

2011 Air Quality Progress Report for Dumfries and Galloway Council

In fulfilment of Part IV of the Environment Act 1995 Local
Air Quality Management

November 2011

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Summary

Results of monitoring for nitrogen dioxide (NO₂) show that all the concentrations meet the objectives, therefore there is no need to proceed to a detailed assessment for NO₂. Additional monitoring carried out to supplement a detailed assessment for PM₁₀ in Dumfries has shown PM₁₀ results which meet the objectives therefore no requirement to designate any air quality management areas for PM₁₀ has been identified. In previous reports the objectives for sulphur dioxide, carbon monoxide, lead, benzene and 1,3 butadiene have all been assessed as being unlikely to be exceeded in Dumfries and Galloway. Hence no requirement for a new detailed assessment has been identified from monitoring.

No new requirement to proceed to a detailed assessment for any of the relevant pollutants has been identified as a result of new local developments. As mentioned in previous reports it is intended to carry out a detailed assessment for PM₁₀ at the village of Cairnryan due to the perceived increase in traffic through the village when the new Stena Line ferry at Old House Point, Cairnryan is fully operational (the new port is opening this month, November 2011).

No part of the Council area has been designated as an air quality management area to date.

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1 Introduction

1.1 Description of local authority area.

Dumfries and Galloway is located in south-west Scotland. To the north, the region shares borders with South Ayrshire, East Ayrshire and South Lanarkshire; to the east with Scottish Borders; and to the south with the county of Cumbria. Lying to the north of the Solway Firth and to the east of the Irish Sea, Dumfries and Galloway occupies a land area of approximately 6,439 km², making it the third largest of Scotland's 32 local authorities. Its population of approximately 147,284 is projected to fall to around 146,000 over the next 10 years. The largest town is Dumfries (31,600), followed by Stranraer (10,800) and Annan (8,300), with other settlements having populations of 4,500 or fewer. The economy of the region is based primarily on agriculture and forestry with light industry and tourism making significant contributions. Some 30% of Scotland's dairy cattle come from Dumfries and Galloway, and textiles, engineering and food processing are important industries in towns such as Dumfries, Kirkcudbright, Wigtown, Newton Stewart, New Galloway, Moffat, Lockerbie, Annan, Castle Douglas and Dalbeattie. The ferry ports at Cairnryan provide links to Belfast and Larne via Loch Ryan and the Irish Sea.

1.2 Purpose of progress report.

Under Part IV of the Environment Act 1995ⁱ every local authority is required to regularly review and assess the air quality in its area to determine whether the Government's air quality objectives are being or will be met. Progress reports are required in the intervening years between three-yearly updating and screening assessment reports. The purpose of progress reports is to maintain continuity in the local air quality management process.

Progress reports are not intended to be as detailed as updating and screening assessment reports however if a risk of non-compliance with an air quality objective is identified the local authority is required to proceed to a detailed assessment in respect of the pollutant concerned.

1.3 Air quality objectives.

The air quality objectives applicable to local air quality management in Scotland are set out in the Air Quality (Scotland) Regulations 2000 and the Air Quality (Scotland) (Amendment) Regulations 2002ⁱⁱ. Table 1 shows the objectives in units of microgrammes per cubic metre ($\mu\text{g}/\text{m}^3$) except for the carbon monoxide objective which is expressed in milligrammes per cubic metre (mg/m^3) with the number of exceedences in each year that are permitted (where applicable). (Air quality objectives for the UK can be found in the Government's Air Quality Strategy for England, Scotland, Wales and Northern Irelandⁱⁱⁱ).

^{i,ii,iii} See references on page 22

Table 1 Air quality objectives prescribed in regulations for the purpose of local air quality management in Scotland.

Pollutant	Concentration	Measured as	Date to be achieved by
Benzene	16.25 µg/m ³ (or less)	Running annual mean	31/12/2003
	3.25 µg/m ³ (or less)	Running annual mean	31/12/2010
1,3-butadiene	2.25 µg/m ³ (or less)	Running annual mean	31/12/2003
Carbon monoxide	10.0 mg/m ³ (or less)	Running 8-hour mean	31/12/2003
Lead	0.5 µg/m ³ (or less)	Annual mean	31/12/2004
	0.25 µg/m ³ (or less)	Annual mean	31/12/2008
Nitrogen dioxide	200 µg/m ³ (or less), not to be exceeded more than 18 times a year	1-hour mean	31/12/2005
	40 µg/m ³ (or less)	Annual mean	31/12/2005
Particles (PM ₁₀)	50 µg/m ³ (or less), not to be exceeded more than 35 times a year	24-hour mean	31/12/2004
	40 µg/m ³ (or less)	Annual mean	31/12/2004
	50 µg/m ³ (or less), not to be exceeded more than 7 times a year	24-hour mean	31/12/2010
	18 µg/m ³ (or less)	Annual mean	31/12/2010
Sulphur dioxide	350 µg/m ³ (or less), not to be exceeded more than 24 times a year	1-hour mean	31/12/2004
	125 µg/m ³ (or less), not to be exceeded more than 3 times a year	24-hour mean	31/12/2004
	266 µg/m ³ (or less), not to be exceeded more than 35 times a year	15-minute mean	31/12/2005

1.4 Summary of previous review and assessments^{iv}.

- 1.4.1 The findings of the first review and assessment of air quality in Dumfries and Galloway (commenced in 1998) were that the air quality objectives were likely to be met. As a consequence no air quality management areas were declared (which is still the position to date).
- 1.4.2 In 2003, an updating and screening assessment was carried out, the results of which generally supported the conclusions of the first round. However, in line with the Department for Environment, Food and Rural Affairs' (DEFRA's) revised technical guidance (2003), it was found that a detailed assessment of sulphur dioxide (SO₂) levels at the ferry ports of Stranraer and Cairnryan would be required.
- 1.4.3 In 2004 a detailed assessment of the influence of shipping on SO₂ levels at Cairnryan was carried out, the conclusion of which was that an air quality management area was not required. With regard to the detailed assessment at Stranraer this was initially put on hold pending Stena Line's proposed re-location to Cairnryan but subsequent to DEFRA's amendment of their technical guidance (2006) which relaxed the screening criteria for SO₂ related to shipping it was found that a detailed assessment for SO₂ at Stranraer was no longer required.
- 1.4.4 In 2005 monitoring results detailed in a progress report indicated that there was no requirement to proceed to a detailed assessment for any of the relevant pollutants.
- 1.4.5 In 2006 the conclusions of an updating and screening assessment were that the relevant air quality objectives would be met and that consequently there was no requirement to undertake a detailed assessment. Three road junctions in Dumfries were however predicted to marginally exceed the 2010 annual mean PM₁₀ objective.
- 1.4.6 Monitoring results detailed in the 2007 progress report showed that the current air quality objectives for the relevant pollutants were being met. Projected PM₁₀ levels at the monitoring site at Buccleuch Street, Dumfries indicated that the 2010 annual mean PM₁₀ objective would not be met but there was no relevant exposure at this roadside site. With regard to the marginal exceedences of the PM₁₀ annual mean predicted at three road junctions in the 2006 updating and screening assessment, traffic flows would be checked at the relevant areas to see if they were in line with estimated levels.
- 1.4.7 The main findings of the 2008 progress report were that whilst the air quality objectives in force at the time were being met, PM₁₀ levels at Buccleuch Street, Dumfries were again predicted to exceed the 2010 PM₁₀ annual mean objective and after a re-assessment of relevant exposure it was decided that a detailed assessment for PM₁₀ should be carried out to include Buccleuch St., Dumfries and the three road junctions in Dumfries which had previously been predicted to marginally exceed the 2010 PM₁₀ annual mean objective.

