2019	26442	A40_2	12023	1.6	48.3
DFT Traffic Data 2019	18553	ImpSq_Jct_2	10852	1.9	20.0
DFT Traffic Data 2019	18553	ImpSq_Rd_2	10852	1.9	48.3
DFT Traffic Data 2019	18553	ImpSq_JctW_A46	10852	1.9	20.0
DFT Traffic Data 2019	18275	A4019_Swindon_Rd_1	14723	3.0	48.3
DFT Traffic Data 2019	18275	A4019_SwdnR_JctE_StG	14723	3.0	20.0
DFT Traffic Data 2019	18275	A4019_Swindon_Rd_4	14723	3.0	48.3
DFT Traffic Data 2019	18275	A46_Fairvw_JctW_Prtl	14723	3.0	20.0
DFT Traffic Data 2019	18275	A4019_Swindon_Rd_3	14723	3.0	48.3
DFT Traffic Data 2019	18275	A4019_SwdnR_JctW_StG	14723	3.0	20.0
DFT Traffic Data 2019	18275	A4019_StMar_Rd_5	14723	3.0	48.3
DFT Traffic Data 2019	18275	A4019_StMar_JctW_MoA	14723	3.0	20.0
DFT Traffic Data 2019	18275	A4019_SwdnR_JctW_DuS	14723	3.0	20.0
DFT Traffic Data 2019	18275	A4019_SwdnR_JctE_DuS	14723	3.0	20.0
DFT Traffic Data 2019	18275	A4019_StMar_JctW_NoP	14723	3.0	20.0
DFT Traffic Data 2019	18275	A4019_StMar_JctE_NoP	14723	3.0	20.0
DFT Traffic Data 2019	18275	A4019_StMar_JctE_MoA	14723	3.0	20.0
DFT Traffic Data 2019	18275	A4019_StMar_Rd_6	14723	3.0	48.3
DFT Traffic Data 2019	18275	A4019_Swindon_Jct_1	14723	3.0	20.0
DFT Traffic Data 2019	18275	A4019_Swindon_Rd_2	14723	3.0	48.3
DFT Traffic Data 2019	17981	A435_JctN_A40/B4075	14182	2.3	20.0
DFT Traffic Data 2019	17981	A435_Rd_1	14182	2.3	23.4
DFT Traffic Data 2019	17981	A435_Rd_2	14182	2.3	48.3
DFT Traffic Data 2019	17981	A435_JctE_HewlettRd	14182	2.3	20.0
DFT Traffic Data 2019	16411	A40_LndRd_Rd_2	17533	3.0	48.3
DFT Traffic Data 2019	16411	A40_JctS_A40/B4075	17533	3.0	20.0
DFT Traffic Data 2019	16411	A40_JctN_A435/Haywar	17533	3.0	20.0
DFT Traffic Data 2019	16411	A40_LndRd_Rd_1	17533	3.0	48.3
DFT Traffic Data 2019	8570	MntTerr_Rd_2_Xin	11598	1.8	20.0
DFT Traffic Data 2019	8570	MntTerr_Rd_3	11598	1.8	24.6
DFT Traffic Data 2019	8570	MntTerr_JctE_RdbLans	11598	1.8	24.6
DFT Traffic Data 2019	8570	MntTerr_JctW_BathRd	11598	1.8	20.0

