THIRD WAVE LOCAL AUTHORITIES – TARGETED FEASIBILITY STUDY TO DELIVER NITROGEN DIOXIDE CONCENTRATION COMPLIANCE IN THE SHORTEST POSSIBLE TIME

Local authorities covered	Sunderland City Council

Further information on the content of each section is set out in the guidance.

Part 1: Understanding the problem

This section should set out background on the information about the road links projected to have exceedances in the PCM national model, in combination with source apportionment data, to provide a description of the severity of the NO_2 exceedance and its possible sources and causes. It should set out the scale of the problem and the case for change. Maps and local data should be included. ***Each road link should be addressed in turn.***

Introduction

The Pollution Climate Mapping (PCM) national model has identified that Sunderland City Council (the Council) have one road link (Census ID 57620) projected to have an exceedance of the annual mean EU Limit Value of 40µg/m^3 for nitrogen dioxide (NO_2). The road link under consideration is a section of the A1231, from its junction with A182 to its junction with the A195. This road link is managed by the Council's Highways Team.

In line with the Ministerial Direction, this Targeted Feasibility Study (TFS) sets out the Council's work undertaken to:

- Characterise the air quality issue along the A1231 PCM exceedance stretch, as identified in the national modelling; and
- Identify measures which could reduce the concentration of NO_2 along the A1231 PCM exceedance stretch as quickly as possible, with the principal objective of bringing forward compliance with the statutory annual mean EU Limit Value.

This TFS report has been prepared by the Council with consultancy support provided by Bureau Veritas UK Ltd.

Figure 1 details the A1231 PCM exceedance stretch, whilst figure 2 illustrates a section of the A1231 PCM exceedance stretch.

Figure 1 - Predicted A1231 PCM Exceedance Location in Sunderland

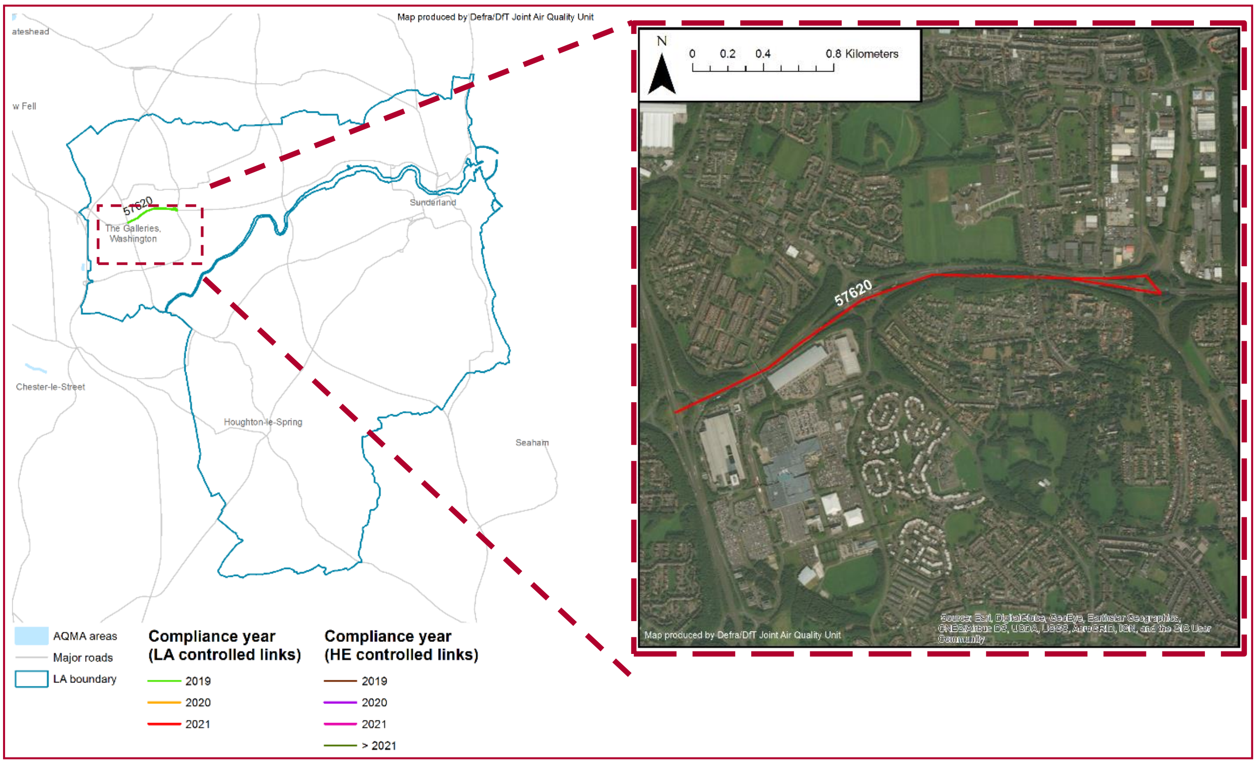
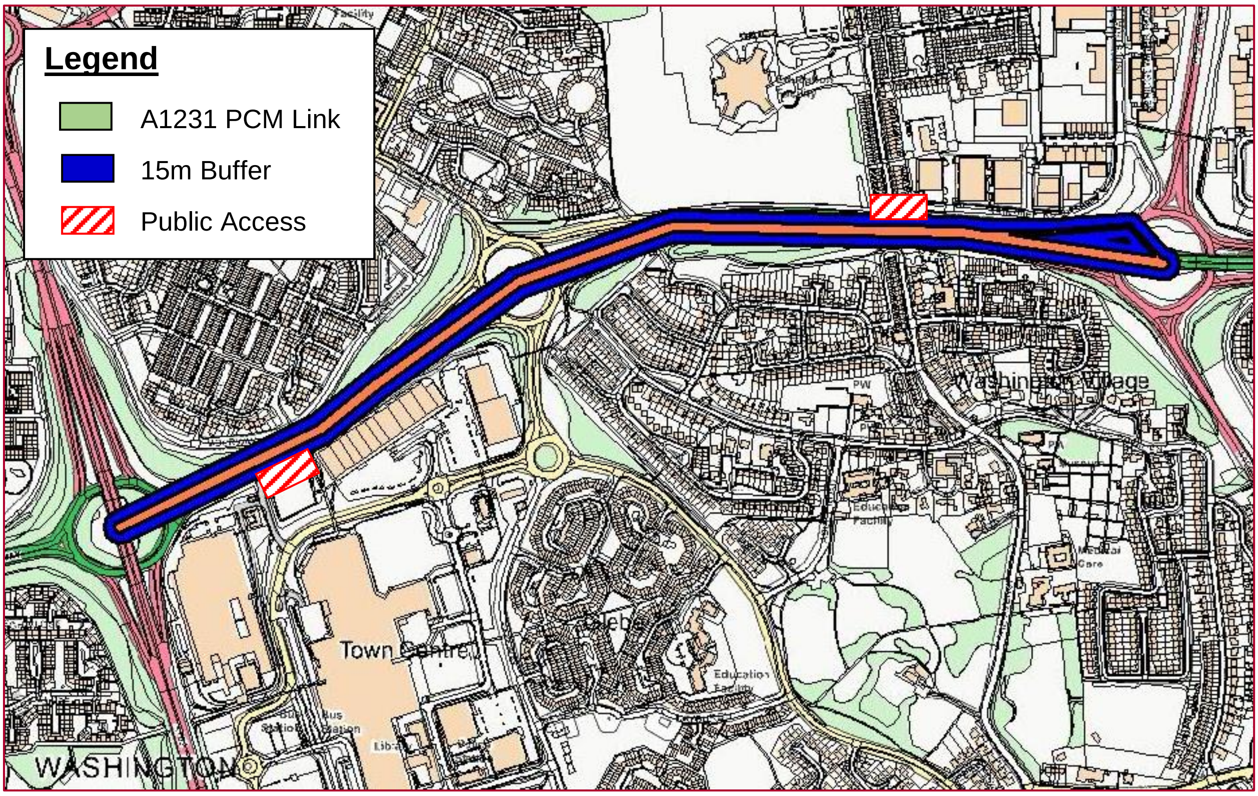


Figure 2 - View of A1231 Westbound from Census ID 57620 (E 430000, N 556595) taken 12/04/18 @ 15.31

Public Access and Exposure

The Council have undertaken spatial analysis using a 15m buffer around the A1231 PCM exceedance stretch (figure 3)

Figure 3 - Spatial Analysis with 15m buffer around the A1231 PCM Exceedance Stretch



The analysis confirmed that there is minimal public access along the A1231 Census ID 57620, with the following two areas of public access identified:

- A stretch of Brindley Road that is within 15m of the carriageway (estimated to be between 50m and 70m in length); and
- A pavement running adjacent to the car park close to the commercial estate (M&S Galleries Simply Food) south of the carriageway, close to the Department of Transport (DfT) traffic Count Point 57620 (estimated to be approximately 80m in length).

PCM Findings

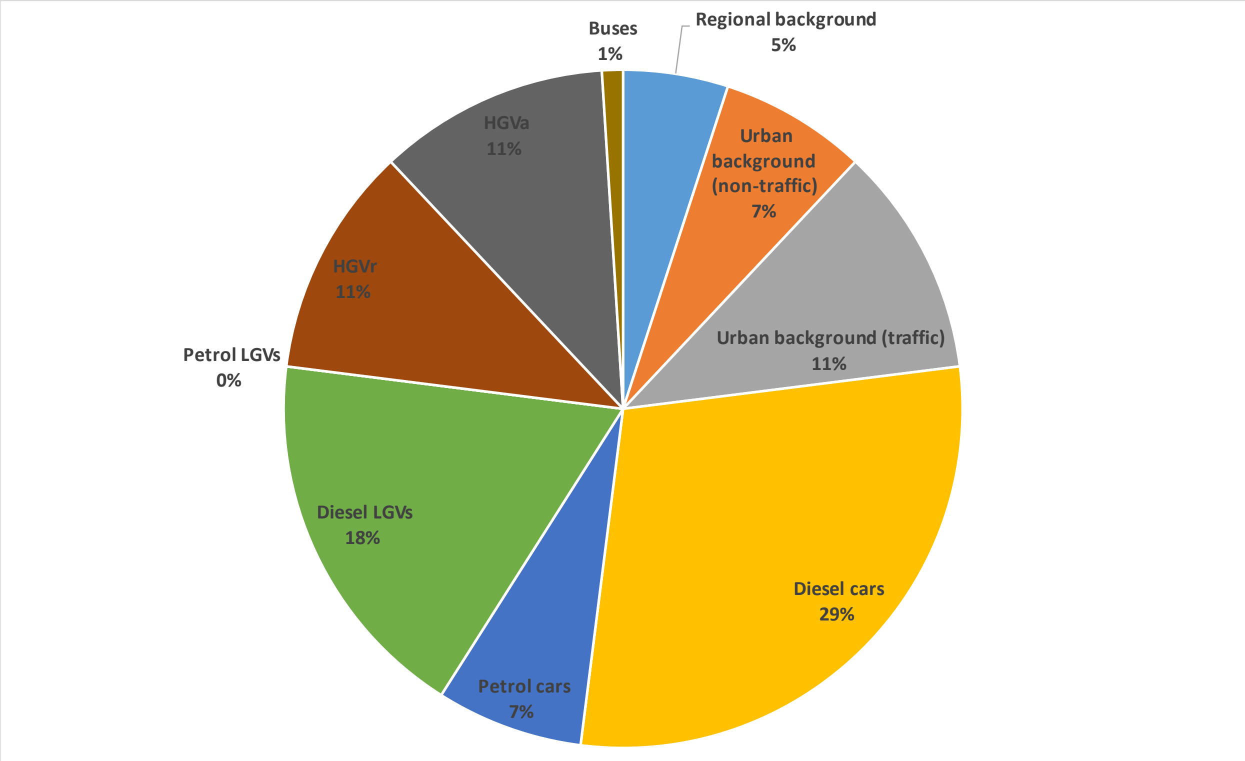
The results from the PCM model show that the Census ID 57620 road link is predicted to have the following annual mean NO_2 concentrations, with compliance with the annual mean NO_2 EU Limit Value of 40µg/m^3 projected to be achieved in 2019.