- 1.4.8 A detailed assessment for PM₁₀ was commenced in 2008 covering Buccleuch Street, and the junctions of Brooms Road/Annan Road, Glasgow Street/Galloway Street and Whitesands/Buccleuch Street, all in Dumfries. Concentrations of PM₁₀ were modelled for 2010 using the ADMS roads dispersion model. Projections of measured PM₁₀ concentrations did not identify an exceedence at the site of the Buccleuch Street PM₁₀ monitor itself; however exceedences of the 2010 annual mean objective were predicted at all three junctions and exceedence of the 2010 PM₁₀ 24-hour mean objective was predicted at one junction (Whitesands/Buccleuch Street). It had been intended to carry out PM₁₀ monitoring at these junctions to supplement this assessment. PM₁₀ monitoring at the Buccleuch St./Whitesands junction was commenced on 10/08/10.
- 1.4.9 In 2009 an updating and screening assessment was carried out having regard to DEFRA's further revision of their technical guidance published in February 2009. The results of monitoring together with the evaluation of new and changed sources to identify those that might give rise to a risk of an exceedence of an air quality objective did not identify any new requirement to proceed to a detailed assessment. A previous commitment to carry out a detailed assessment of PM₁₀ at Cairnryan in the event that Stena Line re-located from Stranraer to Cairnryan was reiterated.
- 1.4.10 A progress report in 2010 found that NO₂ levels monitored during the previous year met the relevant objectives. PM₁₀ monitoring at the junction of Whitesands and Buccleuch Street had commenced but no new PM₁₀ data were reported as the BAM monitor had only recently been set up. No new requirement to proceed to a detailed assessment was identified as a result of monitoring or new developments.
- 1.4.11 A report supplementary to the PM₁₀ detailed assessment carried out in 2008/09 has recently been prepared. The report details the results of PM₁₀ monitoring which was carried out for six months at the junction of Buccleuch Street and Whitesands in Dumfries using a BAM monitor. The results when annualised for 2010 showed an annual mean of 15.75 µg/m³ and no exceedences of the 24-hour mean. Originally it had been intended to monitor at all three junctions but as the modelling had indicated a higher annual mean and more exceedences of the 24-hour mean at the Buccleuch Street/Whitesands road junction than at the other two junctions (i.e. it was the worst case) it is concluded in the report that the objectives are also being met at the other two junctions and that there is no need to designate any air quality management areas.

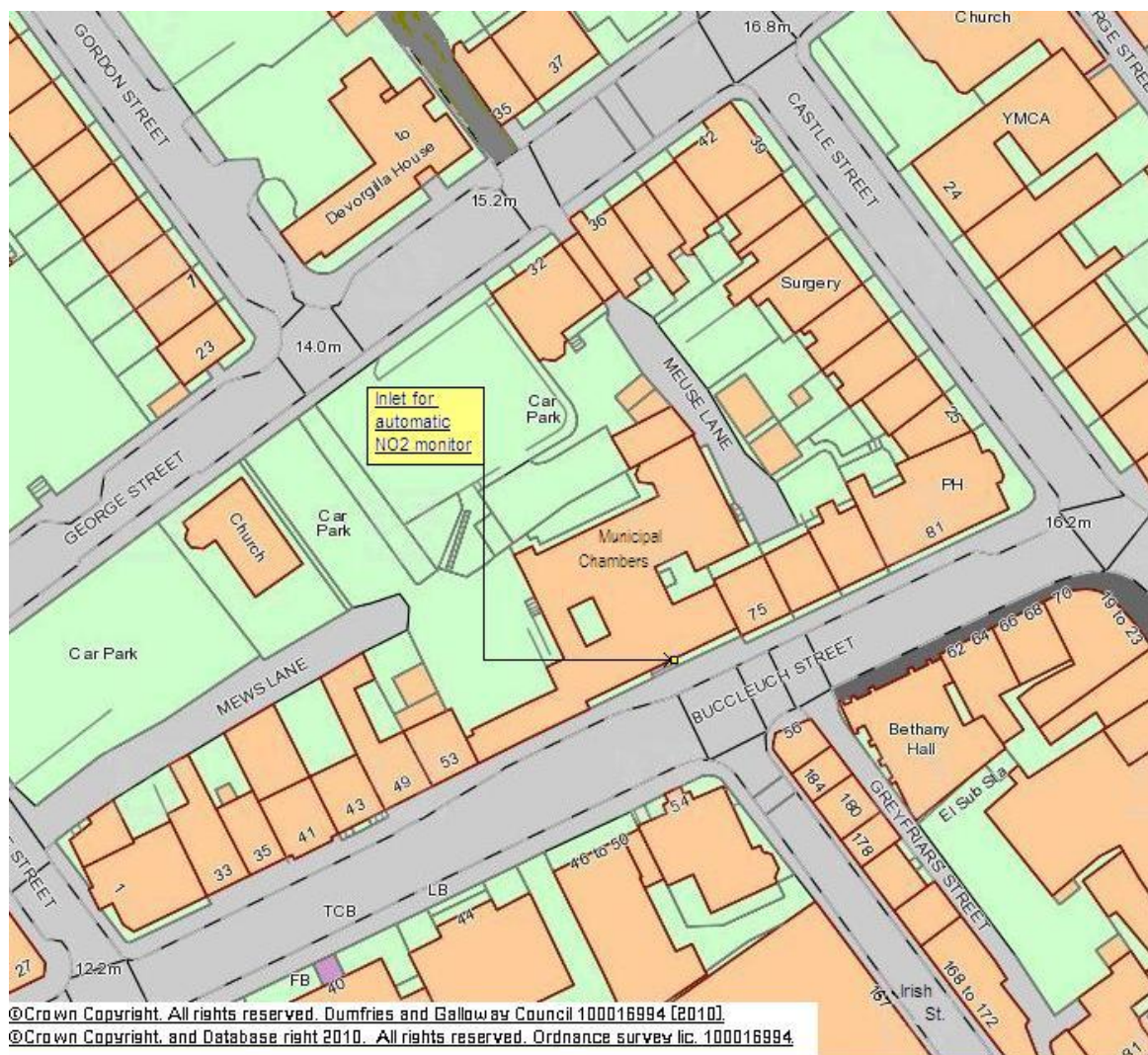
2. Monitoring data

2.1 Automatic monitoring

2.1.1 Dumfries NO₂

A continuous (chemiluminescent) NO₂ monitor (API M200A) is located at the Municipal Chambers, Buccleuch Street, Dumfries and forms part of the UK Automatic Urban and Rural Air Quality Monitoring Network (AURN). Routine calibrations of the automatic monitor are carried out fortnightly by Council staff, with six-monthly audits carried out by AEA Energy and Environment. Ratification is carried out by the Quality Assurance and Control (QA/QC) Unit at AEA Energy & Environment.

Figure 1 - Map of NO₂ automatic monitoring site at Buccleuch St., Dumfries.

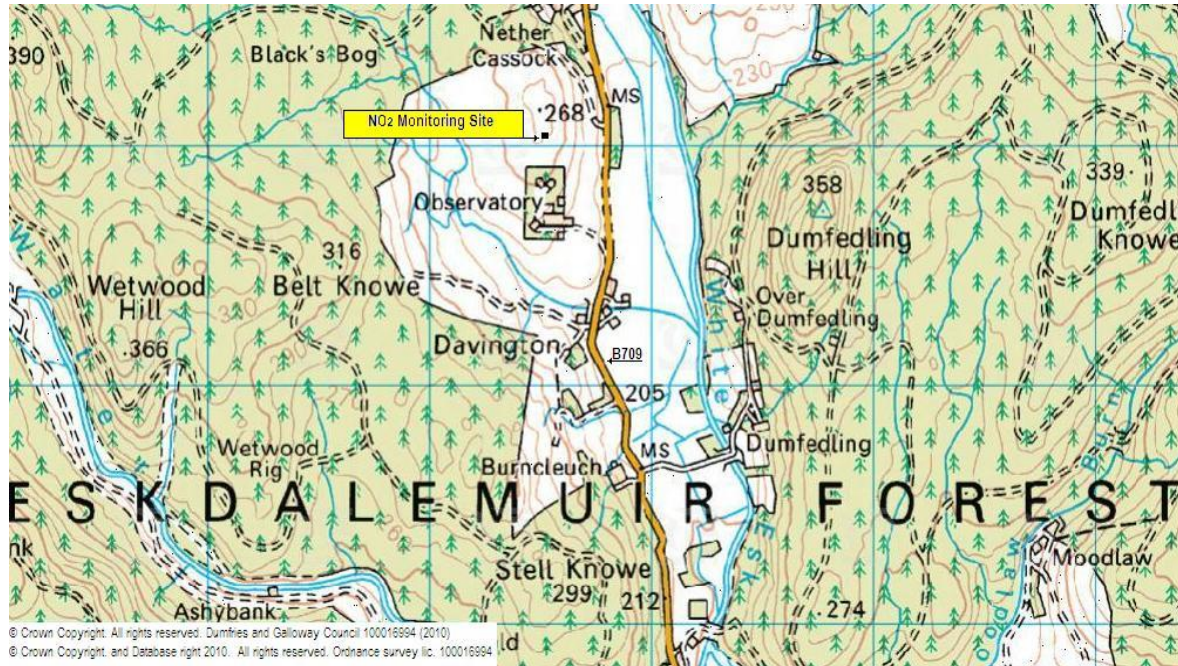


The air intake for the monitor is situated at a height of approximately 2.2 metres in the supporting framework of one of two decorative lamps on either side of the Municipal Chambers entrance. The air-intake tube goes through a window to the monitor which is located in the basement of the building.

2.1.2 Eskdalemuir NO₂

Since December 2004 a continuous NO₂ monitor has been located at the Observatory at Eskdalemuir as part of the AURN. The Observatory^v is currently managed by the British Geological Society and the Met Office. Ratification is carried out by the QA/QC unit at AEA. (Ozone is also monitored at this site).

