
# 2014 Air Quality Progress Report for Ballymena Borough Council

In fulfillment of Environment (Northern Ireland) Order 2002

Local Air Quality Management

August 2014

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|---|---|
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# Executive Summary

A review of new monitoring data for the period 1 January 2013 – 31st December 2013 has identified the following:

**Nitrogen Dioxide**

- The North Road automatic analyser for Nitrogen Dioxide had an Annual mean nitrogen dioxide concentration of 28 $\mu gm^{-3}$ therefore below the Annual Mean Air Quality Objective of 40 $\mu gm^{-3}$.
- Throughout the year there were 2 exceedances of the hourly mean concentration (>200 $\mu gm^{-3}$)

**Sulphur Dioxide**

- During the 2013 monitoring period there were no exceedances of the 15- minute, hourly, daily or the annual means for sulphur dioxide,

**$PM_{10}$**

- During the 2013 monitoring period there were 7 exceedances of the daily mean for $PM_{10}$.
- There were no exceedances of the annual mean objectives.

# Table of Contents

**1 Introduction ..... 1**

1.1 Description of Local Authority Area ..... 1

1.2 Purpose of Progress Report ..... 3

1.3 Air Quality Objectives ..... 4

1.4 Summary of Previous Review and Assessments ..... 5

**2 New Monitoring Data ..... 16**

2.1 Summary of Monitoring Undertaken ..... 16

2.2 Comparison of Monitoring Results with Air Quality Objectives ..... 32

**3 New Local Developments ..... 48**

**4 Planning Applications ..... 49**

**5 Local Transport Plans and Strategies ..... 50**

**6 Implementation of Action Plans ..... 51**

**7 Conclusions and Proposed Actions ..... 57**

7.1 Conclusions from New Monitoring Data ..... 57

7.2 Conclusions relating to New Local Developments ..... 58

7.3 Other Conclusions ..... 58

7.4 Proposed Actions ..... 59

**8 References ..... 60**

**9 Appendices ..... 61**

Appendix A: Quality Assurance / Quality Control (QA/QC) ..... 62

Appendix B: NO2 Diffusion Tube Monthly Data 2013 ..... 64

# List of Tables

Table 1-1 Air Quality Objectives included in Regulations for the purpose of LAQM in Northern Ireland 4
Table 2-1 Air Quality Objectives included in Regulations for the purpose of LAQM in Northern Ireland 17
Table 2-2 Details of Non- Automatic Monitoring Sites– NOx Diffusion Tubes 21
Table 2-3 Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with Annual Mean Objective 32
Table 2-4 Results of Automatic Monitoring for NO2: Comparison with Annual Mean Objective 33
Table 2-5 Results of Automatic Monitoring for $NO_2$: Comparison with 1-hour Mean Objective 34
Table 2-6 Results of $NO_2$ Diffusion Tubes 2013 36
Table 2-7 Results of $NO_2$ Diffusion Tubes (2008 to 2013) 38
Table 2-8 Results of Automatic Monitoring for $PM_{10}$ 2013 41
Table 2-9 Results of Automatic Monitoring for $PM_{10}$: Comparison with Annual Mean Objective 43
Table 2-10 Results of Automatic Monitoring for $PM_{10}$: Comparison with 24-hour Mean Objective 44
Table 2-11 Results of Automatic Monitoring for $SO_2$ 2013 45
Table 2-12 Results of Automatic Monitoring for $SO_2$: Comparison with Objectives 46
Table 6-1 Linenhall Street AQMA Action Plan Progress 53

# List of Figures

Figure 1-1 Map of Ballymena Town and surrounding villages. 2
Figure 2-1 Photo - Ballykeel Automatic Analysers 18
Figure 2-2 Photo - North Road Automatic Analyser 18
Figure 2-3 Showing location map of Ballykeel and North Road Automatic Analysers and declared AQMA's 19
Figure 2-4 Maps of Non-Automatic Monitoring Sites 24
Figure 2-5 Trends in Annual Mean $NO_2$ Concentrations Measured at Automatic Monitoring Sites 34
Figure 2-6 Trends in Annual Mean Nitrogen Dioxide Concentrations Measured at Diffusion Tube Monitoring Sites 2008-13 40
Figure 2-7 Trends in Annual Mean $PM_{10}$ Concentrations 43

# 1 Introduction

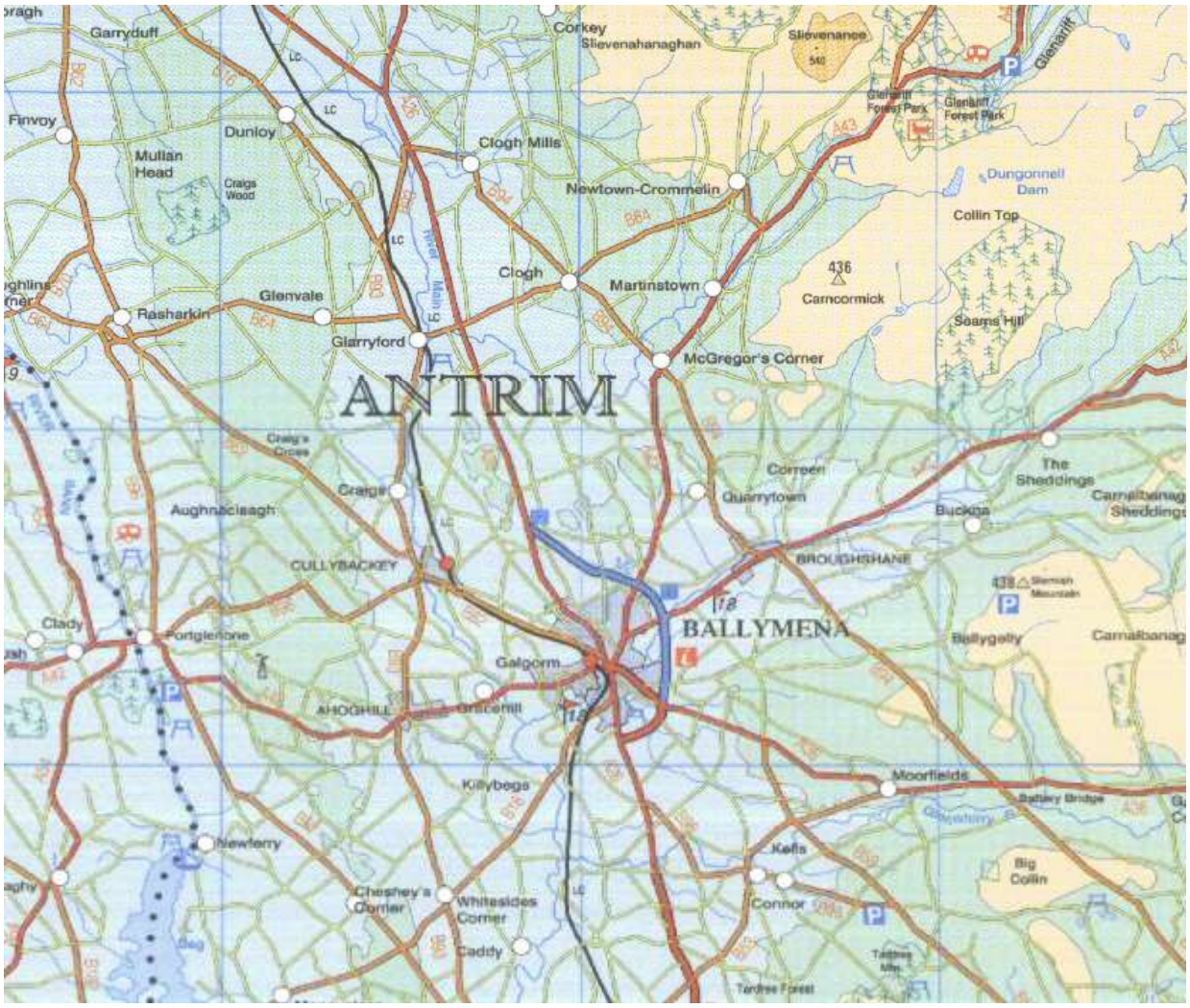
## 1.1 Description of Local Authority Area

Ballymena Borough has a population of approximately 64,000. The borough is approximately 200 square miles, and has a mixed urban and rural character. The Borough has a central location within Northern Ireland with good roads and rail communication network. It is served by the M2 motorway and with a Train station on the Belfast to Londonderry rail-line.

Belfast International Airport is located 18 miles and Belfast City Airport is 30 miles from Ballymena. It is also accessible to the seaports of Larne and Belfast, 20 and 27 miles respectively.

The Antrim Coast and Giants Causeway bound it to the north, to the east by Slemish Mountain, to the west the river Bann, and to the south by Lough Neagh. The figure below illustrates the positioning of both Ballymena Town and the surrounding villages.

**Figure 1-1 Map of Ballymena Town and surrounding villages.**




Local conditions that have a bearing on air quality include:

- Good transport infrastructure
- High levels of owner occupied housing/good quality housing
- Strong manufacturing base
- Above average reliance on agriculture, retail/distribution and public sectors in comparison to Northern Ireland overall.

## 1.2 Purpose of Progress Report

This report fulfills the requirements of the Local Air Quality Management process as set out in the Environment (Northern Ireland) Order 2002, the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 and the relevant Policy and Technical Guidance documents. The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where exceedances are considered likely, the local authority must then declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives.

Progress Reports are required in the intervening years between the three-yearly Updating and Screening Assessment reports. Their purpose is to maintain continuity in the Local Air Quality Management process.

They are not intended to be as detailed as Updating and Screening Assessment Reports, or to require as much effort. However, if the Progress Report identifies the risk of exceedance of an Air Quality Objective, the Local Authority (LA) should undertake a Detailed Assessment immediately, and not wait until the next round of Review and Assessment.

## 1.3 Air Quality Objectives

The air quality objectives applicable to LAQM in Northern Ireland are set out in the Air Quality Regulations (Northern Ireland) 2003, Statutory Rules of Northern Ireland 2003, no. 342, and are shown in Table 1.1. This table shows the objectives in units of micrograms per cubic metre µg/m$^3$ (milligrammes per cubic metre, mg/m$^3$ for carbon monoxide) with the number of exceedences in each year that are permitted (where applicable).

**Table 1-1 Air Quality Objectives included in Regulations for the purpose of LAQM in Northern Ireland**

| Pollutant | Air Quality Objective | | Date to be achieved by |
|---|---|---|---|
| | Concentration | Measured as | |
| Benzene | 16.25 µg/m$^3$ | Running annual mean | 31.12.2003 |
| | 3.25 µg/m$^3$ | Running annual mean | 31.12.2010 |
| 1,3-Butadiene | 2.25 µg/m$^3$ | Running annual mean | 31.12.2003 |
| Carbon monoxide | 10 mg/m$^3$ | Running 8-hour mean | 31.12.2003 |
| Lead | 0.50 µg/m$^3$ | Annual mean | 31.12.2004 |
| | 0.25 µg/m$^3$ | Annual mean | 31.12.2008 |
| Nitrogen dioxide | 200 µg/m$^3$ not to be exceeded more than 18 times a year | 1-hour mean | 31.12.2005 |
| | 40 µg/m$^3$ | Annual mean | 31.12.2005 |
| Particulate Matter ($PM_{10}$) (gravimetric) | 50 µg/m$^3$, not to be exceeded more than 35 times a year | 24-hour mean | 31.12.2004 |
| | 40 µg/m$^3$ | Annual mean | 31.12.2004 |
| Sulphur dioxide | 350 µg/m$^3$, not to be exceeded more than 24 times a year | 1-hour mean | 31.12.2004 |
| | 125 µg/m$^3$, not to be exceeded more than 3 times a year | 24-hour mean | 31.12.2004 |
| | 266 µg/m$^3$, not to be exceeded more than 35 times a year | 15-minute mean | 31.12.2005 |

## 1.4 Summary of Previous Review and Assessments

### 1.4.1 First stage review and assessment (2000/01)

A First Stage Review and assessment of local air quality in Ballymena had highlighted the need to progress to second stage for:

- $SO_2$ and $PM_{10}$ for domestic fuel burning
- $PM_{10}$ and $NO_2$ for traffic data
- SO2 from Two Industrial point sources, i.e. plant burning over 5 MW

### 1.4.2 Second stage review and assessment (2003/04)

A Second Stage Review and assessment concluded the following:

- $NO_2$ and $PM_{10}$ from Road Traffic

Further DMRB modelling in February 2004 using 2002-04 monitoring data and 2003 road traffic counts confirmed that there was no need to declare an AQMA due to Road Traffic sources for either $NO_2$ or $PM_{10}$ as these would not exceed objectives in 2004/05.

- $SO_2$ and $PM_{10}$ from Domestic Fuel Burning

Commenced monitoring of $SO_2$ by means of Real Time Analyser in August 2002 within the worse case square, Ballykeel in relation to domestic fuel combustion.

