



# 2015 Updating and Screening Assessment for **Dundee City Council**

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

**June 2015**

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## Executive Summary

This report is the 2015 Updating and Screening Assessment (USA) of air quality for Dundee City Council. It fulfils the requirements of the Local Air Quality Management (LAQM) process as set out in Part IV of the Environment Act 1995 and the National Air Quality Strategy 2007. The report has been completed in accordance with statutory Technical Guidance (LAQM.TG(09)) produced by DEFRA and the Devolved Administrations.

The objective of an Updating and Screening Assessment is to identify any matters that have changed which may lead to a risk of an air quality objective being exceeded, and whether there is sufficient risk of an exceedence to justify a Detailed Assessment. Regulations prescribe health based air quality objectives for seven pollutants.

The whole of Dundee has been declared an Air Quality Management Area (AQMA) for nitrogen dioxide (NO<sub>2</sub>) (40µg/m<sup>3</sup>) and particulate matter (PM<sub>10</sub>) (18µg/m<sup>3</sup>) annual mean objectives and the one hour mean objective for NO<sub>2</sub> (200µg/m<sup>3</sup>). Having considered and assessed each emission source (as necessary), it is concluded that the air quality objectives for benzene, 1, 3-butadiene, carbon monoxide, lead, and sulphur dioxide (SO<sub>2</sub>) will be met.

The 2014 monitoring data confirm the continuing need for the AQMA and the subsequent Air Quality Action Plan (AQAP). Annual mean concentrations of NO<sub>2</sub> and PM<sub>10</sub> remain above the objective or are 'borderline' in several areas of the city. No exceedences of the hourly mean objective for NO<sub>2</sub> were recorded in 2014. No exceedences of any of the SO<sub>2</sub> objectives were recorded in 2014. Exceedences of the Scottish 24 hour mean PM<sub>10</sub> objective were recorded at two locations using indicative monitors. The need for a Detailed Assessment for this pollutant objective will be kept under review.

The assessment of the various pollutant emission sources, including road traffic, industry, solid fuel combustion etc., has identified several roads, a fugitive emission source and biomass combined combustion sources which require further investigation.

The Dundee City Council USA 2015 concludes that no assessments of monitoring data or emission sources justify the need to proceed to a Detailed Assessment for any pollutant.

Proposed actions arising from the USA 2015 are listed in Section 9.3.

# Table of contents

	GLOSSARY OF ACRONYMS AND DEFINITIONS .....	8
<b>1</b>	<b>Introduction .....</b>	<b>10</b>
1.1	Description of Local Authority Area .....	10
1.2	Purpose of Report.....	10
1.3	Air Quality Objectives .....	11
1.4	Summary of Previous Review and Assessments .....	12
<b>2</b>	<b>New Monitoring Data .....</b>	<b>23</b>
2.1	Summary of Monitoring Undertaken .....	23
2.1.1	Automatic Monitoring Sites .....	23
2.1.2	Non-Automatic Monitoring Sites .....	26
2.2	Comparison of Monitoring Results with Air Quality Objectives .....	34
2.2.1	Nitrogen Dioxide .....	34
2.2.1.1	Automatic Monitoring Data .....	34
2.2.1.2	Diffusion Tube Monitoring Data .....	42
2.2.1.3	Overview of Diffusion Tube NO <sub>2</sub> Concentrations in Areas of Concern .....	51
2.2.1.4	Overview of NO <sub>2</sub> Monitoring Concentrations at Urban Background Locations .....	67
2.2.2	PM <sub>10</sub> .....	69
2.2.3	Sulphur Dioxide.....	84
2.2.4	Summary of Compliance with AQS Objectives .....	86
<b>3</b>	<b>Road Traffic Sources .....</b>	<b>87</b>
3.1	Narrow Congested Streets with Residential Properties Close to the Kerb .....	87
3.2	Busy Streets Where People May Spend 1-hour or More Close to Traffic.....	87
3.3	Roads with a High Flow of Buses and/or HGVs .....	88
3.4	Junctions (including busy roads & junctions in Scotland).....	88
3.5	New Roads Constructed or Proposed Since the Last Round of Review and Assessment.....	91
3.6	Roads with Significantly Changed Traffic Flows.....	92
3.7	Bus and Coach Stations .....	92
<b>4</b>	<b>Other Transport Sources.....</b>	<b>94</b>
4.1	Airports.....	94
4.2	Railways (Diesel and Steam Trains) .....	94
4.2.1	Stationary Trains.....	94
4.2.2	Moving Trains .....	95
4.3	Ports (Shipping) .....	95
<b>5</b>	<b>Industrial Sources.....</b>	<b>96</b>
5.1	Industrial Installations .....	96
5.1.1	New or Proposed Installations for which an Air Quality Assessment has been Carried Out.....	96

5.1.2	Existing Installations where Emissions have Increased Substantially or New Relevant Exposure has been Introduced .....	97
5.1.3	New or Significantly Changed Installations with No Previous Air Quality Assessment.....	97
5.2	Major Fuel (Petrol) Storage Depots .....	98
5.3	Petrol Stations.....	98
5.4	Poultry Farms.....	98
<b>6</b>	<b>Commercial and Domestic Sources .....</b>	<b>99</b>
6.1	Biomass Combustion – Individual Installations .....	99
6.2	Biomass Combustion – Combined Impacts.....	99
6.3	Domestic Solid-Fuel Burning .....	101
<b>7</b>	<b>Fugitive or Uncontrolled Sources.....</b>	<b>102</b>
<b>8</b>	<b>Implementation of Action Plans.....</b>	<b>105</b>
<b>9</b>	<b>Conclusions and Proposed Actions.....</b>	<b>107</b>
9.1	Conclusions from New Monitoring Data .....	107
9.2	Conclusions from Assessment of Sources .....	108
9.3	Proposed Actions.....	108
<b>10</b>	<b>References.....</b>	<b>110</b>

## List of Tables

Table 1.1	Air Quality Objectives included in Regulations for the purpose of LAQM in Scotland	11
Table 1.2	Summaries of Review and Assessment Reports	12
Table 2.1	Details of Automatic Monitoring Sites	24
Table 2.2	Description of Automatic Monitoring Sites	25
Table 2.3	New Diffusion Tube Locations 2014	26
Table 2.4	Discontinued Diffusion Tube Locations 2014	26
Table 2.5	Details of Non-Automatic Monitoring Sites	29
Table 2.6	Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with Annual Mean and Hourly Mean Objectives	34
Table 2.7	Summary of Annual Mean Nitrogen Dioxide trends measured at long-term Automatic Monitoring Sites	35
Table 2.8	Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with 1-Hour Mean Objective	38
Table 2.9	Summary of 1-hour mean 99.8 <sup>th</sup> Percentile Nitrogen Dioxide trends measured at long-term Automatic Monitoring Sites	39
Table 2.10	Results of Nitrogen Dioxide Diffusion Tubes in 2014	43
Table 2.11	Predicted Exceedences of NO <sub>2</sub> Annual Mean at Façade of Receptors	49
Table 2.12	Locations at risk of Exceeding NO <sub>2</sub> Annual Mean at Façade of Receptors	50
Table 2.13	Comparison of Measured Background NO <sub>2</sub> Results for 2014 with Scottish Government Background Map Data (Released June 2014)	67
Table 2.14	Results of Automatic Monitoring for PM <sub>10</sub> : Comparison with Annual Mean Objective	70
Table 2.15	Results of Automatic Monitoring for PM <sub>10</sub> : Comparison with NAQS 24-hour Mean Objective	73
Table 2.16	Summary of Annual Mean PM <sub>10</sub> trends measured at long-term Automatic Monitoring Sites	76
Table 2.17	Comparison of Measured Background PM <sub>10</sub> Results for 2014 with Scottish Government Background Map Data.	77
Table 2.18	Summary of 98.08 <sup>th</sup> Percentile PM <sub>10</sub> trends measured at long-term Automatic Monitoring Sites	77
Table 2.19	Comparison of Eighteen 24hr Mean Exceedence 'Events' in Dundee with Wind Speed and Direction and Urban Background Sites	79
Table 2.20	Results of SO <sub>2</sub> Automatic Monitoring at Broughty Ferry Road: Comparison with Objectives	84
Table 3.1	New Locations requiring assessment identified from screening of road traffic data	89
Table A.1	Bias Factors from 2014 Co-location Studies and National Bias Adjustment Spreadsheet (Version 06/14)	112
Table A.2	Manual Approximate Orthogonal Regression Calculation 2014	113
Table F1	DCC Automatic Traffic Count Sites	147
Table F2	Comparison of 2014 DCC Traffic Count Data with Previous Assessments	150

## List of Figures

Figure 2.1	Map of Automatic Monitoring Sites	23
Figure 2.2a	Map of NO <sub>2</sub> Diffusion Tubes in the City Centre	27
Figure 2.2b	Map of NO <sub>2</sub> Diffusion Tubes to the East of the City	27
Figure 2.2c	Map of NO <sub>2</sub> Diffusion Tubes to the West of the City	28
Figure 2.3	Annual Mean Nitrogen Dioxide Concentrations at Real-time Monitors from 2006 to 2014	36
Figure 2.4	Trends in Annual Mean Nitrogen Dioxide Concentrations at Automatic Monitors from 2006 to 2014	37
Figure 2.5	Number of Exceedences of the NO <sub>2</sub> Hourly Mean Standard (200µg/m <sup>3</sup> ) (18 Allowed) at Real Time Monitoring Locations in Dundee between 2006 and 2014	39
Figure 2.6	Overview of 99.8th Percentile values of NO <sub>2</sub> Hourly Mean compared with the short-term standard (200µg/m <sup>3</sup> ), 2006-2014	40
Figure 2.7	Trends in 1-hr Mean 99.8 <sup>th</sup> Percentile Concentrations at Automatic Monitors from 2006 to 2014	41
Figure 2.8	Change in NO <sub>2</sub> concentrations at 47 Diffusion tube monitoring locations between 2006 and 2014	52
Figure 2.9	NO <sub>2</sub> Monitoring Locations in Union Street and Whitehall Street	53
Figure 2.10	Overview of NO <sub>2</sub> Concentrations in Union St and Nethergate (east of Marketgait).	53
Figure 2.11	Overview of NO <sub>2</sub> Concentrations in Whitehall St and Crichton St.	54
Figure 2.12	NO <sub>2</sub> Monitoring Locations in Seagate	55
Figure 2.13	Overview of NO <sub>2</sub> Concentrations in Seagate.	55
Figure 2.14	NO <sub>2</sub> Diffusion Tube Locations in Nethergate	56
Figure 2.15	Overview of NO <sub>2</sub> Diffusion Tube Concentrations in Nethergate.	56
Figure 2.16	NO <sub>2</sub> Diffusion Tube Locations in Victoria Road / Meadowside	57
Figure 2.17	Overview of NO <sub>2</sub> Diffusion Tube Concentrations in Victoria Road / Meadowside.	57
Figure 2.18	NO <sub>2</sub> Diffusion Tube Locations in Albert Street / Dura Street	58
Figure 2.19	Overview of NO <sub>2</sub> Diffusion Tube Concentrations in Albert Street / Dura Street.	58
Figure 2.20	NO <sub>2</sub> Monitoring Locations in Lochee Road	59
Figure 2.21	Overview of NO <sub>2</sub> Concentrations in Lochee Road	59
Figure 2.22	NO <sub>2</sub> Diffusion Tube Locations in Logie Street	60
Figure 2.23	Overview of NO <sub>2</sub> Diffusion Tube Concentrations in Logie St.	60
Figure 2.24	NO <sub>2</sub> Diffusion Tube Locations in Albert St. / Arbroath Road	61
Figure 2.25	Overview of NO <sub>2</sub> Diffusion Tube Concentrations in Albert St. / Arbroath Road	61
Figure 2.26	NO <sub>2</sub> Diffusion Tube Locations on/near the Kingsway	62
Figure 2.27	Overview of NO <sub>2</sub> Diffusion Tube Concentrations on/near the Kingsway	62
Figure 2.28	NO <sub>2</sub> Diffusion Tube Locations on Bus Corridor	63
Figure 2.29	Overview of NO <sub>2</sub> Diffusion Tube Concentrations on Bus Corridor	63
Figure 2.30	NO <sub>2</sub> Diffusion Tube Locations on Inner Ring Road	64
Figure 2.31	Overview of NO <sub>2</sub> Diffusion Tube Concentrations on Inner Ring Road	64
Figure 2.32	NO <sub>2</sub> Diffusion Tube Location at Stannergate Roundabout	65
Figure 2.33	Overview of NO <sub>2</sub> Diffusion Tube Concentration at Stannergate Roundabout	65
Figure 2.34	NO <sub>2</sub> Diffusion Tube Location at Strathmore Avenue	66
Figure 2.35	Overview of NO <sub>2</sub> Diffusion Tube Concentration at Strathmore Avenue	66
Figure 2.36	Urban Background NO <sub>2</sub> Monitoring Locations	68
Figure 2.37	Overview of NO <sub>2</sub> Concentrations at Urban Background Locations	68
Figure 2.38	Overview of Annual Mean PM <sub>10</sub> Concentrations 2008 -2014 (Gravimetric equivalent data)	71
Figure 2.39	Trends in Annual Mean PM <sub>10</sub> Concentrations 2008 - 2014 at Long-Term Monitoring Sites (gravimetric equivalent data)	72
Figure 2.40	Frequency of Exceedences of PM <sub>10</sub> 24hour Mean Objective 2010 (50µg/m <sup>3</sup> , 7 allowed) 2008-2014	74
Figure 2.41	Trends in Scottish PM <sub>10</sub> 24-hour Mean Objective 2010 – 98.08 <sup>th</sup> Percentile of Daily Means (cf.50µg/m <sup>3</sup> ) 2008-2014	75
Figure 2.42	Comparison of Dundee PM <sub>10</sub> Monitoring Sites and Urban Background Locations from 16/01/2014 to 06/02/2014 (Events 1& 2)	80
Figure 2.43	Comparison of Dundee PM <sub>10</sub> Monitoring Sites and Urban Background Locations from 07/03/2014 to 20/03/2014 (Event 3& 4)	80
Figure 2.44	Comparison of Dundee PM <sub>10</sub> Monitoring Sites and Urban Background Locations from 23/03/2014 to 06/04/2014 (Events 5& 6)	81
Figure 2.45	Comparison of Dundee PM <sub>10</sub> Monitoring Sites and Urban Background Locations from 14/04/2014 to 30/04/2014 (Events 7& 8)	81
Figure 2.46	Comparison of Dundee PM <sub>10</sub> Monitoring Sites and Urban Background Locations from 17/05/2014 and 31/05/2014 (Events 9& 10)	82
Figure 2.47	Comparison of Dundee PM <sub>10</sub> Monitoring Sites and Urban Background Locations from 18/07/2014 and 01/08/2014 (Events 11& 12)	82
Figure 2.48	Comparison of Dundee PM <sub>10</sub> Monitoring Sites and Urban Background Locations from 10/09/2014 to 19/09/2014 (Events 13& 14)	83
Figure 2.49	Comparison of Dundee PM <sub>10</sub> Monitoring Sites and Urban Background Locations from 13/11/2014 to 30/11/2014 (Events 15& 17)	83

Figure 2.50	Overview of Maximum (15min) SO <sub>2</sub> Concentrations and Relevant Percentiles from 2002 to 2014	85
Figure 6.1	2011 Census Output Areas Containing Solid Fuel Central Heating Systems	100
Figure 6.2	2011 Census Output Areas Containing Properties with No Central Heating	100
Figure 7.1	Background PM <sub>10</sub> Concentrations for 2014	103
Figure F.1	Dundee City Council Automatic Traffic Count Locations	149

### Appendices

Appendix A:	QA:QC Data	112
Appendix B:	VCM Methodology	117
Appendix C:	Pollution Reports	121
Appendix D:	Bias Calculations for Diffusion Tube Co-location Studies	135
Appendix E:	List of Industrial Processes	140
Appendix F :	Road Traffic Data	147
Appendix G :	Monthly Diffusion Tube Concentrations	153
Appendix H:	DMRB Calculations	157
Appendix I:	Trends in NO <sub>2</sub> Concentrations at PDT Sites with 5 or more year's data	160
Appendix J:	Action Plan Progress Report	162



## GLOSSARY OF ACRONYMS AND DEFINITIONS

AADT	Annual Average Daily Traffic Flow
ADMS	An atmospheric air pollution dispersion model
AEA	AEA Energy & Environment
annualise	the means of estimating an annual mean from a shorter study period mean by comparison with full datasets from background AURN sites
AQ Archive	UK Air Quality Archive
AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
ATC	Automatic Traffic Count
AURN	Automatic Urban and Rural Network (Defra funded air quality monitoring network)
Borderline	A concentration that is a potential exceedence (e.g. sites above $36\mu\text{g}/\text{m}^3$ for $\text{NO}_2$ or $16.2\mu\text{g}/\text{m}^3$ for $\text{PM}_{10}$ annual mean)
CHP	Combined Heat and Power
CO	Carbon Monoxide
DCC	Dundee City Council
Defra	Department for Environment, Food and Rural Affairs
DERL	Dundee Energy Recycling Ltd
DMRB	Design Manual for Roads and Bridges
EC	European Community
EHTS	Environmental Health and Trading Standards Department
EPA	The Environmental Protection Act 1990
EPAQS	Expert Panel on Air Quality Standards
EU	European Union
GF	Ground floor
GIS	Geographical Information System
HDV	Heavy goods vehicles and buses
HFO	Heavy Fuel Oil
HGV	Heavy Goods Vehicle
HSL	Health & Safety Laboratory
IPC	Integrated Pollution Control
kerbside	0 to 1 metre from the kerb
LAQM.TG(03)	Local Air Quality Management: Technical Guidance (2003)
LAQM.TG(09)	Local Air Quality Management: Technical Guidance (2009)
LDP	Local Development Plan
LEZ	Low Emission Zone
Limit Value	An EU definition for a mandatory air quality standard of a pollutant listed in the air quality directives
MW	Mega Watts
mg/kg	Milligrams per Kilogram
$\text{mg}/\text{m}^3$	Milligrams per cubic metre
NAEI	National Atmospheric Emission Inventory
NAQS	National Air Quality Standard
NO	Nitric Oxide
$\text{NO}_2$	Nitrogen Dioxide
$\text{NO}_x$	Oxides of nitrogen
$\text{ng}/\text{m}^3$	Nanograms per cubic metre
NPL	National Physical Laboratory
NRS	National Registers of Scotland
NRTF	National Road Traffic Forecast
Osiris	the brand name given by Turnkey Instruments Ltd. to their particle

	measuring nephelometer
PDT	Passive Diffusion Tube
P&T	Planning and Transportation
PM <sub>2.5</sub>	Particulate Matter less than 2.5µm aerodynamic diameter
PM <sub>10</sub>	Particulate Matter less than 10µm aerodynamic diameter
Pb	Lead
percentile	The percentage of results below a given value
ppb	Parts per billion
ppm	Parts per million
receptor	In this study, the relevant location where air quality is assessed or predicted (for example, houses, hospitals and schools)
roadside	1 to 5 m from the kerb
SCA	Smoke Control Area
SED	Solvent Emissions Directive
SEPA	Scottish Environment Protection Agency
SO <sub>2</sub>	Sulphur Dioxide
SPG	Supplementary Planning Guidance
Street Canyon	A relatively narrow street with buildings on both sides, where the height of the buildings is generally greater than the width of the road
SULP	Sustainable Urban Logistics Plan
TEA	Triethanolamine
TEOM	Tapered Element Oscillating Microbalance
UKAS	United Kingdom Accreditation Service
USA	Updating and Screening Assessment
µg/m <sup>3</sup>	Micrograms per cubic metre
VCM	Volatile Correction Method
VOC	Volatile Organic Compound
vpd	Vehicles per day
WASP	Workplace Analysis Scheme for Proficiency

# 1 Introduction

## 1.1 Description of Local Authority Area

Dundee City is located on the north bank of the river Tay in the Tay valley. The Dundee City Council area covers approx. 63 square kilometres (24 square miles) and is geographically the smallest local authority area in Scotland. It is bordered by Perth and Kinross Council to the west and by Angus Council to the north and east. The former Tayside Regional Council area previously covered all three councils and Dundee continues to serve as the regional centre for this area and north-east Fife, with an estimated catchment population of some 400,000 people.

Dundee is the fourth largest city in Scotland with an estimated population of 148,170 (National Registers of Scotland (NRS) 2013 mid-year estimate). This equates to a population density of 2352 people per square kilometre.

Dundee is served by an airport which has daily flights to London. Dundee also has a modern deep-water port and large harbour area. The port area has been a major industrial and commercial source of employment and wealth creation for Dundee and the Central Waterfront project is one of the key priorities in terms of re-connecting the city and its people with the river.

The City is almost entirely urban and suburban in character and is a hub for many routes. It is connected to Fife by the Tay road and rail bridges. The A92 crosses the Tay and emerges in the centre of Dundee. There is an inner ring road, the Marketgait (A991), and five arterial routes - Broughty Ferry Road (A930), Arbroath Road (A92), Riverside Drive (A85), Lochee Road (A923) and Forfar Road (A929). There is an outer-ring road, the Kingsway, which consists of the A90(T), the main route from Edinburgh/Perth to Aberdeen, and the A972(T), the route to Arbroath. There are a significant number of busy road junctions across the City. A large proportion of roads in the City have a gradient due to a central topographical feature, The Law, the plug of an extinct volcano (height 174 metres above sea level). The main sources of pollution in the area are from the road traffic emissions from these routes, with additional emissions from industrial sources, most of which are located around the periphery of the city and in the port area.

In common with many Scottish cities the architecture consists of a significant number of 4 or 5-storey tenemental properties creating numerous street canyons. In the commercial centres, a common feature of these tenemental properties is that commercial premises are located on the ground floor with residential premises on the floors above. The main shopping area in the city is pedestrianised.

## 1.2 Purpose of Report

This report fulfils the requirements of the Local Air Quality Management process as set out in Part IV of the Environment Act (1995), 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 exceedences 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.

The objective of this Updating and Screening Assessment is to identify any matters that have changed which may lead to risk of an air quality objective being exceeded. A checklist approach and screening tools are used to identify significant new sources or changes and whether there is a need for a Detailed Assessment. The USA report should provide an update of any outstanding information requested previously in Review and Assessment reports.

### 1.3 Air Quality Objectives

The air quality objectives applicable to LAQM in Scotland are set out in the Air Quality (Scotland) Regulations 2000 (Scottish SI 2000 No 97), the Air Quality (Scotland) Amendment Regulations 2002 (Scottish SI 2002 No 297), and are shown in **Table 1.1**. This table shows the objectives in units of microgrammes per cubic metre  $\mu\text{g}/\text{m}^3$  (milligrammes per cubic metre,  $\text{mg}/\text{m}^3$  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 Scotland**

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2003
	3.25 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2003
Carbon monoxide	10.0 $\text{mg}/\text{m}^3$	Running 8-hour mean	31.12.2003
Lead	0.5 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2004
	0.25 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2008
Nitrogen dioxide	200 $\mu\text{g}/\text{m}^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2005
Particles (PM <sub>10</sub> ) (gravimetric)	50 $\mu\text{g}/\text{m}^3$ , not to be exceeded more than 7 times a year	24-hour mean	31.12.2010
	18 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2010
Sulphur dioxide	350 $\mu\text{g}/\text{m}^3$ , not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 $\mu\text{g}/\text{m}^3$ , not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 $\mu\text{g}/\text{m}^3$ , not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

## 1.4 Summary of Previous Review and Assessments

As established by the Environment Act 1995 Part IV, all local authorities in the UK are under a statutory duty to undertake an air quality assessment within their area and determine whether they are likely to meet the air quality objectives for a number of pollutants. The process of review and assessment of air quality undertaken by local authorities is set out under the Local Air Quality Management (LAQM) regime and involves a phased three yearly assessment of local air quality. Where the results of the review and assessment process highlight that problems in the attainment of health-based objectives for air quality will arise, the authority is required to declare an Air Quality Management Area (AQMA) – a geographic area defined by high levels of pollution and exceedences of health-based standards.

The LAQM regime was first set down in the 1997 National Air Quality Strategy (NAQS) and introduced the idea of local authority 'Review and Assessment'. The Government and Devolved Administrations subsequently published policy and technical guidance related to the review and assessment processes in 1998. This guidance has since been reviewed and the latest documents include Policy Guidance (LAQM.PGS (09)) and Technical Guidance (LAQM.TG (09)). The guidance lays down a progressive, but continuous, framework for the local authorities to carry out their statutory duties to monitor, assess and review air quality in their area and produce action plans to work towards achieving the air quality objectives.

A summary of the conclusions of previous rounds of review and assessment are presented in **Table 1.2** below. A map of the boundary of the Air Quality Management Area for nitrogen dioxide (NO<sub>2</sub>) and particulate matter (PM<sub>10</sub>) is shown in **Figure 1.1** below.

**Table 1.2 Summaries of Review and Assessment Reports**

REVIEW & ASSESSMENT REPORTS	BRIEF SUMMARY of OUTCOMES
Stage 1 (1998)	The principle conclusion of Dundee City Council's Stage 1 report was that it was necessary to proceed to the next stage of assessment for all seven of the key LAQM pollutants ( nitrogen dioxide (NO <sub>2</sub> ), particulate matter (PM <sub>10</sub> ), lead, carbon monoxide (CO), benzene, 1,3-butadiene and sulphur dioxide(SO <sub>2</sub> ) ). The chief reasons for this conclusion were a lack of available information relating to potentially significant traffic and industrial pollution sources within the city.
Stage 2 (2000)	Additional monitoring was carried out and additional information was obtained concerning industrial and traffic sources. Screening assessments incorporating this new information were carried out in accordance with national guidance and concluded that the National Air Quality Standards and Objectives (NAQS) would be achieved in Dundee.

REVIEW & ASSESSMENT REPORTS	BRIEF SUMMARY of OUTCOMES
Updating and Screening Assessment (2003)	<p>The imposition of stricter pollutant thresholds, changes in the technical guidance and methodologies for assessment led to an investigation of new areas. This review concluded that the NAQS for carbon monoxide, benzene, 1,3-butadiene and lead would be achieved. It was also concluded that a detailed assessment would be required as a result of potential exceedences of the NAQS for NO<sub>2</sub> and PM<sub>10</sub> at busy roads and junctions and to investigate the likelihood of exceedences of the NAQS for sulphur dioxide at new residential premises introduced close to an industrial source.</p>
Detailed Assessment (2005)	<p>The detailed assessment of NO<sub>2</sub> and PM<sub>10</sub> from traffic sources identified exceedences of the NAQS annual mean standard for NO<sub>2</sub> at relevant receptors in the city centre and along the north-west arterial route.</p> <ul style="list-style-type: none"> <li>• <b>NO<sub>2</sub></b> - the detailed assessment established the need for Dundee City Council to declare an Air Quality Management Area (AQMA), carry out a further assessment of NO<sub>2</sub> and develop an Action Plan to try and reduce pollution levels in exceedence areas.</li> <li>• <b>PM<sub>10</sub></b> -there was insufficient confidence in the modelled results for 2010 and it was concluded that additional monitoring and modelling would be required to determine whether an AQMA was also required for PM<sub>10</sub>.</li> <li>• <b>SO<sub>2</sub></b> -the detailed assessment concluded that the NAQS would be achieved at new residential developments introduced close to an industrial source and that an AQMA was not required for this pollutant.</li> </ul>
Progress Report (2005)	<p>2004 monitoring data and new local developments with the potential to affect air quality were assessed in accordance with statutory guidance and the conclusions reached were:</p> <ul style="list-style-type: none"> <li>• <b>Benzene</b> - no AQMA required for Benzene, as a result monitoring was discontinued.</li> <li>• <b>NO<sub>2</sub></b> - identified additional areas of exceedence of the NO<sub>2</sub> annual mean at relevant receptors on the north-west arterial route. 22 exceedences of the hourly mean NAQS for NO<sub>2</sub> were recorded at the Lochee Road monitoring site. 18 of the 22 occurred during water main rehabilitation works which caused traffic congestion in the vicinity of the monitor. The results were not thought to be representative of the ambient conditions in the area and no AQMA was considered necessary at that time.</li> <li>• <b>PM<sub>10</sub></b> - the results for 2004 indicated that the 2004 and 2010 NAQS for PM<sub>10</sub> would be achieved at the Broughty Ferry Road and background monitoring sites. Exceedences of the 2010 annual mean and daily mean NAQS were recorded at the Union Street monitoring location. These were investigated and it was considered that low data capture, local demolition works and the temporary re-routing of buses along Union St during the construction of a bus-interchange in Whitehall St has contributed to these exceedences and the monitored concentrations did not represent the normal ambient concentrations.</li> <li>• <b>SO<sub>2</sub></b> - monitoring indicated that no AQMA was required.</li> </ul>

REVIEW & ASSESSMENT REPORTS	BRIEF SUMMARY of OUTCOMES
Updating and Screening Assessment (2006)	<p>The Updating and Screening Assessment (USA) 2006 marked the beginning of the third round of review and assessment and required the re-examination all of the seven LAQM pollutants. 2005 data and any significant changes in pollutant sources and public exposure to pollutants were examined in accordance with statutory guidance. The conclusions reached were:</p> <ul style="list-style-type: none"> <li>• that the NAQS for CO, benzene, 1,3-butadiene, lead and SO<sub>2</sub> would be achieved and hence no detailed assessment would be needed.</li> <li>• <b>NO<sub>2</sub></b> - the report confirmed the need for the AQMA for NO<sub>2</sub> (which was declared for the whole city in July 2006) and identified an additional exceedence area in the city centre, one of the main bus corridors (Meadowside).</li> <li>• <b>PM<sub>10</sub></b> - the report concluded that the only monitored PM<sub>10</sub> concentrations predicted to breach the annual mean NAQS for 2010 was the monitoring location in Union Street this was investigated and it was determined that major construction projects in the vicinity might have had an influence on the levels recorded and these may not be truly represent ambient concentrations at this location.</li> </ul>
Progress Report (2007)	<p>2006 monitoring data and new local developments with the potential to affect air quality were assessed in accordance with statutory guidance and the conclusions reached were:</p> <ul style="list-style-type: none"> <li>• <b>NO<sub>2</sub></b> - analysis of the 2006 data re-confirmed the need for the AQMA and the development of an Action Plan. Two new areas of potential exceedence of the annual mean NAQS were identified on the north-east arterial route. (Kingsway/Forfar Road and Albert Street/Arbroath Road).</li> <li>• <b>PM<sub>10</sub></b> - Dundee City Council operate a local Partisol/TEOM co-location study which allows a local gravimetric correction factor to be calculated. This was used to correct TEOM and Osiris data in the monitoring network. Using this factor, exceedences of the 2010 PM<sub>10</sub> NAQS were predicted at the following monitoring locations in the city centre and the north-west arterial route: <ul style="list-style-type: none"> <li>• Victoria Road / Hilltown Junction, Seagate, Logie Street, and Lochee Road.</li> <li>• The Union Street site was also very close to exceeding the annual mean for 2010 and remains an area of concern due to increasing PM<sub>10</sub> at this city centre location. There were also potential exceedences of the daily mean NAQS predicted at the Osiris monitoring locations. The 2006 PM<sub>10</sub> monitoring results indicated that a detailed assessment would be required for PM<sub>10</sub>.</li> </ul> </li> <li>• <b>SO<sub>2</sub></b> - the monitoring results for 2006 indicate that all NAQS objectives were met at the monitoring locations in Dundee. Exceedences of the 15min mean NAQS occurred at the Broughty Ferry Road site; these were well below the 35 exceedences allowed and were thought to have been caused by certain shipping movements and activities. A detailed assessment of this pollutant was not required, but monitoring data would be kept under review.</li> </ul>

REVIEW & ASSESSMENT REPORTS	BRIEF SUMMARY of OUTCOMES
<p>Further Assessment of Nitrogen Dioxide and Detailed Assessment of Particulate Matter PM<sub>10</sub> (2009 )(FA/DA)</p>	<p>The FA/DA combined the detailed assessment of PM<sub>10</sub> with a further assessment of both NO<sub>2</sub> and PM<sub>10</sub>. It examined the 2007 monitoring data and established the main sources of pollution in the exceedence areas and the reduction in pollutant levels necessary to meet the NAQS. The report confirmed the need for the existing AQMA for NO<sub>2</sub> and concluded that an AQMA should be declared for PM<sub>10</sub>. The report also estimated that 4,600 people were living in areas at risk of exceeding the NAQS for NO<sub>2</sub> and PM<sub>10</sub> and concluded that significant reductions in pollutant concentrations are required to meet the annual mean NAQS for both pollutants. The results of the source apportionment exercise are summarised below:</p> <ul style="list-style-type: none"> <li>• <b>Source apportionment of NOx</b>, indicates road traffic emissions of NOx are the main contribution to total NOx concentrations, as they account for 74 - 91% of the total NOx concentrations at receptors. Heavy-duty vehicles (HDVs) contribute around 38 - 77% to the total NOx concentrations at receptors and exceed the LDV contributions. HDV contributions are disproportionately high given their proportion within the vehicle fleet in the AQMA.</li> <li>• <b>Source apportionment of PM<sub>10</sub></b>, indicates background sources of PM<sub>10</sub> (e.g. sea salt) make a significant contribution to total PM<sub>10</sub> concentrations, as they account for 28-59% of the total PM<sub>10</sub> concentrations at receptors, with the majority of this being made up of secondary particulates, residual and salt contributions. Road traffic contributes 41% to 72% of the total PM<sub>10</sub> concentration at receptors. Light duty vehicles (LDVs) contribute around 7 – 24 and heavy-duty vehicles (HDVs) contribute around 11-36% to the total PM<sub>10</sub> concentrations at receptors. Brake and tyre wear contribute around 13-29% to the total PM<sub>10</sub> concentrations at receptors. HDV contributions are disproportionately high given their proportion within the vehicle fleet in the AQMA. On Commercial Street and Seagate, where there are significant bus movements, the HDV contribution exceeds the LDV contribution.</li> </ul> <p>(HDV - is a collective term for heavy goods vehicles (HGV) and buses)</p>
<p>Updating and Screening Assessment 2009 (2010)</p>	<p>The Updating and Screening Assessment (USA) 2009 marked the beginning of the fourth round of review and assessment and required the re-examination of all the seven LAQM pollutants. This was carried out in accordance with revised statutory guidance and examined 2008 data and any significant changes in pollutant sources and public exposure to pollutants. The conclusions reached were:</p> <ul style="list-style-type: none"> <li>• that the NAQS for CO, benzene, 1,3-butadiene, lead and SO<sub>2</sub> would be achieved and hence no detailed assessment would be needed.</li> </ul> <p><b>NO<sub>2</sub></b> - the report re-confirmed the need for the AQMA for NO<sub>2</sub> (which was declared for the whole city in July 2006) and identified an additional potential annual mean exceedence area in Strathmore Avenue. Diffusion tube monitoring also indicated potential exceedences of the hourly mean NAQS in the vicinity of Victoria Road / Meadowside junction and informed the need for automatic monitoring to investigate whether an additional AQMA is required for hourly mean NAQS for NO<sub>2</sub>. Monitoring programmed to begin in 2011.</p>



REVIEW & ASSESSMENT REPORTS	BRIEF SUMMARY of OUTCOMES
	<ul style="list-style-type: none"> <li>• <b>PM<sub>10</sub></b> - the report noted that monitored PM<sub>10</sub> concentrations at Lochee Road and Seagate breach the annual mean NAQS for 2010. Combined with the predicted exceedences of the 2010 PM<sub>10</sub> annual mean in the FA/DA, it was concluded that an AQMA should be declared. Consequently, the 2006 AQMA order was amended in October 2010 to include PM<sub>10</sub>.</li> <li>• the revised statutory guidance contained a new requirement to review and assess biomass combustion sources. The review did not identify any sources within the local authority area that met the criteria for assessment. However, it was considered there was insufficient information available to adequately assess these sources. This will be reported in subsequent review and assessment reports as information becomes available.</li> </ul>
Progress Report 2010	<p>2009 monitoring data and new local developments with the potential to affect air quality were assessed in accordance with statutory guidance and the conclusions reached were:</p> <p><b>SO<sub>2</sub></b> - New monitoring data for 2010 show the objectives for SO<sub>2</sub> are being achieved. Sulphur dioxide concentrations measured at the Broughty Ferry Road monitoring location remained low and achieved the objectives during 2009.</p> <p><b>PM<sub>10</sub></b> - PM<sub>10</sub> objectives for 2004 are being met at all monitoring locations within the city. However, there is a risk of exceedence of the 2010 PM<sub>10</sub> annual mean objective being exceeded at roadside sites. The 2010 PM<sub>10</sub> daily mean was also exceeded at the monitoring location in Seagate using the VCM corrected data, but not when the local gravimetric correction factor was applied to the data. Osiris monitoring units have a tendency to over-estimate the number of exceedences compared to TEOMs. The council intend to install a reference equivalent PM<sub>10</sub> analyser in this area, and the need for a detailed assessment or AQMA in relation to the daily mean will be kept under review. A detailed assessment undertaken in 2009 for PM<sub>10</sub>, also identified a risk of exceedence of the 2010 objectives at receptors adjacent to busy roads and junctions in the city centre</p> <p><b>NO<sub>2</sub></b> - Exceedences of the nitrogen dioxide annual mean objective continued to occur within the existing AQMA in 2009 and, after façade projections were calculated, concentrations at fourteen sites failed to meet the annual mean standard. Uncertainties associated with the distance calculator tool used to estimate pollutant concentrations at façade suggest that Strathmore Avenue may be a new potential area of exceedence; this will be kept under review.</p>
Progress Report 2011	<p>This Progress Report presented the 2010 NO<sub>2</sub>, PM<sub>10</sub> and SO<sub>2</sub> monitoring results. Trends in pollutant concentrations were also examined within the report.</p> <p><b>Nitrogen dioxide (NO<sub>2</sub>)</b> – analysis of the 2010 data for nitrogen dioxide has reconfirmed the need for the AQMA and development of an Action Plan. One new area of potential exceedence of the annual mean has been identified at Strathmore Avenue.</p> <p>Sixty-seven exceedences of the NO<sub>2</sub> hourly mean were recorded at</p>

REVIEW & ASSESSMENT REPORTS	BRIEF SUMMARY of OUTCOMES
	<p>the automatic monitoring station on Lochee Road; this breaches the NAQS objective as only 18 are allowed. Analysis suggests this may have occurred as a result of traffic congestion caused by severe winter weather at the end of 2010. The need for a detailed assessment / AQMA for the hourly NO<sub>2</sub> will be kept under review.</p> <p>NO<sub>2</sub> annual mean concentrations throughout the city have increased since the AQMA was declared in 2006. The greatest increases in pollutant concentrations have been recorded along the city centre bus corridor, the north-west arterial route and associated access roads, major junctions on the Kingsway and at Stannergate Junction, on Broughty Ferry Road.</p> <p><b>Small Particulates (PM<sub>10</sub>)</b> - PM<sub>10</sub> objectives for 2004 are being met at all monitoring locations within the city. However, the 2010 PM<sub>10</sub> annual mean and 24-hour objective are being exceeded at roadside and kerbside Osiris sites. Osiris monitoring units are indicative only and the results should be treated with caution. In Spring 2011 the council installed reference equivalent PM<sub>10</sub> analysers in Lochee Road, Seagate and at the Victoria Rd/Meadowside junction, and the need for a detailed assessment or AQMA in relation to the daily mean will be kept under review. A detailed assessment undertaken in 2009 for PM<sub>10</sub>, also identified a risk of exceedence of the 2010 objectives at receptors adjacent to busy roads and junctions in the city centre.</p> <p>Generally PM<sub>10</sub> concentrations between 2006 and 2009 levelled off or were decreasing slightly. However, monitoring locations on the north-west arterial route (Logie Street and Lochee Road) showed a significant increase in PM<sub>10</sub> concentrations in 2010.</p> <p><b>Sulphur Dioxide (SO<sub>2</sub>)</b> -The monitoring results for 2010 indicate that all the NAQS objectives were met at the monitoring location in Dundee. A detailed assessment is not currently required for this pollutant.</p> <p>SO<sub>2</sub> concentrations have declined at the Broughty Ferry Road monitoring station between 2002 and 2010; this is thought to be largely due to the introduction of low sulphur fuels at a nearby industrial process in the port. From 2002 to 2006 occasional exceedences of the 15min mean objective were recorded as a result of certain shipping activities/movements within the port.</p>
<p>Updating &amp; Screening Assessment 2012</p>	<p>The Updating and Screening Assessment (USA) 2012 marked the beginning of the fifth round of review and assessment and required the re-examination all of the seven LAQM pollutants. This was carried out in accordance with statutory guidance and examined 2011 data and any significant changes in pollutant sources and public exposure to pollutants.</p> <p>New monitoring data for 2011 confirmed the need for the Air Quality Management Area (AQMA) in relation to exceedences of the NO<sub>2</sub> and PM<sub>10</sub> National Air Quality Strategy (NAQS) annual mean objectives and the subsequent Air Quality Action Plan (AQAP). The USA 2012 identified the need to amend the existing AQMA order to include the hourly objective for nitrogen dioxide. The need to include the daily objective for PM<sub>10</sub> will be kept under review.</p> <p>The conclusions reached are summarised below:</p>

REVIEW & ASSESSMENT REPORTS	BRIEF SUMMARY of OUTCOMES
	<p>That the NAQS for CO, benzene, 1,3-butadiene, lead and SO<sub>2</sub> would be achieved and hence no detailed assessments of these pollutants were required.</p> <p><b>NO<sub>2</sub></b> - Dundee City Council measured concentrations of NO<sub>2</sub> above the annual mean objective at relevant locations within the AQMA, previously declared for NO<sub>2</sub> and PM<sub>10</sub> annual mean (i.e. the whole council area). However, uncertainties associated with the distance calculator tool used to estimate NO<sub>2</sub> concentrations at façade suggested that the number of locations where the objective was breached at façade would exceed the number estimated (7). NO<sub>2</sub> annual mean concentrations decreased between 2010 and 2011 at the majority of monitoring locations except Whitehall Street. Throughout the city NO<sub>2</sub> annual mean concentrations have generally increased since the AQMA was declared in 2006. The greatest increases in pollutant concentrations have been recorded along the city centre bus corridor, the north-west arterial route and associated access roads, major junctions on the Kingsway and at Stannergate Junction. In Strathmore Avenue additional monitoring has shown that the potential problem area is highly localised and in 2011 the NO<sub>2</sub> annual mean objective was met at this location.</p> <p>Dundee City Council measured concentrations of NO<sub>2</sub> above the 1-hour objective at one location (Lochee Road) for three consecutive years. This is thought to have occurred as a result of traffic congestion caused by the impact of the severe winter weather on the road network in 2009 and 2010. The winter weather was less severe during 2011 and the number of exceedences was still greater than the 18 allowed (43). In view of the ongoing exceedences of the hourly NO<sub>2</sub> objective at Lochee Road, and the advice of the Scottish Government's consultants<sup>1</sup>, it was considered necessary to amend the AQMA order to include the hourly objective (11<sup>th</sup> March 2013). Despite recording an annual mean in excess of 60 µg/m<sup>3</sup>, the real-time monitor in Meadowside did not record any exceedences of the hourly objective. However, the new monitoring station was only installed in June 2011 (52.3% data capture) so a true comparison with the hourly objective was not possible. The potential for exceedences of the hourly objective at this location will be kept under review.</p> <p><b>PM<sub>10</sub></b> objectives for 2004 were met at all locations within the city, however Dundee City Council measured concentrations of PM<sub>10</sub> above the 2010 annual mean at Osiris units (Lochee Road, Logie Street, Victoria Road and Seagate ), Union Street (TEOM &amp; Osiris) and at two of the new BAMs (Lochee Road and Meadowside). The new BAMs had low data capture in 2011 and the results were annualised. At most locations PM<sub>10</sub> concentrations between 2006 and 2009 remained level or decreased slightly. Monitoring locations on the north-west arterial route (Logie Street and Lochee Road) showed a significant increase in PM<sub>10</sub> concentrations in 2010 and 2011. Annual mean concentrations also increased in Seagate in 2011 and in Union Street. Road works from May to November in 2011 are thought to have contributed to the annual mean exceedence in Union Street.</p>

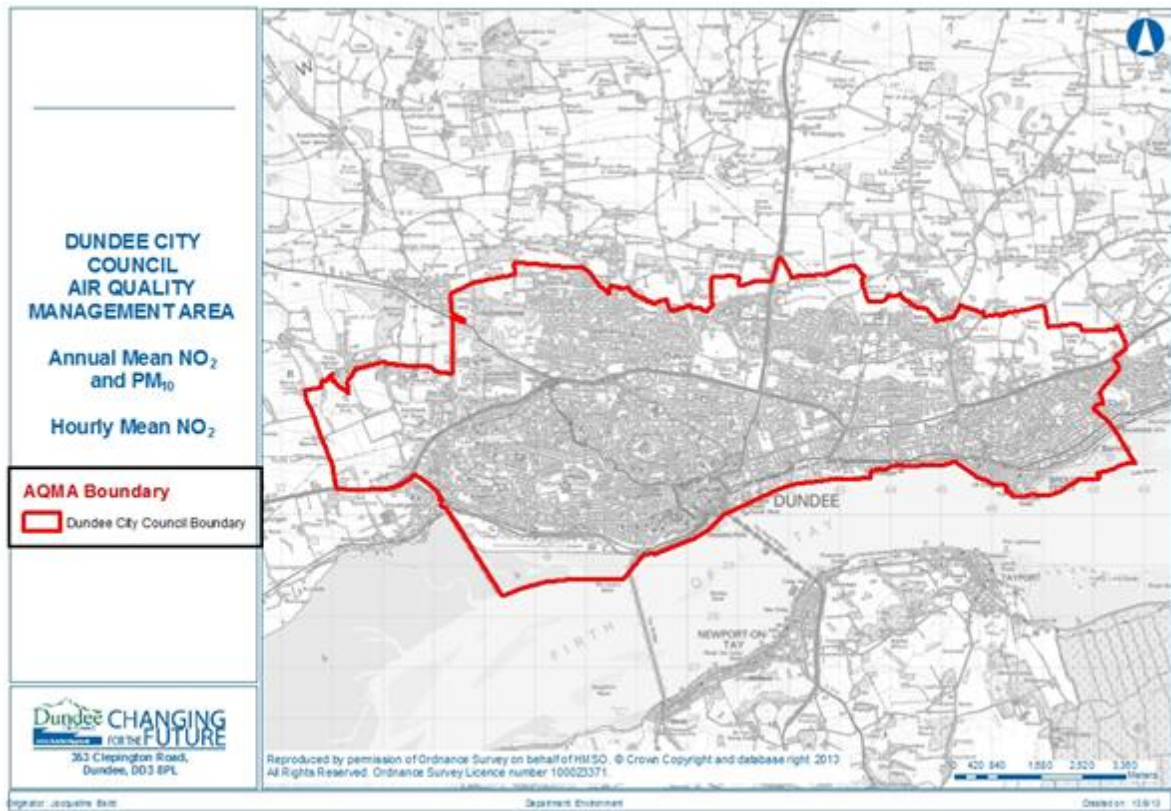
<sup>1</sup> Progress Report Appraisal Report PR-648

REVIEW & ASSESSMENT REPORTS	BRIEF SUMMARY of OUTCOMES
	<p>Only the kerbside Osiris units recorded more than 7 exceedences allowed of the 24-hour objective. Osiris units are indicative monitors and have a tendency to over-estimate the number of exceedences, although the doubling of the number of exceedences recorded at Lochee Road and Seagate between 2010 and 2011 is significant. The council installed reference equivalent PM<sub>10</sub> analysers (BAMs) in Lochee Road, Seagate and at the Victoria Rd / Meadowside junction during 2011. The data capture at these monitors was low and the number of exceedences recorded did not exceed the 7 allowed but the 98.08<sup>th</sup> percentile concentration was close to 50 µg/m<sup>3</sup> at Meadowside. The need to amend the AQMA order in relation to the daily mean will be reviewed as more data becomes available.</p> <p><b>SO<sub>2</sub></b> - New monitoring data for 2011 showed that the NAQS objectives for SO<sub>2</sub> are being achieved. SO<sub>2</sub> concentrations have declined at the Broughty Ferry Road monitoring station between 2002 and 2011; this is thought to be largely due to the introduction of low sulphur fuels at a nearby industrial process in the port. From 2002 to 2006 occasional exceedences of the 15min mean objective were recorded as a result of certain shipping activities/movements within the port; these were well within the number allowed</p>
<p>Progress Report 2013</p>	<p>Dundee City Council has examined the results from monitoring in 2012. Concentrations within the AQMA, previously declared for NO<sub>2</sub> and PM<sub>10</sub> annual mean and NO<sub>2</sub> the hourly mean (i.e. the whole council area), still exceed the relevant objectives and the AQMA should remain.</p> <p><b>NO<sub>2</sub></b> - Dundee City Council has measured concentrations of NO<sub>2</sub> above the annual mean objective at relevant locations within the AQMA. There are 17 diffusion tube (and 3 associated continuous analyser) locations where the annual mean NO<sub>2</sub> concentration at façade is estimated to exceed the objective. The concentration at the Whitehall Street continuous analyser is also estimated to breach the annual mean objective at the building façade. There are at least a further 14 locations at risk of breaching the objective. A new potential exceedence area has been identified at South Road (Denbank) which is an access route for Ninewells Hospital and Dundee Technology Park.</p> <p>NO<sub>2</sub> annual mean concentrations throughout the city have generally increased since the AQMA was declared in 2006. The greatest increases in pollutant concentrations have been recorded along the city centre bus corridor, the north west arterial route and associated access roads, major junctions on the Kingsway and at Stannergate roundabout, on Broughty Ferry Road. Large increases (&gt;6 µg/m<sup>3</sup>) between 2011 and 2012 were detected in Whitehall Street, Whitehall Crescent, Dock Street and on the Kingsway.</p> <p>Dundee City Council has measured concentrations of NO<sub>2</sub> above the 1-hour objective at one location (Lochee Road) for four consecutive years. The patterns of exceedences suggest this may have occurred as a result of traffic congestion caused by the impact of the severe winter weather on the road network in 2009 and 2010. The winter weather was less severe in 2011 and 2012 but the number of exceedences recorded in 2012 is still greater than the 18 allowed (36). This area is within the AQMA declared in relation to breaches of the hourly objective.</p>

REVIEW & ASSESSMENT REPORTS	BRIEF SUMMARY of OUTCOMES
	<p><b>PM<sub>10</sub></b> - The PM<sub>10</sub> NAQS 2004 annual mean objective continues to be achieved at all locations within the city, however in 2012 Dundee City Council has measured concentrations of PM<sub>10</sub> above the stricter Scottish 2010 annual mean objective at Meadowside (BAM) and at Osiris units located in Stannergate and Seagate. Concentrations at two other Osiris monitors in Lochee Road and Logie Street were close to exceeding the annual mean objective. The Osiris units are indicative PM<sub>10</sub> monitors and owing to their relocation and hence low data capture, the 2012 annual mean had to be estimated ("annualised") for all except Logie Street Osiris. The aforementioned annual mean PM<sub>10</sub> exceedence at Stannergate roundabout is newly identified and will be the subject of further study.</p> <p>Over the long term there has been a slight reduction in annual mean PM<sub>10</sub> concentrations. However since 2008 levels have remained relatively stable with some year to year fluctuations at roadside and kerbside sites.</p> <p>The Scottish 24-hour mean objective was exceeded at two locations, Seagate and Lochee Road in 2012 using Osiris monitors. It is known that Osiris monitors tend to over-estimate the number of 24-hour mean exceedences, so these results should be treated with caution. However, the gravimetric reference equivalent BAM at Meadowside measured four exceedences and had a 98.08<sup>th</sup> percentile value which was close to the objective. Consequently the potential for an exceedence of the 24hour mean objective will remain under review at this location, especially as 2012 data for Meadowside may be favourable owing to the 14 week lane closure in the street.</p> <p><b>SO<sub>2</sub></b> - The monitoring results for 2012 indicate that all the NAQS objectives for sulphur dioxide (SO<sub>2</sub>) were met at monitoring locations in Dundee. A detailed assessment is not currently required for this pollutant.</p> <p>SO<sub>2</sub> concentrations have declined at the Broughty Ferry Road monitoring station between 2002 and 2012; this is thought to be largely due to the introduction of low sulphur fuel at a nearby industrial process in the port. From 2002 to 2006 occasional exceedences of the 15min mean objective were recorded as a result of certain shipping activities/movements within the port; these were well within the number allowed.</p>
Progress Report 2014	<p>Dundee City Council has examined the results from monitoring in 2013. Concentrations within the AQMA, previously declared for NO<sub>2</sub> and PM<sub>10</sub> annual mean and NO<sub>2</sub> the hourly mean (i.e. the whole council area), still exceed the relevant objectives and the AQMA should remain.</p> <p><b>NO<sub>2</sub></b> -Dundee City Council has measured concentrations of NO<sub>2</sub> above the annual mean objective at relevant locations within the AQMA. There are 13 diffusion tube (and 3 associated continuous analyser) locations where the annual mean NO<sub>2</sub> concentration at façade is estimated to exceed the objective. The concentration at the Whitehall Street continuous analyser is close to breaching the annual mean objective at the nearest façade. There are at least a further 16 locations at risk of breaching the objective. A new potential exceedence area has been identified at West Marketgait near Guthrie Street on the inner ring road (A991).</p>

REVIEW & ASSESSMENT REPORTS	BRIEF SUMMARY of OUTCOMES
	<p>Dundee City Council has measured concentrations of NO<sub>2</sub> above the 1-hour objective at one location (Lochee Road) for five consecutive years. Ninety-nine exceedences (18 allowed per year) were recorded in 2013. Analysis of the patterns of these exceedences has shown that the majority occur at peak traffic times on weekdays during the winter months. However it is thought that traffic may not be the sole cause of these exceedences, e.g. topography, meteorology and domestic heating are factors that may contribute. This area is within the AQMA declared in relation to breaches of the hourly objective.</p> <p><b>PM<sub>10</sub></b> - The PM<sub>10</sub> NAQS 2004 annual mean objective continues to be met at all locations within the city; however Dundee City Council has measured concentrations of PM<sub>10</sub> above the stricter Scottish 2010 annual mean objective at Meadowside (BAM) and Stannergate Osiris. Concentrations at Lochee Road (BAM) and Osiris monitors located in Albert Street and Logie Street were close to exceeding the annual mean objective. The Osiris units are indicative PM<sub>10</sub> monitors.</p> <p>The PM<sub>10</sub> NAQS 2004 24-hour objective continues to be met at all locations within the city, however, the stricter Scottish 24-hour mean objective (2010) was exceeded at two Osiris monitors located at Stannergate Roundabout and Albert Street in 2013. Both locations experienced transient PM<sub>10</sub> events as a consequence of localised road works and it is known that Osiris monitors have a tendency to over-estimate the number of 24-hour mean exceedences. A detailed assessment for the short-term Scottish objective is not considered necessary at this time though future monitoring results at these locations will be kept under review.</p> <p><b>SO<sub>2</sub></b> - New monitoring data for 2013 show all the objectives for SO<sub>2</sub> are being achieved.</p>

Figure 1.1 Map of AQMA Boundary



## 2 New Monitoring Data

### 2.1 Summary of Monitoring Undertaken

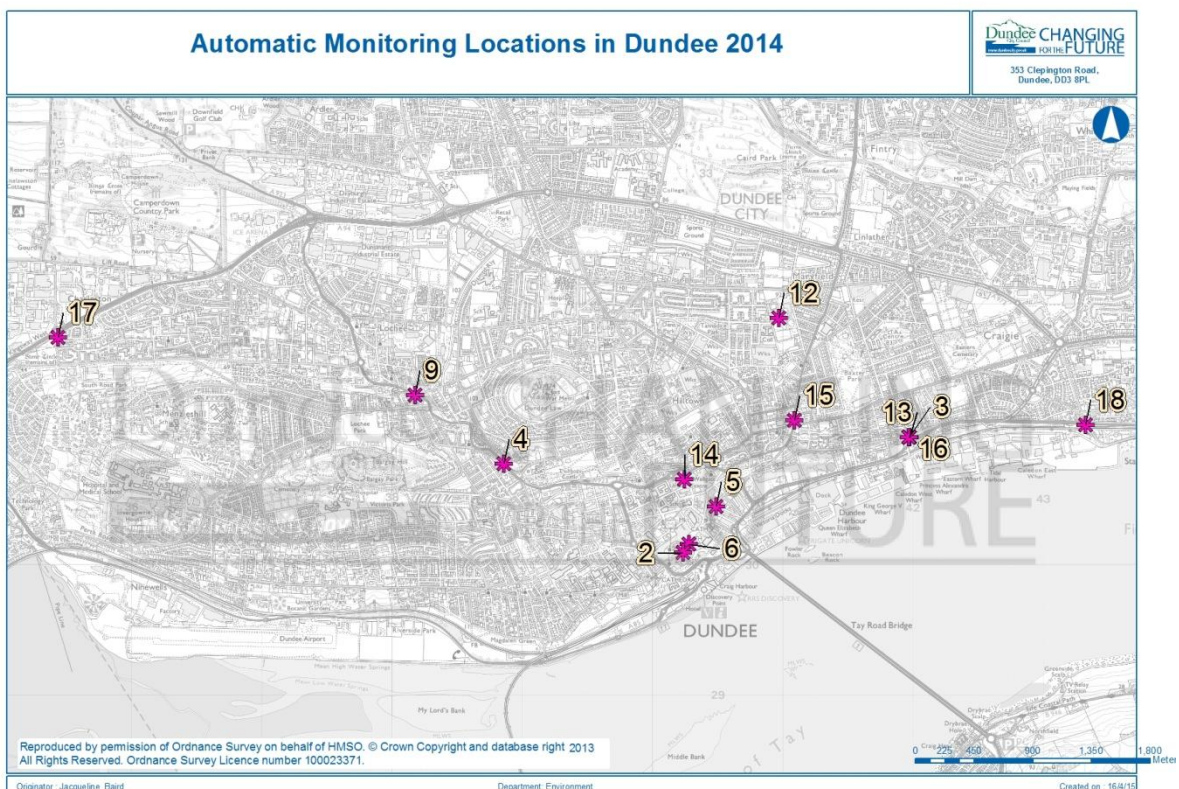
#### 2.1.1 Automatic Monitoring Sites

Dundee City Council carried out automatic monitoring at 13 sites throughout Dundee in 2014. All stations were operational throughout 2014. Siting automatic monitoring sites in urban areas is problematic and compromises mean that monitors cannot always be situated in the worst case location.

Details and descriptions of the automatic monitoring sites for 2014 are shown in **Figure 2.1**, **Table 2.1** and **Table 2.1a**.

Quality assurance and quality control procedures for automatic monitors are detailed in **Appendix A**.

**Figure 2.1 Map of Automatic Monitoring Sites**



**Note:** Numbers shown correspond to the Site ID in **Table 2.1**



**Table 2.1 Details of Automatic Monitoring Sites**

Site ID (CM)	Site Name	Site Type	X OS Grid Reference	Y OS Grid Reference	Inlet Height (m)	Pollutants Monitored	In AQMA? <sup>1</sup> (Y/N)	Monitoring Technique	Relevant Exposure? (Y/N, with distance (m) from monitoring site to relevant exposure) <sup>3</sup>	Distance to Kerb of Nearest Road (m) <sup>4</sup> (N/A if not applicable)	Does this Location Represent Worst-Case Exposure? <sup>2</sup> ?
3	Broughty Ferry Road Rollalong	Urban Industrial	341970	730977	2.99	SO <sub>2</sub>	Y	UV Fluorescence <sup>a</sup>	Y, 0.00	n/a	No
					2.93	PM <sub>10</sub>		TEOM		6.88	
13	Broughty Ferry Road Partisol	Urban Industrial	341971	730978	2.84	PM <sub>10</sub>	Y	Partisol	Y, 0.00	n/a 6.11	No
4	Lochee Road Romon	Roadside	338861	730773	1.77	NO <sub>2</sub>	Y	Chemiluminescence <sup>b</sup>	Y, 2.24	1.15	No
					2.06	PM <sub>10</sub>		Beta Attenuation (BAM)			
9	Logie Street Osiris	Kerbside	338176	731298	3.31	PM <sub>10</sub>	Y	Osiris (nephthalometer)	Y, 1.65	0.57	Yes
12	Mains Loan	Urban Background	340972	731893	1.80	NO <sub>2</sub>	Y	Chemiluminescence <sup>c</sup>	N, 0.00	n/a	No
					1.98	PM <sub>10</sub>		TEOM			
5	Seagate Romon	Roadside	340487	730446	1.70	NO <sub>2</sub>	Y	Chemiluminescence <sup>b</sup>	Y, 2.00	1.10	No
					2.06	PM <sub>10</sub>		Beta Attenuation (BAM)			
2	Union Street Rollalong	Roadside	340235	730091	2.92	NO <sub>2</sub>	Y	Chemiluminescence <sup>b</sup>	Y, 3.55	1.64	Yes
					3.00	PM <sub>10</sub>		Beta Attenuation (BAM) <sup>e</sup>		1.64	
6	Whitehall Street Romon	Roadside	340278	730156	1.80	NO <sub>2</sub>	Y	Chemiluminescence <sup>b</sup>	Y, 1.86	3.26	No
14	Meadowside Romon	Roadside	340243	730653	2.26	NO <sub>2</sub>	Y	Chemiluminescence <sup>d</sup>	Y, 0.42	1.60	Yes
					2.17	PM <sub>10</sub>		Beta Attenuation (BAM)		1.63	
15	Albert Street Osiris	Kerbside	341090	731105	3.15	PM <sub>10</sub>	Y	Osiris (nephthalometer)	Y, 1.54	0.89	No
16	Broughty Ferry Road Osiris	Urban Industrial	341970	730977	3.00	PM <sub>10</sub>	Y	Osiris (nephthalometer)	Y, 0m	7.15	No
17	Myrekirk Osiris	Roadside	335438	731740	3.11	PM <sub>10</sub>	Y	Osiris (nephthalometer)	Y, 0.4	14.00	No
18	Stannergate Osiris	Roadside	343322	731073	3.11	PM <sub>10</sub>	Y	Osiris (nephthalometer)	Y, 1.93	1.16	No

**Notes:**

<sup>1</sup>The whole of Dundee is an AQMA for NO<sub>2</sub> and PM<sub>10</sub>

<sup>2</sup> Explanation provided in para.3.11 page3-3 LAQM.TG(09): The term 'worst-case' is used to represent those places, "where concentrations are expected to be highest, and where the public may be exposed over the relevant averaging period of the objectives"

<sup>3</sup> Explanation provided in Box 3.1 of LAQM.TG(09), *When describing sites, it should be made clear whether they represent relevant exposure. For instance, if the site is kerbside, it would be appropriate to say that "the nearest relevant exposure is residential properties set back 5 m from the kerb."*

<sup>4</sup> 'Kerb' is taken as being the edge of the carriageway with flowing traffic

<sup>a</sup> Equipment is model ML 9850A

<sup>b</sup> During 2013 equipment was updated from model ML 9841A to model API T200

<sup>c</sup> Equipment is model Thermo 42i

<sup>d</sup> Equipment is model ML 2041

<sup>e</sup> During 2013 equipment was updated from TEOM to BAM

**Table 2.2 Description of Automatic Monitoring Sites**

Site ID	Site Name	Site Type	Description of automatic monitoring location
3	Broughty Ferry Road Rollalong	UI	On pavement in-line with residential properties adjacent to Broughty Ferry Road , and down-wind of the port and bitumen refinery. Co-located with TEOM and Partisol to provide a local gravimetric correction factor for Osiris units.
13	Broughty Ferry Road Partisol	UI	On pavement in-line with residential properties adjacent to Broughty Ferry Road , and down-wind of the port and bitumen refinery
4	Lochee Road Romon	R	Located on an inclined section of the north-west arterial (A923) route into the city. On pavement north of the junction with Cleghorn Street, canyon-like environment with 4-storey tenements to the east and steeply rising ground to the west. Does not take account of higher traffic flows south of Cleghorn St. There are ground floor flats bordering the pavement at this location & at the more trafficked section south of Cleghorn St.
9	Logie Street Osiris	K	On the outbound side of the north-west arterial route (A923), at the busy signalised junction with Loons Road & Muirton Road. There are first floor flats bordering the pavement at this location.
12	Mains Loan	UB	Located at background location, near playing fields away from busy roads and junctions
5	Seagate Romon	R	Located in a street canyon environment on the main bus corridor through the city centre, bounded on both sides with up to 5 storey tenements. There are ground floor flats bordering the pavement at this location. Does not experience the higher pollution levels closer to the bus stances to the east, where there are ground floor flats bordering the narrower pavement (i.e. not the worst case location).
2	Union Street Rollalong	R	Located in a street canyon environment on the main bus corridor through the city centre, bounded on both sides with 4 storey tenements. There are first floor flats bordering the pavement at this location. There are plans to open up access to this street by linking it with the A991 South Marketgait and new boulevards of the waterfront development which has the potential to increase vehicle numbers and emissions within the street canyon.
6	Whitehall Street Romon	R	Located on the east side of a city centre street canyon environment where there is a main bus interchange and bounded on both sides with 4-5 storey tenements. Owing to the location of the bus stances, traffic emissions are greater on the west side where residential flats border the pavement at 1st floor level. There are flats at third floor flats bordering the pavement at the monitoring location (i.e.this is not the worst-case pollution location).
14	Meadowside Romon	R	Located on the north west side of a street canyon on the main bus corridor, on an uphill incline, near traffic lights and near where traffic exits from a multi-storey car park. There are ground floor flats bordering the pavement at this location. The monitor is at the building facade and hence represents worst case exposure.
15	Albert Street Osiris	K	Next to the city-bound carriageway of the north-east arterial route (A929) in a street canyon environment bounded on both sides by 4-storey tenements and just uphill from a signalised junction. Downhill traffic potentially queues back to the monitor where there are first floor flats bordering the pavement. However, the pavement of the steep uphill carriageway is bordered by ground floor residential properties and so the monitoring location may not represent the worst case exposure location.
16	Broughty Ferry Road Osiris	UI	On pavement in-line with residential properties adjacent to Broughty Ferry Road , and down-wind of the port and bitumen refinery. Co-located with TEOM and Partisol to provide a local gravimetric correction factor for Osiris units.
17	Myrekirk Osiris	R	Installed at the Kingsway A90(T)/ Myrekirk roundabout on Dundee's outer-ring road which was reconfigured as part of a new superstore development. Location is approximately in line with nearby residential properties, relative to westbound traffic movements. However, monitor is closer to the junction's north-south movements whereas the residential properties are closer to westbound queues.
18	Stannergate Osiris	R	Installed at Stannergate roundabout on the south-east arterial route (A930) into the city, which is also the eastern access to the port. Located on lampost closer to the road than nearby houses. Down prevailing wind of the railway, the port, unmade trafficked ground and commercial activities that may generate dust. Proposed port expansion is predicted to generate more traffic close to this monitor.