Figure 2 - Map of NO₂ automatic monitoring site at Eskdalemuir Observatory.



2.1.3 Dumfries PM₁₀

PM₁₀ monitoring using a Partisol monitor on a flat roof of a single-storey building immediately to the south-west of the NO₂ inlet site was carried out from August 2001 to March 2008 as part of the AURN and was re-commenced for a six-month period by the Council from October 2008 to April 2009. (PM_{2.5} monitoring using an additional Partisol at the same site was carried out as part of a Scottish Government project^{vi} from February 2007 to March 2008). The PM₁₀ and the PM_{2.5} monitors were removed from the site in May 2011.

A beta-attenuation mass (BAM) PM₁₀ monitor was hired for six months from August 2010 to February 2011 and sited as shown in map below.

Figure 3 - Map of BAM PM₁₀ monitoring site at Buccleuch St., Dumfries.

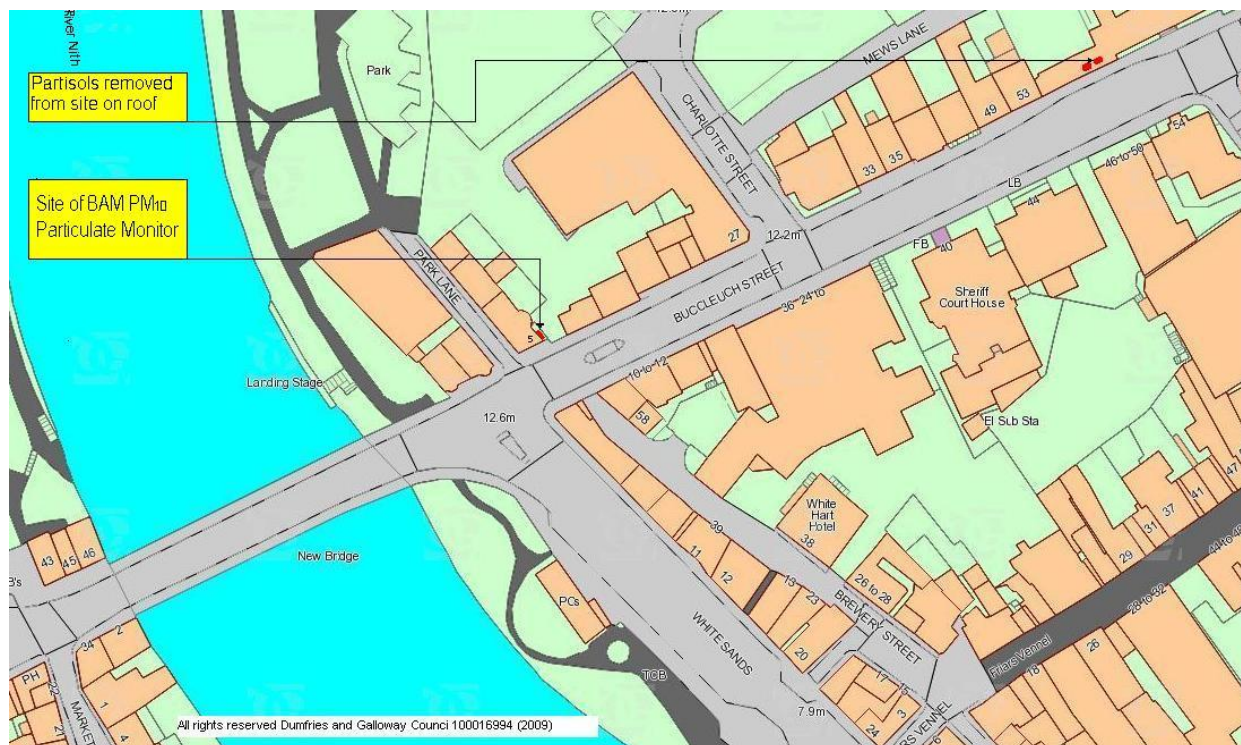


Table 2 Details of automatic monitoring sites.

Site Name	Site Type	Grid Ref.	Pollutant	Monitoring Technique	Within AQMA?	Relevant Exposure?	Distance to kerb (metres)	Worst-case Exposure?
Buccleuch Street Dumfries	Roadside	297025 576259	NO ₂	Automatic	No	Yes	4.3	Yes
Eskdalemuir	Rural	323551 603021	NO ₂	Automatic	No	No	n/a	n/a
Buccleuch Street (BAM) Dumfries (for 6-month period only - monitor now removed)	Roadside	296873 576186	PM ₁₀	Beta-attenuation mass	No	Yes	5.0	Yes

2.2 Non-automatic monitoring.

NO₂ diffusion tubes are deployed for monthly exposure periods at the twelve sites shown in Table 3. Triplicate tubes are used at two sites namely at Buccleuch Street (East), and Buccleuch Street Bridge, with duplicate tubes at Buccleuch Street (West), while the rest of the sites have single tubes. Locations of the diffusion tubes are shown in Appendix 2 Figures 10 to 17. The tubes were prepared and analysed by Environmental Scientifics Group using 20% triethanolamine (TEA) in water*. Environmental Scientifics Group demonstrated good performance for 2010 in the Workplace Analysis Scheme for Proficiency (WASP) (an independent analytical performance-testing scheme).

The triplicate tubes at Buccleuch St., (East) are co-located with the NO₂ automatic monitor. The local bias-adjustment factor was 0.92 and this has been used in preference to the national bias-adjustment factor for 2010 of 0.84 (derived by amalgamation of 10 studies including Dumfries and Galloway's). Further details of the local co-location study are provided in Appendix 1.

*50% TEA in acetone from January 2011.

Table 3 Details of NO₂ diffusion tube sites.

Site Name	Site Type	OS Grid Ref	Number of tubes	Within AQMA?	Relevant Exposure?	Distance to kerb of nearest road (metres)	Worst-case Location?
M74 Slip Rd. Lockerbie	Intermediate	NY133814	single	No	No (32m)	1.9	Yes
Buccleuch St. (E) Dumfries	Roadside	NX970763	triplicate (co-located with automatic monitor)	No	Yes (<1m)	4.3	Yes
Buccleuch St. (W) Dumfries	Kerbside	NX969762	duplicate	No	Yes (<1m)	1.0	No
Buccleuch St. (S) Dumfries	Kerbside	NX970762	single	No	Yes (<1m)	0.6	No
Buccleuch St. Bridge Dumfries	Roadside	NX968762	triplicate	No	Yes (<1m)	5.0	Yes
Loreburn St. Dumfries	Kerbside	NX974762	single	No	Yes (<1m)	1.0	No
St. Michael St. Dumfries	Roadside	NX975757	single	No	Yes (<1m)	3.1	No
Argyll Drive Dumfries	Background	NX994788	single	No	Yes (1m)	1.7	No
Nith Place Dumfries	Kerbside	NX973758	single	No	Yes (<1m)	0.7	Yes
Charlotte St. Stranraer	Kerbside	NX061608	single	No	Yes (<1m)	0.5	No
Port Rodie Car Park Stranraer	Other	NX063610	single	No	No (160m)	N/A	Yes
A77 Cairnryan	Roadside	NX072674	single	No	No (19m)	2.0	Yes

2.3 Comparison of monitoring results with air quality objectives.

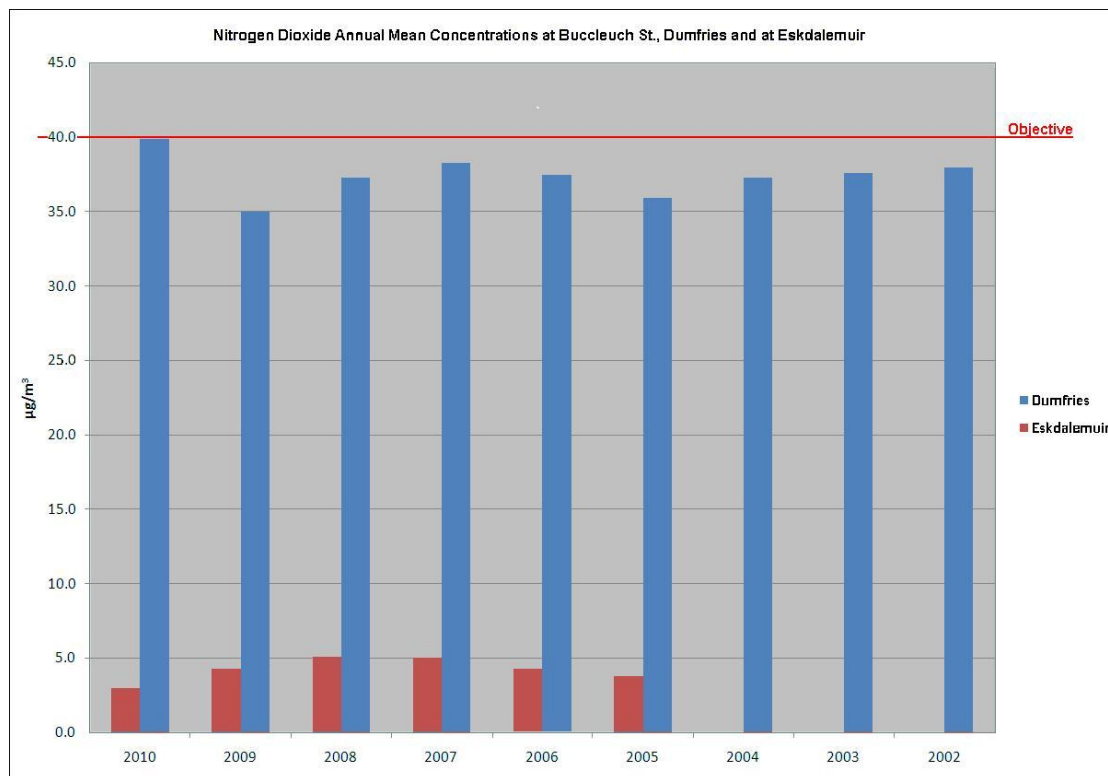
2.3.1 NO₂ automatic monitoring data.