Source	Traffic Point	Modelled Road Link	AADT	HGV (%)	Average Speed (kph)
DFT Traffic Data 2019	8570	MntTerr_Rd_1	11598	1.8	48.3
DFT Traffic Data 2019	8569	PrtlndSt_Rd_1	7892	7.0	23.6
DFT Traffic Data 2019	8569	Prtlnd_JctS_Clarence	7892	7.0	20.0
DFT Traffic Data 2019	8569	PrtlndSt_JctN_A4019	7892	7.0	20.0
DFT Traffic Data 2019	38372	OldBathRd_Rd_1	11915	1.8	20.4
DFT Traffic Data 2019	38372	OldBathRd_Rd_2	11915	1.8	20.4
DFT Traffic Data 2019	38372	OldBathRd_Rd_3	11915	1.8	48.3
DFT Traffic Data 2019	38372	OldBathRd_JctN_Sandf	11915	1.8	20.0
DFT Traffic Data 2019	38372	OldBathRd_JctN_CBath	11915	1.8	20.0
DFT Traffic Data 2019	38372	OldBathRd_JctS_CBath	11915	1.8	20.0
DFT Traffic Data 2019	6436	Lansdown_Rd	18384	3.3	27.5
DFT Traffic Data 2019	6436	LndsRd_2Jct	18384	3.3	32.2
DFT Traffic Data 2019	6436	LnsdwnRd_Jct_Rdbnt	18384	3.3	20.0
DFT Traffic Data 2019	6436	LnsdwnRd_Rdbt	18384	3.3	20.0
DFT Traffic Data 2019	6436	LnsdwnRd_JctE_Rdbt	18384	3.3	57.9
DFT Traffic Data 2019	58259	ClrParade_JctS_Clrnc	7921	4.3	20.0
DFT Traffic Data 2019	58259	RoyalWell_JctS_Crec	7921	4.3	20.0
DFT Traffic Data 2019	58259	RoyalWell_Rd_1	7921	4.3	48.3
DFT Traffic Data 2019	58259	ClrParade_Rd_1	7921	4.3	48.3
DFT Traffic Data 2019	58259	ClrParade_JctN_CrecT	7921	4.3	20.0
DFT Traffic Data 2019	48638	AlbionSt_Rd_5	4871	6.4	48.3
DFT Traffic Data 2019	48638	AlbionSt_JctW_StJmes	4871	6.4	20.0
DFT Traffic Data 2019	28699	A4013_MJct	26222	2.3	41.0
DFT Traffic Data 2019	28699	A4013	26222	2.3	41.0
DFT Traffic Data 2019	18553	ImpSq_Rd_1	12963	1.9	48.3
DFT Traffic Data 2019	18553	ImpSq_Jct_1	12963	1.9	20.0
DFT Traffic Data 2019	18553	ImpSq_JctE_A46	12963	1.9	20.0
DFT Traffic Data 2019	8290	ClarenceRd_JctW_A46	8787	2.9	20.9
DFT Traffic Data 2019	28221	Sndfrd_JctE_BathRd	10090	2.0	20.0
DFT Traffic Data 2019	28221	Sndfrd_JctW_OldBathR	10090	2.0	20.0
DFT Traffic Data 2019	28221	SndfrdRd_Rd	10090	2.0	27.2
County Traffic Data 2019	5032	Prestbry_Rd_2_Xin	10654	5.8	20.0
County Traffic Data 2019	5032	Prestbry_Rd_3	10654	5.8	48.3
County Traffic Data 2019	5032	Prestbry_Rd_5	10654	5.8	48.3
County Traffic Data 2019	5032	Prestbry_Rd_6	10654	5.8	48.3
County Traffic Data 2019	5032	Prestbry_NJct_Rdbt	10654	5.8	20.0
County Traffic Data 2019	5032	Prestbry_Rd_9	10654	5.8	48.3
County Traffic Data 2019	5032	Prestbry_Rd_4	10654	5.8	48.3
County Traffic Data 2019	5032	Prestbry_Rd_7	10654	5.8	48.3
County Traffic Data 2019	5032	Prestbry_Rd_8	10654	5.8	48.3
County Traffic Data 2019	5032	Prestbry_Jct_A46	10654	5.8	20.0
County Traffic Data 2019	5032	Prestbry_Rd_1	10654	5.8	48.3
County Traffic Data 2019	5032	Prestbry_Jct_Rdbt	10654	5.8	20.0

Source	Traffic Point	Modelled Road Link	AADT	HGV (%)	Average Speed (kph)
County Traffic Data 2019	5032	Prestbry_Rdbt	10654	5.8	20.0
County Traffic Data 2019	5021	Poole_Way_Jct	14008	1.4	20.0
County Traffic Data 2019	5020	A4019_High_St_1	24066	2.7	48.3
County Traffic Data 2019	5021	A4019_Poole_Way_1	14008	1.4	48.3
County Traffic Data 2019	5020	A4019_Jct	24066	2.7	20.0
County Traffic Data 2019	5021	A4019_Poole_Way_2	20822	1.7	48.3
County Traffic Data 2019	5069	Winchombe_Jct	3127	1.7	25.3
County Traffic Data 2019	5047	RodneyRd	7408	1.8	48.3
County Traffic Data 2019	5047	RodneyRd_Jct	7408	1.8	20.0
County Traffic Data 2019	99185980_9 9185981	RodneyRd_2	7880	3.1	29.9
County Traffic Data 2019	99185980_9 9185981	RodneyRd_1	7880	3.1	29.9
County Traffic Data 2019	5037	A40_MJct_Split2_1	44059	2.5	50.7
County Traffic Data 2019	5036	A4013_1_Xin	26222	1.8	41.0
County Traffic Data 2017 (factored to 2019 using TEMPro)	70	Leckhampton_Rd_Jct	10634	2.3	20.0
County Traffic Data 2017 (factored to 2019 using TEMPro)	70	Leckhampton_Rd	10634	2.3	26.4
County Traffic Data 2017 (factored to 2019 using TEMPro)	70	Leckhampton_Rd_1	10634	2.3	48.3
County Traffic Data 2017 (factored to 2019 using TEMPro)	118	B4633_Jct_2	13648	2.5	20.0
County Traffic Data 2017 (factored to 2019 using TEMPro)	118	Glcs_Rd	13648	2.5	48.3
County Traffic Data 2017 (factored to 2019 using TEMPro)	118	B4633_Jct_3	13648	2.5	20.0
County Traffic Data 2017 (factored to 2019 using TEMPro)	118	B4633_Glcster_Rd_1	13648	2.5	21.2
County Traffic Data 2017 (factored to 2019 using TEMPro)	118	B4633_Glcster_Rd_2	13648	2.5	48.3
County Traffic Data 2017 (factored to 2019 using TEMPro)	118	B4633_1_2Jct	13648	2.5	24.1
County Traffic Data 2017 (factored to 2019 using TEMPro)	118	B4633_Glcster_Rd_5	13648	2.5	48.3
County Traffic Data 2017 (factored to 2019 using TEMPro)	118	B4633_Glcster_Rd_4	13648	2.5	48.3
County Traffic Data 2017 (factored to 2019 using TEMPro)	118	B4633_Glcster_Rd_3	13648	2.5	48.3
County Traffic Data 2017 (factored to 2019 using TEMPro)	118	B4633_2Jct	13648	2.5	24.1
County Traffic Data 2017 (factored to 2019 using TEMPro)	118	B4633_Glcster_Rd_6	13648	2.5	48.3
County Traffic Data 2017 (factored to 2019 using TEMPro)	118	B4633_Jct	13648	2.5	20.0
County Traffic Data 2017 (factored to 2019 using TEMPro)	118	B4633_Jct_1	13648	2.5	20.0
County Traffic Data 2017 (factored to 2019 using TEMPro)	118	Glcstr_Rd_Jct	13648	2.5	20.0
County Traffic Data 2017 (factored to 2019 using TEMPro)	118	B4633_Jct_4	13648	2.5	20.0
County Traffic Data 2017 (factored to 2019 using TEMPro)	78	Hewlett_Rd_Rdbt	5588	1.7	20.0
County Traffic Data 2017 (factored to 2019 using TEMPro)	78	Hewlett_Rd_Jct_2	5588	1.7	20.0
County Traffic Data 2017 (factored to 2019 using TEMPro)	78	Hewlett_Rd_Jct_1	5588	1.7	20.0