Relocation of two existing smoke and sulphur dioxide bubblers in 2002 to more appropriate locations within residential coal burning areas, namely Ballykeel and Dunclug.

Commenced monitoring of $SO_2$ by Diffusion Tubes in residential areas (10).

Modelling undertook in 2003/04 in respect of domestic fuel combustion for 6 areas of concern. This modelling has concluded that an AQMA be declared in respect of $PM_{10}$

for two areas of concern, broadly named Ballykeel and Dunclug. However further investigative work was required.

- $SO_2$ and $PM_{10}$ from Industrial Point Sources

GSS Modelling for two industrial plants confirmed that $SO_2$ and $PM_{10}$ objectives would not be exceeded in 2004.

### 1.4.3 Third stage review and assessment (2004)

The outcome of domestic fuel combustion modelling resulted in declaration of two AQMAs broadly named Dunclug and Ballykeel in respect of predicted exceedence on $PM^{10}$. Ballymena Borough Council proceeded to declare two AQMA's in respect of PM10 on 25th October 2004. A copy of the AQMA Order together with maps is shown in Appendix One.

The department's technical guidance stresses the importance of verifying the dispersion modelling by conducting local monitoring. Therefore a decision to co-locate a $PM_{10}$ Real Time analyser with our existing $SO_2$ Real Time analyser within the Ballykeel AQMA was implemented in December 2004.

### 1.4.4 Stage Four Review and Assessment (2004/05).

With updated fuel use data obtained in late 2004 NETCEN were commissioned to conduct a Stage 4 Air Quality Review for domestic emissions sources within both AQMA'S. Importantly at this stage NIHE had embarked on a fuel conversion scheme with the Dunclug AQMA. Fresh data in respect of both areas was incorporated into the study. The report dated September 2005 assessed current and potential future $PM_{10}$ and $SO_2$ concentrations as a result of domestic fuel combustion emissions in two grids Ballykeel and Dunclug.

It should be noted that the modelling methodology used in the Stage 4 assessment differed from that used in the Stage 3 assessment. Until model verification with local

monitoring data can be undertaken these model results are not finalised. This Stage 4 study represents a more accurate modelling exercise using more up to date information than the previous stage 3 modelling.

The conclusions of this report were:

- Particulate Matter ($PM_{10}$ gravimetric)

Detailed modelling has shown that $PM_{10}$ emissions arising from domestic fuel combustion in Ballymena Borough Council was predicted to cause an exceedence of the daily $PM_{10}$ objective at relevant receptors within the assessed areas, specifically Ballykeel.

- Sulphur dioxide ($SO_2$)

Detailed modelling has shown that $SO_2$ emissions arising from domestic fuel combustion in Ballymena Borough Council were not predicted to cause an exceedence of the air quality objectives at relevant receptors within the assessed areas.

The modelling had predicted an exceedance of the regulated objectives. The designation of an AQMA remained valid subject to verification of the modelling using local monitoring data. Continuous monitoring of $SO_2$ was already in place to capture data for the purpose of verification and $PM_{10}$ monitoring was introduced in December 2005.

The modelling has also predicted an exceedance of the provisional $PM_{10}$ annual objective in 2010 in Ballykeel.

### 1.4.5 Update and Screening Assessment (April 2006)

The purpose of the update and screening assessment (USA) report was to reconsider all seven pollutants screened at first stage accounting for new or changed circumstances which may influence air quality. There are two key findings within the report:

Firstly, detailed assessment to particulate matter in relation to domestic coal burning within the two AQMA's should continue, with a verification study required as sufficient data was now available.

Secondly, in respect of nitrogen dioxide from traffic, a co-location study which was being undertaken using diffusion tubes and our real time analyser, indicated further investigative work is required regarding bias adjustment to diffusion tube data.
The conclusions of this report in respect of all pollutants were as follows;

| Pollutant | Detailed Assessment Required |
|---|---|
| Carbon Monoxide | Yes/No |
| Benzene | Yes/No |
| 1,3 Butadiene | Yes/No |
| Lead | Yes/No |
| Nitrogen Dioxide | Yes/No. However the diffusion tube co-location study remains under review. |
| Sulphur Dioxide | Yes/No |
| Particulate Matter | Detailed assessment continues, with the preparation of an action plan. |

### 1.4.6 Progress Report (2007)

The main sources of pollutants in the Ballymena Borough continue to be nitrogen dioxide from road traffic and sulphur dioxide / particulate matter from domestic sources. Nitrogen dioxide, sulphur dioxide and particulate matter will continue to be monitored in key locations, with update to the department provided with reference to the objectives of relevance.

- Nitrogen Dioxide

The 2006 annual average concentrations for the passive nitrogen dioxide monitoring sites at Galgorm Road and Queen Street are above the Annual Mean Air Quality Objective of 40 $\mu gm^{-3}$ with the application of a **local** (2.07) bias adjustment factor. In using the **national** (1.33) bias adjustment factor all sites remain below the 40 $\mu gm^{-3}$ objective. In 2005 using a local bias adjustment (1.51) Galgorm Road was under the objective at 36.7 $\mu gm^{-3}$, however Queen Street was in exceedence of the objective at 45.7 $\mu gm^{-3}$. Importantly in 2005 using a national bias adjustment no site was in exceedence of this objective.

There has been some doubt as to diffusion tube precision used during 2006. Efforts have been made to address this issue, this includes renewing our diffusion tube contract with an alternative service provider. The contract commenced 1$^{st}$ October 2007. It is proposed to review the matter at the earliest opportunity when sufficient diffusion tube data becomes available and provide an update within the next progress report due April 2008.

- Sulphur Dioxide and Particulate Matter ($PM_{10}$)

The mean 2006 concentrations for both $SO_2$ and $PM_{10}$ are below the annual air quality objectives for both these pollutants.

The Council has relocated the Ballykeel AQMS to a best-fit location within the Ballykeel AQMA. Once sufficient monitoring data becomes available consideration will be given to the revocation of the Dunclug AQMA and either revocation / amendment of the Ballykeel AQMA.

### 1.4.7 Progress Report (2008).

The main sources of pollutants in the Ballymena Borough continue to be nitrogen dioxide from road traffic and sulphur dioxide / particulate matter from domestic sources. Nitrogen dioxide, sulphur dioxide and particulate matter will continue to be monitored in key locations, with update to the department provided with reference to the objectives of relevance.

- Nitrogen Dioxide

In using the **national** (1.06 Lambeth) bias adjustment factor all sites remain below the 40 $\mu gm^{-3}$ objective, however the Gradko bias adjusted (0.89) levels show Linenhall Street and George Street are in exceedence. Four other sites are close to the 40 $\mu gm^{-3}$ objective. Of these six sites two are not considered relevant as there are no residential properties in these locations, i.e.

- George Street
- Ballymoney Street

For the other four sites it is this departments intention to undertaken further detailed assessment to determine whether declaration of an AQMA(s) is necessary

- Sulphur Dioxide and Particulate Matter ($PM_{10}$)

The mean 2007 concentrations for both $SO_2$ and $PM_{10}$ are below the annual air quality objectives for both these pollutants.

The Council had relocated the Ballykeel AQMS to a best-fit location within the Ballykeel AQMA and will continue to monitor $SO_2$ and $PM_{10}$ in this area. FDMS upgrade to the Ballykeel analyser is currently operating and once sufficient monitoring data comparable with that produced within the DEFRA National Network becomes available consideration will be given to either revocation / amendment of the Ballykeel AQMA as required.

It is likely that in light of the re-verification modelling in relation to the 2006 Updating and Screening Assessment that the AQMA for Dunclug will be revoked in 2008.

### 1.4.8 Update and Screening Report (2009)

The update screening and assessment findings are summarised as follows;

- Conclusions from New Monitoring Data

There are two significant conclusions from new monitoring data which support ongoing work since the last round of update and screening, these are;

1. Revocation of the Ballykeel and Dunclug AQMAs.

In October 2004 Ballymena Borough Council declared two Air Quality Management Areas broadly termed Ballykeel and Dunclug. Both AQMAs were designated in relation to likely exceedences of PM10 (annual and daily mean) objectives as specified by the air quality regulations. Source apportionment showed these exceedences were due to domestic coal burning.

The Air Quality Regulations state that PM10 gravimetric concentration as a daily average of 50ug/$m^3$ should not be exceeded more than 35 times per annum, in addition a target annual mean of 40ug/$m^3$ should be achieved. Local monitoring in 2008 has shown these objectives are being achieved even within the worst case contour for which the conversion to gas will not be completed until 2011. The major contributor to this improvement in air quality being that over 50% of NIHE housing stock has been converted to natural gas there has been a positive impact even on this worst case contour. In addition it is hoped that fuel efficiency work undertaken by this department has also had a beneficiary impact, including owner occupiers available of various grant aided schemes through sign posting by this department.

2. Declaration of an AQMA in the Linenhall / George Street Area.

A detailed assessment has just been completed by AEA technology on behalf of Ballymena Borough Council (April 2009). This concluded an air quality management

area be designated in the Linenhall / George Street area due to modelled nitrogen concentrations along Linenhall and George Street above the objective of 40 ug/m3. This is reflected in the nitrogen dioxide diffusion tube monitoring results.

- Conclusions from Assessment of Sources

The assessment of sources has not highlighted any new areas of concern.

- Proposed Actions

The Updating and Screening Assessment has not identified the need to proceed to a Detailed Assessment for any new pollutant. As discussed above a detailed assessment has just been completed by AEA technology on behalf of Ballymena Borough Council (April 2009). This concluded an air quality management area be designated in the Linenhall / George Street area due to modelled nitrogen concentrations along Linenhall and George Street above the objective of 40 ug/m3. This report is currently with assessors for validation and approval to proceed with a declaration for an AQMA, as described above.

The Updating and Screening Assessment has not identified any need for additional monitoring, or changes to the existing monitoring programme mainly because there as been a continual review of same since 2006, in particular regarding domestic fuel burning and road traffic sources.

There are changes required to existing Ballykeel and Dunclug AQMAs by way of revocation. The air quality objectives within both areas are now being achieved due to substantial fuel conversion work undertaken by the NIHE since the declaration of these areas. This matter is with the devolved administration for approval. It is not proposed to proceed to a Detailed Assessment due to the number of fuel burning sources that have been removed and local monitoring data.

Next course of action;

- To declare an AQMA along the Linenhall Street / George Street area (subject to approval) due to modelled nitrogen concentrations above the objective of 40 ug/m3. Then to proceed with Action Planning as required.

- To revoke both Ballykeel and Dunclug AQMAs (subject to approval) as local monitoring has shown $PM_{10}$ objectives are being achieved
- Submit 2010 Progress Report.

### 1.4.9 Progress Report 2010

The 2010 progress Report highlighted the following actions were necessary.

A further assessment for nitrogen dioxide should be undertaken to review the recently declared AQMA, including scenarios with a view to action planning.

A detailed assessment with a view to revocation of the AQMAs in Dunclug and Ballykeel should be undertaken.

Planning application consultations should continue to be assessed with regard to potential impact on local air quality.

### 1.4.10 Progress Report 2011

The 2011 progress Report highlighted the following actions were necessary

Following a detailed assessment of AQMA's in Dunclug and Ballykeel, decision reached to revoke Dunclug AQMA.

Ballykeel AQMA to remain due to continuing increased levels in $PM_{10}$

### 1.4.11 Update and Screening Assessment Report 2012

The updating and screening assessment showed that no significant actions are required in relation to air quality management for identified pollutants.

Nitrogen Dioxide

Ballymena North Road Automatic monitor showed that mean nitrogen dioxide concentrations for the period 1 January 2011 to 31 December 2011 (27 µgm-3 )did not exceed the Annual Mean Air Quality Objective of 40 µgm-3. There were no exceedences of the hourly mean or of the Daily mean objective.

Diffusion Tube Monitoring did show exceedance for nitrogen dioxide within the Linenhall Street Air Quality Management Area.

Nitrogen dioxide remains under focus as a action point to address within the action plan for the Linenhall Street AQMA.

PM10 and Sulphur Dioxide

During the 2011 monitoring period there were no exceedences of the 15- minute, hourly, daily or the annual means for sulphur dioxide, however there were 10 exceedences of the daily mean for PM10. A detailed assessment was undertaken with a view to revocation of the Ballykeel and Dunclug AQMAs. This study was completed in early 2011 with a conclusion to revoke Dunclug AQMA, but to retain the Ballykeel AQMA.

### 1.4.12 Progress Report 2013

This progress report identified that no exceedances of annual mean concentrations of Pollutants for any of the parameters $NO_2$, $SO_2$, or $PM_{10}$.

However given the fluctuation of the concentrations and close exceedences of hourly concentration levels, it was determined pruedent to maintain both Ballykeel and North Road AQMA's.