All NO₂ results from automatic monitoring meet the relevant objectives.

Table 4 Results of automatic monitoring for NO₂ - comparison with annual mean objective (40µg/m³ or less).

Location	Within AQMA?	Data capture for full calendar year 2010 %	Annual mean concentrations (µg/m ³)								
			2010	2009	2008	2007	2006	2005	2004	2003	2002
Buccleuch St Dumfries	No	99.3%	39.9	35.0	37.3	38.3	37.5	35.9	37.3	37.6	38.0
Eskdalemuir	No	97.5%	3.0	4.3	5.1	5.0	4.3	3.8	n/a	n/a	n/a

Figure 4 Trends in annual mean NO₂ concentrations at automatic monitoring sites at Dumfries and at Eskdalemuir.



The above chart shows that annual mean concentrations at the roadside site at Buccleuch Street, Dumfries have stayed close to but below the annual mean objective, whereas the concentrations at the rural background site at Eskdalemuir are well below the objective.

Table 5 Results of automatic monitoring for nitrogen dioxide - comparison with 1-hour mean objective ($200\mu\text{g}/\text{m}^3$ not to be exceeded more than 18 times).

Location	Within AQMA?	Data capture for full calendar year 2010 %	Number of exceedences of hourly mean								
			2010	2009	2008	2007	2006	2005	2004	2003	2002
Buccleuch St Dumfries	No	99.3%	‡3	0	4	5	0	1	0	2	0
Eskdalemuir	No	97.5%	0	0	0	0	0	0	n/a	n/a	n/a

‡99.8th percentile of hourly NO₂ concentrations for 2010 was $115\mu\text{g}/\text{m}^3$.

2.3.2 NO₂ diffusion tube monitoring data.

All bias-corrected NO₂ results from diffusion tube monitoring meet the annual mean objective of $40\mu\text{g}/\text{m}^3$ or less.

Table 6 Annual mean results of nitrogen dioxide diffusion tubes 2010 to 2005.

Location		Within AQMA?	Data capture for calendar year 2010 %	Annual mean concentrations (microgrammes per cubic metre)					
				2010 (bias corrected x 0.92)	2009 (bias corrected x 0.83)	2008 (bias corrected x 0.93)	2007 (bias corrected x 1.01)	2006 (bias corrected x 0.97)	2005 (bias corrected x 0.968)
M74 Slip Road	Lockerbie	No	92%	37.0	28.2	31.1	34.0	28.4	31.5
***Buccleuch St. (E)	Dumfries	No	100%	39.8	34.2	37.3	38.1	37.5	36.2
††Buccleuch St. (W)	Dumfries	No	96%	35.2	31.3	32.4	35.5	35.2	34.9
Buccleuch St. (S)	Dumfries	No	100%	36.1	32.5	32.2	32.8	35.7	n/a
†††Buccleuch St Bridge	Dumfries	No	94%	34.0	32.3	31.6	30.2	32.2	n/a
Nith Place,	Dumfries	No	100%	35.0	30.8	32.9	n/a	n/a	n/a
Loreburn St.	Dumfries	No	100%	30.8	26.0	28.4	28.2	25.7	27.2
St Michael St.	Dumfries	No	100%	28.5	24.9	24.9	25.7	25.5	25.8
Argyll Drive	Dumfries	No	100%	12.1	11.0	12.2	13.7	11.8	11.7
Charlotte St.	Stranraer	No	67%	21.8	18.7	20.3	20.1	18.4	19.6
Port Rodie Car Park	Stranraer	No	100%	18.2	17.5	15.0	18.0	16.0	18.8
A77 Cairnryan	Stranraer	No	92%	21.6	19.2	20.6	23.4	19.6	18.1

*** Triplicate tubes co-located with AURN automatic monitor

†† Duplicate tubes

††† Triplicate tubes

n/a not applicable i.e. tube not deployed at site in year shown.

Figure 5 Trends in annual mean NO₂ diffusion tube results.

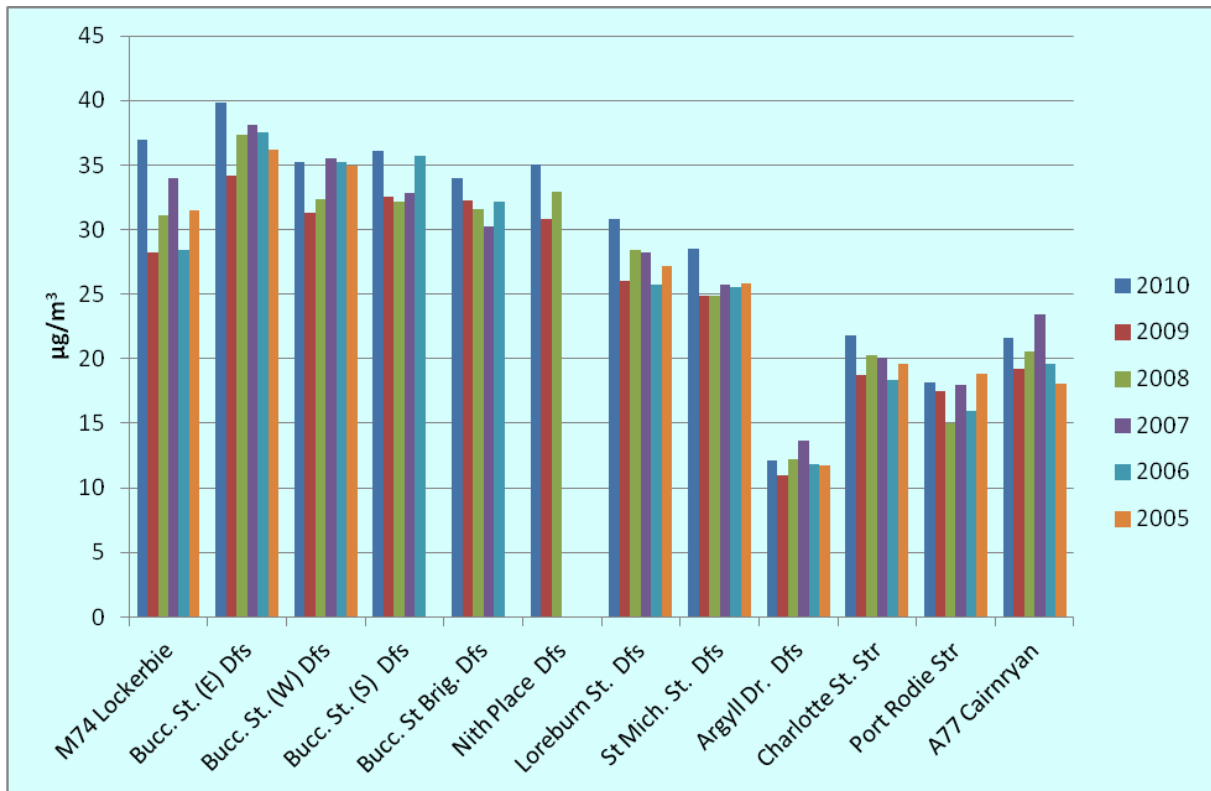


Figure 6 Graphs of diffusion tube results at sites at Buccleuch Street, Dumfries.



Figure 7 Graphs of diffusion tube results at site at M74 Lockerbie and sites at Dumfries (other than Buccleuch Street).