## 2.1.2 Non-Automatic Monitoring Sites

Dundee City Council operates an extensive network of nitrogen dioxide passive diffusion tube monitors throughout the city. These are all located within the AQMA with the majority located close to busy roads and junctions in the city centre, along the main arterial routes and the outer ring road (the Kingsway).

A review of the diffusion tube network was carried out at the end of 2013, with two new tube locations added to the network and 10 sites where monitoring was discontinued. **Tables 2.3 and 2.4** detail the new and discontinued tubes and the reasons for the change.

**Table 2.3 New Diffusion Tube Locations 2014**

Site ID	Location	x	y	Site Type	Reason
192	Dock Street (12)	340389	730079	R	To replace site discontinued due to removal of lampost
193	Horsewater Wynd	339549	730252	K	New receptor identified closer to road

**Table 2.4 Discontinued Diffusion Tube Locations 2014**

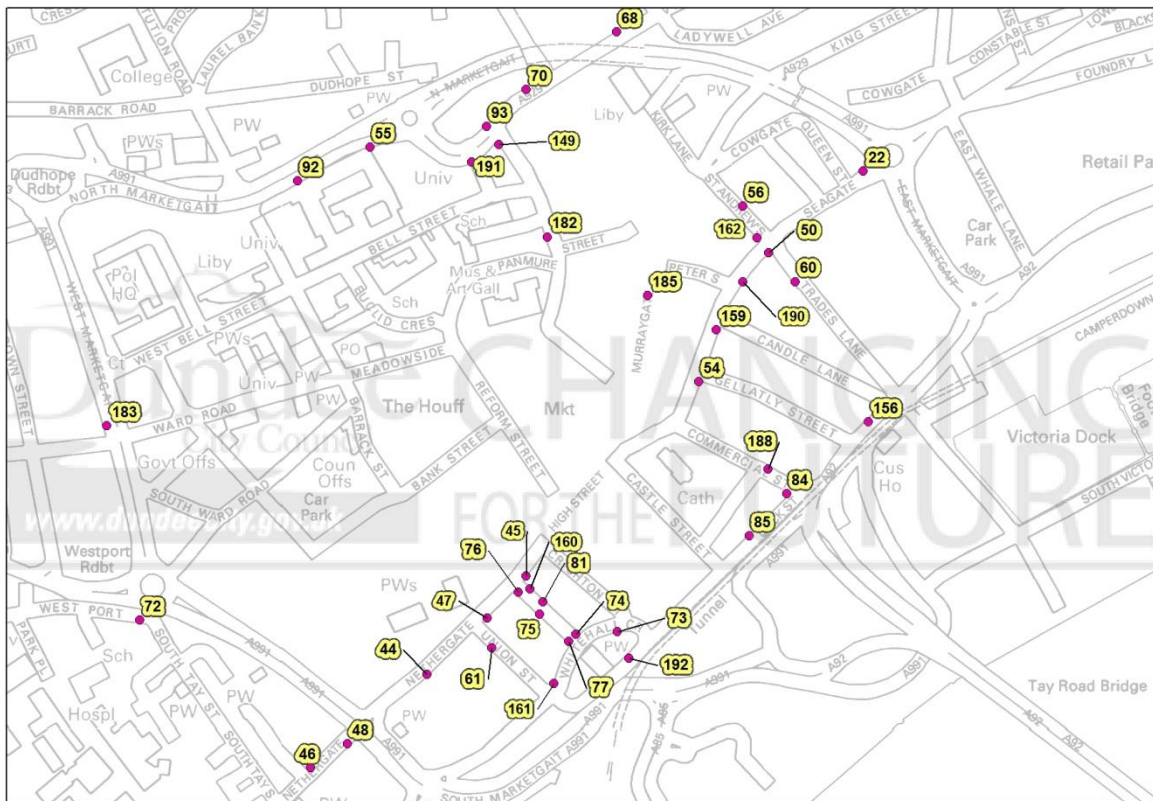
Site ID	Location	x	y	Site Type	Reason
171	Claypotts/Arbroath Rd (502)	345347	732080	R	Well below the objective
174	Cleington Rd (172)	339974	732147	K	Lampost removed, below the objective
17	Dens Rd (Crossing)	340725	731238	R	Consistently below the objective
169	Dura St (30)	341021	731434	R	Well below the objective
178	Hawkhill/Horsewater Wynd	339576	730223	K	Well below the objective
176	Logie St/Grays Lane	338062	731366	R	Well below the objective
170	Monifieth Rd (4)	346554	730919	R	Well below the objective
173	Old Glamis Rd(9)/Balgray St	339941	732251	K	Well below the objective
172	Pitkerro Rd (3)	341227	731629	R	Well below the objective
90	Ward Rd / N. Lindsay St	339893	730336	R	Consistently below the objective

Note: Locations highlighted in pink were added to the network in 2013.

Details for each of the diffusion tubes deployed in the network in 2014 are shown in **Table 2.5**. Maps illustrating the extent of the network are shown in **Figures 2.2a to 2.2c**.

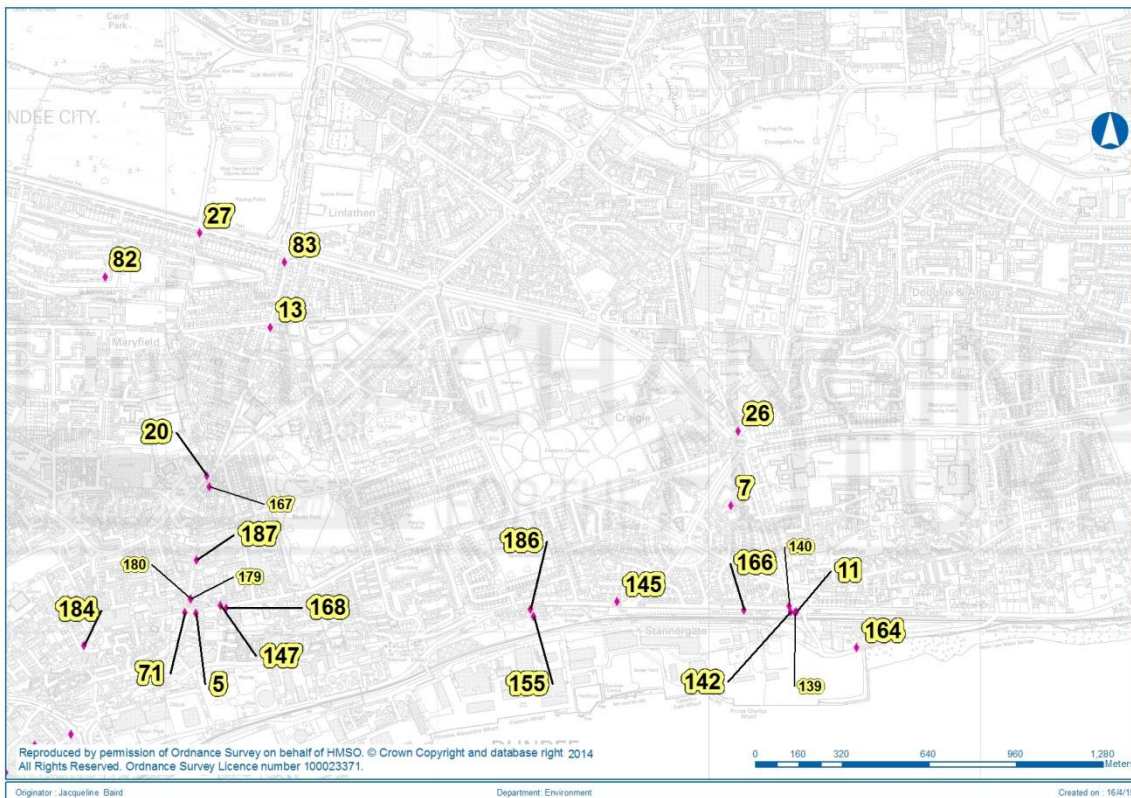
NO<sub>2</sub> diffusion tubes used in Dundee tend to over-read compared to automatic analysers and need to be bias corrected. QA/QC procedures and bias correction methodologies are discussed in **Appendix A**.

Figure 2.2a Map of NO<sub>2</sub> Diffusion Tubes in the City Centre



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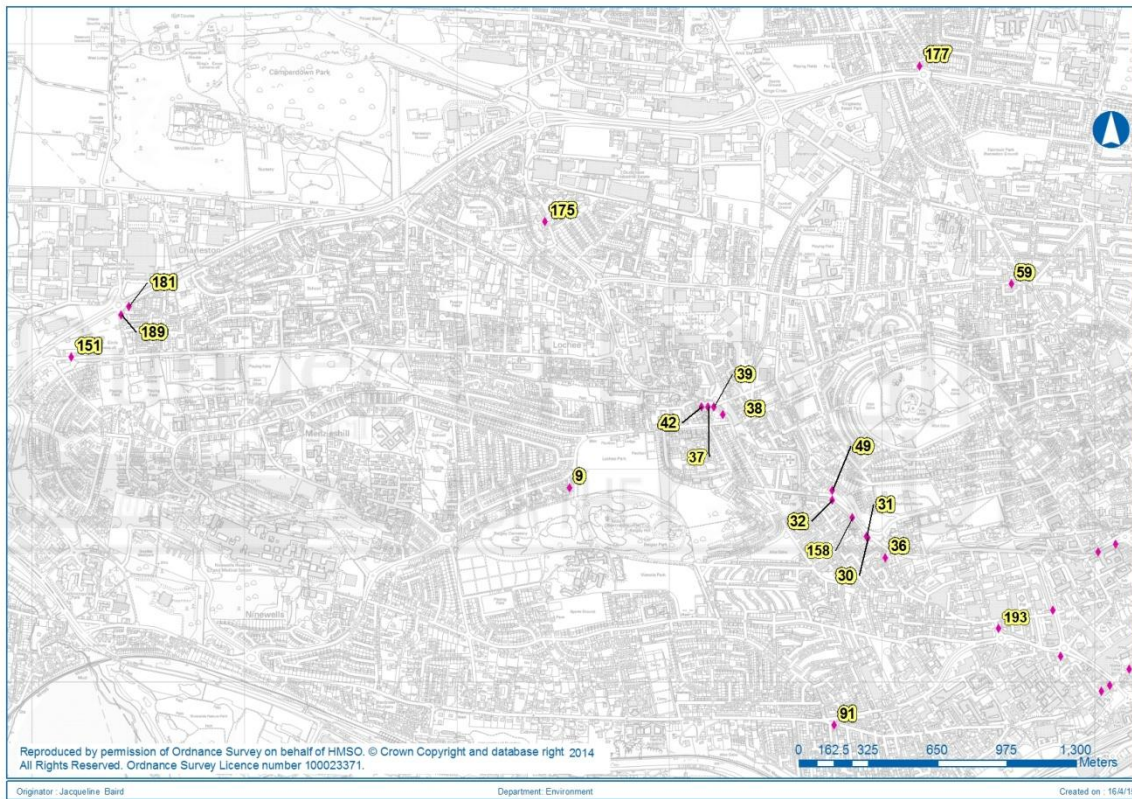
Figure 2.2b Map of NO<sub>2</sub> Diffusion Tubes to the East of the City



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Originator: Jacqueline Baird Department: Environment Created on: 16/4/15

Figure 2.2c Map of NO<sub>2</sub> Diffusion Tubes to the West of the City



**Table 2.5 Details of Non-Automatic Monitoring Sites**

Site ID (DT)	Site Name	Site Type	X OS Grid Reference	Y OS Grid Reference	Site Height (m)	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?*
92	Abertay 2	R	340019	730612	2.36	N	Y (2.01)	1.95	N
179	Albert Street (15) (Facade)	R	341092	731121	2.36	N	0.25	2.04	Y
180	Albert Street (15) (Roadside)	K	341091	731121	2.40	N	1.75	0.54	N
167	Albert Street (191)	K	341161	731535	2.53	N	2.70	0.62	N
187	Albert Street (81)	K	341113	731265	2.53	N	2.95	0.47	N
5	Arbroath Road (13)	K	341111	731070	2.75	N	Y (2.52)	0.73	Y
168	Arbroath Road (27)	R	341223	731089	2.53	N	2.43	1.88	N
147	Arbroath Road 38	K	341202	731097	2.47	N	Y (2.97)	0.50	N
7	Balgavies Place	UB	343082	731465	2.44	N	N	n/a	N
9	Birnam Place	UB	337531	730914	2.63	N	N	0.47	N
145	Broughty Ferry Rd - Greendykes	R	342662	731112	2.44	N	Y (7.72)	4.10	N
139	Broughty Ferry Rd 141 (Downpipe)	R	343317	731072	2.44	N	Y (0.2)	4.32	Y
142	Broughty Ferry Rd 141 (Streetsign)	R	343302	731075	2.32	N	Y (0.2)	3.82	N
140	Broughty Ferry Rd Post Box (Opp. 141) Lp66	R	343297	731096	2.59	N	Y (8.5)	2.10	N
11	Broughty Ferry Road (141)	R	343322	731073	2.69	N	Y (1.98)	1.32	Y
166	Broughty Ferry Road Lamppost 59 (2)	R	343129	731081	2.69	N	Y (4.53)	2.97	N
155	Carolina Court	UB	342353	731058	2.44	N	N	0.56 (33.34 to the A92(T))	N
186	Carolina Court 30 mph sign	R	342342	731083	2.37	N	-0.38	7.60	Y
13	Clelington Road/Forfar Road	K	341385	732121	2.66	N	Y (8.28)	0.78	Y
84	Commercial St / Dock St. (40)	R	340565	730263	2.73	N	Y (0.17)	2.78	Y

Dundee City Council

Site ID (DT)	Site Name	Site Type	X OS Grid Reference	Y OS Grid Reference	Site Height (m)	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?*
188	Commercial Street (9)	R	340544	730291	2.31	N	2.44	2.57	N
175	Coupar Angus Road (38)	R	337414	732164	2.45	N	2.36	2.10	N
85	Dock St Carol Whyte (21)	R	340524	730216	2.39	N	Y (0.34)	5.13	Y
192	Dock Street -12	R	340389	730079	2.64	N	Y-4.0	2.49	N
156	Dock Street - 57	R	340656	730343	2.51	N	Y (3.25)	2.53	N
20	Dura Street (Fortes) (100)	K	341150	731576	2.58	N	Y (1.65)	0.57	N
22	Eastport Roundabout	R	340651	730623	2.69	N	Y (1.56)	1.00	Y
83	Forfar Road (104)	K	341437	732360	2.57	N	Y (7.68)	0.67	Y
193	Horsewater Wynd	K	339549	730252	2.7	N	Y-2.58	0.8	N
177	Kingsway / Strathmartine Road (279)	R	339179	732896	2.47	N	Y- 3.63	3.14	N
26	Kingsway E. Roundabout	R	343107	731740	2.66	N	Y (14.3)	2.90	N
27	Kingsway/ Mains Loan 1	R	341124	732468	2.56	N	Y (15.4)	6.20	Y
30	Lochee Rd (138)	K	338936	730680	2.75	N	Y (2.06)	0.44	N
31	Lochee Rd (140) Traffic Lts	R	338927	730685	2.62	N	Y (0.25)	2.22	Y
32	Lochee Rd (184)	K	338767	730856	2.35	N	Y (3.19)	0.73	Y
158	Lochee Rd (Romon) Average	R	338861	730773	2.04	Y	Y (2.03)	1.34	N
36	Lochee Rd/Polepark Rd	K	339016	730586	2.65	N	Y (9.21)	0.95	Y
37	Logie Street (114)	R	338184	731293	2.70	N	Y (0.53)	1.73	Y
38	Logie Street (98)	K	338252	731258	2.62	N	N	0.84	N
39	Loons Road (1)	R	338211	731293	2.73	N	Y (0.5)	1.90	Y

Dundee City Council

Site ID (DT)	Site Name	Site Type	X OS Grid Reference	Y OS Grid Reference	Site Height (m)	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?*
164	Lower Broughty Ferry Road	UB	343545	730942	2.57	N	N	3.15	N
182	Meadowside (28)	K	340298	730550	2.53	N	2.95	0.80	N
149	Meadowside (Romon) Average	R	340243	730653	2.05	Y	Y (0.33)	1.85	Y
42	Muirton Road (6)	R	338152	731293	2.50	N	Y (0.3)	1.11	Y
185	Murraygate (46)	UB	340409	730484	2.52	N	n/a	n/a	N
189	Myrekirk Road (29)	R	335420	731726	2.34	N	5.17	2.00	N
181	Myrekirk Terrace (8)	R	335458	731767	2.46	N	1.64	11.20	N
48	Nethergate (132) / Marketgait	R	340074	729984	2.60	N	Y (3.6)	1.33	Y
44	Nethergate (B&B)(88)	K	340163	730061	2.14	N	Y (5)	0.86	Y
45	Nethergate (Bradford)(6)	R	340274	730171	2.65	N	Y (2.51)	1.25	Y
46	Nethergate (Charlie T)(95)	K	340033	729957	2.57	N	Y (1.84)	0.86	Y
47	Nethergate (Trades House)(40)	R	340230	730124	2.65	N	Y (2.72)	1.26	Y
91	Perth Rd 320	K	338776	729798	2.55	N	Y (3.78)	0.42	Y
49	Rankine St (2)	R	338768	730900	2.70	N	Y (0.4)	1.76	Y
50	Seagate	R	340545	730532	2.80	N	Y (0.19)	1.94	N
190	Seagate (97)	R	340516	730499	2.28	N	0.00	2.26	Y
159	Seagate (Romon) Average	R	340487	730446	1.73	Y	Y (1.81)	1.29	N
54	Seagate (Yates)(7-9)	R	340467	730388	2.84	N	Y (0.9)	1.70	N
55	Soapwork Lane	R	340099	730650	2.77	N	Y (as facade)	3.51	Y
151	South Road - Denbank	R	335188	731528	2.36	N	Y (0.28)	1.79	Y



Dundee City Council

Site ID (DT)	Site Name	Site Type	X OS Grid Reference	Y OS Grid Reference	Site Height (m)	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?*
56	St Andrews St (Jaf)(26)	K	340516	730584	2.69	N	Y (1.77)	0.71	Y
162	St. Andrews St PB (facade)/Seagate(116)	R	340532	730548	2.52	N	Y (0.18)	2.53	Y
59	Strathmore Avenue (353)	K	339609	731871	2.69	N	Y (1.45)	0.67	Y
60	Trades Lane (31)	K	340575	730500	2.69	N	Y (1.82)	0.44	Y
61	Union St (Rollalong) Average	R	340235	730091	2.66	Y	Y (3.25)	1.20	Y
93	Victoria Road (10)(Osiris)	K	340230	730673	2.55	N	Y (2.7)	0.30	Y
184	Victoria Road (104) / William Street	R	340697	730950	2.52	N	1.50	1.36	N
191	Victoria Road (4) - India Buildings	R	340213	730633	2.25	N	0.00	2.77	Y
68	Victoria Road (60)	R	340375	730779	2.73	N	Y (0.56)	2.18	Y
70	Victoria Road/Hilltown	R	340274	730714	2.77	N	Y (2.01)	1.15	N
71	Victoria St / Albert Street	K	341071	731072	2.58	N	Y (1.7)	0.75	Y
183	West Marketgait / Guthrie Street	R	339805	730338	2.42	N	2.02	1.16	N
72	Westport (2)	R	339842	730122	2.62	N	Y (2.5)	0.46 (12m to W. M'tgait)	Y
73	Whitehall Cr (Xpresso)(4)	K	340376	730109	2.62	N	Y (3)	0.88	Y
161	Whitehall Crescent - (McIntyres)/Union St. (50)	K	340305	730051	2.54	N	Y (4.78)	0.64	N
74	Whitehall St (Brj)(40)	K	340330	730106	2.76	N	Y (3.57)	0.78	Y
75	Whitehall St (Bus)(5)	R	340289	730128	2.58	N	Y (3.17)	2.51	N
76	Whitehall St (Deb A)(1)	K	340265	730153	2.68	N	Y (5.57)	0.88	N
77	Whitehall St (Deb E)(15)	K	340322	730098	2.65	N	Y (4.55)	0.75	Y
160	Whitehall St (Romon) Average	R	340278	730156	1.79	Y	Y (1.65)	3.49	N

Dundee City Council

Site ID (DT)	Site Name	Site Type	X OS Grid Reference	Y OS Grid Reference	Site Height (m)	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?*
81	Whitehall St (Tiso)(12)	R	340293	730142	2.78	N	Y (2.67)	3.00	Y
82	Woodside Avenue	UB	340776	732307	2.59	N	N	0.55	N

**Notes:**

The whole of Dundee is an AQMA for NO<sub>2</sub> & PM<sub>10</sub>

K= kerbside (within 1m of a kerb), R=roadside (2-5m from kerb), UB=Urban Background

\*The Y/N categories have been assigned on the consideration of exposure over the Annual mean averaging period.

However - some sites serve a dual purpose i.e. there may also be reason to assess the 1hrly exposure. Consequently it is possible for some city sites to be 'N' for Annual mean because they aren't at facade - but 'Y' for 1hrly because members of the public could be present for 1hr.

## 2.2 Comparison of Monitoring Results with Air Quality Objectives

### 2.2.1 Nitrogen Dioxide

#### 2.2.1.1 Automatic Monitoring Data

The 2014 results of the automatic monitoring stations for nitrogen dioxide are shown in **Table 2.6 & 2.8** and **Figures 2.3 – 2.6**, along with results from previous years. The automatic monitoring sites collected greater than 9 months valid data in 2014 and hence the measurements did not need to be “annualised” (as described in Box 3.2 of LAQM.TG(09)). It should be noted that for a strict comparison against the objective there must be a data capture of more than 90% throughout the calendar year, so details of data capture are included in the table for 2014 and all previous years.

#### Annual Mean Concentrations

Exceedences of the annual mean objective for NO<sub>2</sub> are any concentrations which are greater than 40 µg/m<sup>3</sup>. Concentrations in excess of 36 µg/m<sup>3</sup> are classed as ‘borderline’ exceedences. In 2014 three automatic monitors recorded annual mean exceedences: Lochee Road (45.8 µg/m<sup>3</sup>), Seagate (54.5 µg/m<sup>3</sup>), and Whitehall Street (42.5 µg/m<sup>3</sup>). The concentration at Meadowside was ‘borderline’ having reduced to 39.6 µg/m<sup>3</sup>. The highest annual mean NO<sub>2</sub> concentration was recorded at Seagate. These are known hotspot locations and are located within an AQMA. The automatic monitor locations represent relevant exposure but not necessarily the worst case exposure location, see **Table 2.1 & 2.2**. As described all these locations are in canyon-like environments where there is little reduction of concentrations between the roadside and the nearby relevant receptors.

**Table 2.6 Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with Annual Mean and Hourly Mean Objectives**

Site ID	Location	Site Type	Within AQMA ?	Valid Data Capture for 2014 % <sup>a</sup>	Annual Mean Concentration (µg/m <sup>3</sup> ) <i>(with data capture (%) in italics)</i>								
					2006	2007	2008	2009	2010	2011	2012	2013	2014
CM 4	Lochee Road	R	Y	99.5	<b>49.0<sup>b</sup></b> <i>63.4</i>	<b>52.8</b> <i>93.0</i>	<b>52.9</b> <i>92.0</i>	<b>54.2</b> <i>87.5</i>	<b>55.0</b> <i>94.7</i>	<b>58.2<sup>b</sup></b> <i>39.2</i>	<b>52.9</b> <i>96.5</i>	<b>51.6</b> <i>99.6</i>	<b>45.8</b> <i>99.5</i>
CM 5	Seagate	R	Y	99.1	<b>43.0<sup>b</sup></b> <i>60.7</i>	<b>49.1</b> <i>93.9</i>	<b>51.4</b> <i>81.6</i>	<b>48.4<sup>b</sup></b> <i>74.3</i>	<b>51.0</b> <i>80.0</i>	<b>52.2</b> <i>80.9</i>	<b>47.6</b> <i>88.1</i>	<b>55.0</b> <i>87.8</i>	<b>54.5</b> <i>99.1</i>
CM 2	Union Street	R	Y	97.1	<b>39.0<sup>b</sup></b> <i>59.9</i>	<b>35.8</b> <i>99.3</i>	<b>42.9</b> <i>99.7</i>	<b>45.2</b> <i>99.7</i>	<b>40.0</b> <i>90.7</i>	<b>35.6</b> <i>99.5</i>	<b>31.7</b> <i>84.2</i>	<b>30.5</b> <i>96.7</i>	<b>28.4</b> <i>97.1</i>
CM 6	Whitehall Street	R	Y	98.1	<b>39.8</b> <i>85.1</i>	<b>42.0</b> <i>90.6</i>	<b>46.7</b> <i>75.6</i>	<b>37.8</b> <i>93.2</i>	<b>36.0</b> <i>88.9</i>	<b>34.7</b> <i>83.6</i>	<b>44.4</b> <i>87.1</i>	<b>41.2</b> <i>99.0</i>	<b>42.5</b> <i>98.1</i>
CM14	Meadowside	R	Y	99.8						<b>66.4<sup>b</sup></b> <i>52.3</i>	<b>53.9</b> <i>97.3</i>	<b>49.1</b> <i>90.7</i>	<b>39.6</b> <i>99.8</i>
CM12	Mains Loan	UB	Y	93.3						<b>11.6<sup>b</sup></b> <i>75.5</i>	<b>9.8</b> <i>97.3</i>	<b>11.5<sup>b</sup></b> <i>72.6</i>	<b>12.4</b> <i>93.3</i>

<sup>a</sup> data capture for the full year

<sup>b</sup> Mean “annualised” as in Box 3.2 of TG(09), as valid data capture was less than 75%

Exceedences of the air quality objectives are shown in bold & red. Orange values denote those at risk of exceeding the objective.

indicates insufficient valid data capture - for strict comparison against the objectives data capture should be >90% throughout the calendar year

The methodology detailed in Box 2.3 of LAQM.TG(09) provides a means to predict annual mean concentrations at the façade of relevant residential receptors from nearby roadside monitoring data. Although the results of this methodology are not conservative when used for street canyon-like locations the predicted concentrations still exceed or are close to exceeding the objective at the relevant exposure: i.e. Lochee Road 39.5 µg/m<sup>3</sup>, Seagate 46.7 µg/m<sup>3</sup>, Whitehall Street 40 µg/m<sup>3</sup> and Meadowside 38.5 µg/m<sup>3</sup>.

**Figure 2.3 & 2.4** shows the annual mean NO<sub>2</sub> concentrations at automatic monitoring locations since 2006. Year to year changes to concentrations are common and weather conditions are a key influence. Statistically significant trends, or even a reasonable overview of how concentrations are changing, usually only become meaningful when complete data records extend over five years or more. Nine years data are presented but caution should be exercised when inferring trends as many of the annual averages presented had less than 90% valid data capture, details of which are presented in **Table 2.6**.

Trend analysis has been undertaken at monitoring locations with five or more years of valid data. Annual mean nitrogen dioxide concentrations have been plotted for successive years at Lochee Road, Union Street, Seagate and Whitehall Street. Trend lines have been drawn using an Excel simple regression statistical program. Data trends are shown in **Figure 2.4** and summarised in **Table 2.7**.

**Table 2.7 Summary of Annual Mean Nitrogen Dioxide trends measured at long-term Automatic Monitoring Sites**

Monitoring Location	Site Type	Trend in annual mean NO <sub>2</sub> (years included)	Concentrations of NO <sub>2</sub>
<b>Lochee Road</b>	Roadside	↓ (2006 to 2014)	Slight decrease
<b>Seagate</b>	Roadside	↑ (2006 to 2014)	Increasing
<b>Union Street</b>	Roadside	↓ (2006 to 2014)	Decreasing
<b>Whitehall Street</b>	Roadside	↑ (2006 to 2014)	Slight increase

The reason for the general upward trend in Seagate compared to the other sites is unclear. Refurbishment of the traffic lights at the Commercial Street/Seagate junction took place during February 2013, it was anticipated that the improvements to the traffic light controls would reduce the likelihood of congestion in Seagate and potentially lead to improvements in monitored concentrations. A study has been commissioned to review traffic management options in the Seagate, as part of the council's air quality action plan (AQAP). Monitored levels in Union Street have decreased since the removal of bus stops from the street in 2011. The displacement of buses from Union Street seems to have contributed to the increase in monitored levels in Whitehall Street and Nethergate since 2011. In 2014 monitored annual mean concentrations in Lochee Road dropped below those recorded in 2006 for the first time since the AQMA was declared. The reduction since 2012 may have been influenced by the infrastructure works funded by the AQAP which removed the central reservation to free up road space and ease congestion.

Although there are insufficient years of valid data to determine a trend, the 2014 monitored annual mean concentration at Meadowside is lower than in 2013. The greater reduction seen at this site than at other automatic monitors suggests that the council's action plan measure to introduce a cycle lane between receptors and the main bus route in October 2013 may have had a beneficial influence.

**Figure 2.3 Annual Mean Nitrogen Dioxide Concentrations at Real-time Monitors from 2006 to 2014**

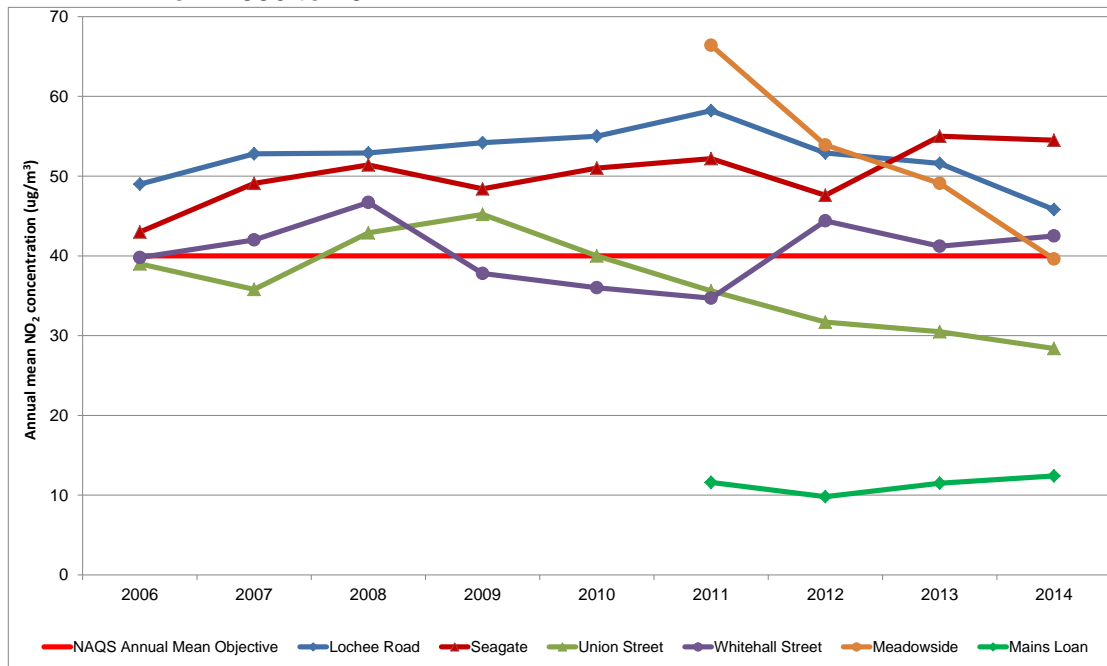
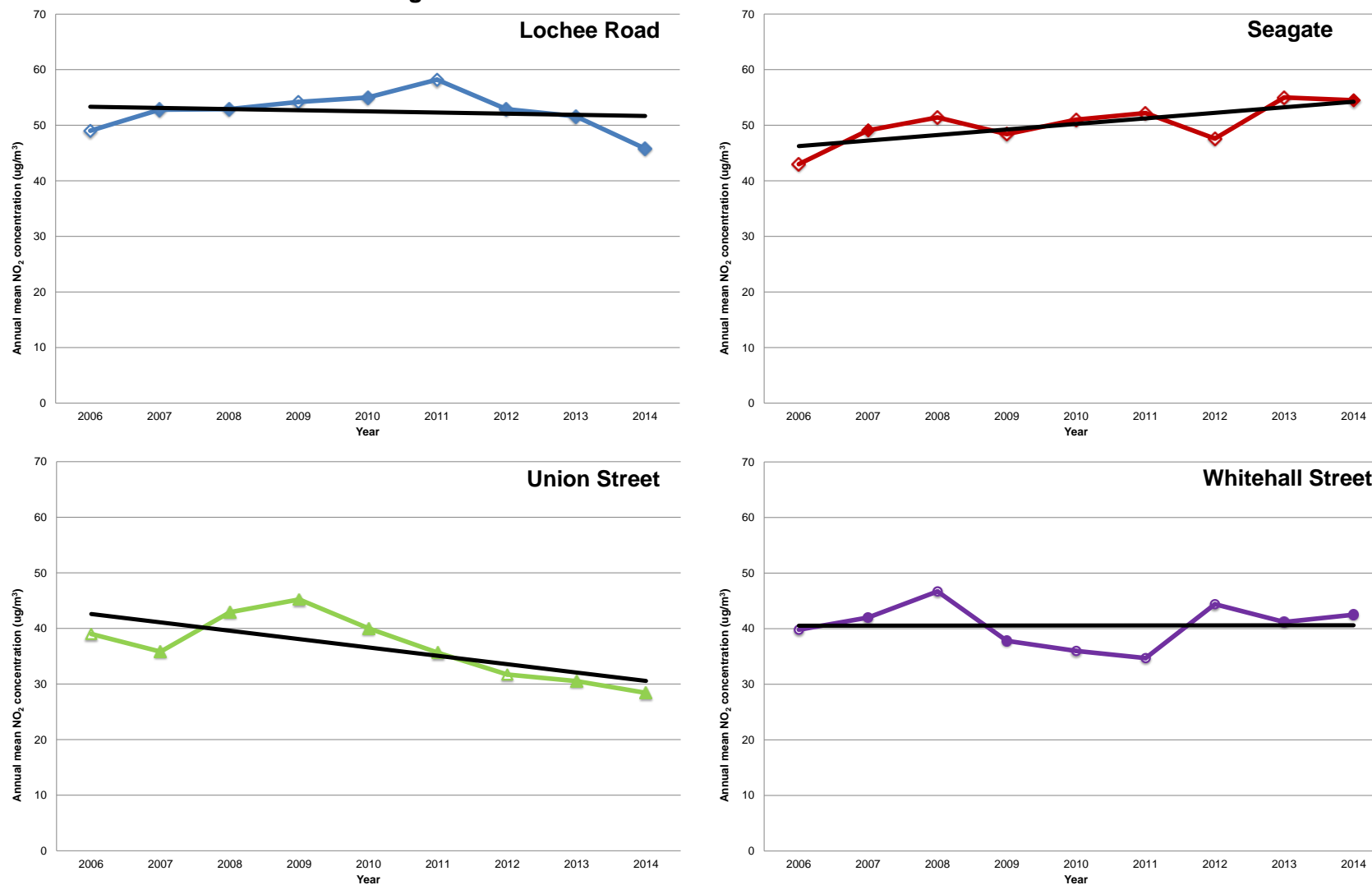


Figure 2.4 Trends in Annual Mean Nitrogen Dioxide Concentrations at Automatic Monitors from 2006 to 2014



Note : Hollow data points represent annual means based on less than 90% valid data capture

**Hourly Mean Concentrations**

**Table 2.8 & Figure 2.5** show the number of exceedences of the NO<sub>2</sub> hourly mean concentration (200µg/m<sup>3</sup>) at each of the real time monitoring locations in Dundee between 2006 and 2013. No more than 18 of these exceedences are allowed in a year. The objective was met at all the monitoring locations in 2014.

Where the measured data capture is less than 90%, it is considered more appropriate to express short-term concentrations as percentile values that approximate to the permitted number of exceedences. Generally, if the value of the 99.8<sup>th</sup> percentile is greater than 200µg/m<sup>3</sup>, then it is likely that the allowed number of hourly mean exceedences will have been breached. Expressing short-term concentrations as 99.8<sup>th</sup> percentile values provides easier inter-year comparison of data and examination of trends. The 99.8<sup>th</sup> percentile values from 2006 are shown in **Figure 2.6**. This shows that the only location where the hourly mean objective has ever been breached is Lochee Road.

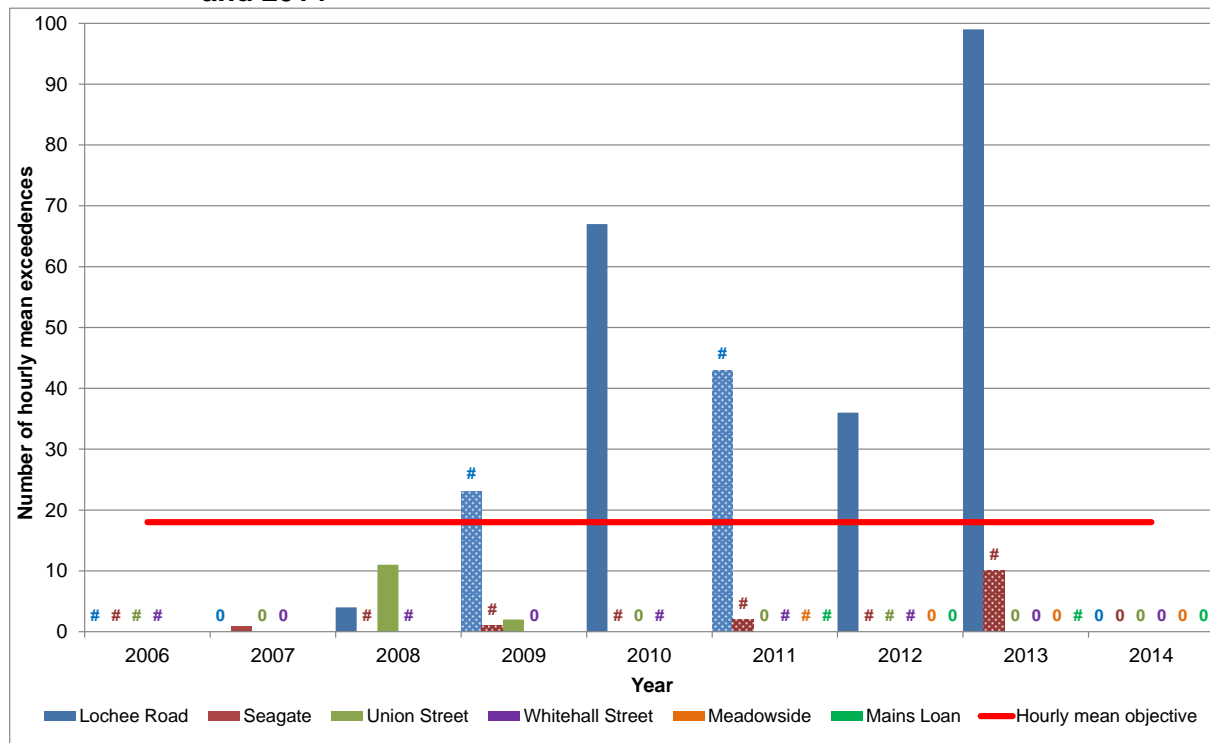
**Table 2.8 Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with 1-Hour Mean Objective**

Site ID	Location	Site Type	Within AQMA ?	Valid Data Capture for 2014 % <sup>a</sup>	Number of Exceedences of Hourly Mean (200 µg/m <sup>3</sup> ) (with the 99.8th percentile of hourly means in italics)									
					2006	2007	2008	2009	2010	2011	2012	2013	2014	
CM 4	Lochee Road	R	Y	99.5	0 <i>141</i>	0 <i>157.5</i>	4 <i>175.6</i>	<b>23</b> <i>206.2</i>	<b>67</b> <i>242.6</i>	<b>43</b> <i>241.6</i>	<b>36</b> <i>227.8</i>	<b>99</b> <i>256.5</i>	0 <i>169.5</i>	
CM 5	Seagate	R	Y	99.1	0 <i>119</i>	1 <i>141.2</i>	0 <i>141.3</i>	1 <i>152.8</i>	0 <i>134.8</i>	2 <i>156.5</i>	0 <i>143.9</i>	10 <i>171.9</i>	0 <i>153.2</i>	
CM 2	Union Street	R	Y	97.1	0 <i>133</i>	0 <i>132.1</i>	11 <i>182.3</i>	2 <i>165.2</i>	0 <i>141.9</i>	0 <i>133.1</i>	0 <i>98.5</i>	0 <i>107.1</i>	0 <i>88</i>	
CM 6	Whitehall Street	R	Y	98.1	0 <i>106</i>	0 <i>136.8</i>	0 <i>139.4</i>	0 <i>111.3</i>	0 <i>101.1</i>	0 <i>117.8</i>	0 <i>136.4</i>	0 <i>118.4</i>	0 <i>121.5</i>	
CM14	Meadowside	R	Y	99.8						0 <i>157.3</i>	0 <i>169.2</i>	0 <i>147.8</i>	0 <i>110.8</i>	
CM12	Mains Loan	UB	Y	93.3						0 <i>80.7</i>	0 <i>62.5</i>	0 <i>84.8</i>	0 <i>69.8</i>	

<sup>a</sup> data capture for the full year

indicates that there is insufficient valid data capture - so the 99.8<sup>th</sup> percentile should be used for comparison against the objective standard (200µg/m<sup>3</sup>)

**Figure 2.5** Number of Exceedences of the NO<sub>2</sub> Hourly Mean Standard (200µg/m<sup>3</sup>) (18 Allowed) at Real Time Monitoring Locations in Dundee between 2006 and 2014



Note: # denotes actual number of exceedences unknown as data capture less than 90%

Trend analysis has been undertaken at monitoring locations with five or more years of valid data. Hourly mean 98.08<sup>th</sup> percentile nitrogen dioxide concentrations have been plotted for successive years at Lochee Road, Union Street, Seagate and Whitehall Street. Trend lines have been drawn using an Excel simple regression statistical program. Data trends are shown in **Figure 2.7** and summarised in **Table 2.9**.

**Table 2.9** Summary of 1-hour mean 99.8<sup>th</sup> Percentile Nitrogen Dioxide trends measured at long-term Automatic Monitoring Sites

Monitoring Location	Site Type	Trend in 99.8 <sup>th</sup> Percentile NO <sub>2</sub> concentration (years included)	Concentrations of NO <sub>2</sub>
Lochee Road	Roadside	↑ (2006 to 2014)	Increasing
Seagate	Roadside	↑ (2006 to 2014)	Increasing
Union Street	Roadside	↓ (2006 to 2014)	Decreasing
Whitehall Street	Roadside	↑ (2006 to 2014)	Slight increase

Although there is an increasing trend at Seagate, for the hourly mean the only location of significance is Lochee Road. Stormy weather conditions particularly during the first few months of 2014 meant that there were none of the stable high pressure conditions which had previously contributed to the large number of hourly exceedences seen in 2013. Although there has been a sudden reduction in the number of exceedences the underlying trend in the 98.08<sup>th</sup> percentile remains upward. If a pattern of lower hourly mean percentile values continues it may be possible to consider amendment of the AQMA in respect of this objective. Any considerations would need to note that this monitor is not at the worst case exposure location, which is on Lochee Road nearer the junction with Dudhope Terrace.



Figure 2.6 Overview of 99.8th Percentile values of NO<sub>2</sub> Hourly Mean compared with the short-term standard (200µg/m<sup>3</sup>), 2006-2014

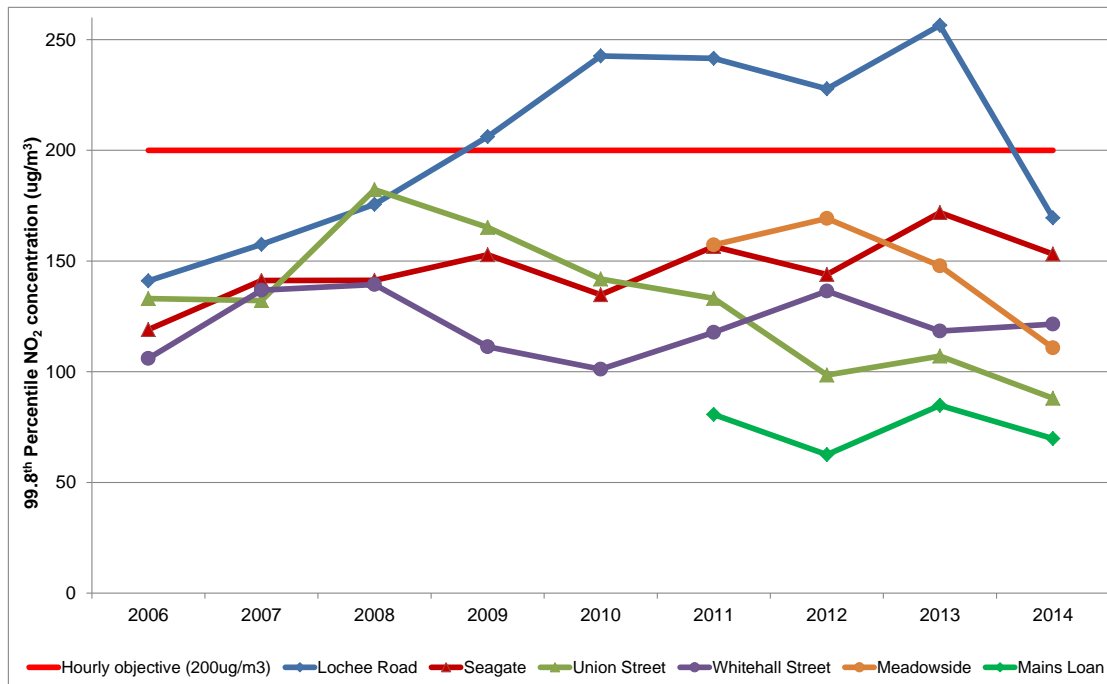
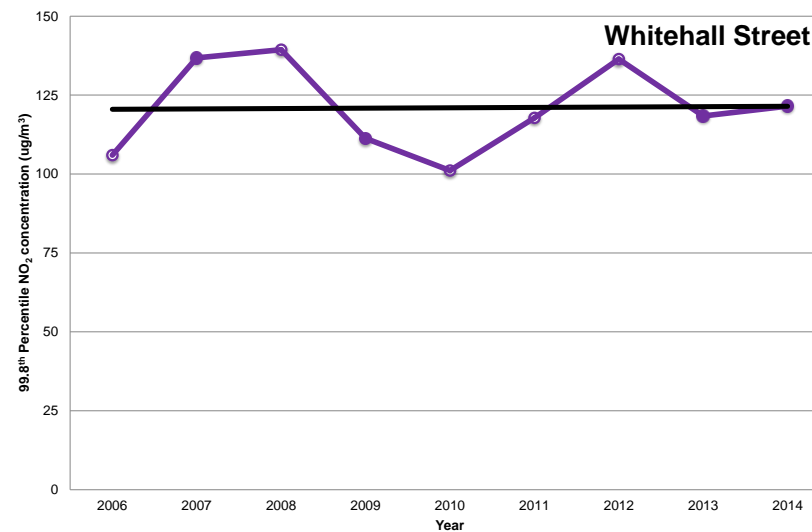
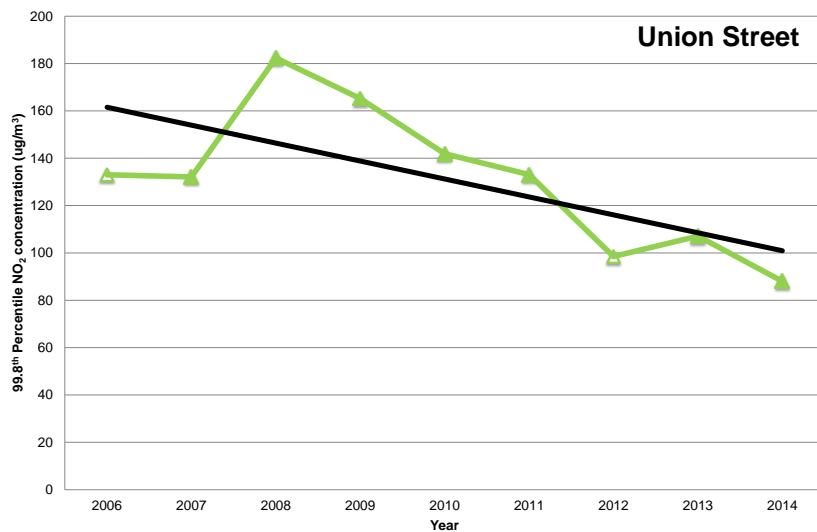
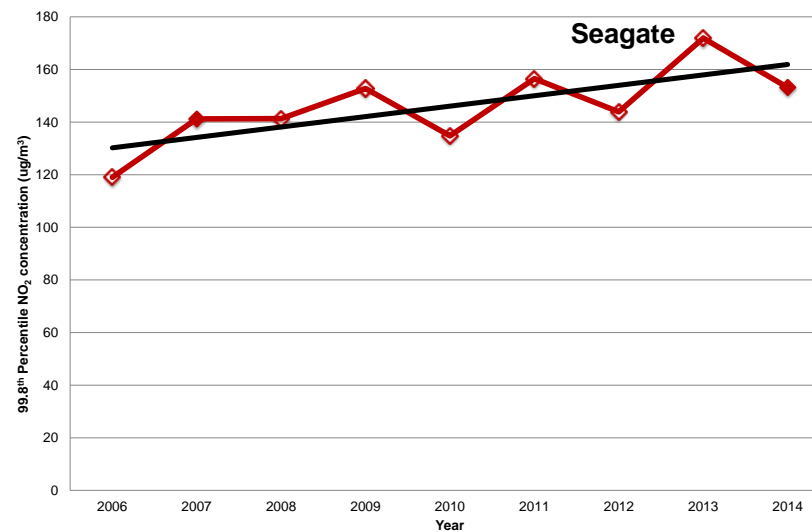
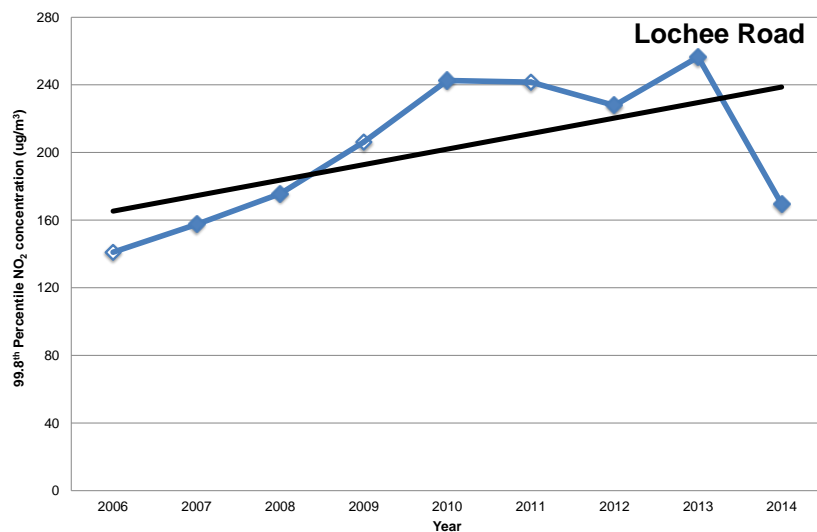


Figure 2.7 Trends in NO<sub>2</sub> Hourly Mean 99.8<sup>th</sup> Percentile Concentrations at Automatic Monitors from 2006 to 2014



Note : Hollow data points represent annual means based on less than 90% valid data capture

### 2.2.1.2 Diffusion Tube Monitoring Data

The nitrogen dioxide diffusion tube results for 2014 are summarised in the **Table 2.10**. The full 2014 dataset (monthly mean values) is included in **Appendix G** for the 82 diffusion tube sites in Dundee. None of the diffusion tube locations had less than 9 months data in 2014 and hence the results did not need to be annualised as described in Box 3.2 of LAQM.TG(09).. The local bias-correction factor (**0.82**) derived for Dundee sites has been applied to the 2014 results. **Appendix A1-A3** details how the local bias correction factor was derived.

The 2014 data show that concentrations measured at 32 diffusion tube sites exceeded the annual mean NO<sub>2</sub> objective. As the Dundee AQMA encompasses the whole local authority area all of these locations are within the existing AQMA. Further consideration of these sites was made with regard to the likely exposure at nearest residential receptors using the LAQM distance calculator tool. Of these, the predicted concentrations were estimated to exceed the NAQS at receptors at 6 sites. At least a further 16 locations were classed as 'borderline' as they were close to (i.e. greater than 36µg/m<sup>3</sup>) and therefore at risk of exceeding the annual mean objective when predicted to façade.

The LAQM.TG(09) guidance considers that there could be a potential risk of breaching the hourly NO<sub>2</sub> standard, where the annual mean NO<sub>2</sub> concentration is greater than (>) 60µg/m<sup>3</sup>. There were no diffusion tube sites with a bias corrected annual mean NO<sub>2</sub> concentration >60µg/m<sup>3</sup> in 2014.

**Table 2.10 Results of Nitrogen Dioxide Diffusion Tubes in 2014**

Site Id.	Location	x	y	Site Type	Annual mean NO <sub>2</sub> conc (µg/m <sup>3</sup> ) adjusted for bias									2014 Data Capture %	2014 Annual mean NO <sub>2</sub> at receptor (µg/m <sup>3</sup> )
					2006 bias (0.78)	2007 bias (0.86)	2008 bias (0.87)	2009 bias (0.83)	2010 bias (0.79)	2011 bias (0.78)	2012 bias (0.88)	2013 bias (0.87)	2014 bias (0.82)		
DT 1	Abertay	340047	730629	K	42.5	46.5	48.5								
DT 92	Abertay 2	340019	730612	R				47.2	42.5	40.1	41.5	40.2	39.7	100.0	36.0
DT 179	Albert St (15) (Facade)	341092	731121	R								36.5	36.5	100.0	36.0
DT 180	Albert St (15) (Rdside)	341091	731121	K								38.0	38.0	100.0	32.8
DT 167	Albert St (191)	341161	731535	K								36.5	35.0	100.0	29.7
DT 157	Albert St (71-73)	341106	731223	K						29.7	30.4				
DT 187	Albert St (81)	341113	731265	K								31.8	31.1	100.0	26.5
DT 2	Albert St (Fish)	341139	731476	K	30.0	30.7	32.8	34.7	33.9	29.2	31.7				
DT 3	Albert St (Shandon Place)	341171	731574	R	32.3	34.3	39.0	39.0	38.2	35.1	35.7				
DT 4	Albert St 1	341104	731210	K	32.1	33.0	37.9	37.4	36.0						
DT 5	Arbroath Rd (13)	341111	731070	K	37.4	38.0	40.2	45.4	40.8	36.6	39.9	38.3	35.7	100.0	30.6
DT 168	Arbroath Rd (27)	341223	731089	R								34.1	32.4	91.7	29.6
DT 147	Arbroath Rd (38)	341202	731097	K						34.6	39.4	37.6	34.3	100.0	28.6
DT 6	Arthurstone Terrace (10)	341051	731203	K	22.6	23.1	25.4	25.2	24.9	21.4	22.3				
DT 7	Balgavies Place	343082	731465	UB	15.3	17.6	18.9	18.6	19.1	17.1	18.0	17.0	15.5	100.0	n/a
DT 8	Bank St/ Reform St	340228	730337	K	26.4	29.4	28.2	30.9	27.7	26.6	28.0				
DT 9	Birnam Place	337531	730914	UB	9.6	10.8	11.7	11.0	11.4	9.6	10.4	10.1	9.6	100.0	n/a
DT 10	Brook St (B.F.)	346293	730872	K	21.8	22.9	23.1								
DT 144	Broughty Ferry Rd LP 59	343129	731082	R						22.2					
DT 166	Broughty Ferry Rd LP 59(2)	343129	731081	R							26.1	25.6	24.0	100.0	22.5
DT 140	Broughty Ferry Rd (L/P 66)	343297	731096	R						34.2	35.4	31.8	30.6	100.0	25.6
DT 139	Broughty Ferry Rd (141 Downpipe)	343317	731072	R						36.5	37.4	32.4	31.1	100.0	30.9
DT 11	Broughty Ferry Rd (141)	343322	731073	R	35.6	40.4	45.3	46.9	44.2	42.5	44.2	39.9	36.5	100.0	32.8
DT 145	Broughty Ferry Rd (Greendykes)	342662	731112	R						32.6	36.2	36.4	34.3	100.0	29.4
DT 142	Broughty Ferry Rd (141) (St.Sign)	343302	731075	R						27.3	32.2	30.4	29.5	83.3	29.4
DT 141	Broughty Ferry Rd Lower (L/P 5)	343415	730944	UB						17.1					
DT 164	Broughty Ferry Rd - Lower	343545	730942	UB							16.7	15.6	14.9	83.3	n/a

Site Id.	Location	x	y	Site Type	Annual mean NO <sub>2</sub> conc (µg/m <sup>3</sup> ) adjusted for bias										2014 Data Capture %	2014 Annual mean NO <sub>2</sub> at receptor (µg/m <sup>3</sup> )
					2006 bias (0.78)	2007 bias (0.86)	2008 bias (0.87)	2009 bias (0.83)	2010 bias (0.79)	2011 bias (0.78)	2012 bias (0.88)	2013 bias (0.87)	2014 bias (0.82)			
DT 155	Carolina Court LP6	342353	731058	UB								22.5	21.6	19.4	91.7	n/a
DT 186	Carolina Court 30 mph sign	342342	731083	R									28.6	25.0	100.0	25.1
DT 171	Claypotts / Arbroath Rd (502)	345347	732080	R									28.6			
DT 12	Claypotts Junction	345315	732103	R	22.7	24.6	28.0	27.5	29.0	25.4	26.5					
DT 174	Clepington Rd (172)	339974	732147	K									31.4			
DT 13	Clepington Rd/ Forfar Rd	341385	732121	K	33.5	36.8	38.5	40.7	39.8	34.7	38.0	36.4	33.6	100.0	26.1	
DT 14	Commercial St	340328	730431	K	31.3	33.5	36.2	34.2	31.2	27.8	29.9					
DT 84	Commercial St/Dock St (40)	340565	730263	R	35.6	38.6	41.9	42.2	41.3	37.6	41.2	40.1	35.9	100.0	35.6	
DT 188	Commercial St (9)	340544	730291	R								43.1	39.4	100.0	35.8	
DT 15	Commercial St (Waterstones)	340481	730325	R	34.9	40.2	47.4	43.2	43.3	38.0	39.5					
DT 175	Coupar Angus Rd (38)	337414	732164	R								32.9	29.8	91.7	27.7	
DT 16	Crichton St	340331	730162	K	28.6	31.6	34.0	33.7	31.3	29.0	31.6					
DT 17	Dens Rd Crossing	340725	731238	R	30.2	35.2	36.0	36.6	34.9	31.7	32.8	32.1				
DT 148	Dock St - Tay Hotel	340340	730033	K								32.9				
DT 192	Dock St (12)	340389	730079	R									25.8	91.7	23.9	
DT 18	Dock St (14)	340395	730086	K	37.1	46.7	43.8	43.1	42.0	36.3	33.1					
DT 85	Dock St (21)	340524	730216	R	36.3	37.8	37.5	38.2	38.3	34.2	40.8	42.6	38.2	75.0	37.8	
DT 156	Dock St (57)	340656	730343	R						43.4	53.1	53.9	51.7	91.7	44.7	
DT 19	Dock St (Unicorn)(No.60)	340659	730348	R	33.3	37.6	40.8	39.6	42.2	36.3						
DT 169	Dura St (30)	341021	731434	R								29.6				
DT 20	Dura St (100)	341150	731576	K	34.0	39.4	41.6	43.0	41.1	36.4	39.6	36.9	34.4	100.0	30.3	
DT 21	Earl Grey Place (Park)	340699	730019	UB	20.2	20.6	20.7	21.8	23.2	19.4	22.8					
DT 22	Eastport Roundabout	340651	730623	R	30.5	35.5	35.9	35.2	34.4	33.1	32.0	35.2	32.9	100.0	30.0	
DT 83	Forfar Rd (104)	341437	732360	K	40.2	45.7	50.2	52.6	49.1	45.6	50.2	45.9	44.8	100.0	32.0	
DT 23	Harefield Rd (35)	338360	731855	K	29.2	32.6	36.0	32.5	29.8	27.7	29.8					
DT 178	Hawkhill / Horsewater Wynd	339576	730223	K								29.6				
DT 154	High St Lochee (106)	337900	731560	R							23.2					
DT 24	Hilltown (Suites)	340088	731116	R	31.0	33.2	35.4	35.6	34.2	29.5	32.4					

Site Id.	Location	x	y	Site Type	Annual mean NO <sub>2</sub> conc (µg/m <sup>3</sup> ) adjusted for bias										2014 Data Capture %	2014 Annual mean NO <sub>2</sub> at receptor (µg/m <sup>3</sup> )
					2006 bias (0.78)	2007 bias (0.86)	2008 bias (0.87)	2009 bias (0.83)	2010 bias (0.79)	2011 bias (0.78)	2012 bias (0.88)	2013 bias (0.87)	2014 bias (0.82)			
DT 193	Horsewater Wynd	339549	730252	K										21.9	83.3	20.7
DT 25	King St (12 & 14)	340598	730757	K	26.4	28.7	30.1	31.1	29.1	26.5	27.2					
DT 177	Kingsway / Strathmartine Rd (279)	339179	732896	R								38.3	36.8	100.0	33.0	
DT 26	Kingsway East Roundabout	343107	731740	R	33.9	40.0	42.6	44.9	40.7	40.7	40.3	39.5	38.8	100.0	29.2	
DT 27	Kingsway/ Mains Loan	341124	732468	R	29.9	34.1	37.8	35.1	36.7	31.3	34.4	36.4	32.0	91.7	26.3	
DT 28	Kingsway/ Pitkerro Rd	341963	732303	R	26.6	30.7	26.7									
DT 29	Kingsway/ Strathmartine Rd (S)	339221	732836	K	37.4	43.3	45.0	43.2	46.3	39.4	45.9					
DT 30	Lochee Rd (138)	338936	730680	K	45.5	52.6	57.4	56.9	56.9	52.7	53.4	51.2	49.6	100.0	40.0	
DT 31	Lochee Rd (140) Traffic Lts	338927	730685	R	45.3	53.4	57.0	57.2	57.4	51.9	54.8	52.8	51.1	100.0	50.2	
DT 32	Lochee Rd (184)	338767	730856	K	31.9	38.1	39.1	40.2	39.7	36.9	37.6	36.1	34.4	100.0	29.1	
DT 158	Lochee Rd (Romon) Average	338861	730773	K	39.2	49.2	51.4	51.2	50.4	47.2	48.7	44.4	43.1	100.0	38.1	
DT 36	Lochee Rd/Polepark Rd	339016	730586	K	26.8	30.9	32.3	33.9	33.4	29.0	31.8	29.6	28.9	100.0	23.6	
DT 37	Logie St (114)	338184	731293	R	46.9	52.2	58.2	57.0	56.9	53.7	54.6	54.8	51.7	100.0	49.6	
DT 38	Logie St (98)	338252	731258	K	32.7	35.2	34.5	35.0	33.4	31.9	34.5	37.5	33.1	91.7	30.4	
DT 176	Logie St / Grays Lane	338062	731366	R								24.1				
DT 39	Loons Rd (1)	338211	731293	R	36.1	39.1	45.3	43.9	44.8	38.4	42.0	40.3	39.1	100.0	38.0	
DT 146	Mains Loan Average	340972	731893	UB						12.2	15.0					
DT 40	Marketgait	339953	730094	R	29.3	33.0	35.8	34.7	32.5	30.8	31.1					
DT 41	Meadowside	340245	730651	R	52.1	61.4	63.5	55.8	57.2	53.0	59.0					
DT 163	Meadowside / Bell St	340282	730592	K							49.1					
DT 182	Meadowside (28)	340298	730550	K								38.4	34.7	100.0	29.6	
DT 149	Meadowside (Romon) Average	340243	730653	R						56.4	56.9	49.9	43.7	100.0	42.7	
DT 170	Monifieth Rd (4)	346554	730919	R								25.2				
DT 42	Muirton Rd (6)	338152	731293	R	26.1	28.4	29.2	30.4	30.4	26.5	27.2	30.0	29.2	100.0	28.6	
DT 185	Murraygate (46)	340409	730484	UB								25.9	23.9	100.0	n/a	
DT 43	Myrekirk Rd	335420	731733	K	27.5	32.9	32.3	35.1	34.9	29.5	34.2					
DT 189	Myrekirk Rd (29)	335420	731726	R								34.8	31.7	83.3	27.5	
DT 181	Myrekirk Terrace (8)	335458	731767	R								30.4	27.6	100.0	27.1	

Site Id.	Location	x	y	Site Type	Annual mean NO <sub>2</sub> conc (µg/m <sup>3</sup> ) adjusted for bias										2014 Data Capture %	2014 Annual mean NO <sub>2</sub> at receptor (µg/m <sup>3</sup> )
					2006 bias (0.78)	2007 bias (0.86)	2008 bias (0.87)	2009 bias (0.83)	2010 bias (0.79)	2011 bias (0.78)	2012 bias (0.88)	2013 bias (0.87)	2014 bias (0.82)			
DT 44	Nethergate (88)	340163	730061	K	40.0	43.1	49.1	48.6	48.1	44.8	50.2	48.4	50.9	100.0	38.4	
DT 45	Nethergate (6)	340274	730171	R	35.8	37.4	43.2	41.9	38.7	38.0	42.3	41.7	40.4	100.0	35.1	
DT 46	Nethergate (95)	340033	729957	K	34.8	39.1	38.4	38.2	37.5	32.5	35.9	34.3	32.2	100.0	28.9	
DT 47	Nethergate (40)	340230	730124	R	34.5	39.6	44.6	41.8	38.9	38.1	42.5	45.0	42.8	100.0	36.7	
DT 87	Nethergate/South Tay St	339987	729919	R	25.4	29.6	30.1	29.3	29.8	24.4	24.5					
DT 48	Nethergate(132) / Marketgait	340074	729984	R	29.8	36.0	35.2	35.4	33.9	30.2	33.5	32.5	29.3	100.0	26.1	
DT 173	Old Glamis Rd(9) / Balgray St	339941	732251	K								24.3				
DT 86	Perth Rd / Hawkhill	338742	729828	K	23.5	25.0	22.9									
DT 91	Perth Rd (320)	338776	729798	K			36.5	39.9	37.6	36.0	36.3	37.1	35.1	100.0	28.2	
DT 172	Pitkerro Rd (3)	341227	731629	R								29.6				
DT 88	Queen St B/F	346207	731007	R			29.8	31.3	30.1	25.1	27.7					
DT 49	Rankine St (2)	338768	730900	R	31.7	39.9	42.6	44.9	45.5	40.5	44.4	40.1	38.1	100.0	37.2	
DT 50	Seagate (101)	340545	730532	R	39.0	42.3	45.9	44.9	42.3	40.2	39.4	41.9	40.8	91.7	40.3	
DT 150	Seagate (95-97)	340511	730492	R						46.2	51.4	40.7				
DT 190	Seagate (97)	340516	730499	R								59.4	46.5	100.0	46.5	
DT 54	Seagate (9)	340487	730446	R	35.1	40.5	38.3	41.5	39.4	35.6	38.4	38.1	36.0	100.0	34.3	
DT 159	Seagate(Romon) Average	340467	730388	K	42.3	47.5	50.8	51.4	48.9	45.0	49.2	48.0	45.5	100.0	40.3	
DT 55	Soapwork Lane	340099	730650	R	29.6	35.0	35.8	36.9	35.4	32.8	34.8	34.7	31.9	91.7	31.9	
DT 151	South Rd (1 Denbank)	335188	731528	R						34.6	36.9	34.7	33.2	100.0	32.7	
DT 56	St Andrews St (26)	340516	730584	K	32.7	34.8	40.4	36.9	36.7	33.5	36.2	36.4	35.3	100.0	31.1	
DT 57	St Andrews St (PB)	340532	730551	K	35.0	41.5	41.6	41.5	40.4	38.1						
DT 162	St Andrews St PB (façade)	340532	730548	R							38.8	37.3	36.3	100.0	35.9	
DT 58	St Mary Flats	339039	730624	R	18.4	20.6	19.8									
DT 153	Strathmore Ave - Ped X	339667	731878	R						26.7	29.4					
DT 152	Strathmore Avenue (337)	339522	731875	K						29.9	35.0					
DT 59	Strathmore Avenue (353)	339609	731871	K	35.0	38.0	42.6	40.3	39.9	35.5	38.8	38.0	38.8	100.0	34.3	
DT 60	Trades Lane (31)	340575	730500	K	29.2	36.3	33.3	32.8	32.6	29.4	30.4	31.4	27.3	100.0	24.6	
DT 61	Union St (Rollalong) Average	340235	730091	R	39.1	43.4	44.7	45.3	40.7	36.2	34.6	34.8	32.0	100.0	28.1	

Site Id.	Location	x	y	Site Type	Annual mean NO <sub>2</sub> conc (µg/m <sup>3</sup> ) adjusted for bias										2014 Data Capture %	2014 Annual mean NO <sub>2</sub> at receptor (µg/m <sup>3</sup> )
					2006 bias (0.78)	2007 bias (0.86)	2008 bias (0.87)	2009 bias (0.83)	2010 bias (0.79)	2011 bias (0.78)	2012 bias (0.88)	2013 bias (0.87)	2014 bias (0.82)			
DT 64	Union St (Goodfellows)	340274	730069	K	28.2	32.4	34.1	32.6	32.1	26.9						
DT 65	Union St (McIntyres)	340293	730051	K	29.0	32.7	33.2	33.5	32.8	28.9						
DT 66	Victoria Rd	340212	730633	R	32.1	36.7	38.4	37.5	36.2	30.9	34.2					
DT 67	Victoria Rd (10a)	340225	730667	R	29.7	32.9	34.0									
DT 184	Victoria Rd (104) / William St	340697	730950	R								33.3	30.7	91.7	28.6	
DT 191	Victoria Rd (4) - India Buildings	340213	730633	R								32.7	31.8	100.0	31.8	
DT 68	Victoria Rd (60)	340375	730779	R	35.2	41.1	43.8	44.0	40.8	38.6	42.2	39.8	37.5	100.0	36.4	
DT 93	Victoria Rd (10b)	340230	730673	K				38.5	37.5	33.8	36.2	34.0	30.6	100.0	25.8	
DT 69	Victoria Rd / Cotton Rd	340740	730996	K	31.3	36.6	37.4	38.1	36.5	34.0	36.7					
DT 70	Victoria Rd/Hilltown	340274	730714	R	47.8	55.8	60.9	59.5	57.9	52.8	57.9	56.1	51.5	100.0	44.4	
DT 71	Victoria St/Albert St	341071	731072	K	31.7	34.1	35.2	36.5	35.2	33.8	34.8	32.2	30.0	100.0	27.2	
DT 90	Ward Rd	339893	730336	R			34.5	35.7	33.3	32.4	30.2	30.3				
DT 89	West Bell St	339815	730395	R			36.0									
DT 95	West Marketgait	339814	730380	K				44.1	38.2	35.0	37.2					
DT 183	West Marketgait / Guthrie St	339805	730338	R								50.7	46.1	91.7	40.1	
DT 72	Westport (2)	339842	730122	R	33.6	38.9	41.3	42.1	37.5	37.0	37.7	39.0	36.3	100.0	30.3	
DT 73	Whitehall Cr (4)	340376	730109	K	27.2	30.3	30.6	30.4	29.5	26.1	37.6	39.4	36.3	100.0	30.9	
DT 161	Whitehall Cr /Union St (50)	340305	730051	K							29.8	30.4	30.5	91.7	25.4	
DT 74	Whitehall St (40)	340330	730106	K	32.2	36.3	37.8	35.8	35.5	33.1	39.7	39.7	39.5	100.0	32.3	
DT 75	Whitehall St (5)	340289	730128	R	42.8	48.6	51.7	48.6	43.4	45.7	49.5	46.7	44.1	100.0	38.8	
DT 76	Whitehall St (1)	340265	730153	K	38.5	43.4	50.3	46.9	42.5	41.4	47.3	49.9	45.9	91.7	34.9	
DT 77	Whitehall St (15)	340322	730098	K	32.2	36.9	39.6	38.3	37.1	34.7	37.9	40.7	36.1	100.0	29.3	
DT 160	Whitehall St (Romon) Average	340278	730156	R	33.2	38.5	42.7	38.9	36.5	36.0	41.6	43.1	42.2	100.0	39.6	
DT 81	Whitehall St (12)	340293	730142	R	34.8	38.8	42.6	40.2	37.1	35.8	39.6	41.8	40.8	100.0	37.0	
DT 82	Woodside Ave	340776	732307	UB	15.6	18.1	18.5	17.7	17.5	15.4	16.2	15.4	14.9	100.0	n/a	

Notes for Table 2.6 (over page)



- All diffusion tubes are located within an AQMA for NO<sub>2</sub> and PM<sub>10</sub> annual mean. New Locations in 2013 are highlighted in pink.
- Monitoring period and data capture percentage is for the full calendar year.
- The means shown in the highlighted cells have been “annualised” as in Box 3.2 of LAQM.TG(09).
- Exceedences of the air quality objectives are shown in bold & red. Orange values denote those at risk of exceeding the objective.
- Definitions and siting criteria for each site type can be found in Box A1.2 (LAQM.TG:09), K=Kerbside, R=Roadside, UB=Urban Background.
- If an exceedence is measured at a monitoring site not representative of public exposure, NO<sub>2</sub> concentration at the nearest relevant exposure should be estimated based on the “NO<sub>2</sub> fall-off with distance” calculator (<http://laqm.defra.gov.uk/tools-monitoring-data/no2-falloff.html>), and results should be discussed in a specific section. The procedure is also explained in Box 2.3 of Technical Guidance LAQM.TG(09) (<http://laqm.defra.gov.uk/technical-guidance/index.html?d=page=30>).

