Durham County Council Air Quality Further Assessment: Chester le Street AQMA

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1 Introduction

1.1 Introduction

AECOM were appointed by Durham County Council (DCC) to undertake a Further Assessment of the nitrogen dioxide (NO_2) Air Quality Management Area (AQMA) encompassing Menceforth Cottages and Glen Terrace, near Chester-le-Street.

The AQMA was declared in May 2013 due to high concentrations of NO_2, following the outcome of a Detailed Assessment (DCC, 2012). The declaration was based on available pollutant monitoring data and dispersion modelling. An additional outcome of the assessment was a requirement to undertake further monitoring at more locations so as to enable the extent of the AQMA to be verified. This verification has been performed as part of the Further Assessment.

The following document constitutes the Further Assessment undertaken in accordance with the guidance in Chapter 7 of LAQM.TG(09) and completed within 12-months of the designation of the AQMA.

1.1.1 Location

The extent of the Chester-le-Street AQMA is provided in Appendix A, Figure 2.

The AQMA is located to the west of Chester-le-Street town centre along the B6313 Pelton Fell Road. The AQMA encompasses the row of terraced properties known as Menceforth Cottages and the row of properties further to the west known as Glen Terrace.

2 Legislation and Guidance

2.1 Regulatory / Policy Framework

2.1.1 European Air Quality Directives

The Air Quality Framework Directive (96/62/EC) on ambient air quality assessment and management defines the policy framework for 12 air pollutants known to have a harmful effect on human health and the environment. The limit values for the specific pollutants are set through a series of Daughter Directives. Following these Directives, Council Directive 2008/50/EC on ambient air quality and cleaner air for Europe came into force in 2008, and was transposed into national legislation in 2010 (The Air Quality Standards(England) Regulations 2010). This essentially requires pollutant concentrations in the UK (such as NO_2) to be below mandatory limits.

2.1.2 National Air Quality Legislation

The provisions of Part IV of the Environment Act 1995 establish a national framework for air quality management, which requires all Local Authorities in England, Northern Ireland, Scotland and Wales to conduct local air quality reviews. Section 82(1) of the Act requires these reviews to include an assessment of the current air quality in the area and the predicted air quality in future years. Should the reviews indicate that the objectives prescribed in the UK Air Quality Strategy (Defra, 2007) and the Air Quality (England) Regulations 2010 (Defra, 2010) (henceforth referred to as the "Air Quality Regulations") will not be met, the Local Authority is required to designate an Air Quality Management Area (AQMA). Action must then be taken at a local level to ensure that air quality in the area improves.

The UK Air Quality Strategy (AQS) (Defra, 2007) identifies nine ambient air pollutants that have the potential to cause harm to human health. These pollutants are associated with local air quality problems, with the exception of ozone, which is instead considered to be a regional problem. Similarly, the Air Quality Regulations set objectives, but for just seven of the pollutants that are associated with local air quality. These objectives aim to reduce the health effects of the pollutants to negligible levels.

The air quality objectives and limit values currently applicable to the UK can therefore be split into two groups. Each has a different legal status and is therefore handled differently within the framework of UK air quality policy. These are:

- UK air quality objectives set down in regulations for the purposes of local air quality management; and
- European Union (EU) limit values transcribed into UK legislation for which compliance is mandatory.

2.2 Nitrogen Dioxide

The Government and the Devolved Administrations adopted two Air Quality Objectives for NO_2 which were to be achieved by the end of 2005. In 2010, mandatory EU air quality limit values on pollutant concentrations were to apply in the UK. The UK Government applied for derogation, although this was refused and the EU is commencing with proceedings that may entail fines due to non-compliance. The EU limit values for NO_2 are the same as the national objectives (HMSO, 2007):

- An annual mean concentration of 40 $\mu g/m^3$; and
- An hourly mean concentration of 200 $\mu g/m^3$, to be exceeded no more than 18 times per year.

In practice, meeting the annual mean objective has been, and is expected to remain, considerably more demanding than achieving the 1-hour objective. The annual mean objective of 40 $\mu g/m^3$ is currently exceeded at many roadside sites throughout the UK, with exceedances also reported at urban background locations in major conurbations. Exceedances are associated almost exclusively with road emissions.