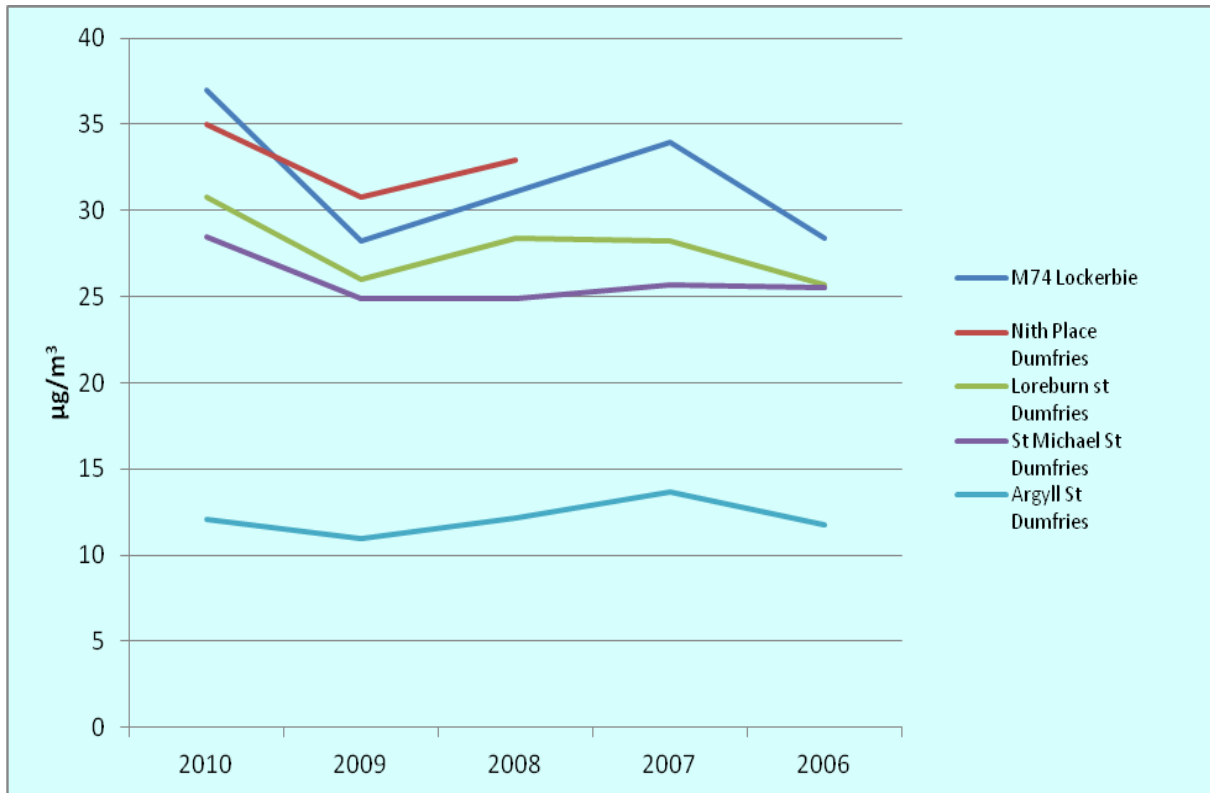
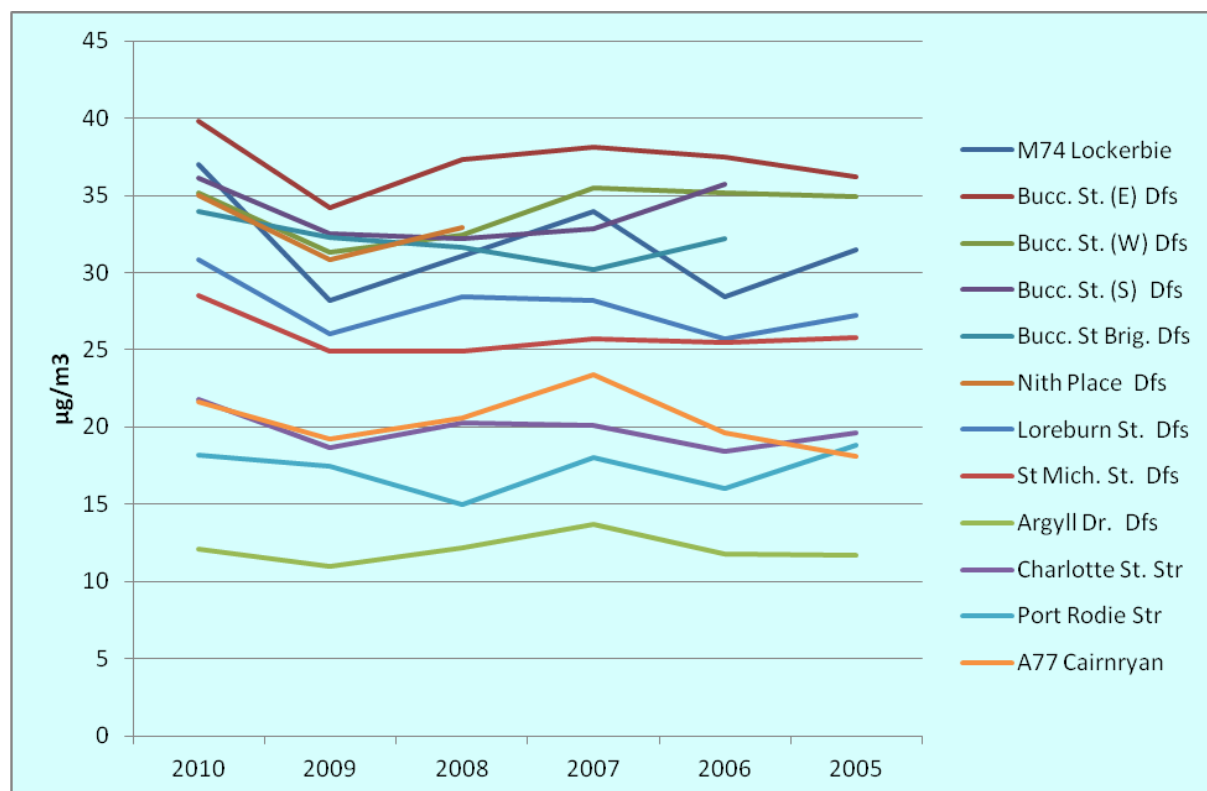


Figure 8 Graphs of diffusion tube results at sites at Stranraer and Cairnryan.



Figure 9 Graphs of diffusion tube results at all sites.



2.3.3 PM₁₀

After being set up and used for several years as part of the AURN, the Partisol PM₁₀ monitor at Buccleuch St., Dumfries was switched off in March 2008 following a Government review of the network. As part of a detailed assessment for PM₁₀ the Partisol (which had been left in situ) was operated by the Council independently from the network from 15/10/08 to 28/04/09 using Emfab instead of quartz filters. The detailed assessment covered Buccleuch Street Dumfries together with 3 road junctions in Dumfries which had been identified in earlier reports as being at risk of exceeding the 2010 PM₁₀ annual mean objective. The three junctions are Brooms Road/Annan Road, Glasgow Street/Galloway Street and Whitesands/Buccleuch Street Dumfries. Exceedences were predicted at all three junctions but as the detailed assessment was largely based on modelling it was decided to supplement the detailed assessment by carrying out additional monitoring, for which purpose a beta-attenuation mass (BAM) PM₁₀ monitor was installed at the Whitesands/Buccleuch Street junction on 10th August 2010 for a period of six months.

Table 7 PM₁₀ monitoring results using BAM monitor at Whitesands/Buccleuch St junction - comparison with the 2010 annual mean objective (18µg/m³ or less).

Location	Within AQMA?	Monitoring Period 11/08/10 to 23/02/11		†Annualised Mean (µg/m ³)	Equivalent Data Capture
		Measured Period Mean (µg/m ³)	Data Capture for Monitoring Period		
Buccleuch St/Whitesands junction, Dumfries (using BAM monitor)	No	15.6	92%	15.75	49.6%

†Details of annualisation are included in report entitled "Supplement to Detailed Assessment for PM₁₀ for Dumfries and Galloway Council" - August 2011.

Table 8 Previous results of PM₁₀ automatic monitoring using a Partisol monitor at Buccleuch St., Dumfries.

Results shown for 2003 to 2007 in Tables 7 & 8 are the corrected results as per Bureau Veritas Report "Analysis of Trends in Gravimetric Particulate Mass Measurements in the United Kingdom January 2009"^{vii}.

Location	Within AQMA?	Measured period mean (µg/m ³)	Projected annual mean (µg/m ³)	Annual mean concentrations (µg/m ³)				
		15/10/08 to 28/04/09	2010	2007	2006	2005	2004	2003
Buccleuch St Dumfries (using Partisol monitor)	No	16.5 (98.5%)	^{††} 14.1	18.3	20.1	18.5	16.2	21.1

^{††}In the detailed assessment carried out in 2009 the period mean was adjusted to an annual figure for 2008 of 15.4 µg/m³ which was projected to an annual mean of 14.1 µg/m³ 2010.