Source	Traffic Point	Modelled Road Link	AADT	HGV (%)	Average Speed (kph)
County Traffic Data 2017 (factored to 2019 using TEMPro)	78	Hewlett_Rd	5588	1.7	48.3
County Traffic Data 2017 (factored to 2019 using TEMPro)	78	Hewlett_Rd_1	5588	1.7	27.2
County Traffic Data 2017 (factored to 2019 using TEMPro)	137	Hewlett_Rd_Jct	5310	1.7	16.1
County Traffic Data 2017 (factored to 2019 using TEMPro)	5054	WellRd_Jct_2	894	1.8	20.0
County Traffic Data 2017 (factored to 2019 using TEMPro)	5053	WellRd	997	1.8	48.3
County Traffic Data 2017 (factored to 2019 using TEMPro)	5053	WellRd_Jct_1	997	1.8	20.0
County Traffic Data 2017 (factored to 2019 using TEMPro)	5053	WellRd_Jct	997	1.8	20.0
County Traffic Data 2017 (factored to 2019 using TEMPro)	5034	RoyalWell_Rd_2	14126	1.8	48.3
County Traffic Data 2017 (factored to 2019 using TEMPro)	5034	StGeorge_Jct	14126	1.8	20.0
County Traffic Data 2017 (factored to 2019 using TEMPro)	5060	ClarenceSt_Rd_1	7921	4.7	48.3
County Traffic Data 2017 (factored to 2019 using TEMPro)	5060	Clrence_JctE_A46	7921	4.7	20.0
County Traffic Data 2017 (factored to 2019 using TEMPro)	5060	NorthSt_Rd_1	7921	4.7	48.3
County Traffic Data 2017 (factored to 2019 using TEMPro)	5060	NorthSt_Rd_2	7921	4.7	48.3
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5068	StPaulsRd_5	8971	2.9	48.3
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5068	StPaulsRd_1	8971	2.9	48.3
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5068	StPaulsRd_2	8971	2.9	48.3
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5068	StPaulsRd_Jct	8971	2.9	20.0
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5068	StPaulsRd	8971	2.9	48.3
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5068	StPaulsRd_4	8971	2.9	48.3
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5068	StPaulsRd_Jct_2	8971	2.9	20.0
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5068	StPaulsRd_3	8971	2.9	48.3
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5068	StPaulsRd_Jct_1	8971	2.9	20.0
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5062	PEW_9_Split_Jct	17034	2.1	20.0
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5062	PEW_8_Jct	17034	2.1	20.0
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5062	PEW_2	17034	2.1	48.3
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5062	PEW_3_Jct	17034	2.1	20.0
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5062	PEW_Jct	17034	2.1	20.0
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5062	PEW_1	17034	2.1	48.3
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5062	PEW_6	17034	2.1	48.3