- 43µg/m^3 in 2017;
- 41µg/m^3 in 2018;
- 40µg/m^3 in 2019;
- 37µg/m^3 in 2020; and
- 35µg/m^3 in 2021.

In line with the PCM predictions, compliance could therefore be brought forwards if annual mean NO_2 concentrations are reduced by at least 1µg/m^3 in 2018. A 3µg/m^3 reduction in annual mean NO_2 concentrations would have been required to achieve compliance in 2017.

The PCM data shows that in 2015 (the most recent national modelling base year), the source contributors to total NO_X concentration on this road link were as illustrated in Figure 4. It is worth noting that over time, the relative contribution to total NO_x concentrations from different sources will change in line with changes to the local fleet composition and traffic flow parameters.

Figure 4 - PCM based Total NO_x Concentration Source Apportionment (2015)



The PCM based NO_x source apportionment would suggest that in 2015, 23% of the total NO_x concentration is attributable to regional and urban background sources (including traffic), whilst the remaining 77% is associated with local road traffic sources. Of this 77%, diesel cars have been identified to be the principal source, contributing 29% of the total NO_x. Petrol cars comparatively contribute significantly less at only 7%. Diesel Light Goods Vehicles (LGVs) contribute 18%, whilst rigid and articulated Heavy Goods Vehicles (HGVs) equally contribute towards 22% of the total. Buses are predicted to contribute only 1% of the total NO_x concentration.

The PCM model utilises traffic data from the Department of Transport (DfT) traffic counts database, which are in turn used to calculate the corresponding vehicle emissions for input on each modelled road link. For PCM Census ID 57620, the traffic data from corresponding DfT count point (ID 57620 - E 430000, N 556595) has been applied. The DfT traffic data for the year 2015 was based upon a manual count, whereby trained enumerators count traffic by vehicle type over a 12 hour period. This raw data is then combined with information from a network of Automatic Traffic Counts (ATCs) to calculate a series of Annual Average Daily Flows (AADFs) with associated fleet composition.

Figure 5 shows the traffic composition at DfT count point ID 57620 for the year 2015, for which a total AADF of 43,280 was recorded with a Heavy Duty Vehicle (HDV) proportion of 4.5%, whilst the general AADF trend at this location since the year 2000 is provided in Figure 6.

Figure 5 - Fleet Composition on the A1231 PCM Exceedance Stretch, as defined at DfT Count Point ID 57620 (2015)

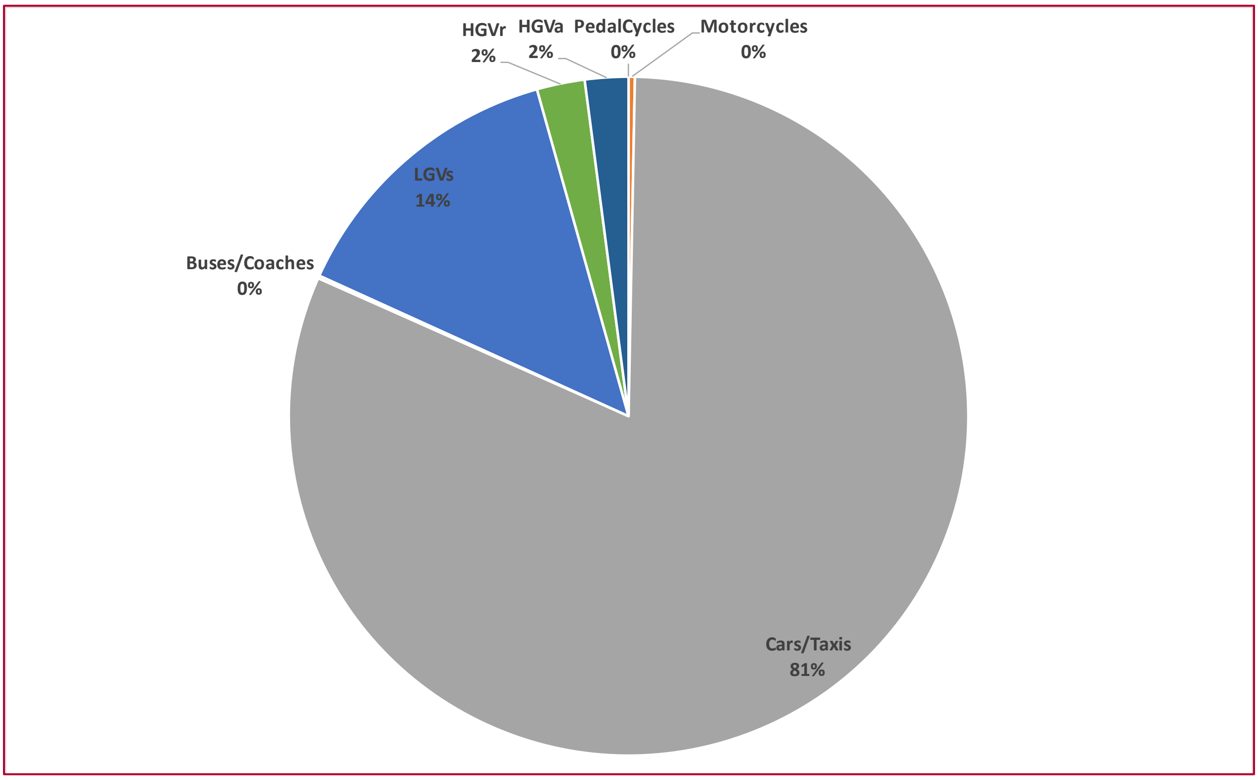
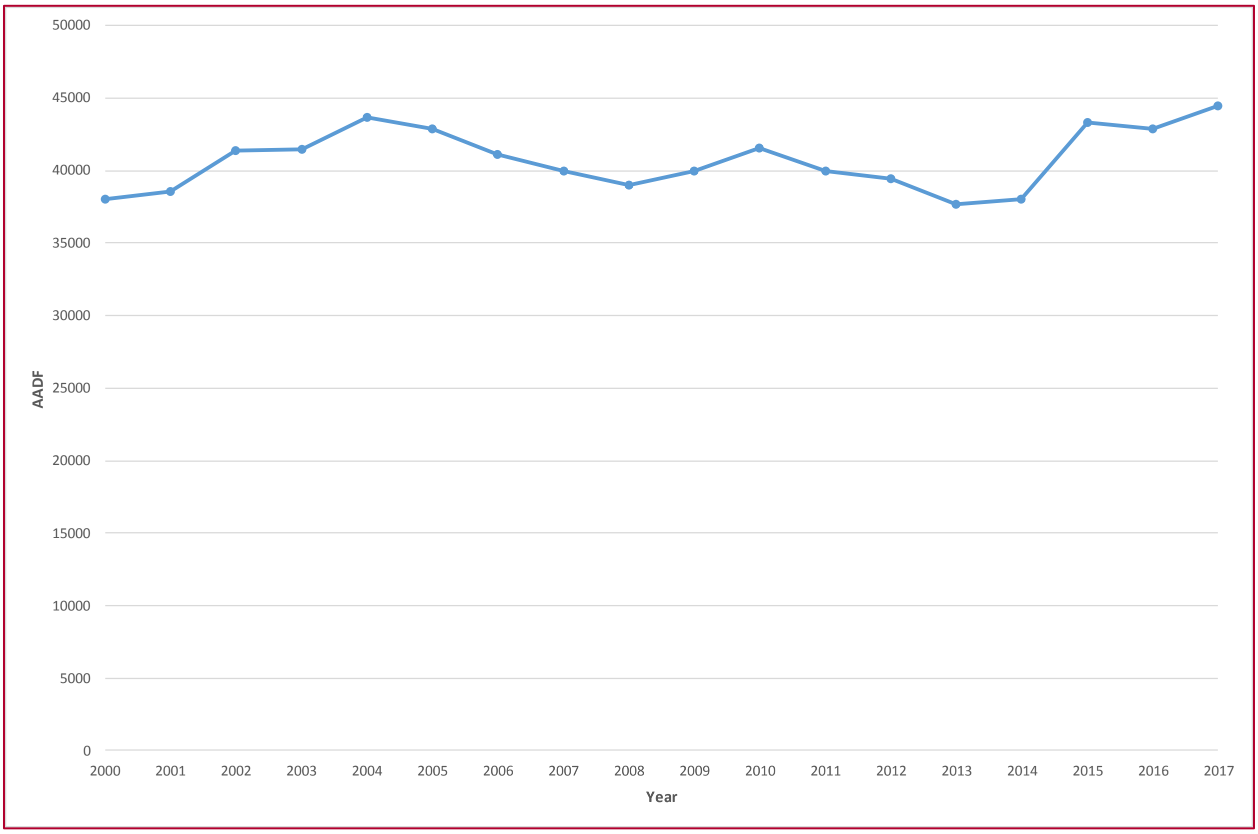


Figure 6 - AADF Trend on the A1231 PCM Exceedance Stretch, as defined at DfT Count Point ID 57620



Local Information

The A1231 PCM exceedance stretch has not been previously highlighted through the Local Air Quality Management (LAQM) regime to be at risk of exceeding the annual mean NO_2 UK Air Quality Strategy (AQS) objective. As such, no Council monitoring or detailed modelling studies have previously been undertaken in the vicinity of the study area. Therefore, initially there was limited local data available to understand either the pollutant concentrations or the source apportionment on this road link, other than that available through the PCM national model.

To address this, in addition to collating various pre-existing local datasets, the Council have sought to undertake a local Automatic Number Plate Recognition (ANPR) survey and associated local dispersion modelling exercise, in order to provide an improved insight into the risk to compliance with the annual mean NO_2 objective along the A1231 PCM exceedance stretch.

This section therefore details the available pre-existing local information, and the findings of the local surveys undertaken by the Council, to inform the extent of any further intervention required to achieve compliance along the A1231 PCM exceedance stretch.

Local Context

The A1231 is a dual carriageway, which provides the principal access to Sunderland city from the north and west. It extends westwards from the city centre crossing the river via Queen Alexandra bridge (until the opening of the new Wear crossing “Northern Spire”), through to the A1 (M)/A194 (M)/B1288 roundabout junction. It is a key road connection within the city, forming part of the Sunderland Strategic Transport Corridor (SSTC), which connects Sunderland city centre and the Port of Sunderland with the Strategic Road Network (A1 (M) and the A19) with Washington. Sunderland itself has a population of 278,000, whilst the new town of Washington comprises approximately 67,000 individuals.

In addition to the residential land use around the A1231 PCM exceedance stretch, a large cluster of employment sites, including the enterprise zone sites, are situated along the A1231 Sunderland Highway in the Washington sub-area. In the immediate vicinity to the A1231 PCM exceedance stretch, this includes the Galleries Retail Park and Shopping Centre located immediately to the south and the Hertburn Industrial Estate located to the north. Slightly further to the north east of the A1231 PCM exceedance stretch is the recently created Low Carbon Enterprise Zone. To the east adjacent the A19 corridor is the home of Nissan Motor Manufacturing UK, which manufactures the Nissan LEAF (Zero Emissions – All Electric Car).

Advanced manufacturing (and particularly the automotive sector) are a key part of the local economy, centred around the Nissan plant, which is producing more than 500,000 vehicles a year, and a thriving supply chain extending along the A19, A1 corridors. The sector employs 30,000 people regionally, with wider supply chains giving rise to a further 141,000 jobs nationally. Therefore, whilst the Nissan site itself is not located immediately adjacent to the stretch of the A1231 PCM Exceedance area, a high proportion of the traffic flows on the identified section of road are associated with commuting employees and associated activities such as deliveries to/from the Nissan site, which is accessed via the A1231 Most notable is the Nissan car manufacturing plant, which is accessed via the A1231/Nissan Way and the A19.

Local Air Quality Monitoring

Whilst the Council do monitor NO_2 using a network of passive monitoring sites across the City, encompassing 36 monitoring passive diffusion tube sites and two continuous analysers in 2016, the closest of these sites to the A1231 PCM exceedance stretch is Site 113 (urban centre), which is located approximately 1.9km north from the A1231 PCM exceedance stretch. Annual mean NO_2 concentrations of 26.3µg/m^3 and 29.5µg/m^3 were recorded at Site 113 in 2015 and 2016 respectively. The closest roadside site to the A1231 PCM exceedance stretch is Site 111 (roadside), located approximately 3.0km south from the A1231 PCM exceedance stretch. Annual mean NO_2 concentrations of 18.1µg/m^3 and 21.0µg/m^3 were recorded at Site 111 in 2015 and 2016 respectively.