Table 9 PM₁₀ monitoring results using BAM monitor at junction of Whitesands/Buccleuch St., Dumfries - comparison with the 2010 24-hour mean objective (50µg/m³ not to be exceeded more than 7 times).

Location	Within AQMA?	Number of exceedences of the 24-hour mean	
		Measured	*Annualised
		11/08/10 to 23/02/11	2010
Buccleuch St/Whitesands junction, Dumfries (using BAM monitor)	No	0	0

*Details of annualisation are included in report entitled "Supplement to Detailed Assessment for PM₁₀ for Dumfries and Galloway Council" - August 2011.

Table 10 Previous PM₁₀ monitoring results using Partisol monitor - comparison with the 2010 24-hour mean objective.

Location	Within AQMA?	Number of exceedences of the 24-hour mean					
		Estimated	Measured				
		[†] 2010	15/08/08 to 28/04/09	2007	2006	2005	2004
Buccleuch St Dumfries Partisol	No	0	3	9	8	6	4

[†]In the detailed assessment carried out in 2009 the number of exceedences was estimated to be 0 for both 2008 and 2010.

Summary of compliance with air quality objectives.

Results of monitoring for NO₂ and PM₁₀ in the Council-area have been examined and the results for 2010 are found to meet the objectives, therefore there is no need to proceed to a new detailed assessment.

3. New local developments.

- A new port at Old House Point north of Cairnryan is just about to come into operation. This development has previously been assessed and is not considered likely to cause an exceedence of the sulphur dioxide objectives as it does not meet the criteria in the technical guidance^{viii} under which a detailed assessment for sulphur dioxide would be required. However it is intended to carry out a detailed assessment for PM₁₀ at Cairnryan when the new ferry terminal is fully operational due to the predicted increase in traffic through the village.
- a biomass plant has been installed at Kirkcudbright swimming pool.

Planning consent has been granted for:-

- a further extension to the existing surface coal mine at Glenmuckloch, Kirkconnel.

A planning application has been lodged in respect of:-

- a containerised biomass boiler for an office building at Creebridge, Minnigaff, Newton Stewart.

Above developments/application(s) will be taken into consideration in the next updating and screening assessment due in 2012.

4. Conclusions

4.1 Conclusions from new monitoring data.

New NO₂ monitoring data indicate that the objectives for NO₂ are being met therefore there is no requirement for a detailed assessment for NO₂.

Supplementary to a detailed assessment, PM₁₀ monitoring at the junction of Whitesands and Buccleuch Street, Dumfries has shown PM₁₀ levels which meet the objectives therefore no air quality management areas are required.

4.2 Conclusions relating to new local developments

No new requirement to proceed to a detailed assessment for any of the relevant pollutants has been identified as a result of new local developments.

5. Proposed actions

Review of provision for monitoring of PM₁₀ and NO₂.

As mentioned in previous reports it is intended to carry out a detailed assessment for PM₁₀ at Cairnryan when the new ferry terminal is fully operational due to the predicted increase in traffic through the village.

6. References

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<http://archive.defra.gov.uk/environment/quality/air/airquality/strategy/documents/air-qualitystrategy-vol1.pdf>
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Appendix 1 Details of NO₂ co-location study

Table 11 Details of co-location study at Buccleuch St., Dumfries 2010.

Date	Monthly average (continuous monitor)	Ratified/provisional data	Data capture %	Average diffusion Tube	Ratio:- continuous/diffusion tube result
January	52.081	Ratified	99.537	54.000	0.964
February	55.673	Ratified	98.361	63.747	0.873
March	36.235	Ratified	99.851	49.367	0.734
April	38.115	Ratified	99.554	37.003	1.030
May	37.253	Ratified	99.762	38.290	0.973
June	31.516	Ratified	99.702	34.590	0.911
July	22.599	Ratified	96.548	28.553	0.791
August	32.421	Ratified	100	35.090	0.924
September	31.681	Ratified	100	36.367	0.871
October	33.545	Ratified	100	37.500	0.895
November	46.607	Ratified	99.406	46.733	0.997
December	60.342	Ratified	99.167	58.900	1.026
Average	39.839			43.345	

Bias-adjustment factor = continuous mean/diffusion tube mean = 39.839/43.345 = 0.92

Diffusion tube bias = (diffusion tube mean minus continuous mean) divided by continuous mean = (43.345 - 39.839)/39.839 = 0.088 i.e. tubes over-read by approximately 9%.

Table 12 Diffusion tube annual averages 2010.

Location of diffusion tube(s)		A	B	C	D
		Annual average $\mu\text{g}/\text{m}^3$	Annual average bias-corrected with local bias adjustment factor (x 0.92)	Annual average using AEA Energy and Environment spreadsheet	Annual average bias-corrected with national bias adjustment factor (x 0.84)
M74 Slip Road	Lockerbie	40.2	37.0	37	34
***Buccleuch St. (E)	Dumfries	43.3	39.8	40	36
**Buccleuch St. (W)	Dumfries	38.3	35.2	36	32
Buccleuch St. (S)	Dumfries	39.2	36.1	36	33
***Buccleuch St Bridge	Dumfries	37.0	34.0	33	31
Nith Place,	Dumfries	38.0	35.0	35	32
Loreburn St.	Dumfries	33.5	30.8	31	28
St Michael St.	Dumfries	31.0	28.5	28	26
Argyll Drive	Dumfries	13.1	12.1	12	11
Charlotte St.	Stranraer	23.7	21.8	22	20
Port Rodie Car Park	Stranraer	19.8	18.2	18	17
A77 Cairnryan	Stranraer	23.5	21.6	22	20

$(\mu\text{g}/\text{m}^3 = \text{microgrammes per cubic metre})$

***Triplicate tubes co-located with AURN automatic monitor

**Duplicate tubes

***Triplicate tubes

All the locally bias-corrected results in column B of Table 9 are within the objective for the NO₂ annual mean ($\leq 40 \mu\text{g}/\text{m}^3$). Use of the national bias-adjustment factor for Environmental Scientifics of 0.84 would have given significantly lower results as shown in column D but the local factor is preferred.

Table 13 Monthly diffusion tube results for 2010

Site	Monthly diffusion tube results (microgrammes per cubic metre)												Average	Adjusted Average. (x0.92)
	j a n	f e b	m a r	a p r	m a y	j u n	j u l	a u g	s e p	o c t	n o v	d e c		
M74 Slip Road, Lockerbie	44.0	46.5	45.3	39.5	28.0	34.7	V	33.2	34.4	36.2	45.2	55.4	40.2	37.0
***Buccleuch St (East), Dumfries	53.0	58.8	44.9	32.6	36.7	34.4	29.9	34.7	36.5	37.8	47.1	59.7	43.3	39.8
	53.0	67.9	53.7	37.7	38.1	36.2	28.5	36.8	36.5	38.4	47.9	60.6		
	56.0	64.6	49.5	40.7	40.1	33.2	27.3	33.8	36.1	36.3	45.2	56.4		
††Buccleuch St (West), Dumfries	48.0	55.2	39.8	29.0	38.1	33.2	27.3	30.5	34.1	35.1	43.8	53.3	38.3	35.2
	48.0	45.9	44.6	V	34.5	33.8	26.5	30.5	31.0	34.7	43.2	51.1		
Buccleuch St (South), Dumfries	48.0	53.7	58.8	26.9	34.8	29.0	29.0	26.5	33.9	36.9	46.1	47.1	39.2	36.1
†††Buccleuch St Bridge, Dumfries	48.0	54.3	48.6	22.3	29.9	30.5	28.5	21.1	32.6	31.9	39.8	42.7	37.0	34.0
	51.0	51.6	59.7	36.8	30.9	V	22.2	21.7	26.5	33.7	42.0	43.5		
	48.0	80.8	38.9	V	24.6	29.6	28.5	22.9	31.4	34.8	43.4	38.5		
Nith Place, Dumfries	48.0	58.8	41.9	29.9	33.3	26.9	26.1	26.9	31.6	33.8	42.1	57.4	38.0	35.0
Loreburn St Dumfries	46.0	54.9	37.1	26.2	29.7	23.5	20.8	21.4	28.0	28.4	35.5	50.2	33.5	30.8
St Michael St Dumfries	41.0	49.8	37.7	23.8	26.8	17.2	17.6	20.2	24.8	29.0	36.1	47.6	31.0	28.5
Argyll Drive Dumfries	19.0	19.6	16.9	8.7	8.0	5.1	8.9	7.2	9.8	11.4	14.3	28.3	13.1	12.1
Charlotte St Stranraer	31.0	40.2	26.0	17.2	21.1	19.3	18.9	16.1	V	V	V	V	23.7	21.8
Port Rodie Car Park Stranraer	32.0	15.6	21.1	22.5	19.4	15.4	11.4	13.6	15.0	21.0	21.1	30.0	19.8	18.2
A77 Cairnryan Stranraer	22.0	20.5	45.5	V	24.2	21.0	23.7	22.7	19.5	19.8	19.9	19.6	23.5	21.6

***Triplicate tubes (co-located with automatic monitor)

††Duplicate tubes

†††Triplicate tubes

V - Tube(s) vandalised (or otherwise removed or sample tubes contaminated or result[s] rejected).