The diffusion tubes monitoring sites were assessed using the procedures and equations set out in LAQM.TG(09) (Box2.3), to determine whether exceedences are likely to occur at the nearest relevant receptor. The average of urban background monitoring locations (Balgavies Place, Broughty Ferry Road (lower), Carolina Court, Murraygate and Woodside Avenue) was used to provide the background concentration ( $17.7\mu\text{g}/\text{m}^3$ ) for these comparisons. Background sites were selected in accordance with the selection criteria contained in Box A1.2 of LAQM.TG(09). Of the 32 sites that recorded an exceedence in 2014, all were located within the AQMA.

There is considerable uncertainty associated with the use of the distance calculator tool. An example of this can be illustrated using two locations where there are diffusion tubes located at both kerbside and at façade. These are on Lochee Road and Albert Street. Lochee Rd (138) (DT 38) is located at kerbside and Lochee Rd (140) (DT 31) is located close to (25cm) the residential façade nearby. When the distance calculator is used to predict the drop-off in pollutant concentrations between the two tubes it calculates that pollution levels drop from  $49.6\mu\text{g}/\text{m}^3$  to  $40.6\mu\text{g}/\text{m}^3$ , i.e. a drop off of  $9.0\mu\text{g}/\text{m}^3$ . The actual monitored value at the façade tube was  $51.1\mu\text{g}/\text{m}^3$ , an increase of  $1.5\mu\text{g}/\text{m}^3$ . Albert St.(15) (Roadside) (DT 180) is located at kerbside and Albert St. (15) (Façade) is located close to (25cm) the residential façade nearby. When the distance calculator is used to predict the drop-off in pollutant concentrations between the two tubes it calculates that pollution levels drop from  $38.0\mu\text{g}/\text{m}^3$  to  $33.2\mu\text{g}/\text{m}^3$ , i.e. a drop off of  $4.8\mu\text{g}/\text{m}^3$ . The actual monitored value at the façade tube was  $36.5\mu\text{g}/\text{m}^3$ , a decrease of  $1.5\mu\text{g}/\text{m}^3$ .

The following 6 sites exceeded the NAQS annual mean when the distance calculator tool was used to estimate concentrations at relevant receptors:

**Table 2.11 Predicted Exceedences of NO<sub>2</sub> Annual Mean at Façade of Receptors**

Site ID	Location	x	y	2014 Bias adjusted NO <sub>2</sub> annual mean ( $\mu\text{g}/\text{m}^3$ )	2014 Predicted annual mean NO <sub>2</sub> concentration at Receptor ( $\mu\text{g}/\text{m}^3$ )
DT 156	Dock St (57)	340656	730343	<b>51.7</b>	<b>44.7</b>
DT 31	Lochee Rd (140) Traffic Lts	338927	730685	<b>51.1</b>	<b>50.2</b>
DT 37	Logie St (114)	338184	731293	<b>51.7</b>	<b>49.6</b>
DT 149	Meadowside (Romon) Average	340243	730653	<b>43.7</b>	<b>42.7</b>
DT 190	Seagate (97)	340516	730499	<b>46.5</b>	<b>46.5</b>
DT 70	Victoria Rd/Hilltown	340274	730714	<b>51.5</b>	<b>44.4</b>

A further 16 locations were close to exceeding the NAQS annual mean ( $>36\mu\text{g}/\text{m}^3$ ) when the distance calculator tool was used to estimate concentrations at relevant receptors.

**Table 2.12 Locations at risk of Exceeding NO<sub>2</sub> Annual Mean at Façade of Receptors**

Site ID	Location	x	y	2014 Bias adjusted NO <sub>2</sub> annual mean (µg/m <sup>3</sup> )	2014 Predicted annual mean NO <sub>2</sub> concentration at Receptor (µg/m <sup>3</sup> )
DT 92	Abertay 2	340019	730612	39.7	36.0
DT 179	Albert St (15) (Facade)	341092	731121	36.5	36.0
DT 85	Dock St (21)	340524	730216	38.2	37.8
DT 30	Lochee Rd (138)	338936	730680	49.6	40.0
DT 158	Lochee Rd (Romon) Average	338861	730773	43.1	38.1
DT 39	Loons Rd (1)	338211	731293	39.1	38.0
DT 47	Nethergate (40)	340230	730124	42.8	36.7
DT 44	Nethergate (88)	340163	730061	50.9	38.4
DT 49	Rankine St (2)	338768	730900	38.1	37.2
DT 50	Seagate (101)	340545	730532	40.8	40.3
DT 159	Seagate(Romon) Average	340487	730446	45.5	40.3
DT 68	Victoria Rd (60)	340375	730779	37.5	36.4
DT 183	West Marketgait / Guthrie St	339805	730338	46.1	40.1
DT 81	Whitehall St (12)	340293	730142	40.8	37.0
DT 75	Whitehall St (5)	340289	730128	44.1	38.8
DT 160	Whitehall St (Romon) Average	340278	730156	42.2	39.6

None of the new tubes installed in 2014 recorded concentrations that breached or were close to breaching the annual mean NAQS when predicted to façade. Diffusion tubes located at Carolina Court (DT 186) (25.1 µg/m<sup>3</sup>), Hawkhill / Horsewater Wynd (DT 193) (20.7 µg/m<sup>3</sup>), Coupar Angus Road (38) (DT 175) (27.7 µg/m<sup>3</sup>), and Myrekirk Terrace (8) (DT 181) (27.1 µg/m<sup>3</sup>), were discontinued at the end of 2014 as the results were well below the objective when predicted to receptor façade.

### 2.2.1.3 Overview of Diffusion Tube NO<sub>2</sub> Concentrations in Areas of Concern

The AQMA was first declared in 2006, **Figure 2.8** shows the difference between 2006 and 2014 bias corrected diffusion tube annual mean results for those 47 tube sites that have been present for nine years. Seven locations have lower concentrations than in 2006 and 40 have higher concentrations. The greatest increases in pollutant concentrations over this time period have been recorded at diffusion tubes located along the city centre bus corridor, the north-west arterial route (A923) and associated access roads, and major junctions on or near the Kingsway.

To give a reasonable overview of how concentrations are changing at different locations, the bias-corrected diffusion tube NO<sub>2</sub> concentrations between 2006 and 2014 in areas of concern throughout the city have been plotted and mapped in **Figures 2.9 to 2.35**. These include:

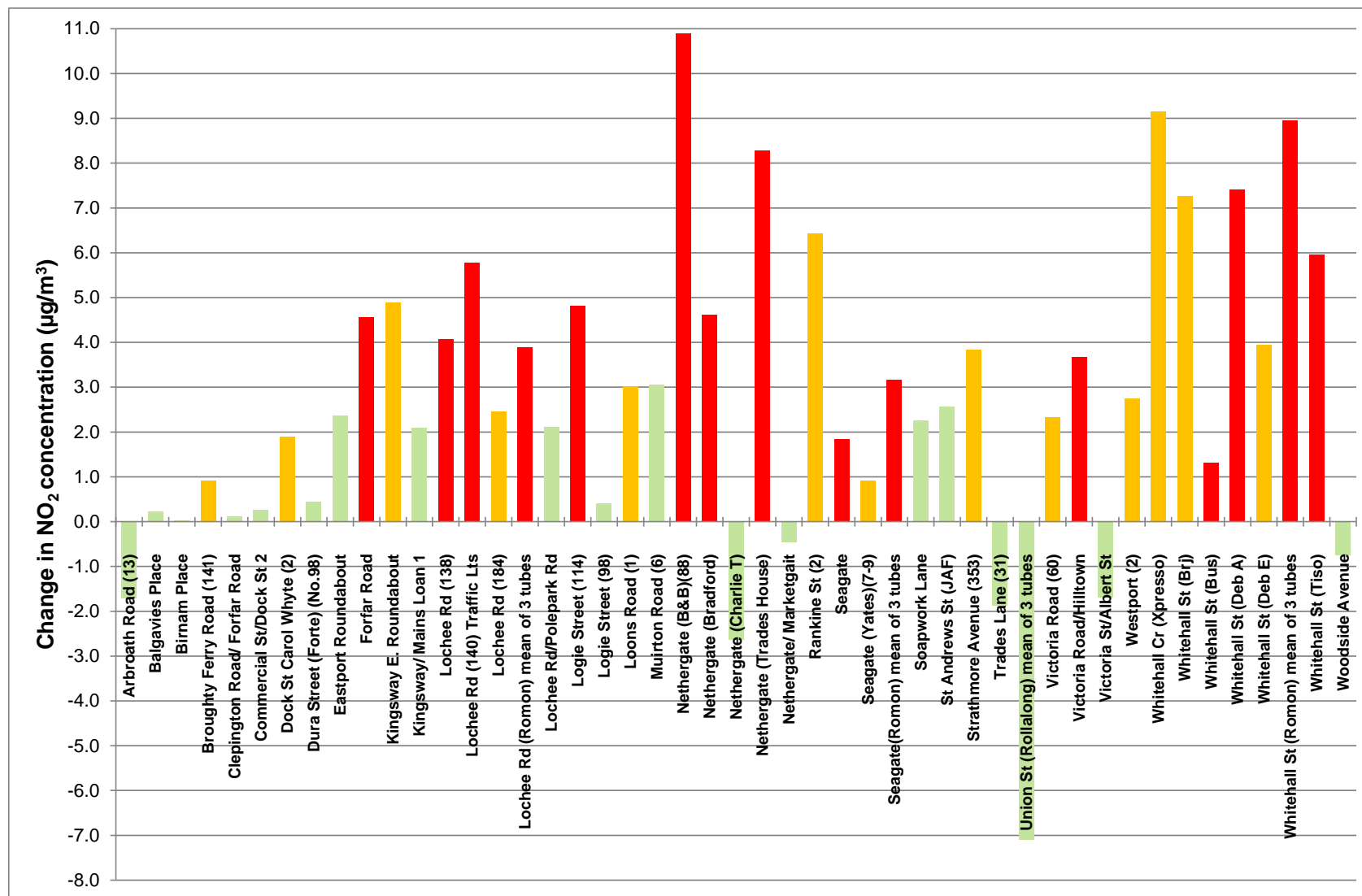
- Union Street
- Seagate
- Victoria Rd / Meadowside
- Lochee Road
- Albert St. / Arbroath Rd.
- Main Bus Corridor
- Stannergate Roundabout
- Whitehall Street
- Nethergate
- Albert St / Dura St.
- Logie St
- Kingsway / Forfar Rd.
- Inner Ring Road
- Strathmore Avenue

All of these locations have been described in previous review and assessment reports.

From the data presented in **Figures 2.9 to 2.35** it is evident that NO<sub>2</sub> concentrations do not show a consistent downward trend and in most cases concentrations remain higher in 2014 than in 2006 when the AQMA was declared. Trend analysis for locations with more than 5 year's data is shown in **Appendix I**. Excel "SLOPE" function has been used to calculate the slope of the best fit linear trend line for the selected data. Negative values indicate a downward trend and positive values an upward one. Higher values denote more pronounced trends. The majority of results have low values, indicating no distinct trend in NO<sub>2</sub> concentrations at these locations. Distinct upward trends are evident for locations on Whitehall Crescent, Whitehall Street, Nethergate (East of West Marketgait), Rankine Street and Dock Street (East of Castle Street). Distinct downward trends, denoting improving air quality, can be seen at Union Street, North Marketgait, Victoria Road (West of Meadowside), and Nethergate (West of West Marketgait).

However, NO<sub>2</sub> concentrations at locations of relevant exposure, previously above the objective, on Union Street, Stannergate Roundabout, and Strathmore Avenue were below the annual mean objective in 2014

**Figure 2.8 Change in NO<sub>2</sub> concentrations at 47 Diffusion tube monitoring locations between 2006 and 2014**  
 (N.B. Red columns are locations where the annual mean air quality objective is exceeded, and orange columns are locations at risk of exceeding.)



Union Street & Whitehall Street

Figure 2.9 NO<sub>2</sub> Monitoring Locations in Union Street and Whitehall Street

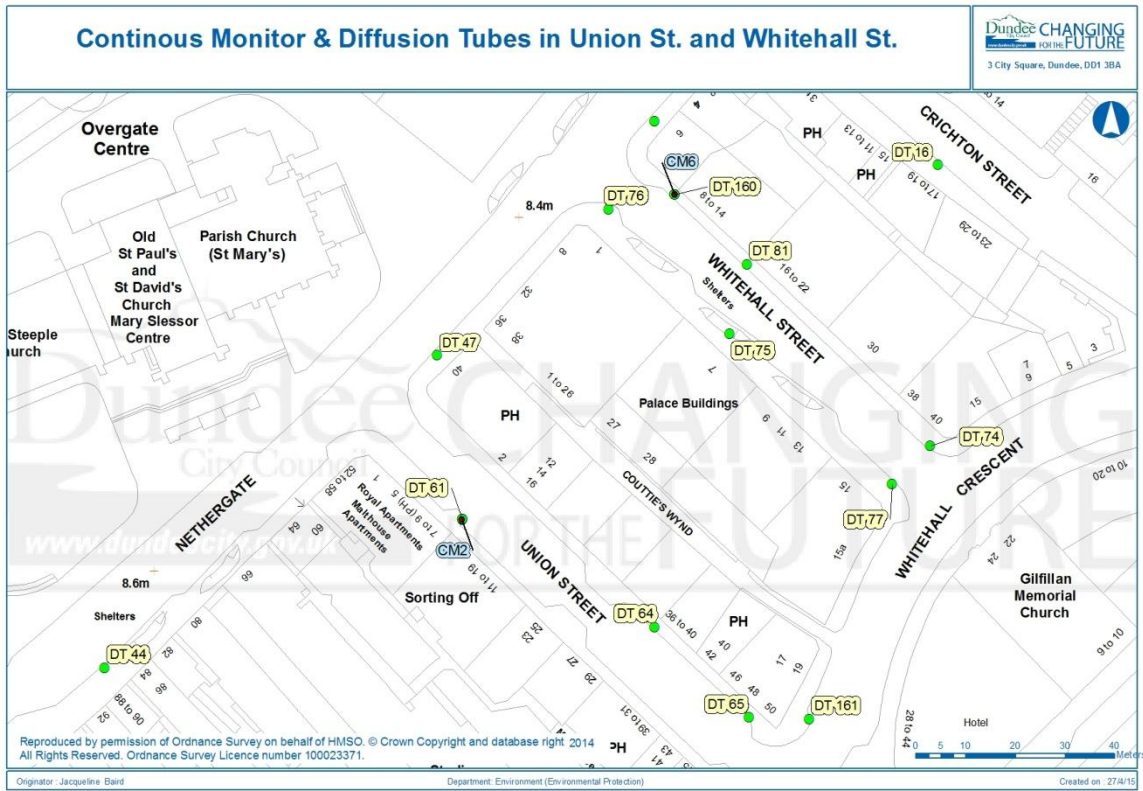


Figure 2.10 Overview of NO<sub>2</sub> Concentrations in Union St and Nethergate (east of Marketgait).

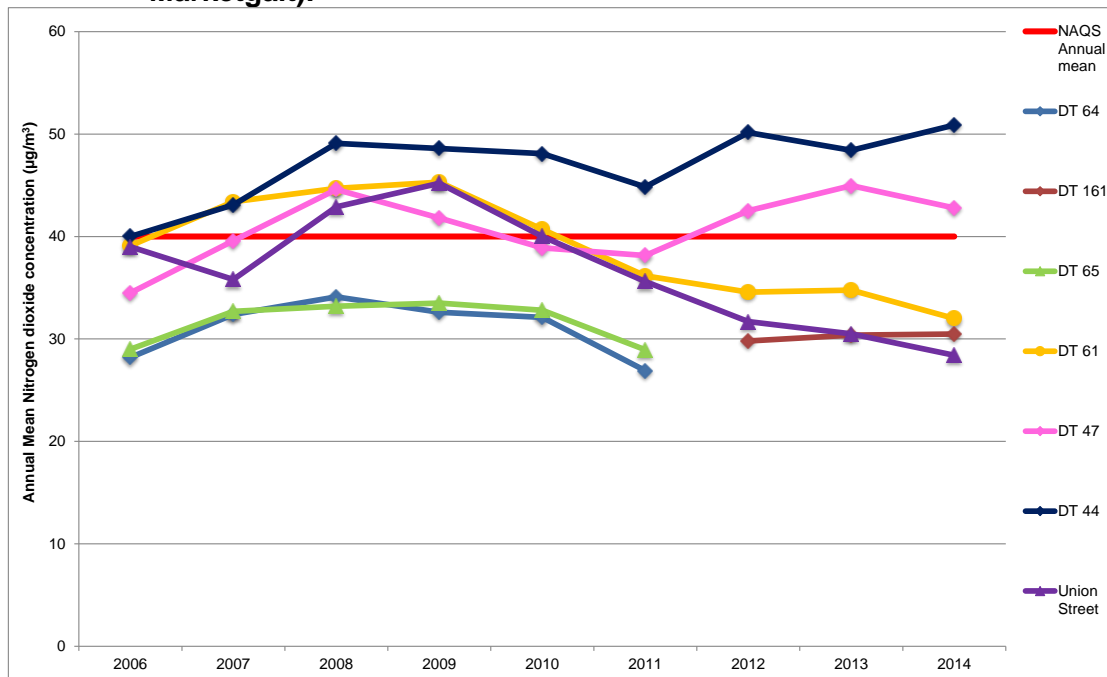
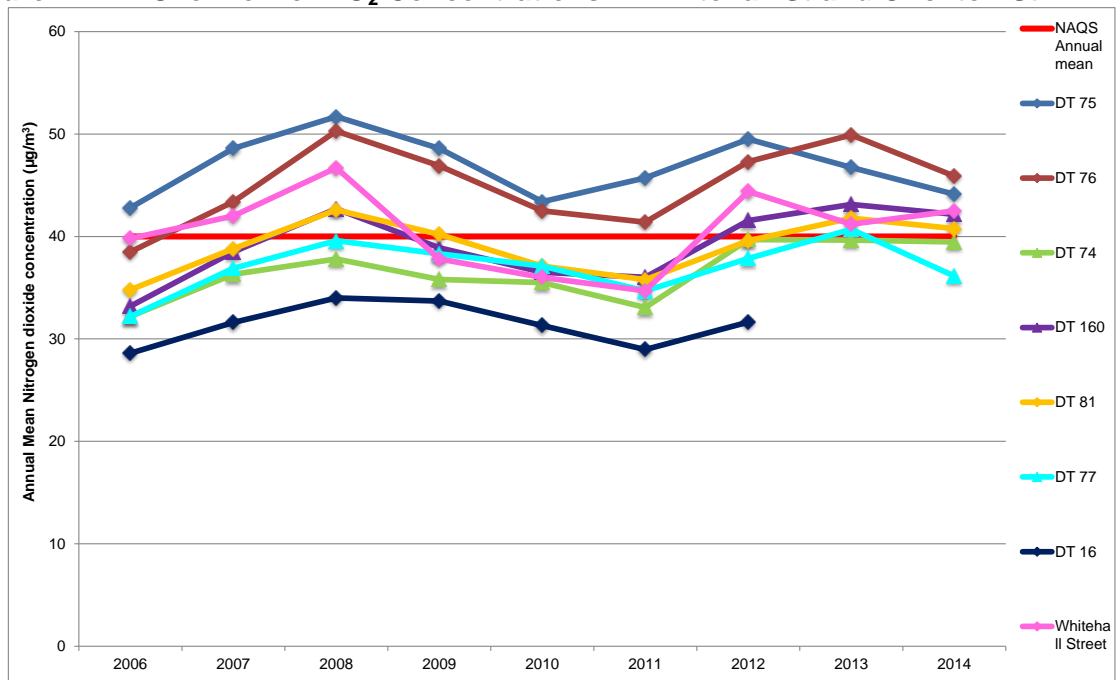


Figure 2.11 Overview of NO<sub>2</sub> Concentrations in Whitehall St and Crichton St.



Seagate  
 Figure 2.12 NO<sub>2</sub> Monitoring Locations in Seagate

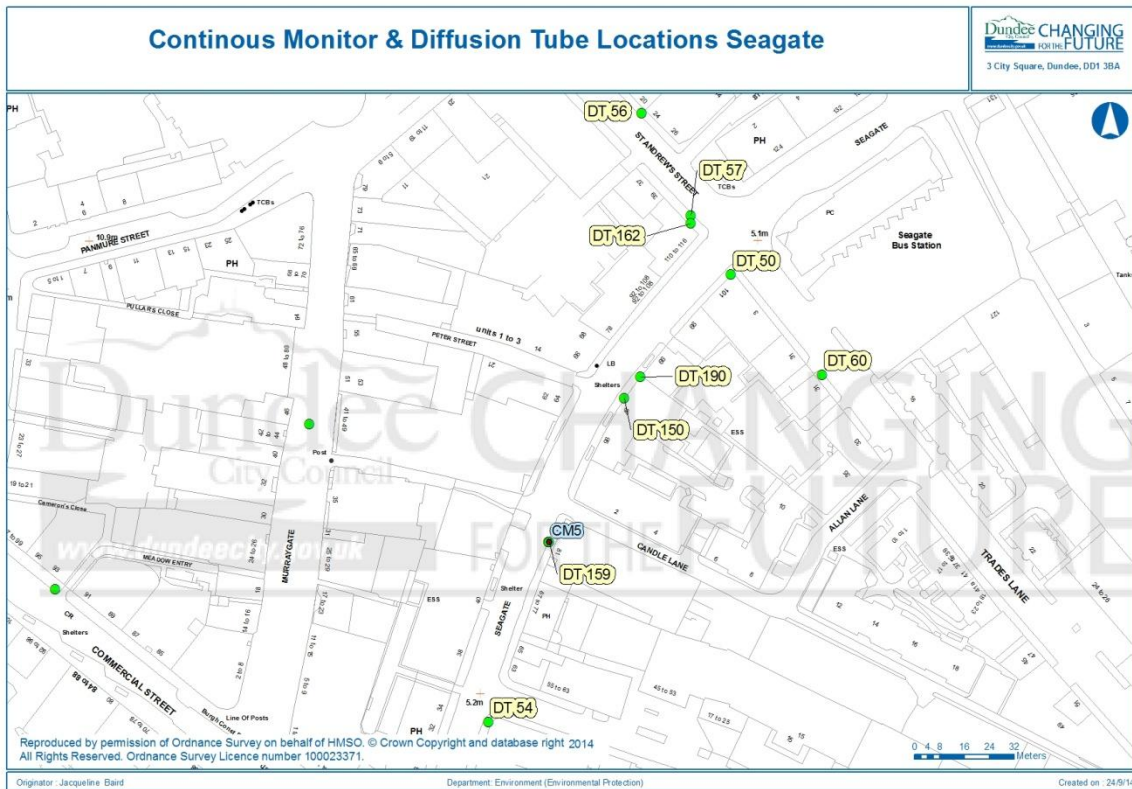
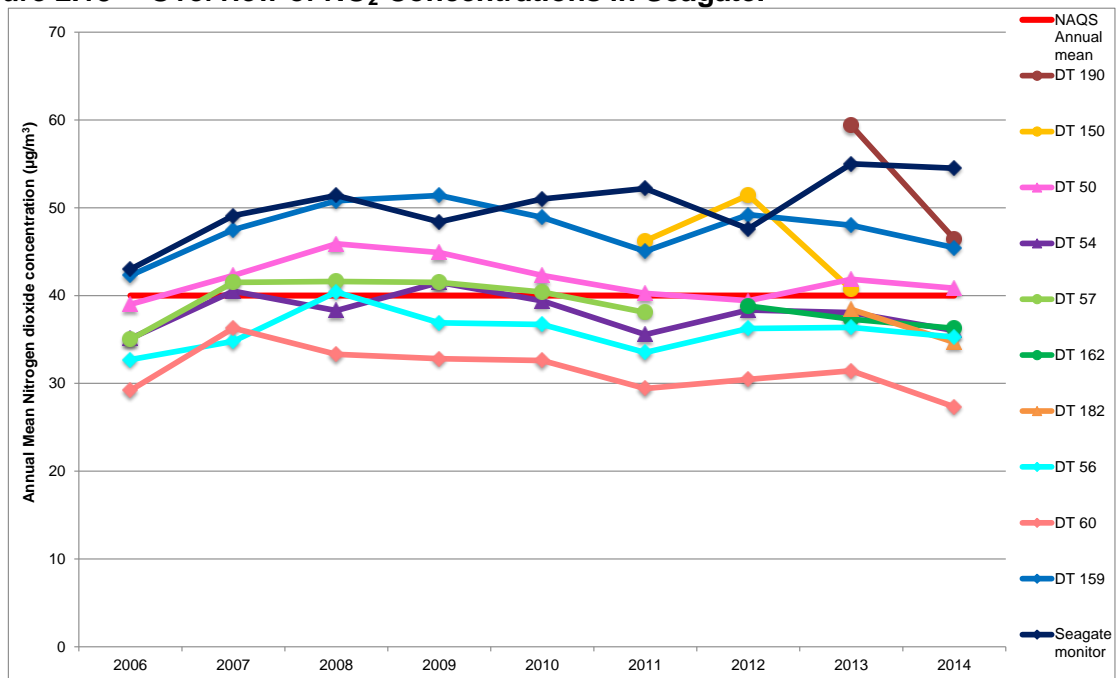
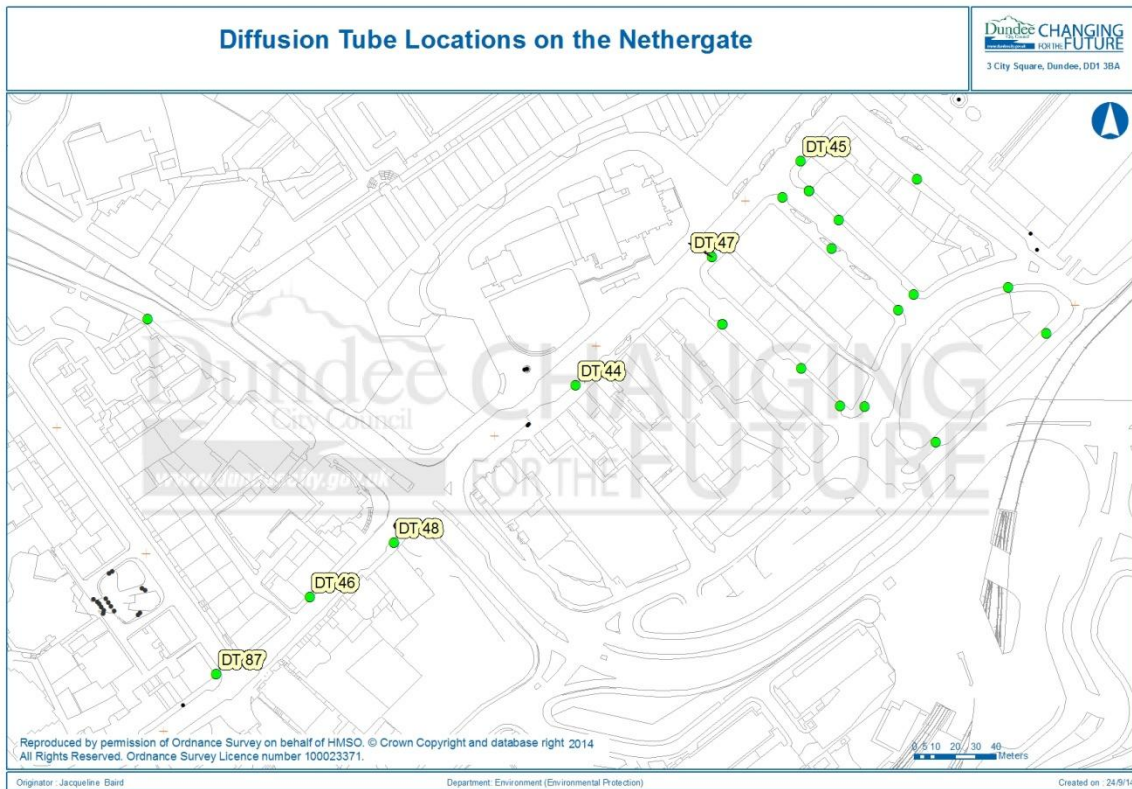


Figure 2.13 Overview of NO<sub>2</sub> Concentrations in Seagate.

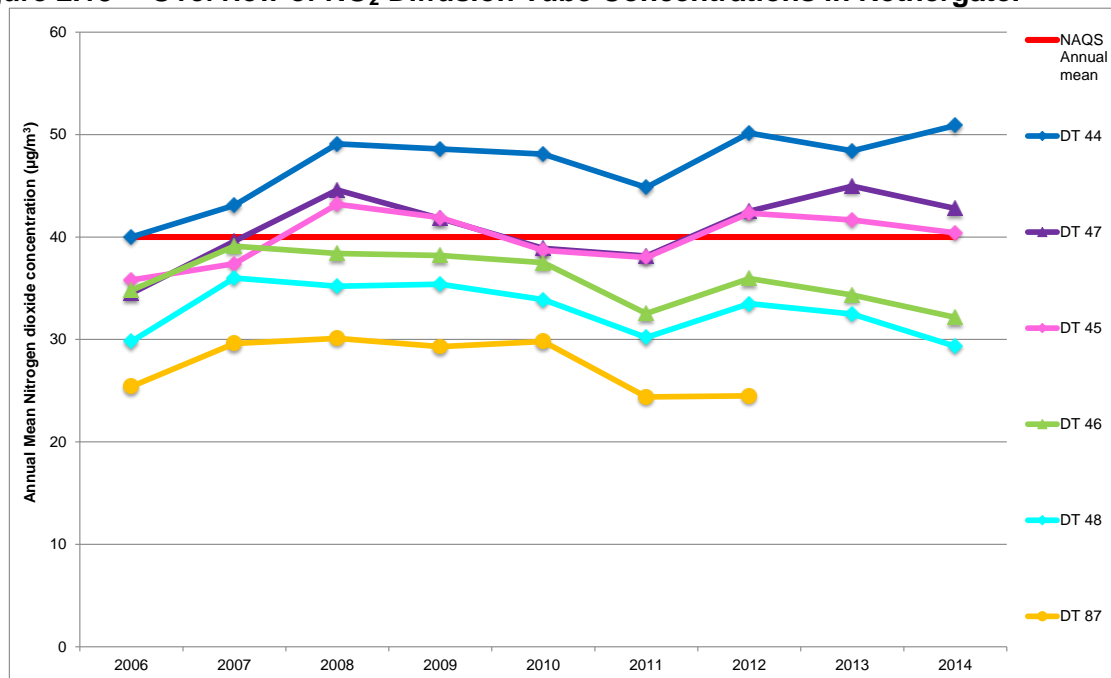




Nethergate  
**Figure 2.14** NO<sub>2</sub> Diffusion Tube Locations in Nethergate



**Figure 2.15** Overview of NO<sub>2</sub> Diffusion Tube Concentrations in Nethergate.



Victoria Road / Meadowside

Figure 2.16 NO<sub>2</sub> Diffusion Tube Locations in Victoria Road / Meadowside

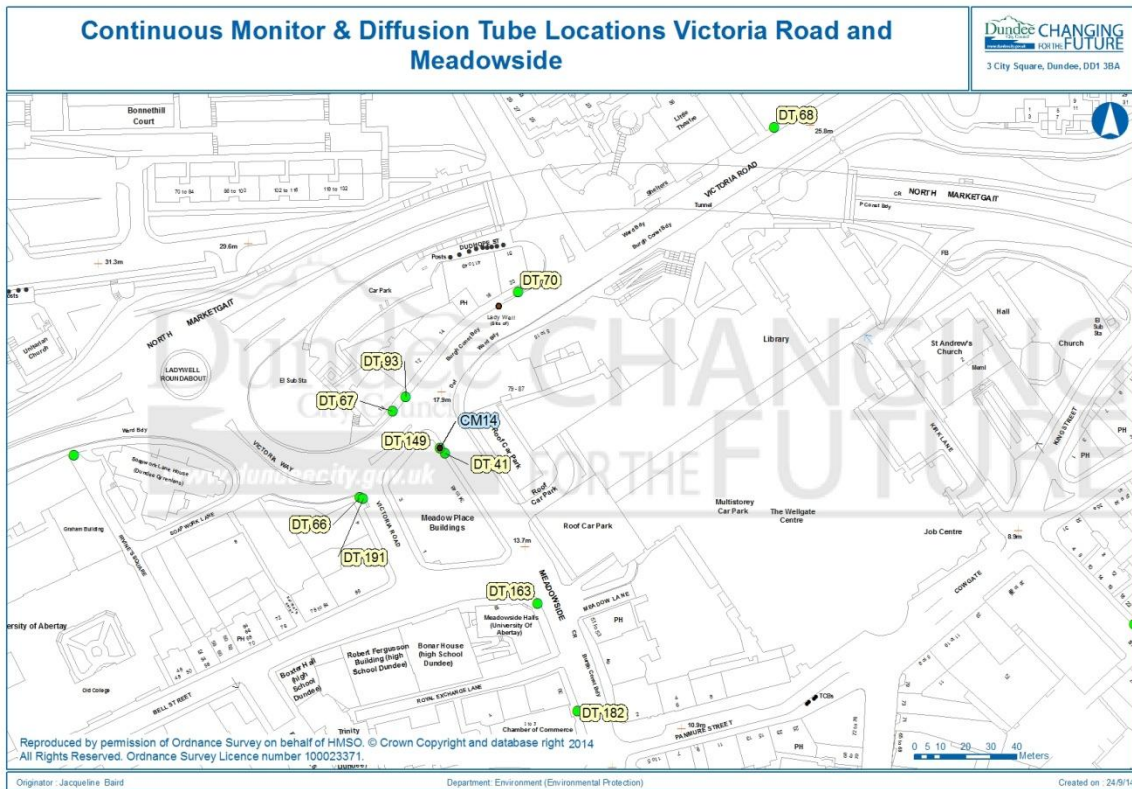
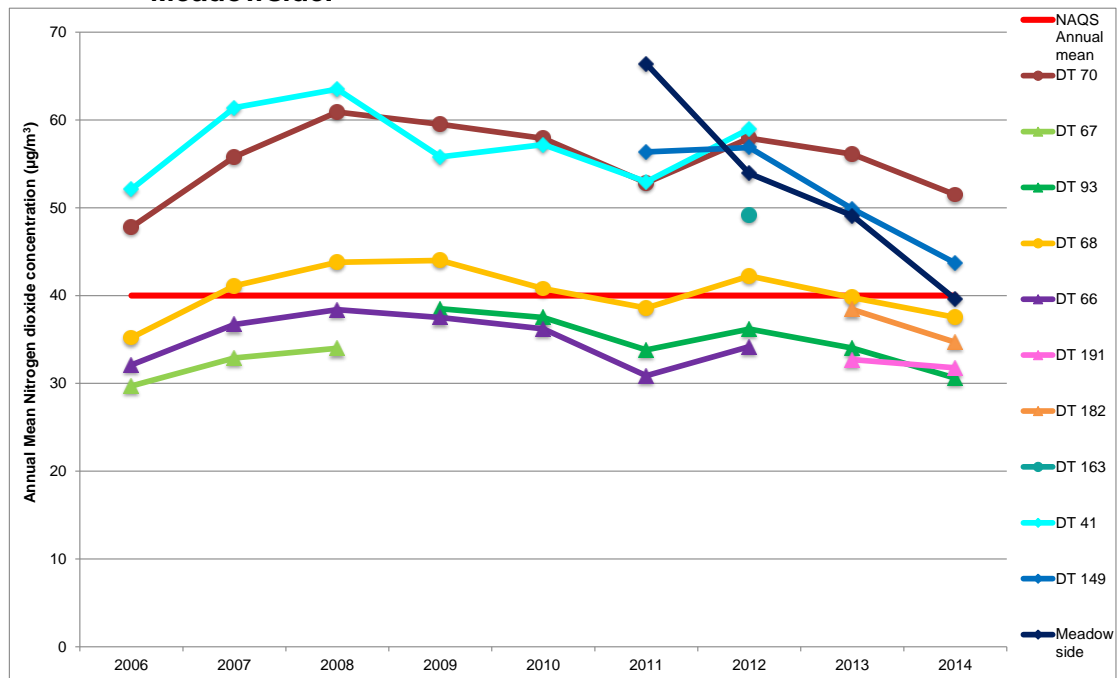


Figure 2.17 Overview of NO<sub>2</sub> Diffusion Tube Concentrations in Victoria Road / Meadowside.



Albert Street / Dura Street

Figure 2.18 NO<sub>2</sub> Diffusion Tube Locations in Albert Street / Dura Street

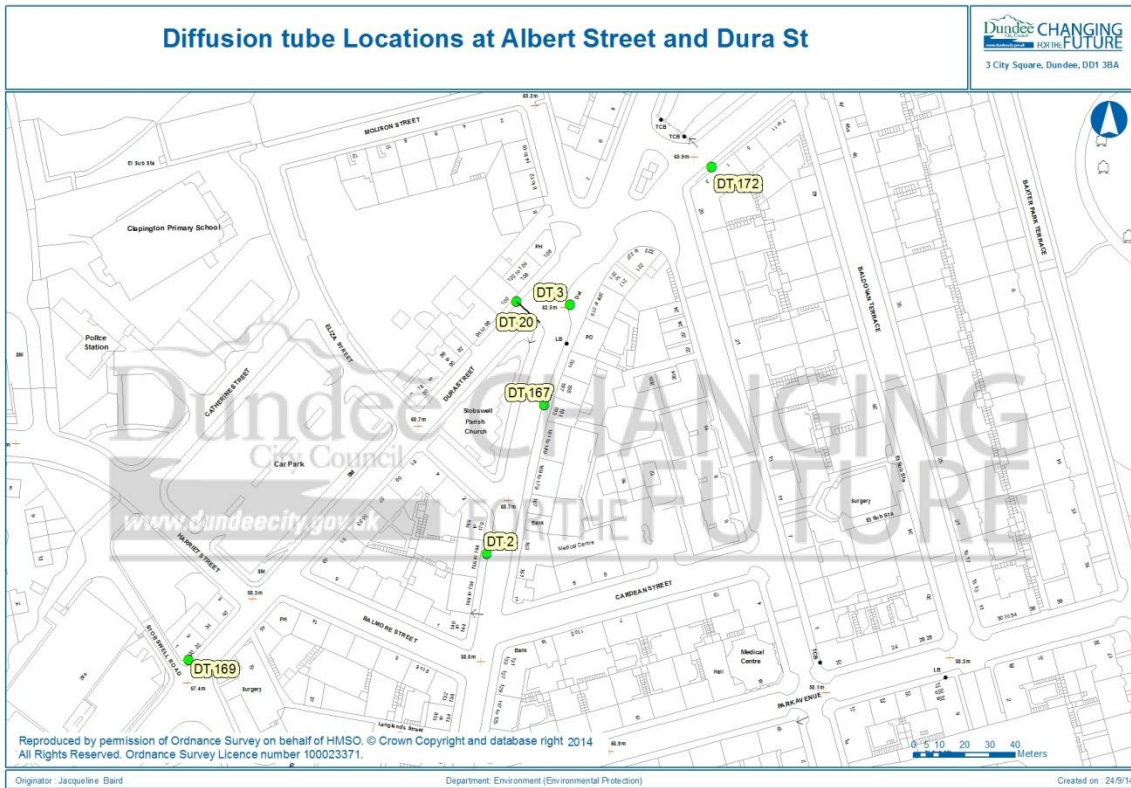
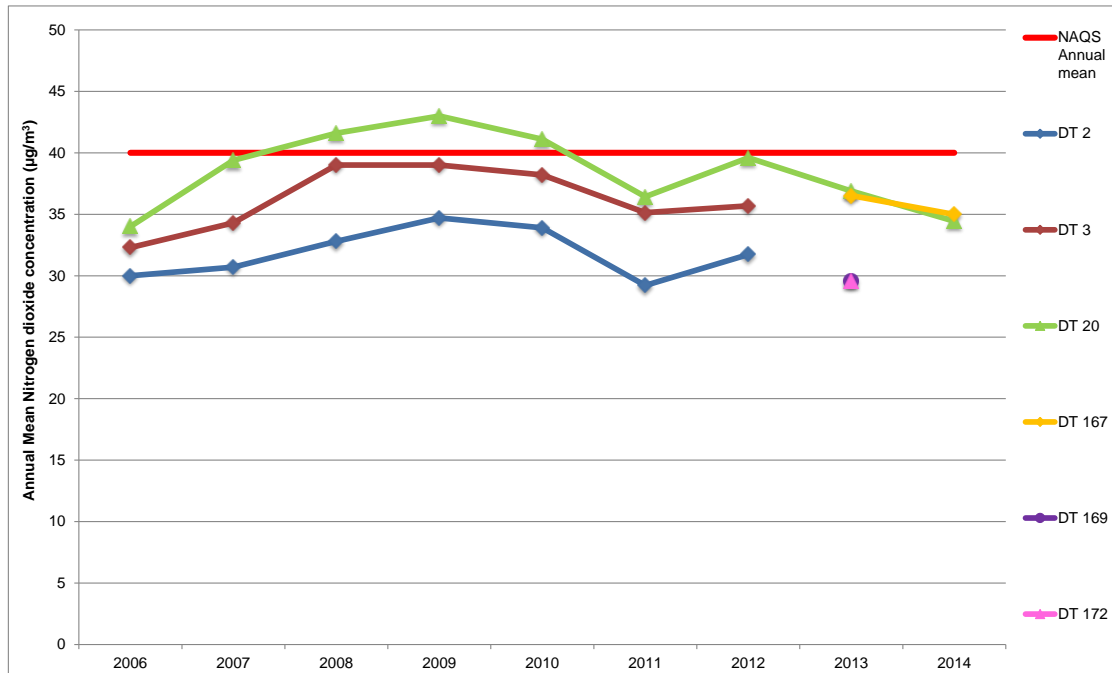


Figure 2.19 Overview of NO<sub>2</sub> Diffusion Tube Concentrations in Albert Street / Dura Street.



Lochee Road

Figure 2.20 NO<sub>2</sub> Monitoring Locations in Lochee Road

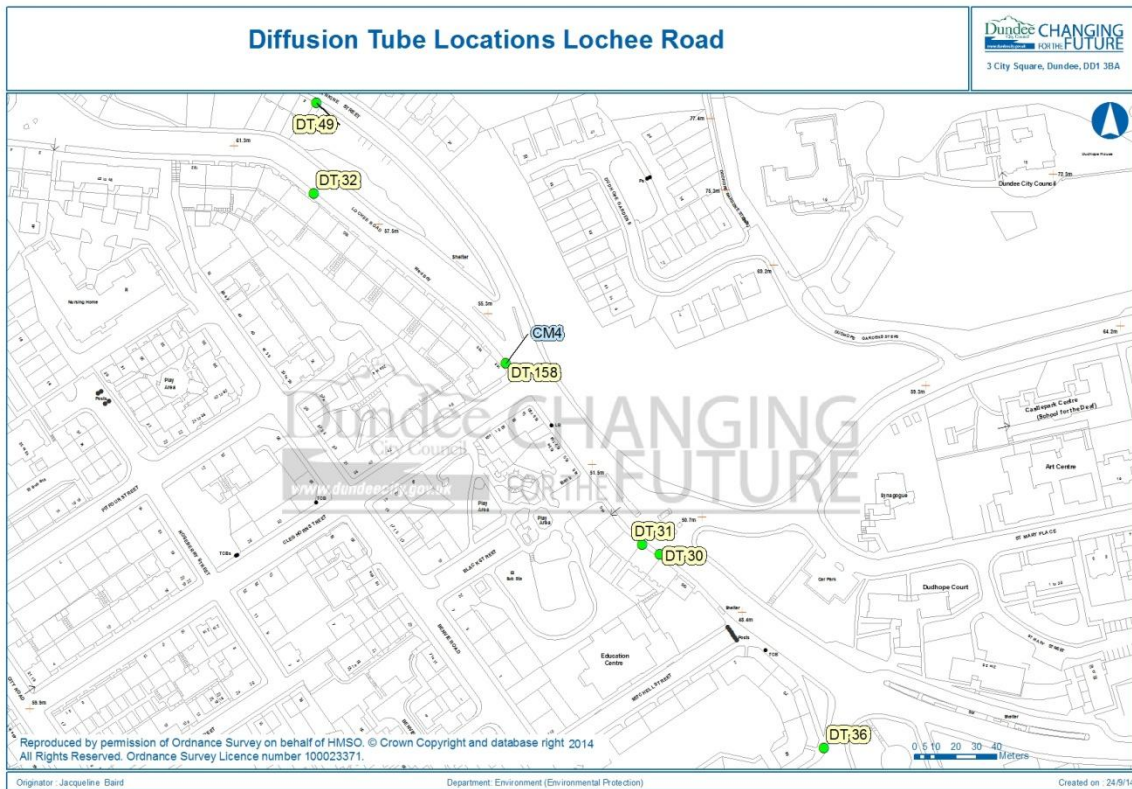
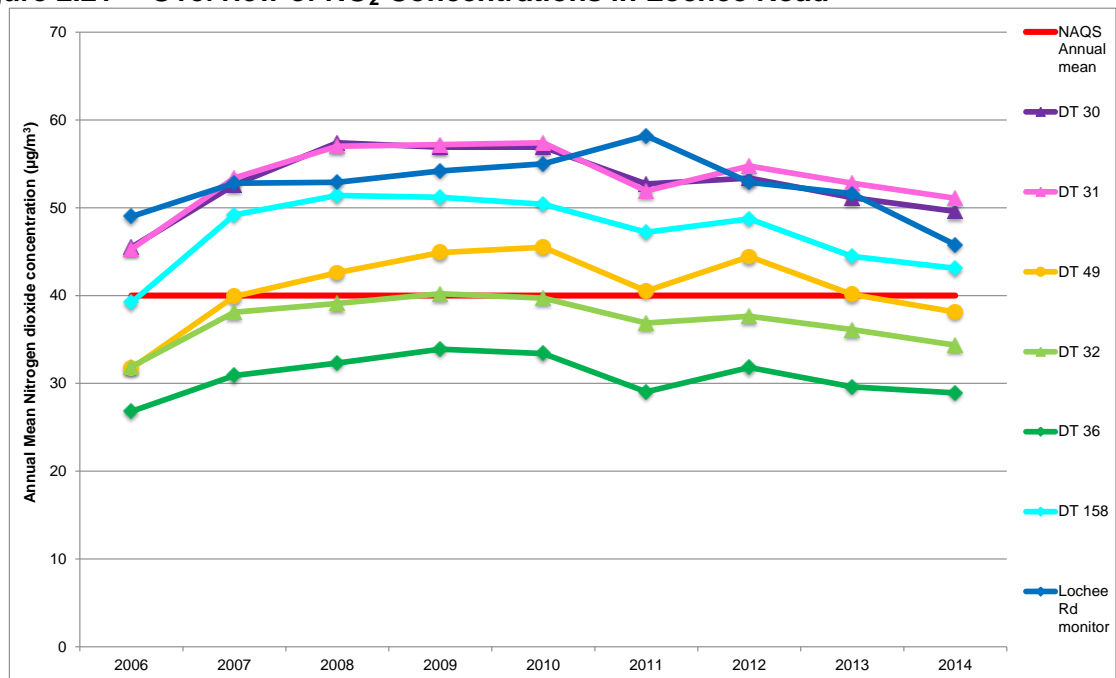


Figure 2.21 Overview of NO<sub>2</sub> Concentrations in Lochee Road



Logie Street  
 Figure 2.22 NO<sub>2</sub> Diffusion Tube Locations in Logie Street

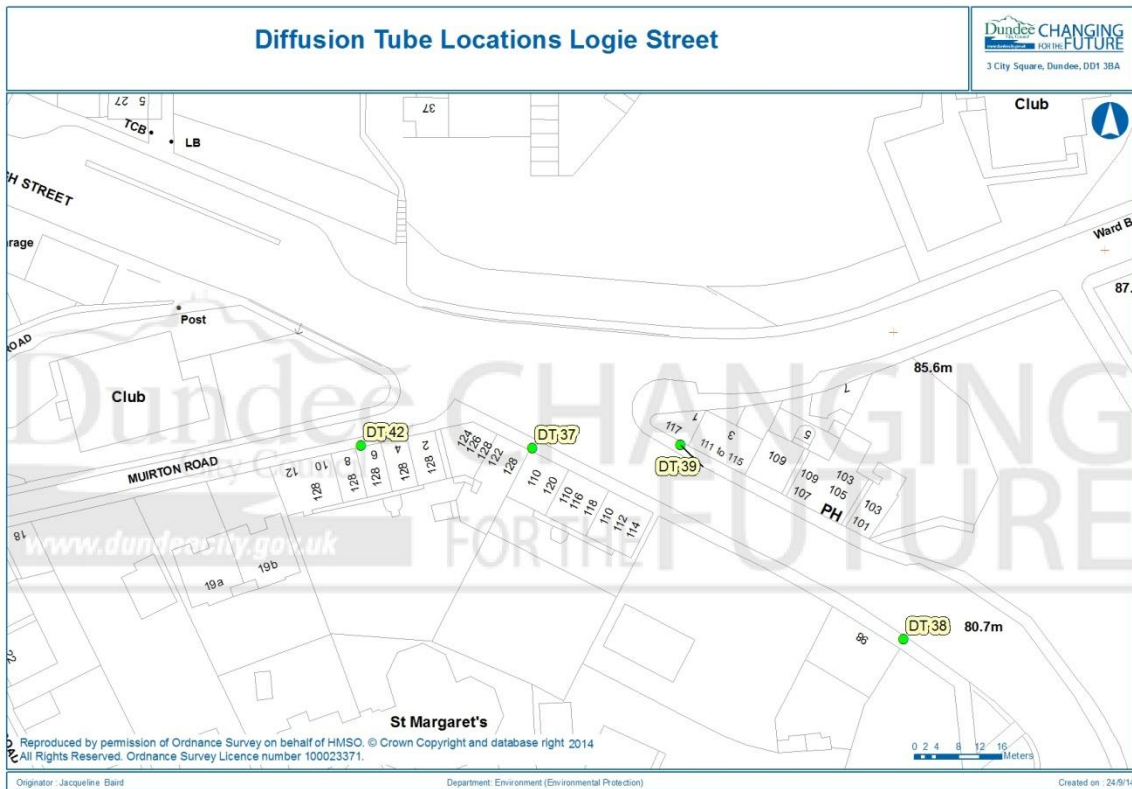
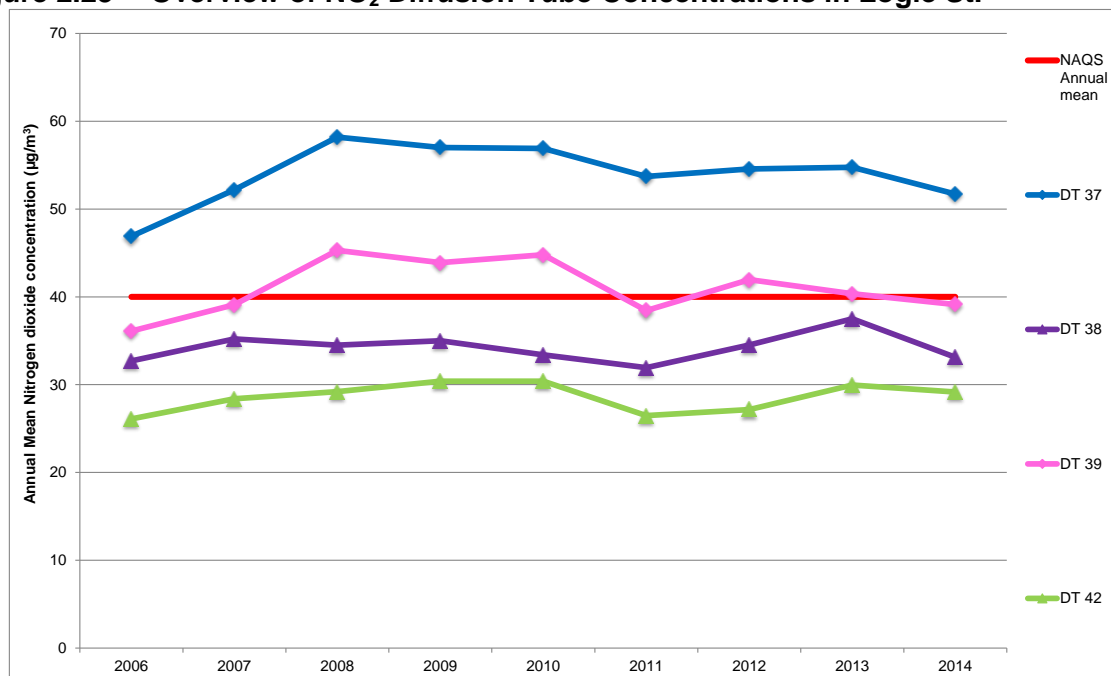


Figure 2.23 Overview of NO<sub>2</sub> Diffusion Tube Concentrations in Logie St.



Albert Street / Arbroath Road

Figure 2.24 NO<sub>2</sub> Diffusion Tube Locations in Albert St. / Arbroath Road

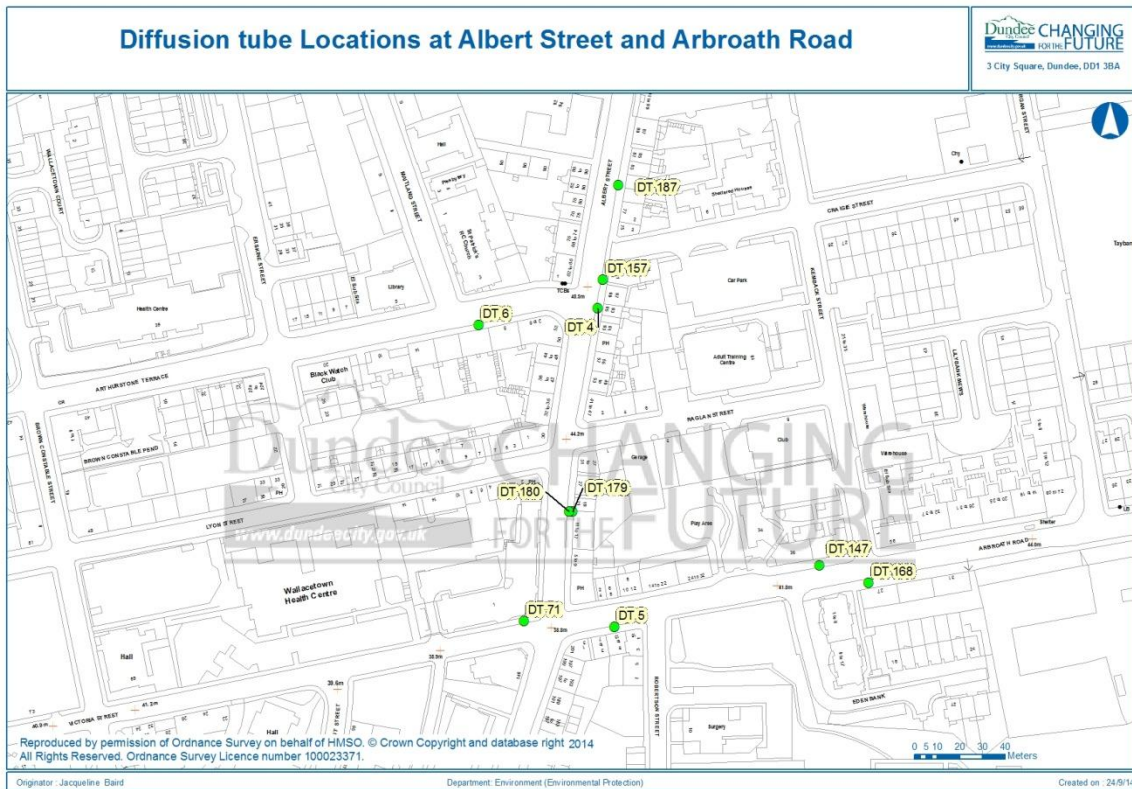
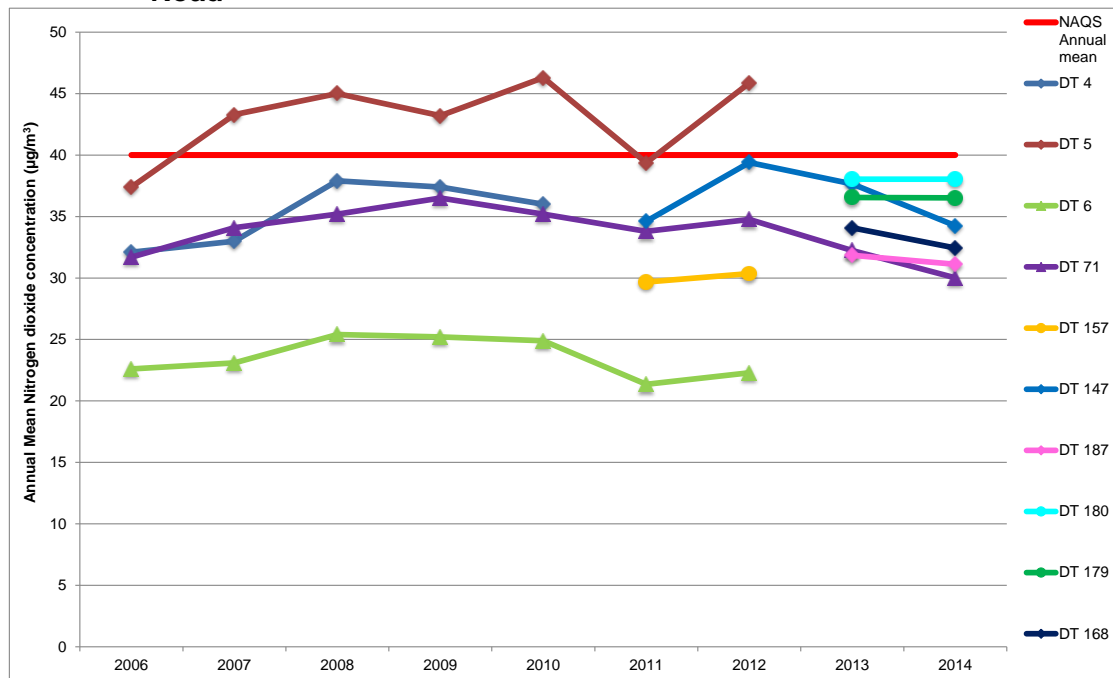


Figure 2.25 Overview of NO<sub>2</sub> Diffusion Tube Concentrations in Albert St. / Arbroath Road



Kingsway / Forfar Road.