# 2 New Monitoring Data

## 2.1 Summary of Monitoring Undertaken

### 2.1.1 Automatic Monitoring Sites

There are three continuous analysers currently in operation, at two locations:

(1) Sulphur dioxide continuous analyser at Ballykeel
(2) Particulate matter (with FDMS) continuous analyser at Ballykeel
(3) Nitrogen dioxide continuous analyser at North Road

All continuous monitoring stations are part of the Calibration Club managed by Ricardo AEA. Data from these sites are quality assured to the AURN standards as part of the Calibration Club. In addition a QA/QC audit which includes calibration of the analysers using zero and span gas standards, and other tests for efficiency is undertaken by Ricardo AEA. Data are fully ratified by Ricardo AEA staff using procedures as applied to data from the AURN UK national monitoring network sites.

**Table 2-1 Air Quality Objectives included in Regulations for the purpose of LAQM in Northern Ireland**

| Site ID | Site Name | Site Type | X OS Grid Reference | Y OS Grid Reference | Inlet Height (m) | Pollutants Monitored | In AQMA? | Monitoring Technique | **Relevant Exposure?** (Y/N with distance (m) from monitoring site to relevant exposure) | Distance to Kerb of Nearest Road (m) (N/A if not applicable) | Does this Location Represent Worst-Case Exposure? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ballykeel CMS | Ballykeel | AQMA | 311900 | 402600 | 2.0 | $PM_{10}$ $S0_2$ | Y | TEOM FDMS | Y | N/A | Y |
| North Road CMS | North Road | Roadside | 310636 | 403072 | 1.5 | NO $NO_x$ $NO_2$ | Y | Thermo I Series | Y | 2m | N* |

*As preferred worst-case location not an option due to a narrow footpath, the second preferred worst-case location was chosen.

**Figure 2-1 Photo - Ballykeel Automatic Analysers**

**Figure 2-2 Photo - North Road Automatic Analyser**

**Figure 2-3 Showing location map of Ballykeel and North Road Automatic Analysers and declared AQMA's**

### 2.1.2 Non-Automatic Monitoring Sites

Ballymena Borough Council operates a network of nitrogen dioxide diffusion tubes across the borough. The diffusion tubes are exposed for a four-week period.

Diffusion tubes during 2013 were prepared and analysed by Gradko using the 20% TEA in water method

Gradko laboratory overall precision in accordance Para 3.23 in TG (09) has been assessed as ‘Good’ (34 out of 36 studies).
A summary of Gradko performance is in Appendix A.

Diffusion tubes 13, 14 and 14B were co-located with the North Road monitoring site in 2013. The results of this co-location study have been utilised to calculate a local bias adjustment factor of 1.02.

Full details of the diffusion tube QA/QC are presented in Appendix A.

The locations of the diffusion tubes in the assessed areas are listed in Table 2.2. Individual tube locations are details in also shown in Figure 2.5.

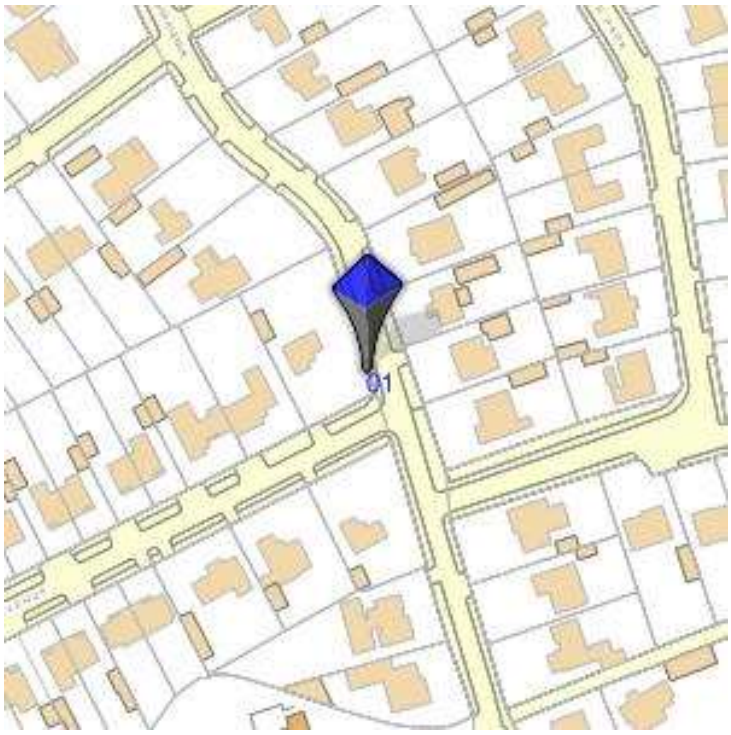
**Table 2-2 Details of Non- Automatic Monitoring Sites– NOx Diffusion Tubes**

| Site ID | Site Name | Site Type | X OS Grid Reference | Y OS Grid Reference | Site Height (m) | Pollutants Monitored | In AQMA? | Is Monitoring Co-located with a Continuous Analyser (Y/N) | **Relevant Exposure?** (Y/N with distance (m) from monitoring site to relevant exposure) | Distance to Kerb of Nearest Road (m) (N/A if not applicable) | Does this Location Represent Worst-Case Exposure? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DT1 | Leighinmohr Ave | Urban Background | 310228 | 402546 | 2.5 | $NO_x$ | N | N | Y | N/A | Y |
| DT2 | Galgorm Road | Kerbside | 310336 | 403196 | 2.5 | $NO_x$ | N | N | Y | 3m | Y |
| DT3 | Main St, Cullybackey | Kerbside | 305841 | 405690 | 2.5 | $NO_x$ | N | N | Y | 2m | Y |
| DT4 | Cullybackey Road | Kerbside | 310350 | 403443 | 2.5 | $NO_x$ | N | N | Y | 3m | Y |
| DT5 | Larne St | Kerbside | 310602 | 402920 | 2.5 | $NO_x$ | N | N | Y | 3m | Y |

| Site ID | Site Name | Site Type | X OS Grid Reference | Y OS Grid Reference | Site Height (m) | Pollutants Monitored | In AQMA? | Is Monitoring Co-located with a Continuous Analyser (Y/N) | **Relevant Exposure?** (Y/N with distance (m) from monitoring site to relevant exposure) | Distance to Kerb of Nearest Road (m) (N/A if not applicable) | Does this Location Represent Worst-Case Exposure? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DT6 | Ballyloughan Ave | Urban Background | 309532 | 404425 | 2.5 | $NO_x$ | N | N | Y | N/A | Y |
| DT7 | George St | Kerbside | 310584 | 403239 | 2.5 | $NO_x$ | N | N | Y | 1m | Y |
| DT8 | Wellington St | Kerbside | 310795 | 403386 | 2.5 | $NO_x$ | N | N | Y | 2m | Y |
| DT9 | Ballymoney St | Kerbside | 310796 | 403582 | 2.5 | $NO_x$ | N | N | Y | 2m | Y |
| DT10 | Parkway | Kerbside | 311000 | 403905 | 2.5 | $NO_x$ | N | N | Y | 2m | Y |
| DT11 | Lisnevenagh Rd | Road Side | 311884 | 397037 | 2.5 | $NO_x$ | N | N | Y | 6m | Y |
| DT12 | Queen St | Kerbside | 310743 | 402219 | 2.5 | $NO_x$ | N | N | Y | 3m | Y |
| DT13 | North Road | Roadside | 310638 | 403079 | 1.5 | $NO_x$ | N | Y | Y | 2m | Y |

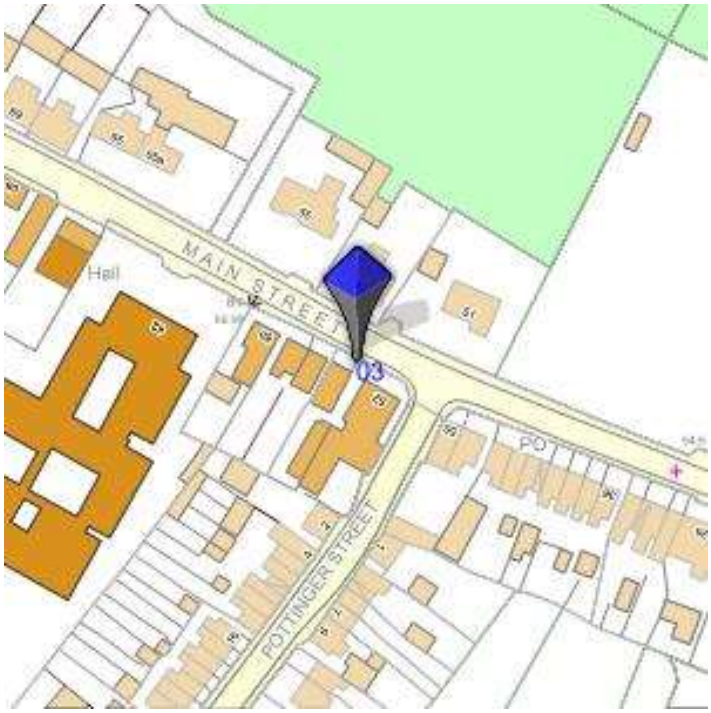
| Site ID | Site Name | Site Type | X OS Grid Reference | Y OS Grid Reference | Site Height (m) | Pollutants Monitored | In AQMA? | Is Monitoring Co-located with a Continuous Analyser (Y/N) | **Relevant Exposure?** (Y/N with distance (m) from monitoring site to relevant exposure) | Distance to Kerb of Nearest Road (m) (N/A if not applicable) | Does this Location Represent Worst-Case Exposure? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DT14 | North Road | Roadside | 310638 | 403079 | 1.5 | $NO_x$ | N | Y | Y | 2m | Y |
| DT14B | North Road | Roadside | 310638 | 403079 | 1.5 | $NO_x$ | N | Y | Y | 2m | Y |
| DT15 | Linenhall St | Kerbside | 310687 | 403122 | 2.5 | $NO_x$ | Y | N | Y | <1m | Y |
| DT16 | Bridge St | Kerbside | 310710 | 403119 | 2.5 | $NO_x$ | N | N | Y | 2m | Y |
| DT17 | Galgorm Rd | Kerbside | 310491 | 403314 | 2.5 | $NO_x$ | N | N | Y | 2m | Y |