By way of comparison, the highest annual mean NO_2 concentration recorded by the Council's air quality monitoring was at Site 132 (roadside) with values of 36.2µg/m^3 and 40.3µg/m^3 for 2015 and 2016 respectively. This site is located approximately 8.4km northeast of the A1231 PCM exceedance stretch.

In response to the need to undertake this TFS, in March 2018 the Council installed four new diffusion tubes along the A1231 PCM exceedance stretch. Details of the new monitoring sites and preliminary NO_2 concentrations are provided in Table 1.

Table 1 - New Diffusion Tubes along the A1231 PCM Exceedance Stretch

Monitoring Location	X	Y	Distance from Receptor to A1231 Carriageway (m)	Period Mean NO_2 Concentration (µg/m^3)
Galleries Service Yard	429993	556586	3.5	31.7
79 Spout Lane, NE37 2UE	430900	556962	37	26.4
3 Musgrove Terrace, NE38 7HR	430878	556858	47	23.5
Esthwaite, NE37 1NB	429936	556634	50	22.3

Whilst data is only presently available for the period 15th March to 25th April 2018, it provides for a useful indication of the NO_2 concentrations in proximity to the A1231 PCM exceedance stretch. Measured period mean concentrations ranged between 31.7µg/m^3 and 22.3µg/m^3, with the concentration declining as a function of an increased separation distance between the monitoring location and the A1231 carriageway clearly observed. Whilst not directly comparable due to the short duration of monitoring currently reported, all measured period mean concentrations (non-bias adjusted or annualised) are below the EU limit value.

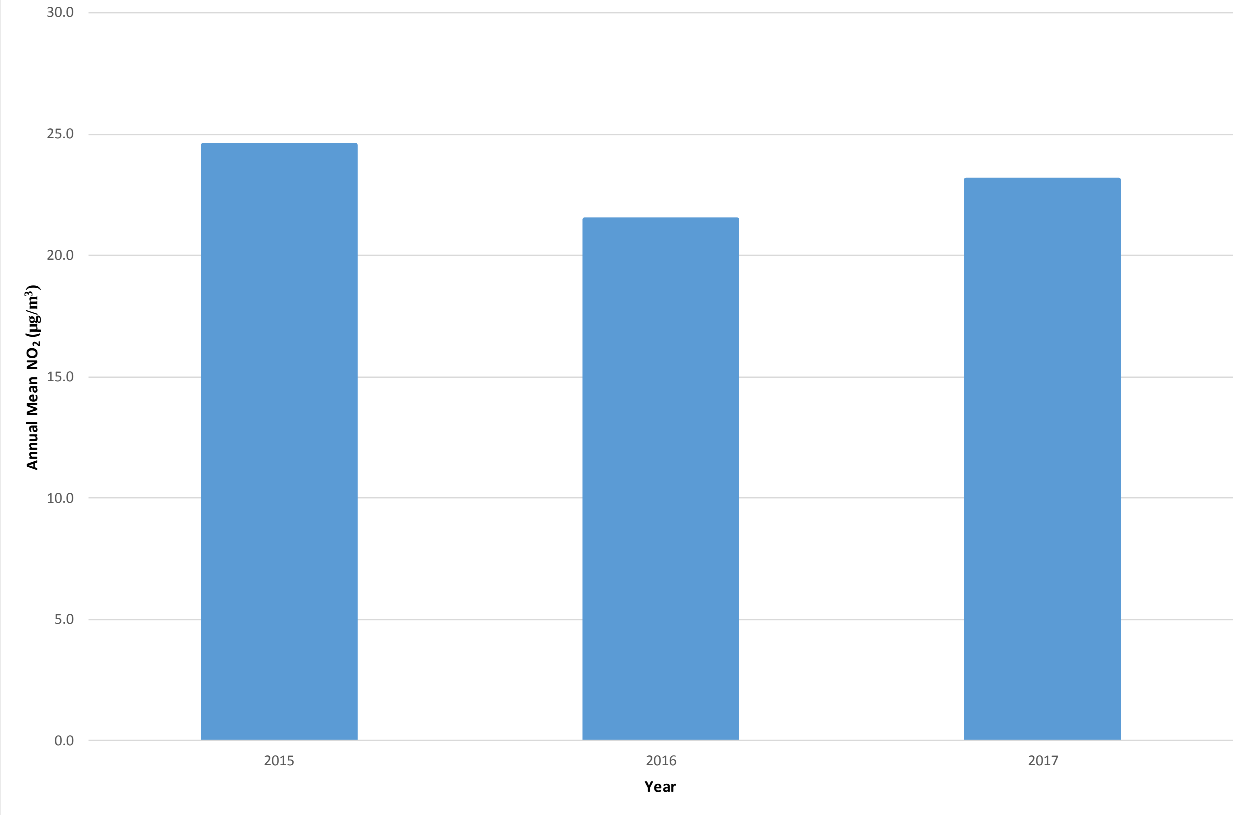
Given the lack of Council air quality monitoring data along the A1231 PCM exceedance stretch, consideration has therefore been given to air quality monitoring data reported for the Sunderland Wessington Way Automatic Urban and Rural Network (AURN) site. The AURN is the UK air quality monitoring compliance network, which reports compliance against the Ambient Air Quality Directive (2008/50/EC). The site has an EU reference identifier of GB1043A.

Whilst the site is located approximately 7km to the east of the A1231 PCM exceedance stretch, it is sited in accordance with the EU Directive siting criteria for compliance as reported through monitoring and has similar characteristics to the A1231 PCM exceedance stretch.

The AURN site is located 7m from the A1231 Wessington Way carriageway and in 2015 had an approximate AADF of 38,922 (DfT count ID 47583) with a HDV proportion of 3.5%. This is comparable to the traffic flows and fleet composition observed in 2015 at DfT Count ID 57620. The concentrations recorded at the AURN site can therefore be considered to be a suitable proxy for direct concentration measurements along Census ID 57620.

Figure 7 presents the annual mean NO_2 concentrations recorded over the last three years at the AURN site. The annual mean NO_2 concentrations are consistently well below the 40µg/m^3 EU limit value.

Figure 7 - Annual mean NO_2 concentration recorded at the Sunderland Wessington Way AURN site



Local Development

With respect to local development proposals which would impact traffic flows and therefore air quality along the A1231 PCM exceedance stretch, the planning application for the International Advanced Manufacturing Park (IAMP ONE - Ref No 18/00092/HE4), which represents the first phase of the IAMP development, is one of the more significant local development schemes currently being pursued in the immediate vicinity of the study area. The IAMP development proposes to deliver a large advanced manufacturing park on an area of land (100 hectares, with a further 50 hectares land safeguarded for future development) to the north of the existing Nissan site. It is anticipated that the IAMP would create some 5,228 new jobs and would be a significant driver for the regional economy and the automotive sector within the UK. IAMP will allow Nissan key chain suppliers to locate directly adjacent the manufacturing plant to assist with the just-in-time assembly process. This in turn will help reduce HGV trips on both the local and strategic road network.

The IAMP ONE planning application, which seeks permission for up to nine specialist automotive and manufacturing units, a new road link from the A1290, associated car parking, service yards, access, landscaping and drainage ponds, has recently been consented.

The air quality assessment submitted in support of the application included three assessed receptors adjacent to the A1231 PCM exceedance stretch (receptor refs: ADM12, ADM13 and ADM14). The annual mean NO_2 concentrations predicted at these locations for the 2016 baseline year, and the 2020 assessment year (both with and without the IAMP ONE scheme), are presented in Table 2.

Table 2 - IAMP ONE Air Quality Assessment Findings

Receptor ID	X	Y	Distance from Receptor to A1231 Carriageway (m)	2016 Annual Mean NO_2 ($\mu g/m^3$)	2020 Annual Mean NO_2 ($\mu g/m^3$)	2020 with IAMP ONE Annual Mean NO_2 ($\mu g/m^3$)
ADM12	430648	557131	190	26.36	26.02	26.05
ADM13	430435	556957	56	25.91	25.70	25.72
ADM14	430671	556816	105	26.96	26.46	26.50

No exceedances of the EU limit value were predicted in either the 2016 base year or the 2020 assessment year, with the highest predicted annual mean NO_2 concentration 26.96$\mu g/m^3$. The maximum increment in annual mean NO_2 concentrations associated with the scheme's implementation at the above receptor locations is predicted to be no more than 0.04$\mu g/m^3$.

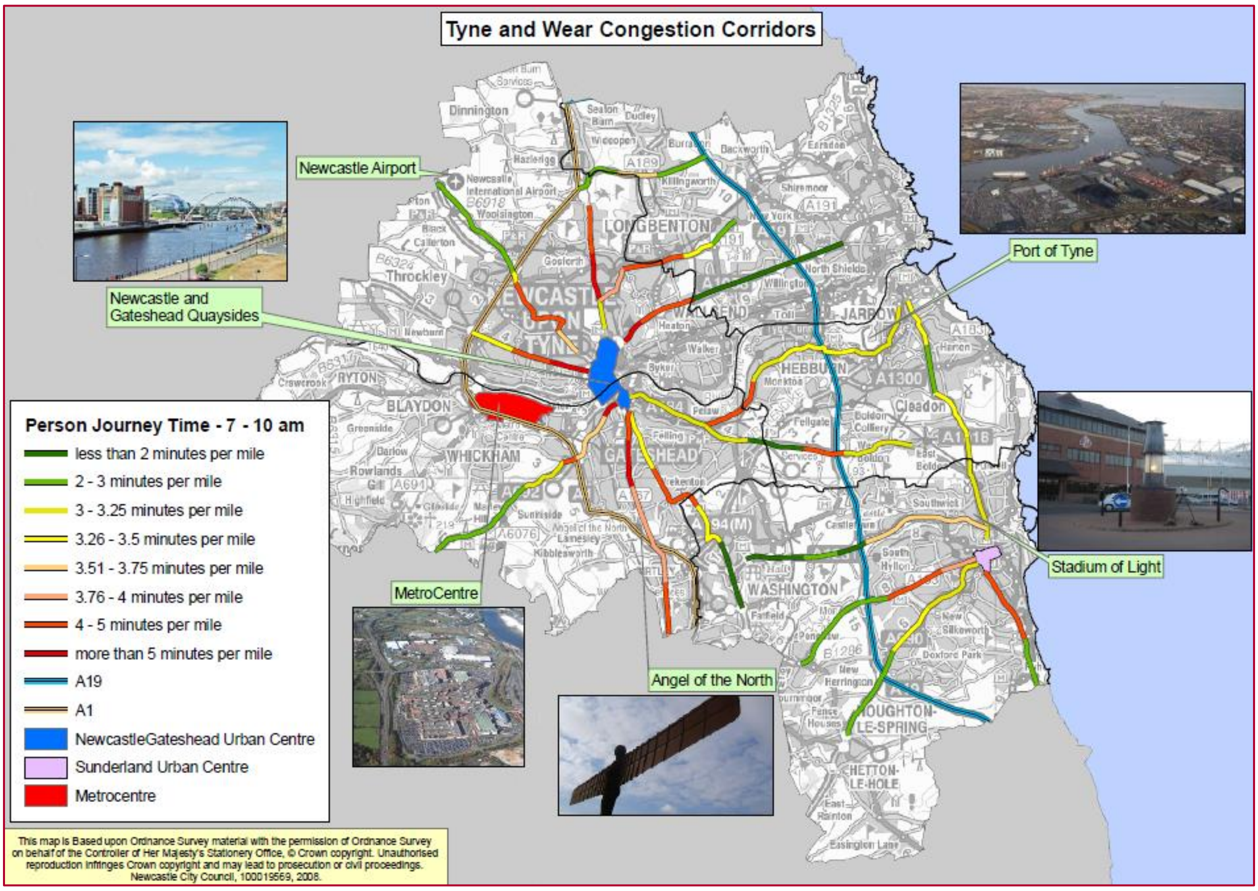
The IAMP ONE air quality assessment concluded that air quality impacts from road traffic emissions from the scheme were predicted to be insignificant. Whilst not presently quantified, it would also be reasonable to expect there to be a comparable impact on air quality from the subsequent phases of the IAMP development. It should be noted that the impacts at locations closer to the A1231 highway would of course be more pronounced than that predicted at the receptors assessed as part of the IAMP ONE air quality assessment, the closest of which is 56m from the A1231 carriageway.