There is considerable year-to-year variation in the number of exceedances of the hourly objective, driven by meteorological conditions which give rise to winter episodes of poor dispersion and summer oxidant episodes. Analysis of the relationship between 1-hour and annual mean NO_2 concentrations at roadside and kerbside monitoring sites indicate that exceedances of the 1-hour objective are unlikely where the annual mean is below 60 $\mu g/m^3$ (AEA, 2008).

NO_2 and nitric oxide (NO) are both oxides of nitrogen, and are collectively referred to as NO_X. All combustion processes produce NO_X emissions, largely in the form of NO, which is then converted to NO_2, mainly as a result of its reaction with ozone in the atmosphere. Therefore the ratio of NO_2 to NO is primarily dependent on the concentration of ozone and the distance from the emission source.

3 Existing Air Quality

3.1 Local Air Quality Management

The Local Air Quality Management (LAQM) procedure undertaken by Durham County Council has recognised that high concentration of NO_2 exist around Menceforth Cottages, to the west of Chester-le-Street, and an AQMA has been declared.

The 2009 Updating and Screening Assessment reported exceedances of the NO_2 annual mean limit at this location, which was partially attributed to an extended period of road works. Monitoring was continued at this location to decide whether it would be necessary to proceed to a Detailed Assessment.

The 2011 Progress Report concluded that, due to continued breaches of the annual mean NO_2 limit at Menceforth Cottages, a Detailed Assessment should be undertaken.

A Detailed Assessment was undertaken in 2012 using the AAQuIRE detailed dispersion model to predict the concentration of NO_2 at roadside and sensitive residential receptor locations at and near to Menceforth Cottages. The model was verified using monitoring data, which determined a relatively high adjustment factor, and accordingly the properties at Glen Terrace, approximately 350 m to the west of the Menceforth Cottages on the same road, where no monitoring had been undertaken, were also predicted to be exposed to high annual mean NO_2 concentrations. The model results were also compared subjectively with the concentrations measured within Chester-le-Street town centre and, despite this area being more congested with slower moving traffic, the monitored concentrations were generally lower than those recorded at the Cottages. This suggested that the physical characteristics of the valley may be contributing to the elevated concentration of NO_2 at the Cottages and it would not be appropriate to extend the AQMA any further east than the section of road between Menceforth Cottages to Glen Terrace, due to the lower concentrations measured in Chester-le-Street.

An AQMA was declared in May 2013 to encompass Menceforth Cottages and Glen Terrace. Additional monitoring within the AQMA using passive diffusion tubes was undertaken in 2013 to confirm whether this designation was appropriate.

3.2 Monitoring

Durham County Council operate a passive diffusion tube monitoring network throughout the County, as well as an automatic continuous monitoring station in Durham City, which is used to determine a local bias adjustment factor for the tube data.

In Chester-le-Street, the Council operated 14 passive diffusion tube monitoring locations during 2013 (see Table 1 and 2, and Appendix A, Figure 2 and 3). The locations within the AQMA are indicated with shading. No exceedances of the NO_2 annual mean limit have been recorded except at Menceforth Cottages (D23; in 2013 and 2010).