Source	Traffic Point	Modelled Road Link	AADT	HGV (%)	Average Speed (kph)
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5062	PEW_7_Jct	17034	2.1	20.0
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5062	PEW_4_Jct	17034	2.1	20.0
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5062	PEW_5	17034	2.1	48.3
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5062	PEW_Split_2Jct	17034	2.1	24.1
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5050	WnchmbeSt_JctS_A46	1717	4.1	20.0
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5050	WnchmbeSt_Rd_4	1717	4.1	48.3
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5050	WnchmbeSt_JctN_Albio	1717	4.1	20.0
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5041	Kingsditch_Rd_Jct	22405	36.4	20.0
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5041	Kingsditch_Rd	22405	36.4	48.3
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5041	Kingsditch_MJct	22405	36.4	10.0
County Traffic Count Data 2019, County Vehicle Composition Data 2017	5041	Kingsditch_Rd_1	22405	36.4	48.3
County Traffic Count Data 2019, DFT Vehicle Composition Data 2019	5037_77985	A40_Glcster_Rd	44059	2.5	50.7
County Traffic Count Data 2019, DFT Vehicle Composition Data 2019	5037 _77985	A40_MJct_Split2	44059	2.5	50.7
County Traffic Count Data 2019, DFT Vehicle Composition Data 2019	5037E_77985	GloucesterRd_J3	21229	2.5	53.6
County Traffic Count Data 2019, DFT Vehicle Composition Data 2019	5037W_77985	GloucesterRd_J4	22830	2.5	47.8
County Traffic Count Data 2019, DFT Vehicle Composition Data 2019	5037_77985	ArleCrt_Rdbt	44059	2.5	20.0
Calculated from surrounding links	6436_58258_26442	A_40_2Rdbt	18254	1.4	20.0
Calculated from surrounding links	6436_58258_26442	A40_10_2Jct	18254	1.4	20.0
Calculated from surrounding links	6436_58258_26442	A40_12	18254	1.4	64.4
Calculated from surrounding links	6436_58258_26442	A40_2Jct	18254	1.4	20.0
Calculated from surrounding links	6436_58258_26442	A40_2Jct_2	18254	1.4	20.0
Calculated from surrounding links	6436_58258_26442	A40_Jct	18254	1.4	20.0
Calculated from surrounding links	6436_58258_26442	A40_Jct_1	18254	1.4	20.0
Calculated from surrounding links	5069_99185980_99185981	High_St_Jct_2	3127	1.7	20.0
Calculated from surrounding links	6436_58258_26442	Lansdown_Rd_A40_1	18254	1.4	20.0
Calculated from surrounding links	6436_58258_26442	Lansdown_Rd_A40_2	18254	1.4	20.0
Calculated from surrounding links	6436_38657_8570	MntPelWalk_Rdbt	14991	1.2	20.0
Calculated from surrounding links	5019_5041_5036_5020	Tew_Rd_MRdbt	26125	1.7	20.0
Calculated from surrounding links, County Vehicle Composition Data 2017	5036_5062	A4013_Rdbt	21934	2.1	20.0

Source	Traffic Point	Modelled Road Link	AADT	HGV (%)	Average Speed (kph)
Calculated from surrounding links, County Vehicle Composition Data 2017	77984_70_5025	A46_BathRd_Rdbt	14862	1.9	20.0
Calculated from surrounding links, County Vehicle Composition Data 2017	5037_5062_58258	PEW_2Rdbt_	41390	3.0	20.0

Notes

Traffic flows and vehicle class compositions were taken from the Gloucestershire County Council roads traffic database and the DfT traffic count point database

Traffic speeds were modelled at either the relevant speed limit for each road or where available monitored vehicle speeds

Where appropriate, vehicle 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)[1]

Appendix D – Receptor Locations and Corresponding Modelled Predictions

Table D.1 – Predicted 2019 Annual Mean Concentrations of NO_2, PM_{10} and $PM_{2.5}$ at Discrete Receptor Locations