Local Traffic Flows

The DfT derived AADF figures for 2016 on the A1231 have been compared to the 2016 AADF figure sourced from the IAMP ONE planning application. The IAMP ONE application specified a total AADF for 2016 along the A1231 PCM exceedance stretch of 41,079, with a HDV AADF of 2,994 (equivalent to a HDV proportion of 7.3%). This compares to a DfT AADF of 42,909 with a 4.5% HDV proportion for 2016 along the same section of the A1231. The DfT traffic flow information applied in the PCM is therefore considered to be comparable to other local surveyed traffic flows for the A1231 PCM exceedance stretch.

The Council are somewhat surprised that this area has been identified by the PCM national model as having “the worst air quality in Sunderland”. In general, there are comparable - if not higher traffic flows and higher levels of peak hour delays – observed at the eastern extent of the A1231, when compared to the A1231 PCM exceedance stretch. This is supported by the findings presented in the Tyne and Wear Congestion Reduction Plan (2011), Map 1 of which is reproduced below in Figure 8. This presents the Tyne and Wear congestion corridors and it is noteworthy that the A1231 PCM exceedance stretch does not feature as having significant congestion.

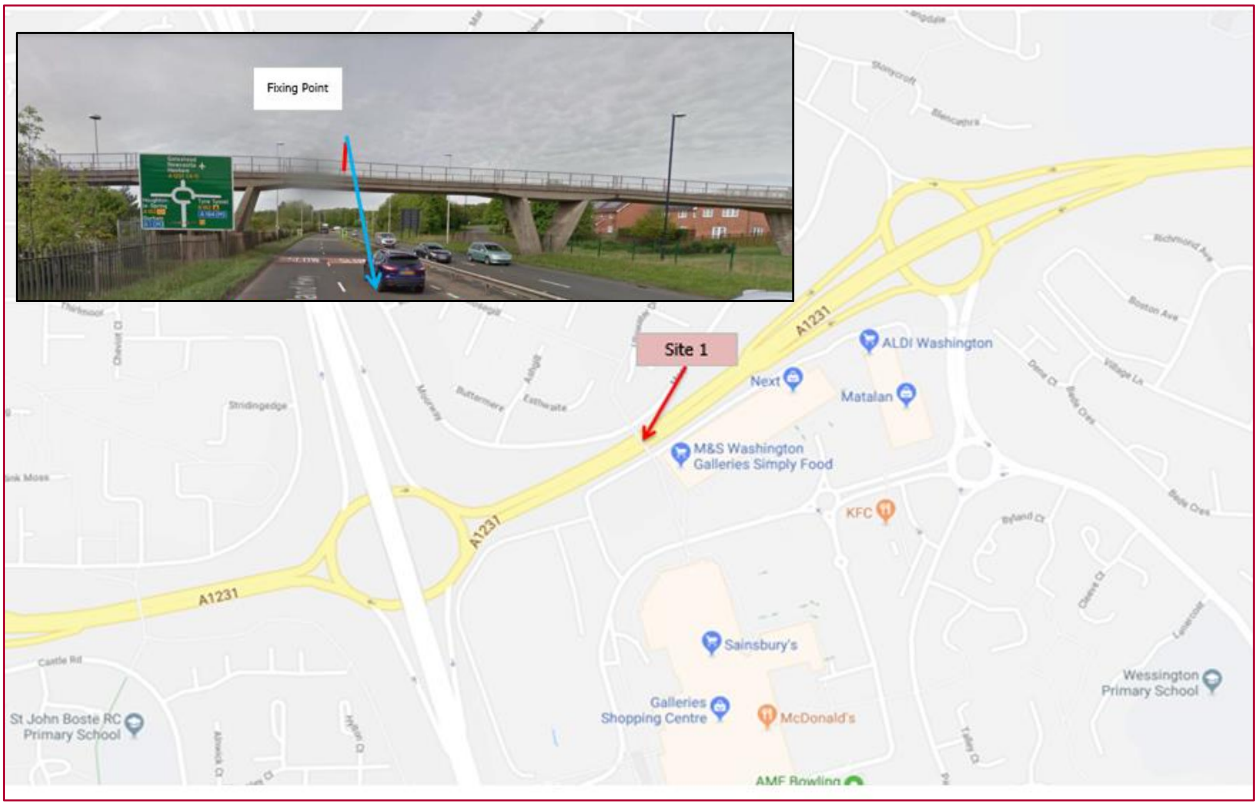
Figure 8 - Tyne and Wear Congestion Corridors



ANPR Survey Findings

An ANPR survey was undertaken along the A1231 PCM exceedance stretch, between 28th to 30th April inclusive, thereby providing data for a Saturday, Sunday and Monday (where Monday is a representative weekday). Two ANPR cameras were installed on the footbridge passing over the A1231. In addition, Manual Classified Count (MCC) cameras were also installed at the same location to capture total traffic flow and to quantify the capture rate of the ANPR data. The survey was designed to capture total traffic flow, diurnal profile, fleet composition (including petrol/diesel/electric split) and Euro classification across both lanes of the eastbound and westbound stretches of the A1231 carriageway. The ANPR survey location is illustrated in Figure 9.

Figure 9 - ANPR Survey Location



The 24-hour total traffic flows obtained for the 28th, 29th, and 30th April 2018 were 39188, 26976 and 48398 respectively. This information was used to derive a 24-hour AADF of 44022 for the A1231. This is comparable to the AADF of 44485 for 2017, as estimated along the A1231 at DfT Count Point 57620.

Figure 10 shows the fleet composition along the A1231 at the survey location. Cars account for 82% of the total fleet, followed by LGVs at 12%. Rigid HGVs and Articulated HGVs both represent 3% of the total fleet, whilst the categories of Buses and Coaches and Motorcycles represent a negligible (<1%) fraction of the total fleet.

Figure 10 - Fleet Composition

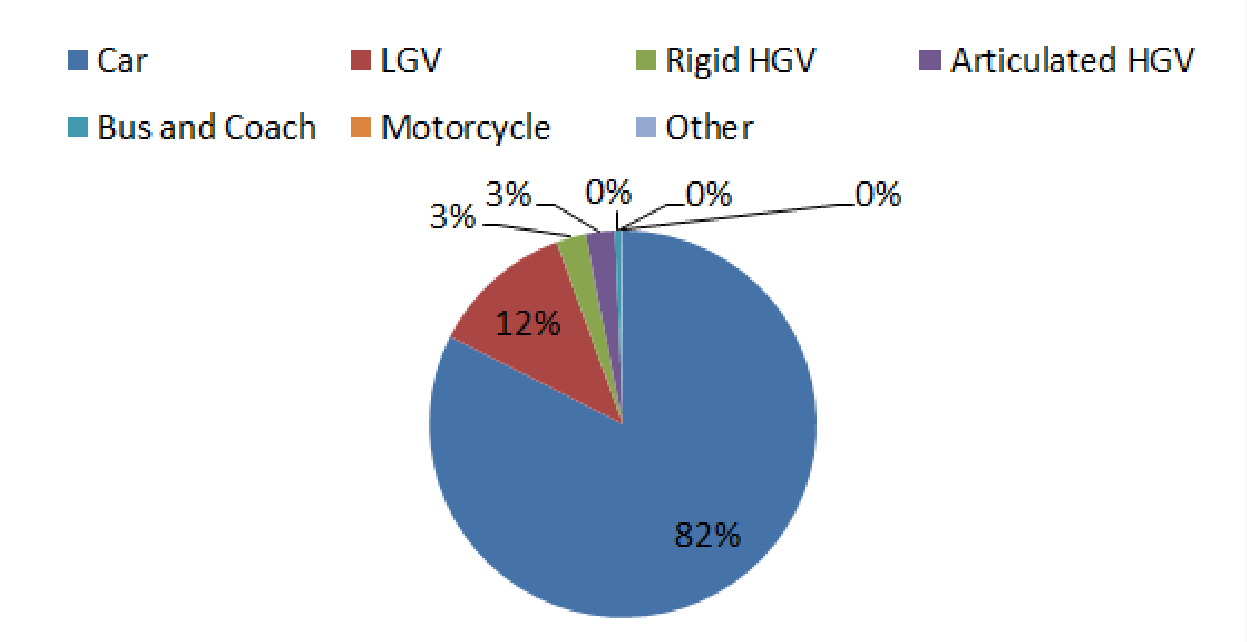


Figure 11 illustrates the Petrol and Diesel Splits for Cars, LGVs and Buses and Coaches based on the ANPR survey data. All Rigid and Articulated HGVs are diesels. The survey results identified that diesel and petrol accounts for 55% and 43% of the total cars respectively, with the remaining 2% being hybrid or all electric. Almost all LGVs and Buses and Coaches were also found to be diesel.

Figure 11 - Petrol and Diesel Split for Cars, LGVs and Buses and Coaches

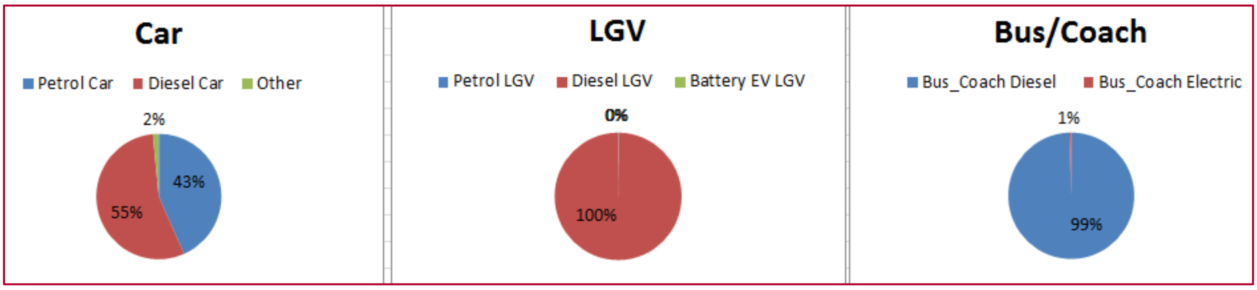


Figure 12 and Figure 13 present the default national Euro proportions (blue headed tables) relative to the local Euro proportions derived from the ANPR survey data for the A1231 (orange headed tables), for Cars and LGVs respectively (tables taken directly from the EFT v8.0.1.a). The survey data show that both Cars and LGVs are predominantly comprised of Euro 4 standard vehicles or higher for both petrol and diesel vehicles. Both petrol and diesel Cars were found to have comparable proportions of the Euro 4, 5 and 6 vehicles to the default national Euro proportion. In line with national assumptions, Euro 5 standard vehicles comprise the largest fraction of petrol and diesel Cars and diesel LGVs. The vast majority (78%) of petrol LGVs are of Euro 4, which is contrary to the national default euro proportion for Euro 4 petrol LGVs of only 20%.