Table 1: Chester-le-Street Air Quality Monitoring

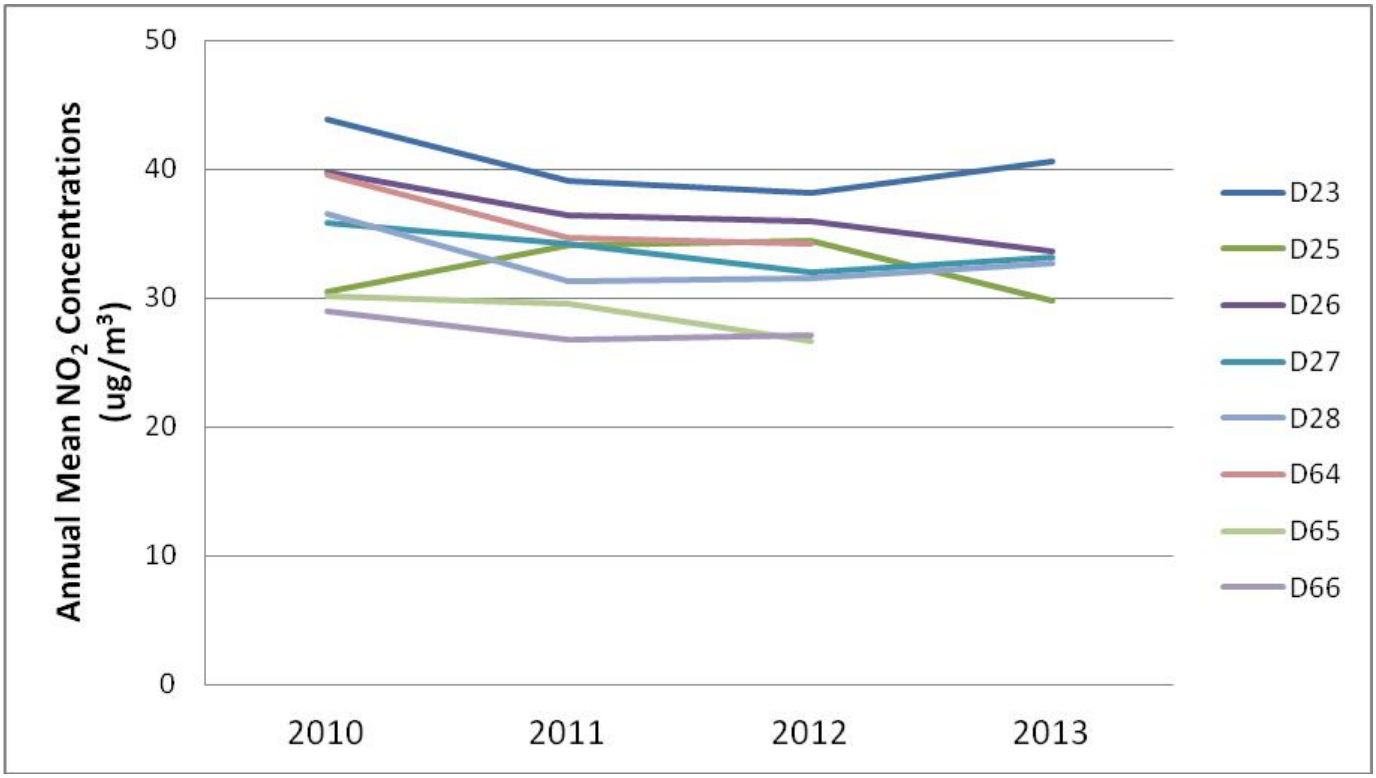
ID	Location	Type	Relevant Exposure?	Distance to kerb of nearest road	Annual Mean NO_2 Concentration ($\mu g/m^3$)						
					2007	2008	2009	2010	2011	2012	2013
D22	Ropery Lane	Roadside	Y	1 m	-	-	Monitoring programme suspended during 2009	25.1	23.6	24.5	-
D23	Menceforth Cottages	Roadside	Y	1 m	**40.0**	**47.2**		**43.9**	39.1	38.1	**40.6**
D24	Market Place	Kerbside			**45.3**	37.1		30.7	29.3	26.6	-
D25	Pelaw Grange Court	Kerbside	N (10m)	0 m	**42.5**	32.9		30.5	34.1	34.4	29.8
D26	North Road	Kerbside	N (15m)	2 m	**47.3**	37.0		39.8	36.4	35.9	33.6
D27	3 Blind Lane	Roadside	Y	8 m	-	-	-	35.8	34.2	32.0	33.2
D28	15 Cherry Banks	Roadside	N (15m)	1 m	-	-	-	36.5	31.3	31.5	32.7
D64	Aldi	Roadside	N	2 m	-	-	-	-	39.6	34.7	34.2
D65	Newcastle Road	Roadside	Y	2 m	-	-	-	-	30.1	29.5	26.7
D66	Pelaw Bank	Roadside	Y	2 m	-	-	-	-	29.0	26.8	27.1
D85	No.24 Picktree Terrace	Kerbside	Y	2.0	-	-	-	-	-	34.7	35.4
D94	20 Glen Terrace	Kerbside	Y	< 1m	-	-	-	-	-	27.7	29.3
D95	8 Glen Terrace	Roadside	Y	4.9	-	-	-	-	-	27.0	26.4
D100	1 Appledore Gardens	Roadside	Y	< 1m	-	-	-	-	-	25.8	33.2
D108	6 Blind Lane	Kerbside	Y	< 2 m	-	-	-	-	-	-	22.2

Note: Exceedances of the NO_2 annual mean limit are shown in bold.