**Figure 2-4 Maps of Non-Automatic Monitoring Sites**



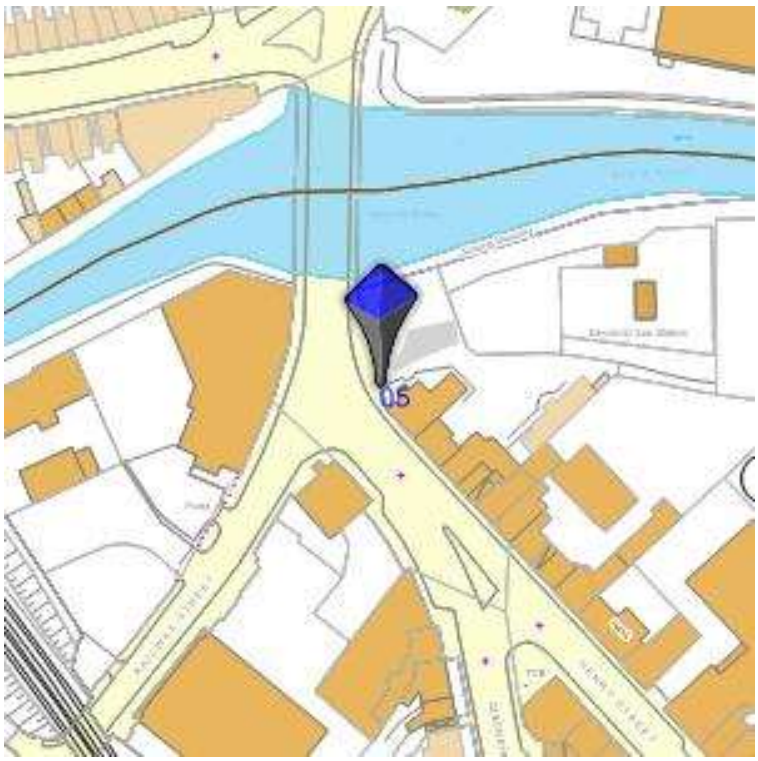

DT1 – Leighmohr Avenue, Ballymena

DT2 – Galgorm Road




DT3 – Main Street, Cullybackey

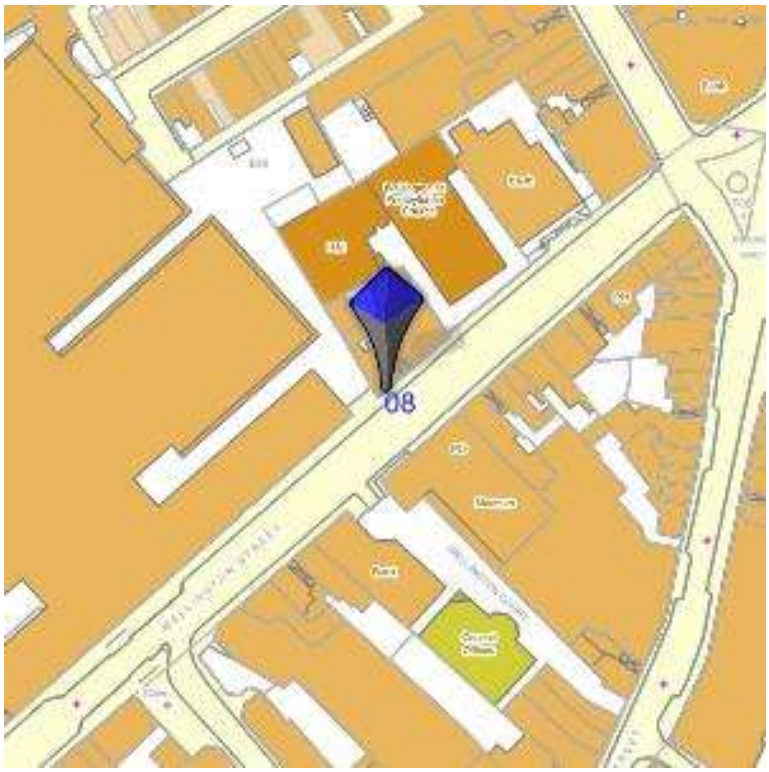

DT4 – Cullybackey Road



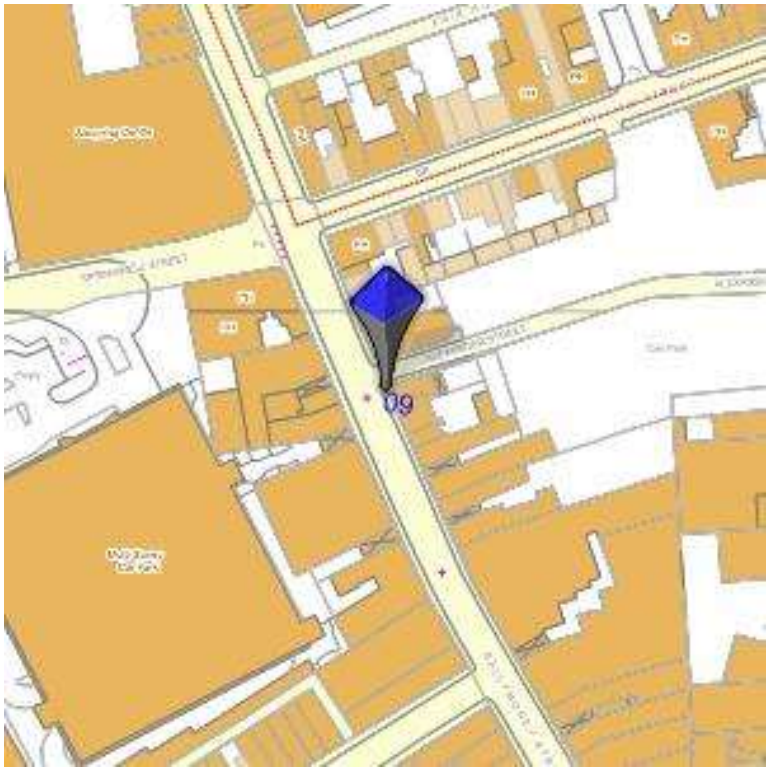

DT5 – Larne Street, Ballymena


DT6 – Ballyloughan Avenue


DT7 – George Street, Ballymena




DT8 – Wellington Street, Ballymena

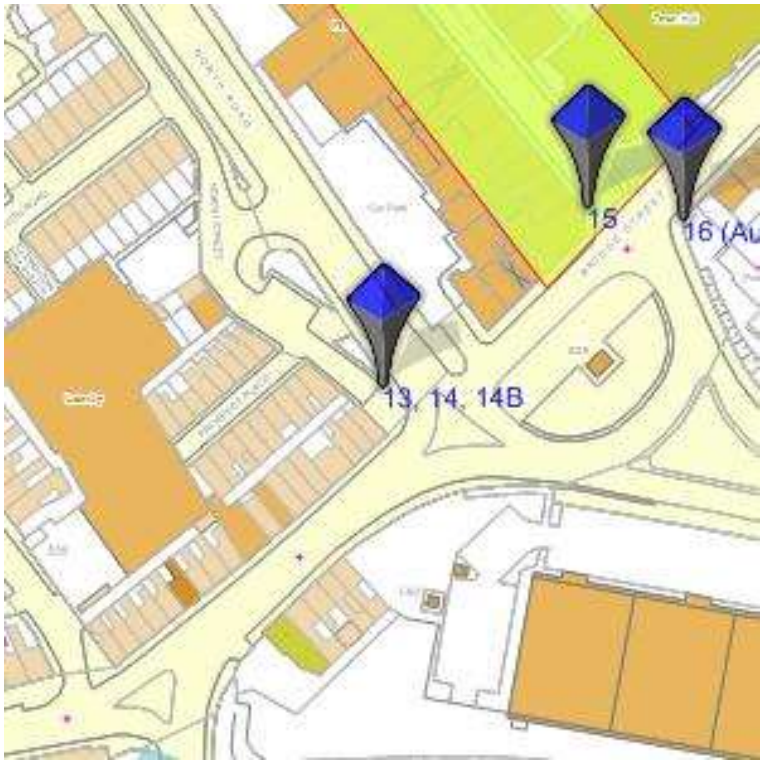



DT9 – Ballymoney Street, Ballymena


DT10 – Parkway, Ballymena

DT11 – Lisnevenagh Road, Ballymena

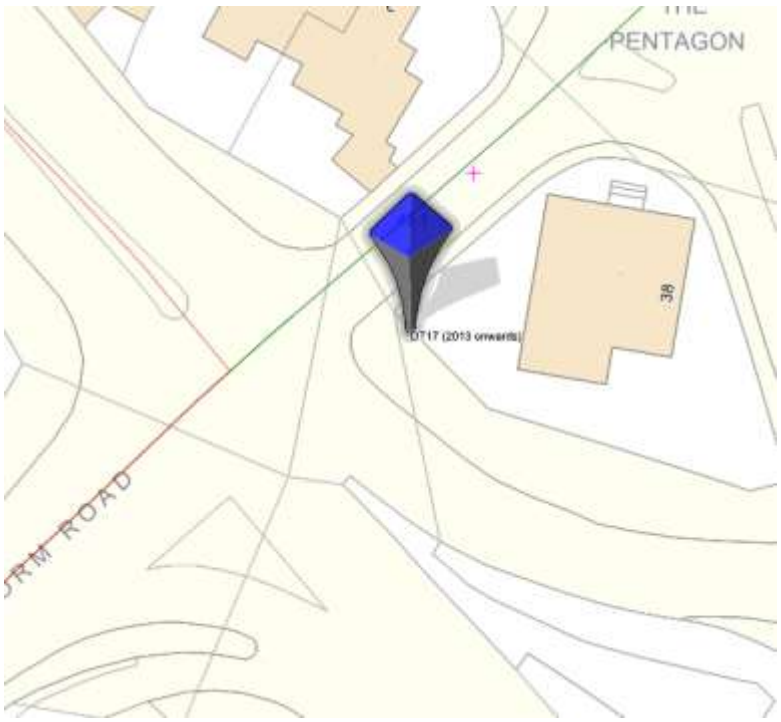
DT12 – Queen Street, Ballymena




DT13,14,14B, North Road, Bridge Street, Ballymena


DT15 – Linenhall Street, Ballymena

DT16 – Bridge Street, Ballymena




DT17 – Galgorm Road, North Road Junction

## 2.2 Comparison of Monitoring Results with Air Quality Objectives

### Automatic Monitoring Data

During the 2013 monitoring period there was 2 exceedances of the hourly or annual mean. However there were no exceedance of the daily or annual mean.

**Table 2-3 Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with Annual Mean Objective**

**BALLYMENA NORTH ROAD**
**01 January to 31 December 2013**

**These data have been fully ratified by Ricardo-AEA**

| POLLUTANT | $NO_X$ | NO | $NO_2$ |
|---|---|---|---|
| Number Very High* | - | - | 0 |
| Number High* | - | - | 0 |
| Number Moderate* | - | - | 0 |
| Number Low* | - | - | 8521 |
| Maximum 15-minute mean | 1753 µg $m^{-3}$ | 858 µg $m^{-3}$ | 443 µg $m^{-3}$ |
| Maximum hourly mean | 777 µg $m^{-3}$ | 390 µg $m^{-3}$ | 279 µg $m^{-3}$ |
| Maximum running 8-hour mean | 440 µg $m^{-3}$ | 215 µg $m^{-3}$ | 129 µg $m^{-3}$ |
| Maximum running 24-hour mean | 301 µg $m^{-3}$ | 144 µg $m^{-3}$ | 82 µg $m^{-3}$ |
| Maximum daily mean | 286 µg $m^{-3}$ | 136 µg $m^{-3}$ | 79 µg $m^{-3}$ |
| Average | 53 µg $m^{-3}$ | 16 µg $m^{-3}$ | 28 µg $m^{-3}$ |
| Data capture | 97.3 % | 97.3 % | 97.3 % |

All gaseous pollutant mass units are at 20'C and 1013mb. Particulate matter concentrations are reported at ambient temperature and pressure.
$NO_X$ mass units are $NO_X$ as $NO_2$ µg m-3

| Pollutant | Air Quality Regulations (Northern Ireland) 2003 | Exceedences | Days |
|---|---|---|---|
| Nitrogen Dioxide | Annual mean > 40 µg $m^{-3}$ | 0 | - |
| Nitrogen Dioxide | Hourly mean > 200 µg $m^{-3}$ | 2 | 2 |

The mean nitrogen dioxide concentrations for the period 1 January 2013 to 31 December 2013 at the North Road site was 28 µgm$^{-3}$ therefore below the Annual Mean Air Quality Objective of 40 µgm$^{-3}$.

**Table 2-4 Results of Automatic Monitoring for NO2: Comparison with Annual Mean Objective**

| Site Name | Site Type | Valid Data Capture 2013 | Within AQMA | Annual Mean Concentration (µgm$^{-3}$) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| North Road | Roadside | 97.3% | N | 29 | 29 | 32 | 27 | 27 | 28 |

A bar chart showing the trend in annual mean $NO_2$ concentrations since 2008 years at the North Road monitoring site is presented in Figure 2-5. The Chart shows the measured annual mean NO2 concentrations have remained generally static, although increased level was detected in 2010 (as was the case in most of the UK).

**Figure 2-5 Trends in Annual Mean $NO_2$ Concentrations Measured at Automatic Monitoring Sites**

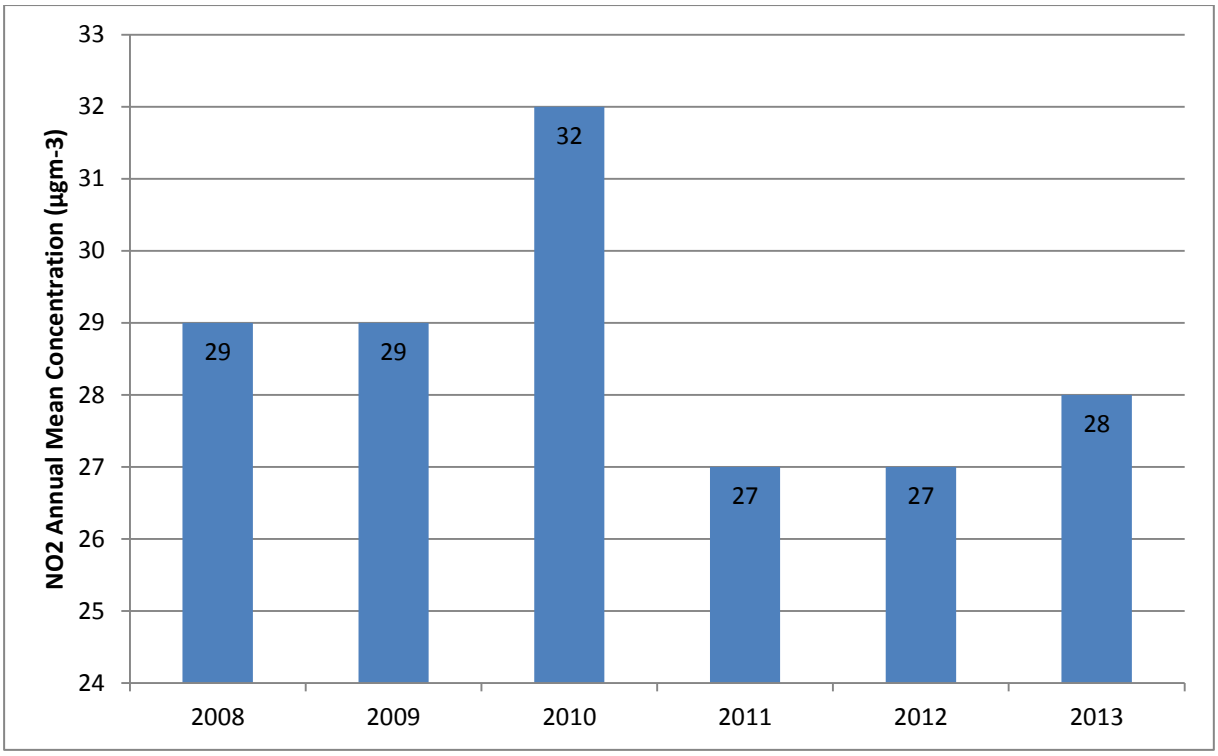



**Table 2-5 Results of Automatic Monitoring for $NO_2$: Comparison with 1-hour Mean Objective**

| Site ID | Site Type | Within AQMA? | Valid Data Capture 2013 % [b] | Number of Hourly Means > 200µg/m$^3$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| North Road | Roadside | N | 97.3% | 0 | 1 | 2 | 0 | 9 | 2 |

**Diffusion Tube Monitoring Data**

Details of the annual mean $NO_2$ concentrations measured using diffusion tube sites during 2013 are presented in Table 2-6 and the series of results measured from 2008 to 2013 are presented in

*DT07 George Street is located on edge of AQMA

**DT16 Bridge St results have been Annualised and Bias Adjusted ustilising the period means of DT1 and DT6.

**DT17 Galgorm Road/North Road Junction results have been Annualised and Bias Adjusted ustilising the period means of DT1 and DT6.