Figure 2.26 NO<sub>2</sub> Diffusion Tube Locations on/near the Kingsway

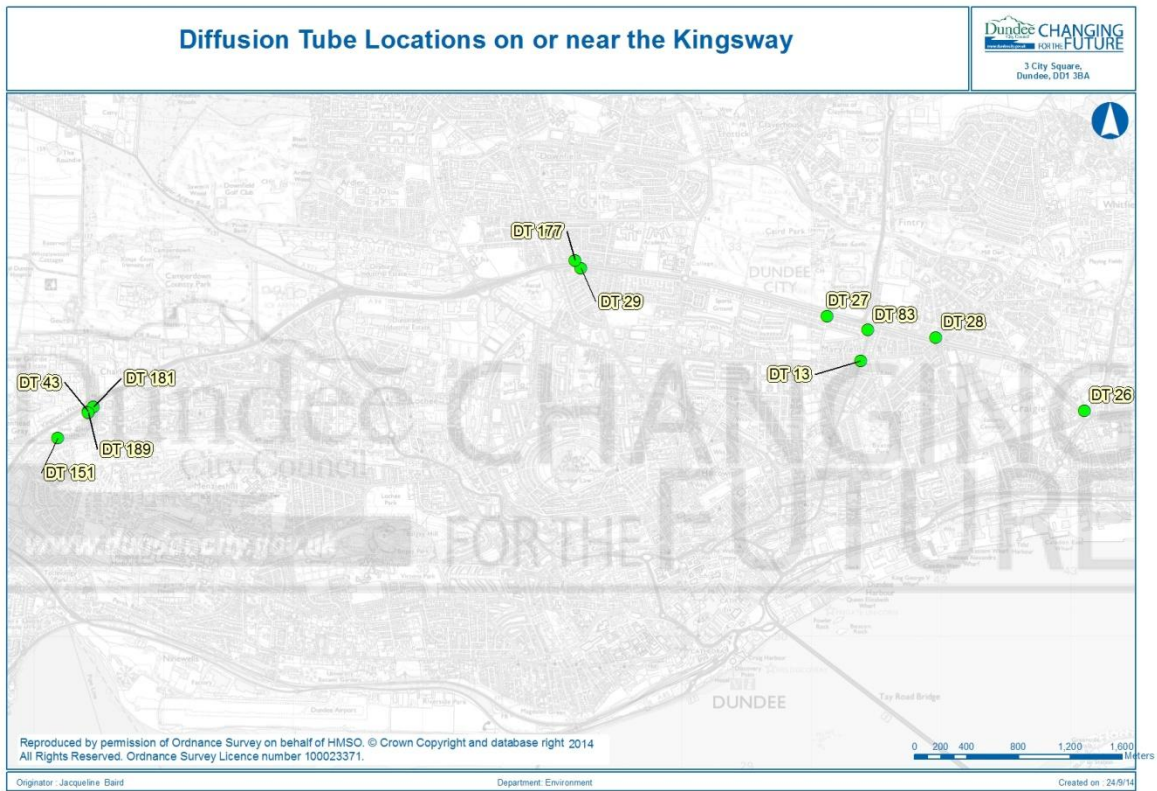
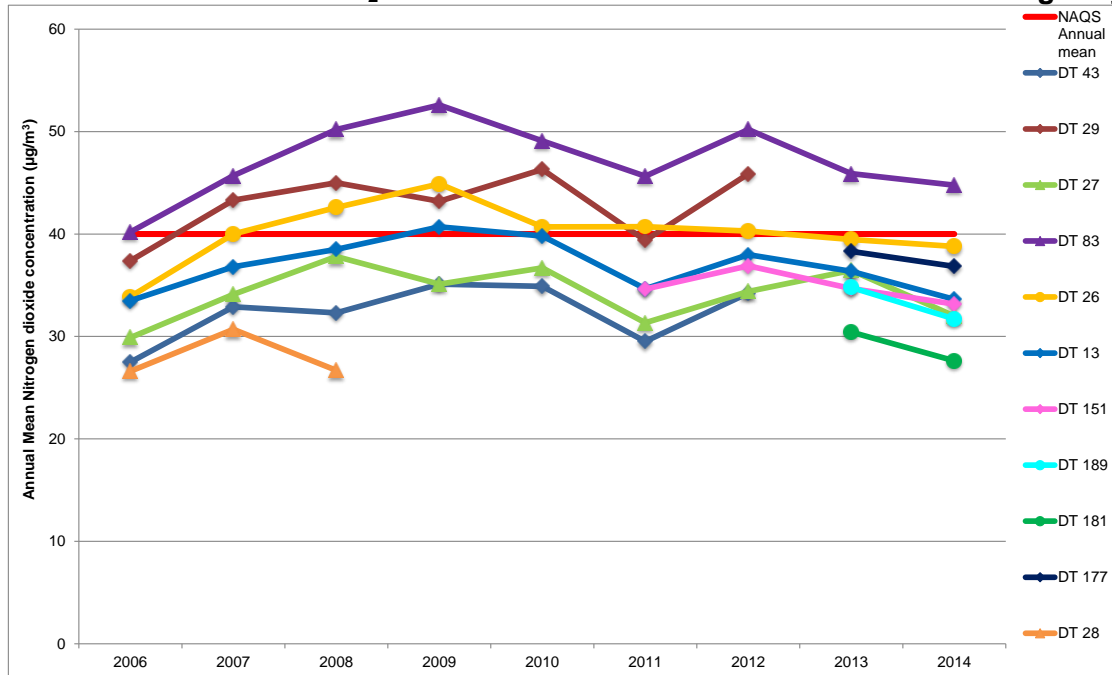


Figure 2.27 Overview of NO<sub>2</sub> Diffusion Tube Concentrations on/near the Kingsway



Bus Corridor

Figure 2.28 NO<sub>2</sub> Diffusion Tube Locations on Bus Corridor

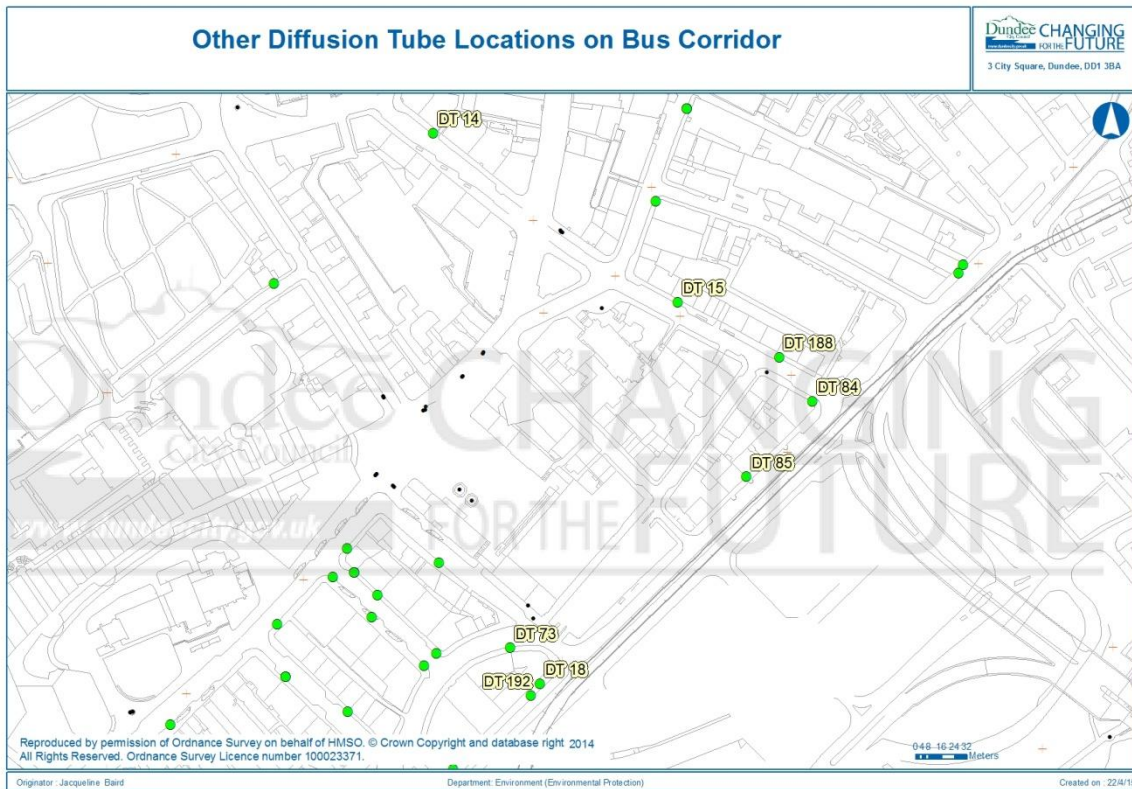
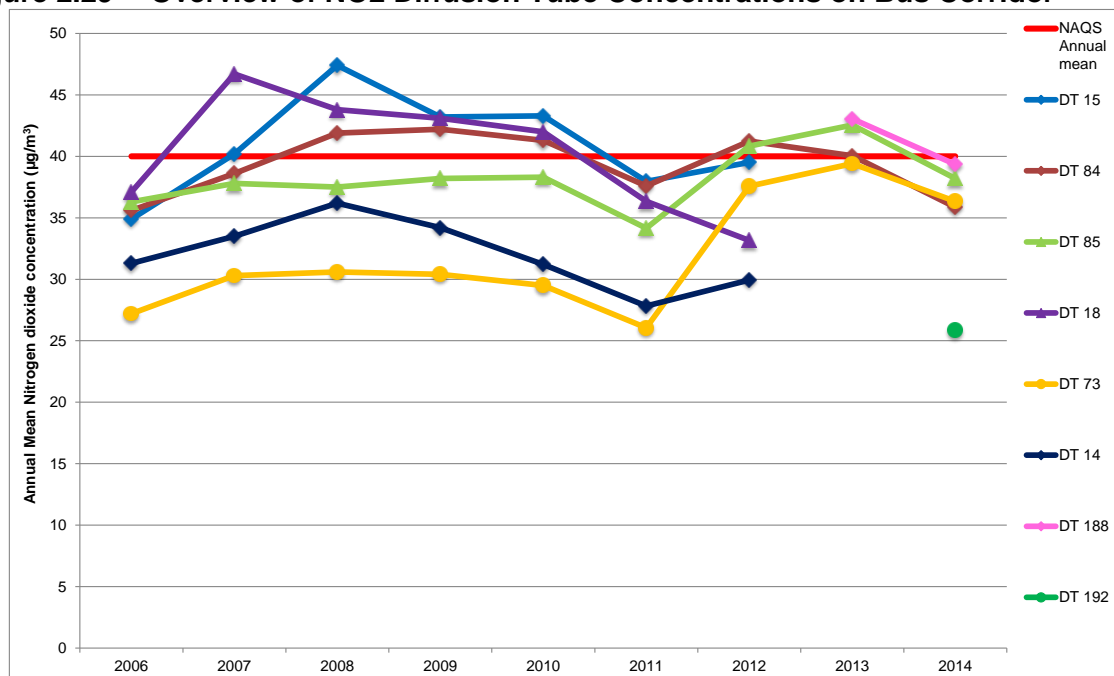


Figure 2.29 Overview of NO<sub>2</sub> Diffusion Tube Concentrations on Bus Corridor





Inner Ring Road

Figure 2.30 NO<sub>2</sub> Diffusion Tube Locations on Inner Ring Road

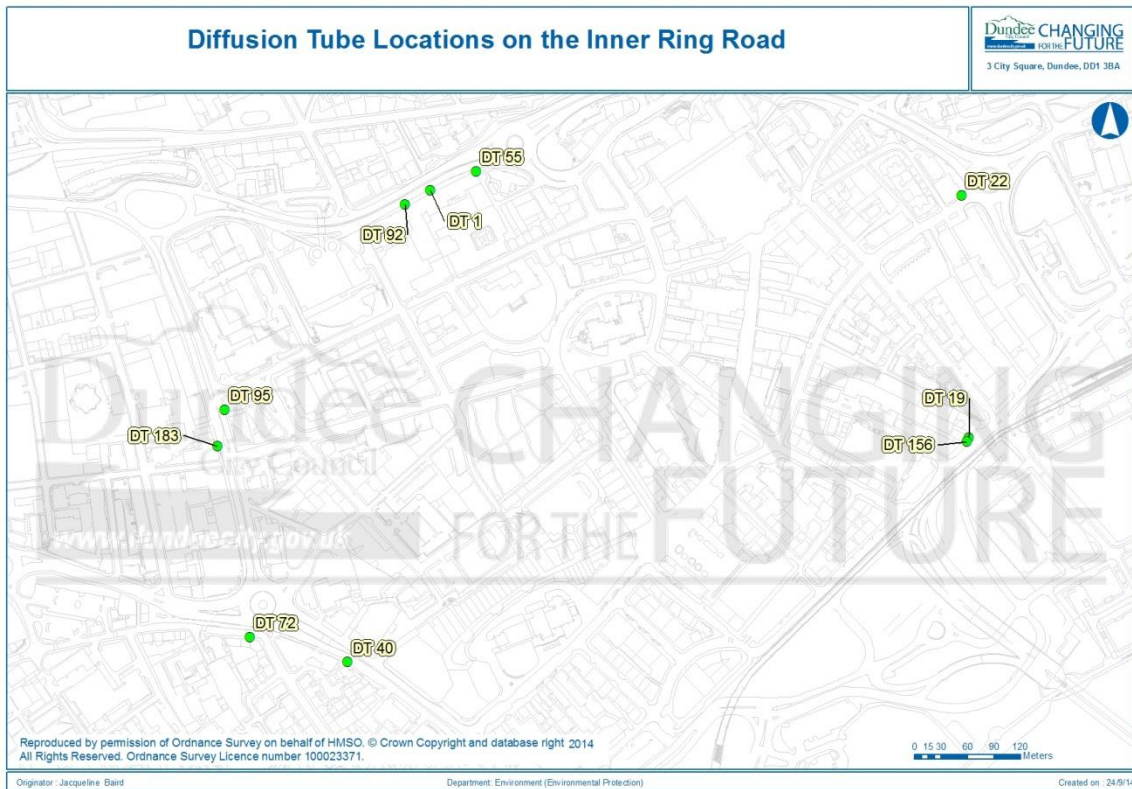
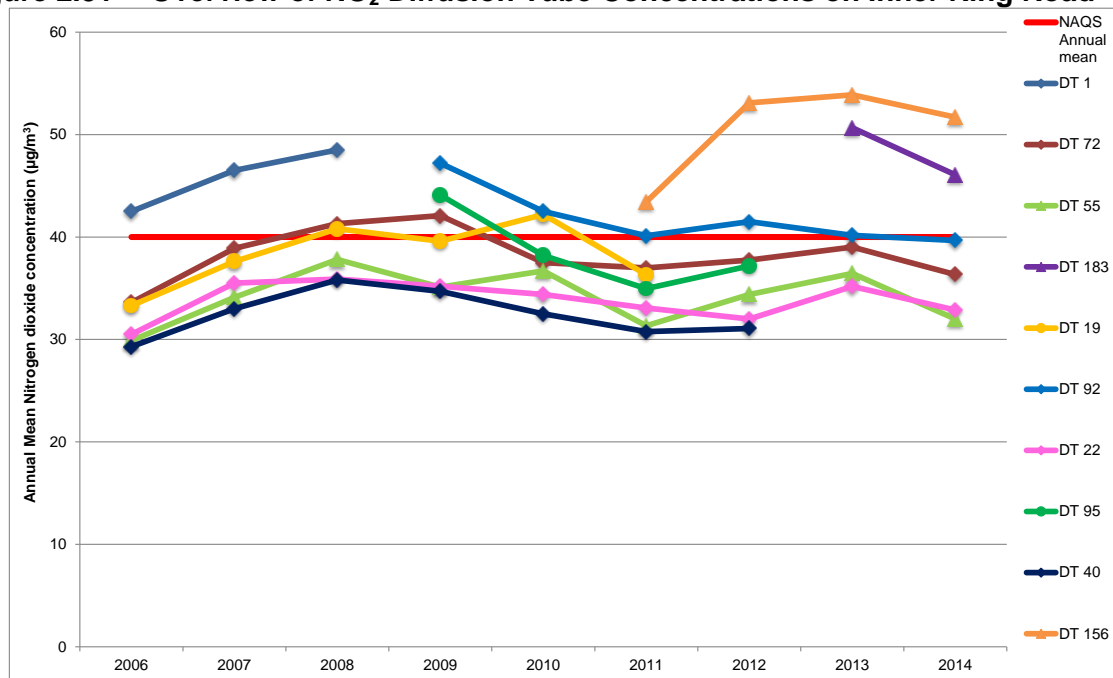


Figure 2.31 Overview of NO<sub>2</sub> Diffusion Tube Concentrations on Inner Ring Road



Stannergate Roundabout

Figure 2.32 NO<sub>2</sub> Diffusion Tube Location at Stannergate Roundabout

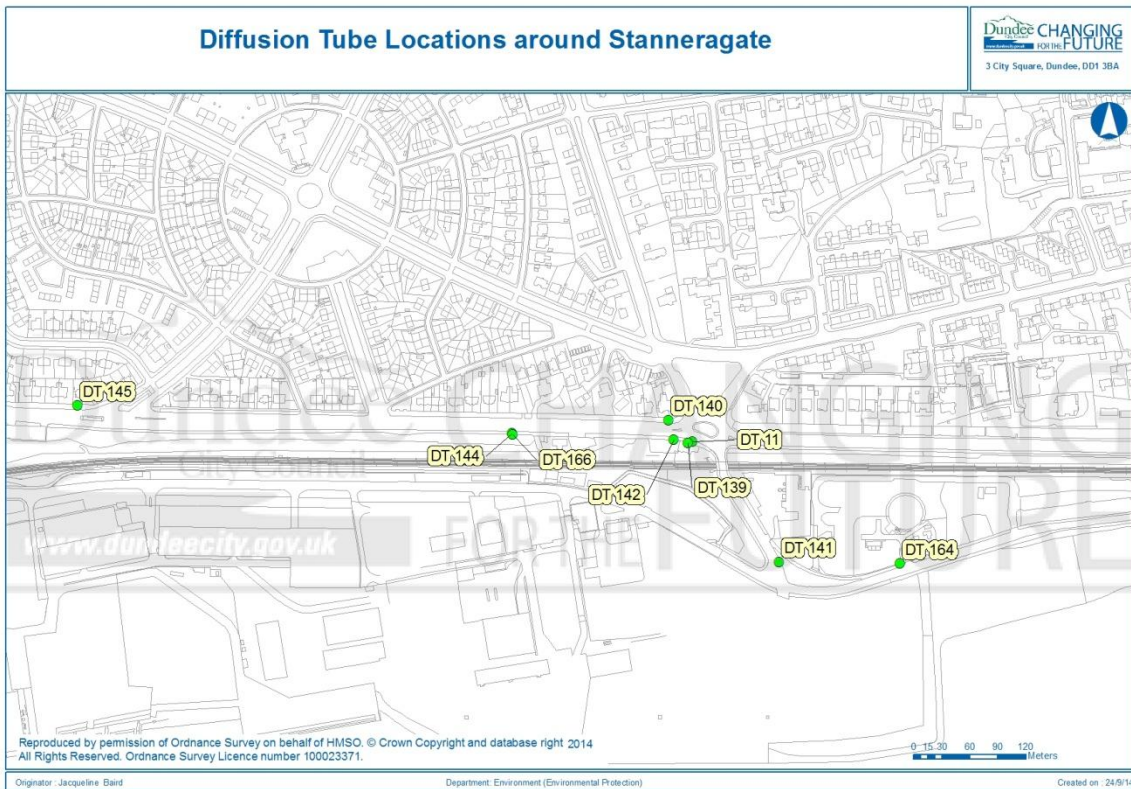
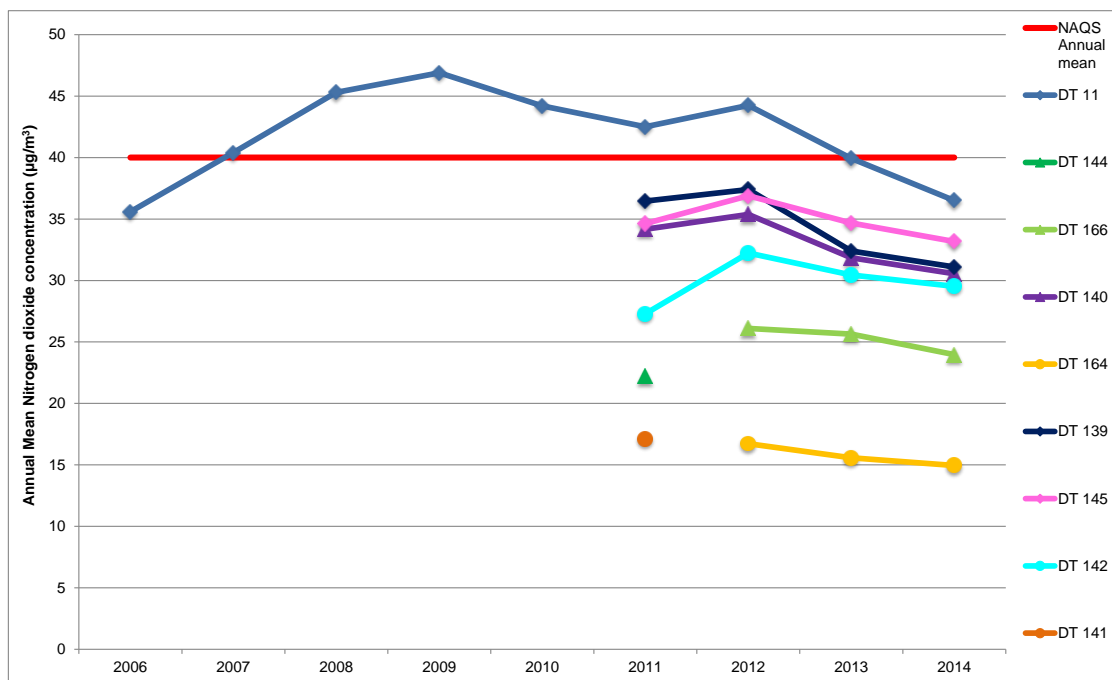


Figure 2.33 Overview of NO<sub>2</sub> Diffusion Tube Concentration at Stannergate Roundabout



Strathmore Avenue

Figure 2.34 NO<sub>2</sub> Diffusion Tube Location at Strathmore Avenue

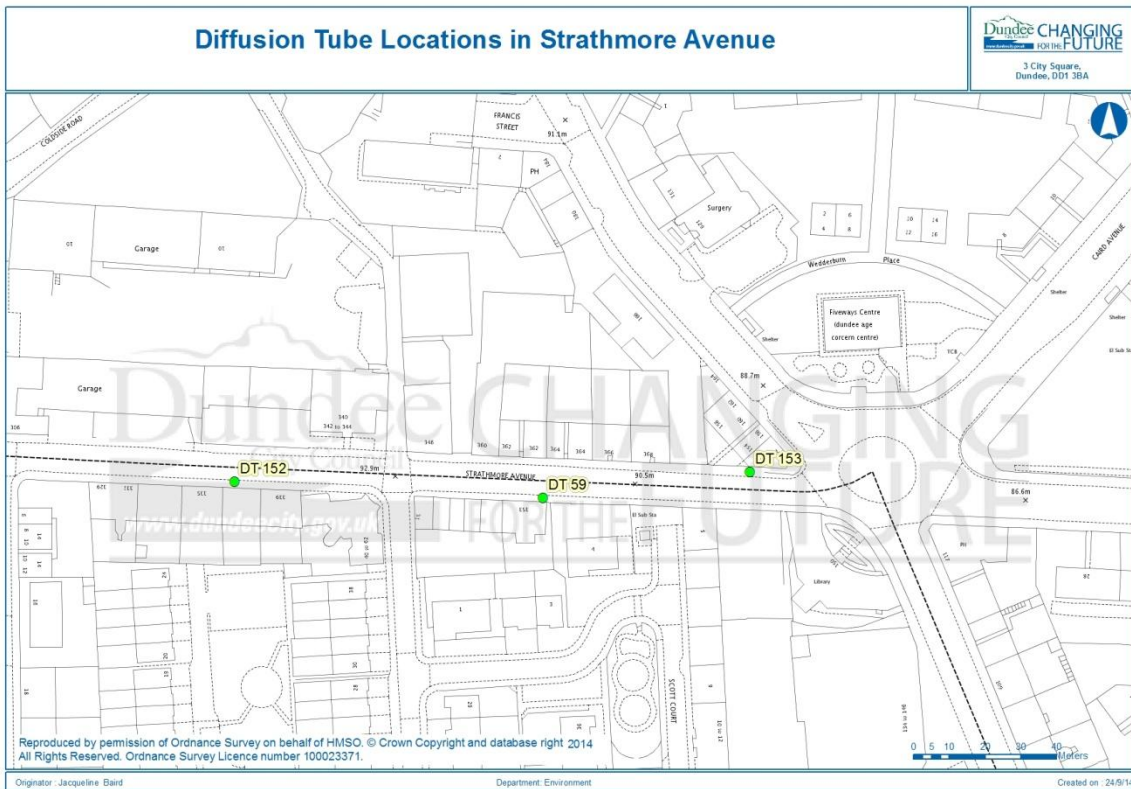
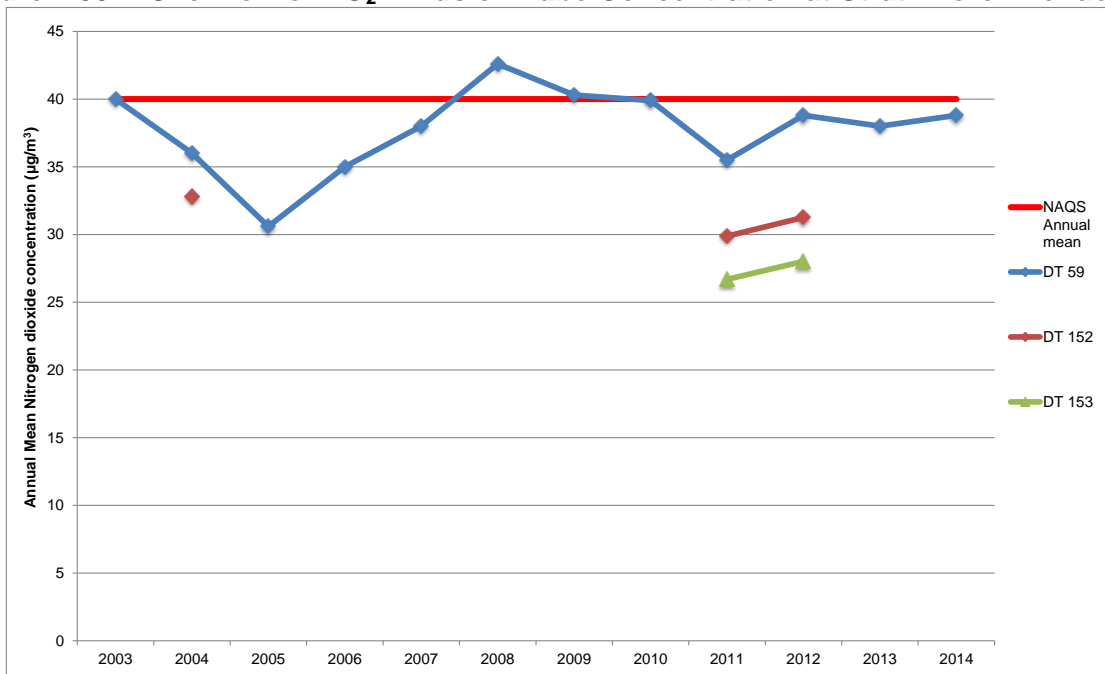


Figure 2.35 Overview of NO<sub>2</sub> Diffusion Tube Concentration at Strathmore Avenue



Note: The 2013 Progress Report showed an inaccurate value for tube DT59 in 2012, the figure above has been corrected.

### 2.2.1.4 Overview of NO<sub>2</sub> Monitoring Concentrations at Urban Background Locations

Dundee City Council operated 7 urban background NO<sub>2</sub> monitoring locations in 2014. Diffusion tubes were deployed at 6 sites, and the automatic analyser at Mains Loan (CM 12) is at an urban background location. These locations are shown in **Figure 2.36** along with Scottish Government modelled background NO<sub>2</sub> concentrations published as (1km x 1km) maps<sup>2</sup> in June 2014. A comparison of measured and modelled background concentrations is shown in **Table 2.13**. The measured 2014 NO<sub>2</sub> annual mean urban background concentrations were slightly higher than the Scottish Government modelled concentrations at the majority of background diffusion tube sites. Concentrations measured at Mains Loan automatic monitor were significantly lower than modelled. The diffusion tubes located to the east of the city and in the city centre recorded higher NO<sub>2</sub> concentrations than the modelled background, whilst those to the west and north of the city centre recorded concentrations lower than the modelled backgrounds.

**Table 2.13 Comparison of Measured Background NO<sub>2</sub> Results for 2014 with Scottish Government Background Map Data (Released June 2014)**

Site ID	Location	Grid Square	Measured Annual Mean 2014 (bias 0.82) (µg/m <sup>3</sup> )	Scottish Government Mapped Concentration 2014 (µg/m <sup>3</sup> )
DT 9	Birnam Place	337500 : 730500	9.6	11.3
DT 82	Woodside Avenue	340500 : 732500	14.9	16.9
DT 7	Balgavies Place	343500 : 731500	15.5	15.1
DT 185	Murraygate (46)	340500 : 730500	23.9	21.8
CM 12	Mains Loan Automatic Monitor	340500 : 731500	12.4	17.0
DT 165	Broughty Ferry Road Lower	343500 : 730500	14.9	12.4
DT 155	Carolina Court	342500 : 731500	19.4	16.5

Note - \* denotes annualised mean

NO<sub>2</sub> concentrations at urban background locations have remained relatively stable over the past 9 years as illustrated in **Figure 2.37**. The fluctuations in background concentrations recorded at Earl Grey Place (DT 21) are thought to have been influenced by road realignments associated with the Central Waterfront Project. This urban background location was replaced in 2013 by one on the Murraygate (DT 185), which is a pedestrianized shopping area in the city centre.

<sup>2</sup> [http://www.scottishairquality.co.uk/maps.php?n\\_action=data](http://www.scottishairquality.co.uk/maps.php?n_action=data)

Figure 2.36 Urban Background NO<sub>2</sub> Monitoring Locations

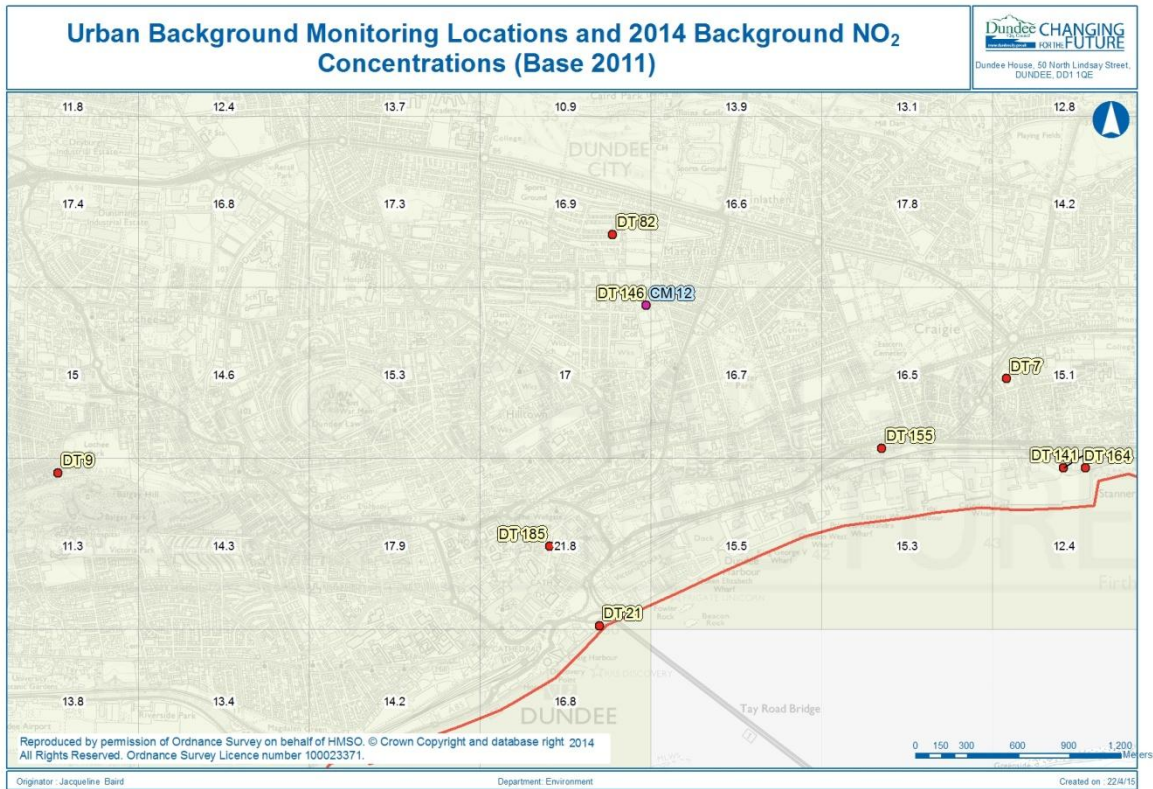
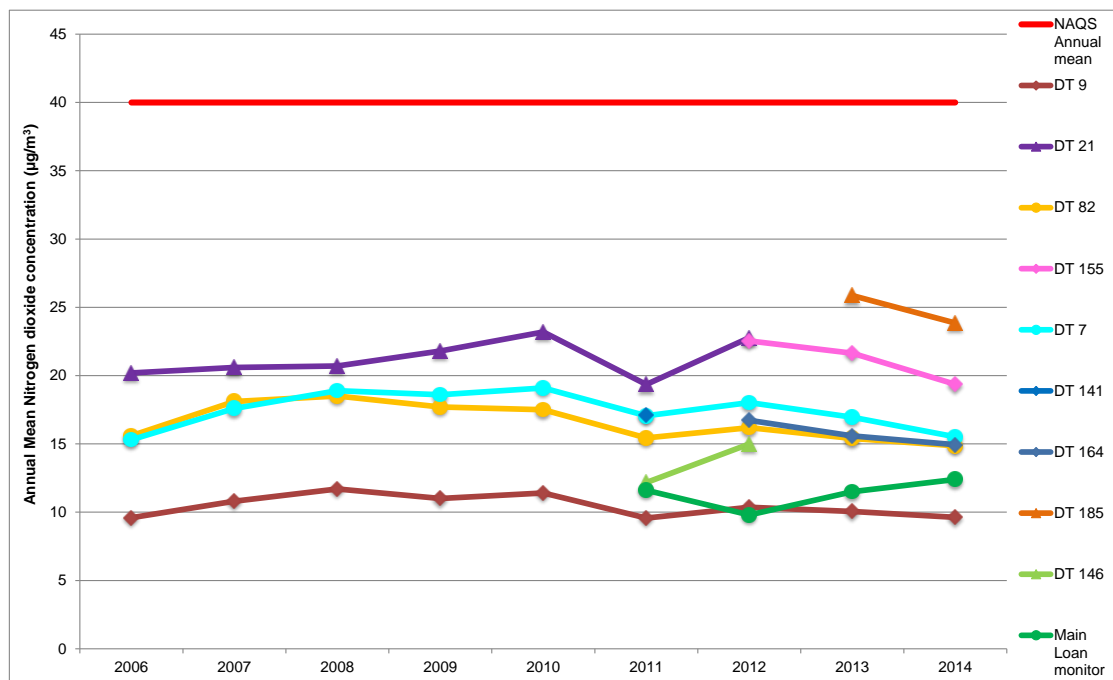


Figure 2.37 Overview of NO<sub>2</sub> Concentrations at Urban Background Locations



## 2.2.2 PM<sub>10</sub>

Dundee City Council undertook automatic monitoring of PM<sub>10</sub> at ten sites in the city in 2014. These are all located within the Dundee AQMA (NO<sub>2</sub> and PM<sub>10</sub> annual mean) with one at an urban background location, another downwind of an industrial facility in the port (triplicate co-location study), and the rest either at busy roads and junctions in the city centre or by main arterial routes.

Dundee City Council uses four types of measurement methods for PM<sub>10</sub> monitoring:

- The Partisol sampler is an equivalent method with the EU reference method for measuring particulates. The Partisol gravimetric sampler collects daily samples onto a filter for subsequent weighing to determine the PM<sub>10</sub> concentration;
- The Tapered Element Oscillating Microbalance (TEOM) system determines particulate concentrations by continuously weighing particles that are deposited onto a filter. This is an approved analyser for detailed and further assessments although it is not gravimetric equivalent, data is corrected to gravimetric using the Volatile Correction Method (VCM) ( see **Appendix B** );
- The Beta Attenuation Monitor (BAM). These devices draw sampled air at a constant flow rate through a section of paper tape, on which particles from the air are collected. At the beginning and end of the sampling period (1 to 24 hours), transmission of beta particles through the tape (from a source inside the instrument) is measured. The difference between the two measurements, caused by the particulate matter collected on the tape, is used to determine the concentration; and
- The Osiris particulate monitors supplied by Turnkey Instruments are nephelometers, which size and count individual particles as they pass through a laser beam. These are indicative analysers which are suitable as a screening tool for LAQM. Annual means compare favourably with TEOM monitored means but peak values tend to be exaggerated, so these results should be treated with some caution.

Details and locations of these monitoring stations can be found in **Tables 2.1** and **2.1a** and **Figure 2.1**

TEOM and Osiris monitors have heated inlets. These tend to drive off volatile organic particulate matter and in consequence the measured concentrations tend to be lower than those measured by gravimetric reference standard monitors. QA/QC procedures and gravimetric correction of the PM<sub>10</sub> analysers is discussed in **Appendix A6**.

None of the automatic monitoring sites had less than 9 months data and hence the results did not need to be annualised as described in Box 3.2 of LAQM.TG(09). However, for strict comparison against the objectives there must be a data capture of more than 90% throughout the calendar year, so details of the data capture are included in the tables for 2014 and all previous years.

The gravimetric equivalent monitoring results for 2014 are shown in **Tables 2.14 - 2.15** along with results for the previous years for which VCM corrected data was available (2008 – 2014). An overview of measured concentrations can be seen in **Figures 2.38 - 2.41**.

Table 2.14 Results of Automatic Monitoring for PM<sub>10</sub>: Comparison with Annual Mean Objective

Site ID (CM)	Location & (Type of monitor)	Site Type	Confirm Gravimetric Equivalent (Y or N/A)	Annual Mean Concentrations (µg/m <sup>3</sup> ) & Valid data capture (%)													
				2008		2009		2010		2011		2012		2013		2014	
2	Union St (TEOMBAM)	R	Y	16.9	99.7	16.5	99.2	17.0	90.5	18.8	99.4	15.5*	76.3	15.1	98.9	16.5	95.0
7	Union St (Osiris)	R	Y <sup>G</sup>	16.9	92.3	16.6*	86.1	16.8	92.9	18.9	92.0	15.5*	64.3	n/a	n/a		
3	Broughty Ferry Rd (TEOM)	UI	Y	15.2	95.4	14.8	98.7	15.6	99.0	16.1	98.6	14.2	97.9	15.9	96.4	14.7*	85.7
13	Broughty Ferry Rd (Partisol)	UI	Y	13.9	97.3	14.2	100.0	14.1	93.7	15.2	99.7	14.3	100.0	15.1	97.0	14.5	95.6
16	Broughty Ferry Rd (Osiris)	UI	Y <sup>G</sup>	n/a		n/a		n/a		n/a		13.4*	28.0	15.0*	89.8	14.6*	83.0
12	Mains Loan (TEOM)	UB	Y	11.4	99.7	12.6*	84.1	12.6	99.1	12.8	93.1	11.4	98.0	11.9	94.0	12.9	96.4
5	Seagate (BAM)	R	Y	n/a		n/a		n/a		17.1*	62.2	14.1	98.7	16.0	96.8	17.7	96.8
10	Seagate (Osiris)	K	Y <sup>G</sup>	20.3	92.6	18.1*	74.2	20.5	93.2	23.6	93.8	20.6*	64.7	n/a	n/a		
14	Meadowside (BAM)	R	Y	n/a		n/a		n/a		23.3*	50.6	18.6	97.7	18.6	90.5	16.6	98.1
11	Victoria Rd (Osiris)	K	Y <sup>G</sup>	17.6	92.6	17.1	91.6	21.0	91.1	19.5	93.8	15.5*	64.7	n/a	n/a		
4	Lochee Rd (BAM)	R	Y	n/a		n/a		n/a		19.4*	72.0	16.5	99.2	17.9	96.9	18.6	92.5
8	Lochee Rd (Osiris)	K	Y <sup>G</sup>	21.1	92.6	18.3*	87.3	24.8	93.0	26.3	93.9	18.3*	64.5	n/a	n/a		
9	Logie St (Osiris)	K	Y <sup>G</sup>	19.0	92.1	15.8	91.9	22.1	93.0	21.6	93.9	18.0*	90.0	16.5	92.1	16.1*	87.4
17	Myrekirk Tce (Osiris)	R	Y <sup>G</sup>	n/a		n/a		n/a		n/a		16.1*	28.0	15.5	94.0	18.3*	87.7
15	Albert St (Osiris)	K	Y <sup>G</sup>	n/a		n/a		n/a		n/a		16.8*	28.0	18.3	95.7	21.4*	87.7
18	Stannergate (Osiris)	R	Y <sup>G</sup>	n/a		n/a		n/a		n/a		19.9*	28.0	24.5*	81.9	26.7*	87.7

Notes: Y<sup>G</sup> - 2008-12 Osiris data has been corrected using an Osiris/TEOM co-location study and then the VCM method to give an approximate gravimetric equivalent result. 2013 & 2014 data were adjusted using factors derived from colocation studies with the Partisol

\* indicates insufficient valid data capture - for a strict comparison against the objectives the data capture should be > 90% throughout the calendar year Exceedences of the PM<sub>10</sub> annual mean AQS objective of 18µg/m<sup>3</sup> are show n in bold & red. Orange values denote those at risk of exceeding the objective.

Means show n in the highlighted cells have been "annualised" as valid data capture is less than 75% ( in accordance with Box 3.2 of LAQM.TG(09))

R=Roadside, UI=Urban Industrial, UB=Urban Background, K=Kerbside

Figure 2.38 Overview of Annual Mean PM<sub>10</sub> Concentrations 2008 -2014 (Gravimetric equivalent data)

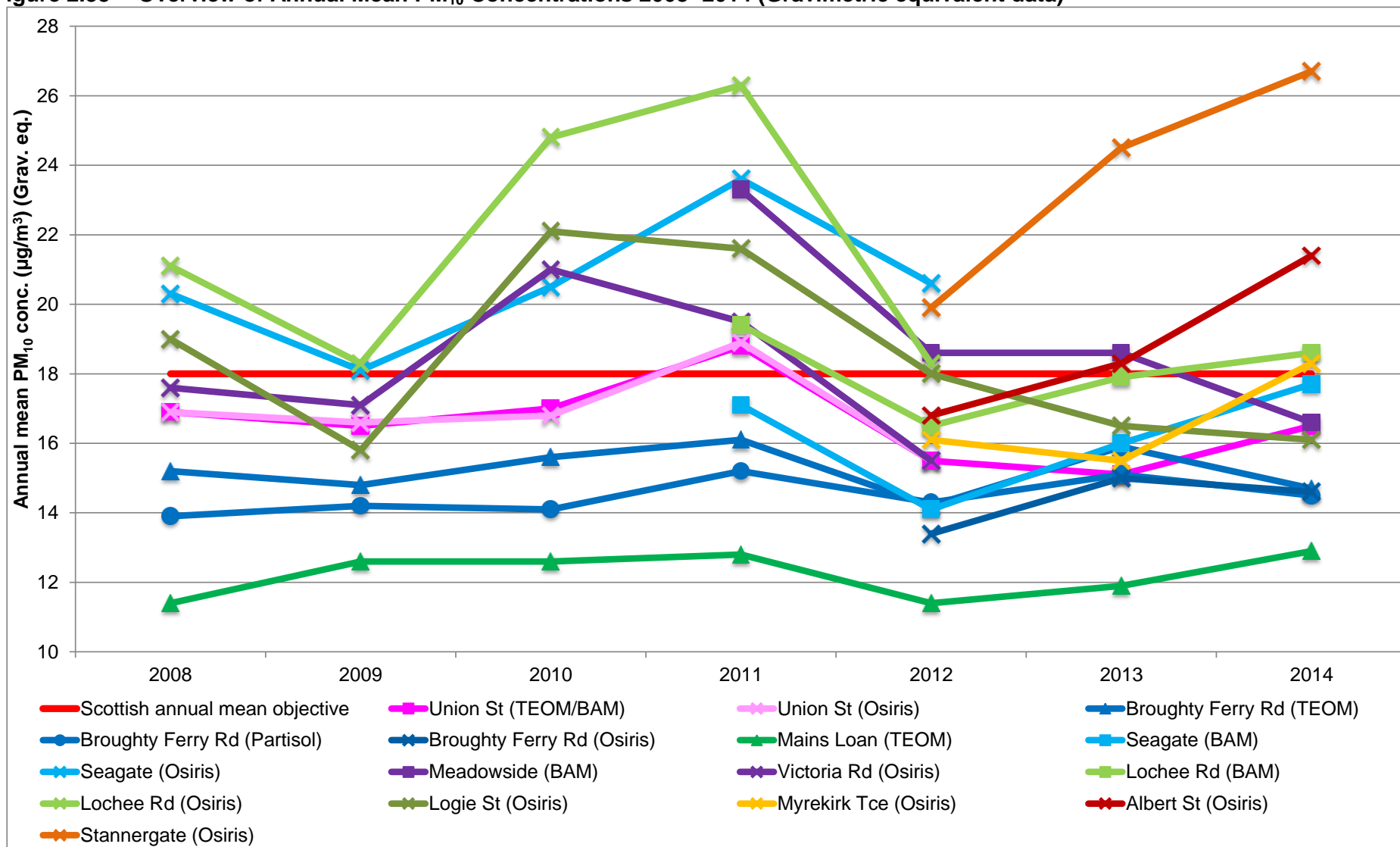
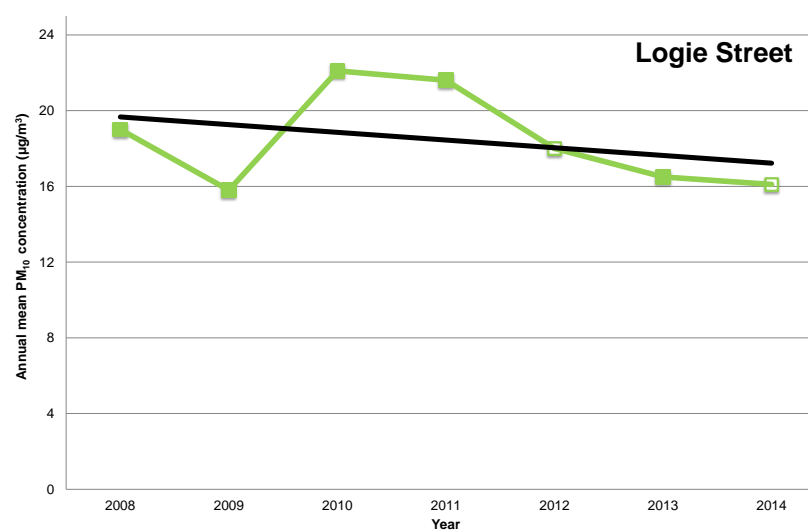
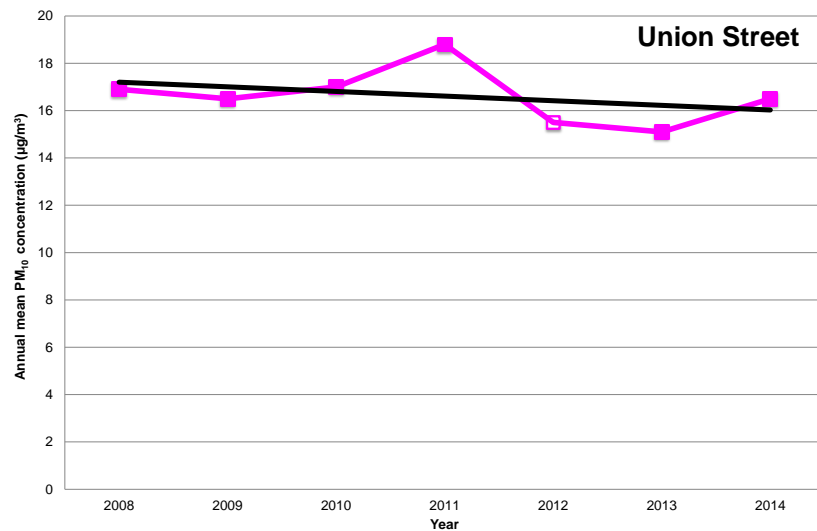
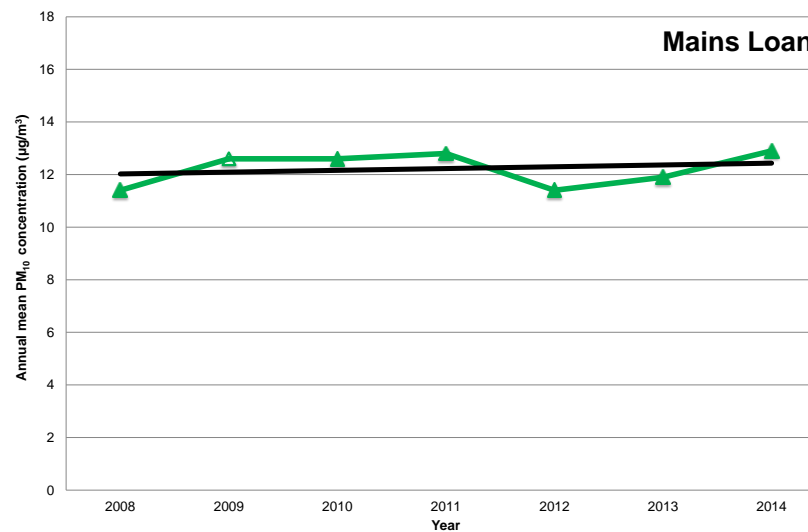
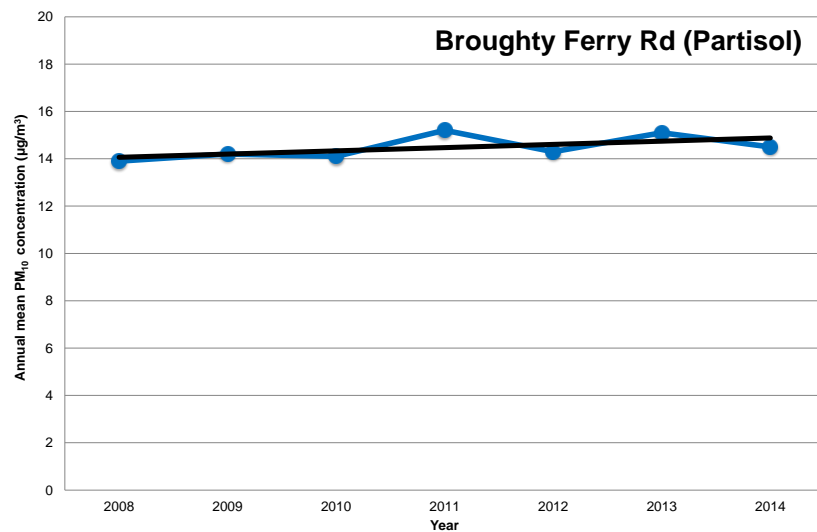




Figure 2.39 Trends in Annual Mean PM<sub>10</sub> Concentrations 2008 - 2014 at Long-Term Monitoring Sites (gravimetric equivalent data)



Note: Hollow data points represent annual means based on less than 90% valid data capture.

Table 2.15 Results of Automatic Monitoring for PM<sub>10</sub>: Comparison with NAQS 24-hour Mean Objective

Site ID (CM)	Location & (Type of monitor)	Site Type	Valid Data Capture 2014 (%)	Confirm Gravimetric Equivalent (Y or N/A)	Number of Daily Means > 50µg/m <sup>3</sup> (not to be exceeded more than 7 times per year) & (98.08 <sup>th</sup> percentile (µg/m <sup>3</sup> ))													
					2008		2009		2010		2011		2012		2013		2014	
2	Union St (TEOM/BAM)	R	95.0	Y	0	(40.3)	2	(33.4)	0	(37.7)	1	(42.8)	2*	(36.3)	1	(37.8)	2	(42.2)
7	Union St (Osiris)	R	n/a	Y <sup>G</sup>	4	(47.0)	6*	(47.9)	0	(38.8)	2	(48.0)	2*	(42.3)	n/a		n/a	
3	Broughty Ferry Rd (TEOM)	UI	85.7	Y	0	(37.6)	2	(35.3)	0	(39.8)	0	(40.3)	2	(35.8)	3	(42.5)	1*	(33.3)
13	Broughty Ferry Rd (Partisol)	UI	95.6	Y	1	(35.6)	2	(34.5)	0	(36.8)	1	(41.9)	3	(37.5)	2	(43.5)	1	(31.8)
16	Broughty Ferry Rd (Osiris)	UI	83.0	Y <sup>G</sup>	n/a		n/a		n/a		n/a	0*	(30.5)	4*	(47.3)	3*	(40.7)	
12	Mains Loan (TEOM)	UB	96.4	Y	0	(30.5)	0	(31.3)	0	(30.0)	0	(33.4)	1	(31.9)	1	(28.8)	1	(31.7)
5	Seagate (BAM)	R	96.8	Y	n/a		n/a		n/a		1*	(38.1)	1	(37.2)	4	(40.4)	3	(44.5)
10	Seagate (Osiris)	K	n/a	Y <sup>G</sup>	12	(56.6)	8*	(53.5)	9	(52.7)	20	(65.0)	13*	(59.5)	n/a		n/a	
14	Meadowside (BAM)	R	98.1	Y	n/a		n/a		n/a		4*	(49.8)	4	(47.5)	4	(43.9)	2	(41.4)
11	Victoria Rd (Osiris)	K	n/a	Y <sup>G</sup>	7	(50.4)	6	(47.7)	7	(49.8)	11	(53.7)	3*	(48.0)	n/a		n/a	
4	Lochee Rd (BAM)	R	92.5	Y	n/a		n/a		n/a		2*	(43.5)	3	(42.6)	3	(38.8)	1	(41.8)
8	Lochee Rd (Osiris)	K	n/a	Y <sup>G</sup>	10	(57.9)	4*	(44.0)	16	(62.5)	28	(70.4)	6*	(50.7)	n/a		n/a	
9	Logie St (Osiris)	K	87.4	Y <sup>G</sup>	9	(54.9)	3	(44.7)	12	(62.7)	16	(53.8)	5*	(46.3)	2	(39.0)	2*	(38.6)
17	Myrekirk Tce (Osiris)	R	87.7	Y <sup>G</sup>	n/a		n/a		n/a		n/a	0*	(30.1)	2	(35.9)	3*	(43.8)	
15	Albert St (Osiris)	K	87.7	Y <sup>G</sup>	n/a		n/a		n/a		n/a	2*	(43.3)	7	(51.2)	14*	(57.8)	
18	Stannergate (Osiris)	R	87.7	Y <sup>G</sup>	n/a		n/a		n/a		n/a	0*	(35.9)	9*	(54.1)	16*	(60.1)	

Notes: YG - 2008-12 Osiris data has been corrected using an Osiris/TEOM co-location study and then the VCM method to give an approximate gravimetric equivalent result. 2013 & 2014 data were adjusted using factors derived from annual co-location studies with the Partisol

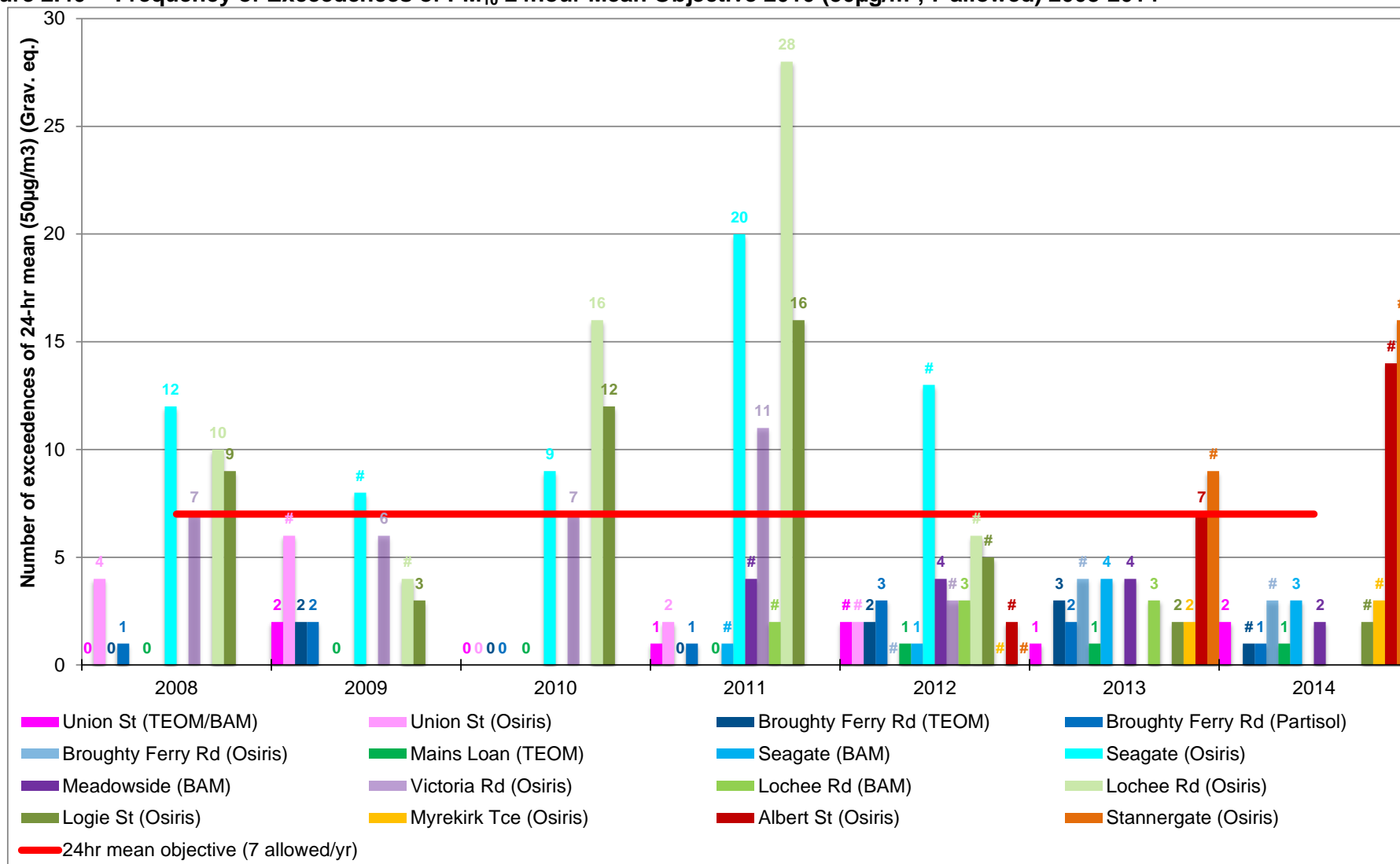
The highlighted cells have less than 75% valid data capture

\* When valid data capture is insufficient (shown n by \*) the 98.08th percentiles (shown in brackets) should be used for comparison with the objective standard (50µg/m<sup>3</sup>)

Values in **bold** indicate an exceedence of the PM<sub>10</sub> 24-hour mean objective (50µg/m<sup>3</sup>) which is not to be exceeded > 7 times per year

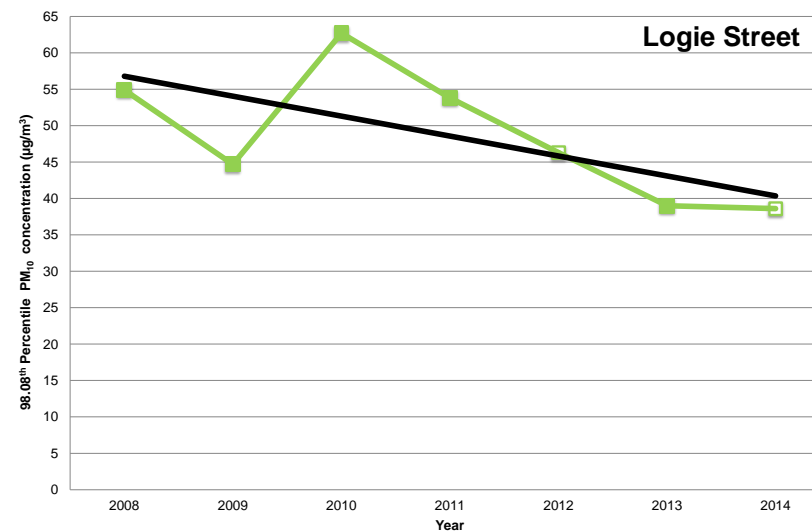
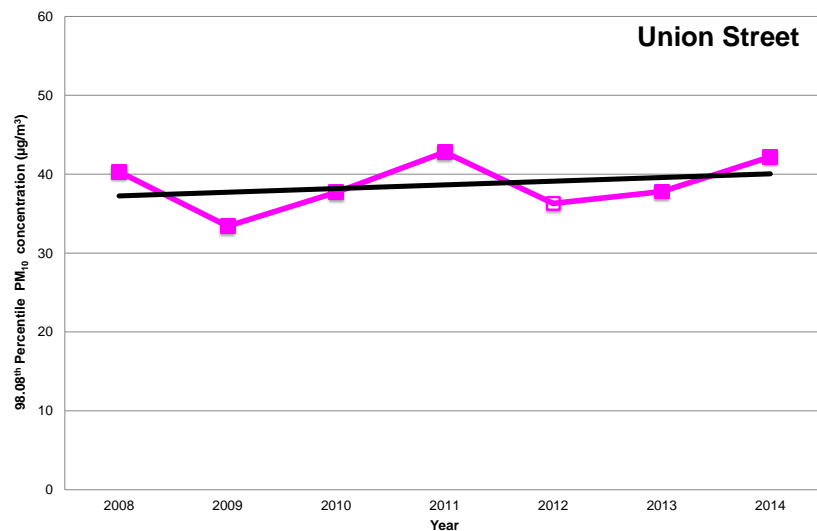
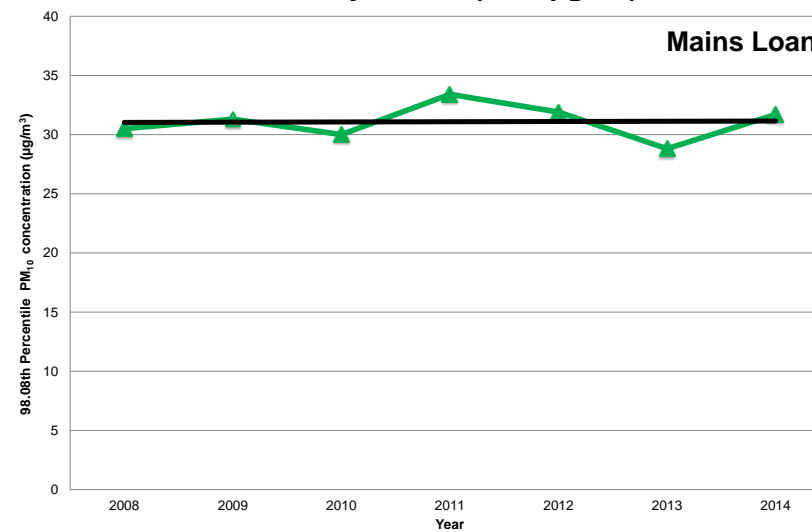
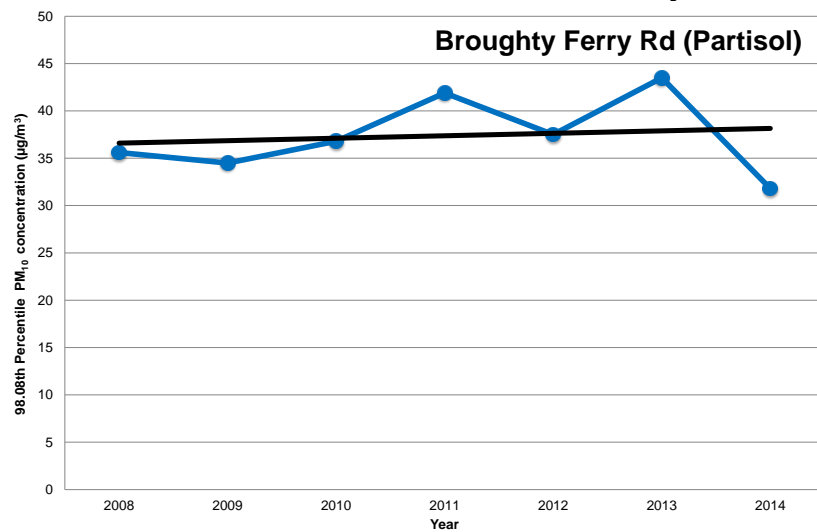
R=Roadside, UI=Urban Industrial, UB=Urban Background, K=Kerbside

Figure 2.40 Frequency of Exceedences of PM<sub>10</sub> 24hr Mean Objective 2010 (50µg/m<sup>3</sup>, 7 allowed) 2008-2014



Note: # denotes actual number of exceedences unknown as data capture less than 90%

Figure 2.41 Trends in Scottish PM<sub>10</sub> 24-hour Mean Objective 2010 – 98.08<sup>th</sup> Percentile of Daily Means (cf.50µg/m<sup>3</sup>) 2008-2014



## Annual Mean PM<sub>10</sub> Concentrations

Annual mean monitoring results are shown in **Table 2.14** and indicate that the NAQS 2004 annual mean PM<sub>10</sub> objective (40µg/m<sup>3</sup>) continues to be met at all monitoring locations. However, there were exceedences of the Scottish 2010 PM<sub>10</sub> annual mean objective (18µg/m<sup>3</sup>) recorded at Lochee Road (BAM) and at the Osiris monitors located at Stannergate roundabout and Albert Street. The results from the Myrekirk Terrace Osiris monitor were 'borderline', as were the concentrations measured by the BAMs located in Meadowside, Seagate and Union Street. The Osiris monitors are indicative PM<sub>10</sub> monitors. (It should be noted that the annual mean concentrations for each of the BAM analysers in 2014 is based on ratified 15min values derived from the hourly averages recorded by the BAM (see **Appendix A4**)). All of these locations are within the AQMA.

Statistically significant trends, or even a reasonable overview of how concentrations are changing, usually only become meaningful when complete data records extend over five years or more. VCM adjusted concentrations have been available since 2008, therefore the examination of trends in PM<sub>10</sub> concentrations is based on VCM corrected TEOM data.

Annual means for those sites with 5 or more years of data are shown in **Figure 2.39**. Linear trend lines have been drawn using an Excel simple regression statistical program, to identify how pollution concentrations are changing over time. However, these need to be interpreted with caution as a high proportion of the data presented is based on less than 90% data capture (see **Table 2.10** for details). Data trends for the annual means are summarised in **Table 2.16**.