There is no clear trend of concentrations in the AQMA either decreasing or increasing, although prior to 2013 concentrations had decreased year on year between 2010 and 2012.

According to Figure 1, annual mean NO_2 concentrations have decreased between 2010 and 2012/2013 at all monitoring sites in Chester le Street, where monitoring has been undertaken for 3 years or more. Of these sites, all recorded an annual mean NO_2 concentration below the annual mean NO_2 limit in 2013. The exception to this was D23, which recorded an exceedence in 2013.

Figure 1: Trends in Annual Mean Nitrogen Dioxide Concentrations Measured at Diffusion Tube Monitoring Sites in Chester-le-Street



3.3 Background

3.3.1 Monitored Background

A large number of sources of air pollutants exist which individually may not be significant, but collectively, over a large area, need to be considered. The concentrations calculated by the modelling due to vehicle emissions can then be added to these background concentrations to give the total concentration.

The background concentrations of NO_2, away from the influence of road sources, have been measured at the County Cricket Ground, near Chester-le-Street since 2012. The concentration recorded at this location was 14.8 $\mu g/m^3$ in 2013.

Table 2: Durham Monitored Background Pollutant Concentrations

ID	Location	Type	Annual Mean NO_2 Concentration ($\mu g/m^3$)	
			2012	2013
D101	Durham County Cricket Ground	Urban Background	11.6	14.8

3.3.2 Defra Estimated Background

In addition to the monitored background data recorded by DCC, modelled estimations of background air quality concentrations are provided by Defra (http://www.defra.gov.uk/environment/quality/air/air-quality/laqm/) for each 1 km square in the UK for each year between 2010 and 2030. For the purpose of modelling, the road sources must be discounted from the total background

pollutant concentrations to give 'adjusted' values. Estimated background concentrations for the Ordnance Survey grid square containing the AQMA (426500, 551500) and the Cricket Ground (428500, 550500) are shown in Table 3 for 2013, and also for the projected future years 2015 and 2017. These data were downloaded in February 2014.

Table 3: Defra Estimated Background Pollutant Concentrations

	Durham County Ground		Menceforth Cottages AQMA					
	2013				2015		2017	
	Total	Adjusted	Total	Adjusted	Total	Adjusted	Total	Adjusted
NO_X	22.0	13.4	24.9	17.3	22.7	16.1	21.0	15.2
NO_2	15.2	9.7	16.9	12.2	15.7	11.5	14.6	10.9

3.3.3 Background Summary

The 2013 concentration estimated by Defra in the grid square containing the cricket ground (Table 3) is very similar to the monitored concentration in that area (Table 2). The 2013 total and adjusted concentration predicted in the grid square containing the AQMA is very similar to that recorded at the cricket ground and the monitoring data at the Cricket Ground is likely to provide a good indication of concentrations at Menceforth Cottages, set back from the main road.

3.4 Summary of Existing Conditions

Monitoring has demonstrated that no exceedances of the NO_2 annual mean limit have been recorded except at Menceforth Cottages. Therefore, the extent of the AQMA should be reduced to just include Menceforth Cottages, as shown in Appendix A, Figure 2.

4 Emission Modelling and Assessment

4.1 Assessment Methodology

The detailed dispersion modelling study undertaken in 2012 indicated that localised street-canyon effects may be occurring near the Menceforth Cottages, due to the valley and narrow road setting. In the absence of reasons to suggest otherwise it was assumed that the same conditions may be present at Glen Terrace. However, as discussed in Section 3, above, additional monitoring at Glen Terrace to the west of the AQMA, and within Chester-le-Street to the east, has confirmed that the annual mean concentration of NO_2 does not exceed the limit at locations or relevant exposure beyond Menceforth Cottages.

The 2012 Detailed Assessment is still applicable to this area, as there have been no changes due to road schemes or alterations to road traffic characteristics in the vicinity of the Chester-le-Street AQMA that potentially may have an impact on air quality.

Due to the availability of suitable monitoring data, additional detailed dispersion modelling has not been repeated and this assessment uses the Emission Factor Toolkit (EFT) published by Defra to determine the significant emission sources and required emission reductions needed to achieve the limit.