Table 2-7.

Data capture was generally good across the network of diffusion tubes and no short or long term adjustment calculations were required.

There was 1 site (DT15 – Linenhall Street) at which the Annual mean NO2 concentration of 40 µg/$m^3$. This location is located within a declared AQMA for $NO_2$ and current action plan is in place to address the issue.

A bar chart showing the trends in annual mean NO2 concentrations measured across the Ballymena Borough Council diffusion tube network during period 2008 – 2012 are presented in Figure 2-6

## Table 2-6 Results of $NO_2$ Diffusion Tubes 2013

| Site ID | Location | Site Type | Within AQMA? | Triplicate or Co-located Tube | Full Calendar Year Data Capture 2013 (Number of Months or %) [a] | 2013 Annual Mean Concentration (µg/m$^3$) - Bias Adjustment factor = 1.02 [b] |
|---|---|---|---|---|---|---|
| DT1 | Leighinmohr Ave | Urban Background | N | N | 100% | 12.32 |
| DT2 | Galgorm Road | Kerbside | N | N | 100% | 33.22 |
| DT3 | Main St, Cullybackey | Kerbside | N | N | 83.33% | 26.84 |
| DT4 | Cullybackey Road | Kerbside | N | N | 100% | 32.08 |
| DT5 | Larne St | Kerbside | N | N | 100% | 27.17 |
| DT6 | Ballyloughan Ave | Urban Background | N | N | 91.66% | 11.45 |
| **DT7*** | **George St** | **Kerbside** | **N** | **N** | **100%** | **40.40** |
| DT8 | Wellington St | Kerbside | N | N | 100% | 26.05 |
| DT9 | Ballymoney St | Kerbside | N | N | 100% | 29.19 |
| DT10 | Parkway | Kerbside | N | N | 100% | 30.07 |
| DT11 | Lisnevenagh Rd | Road Side | N | N | 100% | 27.60 |
| DT12 | Queen St | Kerbside | N | N | 100% | 31.44 |
| DT13 | North Road | Roadside | N | Y | 100% | 29.17 |
| DT14 | North Road | Roadside | N | Y | 100% | 28.96 |

| Site ID | Location | Site Type | Within AQMA? | Triplicate or Co-located Tube | Full Calendar Year Data Capture 2013 (Number of Months or %) [a] | 2013 Annual Mean Concentration (µg/m$^3$) - Bias Adjustment factor = 1.02 [b] |
|---|---|---|---|---|---|---|
| DT14B | North Road | Roadside | N | Y | 100% | 28.35 |
| **DT15** | **Linenhall St** | **Kerbside** | **Y** | **N** | **100%** | **51.78** |
| DT16** | Bridge Street | Kerbside | N | N | 50% | 33.25 (Annualised) |
| **DT17***** | **Galgorm/North Rd** | **Kerbside** | **N** | **N** | **50%** | **40.43 (Annualised)** |
| | | | | | | |

*DT07 George Street is located on edge of AQMA

**DT16 Bridge St results have been Annualised and Bias Adjusted ustilising the period means of DT1 and DT6.

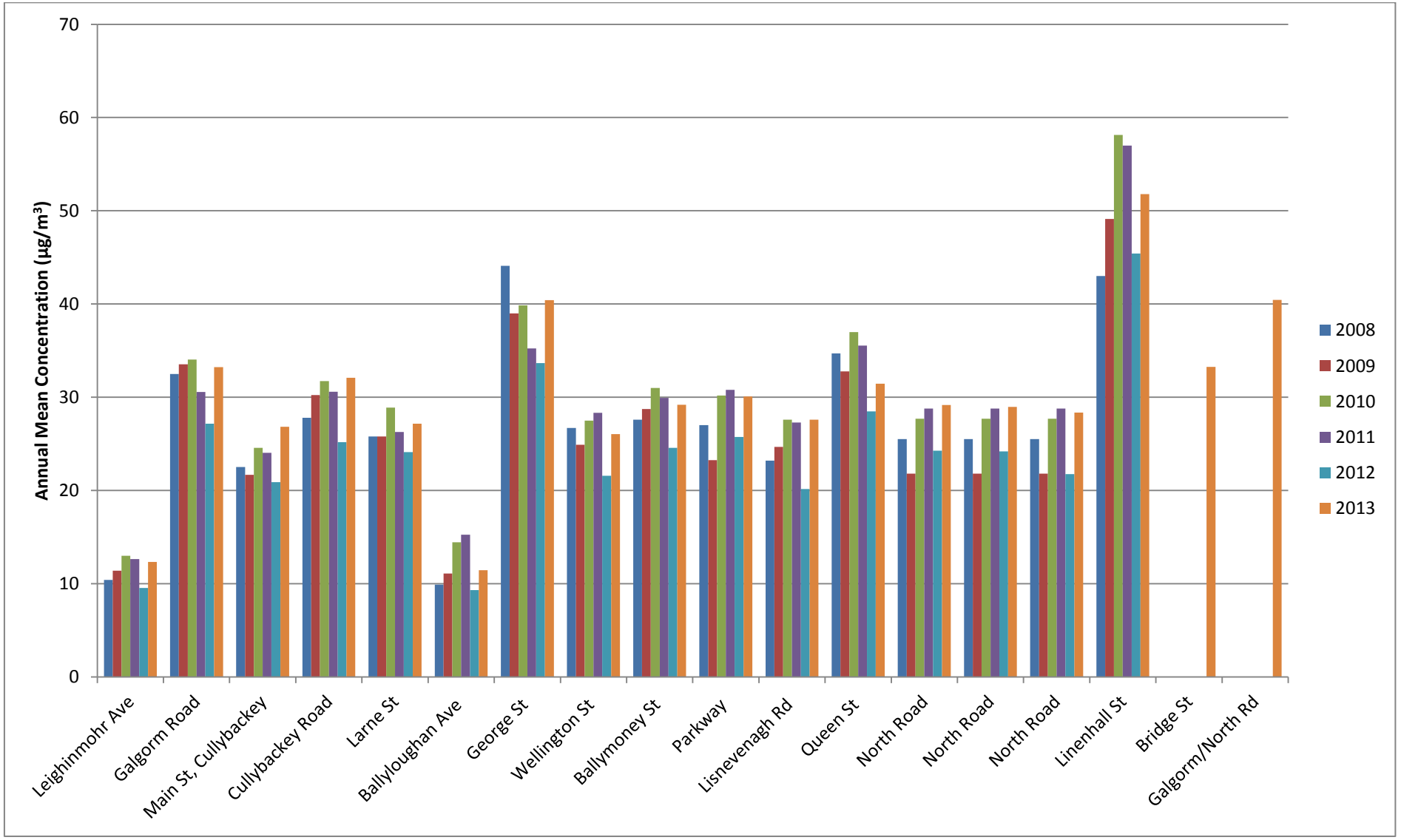
**DT17 Galgorm Road/North Road Junction results have been Annualised and Bias Adjusted ustilising the period means of DT1 and DT6.

**Table 2-7 Results of $NO_2$ Diffusion Tubes (2008 to 2013)**

| Site ID | Location | Site Type | Within AQMA? | Annual Mean Concentration (µg/m$^3$) - Adjusted for Bias [a] | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 2008 (Bias Adjustment Factor = 0.9) | 2009 (Bias Adjustment Factor = 0.9) | 2010 (Bias Adjustment Factor = 0.92) | 2011 (Bias Adjustment Factor = 0.91) | 2012 (Bias Adjustment Factor = 0.96) | 2013 (Bias Adjustment Factor = 1.02) (Local) |
| DT1 | Leighinmohr Ave | Urban Background | N | 10.4 | 11.4 | 13 | 12.63 | 9.53 | 12.32 |
| DT2 | Galgorm Road | Kerbside | N | 32.5 | 33.53 | 34.04 | 30.56 | 27.16 | 33.22 |
| DT3 | Main St, Cullybackey | Kerbside | N | 22.5 | 21.67 | 24.56 | 24.04 | 20.90 | 26.84 |
| DT4 | Cullybackey Road | Kerbside | N | 27.8 | 30.22 | 31.74 | 30.58 | 25.17 | 32.08 |
| DT5 | Larne St | Kerbside | N | 25.8 | 25.8 | 28.89 | 26.28 | 24.11 | 27.17 |
| DT6 | Ballyloughan Ave | Urban Background | N | 9.9 | 11.1 | 14.44 | 15.26 | 9.32 | 11.45 |
| **DT7*** | **George St** | **Kerbside** | **N** | **44.1** | **39.0** | **39.84** | **35.24** | **33.67** | **40.40** |
| DT8 | Wellington St | Kerbside | N | 26.7 | 24.9 | 27.5 | 28.33 | 21.57 | 26.05 |
| DT9 | Ballymoney St | Kerbside | N | 27.6 | 28.73 | 31 | 29.92 | 24.58 | 29.19 |
| DT10 | Parkway | Kerbside | N | 27.0 | 23.25 | 30.18 | 30.8 | 25.74 | 30.07 |
| DT11 | Lisnevenagh Rd | Road Side | N | 23.2 | 24.68 | 27.6 | 27.28 | 20.15 | 27.60 |
| DT12 | Queen St | Kerbside | N | 34.7 | 32.78 | 36.98 | 35.54 | 28.47 | 31.44 |
| DT13 | North Road | Roadside | N | 25.5 | 21.81 | 27.69 | 28.78 | 24.26 | 29.17 |
| DT14 | North Road | Roadside | N | 25.5 | 21.81 | 27.69 | 28.78 | 24.18 | 28.96 |

| Site ID | Location | Site Type | Within AQMA? | Annual Mean Concentration (µg/m$^3$) - Adjusted for Bias [a] | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 2008 (Bias Adjustment Factor = 0.9) | 2009 (Bias Adjustment Factor = 0.9) | 2010 (Bias Adjustment Factor = 0.92) | 2011 (Bias Adjustment Factor = 0.91) | 2012 (Bias Adjustment Factor = 0.96) | 2013 (Bias Adjustment Factor = 1.02) (Local) |
| DT14B | North Road | Roadside | N | 25.5 | 21.81 | 27.69 | 28.78 | 21.74 | 28.35 |
| **DT15** | **Linenhall St** | **Kerbside** | **Y** | **43.0** | **49.12** | **58.14** | **57** | **45.42** | **51.78** |
| DT16** | Bridge St | Kerbside | N | | | | | | 33.25 |
| **DT17***** | **Galgorm/North Rd** | **Kerbside** | **N** | | | | | | **40.43** |

**Figure 2-6 Trends in Annual Mean Nitrogen Dioxide Concentrations Measured at Diffusion Tube Monitoring Sites 2008-13**



### 2.2.1 Particulate Matter ($PM_{10}$)

The annual mean $PM_{10}$ concentrations for 2013 monitoring period is presented in Table 2-8

The 2013 monitoring period there was no exceedances of the $PM_{10}$ annual mean AQS objective of 40µg/$m^3$.