Receptor ID	Verification Zone	X	Y	Height	Closest address/post code	2019 Annual Mean Concentration (µg/m³)		
						NO_2	PM_{10}	$PM_{2.5}$
1	2	391956	222037	1.5	GL51 6BW	33.7	17.7	11.7
2	2	391862	222021	1.5	GL51 6BP	29.6	17.4	11.4
3	2	392013	222033	1.5	GL51 6BN	28.0	17.4	11.5
4	2	392006	222119	1.5	GL51 7TY	51.9	22.1	14.3
5	2	391990	222184	1.5	GL51 7TX	39.4	18.6	12.2
6	2	392064	222078	1.5	GL51 7TT	32.8	18.8	12.3
7	2	391905	222033	1.5	GL51 6BP	31.6	17.6	11.6
8	2	391777	221979	1.5	GL51 6BP	29.0	17.6	11.5
9	2	392123	222065	1.5	GL51 7TW	28.3	17.9	11.8
10	2	391994	222245	1.5	GL51 7ST	30.1	16.9	11.2
11	2	392027	222160	1.5	GL51 7TY	31.4	17.8	11.8
12	2	392053	222120	1.5	GL51 7TS	28.3	17.4	11.5
13	2	391887	222101	0.0	GL51 0FS	47.4	21.3	13.7
14	2	391851	222092	0.0	GL51 0FQ	35.7	18.7	12.2
15	2	391922	222156	0.0	GL51 0FW	39.7	18.8	12.3
16	2	391932	222189	0.0	GL51 0FP	33.2	17.5	11.5
17	2	391910	222136	0.0	GL51 0FT	42.7	19.6	12.7
18	2	391891	222162	0.0	GL51 0FT	28.2	16.8	11.1
19	2	391999	222324	1.5	GL51 7SW	27.4	16.8	11.1
20	2	392118	222637	1.5	GL51 7SG	26.4	16.9	11.3
21	2	392126	222688	4.0	GL51 7SQ	31.8	17.8	11.8
22	2	392140	222696	4.0	GL51 7SF	33.6	18.0	11.9
23	2	392201	222734	1.5	GL51 7RS	36.7	18.5	12.2
24	2	392206	222770	1.5	GL51 7RS	36.5	18.5	12.2
25	2	392106	222783	1.5	GL51 0GY	32.8	17.8	11.8
26	2	392217	222852	1.5	GL51 7NZ	35.1	19.0	12.5
27	2	392241	222986	1.5	GL51 7PX	30.8	18.2	12.0
28	2	392260	223050	1.5	GL51 7PT	30.6	18.2	12.1
29	2	392297	223125	1.5	GL51 7NJ	32.6	18.7	12.3
30	2	392443	223306	1.5	GL51 7LT	28.9	17.8	11.9
31	2	392471	223340	1.5	GL51 7LR	30.3	18.2	12.0
32	2	392518	223418	1.5	GL51 0BL	30.9	18.3	12.1
33	2	392549	223394	1.5	GL51 7PN	28.9	17.9	11.9
34	2	392895	223576	1.5	GL51 7PF	39.7	20.4	13.3
35	2	392995	223628	1.5	GL51 7PE	30.5	18.1	12.0
36	2	393052	223608	1.5	, GL51 7NY	26.8	17.0	11.4
37	2	393127	223760	1.5	GL51 0UW	28.3	17.3	11.5
38	2	393186	223833	1.5	GL51 0UW	32.0	18.0	11.9
39	2	393125	224021	1.5	GL51 0BZ	28.9	17.3	11.2
40	2	393103	224039	1.5	GL51 0BZ	28.1	17.2	11.1
41	2	393057	224059	1.5	GL51 0BZ	23.8	16.2	10.5
42	2	393415	223732	1.5	GL51 9DZ	27.4	17.3	11.5
43	2	393487	223659	1.5	GL51 9EH	26.7	17.2	11.5
44	2	393740	223507	1.5	GL51 9DP	29.3	17.9	11.9
45	2	393793	223471	1.5	GL51 9DN	28.7	17.7	11.8
46	2	393909	223378	1.5	GL51 9BN	28.4	17.7	11.8
47	2	394048	223227	1.5	GL51 9AR	29.3	17.8	11.9

Receptor ID	Verification Zone	X	Y	Height	Closest address/post code	2019 Annual Mean Concentration (µg/m³)		
						NO_2	PM_{10}	$PM_{2.5}$
48	2	393989	223296	1.5	GL51 9AS	29.6	18.0	11.9
49	2	394109	223171	1.5	GL51 9HR	29.1	17.6	11.8
50	1	394259	223038	1.5	GL51 9HA	39.4	19.2	12.7
51	1	394248	223050	1.5	GL51 9HD	39.1	19.2	12.7
52	1	394281	223013	1.5	GL51 9ER	35.7	18.9	12.5
53	1	394233	223001	3.5	GL51 8DW	35.1	18.5	12.3
54	1	394205	222989	1.5	GL51 8PQ	36.1	18.5	12.2
55	1	394250	223000	3.5	GL51 8DW	40.6	19.6	12.9
56	1	394271	222984	3.5	GL51 9ER	41.9	20.1	13.1
57	1	394307	222979	1.5	GL50 3HZ	46.8	21.5	13.9
58	1	394341	222954	1.5	GL50 3HX	47.0	21.4	13.8
59	1	394314	222951	3.5	GL50 3JA	39.6	19.7	12.8
60	1	394360	222917	1.5	GL50 3JA	56.7	22.1	14.3
61	1	394380	222929	1.5	GL50 3HU	51.1	20.9	13.7
62	1	394384	222898	1.5	GL50 3NZ	36.1	18.1	12.0
63	1	394497	222986	1.5	GL50 4BE	31.1	17.8	11.7
64	1	394609	222942	1.5	GL50 4AS	34.6	18.6	12.2
65	1	394519	222978	1.5	GL50 4BD	27.3	17.0	11.3
66	1	394670	222934	1.5	GL50 4AH	32.9	18.3	12.0
67	1	394691	222931	1.5	GL50 4AH	30.2	17.7	11.7
68	1	394727	222916	1.5	GL50 4AH	32.5	18.1	11.9
69	1	394684	222901	1.5	GL50 4AH	30.9	17.8	11.7
70	1	394665	222914	1.5	GL50 4AS	40.7	20.2	13.1
71	1	394745	222886	1.5	GL50 4AL	44.4	19.7	12.9
72	1	394763	222879	1.5	GL50 4AL	44.7	19.8	13.0
73	1	394788	222866	1.5	GL50 4AL	34.3	18.4	12.1
74	1	394823	222852	1.5	GL50 4AL	39.9	18.9	12.4
75	1	394835	222868	4.0	GL50 4FF	34.2	17.8	11.8
76	2	394973	222739	1.5	GL50 4FB	32.8	18.1	11.9
77	2	394994	222723	1.5	GL50 4DZ	32.4	18.0	11.9
78	2	395033	222681	1.5	GL50 4FH	35.9	18.5	12.2
79	2	395116	222668	3.5	GL52 2NB	35.8	18.3	12.1
80	2	395101	222643	3.5	GL52 2NB	30.6	17.5	11.6
81	2	395204	222614	1.5	GL52 2NY	35.5	18.4	12.2
82	2	395231	222606	1.5	GL52 2NY	32.8	18.4	12.1
83	2	395213	222640	1.5	GL52 2NN	37.7	18.6	12.3
84	2	395260	222588	1.5	GL52 2AT	29.1	17.8	11.8
85	2	395252	222625	1.5	GL52 2AT	28.7	17.6	11.7
86	2	395311	222590	1.5	GL52 2JL	26.0	17.2	11.4
87	2	395280	222567	1.5	GL52 2AD	25.2	17.0	11.3
88	2	395284	222575	3.5	GL52 2AD	27.1	17.5	11.6
89	2	395396	222527	1.5	GL52 2EH	25.5	17.1	11.4
90	2	395360	222389	1.5	GL52 2LF	28.2	17.5	11.6
91	2	395413	222477	1.5	GL52 2EX	26.2	17.3	11.5
92	2	395352	222332	1.5	GL52 2LE	30.8	17.7	11.7
93	2	395026	222573	3.5	GL52 2LH	24.3	16.8	11.2
94	2	395072	222561	3.5	GL52 2LP	24.0	16.7	11.2
95	2	395127	222521	3.5	GL52 2LP	25.0	16.9	11.3
96	2	395146	222509	3.5	GL52 2RQ	24.6	16.8	11.2
97	2	395178	222487	3.5	GL52 2RQ	23.3	16.6	11.1
98	2	395236	222449	1.5	GL52 2RW	24.1	16.8	11.2
99	2	395322	222292	1.5	GL52 2UG	27.4	17.1	11.4