Figure 12 - Euro Proportions for Diesel and Petrol Cars

Petrol Car	Default Euro Proportions 2017 - England (not London)		User Euro Proportions 2017 - England (not London)
1Pre-Euro 1	-		-
2Euro 1	-		-
3Euro 2	0.01		0.00
4Euro 3	0.11		0.00
5Euro 4	0.23		0.25
6Euro 5	0.34		0.36
7Euro 6	0.20		0.24
7Euro 6c	0.12		0.15

Diesel Car	Default Euro Proportions 2017 - England (not London)		User Euro Proportions 2017 - England (not London)
1Pre-Euro 1	-		-
2Euro 1	-		-
3Euro 2	0.00		0.00
4Euro 3	0.06		0.00
5Euro 4	0.19		0.16
6Euro 5	0.40		0.42
7Euro 6	0.22		0.26
7Euro 6c	0.13		0.16
7Euro 6d	0.00		-

Figure 13 - Euro Proportions for Diesel and Petrol LGVs

Petrol LGV	Default Euro Proportions 2017 - England (not London)		User Euro Proportions 2017 - England (not London)
1Pre-Euro 1	-		-
2Euro 1	0.00		-
3Euro 2	0.03		-
4Euro 3	0.11		-
5Euro 4	0.20		0.78
6Euro 5	0.34		0.13
7Euro 6	0.32		0.09
7Euro 6c	-		-

Diesel LGV	Default Euro Proportions 2017 - England (not London)		User Euro Proportions 2017 - England (not London)
1Pre-Euro 1	-		-
2Euro 1	0.00		-
3Euro 2	0.01		-
4Euro 3	0.05		0.00
5Euro 4	0.20		0.18
6Euro 5	0.41		0.56
7Euro 6	0.33		0.26
7Euro 6c	-		-
7Euro 6d	-		-

Figure 14 shows the default national Euro proportions (blue headed tables) relative to the local Euro proportions derived from the ANPR survey data for the A1231 (orange headed tables), for Rigid and Articulated HGVs (tables taken directly from the EFT v8.0.1.a). Euro VI is the largest national default proportion of Rigid HGVs (55%), whilst Euro V was found to be the largest proportion of Rigid HGVs (51%) locally. In line with national assumptions, Euro VI standard vehicles comprise the largest fraction of Articulated HGVs locally (67% locally vs 72% nationally).

Figure 14 - Euro Proportions for Rigid and Articulated HGVs

Rigid HGV	Default Euro Proportions 2017 - England (not London)		User Euro Proportions 2017 - England (not London)
1Pre-Euro I	-		-
2Euro I	-		-
3Euro II	0.01		-
4Euro III	0.09		0.02
5Euro IV	0.08		0.13
6Euro V_EGR	0.07		0.13
7Euro V_SCR	0.20		0.38
8Euro VI	0.55		0.34
9Euro II SCRRF	-		-
10Euro III SCRRF	-		-
11Euro IV SCRRF	-		-
12Euro V EGR + SCRRF	-		-

Note: No emissions factors available for HGV SCRRF (Refrofits) therefore standard Euro class emissions factors will be assumed even if fleet information is in

Artic HGV	Default Euro Proportions 2017 - England (not London)		User Euro Proportions 2017 - England (not London)
1Pre-Euro I	-		-
2Euro I	-		-
3Euro II	0.00		0.00
4Euro III	0.02		0.01
5Euro IV	0.03		0.04
6Euro V_EGR	0.06		0.07
7Euro V_SCR	0.18		0.21
8Euro VI	0.72		0.67
9Euro II SCRRF	-		-
10Euro III SCRRF	-		-
11Euro IV SCRRF	-		-
12Euro V EGR + SCRRF	-		-

Figure 15 shows the default national Euro proportions (blue headed tables) relative to the local Euro proportions derived from the ANPR survey data for the A1231 (orange headed tables), for Buses and Coaches (tables taken directly from the EFT v8.0.1.a). Euro VI is the largest proportion of Buses and Coaches nationally (40%), whilst Euro V was found to the largest proportion of Buses and Coaches locally (36%) with only 20% of Euro VI vehicles observed. No Euro II Buses and Coaches were observed in the local fleet.

Figure 15 - Euro Proportions for Buses and Coaches

Buses	Default Euro Proportions 2017 - England (not London)		User Euro Proportions 2017 - England (not London)
1Pre-Euro I	-		-
2Euro I	-		-
3Euro II	0.03		-
4Euro III	0.13		0.10
5Euro IV	0.10		0.34
6Euro V_EGR	0.08		0.09
7Euro V_SCR	0.25		0.27
8Euro VI	0.40		0.20
9Euro II SCRRF	-		-
10Euro III SCRRF	-		-
11Euro IV SCRRF	-		-
12Euro V EGR + SCRRF	-		-

Note: Emissions factors (scaled) are available for Bus SCRRF (Refrofits) therefore user defined fleet may be used

Coaches	Default Euro Proportions 2017 - England (not London)		User Euro Proportions 2017 - England (not London)
1Pre-Euro I	-		-
2Euro I	-		-
3Euro II	0.03		-
4Euro III	0.13		0.10
5Euro IV	0.10		0.34
6Euro V_EGR	0.08		0.09
7Euro V_SCR	0.25		0.27
8Euro VI	0.40		0.20
9Euro II SCRRF	-		-
10Euro III SCRRF	-		-
11Euro IV SCRRF	-		-
12Euro V EGR + SCRRF	-		-

Figure 16 shows the default national Euro proportions (blue headed tables) relative to the local Euro proportions derived from the ANPR survey data for the A1231 (orange headed tables), for Full Hybrid Petrol and Diesel Cars (tables taken directly from the EFT v8.0.1.a). Euro 6 standard comprises the largest proportion of Full Hybrid Petrol Cars both nationally

(62%) and locally (76%). Euro 6 standard is also the largest proportion of Full Hybrid Diesel Cars nationally with 86%, whilst Euro 5 standard was found to be the largest proportion locally with 57%.

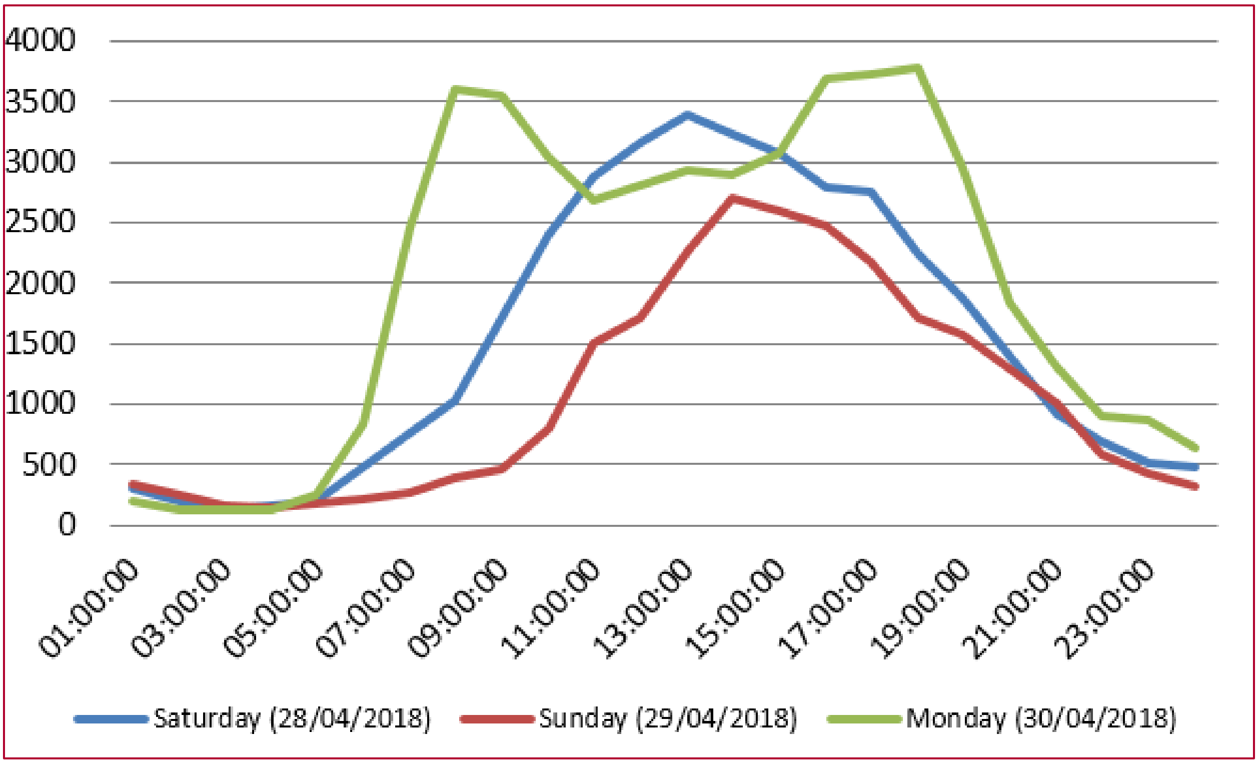
Figure 16 - Euro Proportions for Full Hybrid Petrol and Diesel Cars

Full Hybrid Petrol Car	Default Euro Proportions 2017 - England (not London)	User Euro Proportions 2017 - England (not London)
1Pre-Euro 1	-	-
4Euro 3	0.00	-
5Euro 4	0.09	0.02
6Euro 5	0.29	0.22
7Euro 6	0.32	0.39
7Euro 6c	0.30	0.37

Full Diesel Hybrid Car	Default Euro Proportions 2017 – England (not London)	User Euro Proportions 2017 – England (not London)
6Euro 5	0.13	0.57
7Euro 6	0.37	0.19
7Euro 6c	0.49	0.25
7Euro 6d	-	-

Figure 17 illustrates the diurnal profile in traffic flows at each hour throughout the day on 28th (Saturday), 29th (Sunday), and 30th (Monday – representative Weekday) April 2018. The a.m. and p.m. peaks, inter-peak and off-peak periods are clearly visible on the Monday, whilst the profile on the Saturday and Sunday show a characteristic single peak later in the day (with the Sunday exhibiting a lower flow than the Saturday).

Figure 17 - Diurnal Traffic Flows



Local Dispersion Modelling

A local dispersion modelling study was undertaken to assess annual mean NO_2 concentrations across the A1231 PCM exceedance stretch, with 2017 taken to be the baseline year. The ADMS-Roads model (version 4.1.1) and the Emissions Factors Toolkit (EFT version 8.0.1.a) were used for the purposes of the study, with traffic data used as input to the model derived from a combination of available sources, including:

- 2015 and 2016 DfT traffic count data (AADF and fleet composition);
- April 2018 ANPR survey data (AADF, fleet composition, Euro composition and diurnal profile);
- 2015 Traffic data included in the IAMP One air quality assessment submitted in support of the planning application (AADF and fleet composition); and
- 2018 Traffic data for Census ID 57584 used in the PCM model was used for the A1231 Wessington Way model verification domain (AADF and fleet composition).

Where required, traffic data inputs were factored to the baseline year of 2017 using the relevant Trip End Model Presentation Program (TEMPro) factors. TEMPro is a modelling tool designed to allow users to look at the growth in trip ends, using actual and forecast data supplied by the DfT. A factor of 1.021341 was applied to 2015 flows, whilst a factor of 0.999704 was applied to adjust 2016 flows to 2017.

Meteorological data for the year 2017 from Newcastle airport, approximately 18km NW from the A1231 PCM exceedance stretch, was used as a model input.

Owing to the lack of available air quality monitoring data in the immediate vicinity to the A1231 PCM exceedance stretch, a second model domain was considered along the A1231 Sunderland Wessington Way AURN site, which was adopted for the purposes of model verification.

Annual mean NO_2 concentrations were predicted for the 2017 baseline scenario at the following discrete and generic receptor groups:

- Receptors 4m from the kerb and at least 25m from major junction along the A1231 PCM exceedance stretch (150 receptors to facilitate direct comparison against the PCM model predictions - referred to as ‘PCM receptors’); and
- Other locations of relevant exposure, including public access locations (4) and residential properties (3) adjacent to the A1231 PCM exceedance stretch (7 receptors - referred to as ‘Other receptors’).

All receptors were included at a height of 2m.

Details of the model inputs and model verification process can be found in Annex 1, whilst Annex 2 provides the model predicted annual mean NO_2 concentration results.

Local Dispersion Modelling Results - Discrete PCM Receptors

There are no exceedances predicted at any of the modelled discrete receptors for the 2017 baseline year. The maximum annual mean NO_2 concentration at a discrete receptor along the A1231 PCM exceedance stretch was predicted to be 35.2µg/m^3 at PCM receptor 119. This is below the annual mean EU limit value of 40µg/m^3, suggesting that compliance along Census ID 56720 has already been achieved by 2017.

Table 3 presents a comparison of the annual mean NO_2 concentration results predicted by the local dispersion model against the preliminary period mean concentrations obtained from the new diffusion tube locations recently installed by the Council along the A1231 PCM exceedance stretch.