Appendix 2 Maps of non-automatic monitoring sites.

Figure 10 Map of diffusion tube site at M74 Lockerbie.

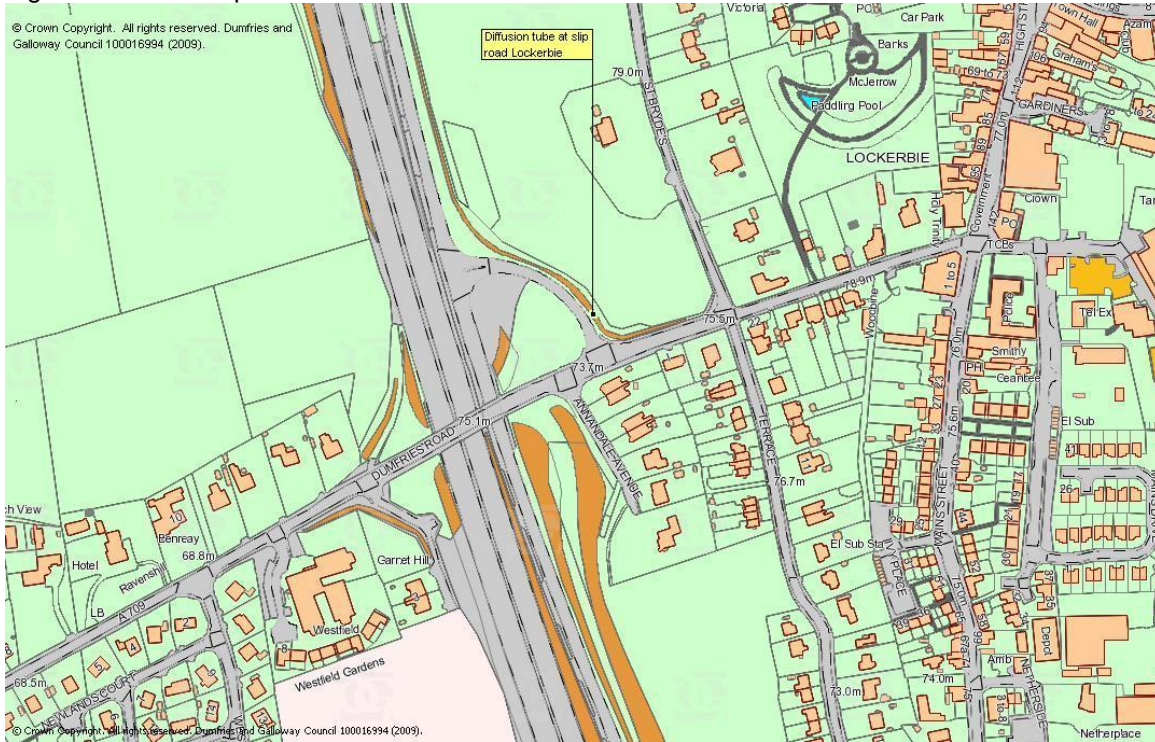
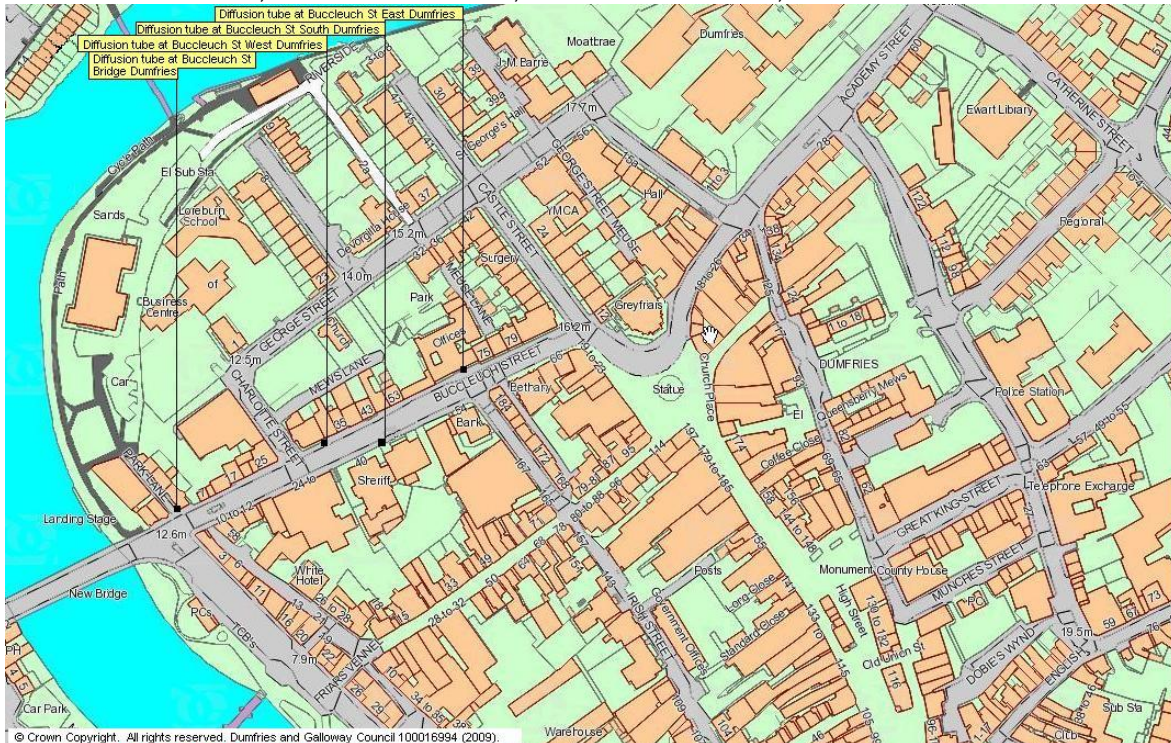


Figure 11 Map of diffusion tube sites at (from left to right) Buccleuch St. Bridge, Buccleuch St. West, Buccleuch St. South, & Buccleuch St. East, Dumfries.



Appendix 2 Maps of non-automatic monitoring sites (continued).

Figure 12 Map of diffusion tube site at Loreburn St., Dumfries.