Receptor ID	Verification Zone	X	Y	Height	Closest address/post code	2019 Annual Mean Concentration (µg/m³)		
						NO_2	PM_{10}	$PM_{2.5}$
100	2	395385	222232	1.5	GL52 2SW	33.5	18.8	12.4
101	2	395398	222240	1.5	GL52 2SS	38.8	20.1	13.1
102	2	395415	222228	1.5	GL52 2SU	33.5	18.8	12.3
103	2	395416	222180	1.5	GL52 2SY	32.4	18.6	12.2
104	2	395407	222154	1.5	GL52 2SY	30.1	18.1	11.9
105	2	395353	222127	1.5	GL52 6GA	30.7	18.1	12.0
106	2	395343	222072	1.5	GL52 6GA	39.9	19.6	12.9
107	2	395328	222080	1.5	GL52 6DB	40.8	19.7	12.9
108	2	395290	222028	1.5	GL50 1DZ	33.4	18.4	12.2
109	2	395267	222053	1.5	GL50 1DZ	31.6	18.1	12.0
110	2	395252	222069	1.5	GL50 1EE	30.5	17.9	11.9
111	2	395268	222086	1.5	GL52 6DA	35.1	18.9	12.4
112	2	395196	222149	3.5	GL50 1EE	32.9	18.4	12.2
113	2	395184	222161	3.5	GL50 1EE	32.7	18.4	12.1
114	2	395187	222183	4.0	GL50 1DU	30.2	17.9	11.8
115	2	395175	222170	3.5	GL50 1EE	35.3	18.9	12.4
116	2	395152	222150	3.5	GL53 7HA	32.2	18.0	12.0
117	2	395078	222109	1.5	GL53 7HG	32.7	18.6	12.3
118	2	395052	222086	1.5	GL53 7HG	30.4	18.2	12.0
119	2	395035	222036	1.5	GL53 7HW	31.3	18.4	12.1
120	2	395021	222049	0.0	GL53 7HG	34.8	19.2	12.6
121	2	395018	222016	1.5	GL53 7HJ	30.4	18.2	12.0
122	2	395000	221994	0.0	GL53 7HJ	29.3	17.3	11.5
123	2	394909	222010	1.5	GL50 1XP	25.5	16.5	11.0
124	2	394557	221997	4.0	GL50 1NN	26.3	16.6	11.1
125	2	394544	221981	4.0	GL50 1SA	26.0	16.5	11.1
126	2	394438	221748	0.0	GL50 1US	31.0	17.1	11.4
127	2	394470	221731	0.0	GL50 1UX	28.5	16.7	11.2
128	2	394496	221718	0.0	GL50 1UX	28.2	16.7	11.2
129	2	394614	221673	0.0	GL50 2XH	28.0	16.6	11.1
130	2	394595	221677	0.0	GL50 2XL	26.9	16.5	11.0
131	2	394702	221314	1.5	GL53 7LS	26.1	16.7	11.2
132	2	394614	221161	1.5	GL53 7LY	26.4	16.8	11.2
133	2	394588	221111	1.5	GL53 7LZ	27.5	16.9	11.3
134	2	394577	221075	1.5	GL53 7ND	38.7	18.6	12.3
135	2	394569	221063	0.0	GL53 7NA	34.2	17.7	11.8
136	2	394563	221045	0.0	GL53 7NA	35.1	17.9	11.9
137	2	394542	221004	3.5	GL53 0JB	38.9	18.5	12.3
138	2	394536	220998	1.5	GL53 0JB	38.0	18.5	12.3
139	2	394500	220958	1.5	GL53 0JA	40.7	20.5	13.4
140	2	394481	220947	1.5	GL53 0JA	31.5	18.2	12.1
141	2	394440	220913	1.5	GL50 2DP	30.5	18.0	12.0
142	2	394888	221370	1.5	GL53 7AA	27.8	16.7	11.2
143	2	394926	221349	1.5	GL53 7AA	28.4	16.8	11.3
144	2	394966	221934	1.5	GL53 7JT	26.1	16.7	11.2
145	2	395154	221832	0.0	GL53 7HX	27.5	16.5	11.0
146	2	395139	221810	0.0	GL53 7HX	28.7	16.7	11.2
147	2	395365	222007	0.0	GL52 6DE	38.6	19.1	12.6
148	2	395385	221995	0.0	GL52 6DF	32.4	17.4	11.6
149	2	395420	221969	0.0	GL52 6DF	31.9	17.3	11.5
150	2	395631	221711	1.5	GL52 6DF	30.6	17.0	11.4
151	2	395679	221690	0.0	GL52 6DF	37.8	18.2	12.1