4.1.1 EFT

The study used the emission database published by Defra in the Emission Factors Toolkit (EFT) (v5.2, January 2013) (http://laqm.defra.gov.uk/review-and-assessment/tools/emissions.html#eft). The EFT is a calculation tool designed to determine emissions from road vehicles, taking account of vehicle flow, speeds and vehicle composition. The emission rates are updated periodically to incorporate updated NO_X emissions factors and vehicle fleet information based on current measurements and projections, and are currently based on the European Environment Agency (EEA, 2013) COPERT 4 (v8.1) emission calculation tool, which includes data for all vehicle categories from Pre-Euro 1 to Euro 6.

4.1.2 Traffic Flow Data

The Council recorded traffic flows on the road through the AQMA in June 2011 using an automatic traffic counter. Four different categories of vehicle length were recorded, corresponding to types recommended by '*A manual of guidance: Lorries and Traffic Management – A guide to Lorry Sizes, Civic Trust County Surveyors Society*' (DoT, 1999), which is used by the DCC traffic unit. These data are shown in Table 4.

Monitoring using the same type of equipment on Newcastle Road in Chester-le-Street in October 2011 and March 2012 recorded a decrease in vehicle flows. This suggests that increases in vehicle flow are not occurring on the local roads, and so no adjustment factor was applied to project the 2011 data to the 2013 base year. Similarly, it has been assumed that traffic flows will not significantly increase between 2013 to 2017, although this does not consider potential growth due to developments tha may go ahead.

The number 78/78A and number 8 bus routes pass through the AQMA approximately every 30-minutes between 06:30-23:30. This is equivalent to approximately 72 bus movements per day. These buses were assumed to be Rigid HGV (Heavy Goods Vehicle) category.

Table 4: Traffic Flow Data Within the AQMA

Location	Recording Year	Annual Average Daily Traffic (AADT)				
		Total	Cars/Vans	LGV	Rigid HGV	Artic HGV
B6313	2011	13259	12337	428	342	65

Note: LGV, Light Goods Vehicle. HGV, Heavy Goods Vehicle (>3.5 tonnes).

4.2 Source Apportionment

The data in Table 5 show the estimated contribution from each type of road vehicle on the B6313 through the AQMA.

The background concentration of NO_X is predicted to decrease in the future by the following amounts based on the background pollutant projections provided in Table 3:

- Between 2013-2015 will be a 6.9% reduction.
- Between 2015-2017 will be a 5.6% reduction.

Similarly, the total emissions per km from road vehicles are predicted to decrease due to increasingly stringent legislation controlling exhaust emissions. The following values were estimated using the EFT output data in Table 5:

- 2013-2015 Road emissions 15.5% reduction
- 2015-2017 Road emissions 19.1% reduction

The future percentage background contributions were estimated based on the predicted changes in each year discussed above. This proportional contribution was predicted to increase slightly each year as the emissions from vehicles decreases at a relatively greater rate.

The most significant contribution was predicted to be from diesel cars. Petrol cars and rigid HGVs were each similar, whilst LGVs, articulated HGVs and buses were predicted to be less significant. The contribution from diesel cars was predicted to increase each year, whilst petrol cars and HGVs would decrease. The contributions from buses and LGVs were not predicted to change.

Table 5: NO_X Emissions Analysis of Traffic in the AQMA

Year	All Vehicle Emissions (g/km)	Background Contribution	Road Vehicle Emission Contribution							
			All LDV	All HDV	Petrol Cars	Diesel Cars	Diesel LGV	Rigid HGV	Artic HGV	Buses / Coaches
2013	5131	27.5%	70%	30%	16%	49%	5%	18%	5%	7%
2015	4337	30.3%	76%	24%	13%	57%	6%	15%	4%	6%
2017	3507	35.4%	80%	20%	12%	62%	6%	12%	2%	6%

4.3 Required Reduction

The monitoring at Glen Terrace has demonstrated that the annual mean concentration of NO_2 is well below the limit, and so no reduction of emissions is required in this location. The concentration recorded at this location was sufficiently low that it is considered very unlikely to exceed the limit in the future.

The data in Table 6 show the different components of NO_2 and NO_X, and the reduction of NO_X that is required to achieve the annual mean NO_2 limit at the Menceforth Cottages in the AQMA, based on 2013 data. A total NO_2 reduction of 1.5% is required to achieve the annual mean limit, which would require emissions from NO_X from road vehicles to be reduced by 3.5%, based on the 2013 monitoring.