Table 3 - Comparison of Model Predicted Annual Mean Concentrations with Preliminary Monitoring Data at New Diffusion Tube Locations

Monitoring Location	X	Y	Monitored Period Mean NO_2 (µg/m^3)	Model Predicted 2017 Annual Mean NO_2 (µg/m^3)	Difference Between Model / Monitored (µg/m^3)
Esthwaite, NE37 1NB	429936	556634	22.3	20.8	-1.5
Galleries Service Yard	429993	556586	31.7	28.2	-3.5
79 Spout Lane, NE37 2UE	430900	556962	26.4	21.2	-5.2
3 Musgrove Terrace, NE38 7HR	430878	556858	23.5	19.0	-4.5

The local dispersion model predicted comparable NO_2 concentration results to the preliminary monitoring results, the maximum difference being 5.2µg/m^3. As the measured diffusion tubes results are only for approximately one single month, and not bias adjusted or annualised, the comparison is considered indicative only. Notwithstanding this, the predictions show reasonable comparability. This would suggest that the model can generally be considered to be predicting well along the A1231 PCM exceedance stretch.

Local Dispersion Modelling Results - Source Apportionment

To help inform the development of measures listed in Part 2 of the TFS, source apportionment of the road traffic vehicle categories has been undertaken. 4 and 18show results for the source apportionment exercise based on the modelled discrete receptors, for the modelled baseline year of 2017.

Source apportionment results have been calculated for two different selections of the modelled receptors:

- Average across all modelled receptors – This provides an average at all modelled receptors and so is useful when considering possible measure to test and adopt. It will however understate road NO_x concentrations in problem areas; and
- At the receptor with maximum road NO_x Concentration - Provides the NO_x source apportionment at the receptor with the highest predicted road NO_x concentration. This is likely to be in the area of most concern and so a good place to test and adopt measure. Any gains predicted by measures are however likely to be greatest at this location and so would not represent gains across the whole modelled area.

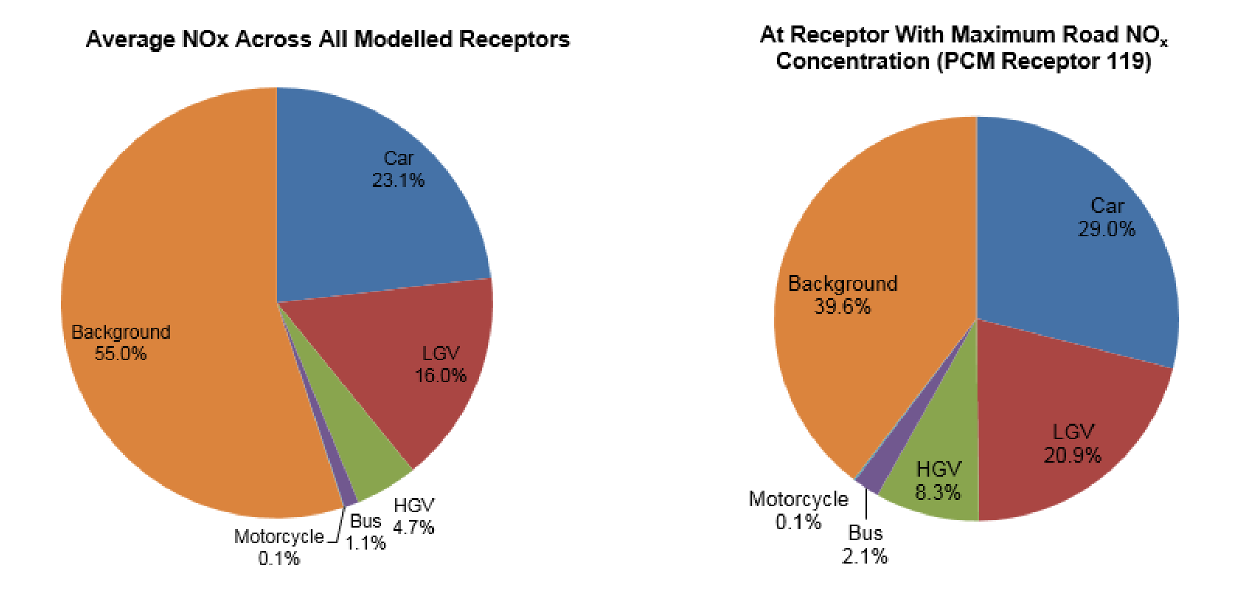
When considering the average annual mean NO_x concentration across all modelled discrete receptors, road traffic accounts for 20µg/m^3 (45%) of 44.4µg/m^3. Of this 20µg/m^3, Cars account for the most (51.5%) of any of the vehicle types. LGVs also account for a relatively high proportion of the overall predicted NO_x concentration at 35.6%.

At the receptor with the maximum road NO_x concentration (PCM receptor 119), road traffic accounts for 37.1µg/m^3 (60.4%) of 61.5µg/m^3. Of this 37.1µg/m^3, Cars account for the most (48.0%) of any of the vehicle types. LGVs are the second highest contributor to the overall predicted NO_x concentration with 34.6%.

Table 4 - Local Model based Total NO_x Concentration Source Apportionment (2017)

Results	All Vehicles	Car	LGV	HGV	Bus	Motorcycle	Background
Average Across All Modelled Receptors							
NO_x Concentration (µg/m^3)	20.0	10.3	7.1	2.1	0.5	0.0	24.4
Percentage of Total NO_x	45.0%	23.1%	16.0%	4.7%	1.1%	0.1%	55.0%
Percentage Contribution to Road NO_x	100.0%	51.5%	35.6%	10.4%	2.4%	0.1%	-
At Location With Maximum Road NO_x Concentration (PCM receptor 119)							
NO_x Concentration (µg/m^3)	37.1	17.8	12.8	5.1	1.3	0.1	24.4
Percentage of Total NO_x	60.4%	29.0%	20.9%	8.3%	2.1%	0.1%	39.6%
Percentage Contribution to Road NO_x	100.0%	48.0%	34.6%	13.7%	3.5%	0.2%	-

Figure 18 - Local Model based Total NO_x Concentration Source Apportionment (2017)



Local Dispersion Modelling Results - Summary

The discrete receptor modelled concentrations suggest that there are no exceedances of the EU limit value along the A1231 PCM exceedance stretch at locations of relevant public access and exposure.

In comparison with the PCM modelled results, the local dispersion modelling results suggest there is a discrepancy with regards to the annual mean NO_2 concentrations predicted along the PCM exceedance stretch, with the PCM model predicting 43µg/m^3 along the A1231 PCM exceedance stretch in 2017 (Census ID 57620).

The reason for the difference between the PCM national model predictions and those obtained from the local dispersion model is likely to be two-fold:

- Improved resolution of local data model inputs to the local dispersion model, i.e. traffic flows, fleet composition, Euro composition, average vehicle speeds, queuing parameters and road geometry. This will reduce the number of assumptions that are otherwise adopted in the PCM national modelling; and
- Measures already implemented by the Council post 2015, which have had a positive impact on air quality (see Part 2 for more information). These will not have been taken in to account as part of the PCM national modelling (2015 baseline) but are inherently included within the inputs to the local dispersion model.

The Joint Air Quality Unit (JAQU) have validated the local dispersion modelling exercise and have concluded that it provides for an accurate reflection of the air quality along the A1231 PCM exceedance stretch (Census ID 57620). The Council therefore consider that the findings from the local dispersion modelling exercise supersede the PCM model predictions, thereby providing for a revised baseline air quality position along Census ID 57620, i.e. the annual mean NO_2 concentration results from the local dispersion model replace the PCM model predictions.

On this basis, it is therefore concluded that no further consideration to possible measures to be implemented is required, with compliance against the annual mean EU limit value of 40μg/m^3 for NO_2 suitably demonstrated to have already been achieved by 2017 along the A1231 PCM exceedance stretch (Census ID 57620).

Part 2: Developing a long list of measures for addressing the exceedances

This section should provide a long list of possible measures to be considered for each road link. Local authorities should consider the source apportionment set out in part 1.

Part 1 of the TFS concluded that there was no need to proceed with subsequent parts of the TFS, with compliance against the annual mean EU limit value of 40μg/m^3 for NO_2 suitably demonstrated to have already been achieved by 2017 along the A1231 PCM exceedance stretch (Census ID 57620).

Part 3: Assessing deliverability/feasibility and delivering a short list

For each of the measures identified in part 2, local authorities should set out an assessment of deliverability including how long it would take to deliver each measure and whether it is practicably feasible to deliver. Based on this assessment of deliverability and feasibility, the local authority should develop a short list of measures to take forward to part 4 of the report.

Part 1 of the TFS concluded that there was no need to proceed with subsequent parts of the TFS, with compliance against the annual mean EU limit value of 40μg/m^3 for NO_2 suitably demonstrated to have already been achieved by 2017 along the A1231 PCM exceedance stretch (Census ID 57620).

Part 4: Evidencing the short listed measures to identify options that could bring forward compliance

In this section, local authorities should set out the likely effectiveness of the shortlisted measures in bringing forward compliance. Local authorities should assess each option against the Primary Critical Success Factor.

Part 1 of the TFS concluded that there was no need to proceed with subsequent parts of the TFS, with compliance against the annual mean EU limit value of 40μg/m^3 for NO_2 suitably demonstrated to have already been achieved by 2017 along the A1231 PCM exceedance stretch (Census ID 57620).

Part 5: Setting out a preferred option

In this section, local authorities should set out a summary of their preferred option to bringing forward compliance (where such measures exist). Where new measures have been identified that could bring forward compliance, local authorities should also assess a range of Secondary Critical Success Factors in order to identify the preferred option.

Summary

The Pollution Climate Mapping (PCM) national model identified that Sunderland City Council (the Council) had one road link (Census ID 57620) projected to have an exceedance of the annual mean EU Limit Value of 40µg/m^3 for nitrogen dioxide (NO_2). The road link under consideration is a section of the A1231, from its junction with A182 to its junction with the A195. This road link is managed by the Council's Highways Team.

In order to determine a more accurate local position on compliance with the annual mean NO_2 limit value, the Council undertook a local Automatic Number Plate Recognition (ANPR) survey and associated local dispersion modelling exercise, in order to provide an improved insight in to the air quality along the A1231 PCM exceedance stretch.

The ADMS-Roads model (version 4.1.1) and the Emissions Factors Toolkit (EFT version 8.0.1.a) were used for the purposes of the dispersion modelling study, with traffic data used as input to the model derived from a combination of available sources. Details of the model inputs and model verification process can be found in Annex 1, whilst Annex 2 provides the model predicted annual mean NO_2 concentration results.

Annual mean NO_2 concentrations were predicted at discrete and generic receptor groups for a 2017 baseline scenario. The maximum annual mean NO_2 concentration at a discrete receptor along the A1231 PCM exceedance stretch was predicted to be 35.2µg/m^3 (PCM receptor 119). The preliminary results obtained for the four new diffusion tube monitoring sites installed adjacent to the A1231 PCM exceedance stretch showed good correlation with the model predictions. Monitoring will be continued at these locations to further validate the local model findings.

In line with the local model results at discrete receptors, at all receptor locations representative of relevant public access and therefore potential exposure, no exceedances of the annual mean EU limit value of 40µg/m^3 are predicted. This suggests that compliance along Census ID 56720 had already been achieved by 2017.

Therefore, in comparison with the PCM modelled results, the local dispersion modelling results suggest there is a discrepancy with regards to the annual mean NO_2 concentrations predicted along the PCM exceedance stretch, with the PCM model predicting 43μg/m^3 along the A1231 PCM exceedance stretch in 2017 (Census ID 57620). The reason for the difference between the PCM national model predictions and those obtained from the local dispersion model is likely to be two-fold:

- Improved resolution of local data model inputs to the local dispersion model, i.e. traffic flows, fleet composition, Euro composition, average vehicle speeds, queuing parameters and road geometry. This will have reduced the number of assumptions that are otherwise adopted in the PCM national modelling; and
- Measures already implemented by the Council post 2015, which have had a positive impact on air quality (see Part 2 for more information). These will not have been taken in to account as part of the PCM national modelling (2015 baseline) but are inherently included within the inputs to the local dispersion model.