Receptor ID	Verification Zone	X	Y	Height	Closest address/post code	2019 Annual Mean Concentration (µg/m^3)		
						NO_2	PM_{10}	$PM_{2.5}$
152	2	395661	221670	1.5	GL52 6DF	37.9	18.3	12.1
153	2	395632	221689	1.5	GL52 6EW	30.7	17.0	11.4
154	2	395604	221656	0.0	GL52 6EW	28.4	16.6	11.1
155	2	395491	221471	1.5	GL52 6EW	27.9	16.6	11.1
156	2	395539	221509	1.0	GL52 6EW	32.1	17.3	11.5
157	2	395679	221645	0.0	GL52 6EW	33.2	17.5	11.7
158	2	395690	221629	0.0	GL52 6EH	29.9	17.2	11.5
159	2	395706	221612	0.0	GL52 6EH	30.5	17.6	11.7
160	2	395745	221555	0.0	GL52 6EH	26.2	16.8	11.2
161	2	395830	221496	1.5	GL52 6EH	29.5	17.6	11.7
162	2	395865	221446	0.0	GL52 6EH	37.9	19.7	12.9
163	2	395934	221371	1.5	GL52 6SD	31.6	17.9	11.9
164	2	395955	221350	0.0	GL52 6SD	33.8	17.7	11.8
165	2	395121	222686	3.5	GL52 2NP	35.4	18.1	12.0
166	2	395183	222799	0.0	GL52 2NB	33.7	17.9	11.9
167	2	395200	222829	0.0	GL52 2NB	34.4	17.9	11.9
168	2	395213	222847	1.5	GL52 2AY	35.7	18.2	12.1
169	2	395183	222858	0.0	GL52 2AU	35.0	18.2	12.0
170	2	395195	222885	0.0	GL52 2AB	38.1	18.8	12.4
171	2	395227	222872	0.0	GL52 2AA	39.0	18.9	12.5
172	2	395218	222939	0.0	GL52 2AB	29.4	17.7	11.7
173	2	395252	222929	0.0	GL52 2AA	28.3	17.4	11.6
174	2	395249	223022	0.0	GL52 2AB	26.8	16.3	10.9
175	2	395251	222732	0.0	GL52 2NL	35.4	17.8	11.9
176	2	395271	222773	0.0	GL52 2NL	34.5	17.7	11.8
177	2	395278	222788	0.0	GL52 2NL	34.1	17.8	11.8
178	2	395272	222823	1.5	GL52 2AZ	34.1	18.2	12.1
179	2	395292	222811	1.5	GL52 2PN	31.8	17.8	11.8
180	2	395323	222836	3.5	GL52 2PN	30.4	17.8	11.8
181	2	395351	222850	3.5	GL52 2PN	28.9	17.6	11.7
182	2	395386	222859	1.5	GL52 2PP	26.5	17.1	11.4
183	2	395416	222903	0.0	GL52 2PW	33.4	18.6	12.2
184	2	395448	222922	0.0	GL52 2PW	32.6	18.3	12.1
185	2	395457	222904	0.0	GL52 2PN	31.0	18.0	11.9
186	2	395437	222893	0.0	GL52 2HP	30.2	17.9	11.9
187	2	395516	222968	1.5	GL52 2BY	32.9	17.9	11.9
188	2	395550	222994	0.0	GL52 2BZ	27.7	17.4	11.6
189	2	395559	222958	0.0	GL52 2BZ	25.0	16.8	11.2
190	2	395636	223055	0.0	GL52 3EP	23.5	16.1	10.8
191	2	395714	223088	1.5	GL52 3EP	24.6	16.4	10.9
192	2	395758	223082	1.5	GL52 2DJ	21.7	15.8	10.6
193	2	395853	223178	1.5	GL52 3EP	23.5	16.2	10.8
194	2	395915	223249	1.5	GL52 5DW	23.6	16.2	10.8
195	2	395883	223208	1.5	GL52 3EP	21.9	15.9	10.6
196	2	395954	223309	1.5	GL52 2DU	25.4	16.6	11.0
197	2	395973	223295	1.5	GL52 3EP	23.0	16.1	10.7
198	2	396009	223322	1.5	GL52 3EP	23.8	16.3	11.0
199	2	396047	223373	1.5	GL52 3EP	31.9	18.1	12.0
200	2	396066	223362	1.5	GL52 3EP	22.5	16.0	10.8
201	2	396128	223430	1.5	GL52 3EP	26.5	16.9	11.3
202	2	396251	223555	1.5	GL52 3EP	25.5	16.7	11.2
203	2	396218	223491	1.5	GL52 5ED	21.8	15.9	10.7