It is important to note that the concentration was only just above the limit value in 2013, and for the two years prior the concentrations was below the limit value. This demonstrates what could be described as typical annual variance due to fluctuations in traffic flows, meteorological conditions, and measurement uncertainty. Essentially, only a small reduction is required of the order of 0-5%.

Table 6: Breakdown of Monitored Emission Sources

	Annual Mean Concentration, µg/m^3
Monitored-NO_2	40.6
Monitored-NO_X	62.8
Background-NO_X	17.3
Road-NO_X	45.5
Annual Mean Limit NO_X	61.3
Road-NO_X Exceeding Limit	1.6
Require Road-NO_X Reduction	3.5%

4.4 Predicted Future Concentrations

The projected changes of emissions from road vehicles and background pollutant concentrations are discussed above in Section 4.2. The estimated projections suggest that the required reduction of 3.5% will be achieved within 1-2 years.

However, a degree of caution is necessary due to the fact that there has been no clear trend of decreasing concentrations over the past four years.

5 Conclusions

5.1 Summary

Monitoring data recorded within the AQMA can be summarised:

- The annual mean concentration of NO_2 recorded at Glen Terrace in 2013 was well below the EU limit (less than 75%) and was sufficiently low that it was considered very unlikely to exceed the limit in the future.
- The annual mean concentration of NO_2 recorded at Menceforth Cottages in 2013 was slightly above the EU limit, (40.6 µg/m^3)) although it was slightly below the limit in 2011 and 2012.
- There has been no clear trend of concentrations within the AQMA decreasing or increasing over the past 4 years.
- The monitoring data clearly supports the proposed reduction in the extent of the AQMA to just include Menceforth Cottages, as shown in Figure 1.

The Further Assessment has determined:

- High concentrations of NO_2 in the AQMA have been attributed to highly localised street canyon effects, as monitoring elsewhere with similar traffic volumes and more congestion has not demonstrated any air quality problems.
- The most significant emission contribution was predicted to be from diesel cars.
- The proportional contribution from diesel cars was predicted to increase each year, whilst petrol cars and HGVs would decrease.
- The reduction of NO_X that is required to achieve the annual mean NO_2 objective at the Menceforth Cottages was estimated to be approximately 0-5%.
- Emissions calculations indicate that concentrations should reduce to below the limit value without specific intervention, however, given that monitored concentrations have not decreased over the past four years, caution should be exercised and the situation should be reviewed annually. Increases in traffic flow could potentially exacerbate the situation, however significant development in the area is not proposed and therefore significant traffic increases are not expected.

5.2 Proposed Actions

5.2.1 Extent of the AQMA

The extent of the AQMA should be reduced to just include Menceforth Cottages, as shown in Appendix A, Figure 2.

5.2.2 Other Actions

The Durham City Air Quality Action Plan (AQAP) is currently being created, which will focused on the Durham City AQMA. However, the high concentrations of NO_2 measured in the Chester-le-Street AQMA are related to highly localised street-canyon dispersion effects rather than large vehicle flows or congestion and so many of the actions and measures may not be appropriate in both areas. Therefore, it is intended to establish and develop a separate Air Quality Action Plan for the Chester-le-Street AQMA using the existing arrangement of the Air Quality Technical Working and Corporate Steering Groups.

Specific actions and measures will be identified in the AQAP that may be used to reduce emissions from road vehicles in the Chester-le-Street area, such as careful consideration of planning applications that may affect vehicle flows through the AQMA. Where suitable measures are identified, these will be explicitly identified and appraised.

5.2.3 Continue Monitoring

Monitoring will continue to keep track of the situation.

6 References

Air Quality Framework Directive (96/62/EC) on ambient air quality assessment and management

Council Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe.

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

Defra (2009) Local Air Quality Management Technical Guidance LAQM.TG(09)

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Dept of Transport (1999), Civic Trust County Surveyors Society, A manual of guidance: Lorries and Traffic Management – A guide to Lorry Sizes

Durham County Council (2012) Local Air Quality Management Chester-le-Street Detailed Assessment

Durham County Council (2013) Local Air Quality Management Progress Report

Durham County Council (2014) Local Air Quality Management Progress Report (Draft)

7 Appendices

Figure 2: Chester-le-Street AQMA (Existing and Amended) and Monitoring

Figure 3: Monitoring locations in Chester-le-Street