**Table 2.16 Summary of Annual Mean PM<sub>10</sub> trends measured at long-term Automatic Monitoring Sites**

Monitoring Location	Site Type	Trend in Annual Mean PM <sub>10</sub> concentration (years included)	Concentrations of PM <sub>10</sub>
Broughty Ferry Road	Urban Industrial	↑ (2008 to 2014)	Slight increase
Logie Street	Kerbside	↓ (2008 to 2014)	Decreasing
Mains Loan	Urban Background	↑ (2008 to 2014)	Slight increase
Union Street	Roadside	↓ (2008 to 2014)	Slight decrease

A slight upward trend in PM<sub>10</sub> concentrations is evident at the urban background and urban industrial sites. A decreasing trend was observed at the roadside and kerbside sites with more than 5 years data capture. All sites can show yearly fluctuations due to meteorological effects. The roadside and kerbside sites show greater fluctuations year on year than the other locations owing to the closer proximity to the pollution source, which can be influenced by long-term road works and traffic management changes.

The 2014 PM<sub>10</sub> annual mean urban background concentration was generally in good agreement with the Scottish Government modelled background PM<sub>10</sub> concentrations published as (1km x 1km) maps<sup>3</sup> in June 2014 (see **Table 2.17**).

<sup>3</sup> [http://www.scottishairquality.co.uk/maps.php?n\\_action=data](http://www.scottishairquality.co.uk/maps.php?n_action=data)

**Table 2.17 Comparison of Measured Background PM<sub>10</sub> Results for 2014 with Scottish Government Background Map Data.**

Location	Grid Square	Measured Annual Mean PM <sub>10</sub> (µg/m <sup>3</sup> )	Scottish Government Mapped Concentration (µg/m <sup>3</sup> )
Mains Loan (VCM)	340500:731500	11.9	12.8

### 24-hour Mean PM<sub>10</sub> Concentrations

Monitoring results in **Table 2.15** and **Figures 2.40 & 2.41** show that the NAQS 2004 24-hour mean objective of 50µg/m<sup>3</sup> (not to be exceeded more than 35 times per year), continues to be met at all monitoring locations. The stricter Scottish 24-hour mean objective of 50µg/m<sup>3</sup> (not to be exceeded more than 7 times per year), was exceeded at two Osiris monitors located at Stannergate Roundabout and Albert Street in 2014. Stannergate Osiris recorded 16 exceedences of the 24-hour objective and Albert Street recorded 14 exceedences.

Where the measured data capture is less than 90%, LAQM TG(09) advises that, it is more appropriate to express short-term concentrations as percentile values for comparison with the objective. In such cases, if the value of the 98.08<sup>th</sup> percentile of 24-hour mean concentrations is greater than 50µg/m<sup>3</sup>, then it is likely that the allowed number of daily mean exceedences (7) will have been breached. Only Stannergate and Albert Street Osiris's had a 98.08<sup>th</sup> percentile greater than 50µg/m<sup>3</sup>. Osiris monitors are considered indicative and the methodology used to adjust the data to gravimetric equivalent, whilst reasonable for annual mean data, has a tendency to over-estimate the number of 24-hour mean exceedences. Consequently these results should be treated with caution.

Of the gravimetric reference equivalent monitors, the highest number of 24-hour mean exceedences (3) was recorded at Seagate BAM. One of these exceedences was due to a combination of smoke from a nearby major building fire and the location of emergency response vehicles in December 2014. However, the concentrations were too high for the instrument to record and as an absolute value could not be determined, the data were omitted from ratified data set. Consequently, the pollution report, shown in **Appendix C** only reports two exceedences.

Expressing short-term concentrations as 98.08<sup>th</sup> percentile values provides easier inter-year comparison of data and examination of possible trends. **Figure 2.41** shows trends for those analysers with at least 5 years data capture. Trend lines have been drawn using an Excel simple regression statistical program. Data trends are summarised in **Table 2.18**.

**Table 2.18 Summary of 98.08<sup>th</sup> Percentile PM<sub>10</sub> trends measured at long-term Automatic Monitoring Sites**

Monitoring Location	Site Type	Trend in 98.08 <sup>th</sup> Percentile PM <sub>10</sub> concentrations (years included)	Concentrations of PM <sub>10</sub>
Broughty Ferry Road	Urban Industrial	↑ (2008 to 2014)	Slight increase
Logie Street	Kerbside	↓ (2008 to 2014)	Decreasing
Mains Loan	Urban Background	↑ (2008 to 2014)	Slight increase
Union Street	Roadside	↑ (2008 to 2014)	Slight increase

The most significant trend in 98.08<sup>th</sup> percentile PM<sub>10</sub> concentrations is the decrease seen at the kerbside Osiris located in Logie Street. Of these four long term sites, only Logie Street has ever exceeded the short term objective. However, the percentile concentrations have been below 50µg/m<sup>3</sup> for the last three years. It is hard to draw conclusions from analysis of trends in short-term PM<sub>10</sub> exceedences because apart from the influence of annual trans-boundary events (in March and April most years) most are caused by transient and unpredictable events such as road works, fires, road gritting and, demolition and construction activities.

An analysis of the frequency of daily mean exceedences is shown in **Table 2.19**. This showed that the majority occurred across eighteen “Events” at times with variable wind speeds of an easterly direction. Easterly winds are often associated with trans-boundary PM<sub>10</sub> pollution events as these bring pollution from the continent, sea salt evaporating from the sea, and sea haars. For example, Event (5) occurring at the end of March coincided with a prolonged period of haar, and Event (6) occurring at the start of April was well documented in the media and included Saharan dust among a range of trans-boundary pollutants<sup>4</sup>.

Four of the events were clearly local:

- Event 3 on 8<sup>th</sup> March 2014 recorded at the Albert Street Osiris coincided with nearby road resurfacing after electrical and telecommunications work;
- Event 4 on 19<sup>th</sup> March 2014 recorded at Stannergate Osiris, the potential cause is unclear, but may have been contributed to by increased traffic passing through Stannergate Roundabout as a result of off-peak works on the Arbroath Road / Claypotts Junction during this week;
- Event 8 on the 31<sup>st</sup> July 2014 recorded at Mains Loan TEOM, coincided with the demolition of a nearby educational establishment;
- Event 18 on the 21<sup>st</sup> December 2014, occurred at Seagate BAM, due to a major building fire, as discussed above. It is recorded as “XXX” in **Table 2.19**, as it is not possible to report an absolute value.

Comparisons of Dundee daily average PM<sub>10</sub> concentrations with those from urban background monitoring locations in Scotland for each of the eighteen identified exceedence episodes are shown in **Figures 2.42 to 2.49**. The majority of these events coincided with widespread raised background concentrations.

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<sup>4</sup> <http://www.airqualitynews.com/2015/03/09/significant-rise-in-doctor-visits-during-2014-pollution/>

**Table 2.19 Comparison of Eighteen 24hr Mean Exceedence ‘Events’ in Dundee with Wind Speed and Direction and Urban Background Sites**

Dates when the PM10 24hr-mean std. was exceeded in Dundee		1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		No. of 24hr mean exceedences at monitor
		17/01/2014	19/01/2014	05/02/2014	08/03/2014	19/03/2014	24/03/2014	25/03/2014	30/03/2014	03/04/2014	16/04/2014	26/04/2014	19/05/2014	28/05/2014	19/07/2014	31/07/2014	11/09/2014	12/09/2014	13/09/2014	17/09/2014	14/11/2014	18/11/2014	29/11/2014	21/12/2014	Average wind speed and dominant wind direction during the 24hr													
Roadside	Dundee Albert St (Osiris-G)	52.5	42.1	52.9	82.4	34.8	57.6	68.9	68.6	91.5	36.8	67.9	55.8	55.4	53.5	9.3	30.6	53.1	57.9	45.3	45.3	44.8	68.9	3.3	14													
	Dundee Logie St (Osiris-G)	34.1	31.8	35.5	20.4	27.2	28.0	29.7	46.7	67.5	34.0	38.8	33.7	37.0	36.6	11.2	20.5	36.6	45.9	28.8	40.4	40.6	58.8	3.5	2													
	Dundee Myrekirk Tce (Osiris-G)	36.5	34.8	41.7	21.8	27.6	27.4	30.6	57.7	81.1	35.5	49.1	37.0	44.1	40.9	11.1	27.3	45.3	49.7	31.7	37.6	41.5	63.9	4.4	3													
	Dundee Lochee Rd (BAM-G)	34	no data	29	18	25	23	27	47	46	33	no data	47	40	39	12	33	52	49	33	36	33	44	11.5	1													
	Dundee Meadowside (BAM-G)	40	32	34	22	23	25	35	51	56	27	47	50	41	23	12	33	49	43	28	24	27	43	4.6	2													
	Dundee Seagate (BAM-G)	42	32	40	20	25	32	39	57	65	26	45	44	37	47	8.4	39	50	42	28	42	45	49	XXX	3													
	Dundee Union St (BAM-G)	32	25	23	18	19	31	31	46	49	24	38	44	30	43	8.9	33	55	49	32	36	42	55	8.2	2													
	Dundee Stannergate (Osiris-G)	58.7	50.9	60.1	30.6	78.5	34.8	46.2	61.6	90.0	62.8	61.4	50.5	48.8	49.2	23.3	52.7	59.6	57.7	56.9	58.0	55.4	77.4	12	16													
Downwind of Port	Dundee Broughty Ferry Rd (Partisol)	27	20	23	19	21	23	31	47	51	30	35	31	18	26	6.3	25	49	41	29	23	24	19	7.1	1													
	Dundee Broughty Ferry Rd (TEOM-)	no data	no data	no data	20	22	24	26	45	41	26	27	30	25	23	10	33	52	41	28	21	25	39	10	1													
	Dundee Broughty Ferry Rd (Osiris-G)	48.4	36.7	34.9	21.8	25.8	23.7	32.2	52.6	75.4	30.1	45.6	34.6	38.5	38.1	5.8	18.9	40.1	42.7	30.3	32.8	37.4	59.4	8.9	3													
Urban Background	Dundee Mains Loan (TEOM-VCM)	25	18	21	16	18	19	22	43	38	21	24	29	21	21	56	no data	no data	no data	26	21	22	35	6.9	1													
	Aberdeen Errol Place	no data	no data	no data	24.8	12.0	17.3	29.8	no data	36.1	24.3	39.3	35.7	36.4	31.8	9.3	26.7	42.8	29.2	14.8	38.1	no data	41.3	5.0	0													
	Auchencorth Moss	9.9	7.8	no data	11.6	11.1	8.0	12.6	30.8	26.0	21.1	12.3	25.3	9.6	11.0	7.7	32.8	30.6	34.3	13.4	7.8	10.5	15.8	3.0	0													
	Edinburgh St Leonards	24.3	16.0	no data	14.2	15.0	16.1	19.3	44.3	40.5	23.2	16.3	29.5	20.8	21.5	9.0	31.7	no data	no data	no data	no data	no data	no data	2.9	0													
	Falkirk Grangemouth MC	22.8	13.7	13.2	17.2	22.0	18.8	17.7	40.0	34.6	26.7	23.2	32.4	25.3	21.2	10.3	35.7	47.7	37.3	20.4	14.1	18.5	26.0	6.5	0													
	N Lanarkshire Coatbridge Whifflet	23.6	10.7	9.8	17.8	no data	no data	no data	35.5	27.6	29.1	16.0	25.5	no data	14.4	10.3	33.7	41.9	40.6	18.9	9.5	12.7	20.0	6.4	0													
	Perth Muirton	17.0	15.2	10.5	12.7	13.9	13.1	22.7	37.1	no data	no data	23.8	26.2	16.5	16.8	no data	29.1	45.1	45.1	18.8	11.8	12.8	28.8	1.6	0													



Figure 2.42 Comparison of Dundee PM<sub>10</sub> Monitoring Sites and Urban Background Locations from 16/01/2014 to 06/02/2014 (Events 1 & 2)

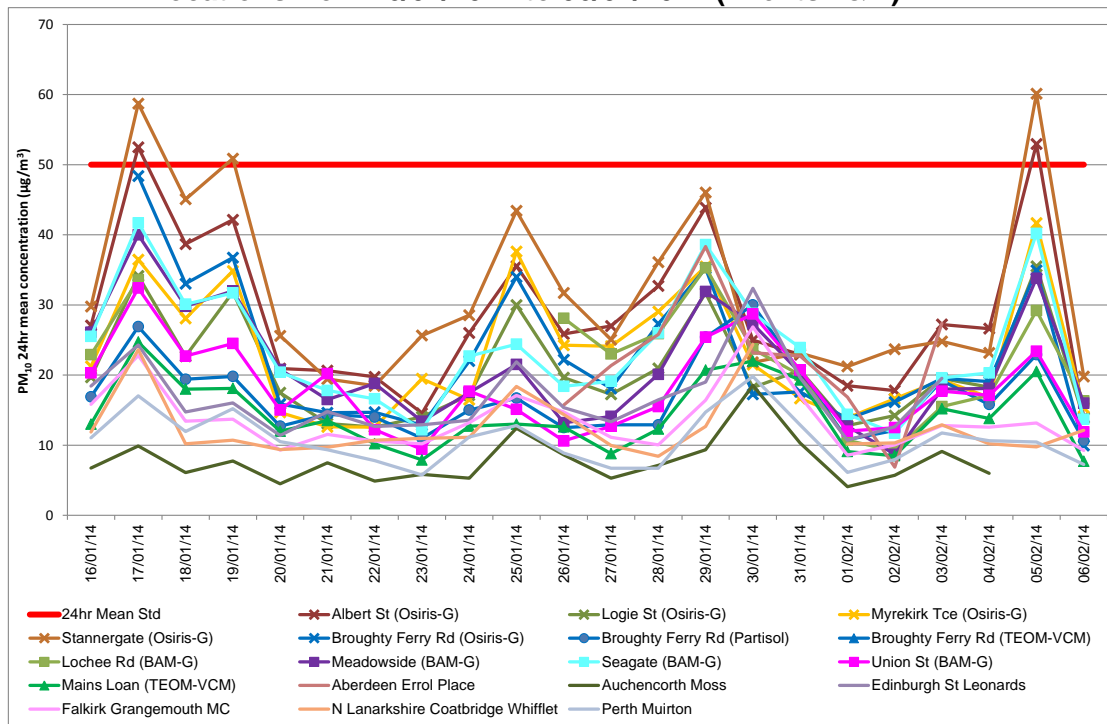


Figure 2.43 Comparison of Dundee PM<sub>10</sub> Monitoring Sites and Urban Background Locations from 07/03/2014 to 20/03/2014 (Event 3 & 4)

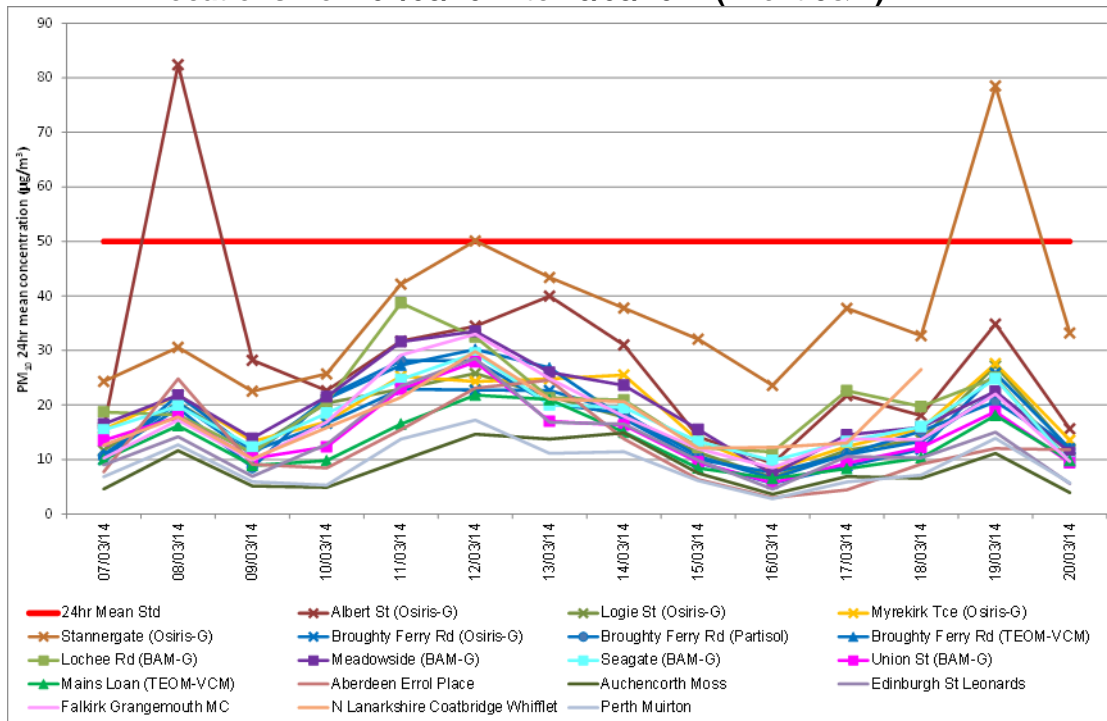


Figure 2.44 Comparison of Dundee PM<sub>10</sub> Monitoring Sites and Urban Background Locations from 23/03/2014 to 06/04/2014 (Events 5& 6)

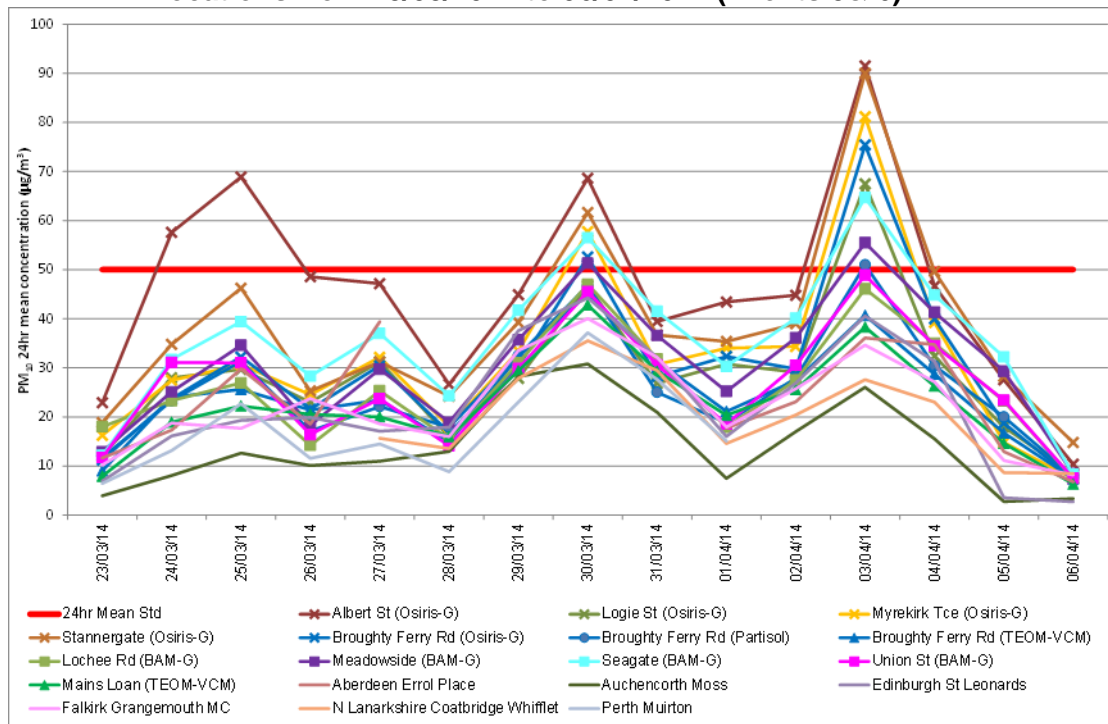


Figure 2.45 Comparison of Dundee PM<sub>10</sub> Monitoring Sites and Urban Background Locations from 14/04/2014 to 30/04/2014 (Events 7& 8)

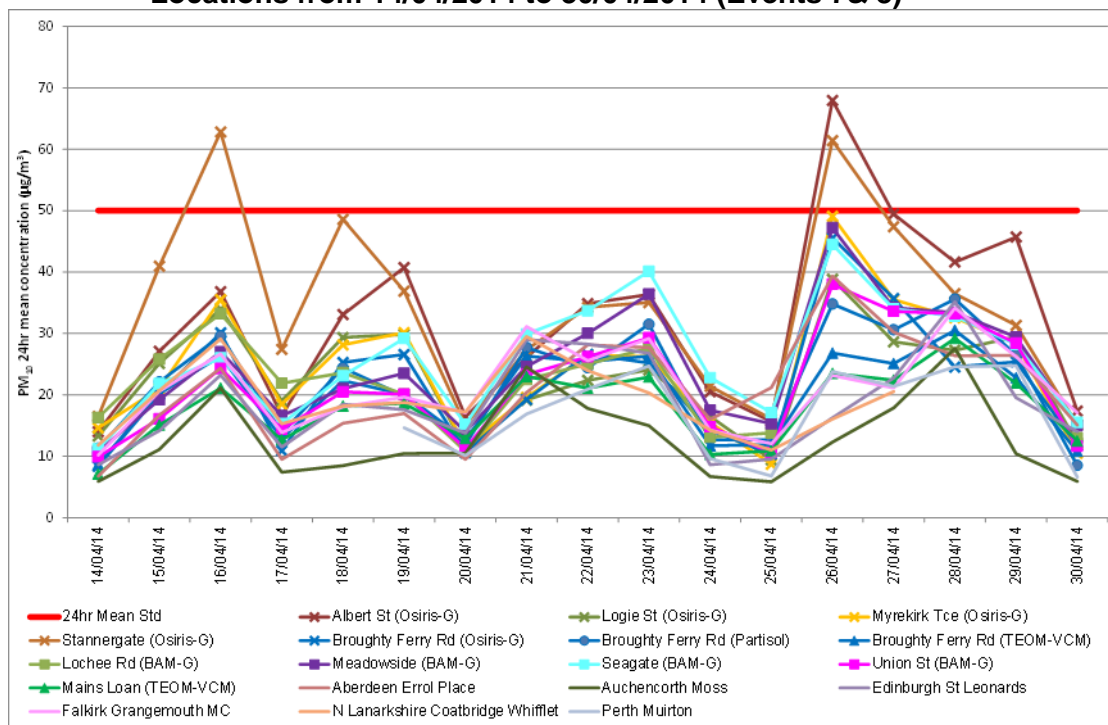


Figure 2.46 Comparison of Dundee PM<sub>10</sub> Monitoring Sites and Urban Background Locations from 17/05/2014 and 31/05/2014 (Events 9& 10)

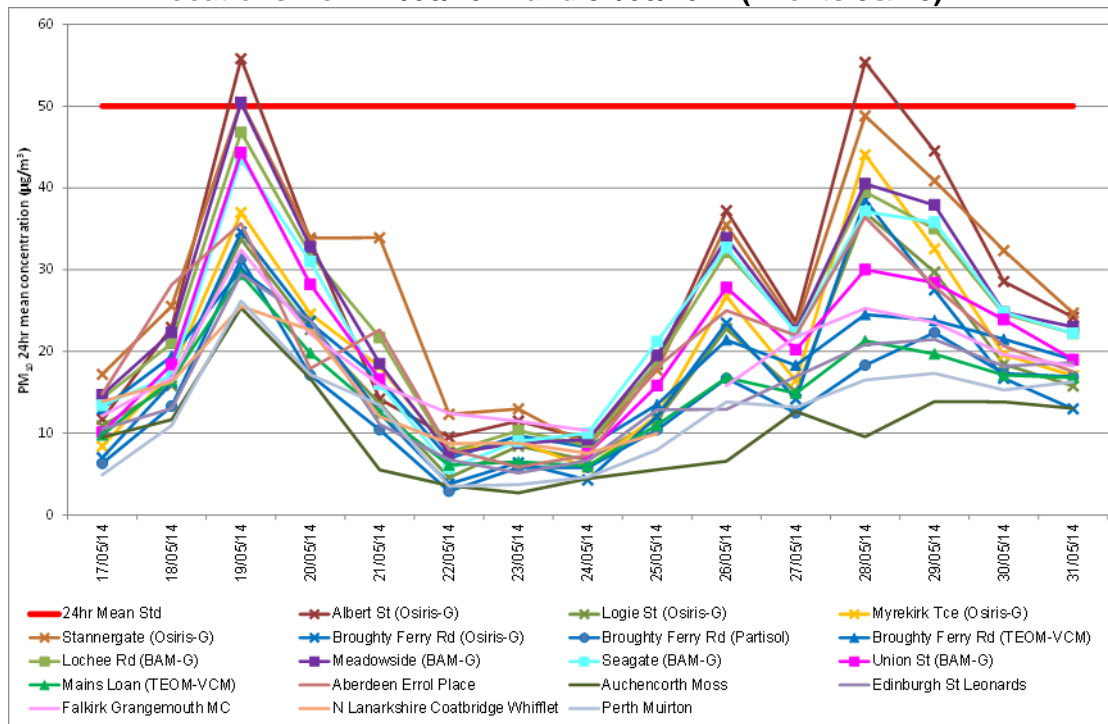
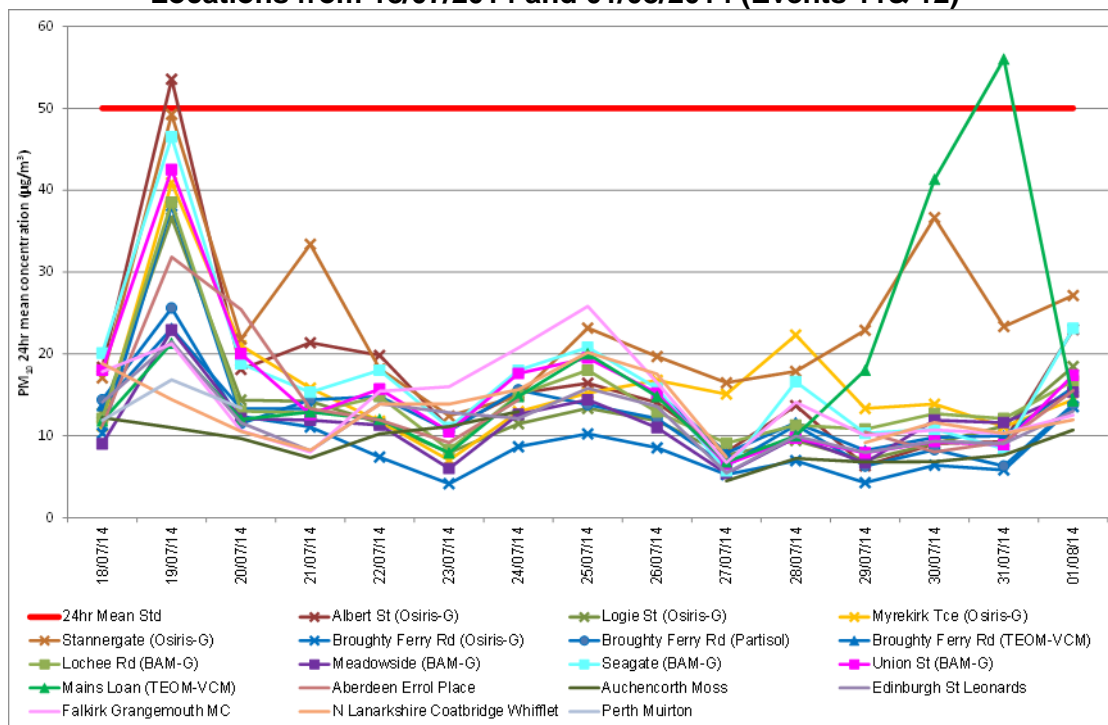
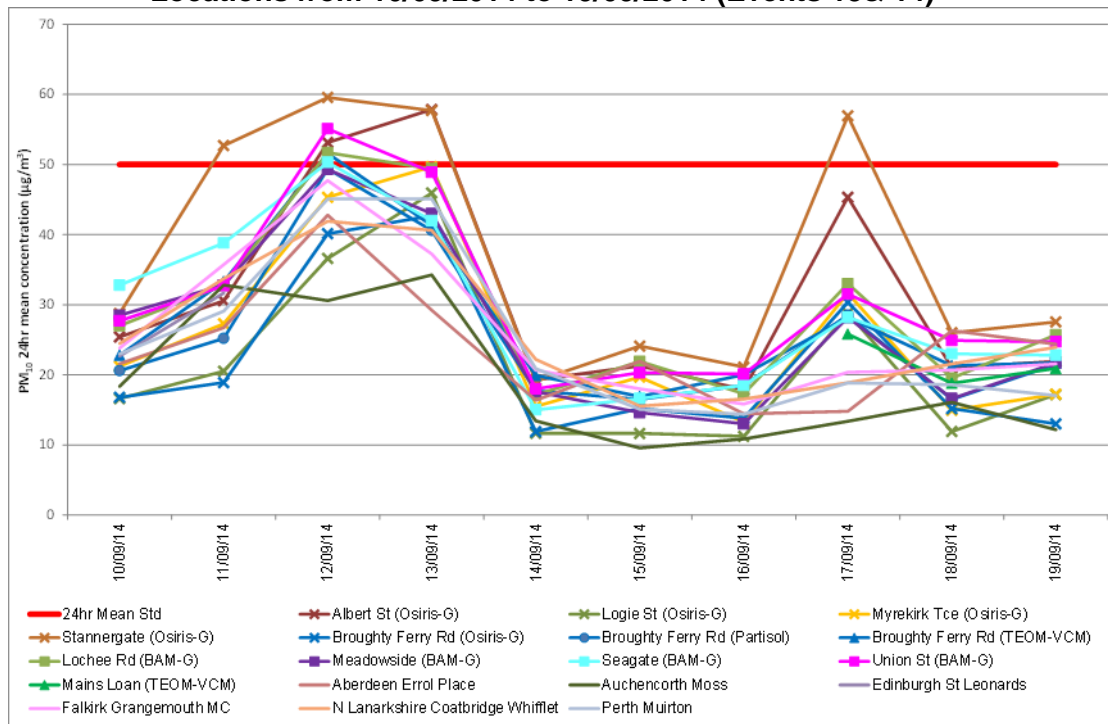


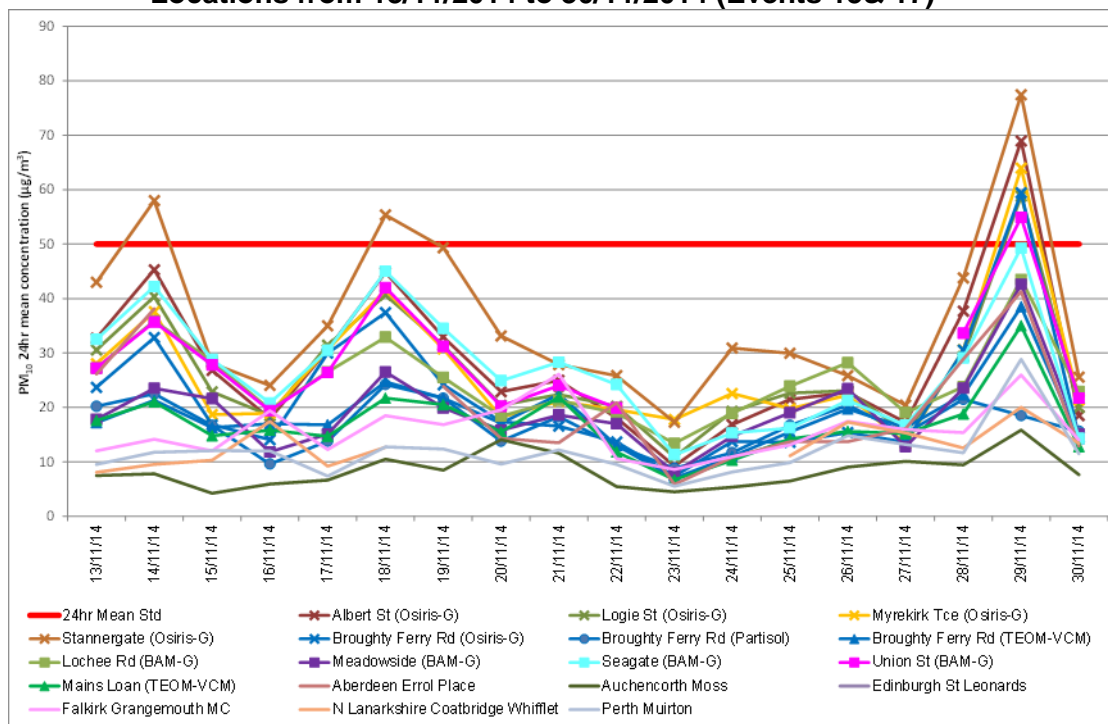
Figure 2.47 Comparison of Dundee PM<sub>10</sub> Monitoring Sites and Urban Background Locations from 18/07/2014 and 01/08/2014 (Events 11& 12)



**Figure 2.48 Comparison of Dundee PM<sub>10</sub> Monitoring Sites and Urban Background Locations from 10/09/2014 to 19/09/2014 (Events 13 & 14)**



**Figure 2.49 Comparison of Dundee PM<sub>10</sub> Monitoring Sites and Urban Background Locations from 13/1/2014 to 30/1/2014 (Events 15 & 17)**



### 2.2.3 Sulphur Dioxide

Dundee City Council measures SO<sub>2</sub> at one location, on Broughty Ferry Road. The monitor is located close to residential receptors located downwind of an urban industrial facility and the port. The UV fluorescence analyser is operated under similar protocols to the AURN stations and the unit is audited twice yearly by AEA. Data are ratified with reference to the Technical Guidance (LAQM.TG(09)).

Results for 2014 are shown in **Table 2.20**, along with the results for previous years. Concentrations of SO<sub>2</sub> are very low and all three objectives were met. The number of exceedences of each objective is given alongside the relevant percentile value.

As shown in **Figure 2.50**, SO<sub>2</sub> concentrations have declined at the Broughty Ferry Road monitoring station between 2002 and 2014. This is largely consistent with the introduction of low sulphur fuels (required by regulations since 1<sup>st</sup> January 2003) at a nearby industrial process (bitumen refinery) in the port. In previous reports, occasional exceedences of the 15min mean objective had been recorded as a result of certain shipping activities/movements within the port. The last recorded exceedences were in 2006. In recent years the sulphur content of marine fuels has decreased significantly, to the extent that fuel oil for ship use at sea in Sulphur Emission Control Areas specified in the MARPOL Convention<sup>5</sup> (which includes the North Sea), is limited to 1.5% sulphur by weight (the average in European waters pre-2007 was of the order 3%). In addition, since January 2010 ships lying at berth in European Union ports have to burn distillate oil with a sulphur content of not greater than 0.1% by weight.

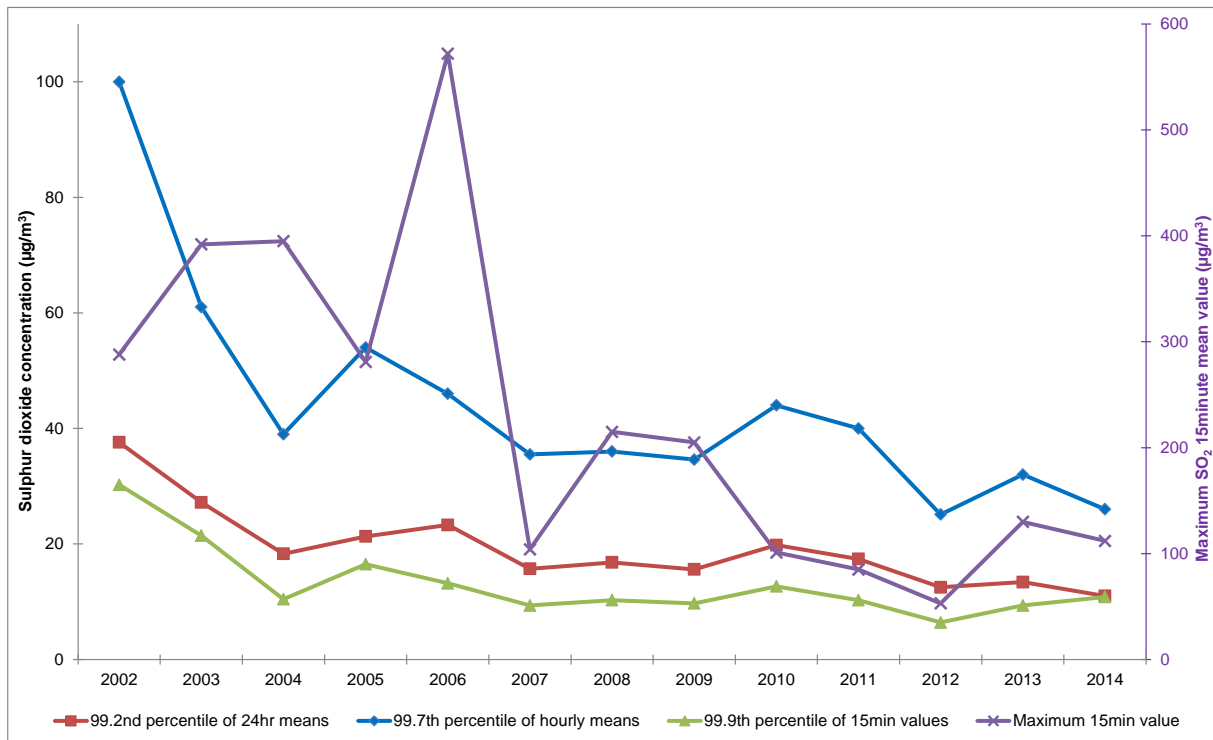
**Table 2.20 Results of SO<sub>2</sub> Automatic Monitoring at Broughty Ferry Road: Comparison with Objectives**

Location : Dundee Broughty Ferry Road, Site ID : CM3, Site Type : Urban Industrial												
Year	24hr mean objective				1hr mean objective				15min mean objective			
	No. of exceedences >125ug/m <sup>3</sup> (3 allowed per year)	Max (ug/m <sup>3</sup> )	99.2 <sup>nd</sup> percentile (ug/m <sup>3</sup> )	data capture %	No. of exceedences >350ug/m <sup>3</sup> (24 allowed per year)	Max (ug/m <sup>3</sup> )	99.7 <sup>th</sup> percentile (ug/m <sup>3</sup> )	data capture %	No. of exceedences >266ug/m <sup>3</sup> (35 allowed per year)	Max (ug/m <sup>3</sup> )	99.9 <sup>th</sup> percentile (ug/m <sup>3</sup> )	data capture %
2002	0	69.7	37.6	92.1	0	207.7	100	92	1	288	165	90.4
2003	0	53.7	27.2	97.3	0	267.3	61	97.5	6	392	117	95.4
2004	0	33.3	18.3	100	0	294.2	39	100	5	395	57	97.9
2005	0	54	21.3	94.8	0	235.1	54	95	2	281	90	93
2006	0	50.1	23.3	96.2	0	277.5	46	96.6	5	572	72	94.5
2007	0	19.6	15.7	99.7	0	68.8	36	99.6	0	104	51	97.5
2008	0	24.5	16.8	97.5	0	137.8	36	97.5	0	215	56	95.6
2009	0	17.4	15.6	93.4	0	119.8	35	93.4	0	205	53	91.5
2010	0	27.4	19.8	96.4	0	92.3	44	96.5	0	101	69	94.5
2011	0	11.0	17.4	82.7	0	66.5	40	83.0	0	85	56	81.3
2012	0	14.8	12.5	94.0	0	42.3	25	93.7	0	53	35	92.6
2013	0	17.6	13.4	98.4	0	64.3	32	98.5	0	130	51	97.5
2014	0	41.3	11.0	89.3	0	110.5	26	89.2	0	112	59	88.9

Notes: The monitoring station is located within an AQMA for NO<sub>2</sub> and PM<sub>10</sub>.  
Data capture percentages are for a full calendar year.

<sup>5</sup> Marpol is the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978, Annex VI -Prevention of air pollution from ships.

**Figure 2.50 Overview of Maximum (15min) SO<sub>2</sub> Concentrations and Relevant Percentiles from 2002 to 2014**



The nearby bitumen refinery stopped refining oil in December 2013, and large tankers carrying crude oil are no longer delivering oil to site. Given that no exceedences of the objectives for sulphur dioxide have been recorded during the monitoring period and following discussions with the regulator (SEPA), it was agreed that monitoring for sulphur dioxide could cease at the end of 2014.

## 2.2.4 Summary of Compliance with AQS Objectives

Dundee City Council has examined the results from monitoring in 2014. Annual mean concentrations within the AQMA, previously declared for NO<sub>2</sub> and PM<sub>10</sub> annual mean and NO<sub>2</sub> the hourly mean (i.e. the whole council area), still exceed the relevant objectives and the AQMA should remain.

Dundee City Council has measured concentrations of NO<sub>2</sub> above the annual mean objective (40µg/m<sup>3</sup>) at relevant locations within the AQMA. There are 6 roads where the annual mean NO<sub>2</sub> concentration at relevant exposure is estimated to exceed the objective. These are: Dock Street; Lochee Road; Logie Street; Seagate; Meadowside; and, Victoria Road. At least a further 8 roads have concentrations which are 'borderline' at locations of relevant exposure. These are: Albert Street; High Street; Loons Road; Nethergate; North Marketgait; Rankine Street; West Marketgait; and, Whitehall Street. Three locations where the annual mean concentrations were previously exceeded at locations of relevant exposure were below the objective in 2014. These are: Stannergate; Strathmore Avenue and Union Street.

None of the Dundee City Council automatic analysers measured concentrations of NO<sub>2</sub> above the 1-hour objective (200µg/m<sup>3</sup>) in 2014. There has been a sudden reduction in the number of exceedences at Lochee Road; however the underlying trend in the 98.08<sup>th</sup> percentile remains upward. If a pattern of fewer hourly mean exceedences and lower hourly mean percentile values becomes established it may be possible to consider amendment of the AQMA in respect of this objective. Any amendment would require a detailed assessment which would need to take into account the worst case exposure location, which diffusion tubes indicate is on Lochee Road nearer the junction with Dudhope Terrace.

The PM<sub>10</sub> NAQS UK annual mean objective (40µg/m<sup>3</sup>) continues to be met at all locations within the city; however Dundee City Council has measured concentrations of PM<sub>10</sub> above the stricter Scottish PM<sub>10</sub> annual mean objective (18µg/m<sup>3</sup>) at Lochee Road (BAM), Albert Street (Osiris) and Stannergate roundabout (Osiris). Annual mean concentrations are higher at Stannergate than other similar roadside locations suggesting contributions from PM<sub>10</sub> sources other than road traffic which requires further investigation. Locations with 'borderline' concentrations for the annual mean objective (18µg/m<sup>3</sup>) include Myrekirk Terrace (Osiris), Meadowside (BAM), Seagate (BAM) and Union Street (BAM).

The PM<sub>10</sub> NAQS UK 24-hour objective continues to be met at all locations within the city; however, the stricter Scottish 24-hour mean objective was exceeded at Stannergate Roundabout (Osiris) and Albert Street (Osiris) in 2014. Osiris monitors are indicative monitors and the methodology used to adjust the data to gravimetric equivalent, whilst reasonable for annual mean data, has a tendency to over-estimate the number of 24-hour mean exceedences. The review of the instances of the 2014 24-hour mean exceedences shows that the majority coincided with raised background concentrations across Scotland and were largely associated with winds from the east. A detailed assessment for the short-term Scottish objective is not considered necessary at this time, though future monitoring results at these locations will be kept under review.

New monitoring data for 2014 show all three objectives for SO<sub>2</sub> are being achieved.

### 3 Road Traffic Sources

This section deals with any changes in the Local Authority area that may affect air quality. It is only necessary to consider locations which:

- have not been assessed during the earlier rounds,
- have experienced a significant change in traffic flows
- have a new development, or
- have new exposure that has not been assessed previously.

Dundee City Council Transport Division collated new and updated road traffic data in February 2015. This included data from over 50 automatic traffic count sites (ATC) and over 250 radar count sites dating from 2005 to 2014. All of the ATC data has been screened in line with the USA criteria. The radar count data is of limited use as they are not classified for vehicle type. However it has been possible to screen this data against the criteria for Section 3.1. Many of the radar count sites are on roads never assessed before. Further review of this data for the presence of relevant exposure where the AADT is greater than 10,000vpd will help identify where new classified traffic counts or NO<sub>2</sub> diffusion tube monitoring is needed.

#### 3.1 Narrow Congested Streets with Residential Properties Close to the Kerb

These are streets where buildings on either side reduce dispersion of ground-level pollutants and there is slow moving traffic that is frequently stopping and starting owing to pedestrian crossings, parked vehicles etc. throughout much of the day (not just during rush hours).

No new/newly identified congested streets which meet the general characteristics set out in the guidance i.e. traffic flows above 5,000 vehicles per day, frequent stop-start flows, average speed less than 25 kph, and residential properties within 2m of the kerb have been identified. There are existing streets, with similar criteria within the Dundee City AQMA, such as Seagate, Union Street, Commercial Street, Crichton Street, Nethergate, Victoria Street, Meadowside, Albert Street and Dock Street, but these are within known areas of exceedence and have been previously assessed.

Dundee City Council confirms that there are no new/newly identified congested streets with a flow above 5,000 vehicles per day and residential properties close to the kerb, that have not been adequately considered in previous rounds of Review and Assessment.

#### 3.2 Busy Streets Where People May Spend 1-hour or More Close to Traffic

The main areas where it is likely that the public may spend one hour or more close to traffic are streets with many shops and streets with outdoor cafes and bars, namely:



- The city centre, a significant proportion of which is pedestrianised;
- Perth Road
- High Street, Lochee; and,
- Brook Street, Broughty Ferry.

These areas have been monitored for nitrogen dioxide using diffusion tubes and the annual mean concentrations have been found to be below  $60\mu\text{g}/\text{m}^3$  indicating that it is unlikely that the short-term objective will be exceeded. There has been an increase in the number of pavement cafes and seating areas; however there are no new/newly identified busy streets where people may spend 1 hour or more close to traffic.

Dundee City Council confirms that there are no new/newly identified busy streets where people may spend 1 hour or more close to traffic.

### 3.3 Roads with a High Flow of Buses and/or HGVs.

There are some streets where traffic flows are not necessarily high (fewer than 20,000 vehicles per day) but there is an unusually high proportion of buses and/or HGVs. An unusually high proportion can be taken to be greater than 20%. The assessment of these streets should consider both  $\text{NO}_2$  and  $\text{PM}_{10}$ .

Traffic data assessed for the Updating and Screening Assessment show no newly identified roads with high flows of buses and heavy goods vehicles >20%. Previous traffic counts indicated the following streets have heavy duty vehicles >20%: Meadowside, High Street, Nethergate, Union Street, Whitehall Crescent. Previous assessments, using traffic counts prior to 2006, also indicate Seagate, St Andrews Street, Whitehall Street, Dock Street, Commercial Street and King Street have >20%. These are all within an AQMA.

Dundee City Council confirms that there are no new/newly identified roads with high flows of buses/HGVs.

### 3.4 Junctions (including busy roads & junctions in Scotland)

Concentrations are usually higher close to junctions owing to the combined impact of traffic emissions from more than one road and to the higher emissions due to stop start driving. The assessment of junctions considers both  $\text{NO}_2$  and  $\text{PM}_{10}$ . It is only necessary to assess busy roads or junctions not considered in previous Review and Assessment reports, and/or where there has been a significant increase (>10% AADT) in traffic flows since the last assessment, and/or where there is new relevant exposure. Generally in terms of  $\text{NO}_2$  a busy junction can be taken to be one with more than 10,000 vehicles per day. Due to the stricter  $\text{PM}_{10}$  objective in Scotland the following criteria are also used to define "busy":

- Roads and/or junctions with more than **5,000** vehicles per day (AADT), where the annual mean  $\text{PM}_{10}$  background in 2010 is expected to be **above  $15\mu\text{g}/\text{m}^3$** .

- Roads and/or junctions with more than **10,000** vehicles per day (AADT), where the annual mean PM<sub>10</sub> background in 2010 is expected to be **below 15 µg/m<sup>3</sup>**.

The 2014 Scottish Government predicted PM<sub>10</sub> background concentrations (June 2014 release) for Dundee did not include any 1km grid squares with a value greater than 15 µg/m<sup>3</sup>, so the assessments need only focus on roads/junctions with more than 10,000 vpd.

Dundee City Council Transport Division collated new and updated road traffic data in February 2015. This included data from over 50 automatic traffic count sites and over 250 radar count sites dating from 2005 to 2014. All the automatic traffic count data were screened and compared to data considered in previous rounds of review and assessment to determine whether any new assessments were required (see **Appendix F**). Three locations requiring assessment were identified and are detailed in **Table 3.1**. In addition the traffic count data up until 2013 from the major Department for Transport traffic count point locations in Dundee were collected and reviewed. The 2014 data will not be available until June 2015. Of the 28 locations an increase in traffic flows of more than 10%, since previously assessed (2006 count data) was identified on the Kingsway (east of Myrekirk roundabout). This location is also detailed in **Table 3.1**.

**Table 3.1 New Locations requiring assessment identified from screening of road traffic data**

Site Number	Road name	Reason for assessment	Type of assessment
92000012	Arbroath Rd at Monymusk	New relevant exposure identified	Road is included in the ADMS-Roads <sup>6</sup> air dispersion model of Dundee East
92000013	Pitkerro Rd (South of Craighill Court)	Road AADT > than 10,000vpd with relevant exposure within 10m	Road is included in the ADMS-Roads air dispersion model of Kingsway/Forfar Rd
92000033	Happyhillock Rd (East of Inglefield St)	Road AADT > than 10,000vpd with relevant exposure within 10m	DMRB <sup>7</sup>
DFT Count Point 40803	Kingsway West (East of Myrekirk roundabout)	Greater than 10% increase since previously assessed	Road included in the ADMS-Roads air dispersion modelling of Kingsway / Myrekirk (includes real-time monitoring)

The result of the DMRB screening assessment at Happyhillock Road and details of its associated verification are detailed in **Appendix H**; no exceedences of any of the air quality objectives were predicted.

The ADMS-Roads dispersion modelling of Dundee East and Kingsway/Forfar Rd is being undertaken as part of the council's AQAP work and is ongoing. The findings of these studies will be reviewed and presented in future LAQM reports. Assessment of air quality at Kingsway West (East of Myrekirk) by the council using NO<sub>2</sub> diffusion tubes and an indicative particulate analyser has been carried out. The results suggest that the NO<sub>2</sub> annual mean

<sup>6</sup> ADMS-Roads is an Atmospheric Dispersion Model produced by Cambridge Environmental Research Consultants  
<sup>7</sup> Design Manual for Roads and Bridges Version 1.03c (July 2007)

objective is met, but are 'borderline' for the PM<sub>10</sub> annual mean concentrations. The 2013 & 2014 PM<sub>10</sub> annual mean for the particulate monitor (Myrekirk Terrace, CM17) were 15.5µg/m<sup>3</sup> and 18.3µg/m<sup>3</sup>. Façade corrected nitrogen dioxide diffusion tube results at the worst case receptor (DT181) recorded 29.8 µg/m<sup>3</sup> (2013) and 27.1 µg/m<sup>3</sup> (2014). Third party monitoring of NO<sub>2</sub> and PM<sub>10</sub> using reference equivalent analysers has been carried out, as part of a post development monitoring and modelling exercise of a new superstore, secured through planning condition. The monitoring and modelling results are not yet available and will be reviewed in future reports.

Forty-seven of the radar count locations have AADTs greater than 10,000vpd. Further review of these locations for the presence of relevant exposure will help identify where new classified traffic counts or NO<sub>2</sub> diffusion tube monitoring is needed.

New relevant exposure within 10 metres of known busy roads been identified, at Broughty Ferry Road (129). This location is included in the Dundee East ADMS-Roads air dispersion model. A NO<sub>2</sub> diffusion tube has also been installed in 2015 at this location. The results from the modelling and monitoring will be reviewed in future LAQM reports.

Since the last USA there have been a number of planned developments given permission that introduce new relevant exposure next to busy roads/junctions, and/or have the potential to increase traffic on the nearby network by 10%. Traffic impacts of the proposed developments were not quantified in all cases nor were air quality assessments carried out prior to approval. The progress report 2014 listed a number of local developments that may impact on air quality which were to be taken into account in this USA, or as information becomes available. These include:

- **New Superstore Kingsway / Myrekirk.** Since the last USA (2012) alterations to the Kingsway / Myrekirk Road roundabout, which forms part of the trunk road network through the city, have taken place as part of a new superstore development. The air quality assessment that accompanied the proposals predicted a new exceedence of the PM<sub>10</sub> annual mean standard as a result of the development<sup>8</sup>. A condition requiring post development pollution monitoring & modelling was applied to the planning consent. The superstore opened in July 2013. The monitoring study commenced in March 2014 and ran until January 2015; the results of monitoring and modelling are awaited, and will be reviewed in future reports.
- **Proposed Wind Turbine Manufacturing Plant<sup>9</sup>.** This has the potential to increase road traffic, in particular HGVs at the Stannergate roundabout, which is a potential PM<sub>10</sub> exceedence area. One of the council Osiris monitors was relocated to a roadside location close to this roundabout in 2012. The 2013 & 2014 PM<sub>10</sub> annual mean for this monitor (Stannergate, CM18) were 24.5µg/m<sup>3</sup> and 26.7µg/m<sup>3</sup>. The Council are undertaking traffic micro-simulation modelling and air dispersion modelling (ADMS-Roads) of Dundee's eastern arterial routes, including Stannergate roundabout, to identify potential traffic management/road infrastructure measures that may improve air quality.
- **Highgate Redevelopment, Lochee.** In 2012, the Council approved the master plan<sup>10</sup> for the redevelopment of the Highgate area of the Lochee district centre, by the summer of 2014 a new road linking the bypass with the High Street, a public transport hub, new car parking had been created. New residences are also being constructed

<sup>8</sup> <http://idoxwam.dundee.gov.uk/WAM133/doc/Report-345111.PDF?extension=.PDF&id=345111&location=VOLUME2&contentType=application/pdf&pageCount=1>

<sup>9</sup> [http://idoxwam.dundee.gov.uk/idoxpa-web/files/7041BE0BD1BEC4C5E14EEC0E473A9E5B/pdf/12\\_00558\\_PPPM-STRATEGIC\\_TRANSPORT\\_ASSESSMENT-429412.pdf](http://idoxwam.dundee.gov.uk/idoxpa-web/files/7041BE0BD1BEC4C5E14EEC0E473A9E5B/pdf/12_00558_PPPM-STRATEGIC_TRANSPORT_ASSESSMENT-429412.pdf)

<sup>10</sup> <http://www.dundee.gov.uk/reports/reports/25-2012.pdf>

within 10m of the bypass which has an AADT of more than 10,000 vpd. Consequently in 2015, a new diffusion tube monitoring location has been installed at sensitive receptors close to Coupar Angus Road/Sinclair Street. To assess PM<sub>10</sub> exposure at this location will require a DMRB assessment but there are no classified traffic counts currently available. These will be undertaken once new traffic flows and patterns become established.

- **Extended Use of Multi-storey Carpark exiting on to Meadowside.** New permitted development for the Wellgate shopping centre proposes to extend the hours of use of the centre's 600 space multi-storey car park. The only exit from the car park leads onto Meadowside so an increase in traffic emissions is likely at the roadside residential properties. Insufficient information is available to quantify the future traffic impacts to determine if there will be a significant increase. However, Meadowside is already known to be a road where concentrations of the objectives have been exceeded at locations of relevant exposure. A condition has been applied to the consent requiring the provision of electric vehicle charging points, or other mitigation measures to be approved by the council prior to the first use of the new development. Air quality impacts will be assessed using existing monitoring locations nearby. Preliminary assessment of the trialling of an Action Plan measure that extends the distance between the facades of ground floor flats and vehicle exhausts by reallocating road space to cycles shows possible improvements in air quality.

New relevant exposure within 10 metres of known busy roads has also been proposed, at High Street (22-24), Lochee and West Marketgait / Old Mill. NO<sub>2</sub> diffusion tubes have been installed at both locations in 2015. The location on High Street, Lochee is included in the North West arterial route ADMS-Roads air dispersion model, which is being undertaken as part of the council's action plan to identify possible traffic management measures to improve air quality on Lochee Road. The results from the monitoring and modelling will be reviewed in future LAQM reports. A DMRB assessment of the proposed new ground floor receptors at West Marketgait / Old Mill was carried out using 2014 ATC count data (Site ID 92000018) (see **Appendix F**). This site does not include vehicle classifications, so the percentage HDV used in the assessment was taken from the council's Further Assessment and Detailed Assessment in 2009, where results were previously predicted at first floor. The results of the DMRB assessment are shown in **Appendix H**. No exceedences of the objectives for NO<sub>2</sub> and PM<sub>10</sub> were predicted.

Dundee City Council has assessed new/newly identified busy roads or junctions meeting the criteria in Section A.4 of Box 5.3 in LAQM.TG(09), and concluded that it will not be necessary to proceed to a Detailed Assessment.

### 3.5 New Roads Constructed or Proposed Since the Last Round of Review and Assessment

The assessment of new roads needs to consider both NO<sub>2</sub> and PM<sub>10</sub>. Assessment is required where traffic flows on the new road are greater than 10,000 vehicles per day or the new road could increase traffic on existing roads where concentrations are 'borderline' for relevant objectives. In both cases there should be relevant exposure within 10m.

New junctions and roads have been constructed and others are proposed as part of the Central Waterfront Development Masterplan 2001 – 2031. Some of these carry more than 10,000 vpd but there are currently no relevant receptors near the locations of the recent network changes. The need for review and assessments of these roads and junctions will be examined in subsequent reports as necessary.

A new link road connecting the Central Waterfront Development with the existing city centre road network opened in January 2015 at the south of Union Street. This has the potential to increase traffic flows in Union Street and other city centre streets where there is relevant exposure and where NO<sub>2</sub> and PM<sub>10</sub> annual mean concentrations are 'borderline'. These locations are all within the AQMA. The impacts will be assessed using existing monitoring locations for NO<sub>2</sub> and PM<sub>10</sub>. The need for classified traffic counts of the new link road and surrounding links will be considered once new traffic flows and patterns become established.

There are no other newly constructed roads since the previous USA that meet these assessment criteria.

Dundee City Council has assessed new / proposed roads meeting the criteria in Section A.5 of Box 5.3 in TG(09), and concluded that it will not be necessary to proceed to a Detailed Assessment.

### 3.6 Roads with Significantly Changed Traffic Flows

The assessment of roads with more than 10,000 vehicles per day that have experienced "large" increases in traffic considers both NO<sub>2</sub> and PM<sub>10</sub>. A "large" increase in this instance is taken to be more than a 25% increase in traffic flow. It is only necessary to consider any roads with significantly changed traffic flows that have not already been considered in parts 3.1 to 3.5. In Scotland, owing to the stricter PM<sub>10</sub> objective **Section 3.4** considers increases in traffic flows of 10% or greater and therefore there is no need to proceed further with this part.

Dundee City Council has assessed new/newly identified roads with significantly changed traffic flows, and concluded that it will not be necessary to proceed to a Detailed Assessment.

### 3.7 Bus and Coach Stations

The assessment considers both the hourly and annual mean standards for nitrogen dioxide at bus stations with >2,500 bus movements per day, where the travelling public are not enclosed and where residential premises are closer than 10m to the buses. The assessment criteria have been relaxed in recent years from a previous threshold of >1,000 movements per day. There are no new bus stations since the last review and although there are

## Dundee City Council

residences within 10m of the Seagate bus station the maximum daily bus movements from the existing local bus station are estimated to be only 786<sup>11</sup>.

Dundee City Council confirms that there are no relevant bus stations in the Local Authority area.

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<sup>11</sup> Personal Communications from Martin Gallagher (Stagecoach East Coast) 2015--02-06

## 4 Other Transport Sources

### 4.1 Airports

The assessment for airports considers nitrogen dioxide. If there are no airports that meet the criteria, there is no need to proceed further with the assessment.

Although there is relevant exposure within 1000m of the Dundee Airport terminal, in 2013/2014 passenger figures were 26,774 and 48,312 in 2012/13<sup>12</sup>, and there were no freight only flights. This is below the threshold for assessment of 10 million passengers per annum or freight equivalent.

Dundee City Council confirms that there are no airports in the Local Authority area that meet the criteria for assessment.

### 4.2 Railways (Diesel and Steam Trains)

The assessment for stationary trains considers sulphur dioxide, while the assessment for moving diesel trains considers nitrogen dioxide. If there are no railways carrying diesel or steam trains in the Local Authority area, there is no need to proceed further with this part.

#### 4.2.1 Stationary Trains

The only site in Dundee where trains may be stationary for more than 15 minutes is Dundee Railway Station. The station has an enclosed passenger waiting area. There are no receptors within 15 metres of the main station. There are no sidings within the city where trains are routinely stationary for periods in excess of 15 minutes.

There is also a station in Broughty Ferry where there is potential exposure as there is no indoor waiting area at the station. However, very few trains stop at the station and these trains are not stationary for longer than 15 minutes.

Dundee City Council confirms that there are no locations where diesel or steam trains are regularly stationary for periods of 15 minutes or more, with potential for relevant exposure within 15m.

<sup>12</sup> Highlands and Islands Airport Ltd. Report and Financial Statements 31<sup>st</sup> March 2014 – SG/2014/149

#### 4.2.2 Moving Trains

The requirement to assess nitrogen dioxide emissions from moving diesel locomotives was introduced in 2009. The LAQM.TG(09) guidance lists the heavily trafficked rail lines that require to be assessed in Table 5.1. None of these pass through Dundee.

Dundee City Council confirms that there are no locations with a large number of movements of diesel locomotives, and potential long-term relevant exposure within 30m.

### 4.3 Ports (Shipping)

The assessment for shipping considers sulphur dioxide emissions (for the 15 minute standard) from busy ports, where the shipping movements range from 5,000 to 15,000 per year and where there is relevant exposure within 250 metres of the berths. If there are no ports or shipping, there is no need to proceed further with this part. There are both residential and other outdoor relevant exposure locations within 250 metres (in some cases as close as ~130m). However, the estimated number of shipping movements for Dundee Port was only 816 in 2014<sup>13</sup>.

Dundee City Council confirms that there are no ports or shipping that meet the specified criteria within the Local Authority area.

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<sup>13</sup> Personal Communication from Dr. Derek McGlashan Environment and Energy Manager - Forth Ports Limited 2015-01-26



## 5 Industrial Sources

### 5.1 Industrial Installations

Industrial sources are regulated by the Scottish Environment Protection Agency (SEPA) under the Pollution Prevention and Control Regulations. Local authorities also have controls over smaller industrial and commercial sources, largely through the Clean Air Act and its associated control of the stack heights. As a result of these controls, there are relatively few sources that may be relevant to local authorities under the Local Air Quality Management (LAQM) regime. The majority of these sources will have been addressed during previous rounds of Review and Assessment and the focus is, therefore, on new installations and those with significantly changed emissions or new exposure.

The technical guidance (LAQM.TG(09)) states that the assessment of industrial installations should consider all of the regulated pollutants, although those most likely to require further work are sulphur dioxide, NO<sub>2</sub>, PM<sub>10</sub> and benzene. A list of industrial processes in the city which are regulated by the Scottish Environmental Protection Agency (SEPA) is provided in **Appendix E**. This Appendix also includes a screening assessment of all the SEPA regulated processes. Those highlighted thus “\*” in the table and the notes are discussed in the relevant sections below.

#### 5.1.1 New or Proposed Installations for which an Air Quality Assessment has been Carried Out

An application for a new gas fired combined heat and power plant (CHP) with associated stack at the University of Dundee was granted planning approval in 2013<sup>14</sup>. The proposed stack installation is in close proximity to three existing CHP stacks and main boiler house stack. A preliminary screening assessment for NO<sub>2</sub> was carried out using the nomogram provided for short stacks in the technical guidance (Fig. 5.3 - LAQM TG.09). This nomogram was selected as the total emissions from the existing units and the new CHP were assumed to be emitted from the shortest stack. The effective stack height was assumed to be zero due to the presence of a taller building within a distance of 5 stack heights. The actual emission rate exceeded the target emission rate for the nearest receptor, indicating that a detailed assessment was required. However the applicants provided a more accurate air dispersion model carried out in 2009. This indicated that though existing impacts are significant the air quality objectives would be achieved if the new CHP emissions used the main boiler house stack. It is not known whether the University will decide to pursue the installation modelled or the arrangement granted planning permission. If the latter arrangement is pursued then an updated air dispersion model will be required, to take account of the different emission parameters, stack location, up-to-date background concentrations, locations of receptors (including those at height), and the contribution from local roads.

Dundee City Council has assessed new/proposed industrial installations, and concluded that it will not be necessary to proceed to a Detailed Assessment.

<sup>14</sup> <http://idoxwam.dundeeecity.gov.uk/idoxpa-web/simpleSearchResults.do?action=firstPage>

### 5.1.2 Existing Installations where Emissions have Increased Substantially or New Relevant Exposure has been Introduced

SEPA were consulted regarding any changes that meet the above criteria at SEPA regulated sites. **Appendix E** summarises SEPA's responses (in the white columns) and screens the processes against the above criteria (orange columns). New exposure was identified close to some SEPA regulated processes but these were not processes requiring review and assessment. One process had relocated within Dundee; however this is not a process that requires review and assessment. Several processes had stopped operating, closed or surrendered permits since the last USA. A bitumen refinery obtained a variation to their permit to increase particulate emissions from May 2013. The increase in emissions was estimated to be less than 7.5%.<sup>15</sup> This does not constitute a substantial rise in emissions (>30%) as detailed in Box 5.5 of LAQM.TG(09), and therefore an updated assessment is not required. The same process stopped refining oil in December 2013 which will have resulted in an overall decrease in emissions.

Dundee City Council has assessed industrial installations with new relevant exposure in their vicinity, and concluded that it will not be necessary to proceed to a Detailed Assessment.

### 5.1.3 New or Significantly Changed Installations with No Previous Air Quality Assessment

Dundee City Council was consulted by SEPA on a PPC Application for a Part A process<sup>16</sup> involving the manufacture of biodiesel and glycerine by transesterification using vegetable oils and fats. DCC highlighted that no air quality assessment of LAQM pollutants had been included with the application. SEPA responded that the process was considered a low impact installation as there are no point source air emissions associated with the process and any fugitive air emissions do not include LAQM pollutants.

Dundee City Council has assessed new/proposed industrial installations, and concluded that it will not be necessary to proceed to a Detailed Assessment.

<sup>15</sup> Attachment 4 – Non Technical Summary Nynas UK AB PPC Permit PPC/A/1013015 (13 March 2013) viewed during meeting with Stuart Anderson SEPA on 23 Oct 2013.

<sup>16</sup> PPC-A-1121850 ASKA Energy Ltd.

## 5.2 Major Fuel (Petrol) Storage Depots

The assessment considers benzene, with respect to the 2010 objective.

There are no major fuel (petrol) storage depots within the Local Authority area.