Receptor ID	Verification Zone	X	Y	Height	Closest address/post code	2019 Annual Mean Concentration (µg/m³)		
						NO_2	PM_{10}	$PM_{2.5}$
204	2	396201	223518	1.5	GL52 3EP	23.2	16.2	10.9
205	2	396268	223530	1.5	GL52 3EP	20.7	15.7	10.6
206	2	396486	223639	1.5	GL52 3DA	20.8	15.7	10.6
207	2	396540	223662	1.5	GL52 3DB	21.4	15.8	10.7
208	2	396653	223717	1.5	GL52 3DB	29.5	17.5	11.7
209	2	392187	222049	1.5	GL51 7TH	26.8	17.7	11.7
210	2	392490	221878	1.5	GL51 7TB	25.7	17.2	11.5
211	2	392536	221855	1.5	GL51 7TB	25.8	17.2	11.5
212	2	392585	221837	1.5	GL51 7TB	26.0	17.3	11.5
213	2	392776	221809	1.5	GL51 7AY	30.2	18.2	12.0
214	2	392798	221834	1.5	GL51 7AY	35.3	19.3	12.7
215	2	392713	221806	0.0	GL51 7AS	26.0	17.2	11.5
216	2	392684	221810	0.0	GL51 7AT	26.0	17.2	11.5
217	2	392629	221823	1.5	GL51 8NS	26.4	17.4	11.6
218	2	392603	221831	1.5	GL51 7TB	26.2	17.3	11.5
219	2	392917	221841	1.5	GL51 6QR	35.2	18.1	12.1
220	2	393932	221637	1.5	GL50 2TR	36.4	18.0	11.9
221	2	393942	221655	1.5	GL50 2HY	35.5	17.9	11.8
222	2	393934	221604	1.5	GL50 2TL	36.8	18.7	12.3
223	2	393975	221659	0.0	GL50 2HT	26.7	16.4	10.9
224	2	394260	221789	0.0	GL50 2HT	28.5	16.9	11.3
225	2	394355	221753	0.0	GL50 2QG	33.4	17.4	11.6
226	2	392888	221866	0.0	GL51 7AN	29.2	17.2	11.5
227	2	392910	221854	1.5	GL51 7AE	36.9	18.7	12.4
228	2	392932	221871	1.5	GL51 7AE	34.7	18.1	12.0
229	2	392910	221884	1.5	GL51 7AE	30.1	17.3	11.6
230	2	392996	221920	1.5	GL51 7AE	30.3	17.1	11.5
231	2	393092	222036	1.5	GL51 7AE	31.2	17.1	11.6
232	2	393143	222083	1.5	GL51 7HX	28.9	16.7	11.3
233	2	393306	222175	1.5	GL51 8QA	28.5	16.8	11.4
234	2	393438	222318	0.0	GL51 8NJ	29.6	17.6	11.8
235	2	393494	222366	1.5	GL51 8NQ	27.2	17.1	11.5
236	2	393791	222585	1.5	GL51 8NE	28.2	16.7	11.3
237	2	393783	222613	1.5	GL51 8NE	35.3	18.1	12.2
238	2	393854	222754	1.5	GL50 3RP	29.9	17.1	11.5
239	2	393861	222768	1.5	GL50 3RB	29.7	17.0	11.5
240	2	393880	222809	1.5	GL51 8NZ	28.7	17.2	11.6
241	2	393913	222853	1.5	GL51 8PA	27.1	17.0	11.4
242	2	393865	222830	1.5	GL51 8NE	28.6	17.3	11.6
243	2	393883	222855	1.5	GL51 8NE	30.1	17.7	11.8
244	1	394179	222979	1.5	GL51 8LN	34.5	18.5	12.1
245	1	394170	222975	1.5	GL51 8LN	33.8	18.3	12.1
246	2	391663	221919	1.5	GL51 6BW	27.6	17.3	11.4
247	2	391500	221823	1.5	GL51 6BL	22.7	16.3	10.7
248	2	391296	221888	1.5	GL51 0UA	28.0	17.1	11.2
249	2	391516	221929	1.5	GL51 0FH	31.7	18.3	11.9