**Table 2-8 Results of Automatic Monitoring for $PM_{10}$ 2013**

**BALLYMENA BALLYKEEL**
**01 January to 31 December 2013**
**These data have been fully ratified by Ricardo-AEA**

| POLLUTANT | $PM_{10}$+ |
|---|---|
| Number Very High* | 0 |
| Number High* | 0 |
| Number Moderate* | 67 |
| Number Low* | 7435 |
| Maximum 15-minute mean | 206 µg $m^{-3}$ |
| Maximum hourly mean | 206 µg $m^{-3}$ |
| Maximum running 8-hour mean | 118 µg $m^{-3}$ |
| Maximum running 24-hour mean | 86 µg $m^{-3}$ |
| Maximum daily mean | 86 µg $m^{-3}$ |
| Average | 21 µg $m^{-3}$ |
| Data capture | 85.4 % |

+ $PM_{10}$ as measured by a FDMS (No Correction)
All gaseous pollutant mass units are at 20'C and 1013mb. Particulate matter concentrations are reported at ambient temperature and pressure.

| Pollutant | Air Quality Regulations (Northern Ireland) 2003 | Exceedences | Days |
|---|---|---|---|
| $PM_{10}$ Particulate Matter (Gravimetric) | Daily mean > 50 µg $m^{-3}$ | 7 | 7 |
| $PM_{10}$ Particulate Matter (Gravimetric) | Annual mean > 40 µg $m^{-3}$ | 0 | - |

The data capture rate for PM10 at the Ballykeel analyser was 85.4%. Therefore an exercise was carried out to estimate the annualised average compared to other analysers within a 50mile radius of the Ballykeel Site.

PM10 results for Lisburn Dunmurry Seymour Hill, and North Down Holywood were chosen as these analysers achieved acceptable levels of data capture for the monitoring period 1st January – 31st December.

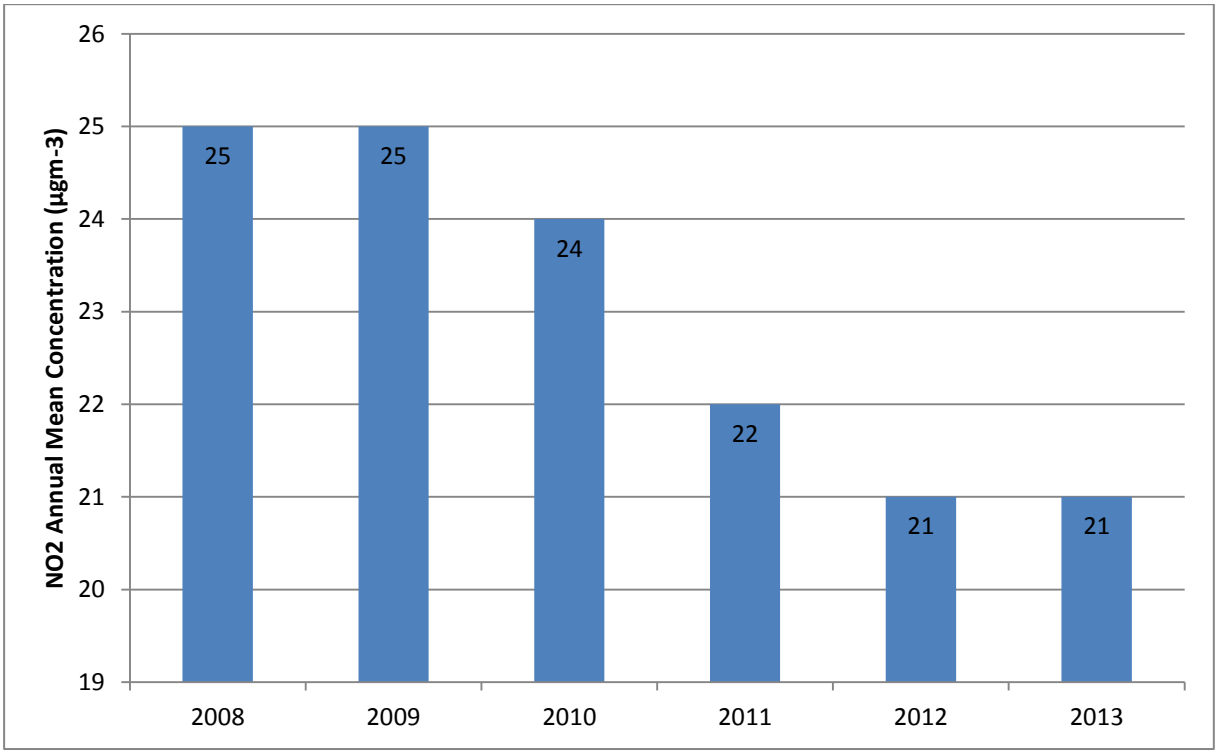
The results of the annualised estimation was that the Ballykeel PM10 of 20.62 $\mu gm^{-3}$. Given that the annual mean concentration given for the Ballykeel analyser was 21 $\mu gm^{-3}$; this figure will be utilised within the report.

Details of the annualised estimation are included within the Appendix.

**Table 2-9 Results of Automatic Monitoring for $PM_{10}$: Comparison with Annual Mean Objective**

| Site ID | Site Name | Site Type | Within AQMA? | Valid Data Capture 2013 % [b] | Confirm Gravimetric Equivalent (Y or N/A) | $PM_{10}$ Annual Mean Concentration ($\mu g/m^3$) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| | Ballykeel | AQMA | Y | 85.4 | Y | 25 | 25 | 24 | 22 | 21 | 21 |

**Figure 2-7 Trends in Annual Mean $PM_{10}$ Concentrations**




Since 2008 there has been a downward trend in the annual mean concentration. Works by housing associations to replace smoky solid fuel fire with natural gas fired heating appliances has been ongoing and has helped this downward trend.

There has been a leveling off of the decrease since 2012. it is advised that the AQMA remain and the situation monitored.

**Table 2-10 Results of Automatic Monitoring for $PM_{10}$: Comparison with 24-hour Mean Objective**

| Site ID | Site Name | Site Type | Within AQMA? | Valid Data Capture 2013 % | Confirm Gravimetric Equivalent | Number of Daily Means > 50µg/m$^3$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| | Ballykeel | AQMA | Y | 91 | Y | 7 | 6 | 11 | 10 | 6 | 7 |

There remains a quite consistent number of exceedances of daily mean objectives, and it is advised that the AQMA remain and the situation monitored

### 2.2.2 Sulphur Dioxide ($SO_2$)

Sulphur dioxide concentrations monitoring at this site is a continuous real time monitor and is affiliated to Defra's Automatic Urban and Rural Network (AURN).

The annual mean $SO_2$ concentrations for 2013 monitoring period is presented in Table 2-11.

There were no exceedances of any of the $SO_2$ AQS objectives objective during the 2013 monitoring period.

**Table 2-11 Results of Automatic Monitoring for $SO_2$ 2013**

**BALLYMENA BALLYKEEL**
**01 January to 31 December 2013**
**This data have been fully ratified by Ricardo-AEA**

| POLLUTANT | $SO_2$ |
|---|---|
| Number Very High | 0 |
| Number High | 0 |
| Number Moderate | 0 |
| Number Low | 35 |
| Maximum 15-minute mean | 72 µg $m^{-3}$ |
| Maximum hourly mean | |
| Maximum running 8-hour mean | |
| Maximum running 24-hour mean | |
| Maximum daily mean | 18 µg $m^{-3}$ |
| Average | 2 µg $m^{-3}$ |
| Data capture | 96 % |

All gaseous pollutant mass units are at 20'C and 1013mb. Particulate matter concentrations are reported at ambient temperature and pressure.

| Pollutant | Air Quality Regulations (Northern Ireland) 2003 | Exceedances | Days |
|---|---|---|---|
| Sulphur Dioxide | 15-minute mean > 266 µg $m^{-3}$ | 0 | 0 |
| Sulphur Dioxide | Hourly mean > 350 µg $m^{-3}$ | 0 | 0 |
| Sulphur Dioxide | Daily mean > 125 µg $m^{-3}$ | 0 | 0 |

**Table 2-12 Results of Automatic Monitoring for $SO_2$: Comparison with Objectives**

| Site ID | Site Name | Site Type | Within AQMA? | Valid Data Ca 2013 % [b] | Number of: [c] | | |
|---|---|---|---|---|---|---|---|
| | | | | | 15-minute Mea 266µg/m$^3$ | 1-hour Means 350µg/m$^3$ | 24-hour Mean 125µg/m$^3$ |
| | Ballykeel | AQMA | Y | 96 | 0 | 0 | 0 |

### 2.2.3 Summary of Compliance with AQS Objectives

Ballymena Borough Council has examined the results from monitoring in the borough

Linenhall Street AQMA – $NO_2$
Concentrations within the Linenhall St AQMA still exceed the Annual and hourly objectives for $NO_2$ and the AQMA should remain.
An action plan has been finalised and the measured will be implemented and monitored on an ongoing basis.

Ballykeel AQMA – $PM_{10}$, $SO_2$
Concentrations of $PM_{10}$ within the Ballykeel AQMA are within the AQS annual mean concentration levels.

However it is considered prudent to retain the Ballykeel AQMA, namely the site affiliated to Defra's Automatic Urban and Rural Network (AURN) and also that the site experiences concentrations that are quite close to the objective. Given the unavoidable uncertainty in assessments of this nature, it is therefore considered prudent to retain the Ballykeel AQMA. Ongoing action plan objectives namely fuel switching and energy efficiency measures will be monitored.

Concentrations of pollutants outside of AQMAs are all below the objectives at relevant locations, therefore there is no need to proceed to a Detailed Assessment.

# 3 New Local Developments

Ballymena Borough Council confirms that there are no significant new or newly identified local developments which may have an impact on air quality within the Local Authority Area.

Ballymena Borough Council confirms that the following have been considered:

- Road Traffic Sources
- Other Transport Sources
- Industrial Sources
- Commercial and domestic sources
- New developments with fugitive or uncontrolled sources.

No significant development applications have received planning permission during the period of this report.

# 4 Planning Applications

A summary of significant planning applications and current/proposed developments across Ballymena Borough Council is described below;

**Tully Quarry Centralised Anaerobic Digestion Plant - G/2013/0282/F**

Planning Status - GRANTED

Development of a 2MW Centralised Anaerobic Digestion (CAD), Combined Heat and Power (CHP) Plant, Process Building, Storage Building, Staff Facilities, Weighbridge, Wheelwash, Substation, Access Lane, Ancillary Site Works.

Environmental Statement submitted and due to compliance with Industrial permiting condition, no detrimental effects are noted for Air Quality.

# 5 Local Transport Plans and Strategies

The Sub-Regional Transport Plan 2015, was produced in 2007 following the Regional Strategic Transport Network Transport Plan. The Plan represented a significant proposed investment of £2.3 billion up to 2015, subject to the availability of funds and contained practical blueprints for the development of sustainable transport networks in towns.

With specific relevance to Ballymena, the Plan stated that “Local Transport Studies have made an allowance for bus based Park and Ride schemes totalling £5 million in Londonderry and possibly Ballymena in the longer term.” The Larne Link Road / Linenhall Street Junction was highlighted as a junction under consideration for improvement in the Highway Blueprint and the proposed south-west distributor road between Ballee Road West and Parkway at the Greenmount Roundabout was also identified.

# 6 Implementation of Action Plans

**Ballykeel AQAP – $SO_2$ and $PM_{10}$**

The action plan outlines the measures to be taken in pursuit of achieving the air quality objectives and air quality standards for sulphur dioxide ($SO_2$)and particulate matter ($PM_{10}$) within the air quality management area and proposes the timescale for implementing such measures. Ballymena Borough Council submitted its Air Quality Action Plan in April 2008.

Since the inception of the action plan, works have been implemented and remain ongoing in regard to the action plan measures. A full report of Action Plan Progress Report is available, but is summarized below:

- Conversion of Solid fuel heating systems to LPG within NIHE housing stock

NIHE housing stock has been converted to LPG heating within the Ballykeel are according to financial and project constraints.

- Promotion of Warm Home, and Energy Efficiency Schemes.

There has been ongoing promotion of various energy efficiency schemes, and Ballymena Borough Council have an energy efficiency officer employed to progress uptake of these schemes.

- Bonfire Guidance & Controls

Ongoing community engagement by various Local authority departments in relation to community bonfires on matters such as what materials are burnt on these.
Also joint working with Central Government departments to tackle illegal waste disposal of items such as tyres from commercial premises on bonfires

Also Environmental Health Officers investigate and enforce legislation to unlicensed or nuisance burning of wastes complaints within the AQMA.

**Linenhall Street - AQAP – $NO_2$**

Ballymena Borough Council has prepared this Air Quality Action Plan (AQAP) following the declaration of an Air Quality Management Area (AQMA) for nitrogen dioxide ($NO_2$) along the Linenhall Street/George Street area in Ballymena town centre in 2009.

This action plan was finalised in October 2012, and the progress to date is summarised in Table 6-1.