## 5.3 Petrol Stations

The assessment considers benzene with respect to the 2010 objective. Large petrol stations, where the annual throughput is more than 2000m<sup>3</sup> of petrol (2 million litres per annum) and with a busy road nearby (i.e. >30,000 annual average daily traffic flows), require consideration where there is relevant exposure (e.g. residential properties) within 10m of the pumps. All existing petrol stations have been assessed previously and there are no residences within 10m of the pumps.

Dundee City Council confirms that there are no petrol stations meeting the specified criteria.

## 5.4 Poultry Farms

Farms housing in excess of: 400,000 birds if mechanically ventilated; 200,000 birds if naturally ventilated; and, 100,000 birds for any turkey unit, require consideration if there is residential exposure within 100m of the poultry units. The assessment needs to consider only PM<sub>10</sub>.

Dundee City Council confirms that there are no poultry farms meeting the specified criteria in Dundee.

## 6 Commercial and Domestic Sources

### 6.1 Biomass Combustion – Individual Installations

The assessment of this item considers both PM<sub>10</sub> and nitrogen dioxide objectives. Biomass burning can lead to an increase in PM<sub>10</sub> emissions owing to the process of combustion. Aerosol formation from volatile materials distilled from the wood is also an issue. Compared to conventional gas-burning, biomass burning can also result in an increase in the overall NO<sub>x</sub> emissions due to the fuel-derived portion that is not present in gas combustion.

Since the last USA there have been no new individual biomass installations that meet the screening assessment criteria.

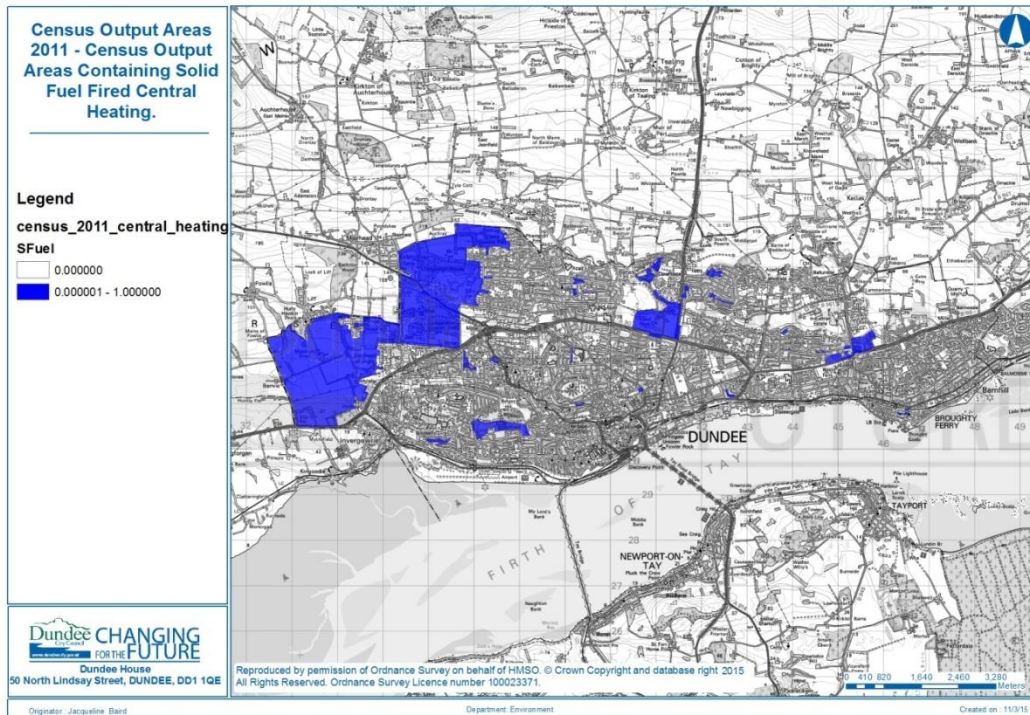
Dundee City Council has assessed new biomass combustion plant, and concluded that it will not be necessary to proceed to a Detailed Assessment

### 6.2 Biomass Combustion – Combined Impacts

There is the potential that many small biomass combustion installations (including domestic solid-fuel burning), whilst individually acceptable, could in combination lead to unacceptably high PM<sub>10</sub> concentrations, particularly in areas where PM<sub>10</sub> concentrations are close to or above the objectives. Previous reviews of PM<sub>10</sub> from solid fuel combustion only considered domestic properties and concluded that it was unlikely that any (500m x 500m square) areas of the city contained more than 50 houses using solid fuel as a primary source of heating. The vast majority of Dundee is urban in character, covered by smoke control areas and connected to the gas grid. In general there has been a rise in gas prices and an increase in the availability of exempt appliances for burning solid fuels, especially wood. Wood is comparatively more polluting than smokeless fuels. Since the last USA there have been an increasing number of planning applications that include the installation of solid fuel burning equipment. Most of the 50 or so applications are for properties in either Broughty Ferry or the West End of the city. There have also been an increasing number of enquiries and complaints about wood burning. The impact of domestic biomass combustion in most areas is thought to be small at present, but could become more important in future.

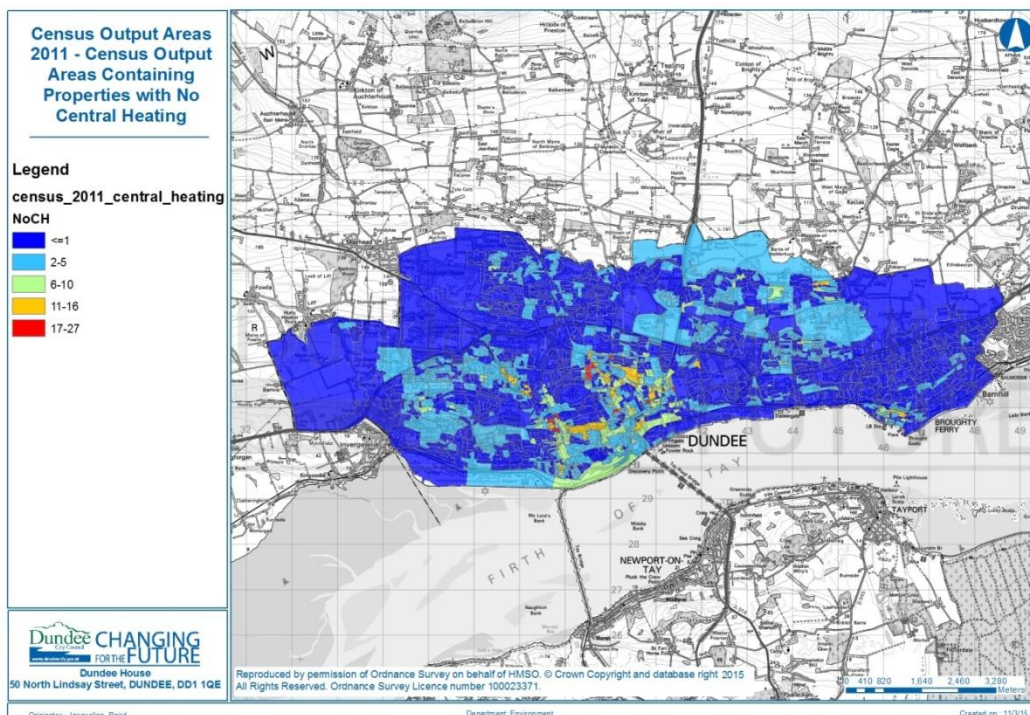
A preliminary screening of 2011 Census Data (released in 2014) regarding central heating suggests that there are relatively few solid fuel fired central heating systems in Dundee. **Figure 6.1** shows those census output areas containing solid fuel fired central heating systems, only one is recorded in each of these areas.

**Figure 6.1 2011 Census Output Areas Containing Solid Fuel Central Heating Systems**



The census data also suggests that there are a large number of census output areas where 10% or more of the properties are recorded as having no central heating (each Census Output Area has approximately 60-80 residential properties). **Figure 6.2** shows those census output areas containing properties with no central heating and the numbers in each.

**Figure 6.2 2011 Census Output Areas Containing Properties with No Central Heating**



If a significant number of the properties with no central heating were using solid fuel as their primary source of heating then there is a potential that the trigger levels in the LAQM FAQ<sup>17</sup> may be exceeded. These sources require further investigation, as there is insufficient information at present to assess this adequately. This will be assessed and reported in subsequent LAQM reports as information becomes available.

Dundee City Council has not identified any areas of the city which meet the criteria for assessment detailed in the LAQM FAQ<sup>18</sup>. However, these sources require further investigation, as there is insufficient information at present to assess this adequately. This will be assessed and reported in subsequent LAQM reports as information becomes available.

### 6.3 Domestic Solid-Fuel Burning

PM<sub>10</sub> from domestic solid fuel burning is covered under the Biomass combustion – combined impacts section above. Therefore, this part considers sulphur dioxide emissions only from significant areas of residential properties that use solid fuel to heat their houses. ‘Significant’ areas are described as those of about 500 x 500 m with more than 100 houses burning coal/smokeless fuel as their primary source of heating. The criteria for assessment has not changed since previous rounds of review and assessment which did not identify any areas where domestic coal/solid fuel burning was likely to give rise to exceedences of the objective for SO<sub>2</sub>.

Dundee City Council has not identified any areas of significant domestic fuel use in the Local Authority area that meet the criteria.

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<sup>17</sup> <http://laqm.defra.gov.uk/laqm-faqs/faq36.html> “How can I identify areas in my district where burning of solid fuels such as coal, smokeless fuel or wood (i.e. biomass) might be leading to exceedences of the 2004 daily mean PM10 air quality objective (and the 2010 annual mean objective in Scotland)?”

<sup>18</sup> <http://laqm.defra.gov.uk/laqm-faqs/faq36.html> “How can I identify areas in my district where burning of solid fuels such as coal, smokeless fuel or wood (i.e. biomass) might be leading to exceedences of the 2004 daily mean PM10 air quality objective (and the 2010 annual mean objective in Scotland)?”

## 7 Fugitive or Uncontrolled Sources

The assessment of new fugitive and uncontrolled sources considers the PM<sub>10</sub> objectives. This includes, though not exclusively, consideration of quarries, landfill sites, opencast coal mining, waste transfer sites and materials handling (i.e. ports, major construction sites). Only locations not covered by previous rounds of review and assessment, or where there have been substantial changes or there is new relevant exposure, require consideration. In the case of proposed new sources, these are only required to be considered if planning approval has been granted.

A Detailed Assessment is required where there is relevant exposure near to the source of fugitive emissions and there are recent complaints about dust or a visual inspection indicates significant dust emissions or dust tracked out of the site onto public roads.

If the relevant exposure is away from off-site roads used as access routes to the site then “near” is defined in relation to the local background PM<sub>10</sub> concentrations, taken from the Air Quality Archive background concentration maps as follows:

For NAQS UK 2004 objectives, near is within:

- 1000 m for a background >28µg/m<sup>3</sup>;
- 400 m for a background >26µg/m<sup>3</sup>; and
- 200 m for any background.

For Scottish 2010 objectives, near is within:

- 1000 m for a background >17µg/m<sup>3</sup>;
- 400 m for a background >16µg/m<sup>3</sup>; and
- 200 m for any background.

These distances are from the source which may not always coincide with the boundary of the site. The Scottish Government’s 2014 PM<sub>10</sub> background concentration predictions (June 2014 version (Base 2011)) for Dundee did not include any 1km x 1km grid squares with a value greater than 16 µg/m<sup>3</sup> (NB the highest value was 14.5 µg/m<sup>3</sup>). Therefore “near” is defined as 200m in Dundee.

If the relevant exposure is within 50m of an off-site road used to access the site and there are visible deposits on the road, then these sections of road, which may extend up to 1000m from the site entrance, are considered to be “near”, as long as the background is above 25 µg/m<sup>3</sup> for the 2004 objectives and 11µg/m<sup>3</sup> for the 2010 objectives. The majority of background grid squares for Dundee were estimated to exceed 11µg/m<sup>3</sup> in 2014 (see **Figure 7.1**).

Since the last USA (2012) planning permission in principle has been granted for a wind turbine manufacturing facility at the Port of Dundee. There is a potential for fugitive emissions to be generated during the construction phase which would involve the demolition of existing facilities prior to the construction of the new facility. An Air Quality Screening Assessment<sup>19</sup> submitted in support of the application concluded that:

*“The significance of the effects of potential emissions from the construction phase has been assessed as ‘negligible’, following the adoption of suitable mitigation measures ...”*

<sup>19</sup> “Port of Dundee – Proposed Mixed Manufacturing and Assembly Facility Air Quality Screening Assessment” Scottish Enterprise October 2012  
Prepared by White Young Green Planning & Environment Job Number:A078815





## Dundee City Council

detailed assessment for the short-term Scottish objective is not considered necessary at this time, though future monitoring results at this location will be kept under close review. Owing to the number of other uncontrolled, transient and unpredictable sources of PM<sub>10</sub>, in the area, the local authority will seek advice from the LAQM Helpdesk on how best to assess PM<sub>10</sub> at this location.

Since the last USA several dust complaints were received during the demolition of Tayside House, this was discussed in the Progress Report 2014 and the site has now been cleared.

Dundee City Council has identified potential source of fugitive particulate matter that may meet the specified criteria at Stannergate, and hence warrant further investigation.

## 8 Implementation of Action Plans

Dundee City Council's Air Quality Action Plan (AQAP) was published in January 2011 and it focuses on the key identified pollutants and sources affecting air quality in the Council's administrative area – namely NO<sub>2</sub> and PM<sub>10</sub>, with road traffic emissions identified as the main contributor. There are 32 measures within the Action Plan, which have been designed to help improve air quality through efforts to tackle traffic emissions, education and raising awareness.

Since the publication of the AQAP, there have not been any modifications to the scope of the plan or the boundaries of the AQMA. The AQAP Progress Report is prepared to fulfil the requirement on reporting on the implementation of the measures contained within the AQAP and to work towards achievement of the air quality objectives. This report covers the period January to December 2014.

The progress made on implementing the measures contained within DCC's AQAP 2011 is listed in **Appendix J** using the table recommended in the Local Air Quality Management Technical Guidance TG (09), Chapter 4 Table 4.3, and contains updates provided by lead officers for each of the various measures.

It can be difficult to attribute changes in monitored pollutant concentrations to the success of individual action plan measures. This can be because the impacts of different measures may overlap. Other impacts are so widespread and diffuse that they are unlikely to be detectable from the normal year-on-year changes caused by other factors such as meteorology and, from the rising primary NO<sub>2</sub> emissions associated with the increasing proportion of diesel vehicles on the roads. Hence surrogate indicators are used where possible.

Some of the main action points completed in 2014/15 are summarized below:

- Introduction of the ECOSTARS Fleet Recognition Scheme for Taxis & Private Hire Vehicles to Dundee, with 4 inaugural members. This is a fleet accreditation system that acknowledges greener fleets;
- Expansion of the highly praised behavioural change primary school programme to include all primary schools in Dundee;
- Expansion of Bluetooth traffic speed monitoring to include the Lochee Road Corridor
- Infrastructure changes to increase separation distances between receptors and road traffic at hotspot location in Meadowside in 2013, contributed to a decrease in NO<sub>2</sub> concentrations measured at the automatic monitoring location situated near the junction with Victoria Road in 2014 during a one year trial;
- In 2014, Dundee City Council was recognised as the leading local authority with the highest number of electric vehicles (38) and the largest electric charging infrastructure in the UK;
- The DCC Air Quality web pages were ranked at number 7 in the UK for local authority web pages in the 2014 peer review<sup>20</sup>, with top marks of 5 stars awarded for the air quality content available on the DCC website;
- "Dr Bike" has visited Dundee City Square several time offering bike maintenance workshops.

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<sup>20</sup> Air Quality Bulletin – September 2014 Issue 101

Notable actions being taken forward in 2015/16 include:

- Review of city centre bus corridor emissions modelling in respect of potential low emission strategy/LEZ options
- Investigation of Traffic Management Options in /around Seagate including possible bus stop relocation
- Continuation of both ECOSTARS Schemes for Heavy Duty Vehicles and Taxis/Private Hire vehicles.
- Ultra Low Emission Vehicle (ULEV) freight distribution feasibility study in partnership with TACTRAN for an ULEV last mile delivery system operated by a social enterprise.
- Provision of permanent infrastructure to increase separation distances between receptors and road traffic at a hotspot location
- Installation of “No Idling” signs at a select number of sites across the city where idling remains a concern
- Introduction of “I-Bike” scheme. The scheme, proven to be successful elsewhere in Scotland, encourages secondary school pupils to cycle more, promotes modal shift for school journeys, and is helpful in securing long-term change in travel behaviour.

## 9 Conclusions and Proposed Actions

### 9.1 Conclusions from New Monitoring Data

Dundee City Council has examined the results from monitoring in 2014. Annual mean concentrations within the AQMA, previously declared for NO<sub>2</sub> and PM<sub>10</sub> annual mean and NO<sub>2</sub> the hourly mean (i.e. the whole council area), still exceed the relevant objectives and the AQMA should remain.

Dundee City Council has measured concentrations of NO<sub>2</sub> above the annual mean objective (40µg/m<sup>3</sup>) at relevant locations within the AQMA. There are 6 roads where the annual mean NO<sub>2</sub> concentration at relevant exposure is estimated to exceed the objective. These are: Dock Street; Lochee Road; Logie Street; Seagate; Meadowside; and, Victoria Road. At least a further 8 roads have 'borderline' concentrations which are at locations of relevant exposure. These are: Albert Street; High Street; Loons Road; Nethergate; North Marketgait; Rankine Street; West Marketgait; and, Whitehall Street. Three locations where the annual mean concentrations were previously exceeded at locations of relevant exposure were below the objective in 2014. These are: Stannergate; Strathmore Avenue and Union Street.

A general upward trend in the NO<sub>2</sub> annual mean is evident in Seagate. A study has been commissioned to review traffic management options in the Seagate, as part of the council's air quality action plan (AQAP). Monitored concentrations in Union Street have decreased since the removal of bus stops from the street in 2011. The displacement of buses from Union Street may have contributed to the increase in monitored levels in Whitehall Street and Nethergate since 2011. In 2014 monitored annual mean concentrations in Lochee Road dropped below those recorded in 2006 for the first time since the AQMA was declared. The reduction since 2012 may have been influenced by the infrastructure works funded by the AQAP which removed the central reservation to free up road space and ease congestion.

None of the Dundee City Council automatic analysers measured concentrations of NO<sub>2</sub> above the 1-hour objective (200µg/m<sup>3</sup>) in 2014. There has been a sudden reduction in the number of exceedences at Lochee Road; however the underlying trend in the 98.08<sup>th</sup> percentile remains upward. If a pattern of fewer hourly mean exceedences and lower hourly mean percentile values becomes established it may be possible to consider amendment of the AQMA in respect of this objective. Any amendment would require a detailed assessment which would need to take into account the worst case exposure location, which diffusion tubes indicate is on Lochee Road nearer the junction with Dudhope Terrace.

The PM<sub>10</sub> NAQS UK annual mean objective (40µg/m<sup>3</sup>) continues to be met at all locations within the city; however Dundee City Council has measured concentrations of PM<sub>10</sub> above the stricter Scottish PM<sub>10</sub> annual mean objective (18µg/m<sup>3</sup>) at Lochee Road (BAM), Albert Street (Osiris) and Stannergate roundabout (Osiris). Annual mean concentrations are higher at Stannergate than other similar roadside locations suggesting contributions from PM<sub>10</sub> sources other than road traffic which requires further investigation. Locations with annual mean concentrations that are 'borderline' for the objective (18µg/m<sup>3</sup>) include Myrekirk Terrace (Osiris), Meadowside (BAM), Seagate (BAM) and Union Street (BAM).

The only monitoring location where the annual mean objective was previously exceeded and is now below 'borderline' is Logie Street (Osiris). However as the valid data capture was below 90%, monitoring will need to continue until it is possible to establish that the downward trend (discussed in Section 2.2.2) can be sustained.

The PM<sub>10</sub> NAQS UK 24-hour objective continues to be met at all locations within the city; however, the stricter Scottish 24-hour mean objective was exceeded at Stannergate Roundabout (Osiris) and Albert Street (Osiris) in 2014. Osiris monitors are indicative monitors and the methodology used to adjust the data to gravimetric equivalent, whilst reasonable for annual mean data, has a tendency to over-estimate the number of 24-hour mean exceedences. The review of the instances of the 2014 24-hour mean exceedences shows that the majority coincided with raised background concentrations across Scotland and were largely associated with winds from the east. A detailed assessment for the short-term Scottish objective is not considered necessary at this time, though future monitoring results at these locations will be kept under review.

New monitoring data for 2014 show all three objectives for SO<sub>2</sub> are being achieved. Located downwind of a bitumen refinery and operational port with shipping movements since 2002, the SO<sub>2</sub> automatic analyser has previously recorded occasional exceedences of the 15min mean objective. Increasingly stricter regulation of the sulphur content of marine fuels and the cessation of oil refining at the nearby bitumen refinery in December 2013 means that the likelihood of exceedences has reduced significantly. Following discussions with the regulator (SEPA) it was agreed that monitoring for sulphur dioxide could cease at the end of 2014.

## **9.2 Conclusions from Assessment of Sources**

The Updating and Screening Assessment has reviewed road transport sources, other transport sources (i.e. airports, railways and ports), industrial installations, commercial and domestic sources and sources of fugitive emissions. No industrial or other transport sources were identified which warrant a Detailed Assessment.

The assessment of road traffic sources identified five areas, "Kingsway/Myrekirk", Stannergate, Lochee District Centre, and Meadowside (Wellgate Centre), and Union Street, where new developments and the consequences of a new road link may impact on air quality. All of these locations are within the existing AQMA. It is unlikely that these developments will result in the breach of any new objective (e.g. PM<sub>10</sub> 24 hour mean) so a detailed assessment is not required. Monitoring and/or modelling studies are ongoing or are proposed in each of these locations. The review and assessment (DMRB) of new road traffic data did not identify any new locations where the air quality objectives were exceeded.

The assessment of fugitive emission sources has identified a potential source of fugitive particulate matter that may meet the specified criteria at Stannergate. This requires further investigation.

It is considered that biomass sources require further investigation as there is insufficient information at present to assess this adequately

## **9.3 Proposed Actions**

The whole of the local authority area has been declared an Air Quality Management Area (AQMA) for the NO<sub>2</sub> and PM<sub>10</sub> annual mean objectives and the one hour mean objective for NO<sub>2</sub>. The Updating and Screening Assessment 2015 has not identified any need to change the existing AQMA or identified the need to proceed to a detailed assessment for any pollutant objective.

The USA 2015 has identified the need for a new diffusion tube site at relevant exposure on Nethergate west of Union Street in order to better assess the impact of the removal/relocation of bus stops from Union Street. Diffusion tubes located at Carolina Court (DT 186), Hawkhill / Horsewater Wynd (DT 193), Coupar Angus Road (38) (DT 175), and Myrekirk Terrace (8) (DT 181), were discontinued as the results were well below the objective when predicted to receptor façade. The SO<sub>2</sub> monitoring was curtailed at the end of 2014 following discussions with SEPA. The USA did not identify the need to make any other changes to the existing monitoring programme. However advice will be sought from the LAQM Helpdesk on how best to assess the impacts of the various PM<sub>10</sub> sources on the possible exceedences at Stannergate roundabout.

Other proposed actions arising from the USA 2015 are as follows:

- Review results of new diffusion tube sites installed on Coupar Angus Rd / Stirling St. , West Marketgait /Old Mill, High Street - Lochee (22-24), Broughty Ferry Rd (129);
- Compare diurnal profiles of pollutant concentrations and traffic (where available), in particular for Lochee Road;
- Undertake further analysis of pollutant concentrations in Meadowside following the one year trialling of an Action Plan measure that extends the distance between the facades of ground floor flats and vehicle exhausts by reallocating road space to cycles;
- Review the remaining DCC traffic radar count data for the presence of relevant exposure to identify where new classified traffic counts or NO<sub>2</sub> diffusion tube monitoring may be needed;
- Review and assess updated traffic data from Department of Transport for 2014 when this becomes available in June 2015;
- Review the results of the council's ongoing air dispersion modelling projects for Kingsway/Forfar Road, Dundee Eastern Arterial Routes (including Stannergate Roundabout), North West arterial route (Lochee Road) and bus emissions in the city centre;
- Review the results of third party air quality monitoring and modelling study of the Kingsway/Myrekirk Road roundabout and associated road network;
- Carry out classified traffic counts on Coupar Angus Road, Lochee District Centre and South Union Street once new traffic flows and patterns become established;
- Investigate sources of biomass/solid fuel combustion in the local authority area to enable appropriate screening and report findings in subsequent LAQM reports as information becomes available;
- Take forward the planned actions highlighted in the Action Plan Progress Report; and
- Undertake and submit the 2016 Progress Report

## 10 References

This report includes references where appropriate throughout the text as footnotes.

# Appendices

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

Appendix B: VCM Methodology

Appendix C: Pollution Reports

Appendix D: Bias Calculations for Diffusion Tube Co-location Studies

Appendix E: List of Industrial Processes

Appendix F: Road Traffic Data

Appendix G: Monthly Diffusion Tube Concentrations

Appendix H: DMRB Calculations

Appendix I: Action Plan Progress Report



**Appendix A: QA:QC Data**

**A1 - Diffusion Tube Bias Adjustment Factors**

The diffusion tubes are supplied by Gradko and analysed by Tayside Scientific Services utilising the 20% Triethanolamine (TEA) in water preparation method. Diffusion tubes are exposed for 4 to 5 weeks in accordance with the recommended dates supplied by DEFRA. The method for preparing and analysing tubes has remained unchanged since 2001. The bias adjustment factor available on the LAQM Support Website<sup>21</sup> for Tayside Scientific Services is **0.77** (Spreadsheet version 03/15). This is based on four roadside sites from Fife Council and the kerbside National inter-comparison site at Marylebone Road.

**A2 - Factor from Local Co-location Studies**

Dundee City Council co-locates three nitrogen dioxide diffusion tubes with each of the roadside automatic nitrogen dioxide analysers. Co-location studies were carried out at 5 automatic monitoring locations in 2014. The factor for each study is shown in **Table A.1** along with the factor for the national inter-comparison site at Marylebone Road in London. A minimum of 9 months is required to make a valid bias calculation. All the Dundee City Council co-location studies met the criteria in 2014. The QA/QC procedures for all Dundee City Council automatic analysers is detailed in **Appendix A6** and is equivalent to the Automatic Urban and Rural Network (AURN), which is run by the national government. Tayside Scientific Services have demonstrated satisfactory performance for the analysis of diffusion tubes over the quarterly AIR-PT/WASP rounds up to December 2014 (see **Appendix A7**). The automatic analyser period means are calculated from mid-day on tube changeover days.

**Table A.1 Bias Factors from 2014 Co-location Studies and National Bias Adjustment Spreadsheet (Version 06/14)**

Site Name	Site Type <sup>1</sup>	Length of Study (months)	PDT <sup>2</sup> Mean Conc. (Dm) (µg/m <sup>3</sup> )	Analyser Mean Conc. (Cm) (µg/m <sup>3</sup> )	%DC <sup>3</sup>	Bias (B)	Tube Precision & average CV <sup>4</sup>	Bias Adjustment Factor (A) (Cm/Dm)
Lochee Road	R	12	53	46	100	15%	G (4%)	<b>0.87</b>
Meadowside	R	12	53	40	100	34%	G (4%)	<b>0.75</b>
Seagate	R	12	55	55	99	2%	G (3%)	<b>0.98</b>
Union Street	R	12	39	28	97	38%	G (4%)	<b>0.73</b>
Whitehall Street	R	12	51	42	98	21%	G (5%)	<b>0.83</b>
Marylebone Road Intercomparison	K	12	113	80	n/a	40.4%	G	<b>0.71</b>

1 - R= Roadside, K= Kerbside

2 - PDT = Passive Diffusion Tube for NO<sub>2</sub>

3 - %DC = Percentage Data Capture on the automatic analyser for the periods used

4 - Tube precision is determined as follows: **G** = Good precision - coefficient of variation (CV) of diffusion tube replicates is considered G when the CV of eight or more periods is less than 20%, and the average CV of all monitoring periods is less than 10%; **P** = Poor precision - CV of four or more periods >20% and/or average CV >10%; **S** = Single tube, therefore not applicable; **na** = not available.

**A3 - Discussion of Choice of Factor to Use**

<sup>21</sup> <http://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html>

The majority of nitrogen dioxide diffusion tubes operated by Dundee City Council are located at roadside or kerbside locations. In view of this it is normally considered appropriate to use an overall factor derived from roadside and kerbside sites. A manual approximate orthogonal regression calculation using Bias B figures (obtained from the precision and accuracy spreadsheets in **Appendix D**) was carried out for the local roadside sites separately and incorporating the national intercomparison kerbside site at Marylebone Road. The calculation was carried out in accordance with the guidance available on the Defra website prepared by Air Quality Consultants<sup>22</sup> (AQC) (see **Table A.2**). The factor obtained using only local roadside sites was **0.82**, and **0.80** when the kerbside site at Marylebone Road was included, both of these are significantly lower than the bias factor calculated for the previous two years. The **0.82** bias correction factor represents a more conservative approach and has been used to bias correct the diffusion tube data presented in this report.

**Table A.2 Manual Approximate Orthogonal Regression Calculation 2014**

Co-location Sites 2014	Site Type <sup>1</sup>	Bias Factor A	Bias B
Lochee Road	R	0.87	15%
Meadowside	R	0.75	34%
Seagate	R	0.98	2%
Union St	R	0.73	38%
Whitehall St	R	0.83	21%
<b>Mean Local</b>		0.83	22.0%
<b>National:</b> Marylebone Road Intercomparison	K	0.71	40.4%
<b>Combined Local &amp; National:</b> Mean Combined		0.81	25.1%

Manual orthogonal regression Calculation as para 2.4 AQC doc <sup>2</sup>		
Express as a factor	Add 1	Inverse
0.22	1.22	<b>0.82</b>
0.251	1.251	<b>0.80</b>

Notes:

1 - R= Roadside, K= Kerbside

2 - Paragraph 2.4 of AQC's report states, "For most purposes, a reasonable approximation of our method can be derived by averaging the bias values, expressed as a factor, i.e. -16% is -0.16. Next add 1 to this value, e.g. -0.16 + 1.00 equals 0.84 in this example, then take the inverse to give the bias adjustment factor 1/0.84 = 1.19. (This will not be exactly the same as the correction factor calculated using orthogonal regression, but will be reasonably close). IT IS IMPORTANT NOT TO AVERAGE THE ADJUSTMENT FACTORS."

#### A4 - PM Monitoring Adjustment

Dundee utilise several methods for monitoring particulate matter (PM<sub>10</sub>) within the city. TEOM and Osiris monitors have heated inlets. These tend to drive off volatile organic particulate matter and in consequence the measured concentrations tend to be lower than those measured by gravimetric reference standard monitors. The Partisol is a reference equivalent method and had been used historically to determine a local correction factor for the TEOMs, which were designated as non-equivalent in 2006. TEOM PM<sub>10</sub> data presented in this report have been corrected using the VCM method (see **Appendix B**) since 2008.

DCC have five Osiris analysers, four of which were re-located during 2012. These are also non-equivalent but their measurements are considered indicative of particulate concentrations. Dundee commenced a yearly study in 2005 to compare the PM<sub>10</sub> data

<sup>22</sup> <http://laqm.defra.gov.uk/documents/NO2-Diffusion-Tube-Collocation-Methodology.pdf>

measured using an Osiris analyser with that from a TEOM. This study determined that the Osiris generally exaggerates peak values compared to the TEOM. Data from the Osiris monitors are checked in-house and are adjusted using a local co-location factor. One of the Osiris units has been co-located with the Partisol 2025 at the urban industrial site at Broughty Ferry Road since September 2012, thus allowing the annual mean Osiris results presented in this report to be gravimetrically corrected prior to reporting. The gravimetric factor applied to 2014 data was **1.583**.

In addition, DCC have four Beta-Attenuation Monitors (BAM), which are gravimetric equivalent monitors. The PM<sub>10</sub> data from these have been corrected for slope by Ricardo-AEA using the factor (0.83333) determined by the UK Equivalence Testing Programme<sup>23</sup>. For comparison with the NAQS objectives annual mean concentrations are calculated from an hourly time base. It should be noted that the annual mean concentrations for each of the BAM analysers in 2014 is based on ratified 15min values derived from the hourly averages recorded by the BAM. BAM analysers record one PM<sub>10</sub> value for each hour. The logger at each site records 4 identical 15 min values (e.g.00:15, 00:30, 00:45 and 01:00) to represent the hourly average recorded by the BAM. It was discovered that during 2013 some of these 15 min values had been allocated incorrectly by the logger (e.g. 00:00, 00:15, 00:30 and 00:45). The consequence of this is that some of the hourly averages calculated would be incorrect. The issue was discussed with Ricardo-AEA<sup>24</sup> and it was agreed that, the annual average would be better calculated from the 15 min values. However, the hourly values and annual means for the DCC BAMs on the Scottish Government website<sup>25</sup> remain based on the hourly averages from the logger, some of which are incorrect.

## **A5 - Short-term to Long-term Data adjustment**

Annualisation of data using the methodology outlined in Box 3.2 of LAQM.TG(09) was not required for the 2014 data, as there was greater than 75% data capture at all automatic monitors and diffusion tube sites.

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<sup>23</sup> <http://laqm.defra.gov.uk/laqm-faqs/faq104.html>

<sup>24</sup> Personal communication between Rachel Brooks DCC and Stephen Stratton Ricardo-AEA

<sup>25</sup> [www.scottishairquality.co.uk](http://www.scottishairquality.co.uk)

## A6 - QA/QC of Automatic Monitoring

All analysers (excluding OSIRIS units) are audited twice yearly by an external consultant, Ricardo-AEA. The gas analyser at Broughty Ferry Road has on-site gases traceable to the National Physical Laboratory (NPL) standards (provided under contract by Ricardo-AEA) and is calibrated automatically every 4 days. The remaining gas analysers do not have on-site gases and are manually calibrated every 3 weeks by Ricardo- AEA using NPL traceable gas.

Dundee City Council secured funding from the Scottish Executive to commission Ricardo-AEA to assist with data management and ratification procedures. Dundee joined the 'Calibration Club' run by Ricardo-AEA at the end of 2006. Ricardo-AEA have ratified all the real-time monitoring data reported from 2006 onwards (excluding the Osiris units) and have provided the Air Pollution Reports shown in **Appendix C**

All instruments (excluding OSIRIS units) are serviced and calibrated every 6 months by the equipment supplier. OSIRIS units undergo quarterly flow checks and filter changes as well as annual service and calibration by the manufacturers (Turnkey Instruments).

## A7 - QA/QC of Diffusion Tube Monitoring

Monitoring of NO<sub>2</sub> concentrations using passive diffusion tubes is widely used throughout the UK. Provided that care is taken with the storage, handling and analysis of the tubes, and an appropriate "bias-adjustment" factor is applied, the overall uncertainty of the annual mean is expected to be about +/-20%. The key issues to be considered are the performance of the laboratory, the precision of the diffusion tubes, and the application of a suitable bias adjustment factor. These issues are considered in turn below.

### Laboratory Performance

The diffusion tubes used by Dundee City Council are supplied by Gradko and analysed by Tayside Scientific Services utilising the 20% Triethanolamine (TEA) in water preparation method. Tayside Scientific Services participate in the Workplace Analysis Scheme for Proficiency (WASP) for NO<sub>2</sub> diffusion tube analysis, and the Annual Field Inter-Comparison Exercise. These provide strict performance criteria for participating laboratories to meet, thereby ensuring NO<sub>2</sub> concentrations reported are robust. The lab' follows the procedures set out in the Working Group on Harmonisation of Diffusion Tubes Practical Guidance that was published in February 2008<sup>26</sup>, and is UKAS accredited for the analysis of nitrogen dioxide. Tayside Scientific Services has demonstrated satisfactory performance over the past five quarterly WASP rounds.<sup>27</sup> Two diffusion tubes from each monthly batch are used as blanks. These tubes are not exposed but are taken round during the monthly deployment and collection and stored in the refrigerator during the exposure period. They are analysed along with the appropriate batch of exposed tubes. The purpose of the blanks is to determine whether contamination occurred during the preparation or deployment.

AIR is an independent analytical proficiency-testing (PT) scheme, operated by LGC Standards and supported by the Health and Safety Laboratory (HSL). AIR PT is a new scheme, started in April 2014, which combines two long running PT schemes: LGC Standards STACKS PT scheme and HSL WASP PT scheme.

<sup>26</sup> AEA Energy & Environment (2008), Diffusion Tubes for Ambient NO<sub>2</sub> Monitoring : Practical Guidance for Laboratories and Users

<sup>27</sup> [http://laqm.defra.gov.uk/documents/LAQM-WASP-Rounds-116-123-\(January-2012--December-2013\)-NO2-report.pdf](http://laqm.defra.gov.uk/documents/LAQM-WASP-Rounds-116-123-(January-2012--December-2013)-NO2-report.pdf)

AIR NO<sub>2</sub> PT forms an integral part of the UK NO<sub>2</sub> Network's QA/QC, and is a useful tool in assessing the analytical performance of those laboratories supplying diffusion tubes to Local Authorities for use in the context of Local Air Quality Management (LAQM). With consent from the participating laboratories, LGC Standards provides summary proficiency testing data to the LAQM Helpdesk for hosting on the webpages at <http://laqm.defra.gov.uk/diffusion-tubes/qa-qc-framework.html>. This information is updated on a quarterly basis following completion of each AIR PT round.

Defra and the Devolved Administrations advise that diffusion tubes used for Local Air Quality Management should be obtained from laboratories that have demonstrated satisfactory performance in the AIR PT scheme. Laboratory performance in AIR PT is also assessed, by the National Physical Laboratory (NPL), alongside laboratory data from the monthly NPL Field Intercomparison Exercise carried out at Marylebone Road, central London.

### **Tube Precision**

For the purposes of Local Air Quality Management, tube precision is separated into two categories, "Good" or "Poor", as follows: tubes are considered to have "good" precision where the coefficient of variation of duplicate or triplicate diffusion tubes for eight or more periods during the year is less than 20%, and the average CV of all monitoring periods is less than 10%. Tubes are considered to have "poor" precision where the CV of four or more periods is greater than 20% and/or the average CV is greater than 10%.

A spreadsheet tool has been developed to calculate the overall precision of a particular co-location study or any sets of duplicate or triplicate results. The tube precision calculated using this spreadsheet is shown in **Appendix D** and are summarised in **Table A.1**. The distinction between "good" and "poor" precision is an indicator of how well the same measurement can be reproduced. This precision reflects the laboratory's performance/consistency in preparing and analysing the tubes, as well as the subsequent handling of the tubes in the field. Any laboratory can show "poor" precision for a particular period/co-location study, if this is due to poor handling of the tubes in the field.

### **Suitable Bias Adjustment Factor**

The discussion and calculation of a suitable bias adjustment factor is detailed in **Appendix A3**.

## Appendix B: VCM Methodology

### Volatile Correction Model

#### Background

The EU Directive on Ambient Air Quality<sup>28</sup> and the UK Air Quality Strategy<sup>29</sup> set targets and limit values for PM<sub>10</sub> concentrations in terms of gravimetric measurements referenced to the EU reference method of measurement (EN 12341). It has long been recognised that PM<sub>10</sub> measurements made with many automatic PM<sub>10</sub> monitors are not equivalent to the EU reference method. However, these analysers are widely used since they provide hourly resolved data and have many operational advantages over the manual reference method. Hence, correction factors, most noticeably the 1.3 correction factor for the TEOM analyser, have been widely used for many years. In setting the value of 1.3 as a correction factor, it was recognized that this was a conservative factor and that TEOMx1.3 data were likely to overestimate PM<sub>10</sub> concentrations. In Scotland, a lower correction factor of 1.14, which was based on intercomparison data obtained in Edinburgh, has also been widely used.

The results of the formal UK PM<sub>10</sub> Equivalence Study<sup>30</sup> carried out in 2006, showed that data from the TEOM could not be considered as equivalent to the EU reference method, whether or not a correction factor was used. The reason for this is that the TEOM heats the filter used to collect PM<sub>10</sub> to 50°C in order to eliminate the possible interference from water vapour – this heating also removes some of the more volatile components of the particulate matter.

In the new modification to the TEOM – the FDMS TEOM, the volatile fraction of PM<sub>10</sub> is measured separately and used to correct the data in order to obtain results that are equivalent to the EU reference method. The equivalence of the FDMS TEOM analyser to the EU reference method was confirmed in the UK Equivalence study. Note that this study also showed that a number of other PM<sub>10</sub> analysers could also provide data equivalent to the EU reference method - Partisol 2025, FDMS Model B, Opsis SM200 Beta Attenuation Monitor (BAM), Opsis SM200 sampler (with slope and intercept correction) and the Met One BAM (with slope correction).

King's College London (KCL) has developed a relationship utilising FDMS purge (volatile PM<sub>10</sub>) measurements to correct data from nearby TEOM analysers. These corrected data were tested for equivalence with the EU reference method and shown to pass the appropriate criteria. Since then, as additional FDMS data have become available throughout the UK, the geographic range of the model has been extended and on-going tests have shown that any TEOM located within 130km of an FDMS TEOM can be corrected with data from that analyser.

KCL has developed a user-friendly web portal (<http://www.volatile-correction-model.info/Default.aspx>), to enable the model to be applied in a straightforward step-by-step approach. The model enables the user to input daily or hourly-average pressure, temperature measurements and purge measurements (volatile measurements) from Filter Dynamics Measurement System (FDMS) analysers. The measured volatile fraction is then added to the TEOM measurements giving the corrected data.

#### Use of the VCM in Scotland - 2014

The VCM correction of Scottish PM<sub>10</sub> data was first undertaken for the 2008 dataset. As the VCM method was relatively new and, hourly meteorological data for pressure were not readily available, the corrections were undertaken on a daily, rather than hourly basis. These corrected data were

<sup>28</sup> Directive 2008/50/EC Of The European Parliament and of The Council of 21 May 2008 on ambient air quality and cleaner air for Europe <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:152:0001:0044:EN:PDF>

<sup>29</sup> The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. July 2007. CM 7169 <http://www.scotland.gov.uk/Topics/Environment/Pollution/16215/6116>

<sup>30</sup> UK Equivalence Programme for Monitoring of Particulate Matter. David Harrison Bureau Veritas UK Ltd. June 2006 (BV/AQ/AD202209/DH/2396) [http://www.airquality.co.uk/archive/reports/cat05/0606130952\\_UKPMEquivalence.pdf](http://www.airquality.co.uk/archive/reports/cat05/0606130952_UKPMEquivalence.pdf)

provided to the local authorities and made available on the Scottish Air Quality website as a separate data spreadsheet.

However, additional refinement of the VCM model has been undertaken and hourly meteorological data for all parameters has been sourced. As a result, VCM correction of the 2009 to 2014 datasets has been undertaken on an hourly basis. This also brings into line the processing of the Scottish local authority data with that of the AURN.

The TEOM measurements are recorded with an inbuilt correction factors of  $1.03x+3$  (where  $x$  is the raw TEOM measurement) as mandated by the US Environmental Protection Agency. This is first removed and the data are then corrected to ambient pressure and temperature (as required by the EU Directive) using meteorological data from met monitoring sites within 260 km of the TEOM.

Data from FDMS analysers within 130 km of the TEOM are then used to provide an estimate of the volatile particle concentration at the TEOM location. This estimated volatile fraction is then added back onto the TEOM measurements to give Gravimetric Equivalent mass concentrations.

The following data were used as inputs to the VCM:

- Hourly average temperatures ( $^{\circ}\text{C}$ )
- Hourly average pressures (mbar)
- Hourly average TEOM concentrations ( $\mu\text{g m}^{-3}$ )
- Hourly average FDMS purge concentrations ( $\mu\text{g m}^{-3}$ )

For the 2014 corrections, temperature and pressure data from Edinburgh Airport meteorological monitoring stations were utilised. This site was selected as a good representation weather conditions in the central belt of Scotland.

Hourly average purge measurements from all Scottish FDMS monitoring sites within the Scottish Government-run network (SAQD) and the UK national network (AURN) were used for the correction. Table 1 lists the sites used for correcting hourly TEOM data from Central Scotland and Aberdeen. A total of 3 FDMS sites were used for correcting Aberdeen TEOM data and 34 FDMS sites used for correcting data from TEOM sites located in the central belt of Scotland.

Any outliers in the FDMS purge measurements were identified using Grubbs' Test<sup>31</sup> on daily average data. All hourly data within a day identified as an outlier were then removed from the data set and the average of each hourly purge measurement from the FDMS sites was calculated and used in the VCM calculations.

The corrected data for 2014 and calculated summary statistics have been provided to the local authorities. In addition, the SAQD website database now shows all ratified TEOM data for 2013 as VCM corrected data via an additional selection option in the data download pages.

A flow chart showing the overall process employed for VCM correction of 2014 SAQD TEOM data is shown in Figure 1.

However, note that it is not possible to correct historical data with the VCM as measurements of volatile particle concentrations are not available prior to 2008.

---

<sup>31</sup> Grubbs' Test is a statistical method for identifying outliers within a dataset. For more information visit the Engineering Statistics Handbook at:

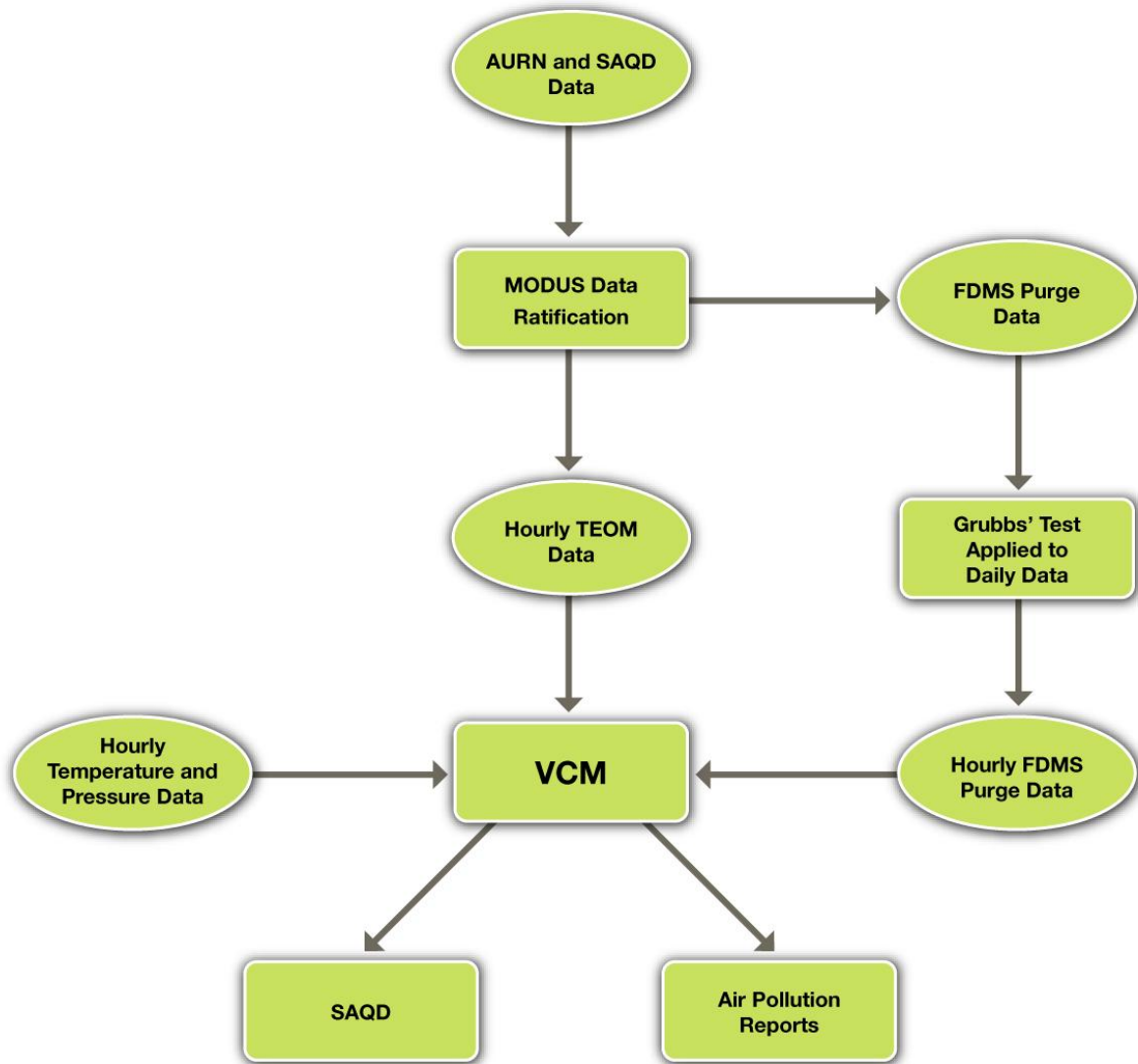
<http://www.itl.nist.gov/div898/handbook/eda/section3/eda35h.htm>

**Table 1 FDMS Monitoring Sites used for VCM Correcting TEOM Data 2014**

FDMS Sites used in VCM	Monitoring Network
Aberdeen	AURN
Aberdeen Union St	SAQD
Alloa	SAQD
Auchencorth Moss	AURN
East Ayrshire Kilmarnock John	SAQD
East Ayrshire St Marnock St FDMS	SAQD
East Dunbartonshire Kirkintilloch	SAQD
East Dunbartonshire Milngavie	SAQD
East Renfrewshire Sheddens	SAQD
Edinburgh Queensferry Road	SAQD
Edinburgh St Leonards	AURN
Fife Cupar	SAQD
Fife Dunfermline	SAQD
Fife Kirkcaldy	SAQD
Fife Rosyth	SAQD
Glasgow Abercromby Street	SAQD
Glasgow Anderston	SAQD
Glasgow Broomhill	SAQD
Glasgow Burgher St	SAQD
Glasgow Byres Road	SAQD
Glasgow Kerbside	AURN
Glasgow Nithsdale Road	SAQD
Grangemouth	AURN
Paisley Gordon Street	SAQD
Paisley St James St	SAQD
Perth Muirton	SAQD
Renfrew Cockels Loan	SAQD
South Ayrshire Ayr Harbour	SAQD
South Ayrshire Ayr High St	SAQD
South Lanarkshire East Kilbride	SAQD
South Lanarkshire Hamilton	SAQD
South Lanarkshire Raith	SAQD
South Lanarkshire Rutherglen	SAQD
West Lothian Broxburn	SAQD
West Lothian Linlithgow High St 2	SAQD
West Lothian Newton	SAQD



Figure 1 Process used for VCM Correcting SAQD TEOM Data



Appendix C: Pollution Reports

Produced by Ricardo-AEA on behalf of the Scottish Government

**DUNDEE BROUGHTY FERRY ROAD**  
**1<sup>st</sup> January to 31<sup>st</sup> December 2014**

These data have been fully ratified by Ricardo-AEA

POLLUTANT	PM <sub>10</sub> <sup>*,+</sup>	SO <sub>2</sub>
Maximum 15-minute mean		112 µg m <sup>-3</sup>
Maximum hourly mean	93 µg m <sup>-3</sup>	112 µg m <sup>-3</sup>
Maximum daily mean	52 µg m <sup>-3</sup>	42 µg m <sup>-3</sup>
Average	15 µg m <sup>-3</sup>	3 µg m <sup>-3</sup>
Data capture	85.6 %	89.2 %

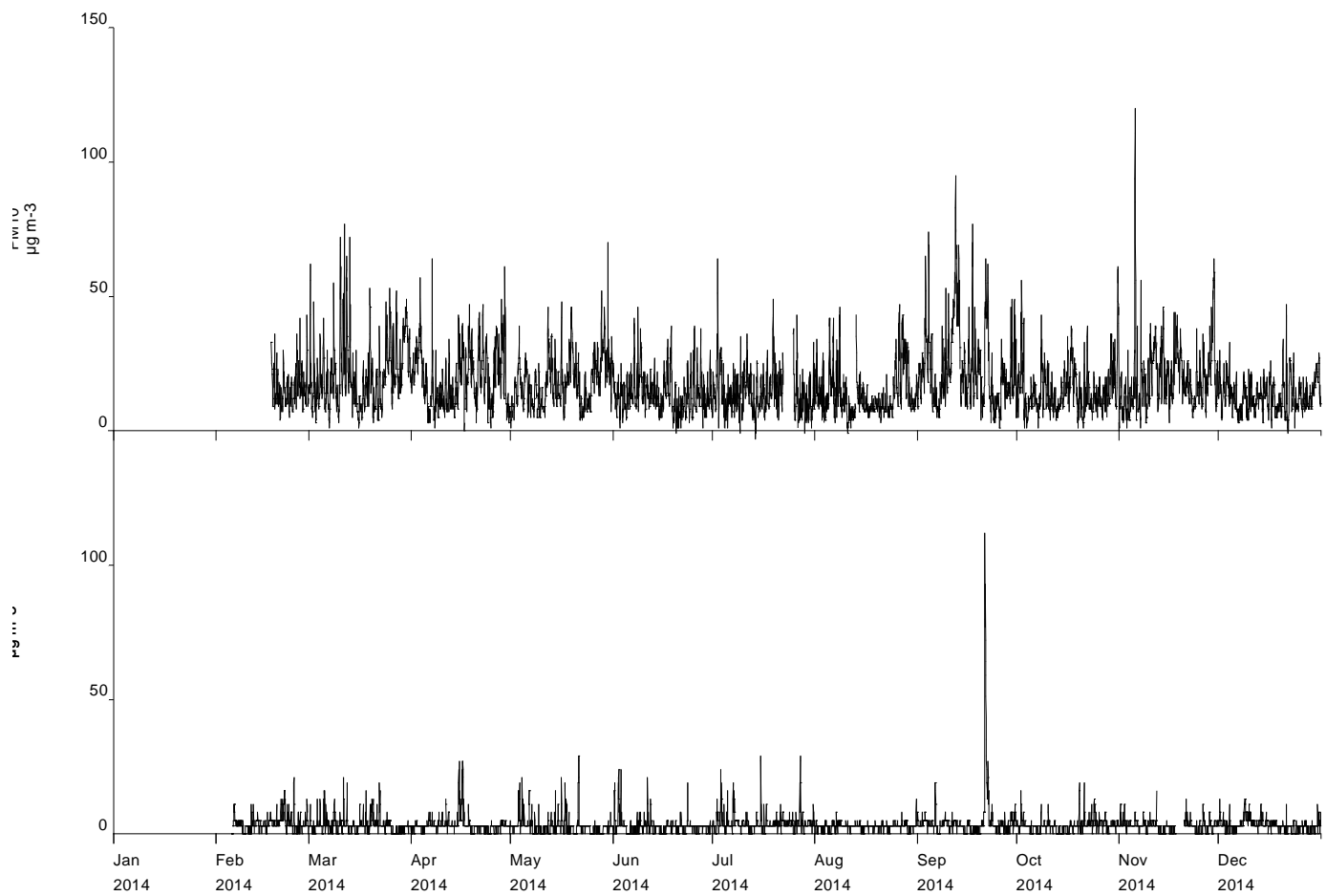
\* PM10 measured by a TEOM and using VCM for Gravimetric Equivalent mass concentrations. All gaseous pollutant mass units are at 20°C and 1013 mb. Particulate matter concentrations are reported at ambient temperature and pressure.

Pollutant	Air Quality Regulations (2000) and Air Quality (Scotland) Amendment Regulations 2002	Exceedences	Days
PM <sub>10</sub> Particulate Matter (Gravimetric)	Daily mean > 50 µg m <sup>-3</sup>	1	1
PM <sub>10</sub> Particulate Matter (Gravimetric)	Annual mean > 40 µg m <sup>-3</sup>	0	-
PM <sub>10</sub> Particulate Matter (Gravimetric)	Annual mean > 18 µg m <sup>-3</sup>	0	-
Sulphur Dioxide	15-minute mean > 266 µg m <sup>-3</sup>	0	0
Sulphur Dioxide	Hourly mean > 350 µg m <sup>-3</sup>	0	0
Sulphur Dioxide	Daily mean > 125 µg m <sup>-3</sup>	0	0

Note: For a strict comparison against the objectives there must be a data capture of >90% throughout the calendar year

Produced by Ricardo-AEA on behalf of the Scottish Government

**Dundee Broughty Ferry Road  
Hourly Mean Data for 1<sup>st</sup> January to 31<sup>st</sup> December 2014**



Date Created: 31/03/2015

Produced by Ricardo-AEA on behalf of the Scottish Government

**DUNDEE LOCHEE ROAD**  
**1<sup>st</sup> January to 31<sup>st</sup> December 2014**

These data have been fully ratified by Ricardo-AEA

POLLUTANT	PM <sub>10</sub> *+	NO <sub>2</sub>	NO <sub>x</sub>
Maximum hourly mean	204 µg m <sup>-3</sup>	201 µg m <sup>-3</sup>	1175 µg m <sup>-3</sup>
Maximum daily mean	52 µg m <sup>-3</sup>	98 µg m <sup>-3</sup>	454 µg m <sup>-3</sup>
Average	19 µg m <sup>-3</sup>	46 µg m <sup>-3</sup>	122 µg m <sup>-3</sup>
Data capture	92.7 %	99.5 %	99.5 %

\* PM10 instruments:

+ BAM using a gravimetric factor of 0.83333 for Indicative Gravimetric Equivalent from 1st January 2013

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

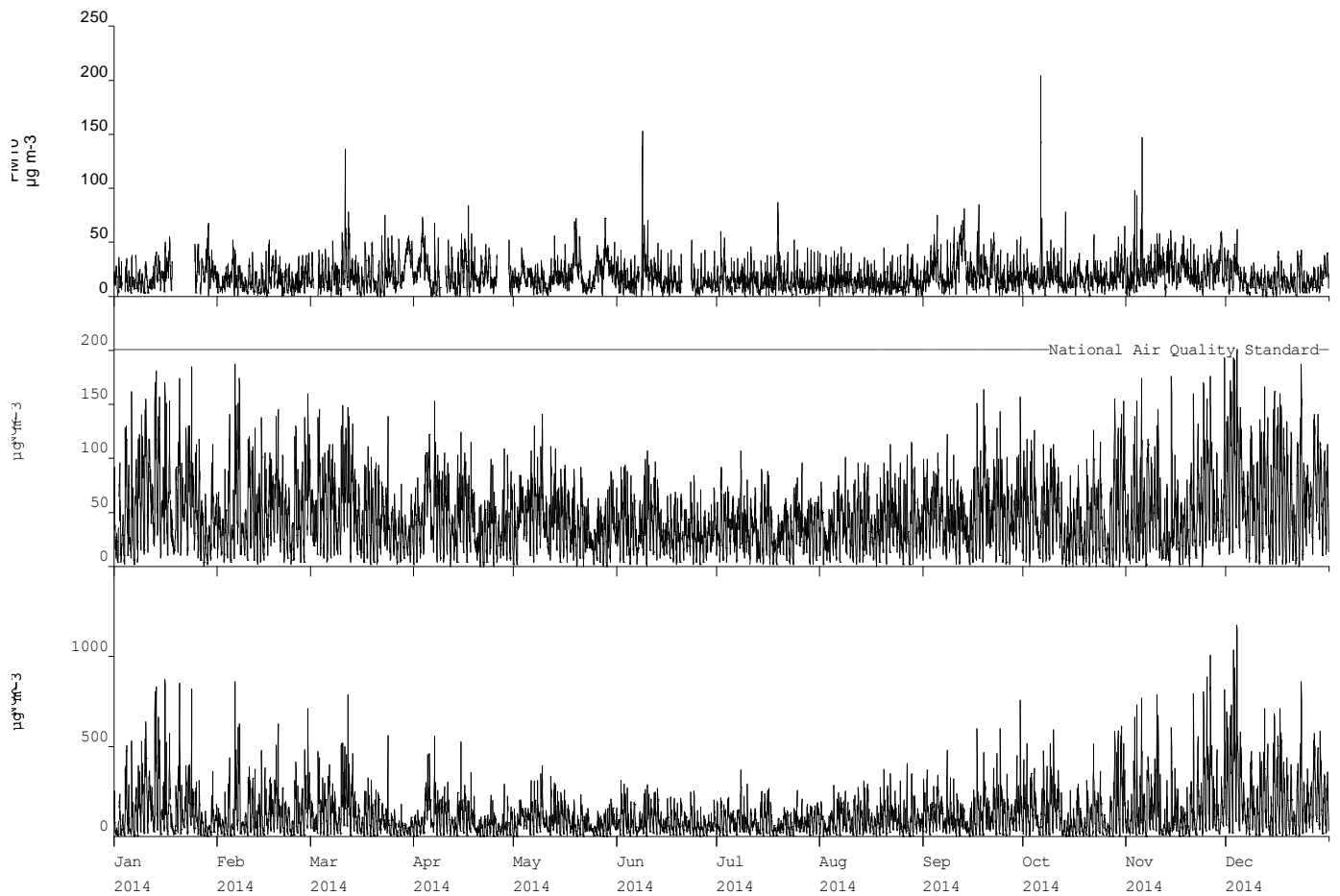
NO<sub>x</sub> mass units are NO<sub>x</sub> as NO<sub>2</sub> µg m<sup>-3</sup>

Pollutant	Air Quality Regulations (2000) and Air Quality (Scotland) Amendment Regulations 2002	Exceedences	Days
PM <sub>10</sub> Particulate Matter (Gravimetric)	Daily mean > 50 µg m <sup>-3</sup>	1	1
PM <sub>10</sub> Particulate Matter (Gravimetric)	Annual mean > 18 µg m <sup>-3</sup>	1	-
Nitrogen Dioxide	Annual mean > 40 µg m <sup>-3</sup>	1	-
Nitrogen Dioxide	Hourly mean > 200 µg m <sup>-3</sup>	1	1

Note: For a strict comparison against the objectives there must be a data capture of >90% throughout the calendar year

Produced by Ricardo-AEA on behalf of the Scottish Government

**Dundee Lochee Road  
Hourly Mean Data for 1<sup>st</sup> January to 31<sup>st</sup> December 2014**



Date Created: 02/04/2015

Produced by Ricardo-AEA on behalf of the Scottish Government

## DUNDEE MAINS LOAN 1<sup>st</sup> January to 31<sup>st</sup> December 2014

These data have been fully ratified by Ricardo-AEA

POLLUTANT	PM <sub>10</sub> *+	NO <sub>2</sub>	NO <sub>x</sub>
Maximum hourly mean	530 µg m <sup>-3</sup>	103 µg m <sup>-3</sup>	294 µg m <sup>-3</sup>
Maximum daily mean	56 µg m <sup>-3</sup>	45 µg m <sup>-3</sup>	75 µg m <sup>-3</sup>
Average	13 µg m <sup>-3</sup>	13 µg m <sup>-3</sup>	16 µg m <sup>-3</sup>
Data capture	96.4 %	93.3 %	93.3 %

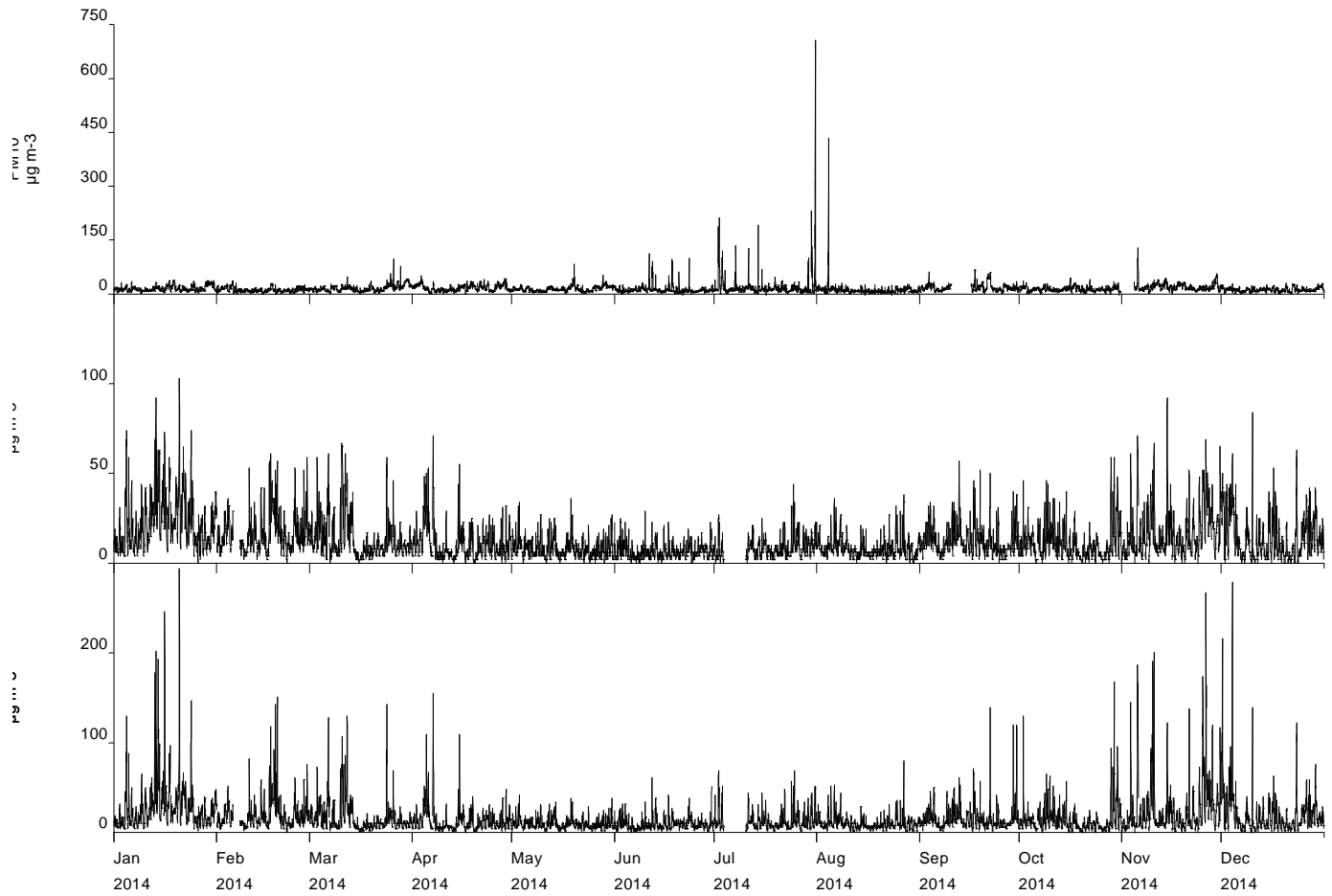
\* PM10 measured by a TEOM and using VCM for Gravimetric Equivalent mass concentrations. All gaseous pollutant mass units are at 20°C and 1013 mb. Particulate matter concentrations are reported at ambient temperature and pressure. NO<sub>x</sub> mass units are NO<sub>x</sub> as NO<sub>2</sub> µg m<sup>-3</sup>