The Joint Air Quality Unit (JAQU) have validated the local dispersion modelling exercise and have concluded that it provides for an accurate reflection of the air quality along the A1231 PCM exceedance stretch (Census ID 57620). The Council therefore consider that the findings from the local dispersion modelling exercise supersede the PCM model predictions, thereby providing for a revised baseline air quality position along Census ID 57620, i.e. the annual mean NO_2 concentration results from the local dispersion model replace the PCM model predictions.

On this basis, Part 1 of the TFS concluded that there was no need to proceed with subsequent parts of the TFS, with compliance against the annual mean EU limit value of 40μg/m^3 for NO_2 suitably demonstrated to have already been achieved by 2017 along the A1231 PCM exceedance stretch (Census ID 57620).

Notwithstanding the above, due to the timings of reaching the above conclusion (i.e. through completion of the local ANPR survey and associated dispersion modelling exercise) relative to the need to progress the TFS, the Council had already prepared Parts 2 to 4 of the TFS. These were originally prepared relative to the PCM model baseline and were then only partially updated relative to the revised baseline position, i.e. that as determined from the local dispersion modelling exercise, which supersedes the PCM model predictions.

Conclusion

A local dispersion modelling study has demonstrated that compliance against the annual mean EU limit value of 40μg/m^3 for NO_2 had already been achieved by 2017 along the A1231 PCM exceedance stretch (Census ID 57620). On this basis, it was concluded that no further consideration to possible measures to be implemented was required.

Notwithstanding the above, the Council remain committed to taking a proactive stance to ensuring positive improvements in air quality continue. The Council will therefore consider further measures that can be implemented, with a collaborative approach with the various stakeholders to be coordinated, in particular ensuring that a joined up approach with the other regional authorities across the north-east is at the forefront of any further action.

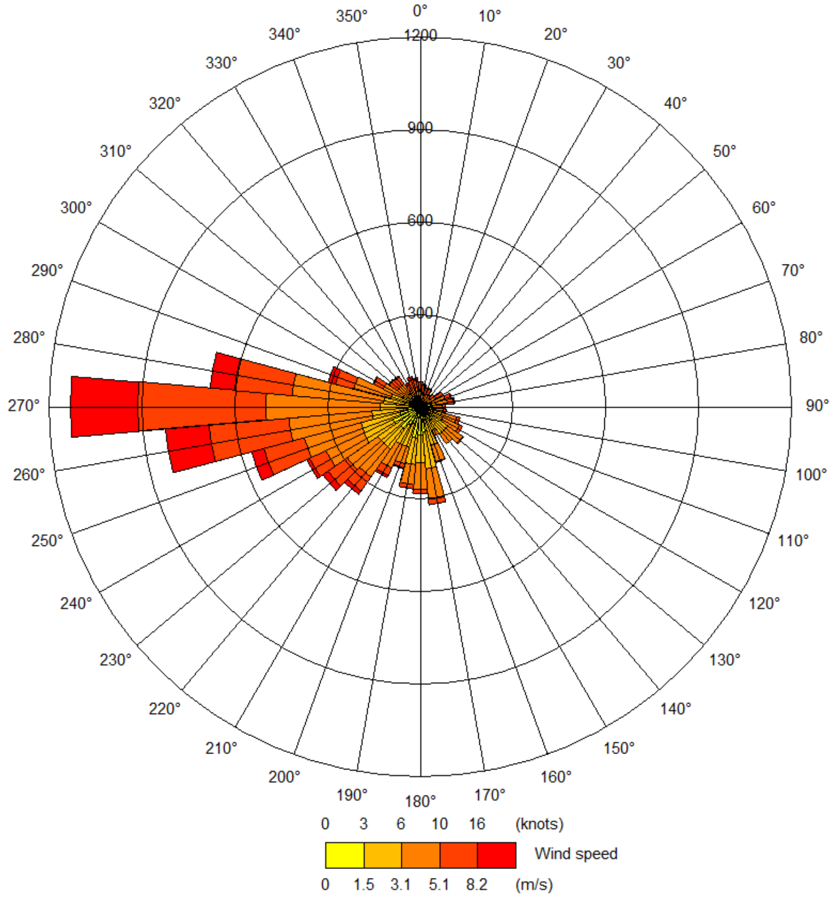
Annex 1: Model Inputs and Verification

Model Inputs

Meteorological Data

Meteorological data from a representative station is required by the dispersion model. 2017 meteorological data from Newcastle Airport's weather station, approximately 18km northwest from the A1231 PCM exceedance stretch, has been used in this assessment. A wind rose for the weather station for the year 2017 is shown in Figure A.1.

Figure A.1 – Wind rose for Newcastle Airport Meteorological Data 2017



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) that the meteorological data file be tested within a dispersion model and the relevant output log file checked, to confirm the number of missing hours and calm hours that cannot be used by the dispersion model. This is important when considering predictions of high percentiles and the number of exceedances. LAQM.TG(16) recommends that meteorological data should 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. 2017 meteorological data from Newcastle includes 8729 lines of usable hourly data out of the total 8,760 for the year, i.e. 99.6% usable data. This is therefore suitable for the dispersion modelling exercise.

Traffic Inputs

The ADMS-Roads assessment incorporates numbers of road traffic vehicles, vehicle speeds on the local roads and the composition of the traffic fleet. The traffic data for this assessment has been derived from 2018 ANPR survey (carried out at 429976,556588), the Department for Transport (DFT) Traffic Counts website and the 2015 survey data for IAMP One development air quality assessment, as detailed in Table A.1 to Table A.4. A growth factor was calculated using TEMPro to apply to the 2015 and 2016 DfT traffic counts and the 2015 IAMP data. Growth factors of 1.021341 and 0.999704 calculated using TEMPro were applied for 2015 to 2017 and 2016 to 2017 respectively.

Traffic speeds were based on speed limits across the road network. However, where appropriate, the speeds have been reduced to simulate queues at junctions, traffic lights and other locations where queues are known to be an issue. Traffic speeds have been assumed to be consistent across all the modelled scenarios.

The Emissions Factors Toolkit (EFT) version 8.0.1a has then been used to determine vehicle emission factors for input into the ADMS-Roads model; these are based upon the traffic data inputs.

Details of the traffic flows used in this assessment are provided in Table A.1 and the modelled roads are presented in

Figure A.2.

Table A.1 – Traffic Data used for Model Verification

Link Name	2017								Speed (kph)
	AADT	% Petrol Car	% Diesel Car	% LGV	% Rigid HGV	% Artic HGV	% Bus and Coach	% Motorcycle	
Wessington Way W[a]	31050	37.1	44.0	14.7	1.9	0.7	1.1	0.6	48.3
Wessington Way_J[a]	31050	37.1	44.0	14.7	1.9	0.7	1.1	0.6	24.2
Note: [a] Estimated based on the PCM model traffic data for road Census ID 57584.									

Table A.2 – Traffic Data used in ADMS-Roads Assessment for the A1231 PCM Exceedance Stretch

Link Name	2017								Speed (kph)
	AADT	% Petrol Car	% Diesel Car	% LGV	% Rigid HGV	% Artic HGV	% Bus and Coach	% Motorcycle	
a1231 E1[a]	41305	37.0	47.0	8.4	4.0	2.5	0.8	0.4	112.7
a1231 E2[b]	39823	35.3	45.0	13.9	2.0	3.2	0.2	0.5	112.7
a1231 E[a]	41305	37.0	47.0	8.4	4.0	2.5	0.8	0.4	112.7
a1231M_above Rb1[c]	34245	36.2	46.0	12.3	2.5	2.5	0.4	0.0	112.7
a1231M_above Rb2[c]	34245	36.2	46.0	12.3	2.5	2.5	0.4	0.0	112.7
a1231M_above Rb[c]	34245	36.2	46.0	12.3	2.5	2.5	0.4	0.0	112.7
Note 1: Speeds have been reduced to simulate queues at junctions, traffic lights and other locations where queues are known to be an issue. Note 2: Growth factors of 1.021341 and 0.999704 were applied for 2015 to 2017 and 2016 to 2017 respectively. [a] 2015 survey data (24 hour AADT) for IAMP air quality assessment.									

Link Name	2017								Speed (kph)
	AADT	% Petrol Car	% Diesel Car	% LGV	% Rigid HGV	% Artic HGV	% Bus and Coach	% Motorcycle	
[b] Combined 2015 survey data (12 hour one day weekday survey data) for IAMP air quality assessment and 2016 DfT count for Census ID 80622.									
[c] Combined 2018 ANPR survey data and 2015 survey data (12 hour one day weekday survey data) for IAMP air quality assessment. 2015 survey data for IAMP air quality assessment grows to 24 hour AADT applied the 24 hour/12 hour ratio of 1.2529 calculated based on 24 hour AADT survey data.									

Table A.3 – ANPR Data used in ADMS-Roads Assessment for the A1231 PCM Exceedance Stretch

Link Name	2017												
	AADT	% Car					% LGV	% HGV		% Buses/Coaches		% Motorcycle	Speed (kph)
		Petrol	Diesel	Full Hybrid Petrol	Full Hybrid Diesel	EV		Rigid	Artic	Diesel	Hybrid		
A1231 W_J	44022	35.7	45.3	0.98	0.02	8.4	12.3	2.5	2.5	0.4	0.01	0.009	112.7
A1231 W_JW	44022	35.7	45.3	0.98	0.02	13.9	12.3	2.5	2.5	0.4	0.01	0.009	112.7
a1231W	44022	35.7	45.3	0.98	0.02	8.4	12.3	2.5	2.5	0.4	0.01	0.009	112.7
a1231W1	44022	35.7	45.3	0.98	0.02	12.3	12.3	2.5	2.5	0.4	0.01	0.009	112.7
Note 1: Speeds have been reduced to simulate queues at junctions, traffic lights and other locations where queues are known to be an issue. Note 2: The survey carried out in April 2018 was taken to be representative of 2017.													

Table A.4 – Traffic Data used in ADMS-Roads Assessment for Additionally Modelling road links to the A1231 PCM Exceedance Stretch

Link Name	2017								Speed (kph)
	AADT	% Petrol Car	% Diesel Car	% LGV	% Rigid HGV	% Artic HGV	% Bus and Coach	% Motorcycle	
A1231 E_Rba	11761	36.1	46.0	10.8	4.8	1.6	0.5	0.1	48.3
A1231 E_SlipNEJa	7279	36.2	46.1	9.5	5.6	2.1	0.3	0.1	24.2
a1231 E_SlipNW_Ja	6804	35.3	44.9	14.3	3.5	0.9	1.1	0.0	24.2
a1231 E_SlipNW1a	6804	35.3	44.9	14.3	3.5	0.9	1.1	0.0	112.7
a1231 E_SlipNW2a	6804	35.3	44.9	14.3	3.5	0.9	1.1	0.0	24.2
A1231 E_SlipNWJa	8538	36.5	46.5	9.1	5.8	1.9	0.2	0.0	24.2
A1231 E_SlipSW_Ja	4648	35.6	45.3	14.0	3.5	0.9	0.7	0.1	112.7
A1231 E_SlipSW1a	4648	35.6	45.3	14.0	3.5	0.9	0.7	0.1	112.7
A1231 E_SlipSW2a	4648	35.6	45.3	14.0	3.5	0.9	0.7	0.1	24.2
A1231 M_Rb_NEa	4730	38.5	49.1	8.4	1.1	-	2.5	0.4	24.2
A1231 M_Rb_NWa	4336	38.2	48.7	8.5	1.5	-	2.7	0.4	24.2
A1231 M_Rb_Sa	25517	39.7	50.6	6.9	1.1	0.1	1.4	0.2	48.3
A1231 M_Rb_SEa	13135	39.7	50.6	7.0	1.0	0.1	1.3	0.2	24.2
A1231 M_Rb_SWa	12382	39.7	50.6	6.8	1.1	0.1	1.4	0.2	24.2
A1231 M_Rba	14370	39.4	50.2	7.6	1.2	0.1	1.3	0.2	48.3
A1231 M_Slip Na	4840	39.7	50.5	7.8	1.6	0.1	0.1	0.2	112.7
A1231 M_Slip NEa	6277	39.7	50.5	7.5	1.3	0.1	0.8	0.2	112.7
A1231 M_Slip NE_Ja	6277	39.7	50.5	7.5	1.3	0.1	0.8	0.2	112.7
A1231 M_Slip NE_Rba	6277	39.7	50.5	7.5	1.3	0.1	0.8	0.2	24.2
A1231 M_Slip NJa	4840	39.7	50.5	7.8	1.6	0.1	0.1	0.2	112.7
A1231 M_Slip SEa	6844	39.3	50.0	8.3	1.1	0.1	0.9	0.2	112.7
A1231 M_Slip SE_Ja	6844	39.3	50.0	8.3	1.1	0.1	0.9	0.2	112.7
A1231 M_Slip SE_Rba	6844	39.3	50.0	8.3	1.1	0.1	0.9	0.2	24.2