**Table 6-1 Linenhall Street AQMA Action Plan Progress**

| No. | Measure | Focus | Lead Authority | Planning Phase | **Implementation Phase** | Indicator | **Target Annual Emission Reduction in the AQMA** | Progress to Date | Progress in Last 12 Months | Estimated Completion Date | Comments Relating to Emission Reductions |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Reduction of Queuing Traffic on Linenhall Street | Reductions in queuing time and therefore reduction of emission from idling cars is therefore likely to reduce pollution levels. | DRDNI | | | Alterations to Linenhall Street / Bridge Street Junction | | Not Progressed | None | | |
| 2 | Improvements in Bus Fleet Emissions | Translink to replace Ulsterbus buses with latest Euro class buses on an ongoing basis | Translink | | Ongoing Replacement | Improvement of bus fleet | | | | | |
| 3 | Encouraging Modal Shift | Public Realm Strategy | BBC | | 2014 - | Implementation of Ballymena Public Realm Strategy | | Public Realm works have commences within Town Centre Streets | | | |
| 4 | Ballymena South West Distributor Road | DRDNI to develop road as and when required by new development | DRDNI | | On Hold | | | | | | |

| No. | Measure | Focus | Lead Authority | Planning Phase | **Implementation Phase** | Indicator | **Target Annual Emission Reduction in the AQMA** | Progress to Date | Progress in Last 12 Months | Estimated Completion Date | Comments Relating to Emission Reductions |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | Bus Park and Ride | DRDNI to consider in accordance with SRTP | DRDNI | | The Sub-Regional Transport Plan (SRTP) 2015 | | | Park and Share Carpark provided in 2013 | | | |
| 6 | Comment upon planning applications to ensure that all relevant air quality issues are highlighted and mitigation measures are considered wherever possible. | Use Planning Process to ensure potential air quality issues are assessed. Comment upon planning applications to ensure that all relevant air quality issues are highlighted and mitigation measures are considered wherever possible | BBC | Ongoing | Ongoing | comment upon all relevant planning applications | | Air Quality addressed within all significant planning applications | | | |

| No. | Measure | Focus | Lead Authority | Planning Phase | **Implementation Phase** | Indicator | **Target Annual Emission Reduction in the AQMA** | Progress to Date | Progress in Last 12 Months | Estimated Completion Date | Comments Relating to Emission Reductions |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | Contribute to influence forthcoming development policies for Ballymena to ensure that air quality considerations are included. | Incorporate policies into future development policies to ensure that sustainable development and air quality considerations are included. | BBC | Ongoing | Ongoing | Air quality added to BBC planning policy | | | | | |
| 8 | Authorise and regularly inspect industrial premises under the Industrial Pollution Control (NI) Order 1997 and the Pollution Prevention and Control (NI) Regulations 2003. | Permitting and inspection of industrial processes and installations under Part C of the Industrial Pollution Control (NI) Order 1997 and the Pollution, Prevention and Control (NI) Regulations 2003 | BBC | Ongoing | Ongoing | Continued permitting and inspection | | | | | |

| No. | Measure | Focus | Lead Authority | Planning Phase | **Implemen-tation Phase** | Indicator | **Target Annual Emission Reduction in the AQMA** | Progress to Date | Progress in Last 12 Months | Estimated Completion Date | Comments Relating to Emission Reductions |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | Enforce relevant legislation to reduce the burning of commercial and domestic waste. | Take enforcement action under Clean Neighbourhoods Act in accordance with Council enforcement policy | BBC | Ongoing | Ongoing | Continued enforcement action | | | | | |

# 7 Conclusions and Proposed Actions

## 7.1 Conclusions from New Monitoring Data

- **Nitrogen Dioxide**

**Automatic Monitoring Data**

The mean nitrogen dioxide concentrations for the period 1 January 2013 to 31 December 2013 at the North Road site was 28 $\mu gm^{-3}$ therefore below the Annual Mean Air Quality Objective of 40 $\mu gm^{-3}$. There were 2 exceedances of the hourly mean objective with a maximum hourly mean of 279 $\mu gm^{-3}$, a maximum daily mean of 82 $\mu gm^{-3}$ or the Daily mean objective, with the maximum daily mean of 79 $\mu gm^{-3}$. (Air Quality Regulations (Northern Ireland) 2003)

**Diffusion Tube Monitoring**

On consideration of Box 3.3 of the technical guidance, in making a choice of bias adjustment factor (locally derived versus national database) for use the locally derived factor was chosen. Reasons for choice include;

1. Tube exposure is monthly
2. Very good data capture rates for the automatic site at 97.3%
3. Diffusion tube study was over one year.

**Local Bias adjustment figure: 1.02**

An exceedance of the nitrogen dioxide annual mean remains at Linenhall Street, Galgorm/North Road, These locations are within the AQMA for nitrogen dioxide.

- **Particulate matter – $PM_{10}$**

The annual mean concentrations for the period 1 January 2013 to 31 December 2013 at the Ballykeel site was 21µgm$^{-3}$, which is well below the annual objective of 40µgm$^{-3}$.

There were 7 exceedances of the daily mean objective of 50 µgm$^{-3}$ with a maximum recorded daily mean of 86 µgm$^{-3}$. These number of exceedances remain below the 35 exceedances per year for this objective.

- **Sulphur Dioxide – $SO_2$**

During the monitoring period 1 January 2013 to 31 December 2013 there were no exceedances of the 15- minute, hourly, daily or the annual means.

## 7.2 Conclusions relating to New Local Developments

There are no new local developments that will require more detailed consideration in the next Updating and Screening Assessment.

## 7.3 Other Conclusions

Planning application consultations will continue to be assessed with regard to potential impact on local air quality.

## 7.4 Proposed Actions

Proposed actions are detailed in the following table;

| **Action** | **Date** |
|---|---|
| Consultation and action planning in respect of the declared AQMA for nitrogen dioxide. | Continuing |
| Submit 2014 Updating and Screening Assessment | April 2015 |

# 8 References

1. Local Air Quality Management Technical Guidance LAQM.TG (09), February 2009, DEFRA.

2. Air Quality Review and Assessment – Detailed Assessment, March 2009, AEA Technology.

# 9 Appendices

# Appendix A: Quality Assurance / Quality Control (QA/QC)

### Diffusion Tube Bias Adjustment Factors

Nitrogen Dioxide diffusion tubes were supplied and analysed by Gradko Environmental Ltd., St Martins, 77 Wales Street, Winchester, Hampshire, S023 ORH. The preparation method is 20% TEA in water. Gradko Environmental Ltd is a UKAS accredited laboratory and follows Laboratory Quality Procedures. Analysis is carried out in accordance with documented in-house laboratory method GLM7.

### Factor from Local Co-location Studies

Ballymena Borough Council used a local Bias Factor from its local Co-location site at North Road.

### $PM_{10}$ Monitoring Adjustment

All data sets for $PM_{10}$ monitoring during 2012 were provided by Ricardo AEA. All monitoring data contained within this report has been adjusted and ratified by Ricardo AEA.

### Short-term to Long-term Data adjustment

NIA

### QA/QC of automatic monitoring

QA/QC of data management is carried out by Ricardo AEA who complete audits of the Ballykeel and North Road automatic analysers on a six monthly basis.

Maintenance of the automatic monitoring equipment was carried out by EMS Environmental Monitoring Systems Ltd) and are available for any urgent call outs with 24 hours notice.

Calibrations and minor maintenance is completed on a fortnightly basis by the air quality management officer of Ballymena Borough Council acting as a Local Site Operator (LSO).

**QA/QC of $NO_2$ Diffusion Tubes**

Gradko Environmental analytical laboratory is assessed annually by UKAS to establish conformance of the Laboratory Quality Procedures to the requirements of ISO/IEC 17025 Standard.

Gradko Environmental have demonstrated “good precision” results for 2013 as detailed in the summary of precision results for the individual laboratories performance on the Defra website; http://laqm.defra.gov.uk/diffusion-tubes/precision.html

Gradko Environmental also demonstrated good performance in the WASP scheme for analysis of nitrogen dioxide diffusion tubes for rounds 116 – 119 (January – December 2012); http://laqm.defra.gov.uk/diffusion-tubes/qa-qc-framework.html

# Appendix B: NO2 Diffusion Tube Monthly Data 2013

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Mean Annual Concentration µg/m3 | Local Bias Adjusted (1.02) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DT1 | 19.18 | 18.74 | 14.95 | 9.79 | 6.87 | 6.88 | 7.27 | 5.17 | 11.56 | 14.04 | 17.46 | 12.98 | 12.1 | 12.32 |
| DT2 | 46.21 | 34.89 | 27.45 | 31.36 | 27.39 | 22.25 | 25.85 | 24.18 | 30.65 | 39.77 | 43.85 | 36.93 | 32.6 | 33.22 |
| DT3 | 36.24 | 32.09 | 26.82 | 27.48 | 18.74 | 20.64 | 22.16 | 19.23 | 23.25 | 33.47 | 32.76 | 22.88 | 26.3 | 26.84 |
| DT4 | 44.50 | 38.69 | 26.78 | 30.56 | 25.59 | 22.83 | 25.26 | 18.45 | 31.05 | 40.17 | 37.07 | 36.51 | 31.5 | 32.08 |
| DT5 | 40.90 | 32.53 | 18.22 | 26.50 | 9.07 | 20.36 | 22.61 | 17.44 | 25.27 | 37.78 | 35.49 | 33.46 | 26.6 | 27.17 |
| DT6 | 19.43 | 18.14 | 12.07 | 9.63 | 1.33 | 6.13 | 7.06 | 4.74 | 9.09 | 13.27 | 18.90 | 14.88 | 11.2 | 11.45 |
| DT7 | 53.75 | 41.02 | 25.42 | 44.76 | 31.66 | 33.50 | 39.10 | 32.97 | 36.74 | 47.89 | 47.74 | 40.75 | 39.6 | 40.40 |
| DT8 | 36.63 | 26.54 | 19.62 | 23.87 | 18.26 | 18.10 | 22.25 | 17.21 | 24.77 | 32.64 | 37.23 | 29.40 | 25.5 | 26.05 |
| DT9 | 20.29 | 36.96 | 29.79 | 28.02 | 22.25 | 24.16 | 26.11 | 20.66 | 28.80 | 34.84 | 37.75 | 33.81 | 28.6 | 29.19 |
| DT10 | 41.18 | 34.98 | 27.26 | 29.47 | 5.12 | 21.32 | 27.36 | 19.40 | 27.43 | 40.98 | 41.26 | 38.05 | 29.5 | 30.07 |
| DT11 | 39.51 | 35.47 | 24.00 | 20.86 | 17.06 | 21.13 | 24.22 | 17.62 | 25.22 | 35.69 | 31.72 | 32.16 | 27.1 | 27.60 |
| DT12 | 38.45 | 33.77 | 23.93 | 31.59 | 22.07 | 25.17 | 31.07 | 22.97 | 27.17 | 39.04 | 40.27 | 34.37 | 30.8 | 31.44 |
| DT13 | 45.00 | 36.19 | 29.74 | 25.89 | 23.13 | 17.48 | 24.36 | 10.19 | 27.87 | 35.19 | 34.98 | 33.12 | 28.6 | 29.17 |
| DT14 | 39.00 | 33.87 | 32.85 | 26.18 | 22.19 | 18.03 | 23.98 | 14.49 | 26.01 | 36.86 | 34.95 | 32.33 | 28.4 | 28.96 |
| DT14 B | 40.44 | 35.64 | 31.53 | 26.53 | 16.14 | 17.83 | 22.72 | 13.57 | 24.47 | 37.34 | 33.40 | 32.20 | 27.8 | 28.35 |
| DT15 | 51.74 | 54.99 | 35.79 | 53.91 | 17.88 | 44.00 | 55.77 | 46.60 | 46.89 | 64.01 | 77.50 | 61.82 | 50.8 | 51.78 |
| DT16 | | | | | | | 27.29 | 24.09 | 26.21 | 36.74 | 45.44 | 31.16 | 31.8 | 33.25 (Annualised) |
| DT17 | | | | | | | 33.05 | 31.93 | 33.25 | 48.86 | 46.58 | 38.49 | 38.7 | 40.43 (Annualised) |

## Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

**Diffusion Tubes Measurements**

| Period | Start Date dd/mm/yyyy | End Date dd/mm/yyyy | Tube 1 $\mu gm^{-3}$ | Tube 2 $\mu gm^{-3}$ | Tube 3 $\mu gm^{-3}$ | Triplicate Mean | Standard Deviation | Coefficient of Variation | 95% CI of mean |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 03/01/2013 | 01/02/2013 | 45 | 39 | 40.44 | 41 | 3.1 | 8 | 7.8 |
| 2 | 01/02/2013 | 06/03/2013 | 36.19 | 33.87 | 35.64 | 35 | 1.2 | 3 | 3.0 |
| 3 | 06/03/2013 | 05/04/2013 | 29.74 | 32.85 | 31.53 | 31 | 1.6 | 5 | 3.9 |
| 4 | 05/04/2013 | 03/05/2013 | 25.89 | 26.18 | 26.53 | 26 | 0.3 | 1 | 0.8 |
| 5 | 03/05/2013 | 31/05/2013 | 23.13 | 22.19 | 17.88 | 21 | 2.8 | 13 | 7.0 |
| 6 | 31/05/2013 | 04/07/2013 | 17.48 | 18.03 | 17.83 | 18 | 0.3 | 2 | 0.7 |
| 7 | 04/07/2013 | 09/08/2013 | 17.48 | 23.98 | 22.72 | 21 | 3.4 | 16 | 8.6 |
| 8 | 09/08/2013 | 05/09/2013 | 10.19 | 14.49 | 13.57 | 13 | 2.3 | 18 | 5.6 |
| 9 | 05/09/2013 | 03/10/2013 | 27.87 | 26.01 | 24.47 | 26 | 1.7 | 7 | 4.2 |
| 10 | 03/10/2013 | 31/10/2013 | 35.19 | 36.86 | 37.34 | 36 | 1.1 | 3 | 2.8 |
| 11 | 31/10/2013 | 28/11/2013 | 34.98 | 34.95 | 33.4 | 34 | 0.9 | 3 | 2.2 |
| 12 | 28/11/2013 | 08/01/2014 | 33.12 | 32.33 | 32.2 | 33 | 0.5 | 2 | 1.2 |
| 13 | | | | | | | | | |