Pollutant	Air Quality Regulations (2000) and Air Quality (Scotland) Amendment Regulations 2002	Exceedences	Days
PM <sub>10</sub> Particulate Matter (Gravimetric)	Daily mean > 50 µg m <sup>-3</sup>	1	1
PM <sub>10</sub> Particulate Matter (Gravimetric)	Annual mean > 18 µg m <sup>-3</sup>	0	-
Nitrogen Dioxide	Annual mean > 40 µg m <sup>-3</sup>	0	-
Nitrogen Dioxide	Hourly mean > 200 µg m <sup>-3</sup>	0	0

Note: For a strict comparison against the objectives there must be a data capture of >90% throughout the calendar year

Produced by Ricardo-AEA on behalf of the Scottish Government

### Dundee Mains Loan Hourly Mean Data for 1<sup>st</sup> January to 31<sup>st</sup> December 2014



Date Created: 21/04/2015

Produced by Ricardo-AEA on behalf of Dundee City Council

## DUNDEE MEADOWSIDE 1<sup>st</sup> January to 31<sup>st</sup> December 2014

These data have been fully ratified by Ricardo-AEA

POLLUTANT	PM <sub>10</sub> *+	NO <sub>2</sub>	NO <sub>x</sub>
Maximum hourly mean	111 µg m <sup>-3</sup>	124 µg m <sup>-3</sup>	947 µg m <sup>-3</sup>
Maximum daily mean	56 µg m <sup>-3</sup>	76 µg m <sup>-3</sup>	404 µg m <sup>-3</sup>
Average	17 µg m <sup>-3</sup>	40 µg m <sup>-3</sup>	142 µg m <sup>-3</sup>
Data capture	98.3 %	99.8 %	99.8 %

\* PM10 instruments:

+ BAM using a gravimetric factor of 0.83333 for Indicative Gravimetric Equivalent from 1st January 2013

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

NO<sub>x</sub> mass units are NO<sub>x</sub> as NO<sub>2</sub> µg m<sup>-3</sup>

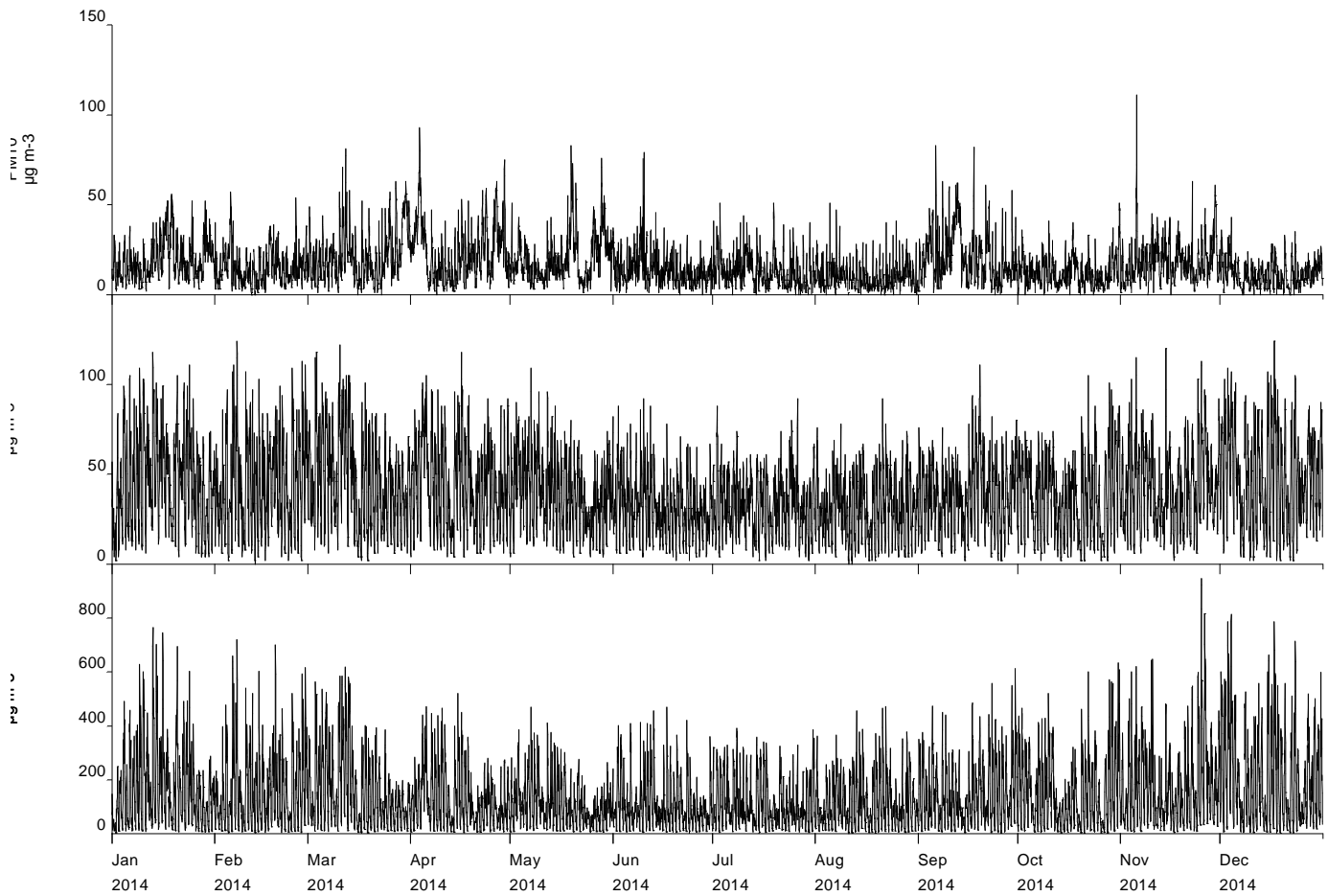
Pollutant	Air Quality Regulations (2000) and Air Quality (Scotland) Amendment Regulations 2002	Exceedences	Days
PM <sub>10</sub> Particulate Matter (Gravimetric)	Daily mean > 50 µg m <sup>-3</sup>	2	2
PM <sub>10</sub> Particulate Matter (Gravimetric)	Annual mean > 40 µg m <sup>-3</sup>	0	-
PM <sub>10</sub> Particulate Matter (Gravimetric)	Annual mean > 18 µg m <sup>-3</sup>	0	-
Nitrogen Dioxide	Annual mean > 40 µg m <sup>-3</sup>	0	-
Nitrogen Dioxide	Hourly mean > 200 µg m <sup>-3</sup>	0	0
Nitrogen Oxides (NO <sub>2</sub> )	Annual mean > 30 µg m <sup>-3</sup>	1	-

Note: For a strict comparison against the objectives there must be a data capture of >90% throughout the calendar year



Produced by Ricardo-AEA on behalf of Dundee City Council

### Dundee Meadowside Hourly Mean Data for 1<sup>st</sup> January to 31<sup>st</sup> December 2014



Date Created: 01/04/2015

Produced by Ricardo-AEA on behalf of the Scottish Government

## DUNDEE SEAGATE 1<sup>st</sup> January to 31<sup>st</sup> December 2014

These data have been fully ratified by Ricardo-AEA

POLLUTANT	PM <sub>10</sub> *+	NO <sub>2</sub>	NO <sub>x</sub>
Maximum hourly mean	167 µg m <sup>-3</sup>	182 µg m <sup>-3</sup>	1052 µg m <sup>-3</sup>
Maximum daily mean	65 µg m <sup>-3</sup>	93 µg m <sup>-3</sup>	415 µg m <sup>-3</sup>
Average	18 µg m <sup>-3</sup>	55 µg m <sup>-3</sup>	178 µg m <sup>-3</sup>
Data capture	97.0 %	99.1 %	99.1 %

\* PM10 instruments:

+ BAM using a gravimetric factor of 0.83333 for Indicative Gravimetric Equivalent from 1st January 2014

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

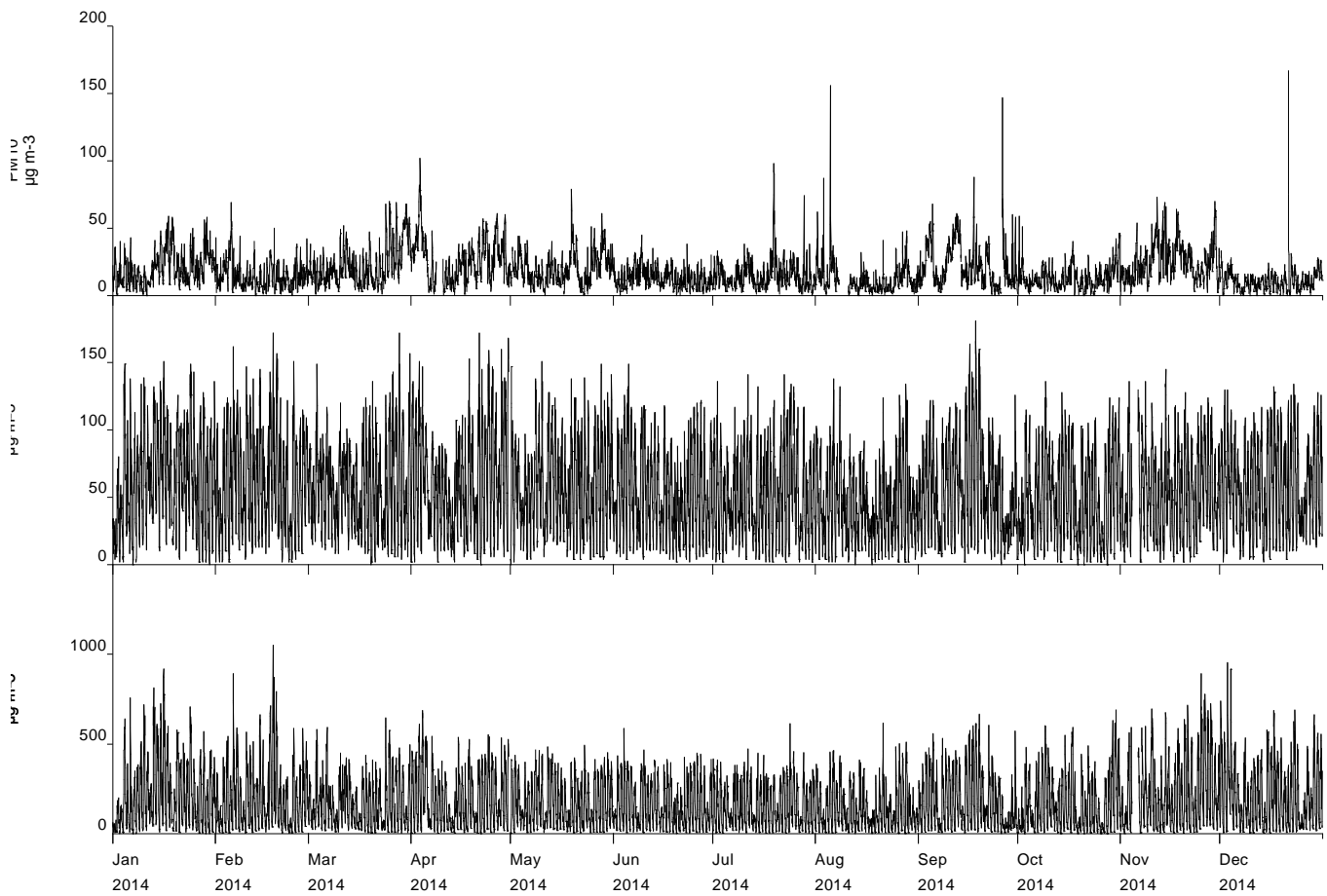
NO<sub>x</sub> mass units are NO<sub>x</sub> as NO<sub>2</sub> µg m<sup>-3</sup>

Pollutant	Air Quality Regulations (2000) and Air Quality (Scotland) Amendment Regulations 2002	Exceedences	Days
PM <sub>10</sub> Particulate Matter (Gravimetric)	Daily mean > 50 µg m <sup>-3</sup>	2	2
PM <sub>10</sub> Particulate Matter (Gravimetric)	Annual mean > 18 µg m <sup>-3</sup>	0	-
Nitrogen Dioxide	Annual mean > 40 µg m <sup>-3</sup>	1	-
Nitrogen Dioxide	Hourly mean > 200 µg m <sup>-3</sup>	0	0

Note: For a strict comparison against the objectives there must be a data capture of >90% throughout the calendar year

Produced by Ricardo-AEA on behalf of the Scottish Government

**Dundee Seagate  
Hourly Mean Data for 1<sup>st</sup> January to 31<sup>st</sup> December 2014**



Date Created: 01/04/2015

Produced by Ricardo-AEA on behalf of the Scottish Government

## DUNDEE UNION STREET 1<sup>st</sup> January to 31<sup>st</sup> December 2014

These data have been fully ratified by Ricardo-AEA

POLLUTANT	PM <sub>10</sub> *+	NO <sub>2</sub>	NO <sub>x</sub>
Maximum hourly mean	139 µg m <sup>-3</sup>	115 µg m <sup>-3</sup>	722 µg m <sup>-3</sup>
Maximum daily mean	55 µg m <sup>-3</sup>	61 µg m <sup>-3</sup>	214 µg m <sup>-3</sup>
Average	16 µg m <sup>-3</sup>	29 µg m <sup>-3</sup>	67 µg m <sup>-3</sup>
Data capture	95.0 %	97.1 %	97.1 %

\* PM10 instruments:

+ BAM using a gravimetric factor of 0.83333 for Indicative Gravimetric Equivalent from 1st January 2014

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

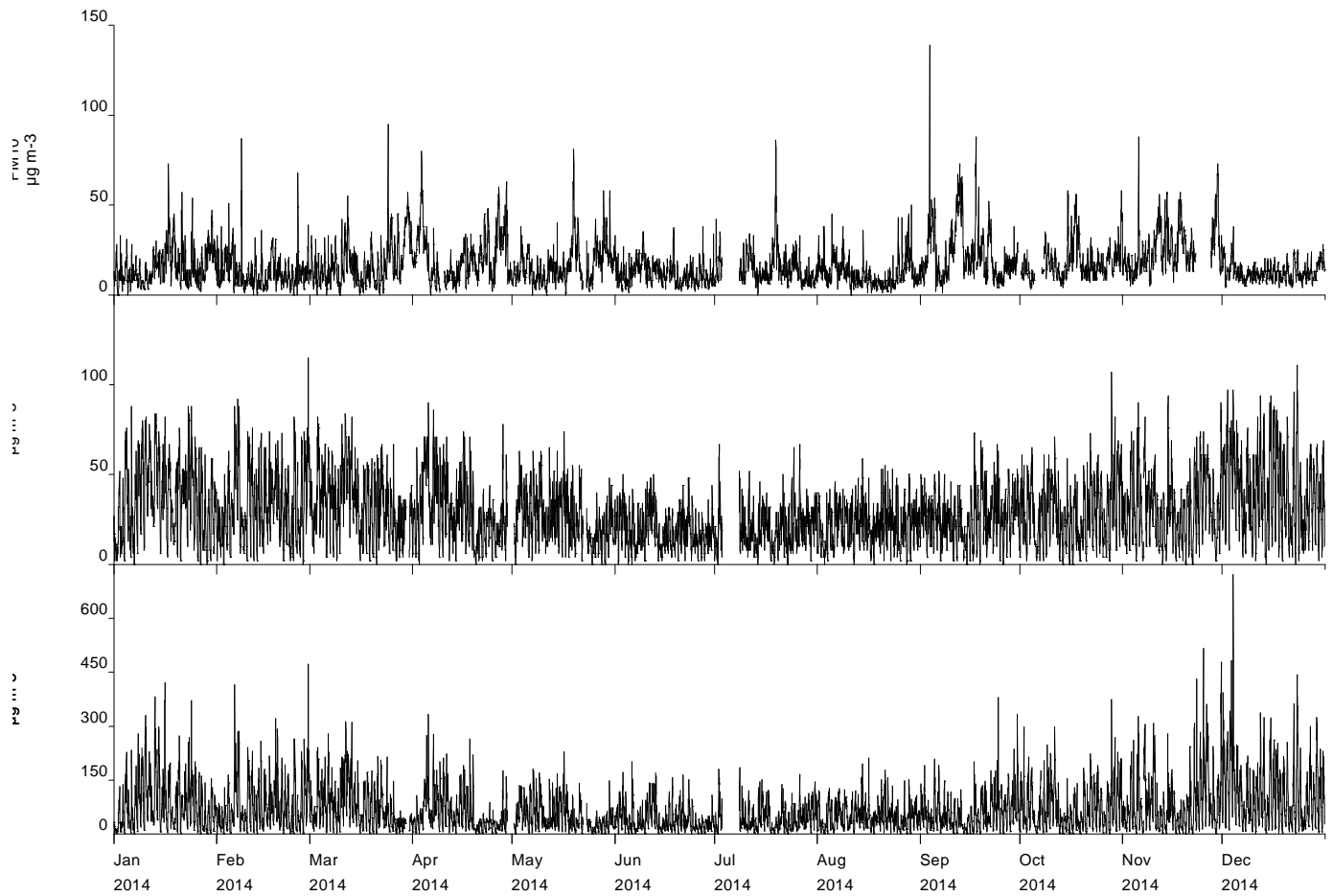
NO<sub>x</sub> mass units are NO<sub>x</sub> as NO<sub>2</sub> µg m<sup>-3</sup>

Pollutant	Air Quality Regulations (2000) and Air Quality (Scotland) Amendment Regulations 2002	Exceedences	Days
PM <sub>10</sub> Particulate Matter (Gravimetric)	Daily mean > 50 µg m <sup>-3</sup>	2	2
PM <sub>10</sub> Particulate Matter (Gravimetric)	Annual mean > 18 µg m <sup>-3</sup>	0	-
Nitrogen Dioxide	Annual mean > 40 µg m <sup>-3</sup>	0	-
Nitrogen Dioxide	Hourly mean > 200 µg m <sup>-3</sup>	0	0

Note: For a strict comparison against the objectives there must be a data capture of >90% throughout the calendar year

Produced by Ricardo-AEA on behalf of the Scottish Government

**Dundee Union Street  
Hourly Mean Data for 1<sup>st</sup> January to 31<sup>st</sup> December 2014**



Date Created: 01/04/2015

Produced by Ricardo-AEA on behalf of the Scottish Government

**DUNDEE WHITEHALL STREET**  
**1<sup>st</sup> January to 31<sup>st</sup> December 2014**

These data have been fully ratified by Ricardo-AEA

POLLUTANT	NO <sub>2</sub>	NO <sub>x</sub>
Maximum hourly mean	174 µg m <sup>-3</sup>	840 µg m <sup>-3</sup>
Maximum daily mean	88 µg m <sup>-3</sup>	292 µg m <sup>-3</sup>
Average	43 µg m <sup>-3</sup>	116 µg m <sup>-3</sup>
Data capture	98.1 %	98.1 %

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

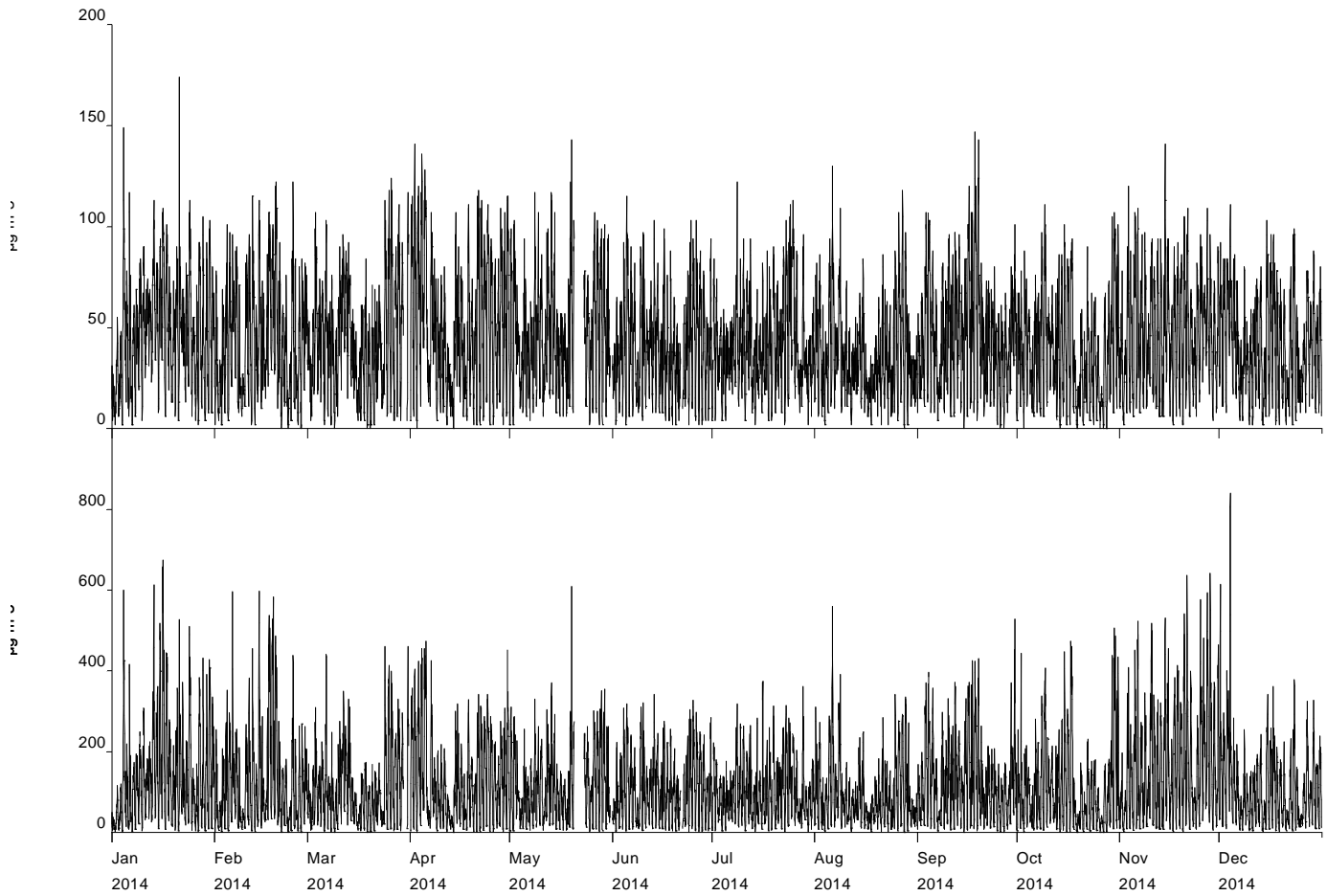
NO<sub>x</sub> mass units are NO<sub>x</sub> as NO<sub>2</sub> µg m<sup>-3</sup>

Pollutant	Air Quality Regulations (2000) and Air Quality (Scotland) Amendment Regulations 2002	Exceedences	Days
Nitrogen Dioxide	Annual mean > 40 µg m <sup>-3</sup>	1	-
Nitrogen Dioxide	Hourly mean > 200 µg m <sup>-3</sup>	0	0

Note: For a strict comparison against the objectives there must be a data capture of >90% throughout the calendar year

Produced by Ricardo-AEA on behalf of the Scottish Government


**Dundee Whitehall Street  
Hourly Mean Data for 1<sup>st</sup> January to 31<sup>st</sup> December 2014**



Date Created: 01/04/2015

Appendix D: Bias Calculations for Diffusion Tube Co-location Studies

### Checking Precision and Accuracy of Triplicate Tubes



From the AEA group

Diffusion Tubes Measurements									
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 $\mu\text{g m}^{-3}$	Tube 2 $\mu\text{g m}^{-3}$	Tube 3 $\mu\text{g m}^{-3}$	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	08/01/2014	05/02/2014	59.7	58.7	54.3	58	2.9	5	7.1
2	05/02/2014	05/03/2014	57.3	52.4	58.6	56	3.3	6	8.1
3	05/03/2014	02/04/2014	48.5	51.7	50.2	50	1.6	3	4.0
4	02/04/2014	30/04/2014	45.8	46.6	48.7	47	1.5	3	3.7
5	30/04/2014	28/05/2014	47.7	45.6	44.9	46	1.5	3	3.6
6	28/05/2014	02/07/2014	39.4	42.8	43.5	42	2.2	5	5.4
7	02/07/2014	30/07/2014	48.2	46.7	46.1	47	1.1	2	2.7
8	30/07/2014	27/08/2014	49.3	46.0	48.5	48	1.7	4	4.3
9	27/08/2014	01/10/2014	55.9	54.8	56.1	56	0.7	1	1.7
10	01/10/2014	29/10/2014	51.6	54.3	46.1	51	4.2	8	10.4
11	29/10/2014	03/12/2014	63.5	68.2	64.2	65	2.5	4	6.3
12	03/12/2014	07/01/2015	65.1	62.3	68.7	65	3.2	5	8.0
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 Data
55.6	99.3	Good	Good
53.4	99.9	Good	Good
44.8	99.9	Good	Good
43.3	99.3	Good	Good
40.4	100.0	Good	Good
34.8	99.6	Good	Good
34.5	99.4	Good	Good
37.9	99.9	Good	Good
46.0	99.6	Good	Good
41.2	98.4	Good	Good
53.1	99.5	Good	Good
61.5	100.0	Good	Good
Overall survey -->		Good precision	Good Overall DC

**Site Name/ID:** Dundee Lochee Road

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

(Check average CV & DC from Accuracy calculations)

**Accuracy (with 95% confidence interval)**  
without periods with CV larger than 20%

Bias calculated using 12 periods of data

Bias factor A **0.87 (0.82 - 0.92)**

Bias B **15% (9% - 22%)**

---

Diffusion Tubes Mean: **53  $\mu\text{g m}^{-3}$**

Mean CV (Precision): **4**

---

Automatic Mean: **46  $\mu\text{g m}^{-3}$**

Data Capture for periods used: **100%**

---

Adjusted Tubes Mean: **46 (43 - 48)  $\mu\text{g m}^{-3}$**

**Accuracy (with 95% confidence interval)**  
**WITH ALL DATA**

Bias calculated using 12 periods of data

Bias factor A **0.87 (0.82 - 0.92)**

Bias B **15% (9% - 22%)**

---

Diffusion Tubes Mean: **53  $\mu\text{g m}^{-3}$**

Mean CV (Precision): **4**

---

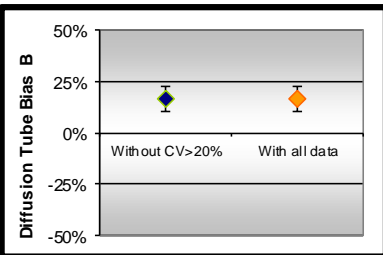
Automatic Mean: **46  $\mu\text{g m}^{-3}$**

Data Capture for periods used: **100%**

---

Adjusted Tubes Mean: **46 (43 - 48)  $\mu\text{g m}^{-3}$**



Jaume Targa, for AEA  
Version 04 - February 2011



## Checking Precision and Accuracy of Triplicate Tubes



Diffusion Tubes Measurements									
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 $\mu g m^{-3}$	Tube 2 $\mu g m^{-3}$	Tube 3 $\mu g m^{-3}$	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	08/01/2014	05/02/2014	59.1	57.1	56.1	57	1.5	3	3.8
2	05/02/2014	05/03/2014	59.1	59.4	59.6	59	0.3	0	0.6
3	05/03/2014	02/04/2014	58.4	59.5	55.9	58	1.8	3	4.6
4	02/04/2014	30/04/2014	57.4	54.6	56.2	56	1.4	3	3.5
5	30/04/2014	28/05/2014	52.3	52.6	52.0	52	0.3	1	0.7
6	28/05/2014	02/07/2014	45.5	45.0	43.0	45	1.3	3	3.3
7	02/07/2014	30/07/2014	48.7	51.6	48.9	50	1.6	3	4.0
8	30/07/2014	27/08/2014	46.4	41.7	44.2	44	2.4	5	5.8
9	27/08/2014	01/10/2014	54.5	53.2	54.2	54	0.7	1	1.7
10	01/10/2014	29/10/2014	53.8	52.1	48.5	51	2.7	5	6.7
11	29/10/2014	03/12/2014	55.5	66.6	56.5	60	6.1	10	15.3
12	03/12/2014	07/01/2015	52.9	49.6	57.0	53	3.7	7	9.2
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 Data
45.7	99.7	Good	Good
45.7	100.0	Good	Good
44.1	99.7	Good	Good
44.3	100.0	Good	Good
39.0	99.7	Good	Good
32.2	99.6	Good	Good
32.8	99.9	Good	Good
30.9	100.0	Good	Good
36.9	99.9	Good	Good
35.2	99.9	Good	Good
44.3	99.9	Good	Good
45.4	100.0	Good	Good
Overall survey -->		<b>Good precision</b>	<b>Good Overall DC</b>

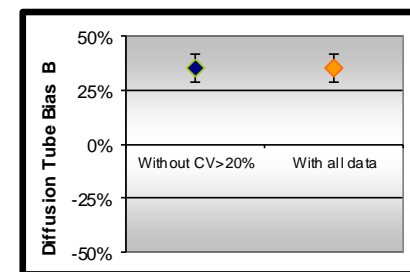
(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	Dundee Meadowside
----------------	-------------------

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	0.75 (0.71 - 0.78)
Bias B	34% (28% - 41%)
Diffusion Tubes Mean:	53 $\mu g m^{-3}$
Mean CV (Precision):	4
Automatic Mean:	40 $\mu g m^{-3}$
Data Capture for periods used:	100%
Adjusted Tubes Mean:	40 (38 - 42) $\mu g m^{-3}$

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.75 (0.71 - 0.78)
Bias B	34% (28% - 41%)
Diffusion Tubes Mean:	53 $\mu g m^{-3}$
Mean CV (Precision):	4
Automatic Mean:	40 $\mu g m^{-3}$
Data Capture for periods used:	100%
Adjusted Tubes Mean:	40 (38 - 42) $\mu g m^{-3}$



Jaume Targa, for AEA  
Version 04 - February 2011

### Checking Precision and Accuracy of Triplicate Tubes



Diffusion Tubes Measurements									
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 $\mu\text{gm}^{-3}$	Tube 2 $\mu\text{gm}^{-3}$	Tube 3 $\mu\text{gm}^{-3}$	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	08/01/2014	05/02/2014	54.4	54.5	55.5	54.8	0.6	1	1.5
2	05/02/2014	05/03/2014	60.4	59.2	57.8	59.1	1.3	2	3.2
3	05/03/2014	02/04/2014	57.3	57.5	55.5	56.8	1.1	2	2.7
4	02/04/2014	30/04/2014	61.7	62.8	60.4	61.6	1.2	2	3.0
5	30/04/2014	28/05/2014	54.8	59.3	58.6	57.6	2.4	4	6.0
6	28/05/2014	02/07/2014	53.2	52.8	51.2	52.4	1.1	2	2.6
7	02/07/2014	30/07/2014	58.5	55.1	59.0	57.5	2.1	4	5.3
8	30/07/2014	27/08/2014	50.8	50.1	50.1	50.3	0.4	1	1.0
9	27/08/2014	01/10/2014	54.7	54.2	55.1	54.7	0.5	1	1.1
10	01/10/2014	29/10/2014	51.2	46.4	42.2	46.6	4.5	10	11.2
11	29/10/2014	03/12/2014	56.6	58.3	58.6	57.8	1.1	2	2.7
12	03/12/2014	07/01/2015	52.5	55.4	60.2	56.0	3.9	7	9.7
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 Data
63.4	99.7	Good	Good
62.0	99.9	Good	Good
57.6	100.0	Good	Good
59.6	99.7	Good	Good
56.1	97.5	Good	Good
53.3	99.4	Good	Good
50.6	99.9	Good	Good
43.7	99.9	Good	Good
52.4	99.8	Good	Good
46.5	99.7	Good	Good
54.6	94.6	Good	Good
54.4	98.9	Good	Good
Overall survey -->		Good precision	Good Overall DC

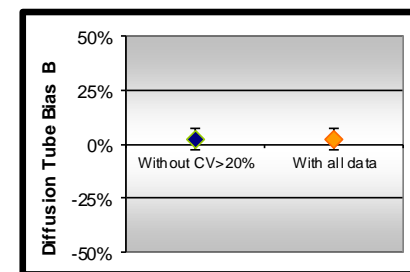
Site Name/ ID: **Dundee Seagate**

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

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval)	
without periods with CV larger than 20%	
Bias calculated using 12 periods of data	
Bias factor A	0.98 (0.94 - 1.03)
Bias B	2% (-3% - 7%)
Diffusion Tubes Mean:	55 $\mu\text{gm}^{-3}$
Mean CV (Precision):	3
Automatic Mean:	55 $\mu\text{gm}^{-3}$
Data Capture for periods used:	99%
Adjusted Tubes Mean:	54 (52 - 57) $\mu\text{gm}^{-3}$

Accuracy (with 95% confidence interval)	
WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.98 (0.94 - 1.03)
Bias B	2% (-3% - 7%)
Diffusion Tubes Mean:	55 $\mu\text{gm}^{-3}$
Mean CV (Precision):	3
Automatic Mean:	55 $\mu\text{gm}^{-3}$
Data Capture for periods used:	99%
Adjusted Tubes Mean:	54 (52 - 57) $\mu\text{gm}^{-3}$



Jaume Targa, for AEA  
Version 04 - February 2011

## Checking Precision and Accuracy of Triplicate Tubes



Diffusion Tubes Measurements									
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 $\mu\text{gm}^{-3}$	Tube 2 $\mu\text{gm}^{-3}$	Tube 3 $\mu\text{gm}^{-3}$	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	08/01/2014	05/02/2014	43.7	42.1	43.0	43	0.8	2	2.0
2	05/02/2014	05/03/2014	48.4	46.7	43.9	46	2.3	5	5.6
3	05/03/2014	02/04/2014	38.0	39.8	37.7	39	1.1	3	2.8
4	02/04/2014	30/04/2014	35.3	36.2	38.2	37	1.5	4	3.7
5	30/04/2014	28/05/2014	35.7	31.6	30.2	33	2.9	9	7.1
6	28/05/2014	02/07/2014	27.6	26.7	26.9	27	0.5	2	1.2
7	02/07/2014	30/07/2014	36.5	35.5	34.9	36	0.8	2	2.0
8	30/07/2014	27/08/2014	36.8	34.8	35.8	36	1.0	3	2.5
9	27/08/2014	01/10/2014	37.9	40.1	37.7	39	1.3	3	3.3
10	01/10/2014	29/10/2014	40.6	39.5	39.6	40	0.6	2	1.5
11	29/10/2014	03/12/2014	45.0	49.5	45.0	47	2.6	6	6.5
12	03/12/2014	07/01/2015	48.5	52.5	43.2	48	4.7	10	11.6
13									

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
36.5	99.4	Good	Good
35.4	99.7	Good	Good
31.9	96	Good	Good
29.6	95.8	Good	Good
25	92.4	Good	Good
19	99.5	Good	Good
20	81.5	Good	Good
22	99.7	Good	Good
25	99.8	Good	Good
27	99	Good	Good
32.7	99.8	Good	Good
37.1	100	Good	Good

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

Overall survey -->

Good precision	Good Overall DC
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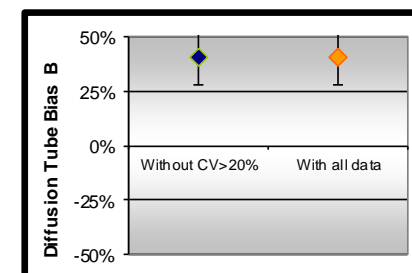
(Check average CV & DC from Accuracy calculations)

Site Name/ ID: Dundee Union Street

Accuracy (with 95% confidence interval) without periods with CV larger than 20%	
Bias calculated using 12 periods of data	
Bias factor A	0.73 (0.67 - 0.8)
Bias B	38% (25% - 50%)
Diffusion Tubes Mean:	39 $\mu\text{gm}^{-3}$
Mean CV (Precision):	4
Automatic Mean:	28 $\mu\text{gm}^{-3}$
Data Capture for periods used:	97%
Adjusted Tubes Mean:	28 (26 - 31) $\mu\text{gm}^{-3}$

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

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.73 (0.67 - 0.8)
Bias B	38% (25% - 50%)
Diffusion Tubes Mean:	39 $\mu\text{gm}^{-3}$
Mean CV (Precision):	4
Automatic Mean:	28 $\mu\text{gm}^{-3}$
Data Capture for periods used:	97%
Adjusted Tubes Mean:	28 (26 - 31) $\mu\text{gm}^{-3}$



Jaume Targa, for AEA  
Version 04 - February 2011

## Checking Precision and Accuracy of Triplicate Tubes



Diffusion Tubes Measurements									
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 $\mu\text{gm}^{-3}$	Tube 2 $\mu\text{gm}^{-3}$	Tube 3 $\mu\text{gm}^{-3}$	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	08/01/2014	05/02/2014	54.6	49.6	67.4	57	9.2	16	22.8
2	05/02/2014	05/03/2014	50.8	48.9	49.7	50	1.0	2	2.4
3	05/03/2014	02/04/2014	52.3	53.7	53.8	53	0.8	2	2.1
4	02/04/2014	30/04/2014	58.0	57.9	54.3	57	2.1	4	5.2
5	30/04/2014	28/05/2014	56.5	52.9	55.3	55	1.8	3	4.6
6	28/05/2014	02/07/2014	48.4	50.7	50.7	50	1.3	3	3.3
7	02/07/2014	30/07/2014	53.5	55.1	54.3	54	0.8	1	2.0
8	30/07/2014	27/08/2014	47.1	45.7	48.0	47	1.2	2	2.9
9	27/08/2014	01/10/2014	50.2	53.9	51.9	52	1.9	4	4.6
10	01/10/2014	29/10/2014	44.7	41.1	45.4	44	2.3	5	5.7
11	29/10/2014	03/12/2014	58.0	53.8	45.8	53	6.2	12	15.4
12	03/12/2014	07/01/2015	46.8	44.0	46.2	46	1.5	3	3.7
13									

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
47.6	99.6	Good	Good
44.2	99.9	Good	Good
44.5	94.3	Good	Good
48.7	99.9	Good	Good
45	89.3	Good	Good
40	95.7	Good	Good
40	99.7	Good	Good
36	99.9	Good	Good
44	99.9	Good	Good
36	99.3	Good	Good
47.2	99.5	Good	Good
37.2	98.1	Good	Good

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

Overall survey -->

Good precision	Good Overall DC
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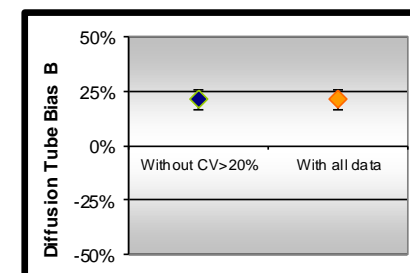
(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	Dundee Whitehall Street
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Accuracy (with 95% confidence interval) without periods with CV larger than 20%	
Bias calculated using 12 periods of data	
Bias factor A	0.83 (0.8 - 0.86)
Bias B	21% (16% - 26%)
Diffusion Tubes Mean:	51 $\mu\text{gm}^{-3}$
Mean CV (Precision):	5
Automatic Mean:	42 $\mu\text{gm}^{-3}$
Data Capture for periods used:	98%
Adjusted Tubes Mean:	43 (41 - 44) $\mu\text{gm}^{-3}$

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

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.83 (0.8 - 0.86)
Bias B	21% (16% - 26%)
Diffusion Tubes Mean:	51 $\mu\text{gm}^{-3}$
Mean CV (Precision):	5
Automatic Mean:	42 $\mu\text{gm}^{-3}$
Data Capture for periods used:	98%
Adjusted Tubes Mean:	43 (41 - 44) $\mu\text{gm}^{-3}$



Jaume Targa, for AEA  
Version 04 - February 2011

**Appendix E: List of Industrial Processes**

Process Name/Address	Process Type	PPC Sector	New source since USA 2012?	Existing process with new exposure?	Is change substantial (>30%)?	Process Potentially Requiring Review & Assessment~	Nomogram screening assessment required?	Detailed assessment Required?	SEPA Comments
Rockwell Solutions, Wester Gourdie, Dundee	Chapter 6: Other Activities Surface treating with organic solvents - Also Chapter 7 SED	6.4.b	No	Yes*	No	No	No	No	New Asda store nearby
Dundee Energy Recycling, Baldovie, Dundee	Chapter 5: Waste Management	IPPC S5.01	No	No	No	Yes, previously assessed	No	No	Resumed operation (Oct' 13) - after fire damage. No change to emissions or emission limits.
Nynas UK AB, East Camperdown Street, Dundee DD1 3LG	Chapter 1: Energy Industries	Section 1.2 Part A Paragraph (f) (i)	No	No	No *	Yes, previously assessed	No	No	Variation to permit to increase particulate emission limits for small hot oil heater (May 2013). Stopped refining oil Dec 2013. Limited bitumen treatment and storage of HFO. Expected to switch to gas 2015.
Nationwide Crash Repair Centres Ltd, Liff Road, Dundee	Chapter 6: Other Activities vehicle respraying	6.4.b	No	Yes*	No	No	No	No	New Asda store nearby but impact unlikely

Process Name/Address	Process Type	PPC Sector	New source since USA 2012?	Existing process with new exposure?	Is change substantial (>30%)?	Process Potentially Requiring Review & Assessment~	Nomogram screening assessment required?	Detailed assessment Required?	SEPA Comments
Hanson Aggregates Piper Street, Dundee	Chapter 3: Mineral Industries cement batchers	3.1.a.(ii)	No	No	No	No	No	No	Not operating.
Subsea Protection Systems	Chapter 3: Mineral Industries cement batching	3.1.b	No	No	No	Yes, previously assessed	No	No	No Change
Discovery Filling Station	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No	No Change
Brochtay Filling Station	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No	No Change
Asda Stores Filling Station Kirkton	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No	No Change
Tesco Stores Ltd, Methven Street, Dundee	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No	Surrendered
BP Kingsway West Filling Station	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No	No Change
Shell Caird Park	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No	No Change
Shell UK Ltd, East Kingsway Dundee	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No	Closed
Asda Stores Ltd, Milton of Craigie, Dundee	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No	No Change

Process Name/Address	Process Type	PPC Sector	New source since USA 2012?	Existing process with new exposure?	Is change substantial (>30%)?	Process Potentially Requiring Review & Assessment	Nomogram screening assessment required?	Detailed assessment Required?	SEPA Comments
Tesco Stores Ltd, Riverside Drive, Dundee	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No	No Change
Tapedrive Ltd, Marketgait F/S, Dundee	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No	No Change
Sainsburys Supermarket Ltd, Dundee	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No	No Change
Jet Petrol Station, Forfar Road, Dundee	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No	No Change
Dens Metals Ltd, West Pitkerro, Dundee	Chapter 2: Production and Processing of Metals	2.2.a	No	No	No	Yes, previously assessed	No	No	Surrendered
Mctavish Ramsay Ltd, Barlow Ave, West Pitkerro	Chapter 6: Other Activities Timber Activity	6.6.(i)	No	No	No	No	No	No	Company in administration. Not operating
Johnsons, Asda Dundee	Chapter 7: SED Activities	Chapter 7: SED Activities	No	No	No	No	No	No	Surrendered
Breedon Aggregates Ltd, Longtown Street, Dundee	Chapter 3: Mineral Industries Cement Batching	3.1.a.(ii)	No	No	No	No, previously assessed	No	No	No Change
Aberdeen Valet Service Dundee	Chapter 7: SED Activities	Chapter 7: SED Activities	No	Site no longer operating.	Site no longer operating.	No	No	No	Surrendered
Lochee Dry cleaning Centre Dundee	Chapter 7: SED Activities	Chapter 7: SED Activities	No	No	No	No	No	No	No Change

Process Name/Address	Process Type	PPC Sector	New source since USA 2012?	Existing process with new exposure?	Is change substantial (>30%)?	Process Potentially Requiring Review & Assessment~	Nomogram screening assessment required?	Detailed assessment Required?	SEPA Comments
Ferry Laundrette Broughty Ferry	Chapter 7: SED Activities	Chapter 7: SED Activities	No	No	No	No	No	No	No Change
Stay-Press Dry Cleaning Centre, Dundee	Chapter 7: SED Activities	Chapter 7: SED Activities	No	No	No	No	No	No	Surrendered
Care Clean, Dundee	Chapter 7: SED Activities	Chapter 7: SED Activities	No	No	No	No	No	No	No Change
Dignity Ltd, Dundee Crematorium, Dundee	Chapter 5: Waste Management	5.1c	No	No	No	No	No	No	No change
Laundry On Line, Annfield Road, Dundee	Chapter 7: SED Activities	Chapter 7: SED Activities	No	No	No	No	No	No	Relocated to Annfield Road
Wm Morrison Supermarkets Plc, Dundee	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	No	No	No	No Change
Wm Morrison Supermarkets plc, 1 Afton Way	Chapter 7: SED Activities	Chapter 7: SED Activities	No	No	No	No	No	No	No Change
Tesco Filling Station, South Road, Dundee	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	No	No	No	No Change
Halley Stevensons (Dyers & Finishers) Limited, Baltic Works, Annfield Road, Dundee DD1 5JH	Chapter 6: Other Activities	Section 6.4 Part A Paragraph (a)	No	No	No	No	No	No	No Change



Process Name/Address	Process Type	PPC Sector	New source since USA 2012?	Existing process with new exposure?	Is change substantial (>30%)?	Process Potentially Requiring Review & Assessment	Nomogram screening assessment required?	Detailed assessment Required?	SEPA Comments
Discovery Flexibles, Kemback St Dundee	Chapter 6: Other Activities surface treatment using organic solvents also Chapter 7 SED coating flexible packaging	6.4.b	No	No	No	No	No	No	No Change
J T Inglis, Riverside Works, Dundee	Chapter 6: Other Activities Textile Treatment	6.4.d	No	No	No	No	No	No	Currently Decommissioning
Michelin Tyre Plant, Dundee	Chapter 6: Other Activities surface treatment of rubber with organic solvents also Chapter 7	6.4.b	No	No	No	Yes, previously assessed	No	No	New line but no real change to emissions
Michelin Tyre Plant, Dundee	Chapter 1: Energy Industries, Combustion	1.1.a	No	No	No	Yes, previously assessed	No	No	No Change
D C Thomson Printers, Dundee	Chapter 6: Other Activities printing process	6.4.b	No	No	No	No	No	No	Not operating permitted activity
Day International Ltd, Balgray St, Dundee	Chapter 6: Other Activities surface treatment of rubber with organic solvents	6.4.b	No	No	No	Yes, previously assessed	No	No	No Change
RMC Readymix Ltd, Dundee	Chapter 3: Mineral Industries, Cement Batching	3.1.a.(ii)	No	No	No	No	No	No	No change
Brown & Tawse Steelstock Ltd, Fowler RD West Pitkerro - Dundee	Chapter 6: Other Activities, paint spraying	6.4.a	No	No	No	No	No	No	No Change

Process Name/Address	Process Type	PPC Sector	New source since USA 2012?	Existing process with new exposure?	Is change substantial (>30%)?	Process Potentially Requiring Review & Assessment	Nomogram screening assessment required?	Detailed assessment Required?	SEPA Comments
Armitages Pet Products Ltd, Broughty Ferry Road-Dundee	Chapter 6: Other Activities, Pet Food Manufacture	6.8.a	No	No	No	No	No	No	No change
Tesco Stores Ltd, Kingsway Retail Park Dundee	Chapter 1: Energy Industries, Petrol Station	1.2.c.(ii)	No	No	No	No	No	No	No Change
Joinery and Timber Creations (65) Ltd,	Chapter 6: Other Activities, Timber Process	6.6.(i)	No	No	No	No, previously assessed	No	No	Waste wood boiler- permitted but not constructed or operating.
Ethiebeaton Quarry	Chapter 3 Mineral Activities - cement batching process 3.1a(ii), roadstone coating 3.5e, crushing and grinding 3.5c	3.1a(ii), 3.5e, 3.5c	No	No	No	Yes, previously assessed	No	No	SEPA investigated dust complaint - concluded quarry not source.
Health Care Environmental Services, Nobel Road, Wester Gourdie Ind. Estate	Chapter 5 Waste Management Part A Treatment of Clinical waste	5.3a	No	No	No	No, previously assessed	No	No	No change
New PVR at Asda, Myrekirk Road	Chapter 1: Energy Industries, Petrol Station	1.2.c.(ii)	Yes	No	No	Yes, but no relevant receptors	No	No	New site
ASKA Energy, 3B Edison Place, Dundee	Chapter 4. Chemical Industry, Part A, Producing organic chemicals (biodiesel)	Section 4, Part A, sub-section b	Yes**	No	No	No (Emissions aren't LAQM pollutants)	No	No	New biodiesel PPC processing site. Permit issued Sept 2014

**Notes:** Yes\* see Section 5.1.2  
Yes\*\* see Section 5.1.3  
No\* see Section 5.1.2  
~ With reference to Annex 2 Appendix E TG.03  
Part A - Processes shaded purple

**Appendix F: Road Traffic Data**

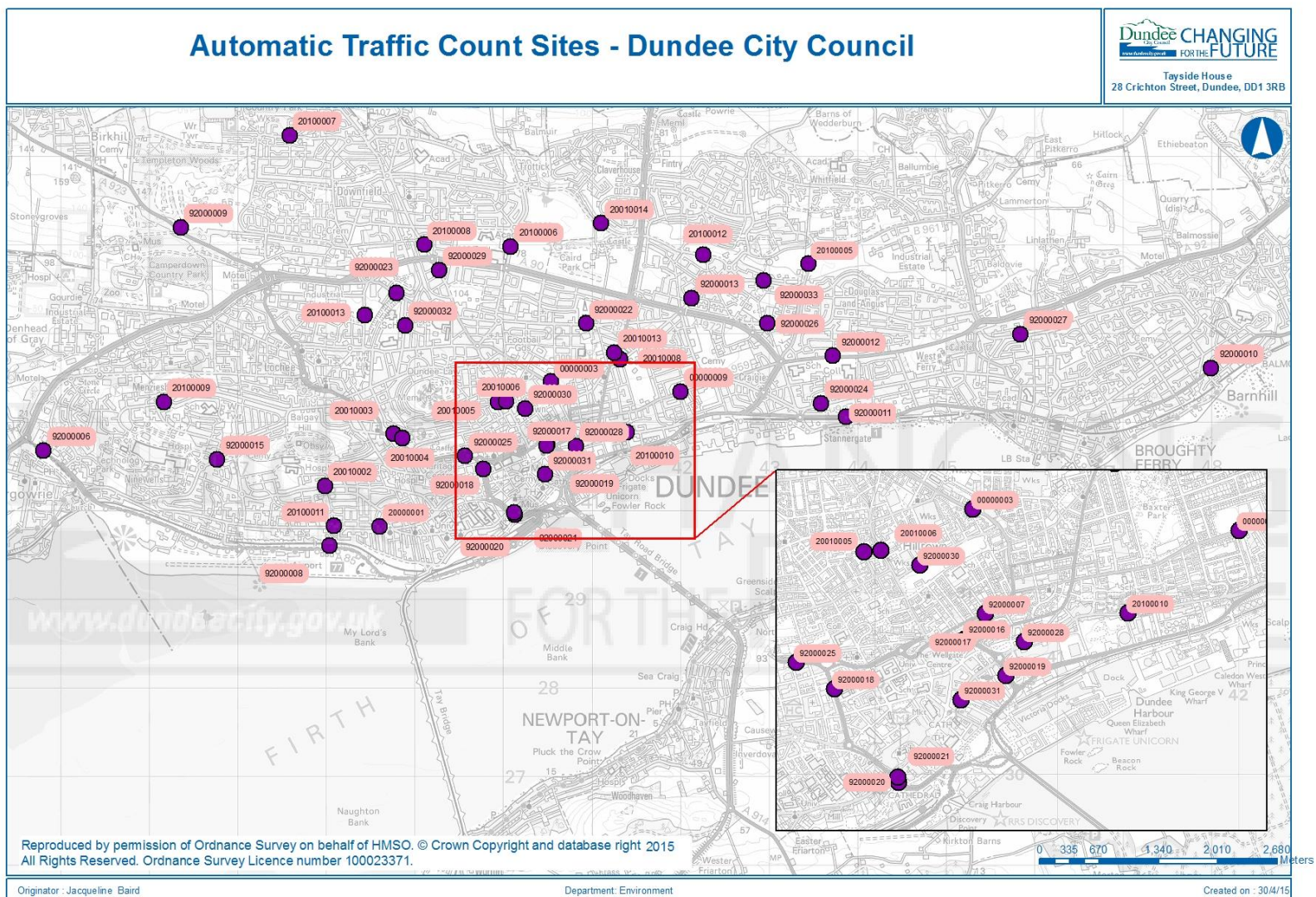
**Table F1 DCC Automatic Traffic Count Sites**

Site Number	Site Location	x	y
00000003	Dens Road (S of Hillbank Rd)	340536	731460
00000009	Arbroath Road (E of Kenilworth Ave)	342001	731343
20000001	Perth Road (E of Windsor St)	338599	729824
20010002	Blackness Road ( W of Marchfield)	337983	730283
20010003	Lochee Road (N of Rankine St)	338759	730872
20010004	Rankine Street (N of Lochee Rd)	338856	730819
20010005	Rosebank Street (N of Kinloch St)	339935	731227
20010006	Hilltown (N of Stirling St)	340027	731235
20010008	Pitkerro Road (S of Baxter Park Terr)	341317	731711
20010013	Forfar Road (N of Janefield Pl)	341251	731787
20010014	Claverhouse Road (East of Caird Park Access)	341101	733244
20100005	Drumgeith Road (Nr St. Saviours School)	343443	732786
20100006	Old Glamis Road (nr Dundee College)	340081	732983
20100007	Laird Street (E of Benholm Place)	337583	734239
20100008	Strathmartine Road (N of Kingsway)	339105	733004
20100009	Charleston Drive (E of Dickson Ave)	336161	731228
20100010	Broughty Ferry Road (W of Market St)	341391	730888
20100011	Perth Road (E of Grosvenor Rd)	338082	729827
20100012	Fountainbleau Drive (near Rowantree Cres)	342257	732892
20100013	Kings Cross Road (N of Lundie Ave)	338436	732210
-	Tay Bridge		
92000001	Tay Bridge Ramp 1 Northbound towards railway station		
92000002	Tay Bridge Ramp 2		
92000003	Tay Bridge Ramp 3		
92000006	Riverside Avenue -South of Swallow Roundabout	334800	730680
92000007	Victoria Road - West of Wellington Street	340604	730886
92000008	Riverside Drive (East of Airport)	338038	729604
92000009	Coupar Angus Road (East of Layby @ Templeton Woods)	336352	733200
92000010	Dalhousie Road - West of Kerrington Crescent	347993	731611
92000011	Dundee Road - West of Christian Road	343866	731065
92000012	Arbroath Road @ Monymusk	343719	731749
92000013	Pitkerro Road (South of Craighill Court)	342123	732401
92000015	Ninewells Avenue (North of Ninewells Drive)	336767	730581
92000016	East Marketgait (North of King Street) Southeast bound	340492	730745
92000017	East Marketgait (North of King Street) Northwest bound	340490	730737
92000018	West Marketgait (South of Dudhope @ Police Station)	339774	730471
92000019	East Marketgait - South of Seagate	340717	730546
92000020	South Marketgait (South of Nethergate) - Northbound	340127	729958
92000021	South Marketgait (South of Nethergate) - Southbound	340121	729984
92000022	Clepington Road (West of Mains Loan)	340932	732114
92000023	Clepington Road (West of Johnson Ave)	338789	732460

Site Number	Site Location	x	y
92000024	Craigie Drive - East of Lavender Street	343586	731212
92000025	Lochee Road (West of Dudhope roundabout)	339563	730617
92000026	Longtown Road (East of Asda Access Rd)	342977	732116
92000027	Balgillo Road (near Seafeld Road )	345838	731991
92000028	Blackcroft (west of Dens Street)	340818	730730
92000029	Strathmartine Road (South of Kingsway)	339276	732717
92000030	Alexander Street (West of Carnegie Street)	340242	731154
92000031	Seagate (East of Gellatly Street)	340468	730410
92000032	Johnston Avenue (North of Glenogil Avenue)	338889	732093
92000033	Happyhillock Road (East of Inglefield Street)	342939	732598

**Notes -** Sites marked in green have been considered in previous review and assessment reports  
Grid references marked in yellow are approximate

Figure F.1 Dundee City Council Automatic Traffic Count Locations



**Table F2 Comparison of 2014 DCC Traffic Count Data with Previous Assessments**

Site Number	2005 AADT	2006 AADT	2007 AADT	2008 AADT	2009 AADT	2010 AADT	2011 AADT	2012 AADT	2013 AADT	2014 AADT	2014 Average Speed (mph)	2014 %HDV	Assessment / DMRB Required ?	Reasons
00000003	10859	-	-	11025	-	11323	10062	10178	9744	9753	24	3.49%	n	less than 10,000 vpd (10,463vpd 10.2% HDV in FA 2009 )
00000009	13189	-	-	12957	-	13048	13283	13697	13142	13176	33	4.01%	n	less than previous, area included in Dundee East Air Dispersion Model
20000001	8343	-	-	7560	-	7764	7053	7184	7180	7238	24	4.74%	n	< 10,000 vpd,not narrow congested, Pm10 background <15ug/m3
20010002	-	-	-	6193	-	6360	5911	5844	5102	5211	28	6.62%	n	< 10,000 vpd,not narrow congested, Pm10 background <15ug/m3
20010003	13018	-	-	13291	-	13384	12684	11603	11603	10296	-	5.53%	n	less than previous, faulty loops suspected, existing exceedance area
20010004	8098	-	-	7931	-	8145	7115	6862	7188	6943	24	1.41%	n	less than previous, potential exceedance area already identified
20010005	-	-	-	-	-	-	4426	4489	4621	4588	-	-	n	< 10,000 vpd,not narrow congested, Pm10 background <15ug/m3
20010006	-	-	-	5598	-	5749	5416	5492	5608	5642	24	2.85%	n	< 10,000 vpd,not narrow congested, Pm10 background <15ug/m3
20010008	9159	-	-	10102	-	10375	8675	8608	8827	8903	-	-	n	< 10,000 vpd,not narrow congested, Pm10 background <15ug/m3
20010013	9276	-	-	8220	-	8278	8861	9053	8768	8824	27	5.62%	n	< 10,000 vpd,not narrow congested, Pm10 background <15ug/m3
20010014	-	-	-	-	-	-	-	-	-	10238	39	3.00%	n	no receptors within 10m
20100005	-	12378	-	-	-	-	12670	-	-	13303	32.4	2.25%	n	no receptors within 10m
20100006	-	9059	-	-	-	-	9285	-	-	9356	31.4	8.04%	n	< 10,000 vpd,not narrow congested, Pm10 background <15ug/m3
20100007	-	-	-	-	-	-	2886	-	-	2907	30.3	10.87%	n	< 10,000 vpd,not narrow congested, Pm10 background <15ug/m3
20100008	-	12554	-	-	-	-	10035	-	-	13185	35.9	10.25%	n	increase < 10% since previously assessed in 2006
20100009	-	-	-	-	-	-	5006	-	-	5162	28.9	2.93%	n	< 10,000 vpd,not narrow congested, Pm10 background <15ug/m3
20100010	-	-	-	-	-	-	6977	-	-	6926	30.2	11.23%	n	< 10,000 vpd,not narrow congested, Pm10 background <15ug/m3
20100011	-	-	-	-	-	-	6512	-	-	6614	28.7	8.10%	n	< 10,000 vpd,not narrow congested, Pm10 background <15ug/m3
20100012	-	-	-	-	-	-	7303	-	-	6938	31.9	11.44%	n	< 10,000 vpd,not narrow congested, Pm10 background <15ug/m3
20100013	-	11347	-	-	-	-	10851	-	-	7698	31.3	14.03%	n	< 10,000 vpd,not narrow congested, Pm10 background <15ug/m3
Tay Bridge	-	-	-	25419	-	25597	25235	24753	24770	-	-	-	n	no receptors within 10m
92000001	-	-	-	-	-	-	-	-	-	-	-	-	n	no receptors within 10m
92000002	-	-	-	-	-	-	-	-	-	-	-	-	n	no receptors within 10m
92000003	-	-	-	-	-	-	-	-	-	-	-	-	n	no receptors within 10m
92000006	-	18061	-	17405	-	-	16091	-	-	16662	39	4.14%	n	no receptors within 10m

## Dundee City Council

Site Number	2005 AADT	2006 AADT	2007 AADT	2008 AADT	2009 AADT	2010 AADT	2011 AADT	2012 AADT	2013 AADT	2014 AADT	2014 Average Speed (mph)	2014 %HDV	Assessment / DMRB Required ?	Reasons
92000007	-	9046	14017	-	-	-	7742	-	-	11634	28	9.61%	n	< previously assessed FA/DA - Bus Emission Modelling assessed at 17,251 AADT (2102)(10% HDV)
92000008	<b>18818</b>	-	-	<b>19054</b>	-	<b>19187</b>	<b>17024</b>	15900	<b>16213</b>	15142	46	-	n	no receptors within 10m
92000009	10973	-	-	-	-	-	-	-	-	-	-	-	n	no receptors within 10m
92000010	-	12860	-	12668	-	-	11892	-	-	10855	-	-	n	less than previously assessed 2006 USA, 12,696 AADT (NO2) & 13515 AADT (PM10) 4.7% HDV
92000011	18180	17415	-	-	-	-	15643	-	-	14976	-	1.75%	n	no receptors within 10m
92000012	-	27245	28290	-	-	-	25113	-	-	22833	32	4.93%	y	less than previously assessed in 2006 USA [29001 AADT (PM10) (10% HDV)]. Receptors closer to road identified - area covered by Dundee East Air Dispersion Modelling.
92000013	-	-	-	-	-	-	-	-	-	11410	33	-	y	>10,000 vpd receptors within 10m area covered by Kingsway/Forfar Road Air Dispersion Model -
92000015	-	-	-	-	-	-	-	-	-	6468	35	-	n	< 10,000 vpd, not narrow congested, Pm10 background <15ug/m3
92000016	-	-	-	-	-	-	-	-	-	8729	24	1.79%	n	Combined flow 17003< than previously assessed (18612 (2.9% HDV) 2010 predicted in 2006)
92000017	-	-	-	-	-	-	-	-	-	8274	34	1.79%	n	Combined flow 17003< than previously assessed (18612 (2.9% HDV) 2010 predicted in 2006)
92000018	-	-	25535	-	-	-	23490	-	-	22805	29	-	n	less than previously assessed 25,828 vpd 2010 (4.6% HDV) in FA/DA
92000019	-	-	-	-	-	-	17269	-	-	-	-	-	n	no update
92000020	9769	-	21100	-	-	-	20959	-	-	7168	20	4.74%	n	combined flow 13563<than previously assessed W.Marketgait (s. of Nethergate) 23,533 vpd assessed in DA 2006
92000021	19469	-	-	-	-	-	-	-	-	6395	-	3.63%	n	combined flow 13563<than previously assessed W.Marketgait (s. of Nethergate) 23,533 vpd assessed in DA 2006
92000022	-	-	-	-	-	-	10208	-	-	11162	30	-	n	increase < 10% since previously assessed in 2012
92000023	-	-	-	-	-	-	13862	-	-	13481	28	3.04%	n	no receptors within 10m
92000024	-	8730/ 8923	-	-	-	-	7976	-	-	8290	32	8.82%	n	< 10,000 vpd, not narrow congested, Pm10 background <15ug/m3
92000025	-	-	17713	-	-	-	17289	-	-	16522	31	3.52%	n	less than previously assessed , area part of Lochee Road Air Dispersion Model
92000026	-	-	-	-	-	-	-	-	-	10741	27	1.72%	n	no receptors within 10m
92000027	-	-	-	-	-	-	-	-	-	7522	30	2.03%	n	< 10,000 vpd, not narrow congested, Pm10 background <15ug/m3



## Dundee City Council

Site Number	2005 AADT	2006 AADT	2007 AADT	2008 AADT	2009 AADT	2010 AADT	2011 AADT	2012 AADT	2013 AADT	2014 AADT	2014 Average Speed (mph)	2014 %HDV	Assessment / DMRB Required ?	Reasons
92000028	20334	-	-	-	-	-	-	-	-	17680	27	3.80%	n	no receptors within 10m
92000029	-	-	-	-	-	-	-	-	-	6875	30	4.09%	n	< 10,000 vpd,not narrow congested, Pm10 background <15ug/m3
92000030	-	-	-	-	-	-	-	-	-	5909	30	3.30%	n	< 10,000 vpd,not narrow congested, Pm10 background <15ug/m3
92000031	-	-	-	-	-	-	-	-	-	5687	17	16.86%	n	exceedence area already identified
92000032	-	-	-	-	-	-	-	-	-	6770	29	1.09%	n	< 10,000 vpd,not narrow congested, Pm10 background <15ug/m3
92000033	-	-	-	-	-	-	-	-	-	10285	28	3.31%	y	>10,000 vpd, receptors within 10m

<b>Note</b>	1	2014 AADT marked in yellow should be treated with caution as they have less than full year's data
	2	2014 AADT marked in orange should be treated with caution as faulty loops are suspected
	3	Assessment required - see Section 3.4
	4	Assessment required - see Section 3.4 and Appendix H (DMRB Calculations)