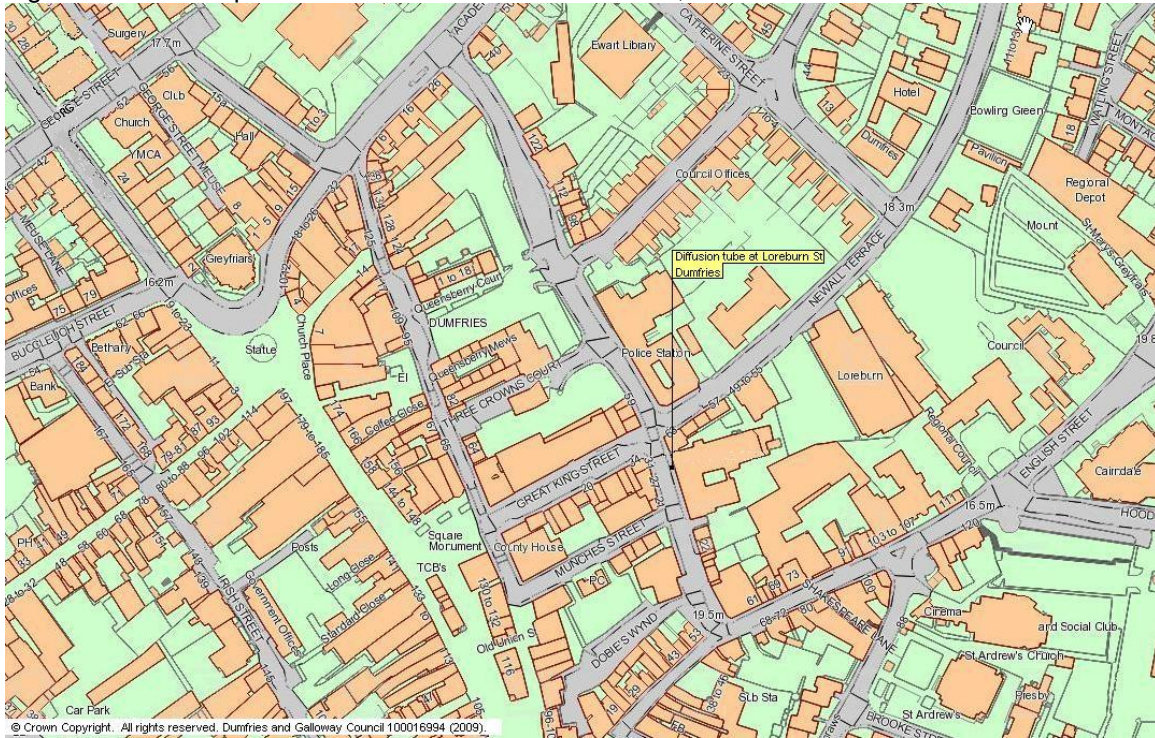
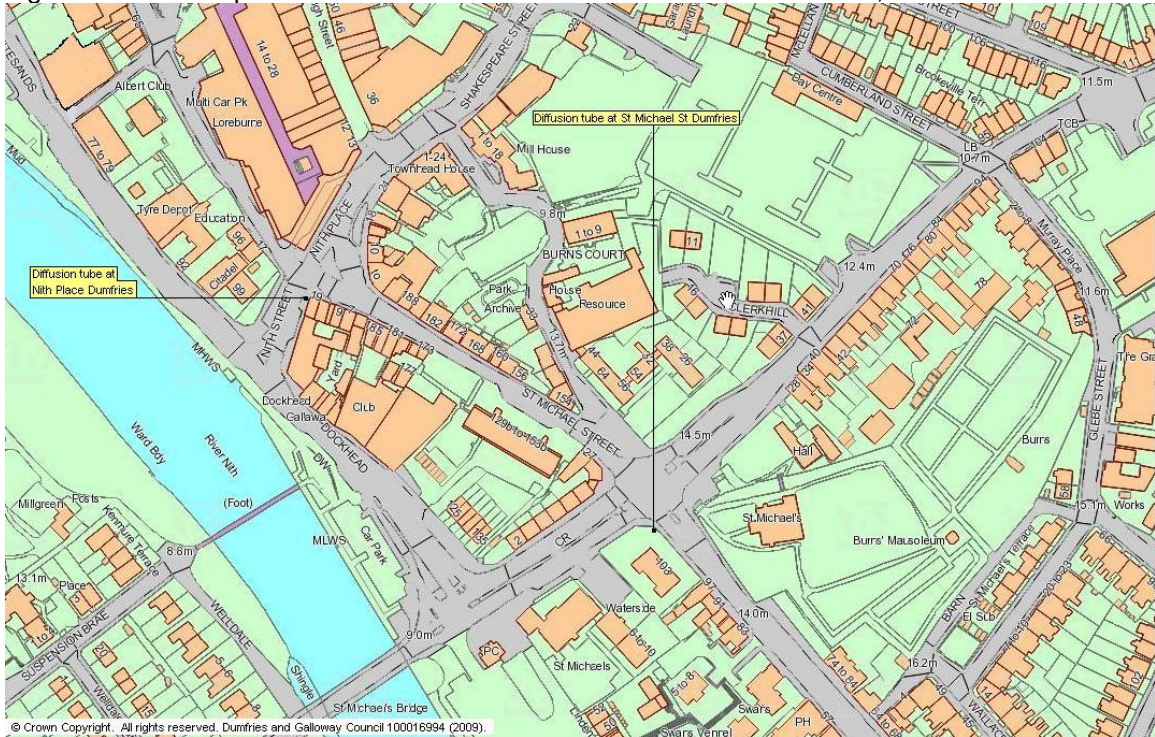


Figure 13 Map of diffusion tube site at Nith Place and St Michael St., Dumfries.

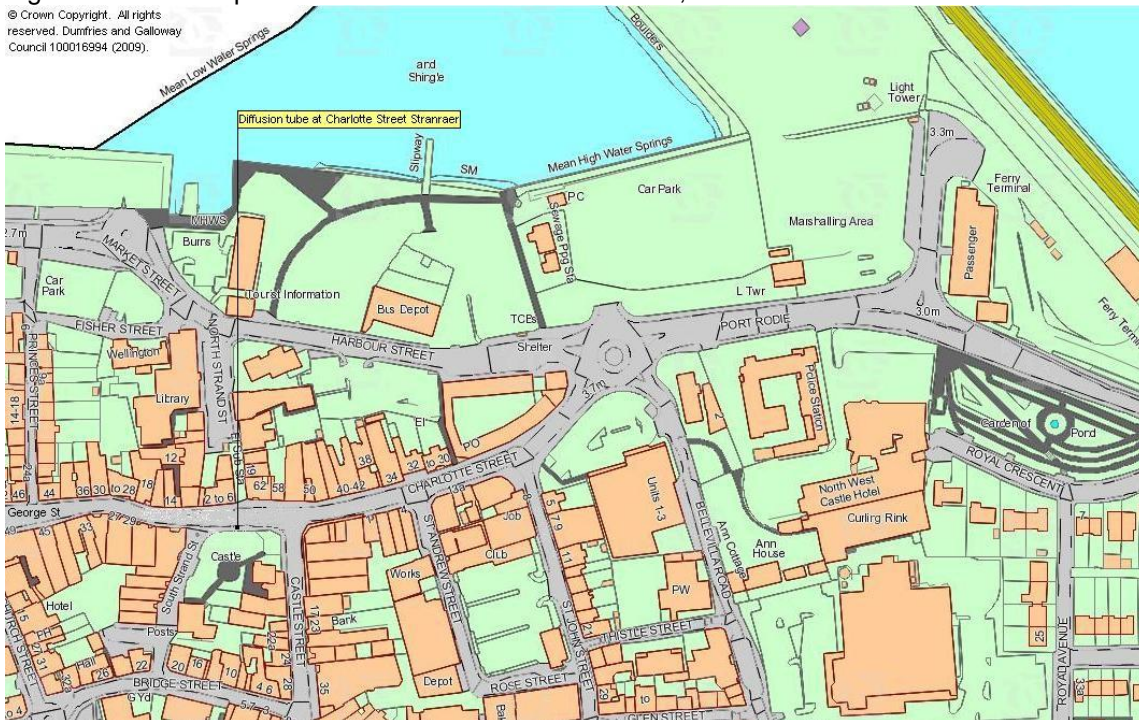


Appendix 2 Maps of non-automatic monitoring sites (continued).

Figure 14 Map of diffusion tube site at Argyll Drive, Heathhall Dumfries.



Figure 15 Map of diffusion tube site at Charlotte St., Stranraer.



Appendix 5 Glossary

AEA Energy and Environment Spreadsheet	An Excel spreadsheet designed to calculate automatically the precision and accuracy of diffusion tubes co-located with an automatic monitor and to adjust non-co-located diffusion tube results with the bias adjustment calculated.
AQMA	air quality management area.
AURN	UK automatic urban and rural (air quality) monitoring network.
BAM PM ₁₀ monitor	beta-attenuation mass particulate monitor in which a small carbon-14 source emits a constant source of high-energy electrons known as beta particles, which are detected by and counted by a sensitive scintillation detector. An external pump pulls a measured amount of particulate-matter-laden air (via a particle-size-selective intake) through a filter tape. Once per hour, after the filter tape has collected some ambient particulate matter, it is automatically placed between the source and the detector thereby causing an attenuation of the beta-particle signal. The degree of attenuation of the beta particles is used to determine the mass concentration of particulate matter in the ambient air.
bias-adjustment factor	a measure of how much the diffusion tube results deviate over a period from the automatic NO ₂ monitor results in a co-location study.
chemiluminescent monitor	a monitor (or analyser) that works on the basis of light emitted by NO ₂ in a chemical reaction inside the monitor.
DEFRA	Department for Environment, Food and Rural Affairs.
Emfab™ filters	PTFE-coated glass-fibre filters.
exposure reduction (approach)	aims to improve air quality everywhere rather than just at local hot-spots of high pollution.
LAQM	local air quality management.
mg/m ³	milligrammes per cubic metre.
NO ₂	nitrogen dioxide.
NO _x	refers to nitrogen dioxide and nitric oxide.
Partisol	a brand name of particulate monitor in which particulate-matter-laden air is pumped (via a particle-size-selective inlet) through pre-weighed filters exposed for 24 hours; automatic filter exchanges take place for 14-15 days before manual re-stocking is required. Filters are re-weighed after exposure to determine the concentration of particulate matter in the ambient air.
percentile	the <i>n</i> th percentile is the level at or below which <i>n</i> % of the results in a ranked list of results fall.
PM ₁₀	mass of particles in the atmosphere with a diameter of less than 10 micrometres.
PM _{2.5}	mass of particles in the atmosphere with a diameter of less than 2.5 micrometres.
SO ₂	sulphur dioxide.
µg/m ³	microgrammes per cubic metre
relevant exposure	where people are likely to be exposed over the averaging period of the objective.
worst-case location	a sampling location where concentrations of the pollutant monitored are expected to be highest, and where the public may be exposed over the relevant averaging period of the objective(s) or a location which is representative of such exposure.
<	less than
>	greater than
≤	less than or equal to
≥	greater than or equal to