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

| Automatic Method | | Data Quality Check | |
|---|---|---|---|
| Period Mean | Data Capture (% DC) | Tubes Precision Check | Automatic Monitor |
| 38 | 98.1 | Good | Good |
| 36 | 96.3 | Good | Good |
| 38 | 98.2 | Good | Good |
| 26 | 98.4 | Good | Good |
| 22 | 96.1 | Good | Good |
| 23 | 98.2 | Good | Good |
| 21 | 98.3 | Good | Good |
| 17 | 98.6 | Good | Good |
| 25 | 99.4 | Good | Good |
| 30 | 97.6 | Good | Good |
| 40 | 94.8 | Good | Good |
| 28 | 93.1 | Good | Good |
| | | | |
| Overall survey --> | | Good precision | Good Overall DC |

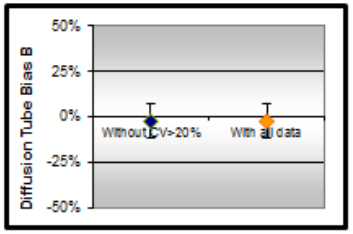
(Check average CV & DC from Accuracy calculations)

**Site Name/ ID:** North Road, Ballymena

Precision: 12 out of 12 periods have a CV smaller than 20%

| Accuracy (with 95% confidence interval) without periods with CV larger than 20% | |
|---|---|
| Bias calculated using 12 periods of data | |
| Bias factor A | 1.02 (0.93 - 1.13) |
| Bias B | -2% (-12% - 7%) |
| Diffusion Tubes Mean: | 28 $\mu gm^{-3}$ |
| Mean CV (Precision): | 7 |
| Automatic Mean: | 29 $\mu gm^{-3}$ |
| Data Capture for periods used: | 97% |
| Adjusted Tubes Mean: | 29 (26 - 32) $\mu gm^{-3}$ |

| Accuracy (with 95% confidence interval) WITH ALL DATA | |
|---|---|
| Bias calculated using 12 periods of data | |
| Bias factor A | 1.02 (0.93 - 1.13) |
| Bias B | -2% (-12% - 7%) |
| Diffusion Tubes Mean: | 28 $\mu gm^{-3}$ |
| Mean CV (Precision): | 7 |
| Automatic Mean: | 29 $\mu gm^{-3}$ |
| Data Capture for periods used: | 97% |
| Adjusted Tubes Mean: | 29 (26 - 32) $\mu gm^{-3}$ |




Jaume Targa, for AEA
Version 04 - February 2011

If you have any enquiries about this spreadsheet please contact the LAQM Helpdesk at: LAQMHelpdesk@uk.bureauveritas.com

Adjustment Single Tubes

## Adjustment of SINGLE Tubes

AEA Energy & Environment
From the AEA group

**Diffusion Tube Measurements**

| Site Name/ID | Periods | | | | | | | | | | | | | Raw Mean | Valid periods |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | | |
| DT1 | 19.2 | 18.7 | 15.0 | 9.8 | 6.9 | 6.9 | 7.3 | 5.2 | 11.6 | 14.0 | 17.5 | 13.0 | | 12.1 | 12 |
| DT2 | 46.2 | 34.9 | 27.5 | 31.4 | 27.4 | 22.3 | 25.9 | 24.2 | 30.7 | 39.8 | 43.9 | 36.9 | | 32.6 | 12 |
| DT3 | 36.2 | 32.1 | 26.8 | 27.5 | 18.7 | 20.6 | 22.2 | 19.2 | 23.3 | 33.5 | 32.8 | 22.9 | | 26.3 | 12 |
| DT4 | 44.5 | 38.7 | 26.8 | 30.6 | 25.6 | 22.8 | 25.3 | 18.5 | 31.1 | 40.2 | 37.1 | 36.5 | | 31.5 | 12 |
| DT5 | 40.9 | 32.5 | 18.2 | 26.5 | 9.1 | 20.4 | 22.6 | 17.4 | 25.3 | 37.8 | 35.5 | 33.5 | | 26.6 | 12 |
| DT6 | 19.4 | 18.1 | 12.1 | 9.6 | 1.3 | 6.1 | 7.1 | 4.7 | 9.1 | 13.3 | 18.9 | 14.9 | | 11.2 | 12 |
| DT7 | 53.8 | 41.0 | 25.4 | 44.8 | 31.7 | 33.5 | 39.1 | 33.0 | 36.7 | 47.9 | 47.7 | 40.8 | | 39.6 | 12 |
| DT8 | 36.6 | 26.5 | 19.6 | 23.9 | 18.3 | 18.1 | 22.3 | 17.2 | 24.8 | 32.6 | 37.2 | 29.4 | | 25.5 | 12 |
| DT9 | 20.3 | 37.0 | 29.8 | 28.0 | 22.3 | 24.2 | 26.1 | 20.7 | 28.8 | 34.8 | 37.8 | 33.8 | | 28.6 | 12 |
| DT10 | 41.2 | 35.0 | 27.3 | 29.5 | 5.1 | 21.3 | 27.4 | 19.4 | 27.4 | 41.0 | 41.3 | 38.1 | | 29.5 | 12 |
| DT11 | 39.5 | 35.5 | 24.0 | 20.9 | 17.1 | 21.1 | 24.2 | 17.6 | 25.2 | 35.7 | 31.7 | 32.2 | | 27.1 | 12 |
| DT12 | 38.5 | 33.8 | 23.9 | 31.6 | 22.1 | 25.2 | 31.1 | 23.0 | 27.2 | 39.0 | 40.3 | 34.4 | | 30.8 | 12 |
| DT13 | 45.0 | 36.2 | 29.7 | 25.9 | 23.1 | 17.5 | 24.4 | 10.2 | 27.9 | 35.2 | 35.0 | 33.1 | | 28.6 | 12 |
| DT14 | 39.0 | 33.9 | 32.9 | 26.2 | 22.2 | 18.0 | 24.0 | 14.5 | 26.0 | 36.9 | 35.0 | 32.3 | | 28.4 | 12 |
| DT15 | 51.7 | 55.0 | 35.8 | 53.9 | 16.1 | 44.0 | 55.8 | 46.6 | 46.9 | 64.0 | 77.5 | 61.8 | | 50.8 | 12 |
| DT14B | 40.4 | 35.6 | 31.5 | 26.5 | 17.9 | 17.8 | 22.7 | 13.6 | 24.5 | 37.3 | 33.4 | 32.2 | | 27.8 | 12 |
| DT16 | | | | | | | 27.3 | 24.1 | 26.2 | 36.7 | 45.4 | 31.2 | | 31.8 | 6 |
| DT17 | | | | | | | 33.1 | 31.9 | 33.3 | 48.9 | 46.6 | 38.5 | | 38.7 | 6 |

**Adjusted measurement (95% confidence interval)**
**with all the data**
**12 periods used in this calcuations**

**Bias Factor A** 1.02 (0.93 - 1.13)
**Bias B** -2% (-12% - 7%)

Tube Precision: 7 Automatic DC: 97%

| | |
|---|---|
| Adjusted with 95% CI | 12 ( 11 - 14 ) |
| Adjusted with 95% CI | 33 ( 30 - 37 ) |
| Adjusted with 95% CI | 27 ( 24 - 30 ) |
| Adjusted with 95% CI | 32 ( 29 - 36 ) |
| Adjusted with 95% CI | 27 ( 25 - 30 ) |
| Adjusted with 95% CI | 11 ( 10 - 13 ) |
| Adjusted with 95% CI | 40 ( 37 - 45 ) |
| Adjusted with 95% CI | 26 ( 24 - 29 ) |
| Adjusted with 95% CI | 29 ( 27 - 32 ) |
| Adjusted with 95% CI | 30 ( 27 - 33 ) |
| Adjusted with 95% CI | 28 ( 25 - 31 ) |
| Adjusted with 95% CI | 31 ( 29 - 35 ) |
| Adjusted with 95% CI | 29 ( 27 - 32 ) |
| Adjusted with 95% CI | 29 ( 26 - 32 ) |
| Adjusted with 95% CI | 52 ( 47 - 57 ) |
| Adjusted with 95% CI | 28 ( 26 - 31 ) |
| Adjusted with 95% CI | 32 ( 30 - 36 ) |
| Adjusted with 95% CI | 39 ( 36 - 44 ) |

*The bias adjustment factor used in these calculations include all the data and no screening of data due to poor precision has been applied.*

Ballymena Borough Council

Triplicate Tube Adjustment Calculation

## Adjustment of DUPLICATE or TRIPLICATE Tubes

AEA Energy & Environment
From the AEA group

**Diffusion Tubes Measurements**

| Period | Start Date dd/mm/yyyy | End Date dd/mm/yyyy | Tube 1 $\mu gm^{-3}$ | Tube 2 $\mu gm^{-3}$ | Tube 3 $\mu gm^{-3}$ | Triplicate Average | Standard Deviation | CV | 95% CI mean | Data Quality Check: Diffusion Tubes Precision Check |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 03/01/2013 | 01/02/2013 | 45 | 39 | 40.44 | 41.5 | 3.13 | 7.55 | 7.78 | Good |
| 2 | 01/02/2013 | 06/03/2013 | 36.19 | 33.87 | 35.64 | 35.2 | 1.21 | 3.44 | 3.01 | Good |
| 3 | 06/03/2013 | 05/04/2013 | 29.74 | 32.85 | 31.53 | 31.4 | 1.56 | 4.98 | 3.88 | Good |
| 4 | 05/04/2013 | 03/05/2013 | 25.89 | 26.18 | 26.53 | 26.2 | 0.32 | 1.22 | 0.80 | Good |
| 5 | 03/05/2013 | 31/05/2013 | 23.13 | 22.19 | 17.88 | 21.1 | 2.80 | 13.29 | 6.95 | Good |
| 6 | 31/05/2013 | 04/07/2013 | 17.48 | 18.03 | 17.83 | 17.8 | 0.28 | 1.57 | 0.69 | Good |
| 7 | 04/07/2013 | 09/08/2013 | 17.48 | 23.98 | 22.72 | 21.4 | 3.45 | 16.11 | 8.56 | Good |
| 8 | 09/08/2013 | 05/09/2013 | 10.19 | 14.49 | 13.57 | 12.8 | 2.26 | 17.76 | 5.62 | Good |
| 9 | 05/09/2013 | 03/10/2013 | 27.87 | 26.01 | 24.47 | 26.1 | 1.70 | 6.52 | 4.23 | Good |
| 10 | 03/10/2013 | 31/10/2013 | 35.19 | 36.86 | 37.34 | 36.5 | 1.13 | 3.10 | 2.80 | Good |
| 11 | 31/10/2013 | 28/11/2013 | 34.98 | 34.95 | 33.4 | 34.4 | 0.90 | 2.62 | 2.24 | Good |
| 12 | 28/11/2013 | 08/01/2014 | 33.12 | 32.33 | 32.2 | 32.6 | 0.50 | 1.53 | 1.24 | Good |
| 13 | | | | | | | | | | |

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

Jaume Targa, for AEA

Version 04 - February 2011

**Site Name/ ID:**

**Adjusted measurement (95% confidence level)**
**Without periods with CV larger than 20%**

Bias calculated using 12 periods of data
Tube Precision: 7 Automatic DC: 97%
Bias factor A: 1.02 (0.93 - 1.13)
Bias B: -2% (-12% - 7%)

*Information about tubes to be adjusted*
Diffusion Tube average: 28 $\mu gm^{-3}$
Average Precision (CV): 7
Adjusted Tube average: 29 +/- 3 $\mu gm^{-3}$

**Adjusted measurement (95% confidence level)**
**with all data**

Bias calculated using 12 periods of data
Tube Precision: 7 Automatic DC: 97%
Bias factor A: 1.02 (0.93 - 1.13)
Bias B: -2% (-12% - 7%)

*Information about tubes to be adjusted*
Diffusion Tube average: 28 $\mu gm^{-3}$
Average Precision (CV): 7
Adjusted Tube average: 29 +/- 3 $\mu gm^{-3}$