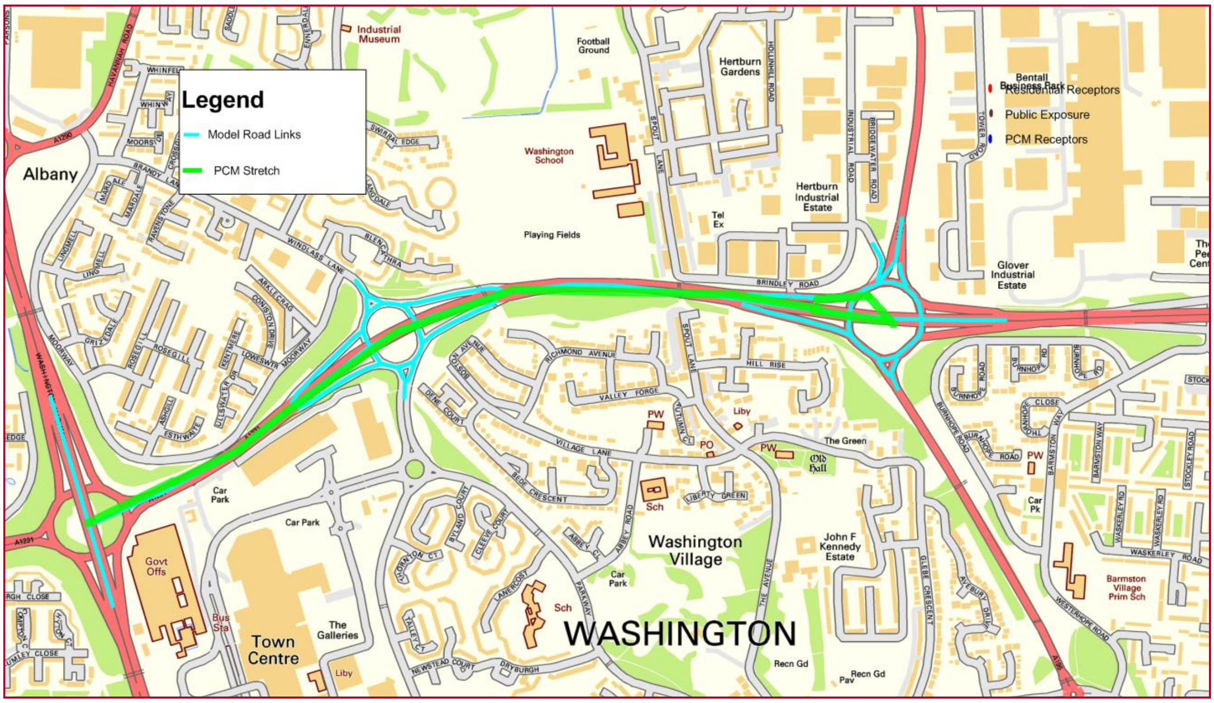
Link Name	2017								Speed (kph)
	AADT	% Petrol Car	% Diesel Car	% LGV	% Rigid HGV	% Artic HGV	% Bus and Coach	% Motorcycle	
A1231 M_SlipN_Rba	4840	39.7	50.5	7.8	1.6	0.1	0.1	0.2	24.2
A1231 M_SlipSa	5048	39.3	50.1	8.6	1.2	0.2	0.3	0.2	112.7
A1231 M_SlipS_Rba	5048	39.3	50.1	8.6	1.2	0.2	0.3	0.2	24.2
A1231 M_SlipSJa	5048	39.3	50.1	8.6	1.2	0.2	0.3	0.2	112.7
A182b	21571	36.3	46.2	14.1	1.7	0.5	0.7	0.4	112.7
a195 Na	15817	36.4	46.3	9.3	5.7	2.0	0.3	0.1	48.3
a195 Sa	11307	37.5	47.7	10.7	3.1	0.6	0.2	0.2	48.3
a195 SE_Ja	5279	37.4	47.6	11.4	2.8	0.4	0.1	0.3	24.2
a195 SW_Ja	6029	37.6	47.9	10.1	3.2	0.7	0.3	0.2	24.2
Industriala	2120	32.7	41.6	16.1	4.2	1.8	3.5	0.2	32.2
Industrial_Ja	2120	32.7	41.6	16.1	4.2	1.8	3.5	0.2	24.2
Windlass Lna	9065	38.4	48.9	8.4	1.3	-	2.6	0.4	48.3

Note 1: Speeds have been reduced to simulate queues at junctions, traffic lights and other locations where queues are known to be an issue.

Note 2: A growth factor of 1.021341 was applied for 2015 to 2017.

[a] 2015 survey data (12 hour one day weekday survey data) for IAMP air quality assessment. 2015 survey data for IAMP air quality assessment grows to 24 hour AADT applied the 24 hour/12 hour ratio of 1.2529 calculated based on 24 hour AADT survey data.

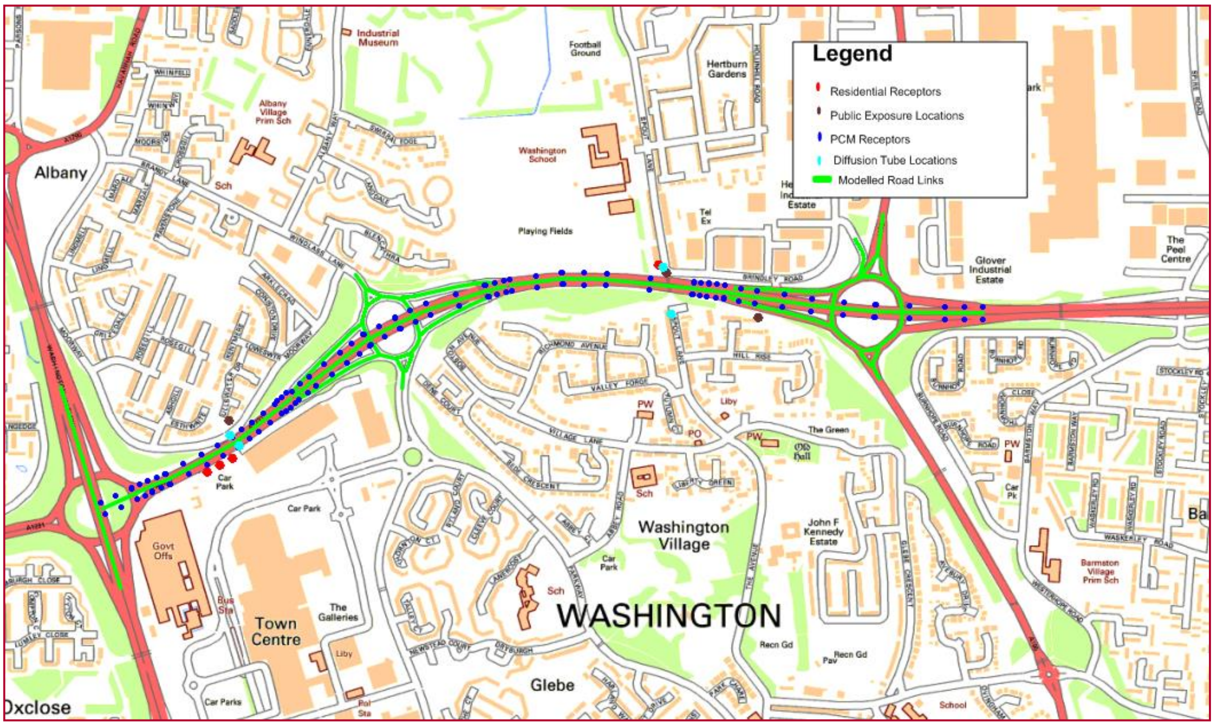
Figure A.2 – Modelled Roads



Receptors

Discrete receptors ('PCM receptors') included within the model have been located at 4m distance from each road link along the A1231 PCM exceedance stretch at a height of 2m, as illustrated in **Figure A.3**.

Figure A.3 – Receptor Locations



Outputs

Annual mean road-NO_x concentrations were output from the ADMS-Roads model at the specified receptor locations. Following the process of model verification and adjustment, these were combined with relevant background NO_x concentrations obtained from Defra's LAQM 1km resolution background maps and, through the use of the NO_x to NO_2 calculator v6.1, total annual mean NO_2 concentrations determined.

All model predicted annual mean NO_2 concentration results are provided are presented in Annex 2.

Model Verification

There are no monitoring sites located within the A1231 PCM exceedance stretch. The closest monitoring site is DT113, which is 1.8km to the northwest of the A1231 PCM exceedance stretch. This location does not represent the road conditions and therefore the air quality encountered along the A1231 PCM exceedance stretch.

The nearest automatic monitoring station is Sunderland Wessington Way AURN with road conditions representative of the A1231 PCM exceedance stretch. This monitoring site has therefore been used for model verification purposes. As the AURN site is 7km from the A1231 PCM stretch, there is therefore a separate model domain for the purposes of model verification than that used for characterising the air quality along the A1231 PCM exceedance stretch.

For model verification, the continuous monitoring data from the Sunderland Wessington Way AURN as presented in Table A.5 for 2017 has been used.

Table A.5 – Details of Sunderland Wessington Way AURN

Receptor ID	X	Y	%Data Capture	2017 NO_2 Concentrations ($\mu g/m^3$)
Wessington Way	438020	558348	81	23

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

For the verification and adjustment of NO_x/NO_2, the annual mean concentrations for 2017 were used as presented in Table A.5.

Table A.6 below shows an initial comparison of the monitored and unverified modelled NO_2 results for the year 2017, in order to determine if verification and adjustment was required.

Table A.6 – Comparison of Unverified Modelled and Monitored NO_2 Concentrations

Site ID	Background NO_2 ($\mu g/m^3$)	Monitored total NO_2 ($\mu g/m^3$)	Unverified Modelled total NO_2 ($\mu g/m^3$)	% Difference (modelled vs. monitored)
Wessington Way	17.1	23	22.83	-0.74

The model was under predicting at this location and no further improvement of the modelled results could be obtained on this occasion. Model adjustment was therefore carried out to allow for improvements in the results.

Model adjustment needs to be undertaken based on NO_x and not NO_2. NO_x concentrations were derived from the monitored NO_2 diffusion tube results used for verification. These calculations were undertaken using a spreadsheet tool available from the LAQM website. Table A.7 provides the relevant data required to calculate the model adjustment based on the ratio of the modelled and monitored road source contribution to NO_x.

Table A.7 – Data Required for Adjustment Factor Calculation

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)
Wessington Way	23.0	35.4	17.1	24.1	5.9	11.4	11.0

As only a single verification point is present it is not possible to undertake linear regression. The ratio of the monitored road NO_x contribution to the modelled road NO_x contribution at the Wessington Way AURN site is 1.0305. Verification therefore gives an adjustment factor for the modelled results of 1.0305.

Table A.8 below illustrates the adjusted modelled NO_2 concentrations plotted against monitored NO_2 concentrations. A verification factor of 1.0305 was therefore used to adjust the model results.

Table A.8 – Adjustment Factor and Comparison of Verified Results against Monitoring Results

Site ID	Ratio of monitored road contribution NO_x / modelled road contribution NO_x	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)
Wessington Way	1.03	1.03	11.38	35.44	23.00	23.00	0.00

Annex 2: Model results

Available on request