**Appendix G: Monthly Diffusion Tube Concentrations**

Site Id. (DT)	Location	x	y	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Mean	% Data	Period Adj <sup>n</sup> Factor	Annual Mean	Annual Mean bias (0.82)
92	Abertay 2	340019	730612	58.4	55.4	41.6	49.5	50.0	36.1	48.5	36.8	51.7	44.5	62.7	45.3	48.4	100.0	1.0	48.4	39.7
179	Albert St (15) (Facade)	341092	731121	51.8	46.8	36.2	47.4	43.8	48.2	43.7	37.6	48.5	39.4	55.3	35.7	44.5	100.0	1.0	44.5	36.5
180	Albert St (15) (Rdside)	341091	731121	54.9	42.4	37.3	50.8	50.6	45.6	47.3	39.7	48.3	41.3	58.3	40.2	46.4	100.0	1.0	46.4	38.0
187	Albert St (81)	341113	731265	49.5	43.3	35.3	29.9	36.1	31.8	37.8	28.3	38.9	36.7	51.0	36.7	37.9	100.0	1.0	37.9	31.1
167	Albert St (191)	341161	731535	48.9	40.4	42.6	45.3	47.6	37.9	40.3	33.2	45.6	40.5	61.1	28.7	42.7	100.0	1.0	42.7	35.0
5	Arbroath Rd (13)	341111	731070	47.9	54.1	42.5	39.4	42.3	38.5	41.9	19.4	45.0	49.6	56.4	45.3	43.5	100.0	1.0	43.5	35.7
168	Arbroath Rd (27)	341223	731089	48.1	40.1	37.1	42.0	35.9	33.7	37.1	30.0	40.9	37.6	52.6	-	39.6	91.7	1.0	39.6	32.4
147	Arbroath Rd (38)	341202	731097	46.5	43.1	36.1	42.8	40.1	33.5	36.0	35.8	45.1	39.8	50.8	51.8	41.8	100.0	1.0	41.8	34.3
7	Balgavies Place	343082	731465	25.0	23.6	19.0	16.3	13.2	9.9	12.3	13.4	16.2	21.4	28.7	28.1	18.9	100.0	1.0	18.9	15.5
9	Birnam Place	337531	730914	19.3	12.8	10.1	11.2	8.3	7.1	8.7	7.7	10.7	11.1	20.7	13.1	11.7	100.0	1.0	11.7	9.6
164	Broughty Ferry Rd - Lower	343545	730942	23.2	24.9	23.7	14.3	8.6	-	12.3	-	14.3	18.4	21.2	21.4	18.2	83.3	1.0	18.2	14.9
140	Broughty Ferry Rd (L/P 66)	343297	731096	39.4	39.3	38.9	33.5	33.1	29.9	33.7	32.3	37.6	37.0	46.0	46.4	37.3	100.0	1.0	37.3	30.6
139	Broughty Ferry Rd (141 Downpipe)	343317	731072	36.3	44.7	40.7	35.1	33.4	29.0	30.9	33.2	36.7	35.7	45.2	54.3	37.9	100.0	1.0	37.9	31.1
11	Broughty Ferry Rd (141)	343322	731073	42.6	42.3	49.5	45.1	39.6	41.5	43.0	39.8	46.0	40.7	49.3	54.9	44.5	100.0	1.0	44.5	36.5
142	Broughty Ferry Rd (141) (St.Sign)	343302	731075	41.7	33.4	39.2	33.6	-	28.6	-	34.1	34.5	30.7	45.8	38.4	36.0	83.3	1.0	36.0	29.5
166	Broughty Ferry Rd LP 59(2)	343129	731081	29.5	30.8	37.5	34.1	25.0	19.8	22.2	22.9	27.5	24.4	40.5	36.5	29.2	100.0	1.0	29.2	24.0
145	Broughty Ferry Rd (Greendykes)	342662	731112	40.5	49.5	44.3	40.1	40.7	33.5	37.4	34.4	42.4	42.9	50.4	46.4	41.9	100.0	1.0	41.9	34.3
155	Carolina Court LP6	342353	731058	35.7	32.8	24.7	19.5	18.0	-	16.6	18.8	20.0	18.5	29.8	25.3	23.6	91.7	1.0	23.6	19.4
186	Carolina Court 30 mph sign	342342	731083	38.6	36.0	31.3	30.6	26.7	21.6	23.5	24.7	29.6	26.3	40.9	36.0	30.5	100.0	1.0	30.5	25.0
13	Cleington Rd/ Forfar Rd	341385	732121	44.7	42.9	39.6	41.5	36.2	31.7	35.1	36.3	43.8	41.7	48.3	50.2	41.0	100.0	1.0	41.0	33.6
188	Commercial St (9)	340544	730291	49.1	45.6	50.1	53.6	49.9	43.5	48.6	42.9	51.0	39.0	56.9	45.7	48.0	100.0	1.0	48.0	39.4
84	Commercial St/Dock St (40)	340565	730263	46.8	42.6	45.1	39.8	41.2	37.9	44.9	46.3	46.1	40.2	46.9	47.0	43.7	100.0	1.0	43.7	35.9
175	Coupar Angus Rd (38)	337414	732164	50.9	38.8	30.9	35.1	32.2	29.8	30.5	-	34.7	33.7	52.0	31.7	36.4	91.7	1.0	36.4	29.8
192	Dock St (12)	340389	730079	38.5	30.1	31.7	32.2	27.7	24.7	27.3	28.4	32.0	28.9	45.0	-	31.5	91.7	1.0	31.5	25.8

Dundee City Council

Site Id. (DT)	Location	x	y	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Mean	% Data	Period Adj' Factor	Annual Mean	Annual Mean bias (0.82)
85	Dock St (21)	340524	730216	50.0	46.6	42.1	47.1	46.1	-	-	-	42.3	44.4	48.5	52.2	46.6	75.0	1.0	46.6	38.2
156	Dock St (57)	340656	730343	61.0	68.1	58.7	54.3	57.4	-	56.9	60.7	64.6	58.6	63.5	89.7	63.0	91.7	1.0	63.0	51.7
20	Dura St (100)	341150	731576	44.9	45.3	39.4	35.9	39.7	39.6	40.7	38.9	47.2	38.5	49.9	44.0	42.0	100.0	1.0	42.0	34.4
22	Eastport Roundabout	340651	730623	44.1	42.2	39.6	40.1	36.5	30.6	38.6	35.7	38.6	40.4	46.7	47.9	40.1	100.0	1.0	40.1	32.9
83	Forfar Rd (104)	341437	732360	59.0	57.9	54.3	54.2	47.8	42.8	50.5	53.9	58.0	53.7	63.2	59.8	54.6	100.0	1.0	54.6	44.8
193	Horsewater Wynd	339549	730252	38.5	27.7	25.2	30.6	29.0	25.7	26.1	19.4	-	24.8	-	20.1	26.7	83.3	1.0	26.7	21.9
26	Kingsway East Roundabout	343107	731740	55.5	53.6	42.5	43.7	44.7	37.4	48.4	35.2	47.2	49.8	53.7	56.0	47.3	100.0	1.0	47.3	38.8
27	Kingsway/ Mains Loan	341124	732468	43.8	34.4	36.3	41.9	38.9	45.2	39.2	37.9	48.9	35.0	-	27.8	39.0	91.7	1.0	39.0	32.0
177	Kingsway / Strathmartine Rd (279)	339179	732896	62.4	51.5	38.9	38.0	39.2	35.3	42.3	33.2	41.0	49.3	52.6	55.5	44.9	100.0	1.0	44.9	36.8
30	Lochee Rd (138)	338936	730680	70.4	61.6	48.0	56.9	56.2	50.0	57.7	54.4	65.1	60.2	74.7	70.4	60.5	100.0	1.0	60.5	49.6
31	Lochee Rd (140) Traffic Lts	338927	730685	63.7	68.1	56.1	47.2	57.2	55.2	60.7	55.9	67.8	57.8	79.2	78.6	62.3	100.0	1.0	62.3	51.1
32	Lochee Rd (184)	338767	730856	53.8	51.8	40.2	33.9	32.2	28.2	38.5	34.9	41.2	41.5	49.8	56.8	41.9	100.0	1.0	41.9	34.4
	Lochee Rd (Romon 1)	338861	730773	59.7	57.3	48.5	45.8	47.7	39.4	48.2	49.3	55.9	51.6	63.5	65.1	52.7	100.0	1.0	52.7	43.2
	Lochee Rd (Romon 2)	338861	730773	58.7	52.4	51.7	46.6	45.6	42.8	46.7	46.0	54.8	54.3	68.2	62.3	52.5	100.0	1.0	52.5	43.1
	Lochee Rd (Romon 3)	338861	730773	54.3	58.6	50.2	48.7	44.9	43.5	46.1	48.5	56.1	46.1	64.2	68.7	52.5	100.0	1.0	52.5	43.0
158	Lochee Rd (Romon) Average	338861	730773	57.6	56.1	50.1	47.0	46.1	41.9	47.0	47.9	55.6	50.7	65.3	65.4	52.6	100.0	1.0	52.6	43.1
36	Lochee Rd/Polepark Rd	339016	730586	50.0	38.4	29.5	33.6	29.5	22.8	29.4	27.7	33.2	33.2	51.7	44.2	35.3	100.0	1.0	35.3	28.9
37	Logie St (114)	338184	731293	77.3	74.2	54.3	52.7	59.8	59.4	59.2	55.6	63.4	55.2	72.5	73.1	63.1	100.0	1.0	63.1	51.7
38	Logie St (98)	338252	731258	-	45.1	40.3	38.6	28.5	28.9	33.2	37.1	40.8	42.0	54.3	55.4	40.4	91.7	1.0	40.4	33.1
39	Loons Rd (1)	338211	731293	56.0	45.7	44.4	52.4	46.7	42.7	40.6	40.0	49.7	45.7	62.9	45.7	47.7	100.0	1.0	47.7	39.1
182	Meadowside (28)	340298	730550	46.4	44.8	45.8	42.5	37.0	29.9	37.7	34.1	42.6	44.3	49.5	53.1	42.3	100.0	1.0	42.3	34.7
	Meadowside (Romon 1)	340243	730653	59.1	59.1	58.4	57.4	52.3	45.5	48.7	46.4	54.5	53.8	55.5	52.9	53.6	100.0	1.0	53.6	44.0
	Meadowside (Romon 2)	340243	730653	57.1	59.4	59.5	54.6	52.6	45.0	51.6	41.7	53.2	52.1	66.6	49.6	53.6	100.0	1.0	53.6	43.9
	Meadowside (Romon 3)	340243	730653	56.1	59.6	55.9	56.2	52.0	43.0	48.9	44.2	54.2	48.5	56.5	57.0	52.7	100.0	1.0	52.7	43.2
149	Meadowside (Romon) Average	340243	730653	57.4	59.4	57.9	56.1	52.3	44.5	49.7	44.1	54.0	51.5	59.5	53.2	53.3	100.0	1.0	53.3	43.7

Dundee City Council

Site Id. (DT)	Location	x	y	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Mean	% Data	Period Adj' Factor	Annual Mean	Annual Mean bias (0.82)
42	Muirton Rd (6)	338152	731293	51.9	39.1	30.0	35.8	32.5	32.4	34.3	25.7	35.1	29.9	53.8	26.2	35.6	100.0	1.0	35.6	29.2
185	Murraygate (46)	340409	730484	35.9	35.2	31.4	33.8	24.8	20.7	25.5	21.3	27.3	26.8	39.5	26.9	29.1	100.0	1.0	29.1	23.9
189	Myrekirk Rd (29)	335420	731726	40.1	41.4	35.8	34.6	33.0	32.2	-	-	38.8	37.1	45.8	47.9	38.7	83.3	1.0	38.7	31.7
181	Myrekirk Terrace (8)	335458	731767	35.2	35.1	36.7	32.2	31.0	26.4	30.2	34.1	30.6	32.9	34.9	45.0	33.7	100.0	1.0	33.7	27.6
45	Nethergate (6)	340274	730171	52.3	57.6	51.3	47.6	46.3	38.9	51.5	42.4	50.6	47.7	58.3	47.0	49.3	100.0	1.0	49.3	40.4
47	Nethergate (40)	340230	730124	62.4	50.3	52.2	58.2	53.5	50.2	54.3	44.4	51.7	45.1	61.0	42.9	52.2	100.0	1.0	52.2	42.8
44	Nethergate (88)	340163	730061	67.5	60.4	65.9	65.0	65.3	63.4	63.6	50.9	62.8	54.3	71.3	54.3	62.1	100.0	1.0	62.1	50.9
48	Nethergate(132) / Marketgait	340074	729984	41.6	38.2	39.9	32.2	32.7	31.0	31.0	34.6	40.0	33.7	43.7	30.8	35.8	100.0	1.0	35.8	29.3
46	Nethergate (95)	340033	729957	41.0	40.8	40.4	38.0	38.4	31.1	33.3	36.2	44.6	38.5	46.9	41.4	39.2	100.0	1.0	39.2	32.2
91	Perth Rd (320)	338776	729798	51.2	44.6	40.5	43.4	37.4	33.5	37.9	38.9	46.5	39.4	53.0	47.2	42.8	100.0	1.0	42.8	35.1
49	Rankine St (2)	338768	730900	52.7	48.9	44.8	42.0	39.1	33.6	39.4	40.5	46.4	46.1	57.8	66.6	46.5	100.0	1.0	46.5	38.1
54	Seagate (9)	340467	730388	46.7	45.2	42.3	46.7	44.2	38.2	43.9	41.0	45.6	39.7	51.1	42.6	43.9	100.0	1.0	43.9	36.0
190	Seagate (97)	340516	730499	54.7	65.3	53.0	54.4	58.0	53.7	62.6	52.0	56.1	49.8	62.9	57.4	56.7	100.0	1.0	56.7	46.5
50	Seagate (101)	340545	730532	52.7	56.1	48.6	50.3	49.9	41.6	-	33.1	46.0	52.0	64.1	53.4	49.8	91.7	1.0	49.8	40.8
	Seagate(Romon 1)	340487	730446	54.4	60.4	57.3	61.7	54.8	53.2	58.5	50.8	54.7	51.2	56.6	52.5	55.5	100.0	1.0	55.5	45.5
	Seagate(Romon 2)	340487	730446	54.5	59.2	57.5	62.8	59.3	52.8	55.1	50.1	54.2	46.4	58.3	55.4	55.5	100.0	1.0	55.5	45.5
	Seagate(Romon 3)	340487	730446	55.5	57.8	55.5	60.4	58.6	51.2	59.0	50.1	55.1	42.2	58.6	60.2	55.4	100.0	1.0	55.4	45.4
159	Seagate(Romon) Average	340487	730446	54.8	59.1	56.8	61.6	57.6	52.4	57.5	50.3	54.7	46.6	57.8	56.0	55.4	100.0	1.0	55.4	45.5
55	Soapwork Lane	340099	730650	48.7	40.4	40.3	38.4	34.5	32.5	34.4	30.2	40.5	36.1	-	51.3	38.8	91.7	1.0	38.8	31.9
151	South Rd (1 Denbank)	335188	731528	45.2	42.1	36.6	39.7	36.8	33.0	40.8	35.3	36.2	38.6	51.6	49.5	40.5	100.0	1.0	40.5	33.2
162	St Andrews St PB (façade)	340532	730548	46.0	47.2	39.9	45.0	45.8	35.0	44.2	37.1	44.5	43.0	54.1	48.9	44.2	100.0	1.0	44.2	36.3
56	St Andrews St (26)	340516	730584	50.6	43.5	41.2	50.8	42.4	35.4	39.8	32.7	40.8	42.0	53.5	43.5	43.0	100.0	1.0	43.0	35.3
59	Strathmore Avenue (353)	339609	731871	56.9	39.5	34.3	45.8	40.4	41.0	51.6	43.7	55.0	39.7	71.9	48.6	47.4	100.0	1.0	47.4	38.8
60	Trades Lane (31)	340575	730500	30.7	36.5	38.1	36.3	29.4	26.4	29.2	30.7	33.4	23.9	40.0	45.3	33.3	100.0	1.0	33.3	27.3
	Union St (Rollalong 1)	340235	730091	43.7	48.4	38.0	35.3	35.7	27.6	36.5	36.8	37.9	40.6	45.0	48.5	39.5	100.0	1.0	39.5	32.4

## Dundee City Council

Site Id. (DT)	Location	x	y	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Mean	% Data	Period Adj' Factor	Annual Mean	Annual Mean bias (0.82)
	Union St (Rollalong 2)	340235	730091	42.1	46.7	39.8	36.2	31.6	26.7	35.5	34.8	40.1	39.5	49.5	52.5	39.6	100.0	1.0	39.6	32.5
	Union St (Rollalong 3)	340235	730091	43.0	43.9	37.7	38.2	30.2	26.9	34.9	35.8	37.7	39.6	45.0	43.2	38.0	100.0	1.0	38.0	31.2
61	Union St (Rollalong) Average	340235	730091	42.9	46.3	38.5	36.6	32.5	27.1	35.6	35.8	38.6	39.9	46.5	48.1	39.0	100.0	1.0	39.0	32.0
191	Victoria Rd (4) - India Buildings	340213	730633	50.4	42.5	38.0	42.7	34.4	31.3	30.1	26.4	38.2	32.9	58.5	39.5	38.7	100.0	1.0	38.7	31.8
93	Victoria Rd (10b)	340230	730673	38.5	35.2	35.3	41.1	39.7	30.4	32.8	28.3	40.1	34.5	51.0	40.8	37.3	100.0	1.0	37.3	30.6
70	Victoria Rd/Hilltown	340274	730714	62.3	76.8	63.2	60.5	57.6	49.2	60.9	58.3	59.0	62.5	65.9	77.1	62.8	100.0	1.0	62.8	51.5
68	Victoria Rd (60)	340375	730779	50.7	50.7	36.2	44.9	46.1	42.9	45.1	39.3	48.6	42.2	53.8	48.6	45.8	100.0	1.0	45.8	37.5
184	Victoria Rd (104) / William St	340697	730950	42.2	40.2	35.2	40.2	39.0	32.9	33.7	29.0	40.0	-	49.7	30.0	37.5	91.7	1.0	37.5	30.7
71	Victoria St/Albert St	341071	731072	41.9	34.0	33.4	39.5	38.3	31.1	32.3	32.5	40.4	32.5	48.4	34.9	36.6	100.0	1.0	36.6	30.0
72	Westport (2)	339842	730122	48.5	53.1	53.7	43.6	42.1	27.9	37.9	34.6	38.2	45.5	51.2	55.6	44.3	100.0	1.0	44.3	36.3
183	West Marketgait / Guthrie St	339805	730338	65.2	53.2	-	47.3	52.7	43.3	53.0	54.5	55.1	58.1	68.9	66.7	56.2	91.7	1.0	56.2	46.1
73	Whitehall Cr (4)	340376	730109	48.4	44.8	40.1	44.5	38.2	35.8	42.3	39.7	43.3	43.5	57.5	53.8	44.3	100.0	1.0	44.3	36.3
161	Whitehall Cr /Union St (50)	340305	730051	-	36.7	36.6	39.7	37.2	30.2	35.7	32.8	36.1	32.6	51.6	39.7	37.2	91.7	1.0	37.2	30.5
74	Whitehall St (40)	340330	730106	52.3	46.7	45.7	54.1	48.1	42.3	42.8	48.8	46.5	45.9	60.1	44.2	48.1	100.0	1.0	48.1	39.5
81	Whitehall St (12)	340293	730142	56.6	44.5	49.1	59.0	56.2	49.4	53.6	45.9	47.5	41.8	52.2	40.8	49.7	100.0	1.0	49.7	40.8
76	Whitehall St (1)	340265	730153	53.6	63.2	55.9	61.0	57.8	51.5	62.0	49.0	59.1	53.6	-	49.1	56.0	91.7	1.0	56.0	45.9
75	Whitehall St (5)	340289	730128	55.5	63.2	55.4	50.5	50.3	45.7	56.1	51.8	53.5	51.1	58.2	54.4	53.8	100.0	1.0	53.8	44.1
77	Whitehall St (15)	340322	730098	46.4	46.1	41.4	45.8	39.2	34.3	41.9	43.2	45.4	42.0	52.3	51.0	44.1	100.0	1.0	44.1	36.1
	Whitehall St (Romon 1)	340278	730156	54.6	50.8	52.3	58.0	56.5	48.4	53.5	47.1	50.2	44.7	58.0	46.8	51.7	100.0	1.0	51.7	42.4
	Whitehall St (Romon 2)	340278	730156	49.6	48.9	53.7	57.9	52.9	50.7	55.1	45.7	53.9	41.1	53.8	44.0	50.6	100.0	1.0	50.6	41.5
	Whitehall St (Romon 3)	340278	730156	67.4	49.7	53.8	54.3	55.3	50.7	54.3	48.0	51.9	45.4	45.8	46.2	51.9	100.0	1.0	51.9	42.6
160	Whitehall St (Romon) Average	340278	730156	57.2	49.8	53.3	56.7	54.9	49.9	54.3	46.9	52.0	43.7	52.5	45.7	51.4	100.0	1.0	51.4	42.2
82	Woodside Ave	340776	732307	27.8	20.1	16.0	16.4	14.2	10.2	12.5	12.6	17.6	20.2	30.8	19.0	18.1	100.0	1.0	18.1	14.9

Note: Locations in green shading were new in 2014

Appendix H: DMRB Calculations

Input Data

Location	Coordinates of Background Grid Squares (1km x 1km)		Background Concentrations			
	x	y	Year	NO <sub>x</sub>	NO <sub>2</sub>	PM <sub>10</sub>
A	342500	732500	2014	26.7	17.8	12.9
B	339500	730500	2014	26.6	17.9	12.7

DMRB Inputs

Location	Link Number	Distance from link to road centre (m)	AADT (combined, veh/day)	Annual Average Speed (km/h)	Road Type (A,B,C,D)	Total % LDV (<3.5t GVW)	Total % HDV (>3.5t GVW)
A	1	11.05	10285	45.06	B	96.7	3.3
B	1	11.13	22805	46.4	B	95.4	4.6

DMRB Results

RECEPTOR (x,y denote the DCC corporate address point)					Description	Year	Rd NO <sub>x</sub> (1)	Verification Factor	Adj Rd NO <sub>x</sub> (2)	Background NO <sub>x</sub>	Adj Total NO <sub>x</sub> (3)	Total NO <sub>2</sub> (4)	PM <sub>10</sub> Annual Mean (µg/m <sup>3</sup> )	PM <sub>10</sub> No. of Days >50
Location	X	Y	UPRN	Name										
A	342952	732612	9059013368	56 Happyhillock Road	urban free flow	2014	6.3	1.8741	11.8	26.7	38.5	23.7	13.61	0
B	339803	730336		W.Marketgait/Old Mill	urban free flow	2014	12.1	1.8741	22.7	26.2	49.3	28.95	14	0

Notes:

<sup>1</sup> Rd NO<sub>x</sub> = Road NO<sub>x</sub> direct from DMRB local output sheet (following Box 1 from DMRB guidance note provided at <http://laqm.defra.gov.uk/laqm-fags/>)

<sup>2</sup> Adj Rd NO<sub>x</sub> = Rd NO<sub>x</sub> x verification factor

<sup>3</sup> Adj Total NO<sub>x</sub> = Adj Rd NO<sub>x</sub> + Background NO<sub>x</sub>

<sup>4</sup> Total NO<sub>2</sub> = from NO<sub>x</sub> to NO<sub>2</sub> calculator (available at LAQM Support website)

Background Figures taken from the Scottish Government Background Maps (Jun 2014), road sector contributions were not removed from these concentrations based on advice given by LAQM helpdesk. Figures in Orange cells were derived from the NO<sub>x</sub> to NO<sub>2</sub> calculator v4.1

Verification

DMRB Verification Results

Verification Sites					Background			2014		DMRB Road NO <sub>x</sub>	Total NO <sub>2</sub>	Road NO <sub>2</sub>	Canyon ?	In canyon Total NO <sub>2</sub>	Verification Factor	Verification factored		
Site ID (DT)	Site type	Description	x	y	NO <sub>x</sub>	NO <sub>2</sub>	PM <sub>10</sub>	NO <sub>2</sub> tube conc (bias-corrected)	NO <sub>2</sub> tube Road NO <sub>x</sub>							Road NO <sub>x</sub>	Total Adj NO <sub>2</sub>	Road adj NO <sub>2</sub>
184	R	urban free flow	340697	730950	33.3	21.8	13.7	30.7	18.45	15.2	29.2	7.4	n	n/a	1.8741	28.49	35.18	13.38
92	R	urban free flow	340019	730612	33.3	21.8	13.7	39.7	39.2	10	26.73	4.93	n	n/a	1.8741	18.74	30.83	9.03
27	R	urban free flow	341124	732468	24.4	16.6	13.1	32	32.22	16.4	24.77	8.17	n	n/a	1.8741	30.74	31.35	14.75
186	R	urban free flow	342342	731083	24.3	16.5	12.5	25	17.08	12.4	22.75	6.25	n	n/a	1.8741	23.24	27.88	11.38

**Notes:** Background Figures taken from the Scottish Government Background Maps (June 2014), road sector contributions were not removed from these concentrations based on advice given by LAQM helpdesk. Figures in Orange cells were derived from the NO<sub>x</sub> to NO<sub>2</sub> calculator v4.1

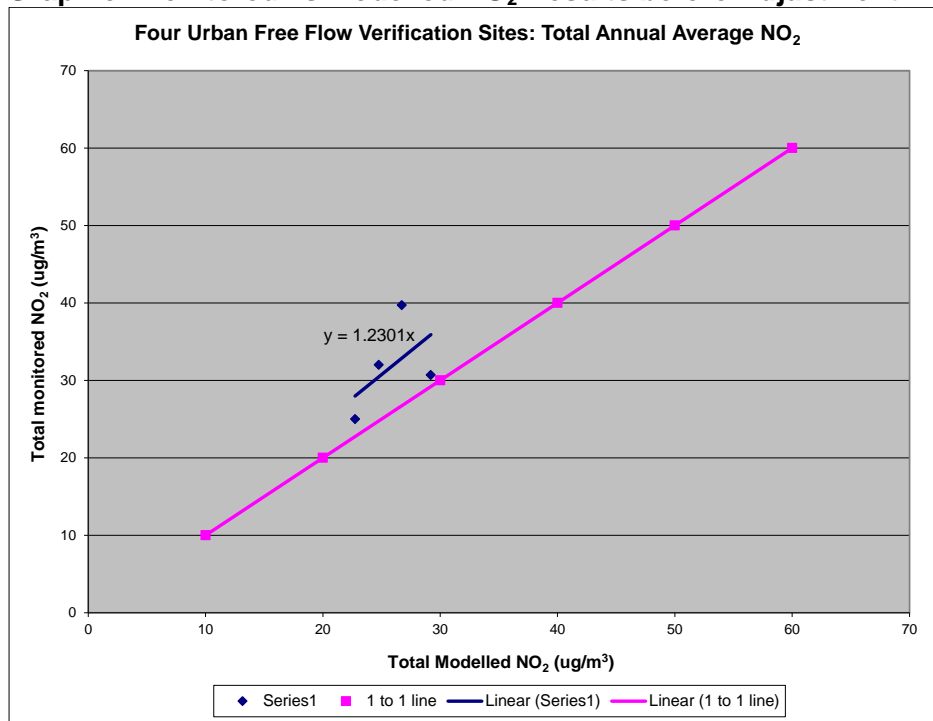
Summary of Modelled vs Monitoring NO<sub>2</sub> Results before Adjustment

Summary	Number
within +10%	0
within -10%	2
<b>Within +-10%</b>	2
within +10% to 25%	0
within -10% to 25%	0
<b>Within +-10% to 25%</b>	0
over +25%	0
under -25%	2
<b>Greater +-25%</b>	2
<b>Within +-25%</b>	2

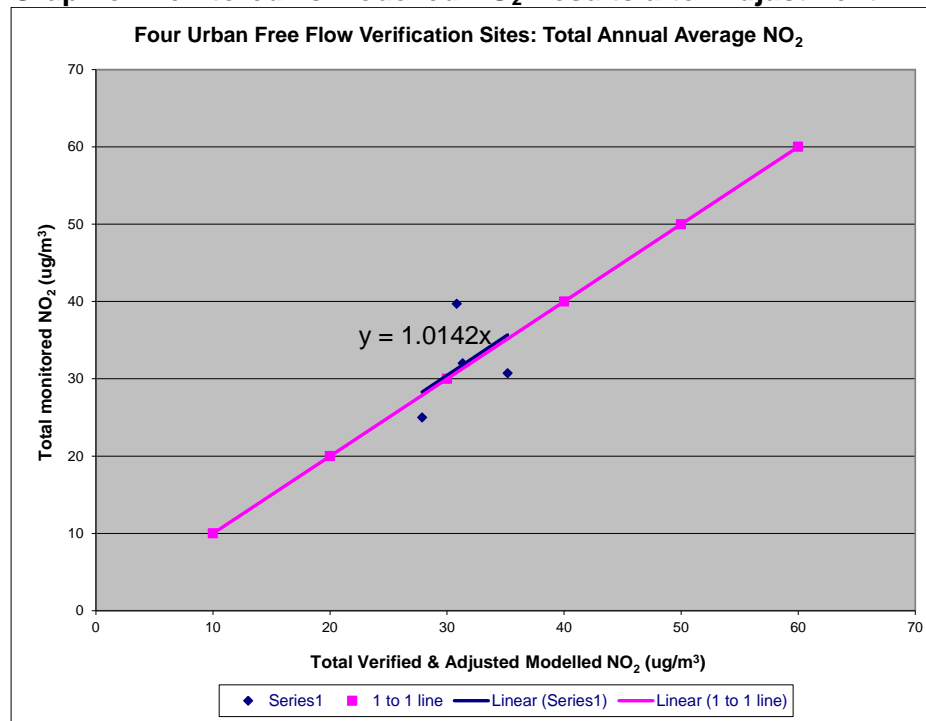
Summary of Modelled vs Monitoring NO<sub>2</sub> Results after Adjustment

Summary	Number
within +10%	0
within -10%	1
<b>Within +-10%</b>	1
within +10% to 25%	2
within -10% to 25%	0
<b>Within +-10% to 25%</b>	2
over +25%	0
under -25%	1
<b>Greater +-25%</b>	1
<b>Within +-25%</b>	3

Graph of Monitored vs Modelled NO<sub>2</sub> Results before Adjustment



Graph of Monitored vs Modelled NO<sub>2</sub> Results after Adjustment





Appendix I: Trends in NO<sub>2</sub> Concentrations at PDT Sites with 5 or more year's data

Site Id.	Location	Annual mean NO <sub>2</sub> conc (µg/m <sup>3</sup> ) adjusted for bias									Trend	
		2006	2007	2008	2009	2010	2011	2012	2013	2014		
DT 73	Whitehall Cr (4)	27.2	30.3	30.6	30.4	29.5	26.1	37.6	39.4	36.3		↑ 1.22
DT 44	Nethergate (88)	40.0	43.1	49.1	48.6	48.1	44.8	50.2	48.4	50.9		↑ 0.96
DT 160	Whitehall St (Romon) Average	33.2	38.5	42.7	38.9	36.5	36.0	41.6	43.1	42.2		↑ 0.74
DT 47	Nethergate (40)	34.5	39.6	44.6	41.8	38.9	38.1	42.5	45.0	42.8		↑ 0.69
DT 74	Whitehall St (40)	32.2	36.3	37.8	35.8	35.5	33.1	39.7	39.7	39.5		↑ 0.67
DT 76	Whitehall St (1)	38.5	43.4	50.3	46.9	42.5	41.4	47.3	49.9	45.9		↑ 0.63
DT 49	Rankine St (2)	31.7	39.9	42.6	44.9	45.5	40.5	44.4	40.1	38.1		↑ 0.43
DT 45	Nethergate (6)	35.8	37.4	43.2	41.9	38.7	38.0	42.3	41.7	40.4		↑ 0.43
DT 85	Dock St (21)	36.3	37.8	37.5	38.2	38.3	34.2	40.8	42.6	38.2		↑ 0.41
DT 81	Whitehall St (12)	34.8	38.8	42.6	40.2	37.1	35.8	39.6	41.8	40.8		↑ 0.37
DT 77	Whitehall St (15)	32.2	36.9	39.6	38.3	37.1	34.7	37.9	40.7	36.1		⇒ 0.33
DT 37	Logie St (114)	46.9	52.2	58.2	57.0	56.9	53.7	54.6	54.8	51.7		⇒ 0.27
DT 83	Forfar Rd (104)	40.2	45.7	50.2	52.6	49.1	45.6	50.2	45.9	44.8		⇒ 0.20
DT 31	Lochee Rd (140) Traffic Lts	45.3	53.4	57.0	57.2	57.4	51.9	54.8	52.8	51.1		⇒ 0.19
DT 26	Kingsway East Roundabout	33.9	40.0	42.6	44.9	40.7	40.7	40.3	39.5	38.8		⇒ 0.15
DT 42	Muirton Rd (6)	26.1	28.4	29.2	30.4	30.4	26.5	27.2	30.0	29.2		⇒ 0.15
DT 38	Logie St (98)	32.7	35.2	34.5	35.0	33.4	31.9	34.5	37.5	33.1		⇒ 0.09
DT 27	Kingsway/ Mains Loan	29.9	34.1	37.8	35.1	36.7	31.3	34.4	36.4	32.0		⇒ 0.08
DT 159	Seagate(Romon) Average	42.3	47.5	50.8	51.4	48.9	45.0	49.2	48.0	45.5		⇒ 0.08
DT 39	Loons Rd (1)	36.1	39.1	45.3	43.9	44.8	38.4	42.0	40.3	39.1		⇒ 0.06
DT 56	St Andrews St (26)	32.7	34.8	40.4	36.9	36.7	33.5	36.2	36.4	35.3		⇒ 0.05
DT 70	Victoria Rd / Hilltown	47.8	55.8	60.9	59.5	57.9	52.8	57.9	56.1	51.5		⇒ 0.05
DT 59	Strathmore Avenue (353)	35.0	38.0	42.6	40.3	39.9	35.5	38.8	38.0	38.8		⇒ 0.05
DT 55	Soapwork Lane	29.6	35.0	35.8	36.9	35.4	32.8	34.8	34.7	31.9		⇒ 0.03

Continued...

Site Id.	Location	Annual mean NO <sub>2</sub> conc (µg/m <sup>3</sup> ) adjusted for bias									Trend	
		2006	2007	2008	2009	2010	2011	2012	2013	2014		
DT 30	Lochee Rd (138)	45.5	52.6	57.4	56.9	56.9	52.7	53.4	51.2	49.6		⇒0.00
DT 84	Commercial St/Dock St (40)	35.6	38.6	41.9	42.2	41.3	37.6	41.2	40.1	35.9		⇒-0.01
DT 72	Westport (2)	33.6	38.9	41.3	42.1	37.5	37.0	37.7	39.0	36.3		⇒-0.01
DT 36	Lochee Rd / Polepark Rd	26.8	30.9	32.3	33.9	33.4	29.0	31.8	29.6	28.9		⇒-0.02
DT 22	Eastport Roundabout	30.5	35.5	35.9	35.2	34.4	33.1	32.0	35.2	32.9		⇒-0.02
DT 32	Lochee Rd (184)	31.9	38.1	39.1	40.2	39.7	36.9	37.6	36.1	34.4		⇒-0.04
DT 68	Victoria Rd (60)	35.2	41.1	43.8	44.0	40.8	38.6	42.2	39.8	37.5		⇒-0.05
DT 11	Broughty Ferry Rd (141)	35.6	40.4	45.3	46.9	44.2	42.5	44.2	39.9	36.5		⇒-0.07
DT 7	Balgavies Place	15.3	17.6	18.9	18.6	19.1	17.1	18.0	17.0	15.5		⇒-0.07
DT 9	Birnam Place	9.6	10.8	11.7	11.0	11.4	9.6	10.4	10.1	9.6		⇒-0.10
DT 75	Whitehall St (5)	42.8	48.6	51.7	48.6	43.4	45.7	49.5	46.7	44.1		⇒-0.13
DT 13	Clepington Rd/ Forfar Rd	33.5	36.8	38.5	40.7	39.8	34.7	38.0	36.4	33.6		⇒-0.13
DT 158	Lochee Rd (Romon) Average	39.2	49.2	51.4	51.2	50.4	47.2	48.7	44.4	43.1		⇒-0.13
DT 54	Seagate (9)	35.1	40.5	38.3	41.5	39.4	35.6	38.4	38.1	36.0		⇒-0.16
DT 50	Seagate (101)	39.0	42.3	45.9	44.9	42.3	40.2	39.4	41.9	40.8		⇒-0.19
DT 5	Arbroath Rd (13)	37.4	38.0	40.2	45.4	40.8	36.6	39.9	38.3	35.7		⇒-0.26
DT 71	Victoria St/Albert St	31.7	34.1	35.2	36.5	35.2	33.8	34.8	32.2	30.0		⇒-0.27
DT 20	Dura St (100)	34.0	39.4	41.6	43.0	41.1	36.4	39.6	36.9	34.4		⇒-0.27
DT 82	Woodside Ave	15.6	18.1	18.5	17.7	17.5	15.4	16.2	15.4	14.9		⇒-0.30
DT 48	Nethergate(132) / Marketgait	29.8	36.0	35.2	35.4	33.9	30.2	33.5	32.5	29.3		⇒-0.35
DT 60	Trades Lane (31)	29.2	36.3	33.3	32.8	32.6	29.4	30.4	31.4	27.3		⇒-0.52
DT 46	Nethergate (95)	34.8	39.1	38.4	38.2	37.5	32.5	35.9	34.3	32.2		⇒-0.59
DT 92	Abertay 2				47.2	42.5	40.1	41.5	40.2	39.7		⇒-1.24
DT 93	Victoria Rd (10b)				38.5	37.5	33.8	36.2	34.0	30.6		⇒-1.36
DT 61	Union St (Rollalong) Average	39.1	43.4	44.7	45.3	40.7	36.2	34.6	34.8	32.0		⇒-1.39

**Appendix J: Action Plan Progress Report**

**KEY TO TABLE**

**Potential Air Quality Benefits**

Small 0 - 0.5 µg/m<sup>3</sup>  
 Medium 0.5 - 1.0 µg/m<sup>3</sup>  
 High greater than 1.0 µg/m<sup>3</sup>  
 n/a not applicable

Action Plan Measure Priority Level	
High	
Medium	
Low	

Timescale (Years from 2011)	
Short	1 - 2
Medium	3 - 5
Long	6 +

2014 Updates are shown in blue text

Summary from Action Plan							Progress Report January to December 2013				
TRAFFIC MEASURES											
No.	Measure	Focus	Lead Authority	Planning Phase	Implementation Phase	Targets/ Indicators	Target Annual Emission Reduction in the AQMA	Progress to Date	Progress in Last 12 Months	Estimated Completion Date	Comments relating to emission reductions
1	Measure M1: Existing Road Infrastructure Improvements	► City Centre Improvements - Union St	DCC City Development Department (Transportation Division)			Implementation of improvements	High	Union Street Road Infrastructure improvements completed December 2011. Two way traffic was maintained. Pavement widths were altered and the bus stops have been removed to reduce congestion and bus idling.		Union Street Road infrastructure improvements completed 2011	The levels of NO <sub>2</sub> at Union St have shown a consistent improving downwards trend to well below the objective level since 2010.
		► NW Arterial Route Improvement - Lochee Rd					Not estimated	Alterations carried out at Lochee Road/Rankine Street in February 2012 removed central reservation to free up road space and reduce congestion		Completed 2012	NO <sub>2</sub> concentrations reduced in 2014 to below those recorded in 2006 when the AQMA was first declared.

## Dundee City Council

No.	Measure	Focus	Lead Authority	Planning Phase	Implementation Phase	Targets/ Indicators	Target Annual Emission Reduction in the AQMA	Progress to Date	Progress in Last 12 Months	Estimated Completion Date	Comments relating to emission reductions
1 cont		<ul style="list-style-type: none"> <li>▣ ► City Centre Improvements - Meadowside</li> </ul>		1 year trial of closing of nearside lane to increase distance between traffic and receptors successful. Seeking funding in 2015/16 to make temporary surface permanent.	2013 +		Not estimated	Meadowside - trial of lane closure at the north end of street to increase separation distance between traffic and receptors (26/11/12 lane closure for 2 weeks) results were inconclusive, Installation of nearside lane closure using temporary paving completed in October 2013. Trial period of 1 year to allow impact on monitored concentrations to be studied.	The scheme is complete in terms of the new streetscape is implemented on Meadowside, to await AQ assessments, looking at making permanent if AQ improvement proven	2015/16	The greatest improvement in annual mean pollutant concentrations between 2013 and 2014 was seen at the Meadowside automatic monitor. (Nitrogen dioxide concentrations, reduced by 19% and 11% for PM10.)
1 cont		<ul style="list-style-type: none"> <li>► Arterial Route Improvements - Stannergate</li> </ul>		Traffic/Pollution Modelling Dundee East area (including Stannergate roundabout) to identify options for AQ improvement	2013		Not estimated	Consultants engaged in 2013 to carry out traffic micro-simulation modelling and air dispersion modelling.	Stannergate approaches being assessed through wide area traffic modelling.	2014	Modelling work on-going.
1 cont		<ul style="list-style-type: none"> <li>▣ ► City Centre Improvements – Seagate / St. Andrews Street.</li> </ul>		Funding provided in Financial Year 14/15 to provide engineering design and air dispersion modelling of changes to bus stop locations	2014/15		Not estimated	Transportation Division are developing traffic management options for Seagate and surrounding street	Seagate options report commissioned due to report back April 2015	2015/16	

## Dundee City Council

No.	Measure	Focus	Lead Authority	Planning Phase	Implementation Phase	Targets/ Indicators	Target Annual Emission Reduction in the AQMA	Progress to Date	Progress in Last 12 Months	Estimated Completion Date	Comments relating to emission reductions
2	<b>Measure M2:</b> DCC will enhance the Urban Traffic Management and Control (UTMC) system to reduce congestion	► Real-time traffic monitoring. ► Improved control regime to smooth out peak traffic.	DCC City Development Department (Transportation Division)	Implementation of UTMC improvements and carry out annual review to measure % reduction in congestion in line with target		► 10% reduction in congestion (journey times) in targeted areas during peak times before and after implementation of measure. ► Annual review of impact	Small	Scheme designed to expand UTMC to two congested junctions in Lochee Rd AQ hotspots.  Schemes now implemented and the traffic management improvements will be assessed in terms of AQ improvements by Environmental Protection Division. ► UTMC was implemented in March 2013 which will see further traffic management enhancements. ► Seagate / Commercial Street traffic light refurbishment to improve bus and traffic flows through this AQ hotspot on the main bus corridor completed Feb 2013. Coupled with increased enforcement of waiting restrictions to reduce congestion. ► Successful trial of Bluetooth journey time monitoring of western arterial route, possibility of expansion to include AQ hotspots.	Schemes now implemented and the traffic management improvements will be assessed in terms of AQ improvements by Environment Service. UTMC now implemented by which will see further traffic management enhancements.	Completed 2013	NO <sub>2</sub> concentrations in Seagate reduced slightly between 2013 and 2014
2 cont				TACTRAN Capital Grant funding for expanded automation of journey time monitoring to allow activation of traffic management systems to alleviate congestion.	2013	Not estimated	Funding provided in FY 14/15 to expand Bluetooth Traffic Speed Monitoring System to include the Lochee Road corridor a known air pollution hotspot.  DCC and Transport Scotland are currently procuring combined system- looking to implement early 2014	Expansion of Bluetooth Traffic Speed Monitoring System including the Lochee Road corridor will be completed by 31 <sup>st</sup> March 2015	2015	n/a	
				Improve traffic flow/ management strategies in Lochee Rd- introduce MOTES	2013	Not estimated	MOTES now unlikely to be deployed as they appear to have limited effect. Expansion of Bluetooth traffic speed monitoring to include the Lochee Road corridor being pursued	Expansion of Bluetooth Traffic Speed Monitoring System including the Lochee Road corridor will be completed by 31st March 2015	2015	n/a	
	Paramic/AIRE modelling of key junctions – Kingsway/Forfar Road & Lochee Road Corridor to test option improvements	2013	Not estimated	Consultants engaged in 2013 to carry out traffic micro-simulation modelling and air dispersion modelling.	Modelling work on-going expected to be completed in 2015	2015	Modelling work on-going				

No.	Measure	Focus	Lead Authority	Planning Phase	Implementation Phase	Targets/ Indicators	Target Annual Emission Reduction in the AQMA	Progress to Date	Progress in Last 12 Months	Estimated Completion Date	Comments relating to emission reductions
3	<p><b>Measure M3:</b> DCC to identify partnership and funding to continue benefits of Smarter Choices/Smarter Places: Dundee Travel Active Programme</p>	<ul style="list-style-type: none"> <li>► Identify and implement wider partnership to continue programme.</li> <li>► Identify funding.</li> </ul>	DCC City Development Department (Transportation Division)			<ul style="list-style-type: none"> <li>► Increase % of people who walk and cycle to work in Dundee.</li> <li>► Identify funding for education</li> </ul>	Small	<ul style="list-style-type: none"> <li>► Social Marketing Campaign undertaken - focussing on the Lochee Road corridor (Reported in AQAP Progress Report 2012, Appendix 1).</li> <li>► DCC initiated partnership with a local social enterprise to develop a Behavioural Change Centre of Excellence.</li> <li>► Designed a programme of in-class workshops to promote sustainable and active travel in 11 primary schools.</li> <li>► Established a new Bike Boost programme to promote cycling to work and other journeys.</li> <li>► DCC is actively working to secure funds for future investment in Dundee Travel Active.</li> </ul> <p>2012 summary - Broughty Ferry targeted for Personalised Travel Planning delivered by Social Enterprise Positive Steps.</p> <ul style="list-style-type: none"> <li>► DCC staff travel policy now being implemented and this will further encourage modal shift to active modes.</li> <li>► Investigated a school based travel behaviour change programme for 2013.</li> <li>► 19.7% of people estimated to be walking or cycling to work in Dundee. The data is published by the Scottish Government every two years. The 19.7% data is taken from the Scottish Household Surveys undertaken in 2009 and 2010. The target in the City Development Service Plan 2012-2017 is 25%.</li> </ul> <p>Summary 2013 ► Broughty Ferry has had Personalised Travel Planning delivered by Social Enterprise Positive Steps. 41% of trips to work by Active Travel (walking and cycling) in 2012. This figure is taken from Scottish households survey (SHS) undertaken in 2012 and relates to a very small sample size (92 people).</p>	<p>Sustrans Funding used to help deliver improved cycling and walking connectivity. A limited level of SCSP funding has been used to improve signage around the Green circular. Doctor Bike has visited Dundee City Square several times offering bike maintenance workshops.</p>	2012+ on-going	<p>A reduction in transport / unnecessary journeys however this may be difficult to measure.</p>

## Dundee City Council

No.	Measure	Focus	Lead Authority	Planning Phase	Implementation Phase	Targets/ Indicators	Target Annual Emission Reduction in the AQMA	Progress to Date	Progress in Last 12 Months	Estimated Completion Date	Comments relating to emission reductions
				Behavioural Change Primary School programme to promote sustainable travel options in all primary schools in Dundee. Funding provided in FY 2014/15 to extend programme to P5 pupils over two academic years Funding sought in FY for 2015/16.	2013+			Primary school focussed Personalised Travel Planning contract awarded and all P5 pupils in Dundee to be given classroom sessions on Air Quality, Sustainable Travel, Active Travel benefits March – October 2013.  Feedback from these sessions has been very positive.	Classroom sessions on Air Quality, Sustainable Travel, Active Travel benefits have been delivered at all primary schools during summer term 2014 with JMP consultants returning to all primary schools during autumn academic session to complete programme with all new P5 pupils in all the schools by the end of November 2014.	Ongoing	
3 cont.				3 "Doctor Bike" Safety Events planned for the City Square  Funding to provide match funding for "I Bike" initiative sought in FY for 2015/16	2013/14  2015/16			Doctor Bike has visited Dundee City Square several times offering bike maintenance workshops	Doctor Bike has visited Dundee City Square several times offering bike maintenance workshops		
4	Measure M4: DCC will introduce measures to improve bus services and reduce emissions	<ul style="list-style-type: none"> <li>†</li> <li>▶ Statutory Bus Quality Partnership.</li> <li>†</li> <li>▶ Voluntary Bus Quality Partnership</li> </ul>	DCC City Development Department (Transportation Division)		2011+	<ul style="list-style-type: none"> <li>▶ Identification of new corridors that directly benefit air quality.</li> </ul>	Medium	Opportunities investigated as part of Air Quality Low Emission Charter	Awaiting publication of Scottish Low Emission Strategy.	Medium Term	
						<ul style="list-style-type: none"> <li>▶ Average age fleet and Euro category, fuel type</li> </ul>				2012+	



No.	Measure	Focus	Lead Authority	Planning Phase	Implementation Phase	Targets/ Indicators	Target Annual Emission Reduction in the AQMA	Progress to Date	Progress in Last 12 Months	Estimated Completion Date	Comments relating to emission reductions
4 cont .	Measure M4, cont.	† ► Fleet Renewal – Emissions Improvements	DCC City Development Department (Transportation Division)		2011+	► Fleet age, Euro class, fuel type	Medium	<p>► National Express Dundee introduced 15 new Euro V buses during December 2011 for use on Services 22 (Ninewells Hospital - City Centre-Downfield-Craigowl View) and 28/29 (Douglas-Charleston-Douglas via City Centre). ► During 2010/11 Stagecoach invested in 20 new Euro V double-deckers on its major Service 73 corridor (Ninewells-City Centre-Broughty Ferry-Carnoustie-Arbroath) and Service 20 (Dundee-Forfar). ► 4 new Euro V coaches also have also been introduced in new route (Dundee-Arbroath-Montrose-Aberdeen)</p> <p>2012 summary -► No bids submitted for Green Bus fund 3 ► DCC looking at Hydrogen Fuel cell opportunities for buses in a collaborative approach through the Scottish Cities Alliance. ► National Express Dundee applied to Scottish Government's Green Bus Fund 2 and invest in hybrid engine technology. ► Stagecoach invested in 6 new Euro V buses on their Dundee to Blairgowrie route (Service 57)</p> <p>2013 Summary - Through the Scottish Cities Alliance (SCA) investigations into potential for Hydrogen fuel alternatives are being developed with major EU funding opportunity hopefully being available 2014 - 2020. SCA and ten Cities are engaged with EU proposal in terms of Scotland's suitability for Hydrogen Fuel cell bus expansion.</p>	<p>In Dundee, National Express has been operating Diesel Electric Hybrid buses since 2013 and these have been operationally very successful in terms of the 'green' message and attracting users. National Express are also looking to modernise the smaller midi bus sized vehicles in their fleet. Stagecoach will introduce 15 Diesel Electric buses in Spring 2015 to Service 73 corridor Electric Vehicle operation and charging infrastructure expansion has put Dundee to the forefront of this technology. Dundee alongside the Scottish Cities Alliance is exploring Hydrogen Fuel cells as alternative fuel technology for buses, through EU funded Hydrogen Fuel cell Joint Undertaking. Stagecoach have announced that approximately 18 new Diesel Electric buses will replace existing Euro 5 buses in Spring 2015 and new Euro 6 diesel vehicles will replace Euro 5 vehicles later this year also. These major bus industry investments will have a positive impact on air quality in Dundee.</p>	2013+	Older buses displaced with new cleaner emission versions
						► Lobby Scottish Government for fuel duty rebates for low carbon fleet		<p>Bus Service Operators Grant (BSOG) changes from April 2012 will reward use of cleaner fuels and incentivise the use of cleaner vehicles.</p> <p>Current enhanced BSOG available for operation of Diesel Electric Hybrid buses. Further investigate enhanced BSOG where Hydrogen Fuel Cell vehicles are introduced.</p>	No Change		

## Dundee City Council

No.	Measure	Focus	Lead Authority	Planning Phase	Implementation Phase	Targets/ Indicators	Target Annual Emission Reduction in the AQMA	Progress to Date	Progress in Last 12 Months	Estimated Completion Date	Comments relating to emission reductions
				National Express Dundee will introduce nine Diesel Electric Hybrid buses into their fleet in April / May 2013 as per Green Bus Fund 2 bid success	2013			In 2013 High profile launch event for the nine Hybrid Buses introduced by National Express Dundee – coupled with promotional work with local schools	Completed	2013	New cleaner emission vehicles are now successfully in operation
				ECO Stars Dundee Fleet Management Recognition Scheme being introduced	2013/14			See Measure 6 – National Express Dundee one of the 12 inaugural members	Stagecoach joined the scheme in 2014		
4 cont.	Measure M4, cont.	► Tackling Idling Bus Emissions	DCC City Development Department (Transportation Division)		2011+	► Traffic Regulation Conditions within the city centre. ► 'No-idling' signage on bus routes. ► Driver Training/ Awareness Raising	Small	► Opportunities being investigated as part of Air Quality Low Emission Charter (Reported in AQAP 2012, Appendix 2). ► National Express Dundee and Stagecoach have invested in in-vehicle monitoring systems and vehicles with auto-shutoff technology	Awaiting publication of Scottish Low Emission Strategy	2012+	
4 cont.	Measure M4, cont.	□ ► Low Emission Zones (LEZ) for buses	DCC City Development Department (Transportation Division)		2013	► Investigate the Traffic Regulation Conditions for LEZ in City Centre. ► Route choice for clean buses see Park & Ride facilities	High	Opportunities being investigated as part of Air Quality Low Emission Charter. (Reported in AQAP 2012, Appendix 2)  see Measure 5 re Park and Ride Facilities)	Awaiting publication of Scottish Low Emission Strategy	Med Term, 2015-2016+	
				Bus Emission Modelling being undertaken to test likely improvements associated with various scenarios including possible LEZ for buses by 2017	2013/14			Model of main City Centre Bus Corridor set up to model the impact of the following low emission Scenarios: S1 – 2017 All Buses Euro V S2 – 2017 All Buses Euro VI S3 – 2017 All Buses & HGVs Euro V S4 – 2017 All Buses & HGVs Euro VI	Modelling Report now expected to be completed in 2015	2014	

No.	Measure	Focus	Lead Authority	Planning Phase	Implementation Phase	Targets/ Indicators	Target Annual Emission Reduction in the AQMA	Progress to Date	Progress in Last 12 Months	Estimated Completion Date	Comments relating to emission reductions
5	<b>Measure M5:</b> DCC will explore provision of Park and Ride facilities that do not have adverse impact on air quality	▶† Provision of Park and Ride (P&R) facilities	DCC City Development Department (Transportation Division) & Tayside and Central Scotland Transport Partnership (TACTRAN)			<ul style="list-style-type: none"> <li>▶ Report on identification and prioritisation of P&amp;R facilities</li> <li>▶ Implementation of scheme</li> <li>▶ Passenger numbers</li> </ul>	Medium	<p>Site at Wright Avenue selected as preferred location for P&amp;R at Dundee West and at site on south side of Tay Road Bridge identified for Dundee South and confirmed by NE Local Plan reporter.</p> <p>▶ Both sites taken forward with detailed design. Dundee West underwent pre - planning application consultation and detailed planning consent applied for in mid 2013.</p> <p>Dundee West site at Wright Avenue rejected by Development Management Committee In October 2013. This will require TACTRAN and DCC to review Dundee area Park and Ride strategy.</p>	TACTRAN and DCC to review Dundee area Park and Ride strategy. Also to engage with Transport Scotland as there are national transport policy implications in terms of Park and Ride around Scotland's cities It is not anticipated that Dundee West Park and Ride option will be revisited in the timeframe of this monitoring framework. Wider strategy around city under review with TACTRAN, SESTRAN, Fife Council and Transport Scotland DCC, Fife Council, TACTRAN and SESTRAN actively investigating funding opportunities to secure land purchase at Dundee South (Tay Road Bridge) landfill.	+	
6	<b>Measure M6:</b> DCC will introduce measures to reduce emissions from Heavy Goods Vehicles	† ▶ Perth & Dundee Retail Freight Consolidation Centre	DCC City Development Department Transportation Division) & TACTRAN		2011+	<ul style="list-style-type: none"> <li>▶ Implementation of scheme</li> <li>▶ Vehicle fleet in the AQMA</li> <li>▶ Study for the alternate system of retail freight</li> </ul>	Small	<p>Opportunities being investigated as part of Air Quality Low Emission Charter (See AQAP2012 Appendix 2)</p> <p>LaMILO (Last Mile Logistics) projects to deliver exploratory social enterprise model freight consolidation based on successful Dutch model. ENCLOSE project developed and looking at Sustainable Urban Logistics Plan for Dundee (SULP)</p>	Dundee City Council is working with the Heavy Duty Vehicle operators to reduce environmental impact of these vehicles. An accreditation scheme - ECO STARS is operating that recognises green fleets. DCC are also partners in an EU funded project ENCLOSE that is looking to make City Logistics more efficient and environmentally friendly. The Dundee Sustainable Urban Logistics Plan was approved by the City Development Committee on 27.10.14	2012+	
6 cont.	<b>Measure M6 cont.</b>	□ ▶ Freight Quality Partnership (FQP)	DCC City Development Department Transportation Division) & TACTRAN			<ul style="list-style-type: none"> <li>▶ Implementation of partnership</li> <li>▶ Changes in hourly profile of HGVs in AQMA</li> </ul>	Small	<p>Dundee is included as part of Tactran's Regional FQP</p>	Ongoing	Long term	

## Dundee City Council

No.	Measure	Focus	Lead Authority	Planning Phase	Implementation Phase	Targets/ Indicators	Target Annual Emission Reduction in the AQMA	Progress to Date	Progress in Last 12 Months	Estimated Completion Date	Comments relating to emission reductions
6 cont .				A freight routing planning tool will be launched by TACTRAN which should encourage HGVs to follow appropriate routes	Jan-13			The Tacfran Freight Planning Tool was established in 2013			
				Dundee is participating in a pan European project (ENCLOSE) investigating city logistics with carbon and emission reduction as important factors under investigation	2013			Sustainable Urban Logistics Plan (SULP) developed to give legacy post ENCLOSE project in terms of energy efficient and 'green' city logistics	The Dundee Sustainable Urban Logistics Plan was approved by the City Development Committee on 27.10.14		
6 cont .				ECO Stars Dundee Fleet Management Recognition Scheme being introduced Seeking funding in 2015/16 to continue scheme	2013			Dundee ECO Stars Fleet Recognition Scheme was successfully launched on the 13th December 2013 with 12 inaugural members. This is a fleet accreditation system that acknowledges greener fleets. The Corporate Air Quality Steering Group intends to seek funding for future years.	Dundee ECO Stars Recognition Scheme for commercial vehicles now has 44 members	Ongoing	A number of participating members are now demonstrating working towards operating greener fleets.
				Seeking match funding for feasibility study for ULEV/ZEV deliveries in 2015/16 FY							

No.	Measure	Focus	Lead Authority	Planning Phase	Implementation Phase	Targets/ Indicators	Target Annual Emission Reduction in the AQMA	Progress to Date	Progress in Last 12 Months	Estimated Completion Date	Comments relating to emission reductions
7	<p><b>Measure M7:</b> DCC will seek improvements in emissions standards, including NO<sub>2</sub> and PM<sub>10</sub> for the council fleet and public service vehicles</p>	<p>Development of Green Procurement Strategy                      ▶ To set target for Euro category/fuel type</p>	<p>▶ DCC Corporate Fleet Manager                      ▶ DCC Environment Department</p>			<p>▶ Approval of Strategy (Asset Management Plan)                      ▶ Average age fleet and Euro category, fuel type</p>	Small	<p>▶ New Corporate Fleet Manager appointed December 2011 ▶ New Fleet Section to develop a reporting procedure to compare replacement vehicles in relation to emission improvements ▶ New Fleet Section will create a replacement plan for all vehicles to maintain fleet age profile ▶ 2011 make up of the waste collection fleet - 12 x Euro 3, 17 x Euro 4 and 23 x Euro 5. Fleet is continually moving towards newest Euro Category</p> <p>▶ The Fleet section replaced 60 vehicles 2012/13 all with improved emissions standards</p> <p>The Fleet Section has bought in over 50 new vehicles in 2013 replacing the oldest and most polluting vehicles where possible. And have also undertaken an exercise with hire company to replace over 30 of the oldest hire vehicles in the fleet. ▶ 2 new Euro 6 engine Refuse Collection vehicles have been ordered to join the fleet in 2014.</p> <p>There are also 39 electric vehicles in the Council Fleet contributing to lower emissions.</p> <p>DCC Transportation delivering in partnership with Developing Car Clubs in Scotland and Co-Wheels seven additional car club vehicles all of which are Electric Vehicles</p> <p>▶ See also Measure 14</p>	<p>Following the introduction of 7 Euro 6 refuse collection vehicles in 2014. The Fleet are looking to introduce another 5 in 2015. A further 7 electric cars have been added to the Fleet towards the end of 2014 with a further cars and 1 van on order. The Fleet Section have also been offered a government grant to lease a number of vehicles, the leasing is currently out to tender but it is hoped to lease a further 7 vehicles.</p>	2014+	Older vehicles displaced with new cleaner emission versions
				<p>The development of an Asset Management Plan which will incorporate environmental issues as part of the replacement criteria</p>	2013/14	<p>A draft asset management plan has been created providing details of the ongoing replacement plan. Due to financial restrictions and vehicle variations the replacement programme will be done on a cost and condition basis. The emphasis of the plan will remain however the oldest and most polluting vehicles</p>					

No.	Measure	Focus	Lead Authority	Planning Phase	Implementation Phase	Targets/ Indicators	Target Annual Emission Reduction in the AQMA	Progress to Date	Progress in Last 12 Months	Estimated Completion Date	Comments relating to emission reductions
				Initial discussions for 2013/14 vehicle/plant replacement programme has identified improved emissions as a high priority	2013/14			Replaced over 30 of the oldest hire vehicles in the fleet. .	See Measure 7		An equivalent number of poorer quality emission vehicles have now been removed from service.
				Participation in ECO Stars Dundee-Fleet Management Recognition Scheme	2013			DCC Fleet Achieved 4-Star Rating in ECO Stars Recognition Scheme as recognition for reducing the environmental impact of the Council's Fleet.	No Change	Ongoing	
8	Measure M8: DCC in consultation with the Taxi Liaison Group will explore means of reducing emissions from taxis and private car hire vehicles in AQMA	<ul style="list-style-type: none"> <li>▶ Enforce No idling for taxis</li> <li>▶ † Increase cleaner taxis</li> </ul>	<ul style="list-style-type: none"> <li>▶ DCC Support Services</li> <li>▶ DCC City Development Department</li> <li>▶ Tayside Police</li> </ul>			<ul style="list-style-type: none"> <li>▶ Traffic Regulation Conditions for 'No Idling' of taxis</li> <li>▶ Explore the potential of introducing Licensing Conditions for minimum taxi Euro category for certain classes of vehicles</li> <li>▶ Provide 'No Idling' street signage</li> <li>▶ Monitoring for idling in place</li> </ul>	Medium	<ul style="list-style-type: none"> <li>▶ Opportunities are being investigated as part of Air Quality Low Emission Charter (See AQAP 2012 Appendix 2).</li> <li>▶ Education Transport contracts to be let with condition that all vehicles must be Euro 4 compliant.</li> <li>▶ Approximately 400 Taxi / PHC driver training sessions were made available in FY 2013/14 -limited uptake alternative training options being considered</li> </ul>	<p>As part of Air Quality Low Emission Charter, opportunities are being investigated for: Traffic Regulation Conditions for 'No Idling' of taxis; Explore the potential of introducing Licensing Conditions for minimum taxi Euro category for certain classes of vehicles; Provide 'No Idling' street signage; Monitoring for idling. Education Transport contracts were let with condition that all vehicles must be Euro 4 compliant. Engaging with taxi operators who are actively investigating electrification of taxi fleet - one operator has indicated desire to convert diesel fleet to all electric (100+ vehicles), currently DCC working with partners to support this major proposal. ECO Stars fleet recognition scheme for Taxis to be launched on the 11<sup>th</sup> March 2015. DCC also looking at collaborative work with taxi operators in developing an Electric Vehicle trial for taxis in Dundee. Dundee will bid into Office of Low Emission Vehicles projects for low emission taxi funding (competitive process later in 2015)</p>	Ongoing+	Objective to remove poor emission vehicles from service
				As part of Air Quality Low Emission Charter, continue to investigate opportunities for: Traffic Regulation Conditions for 'No Idling' of taxis;	2013/2014+				Ongoing		

## Dundee City Council

No.	Measure	Focus	Lead Authority	Planning Phase	Implementation Phase	Targets/ Indicators	Target Annual Emission Reduction in the AQMA	Progress to Date	Progress in Last 12 Months	Estimated Completion Date	Comments relating to emission reductions
				Explore the potential of introducing Licensing Conditions for minimum taxi Euro category for certain classes of vehicles;				Assuming successful implementation of the proposed ECOSTARS scheme for Taxi Operators, the Council will consider making achievement of a certain minimum star rating a pre-requisite for Council Contracted work.	No Update		
				Provide 'No Idling' street signage; Monitoring for idling.				No progress	Funding to be sought in 2015/16		
8 cont .				DCC also looking at collaborative work with taxi operators in developing an Electric Vehicle trial for taxis in Dundee				Looking at City Wide rapid charger network to support individuals use, where they can't easily home charge and this will support a taxi fleet of EVs (over and above their home / depot charging infrastructure). Up to seven rapid chargers would be located in neighbourhoods city wide	Ongoing		
				Expansion of ECOSTARS to include taxi / private hire operators	2014/15			ECO Stars expanded to include taxi operators in 2014/15. Seeking funding in 2015/16 to continue scheme	Scheme documentation is in place and TTR consultants are actively recruiting inaugural members. The scheme will be launched on the 11 <sup>th</sup> March 2015		
9	Measure M9: DCC will investigate to initiate a Roadside Emission Testing (RET) scheme inside the AQMA and routes leading to AQMA	<ul style="list-style-type: none"> <li>▣ ► To investigate into the establishment of a programme of RET in the AQMA</li> </ul>	<ul style="list-style-type: none"> <li>► VOSA</li> <li>► Tayside Police</li> <li>► DCC Environment Department.</li> </ul>			<ul style="list-style-type: none"> <li>► Approval/non -approval of RET scheme</li> <li>► Traffic Regulation Conditions if necessary.</li> </ul>	Small		Project on hold till funding identified	tbc	
				To seek funding to undertake feasibility study of introduction of RET	2015/16+						

No.	Measure	Focus	Lead Authority	Planning Phase	Implementation Phase	Targets/ Indicators	Target Annual Emission Reduction in the AQMA	Progress to Date	Progress in Last 12 Months	Estimated Completion Date	Comments relating to emission reductions
<b>POLICY AND PARTNERSHIP WORKING MEASURES</b>											
10	<p><b>Measure M10:</b> DCC will ensure local air quality is fully integrated into the Local Development Plan (LDP) process and development scenarios are appropriately assessed with respect to the potential impacts on air quality</p>	<ul style="list-style-type: none"> <li>▶ Provide AQ policy within Local Development Plan with commitment to improve air quality</li> <li>▶ Produce air quality Supplementary Planning Guidance (SPG)</li> </ul>	<ul style="list-style-type: none"> <li>▶ DCC City Development (Planning Division)</li> <li>▶ DCC Environment Department.</li> </ul>			<ul style="list-style-type: none"> <li>▶ Adoption of Local Development Plan</li> <li>▶ Adoption of Air Quality SPG</li> </ul>	Small	<ul style="list-style-type: none"> <li>▶ Main Issues Report Consultation exercise completed 2/12/2011. Proposed Plan by late autumn 2012.</li> <li>▶ Method of integrating AQ into SPG considered. ▶ Air Quality Policy incorporated into draft LDP. Air Quality Supplementary Planning Guidance approved as part of a package of SPGs for adoption of the Local Development Plan.</li> </ul>	<p>Supplementary Guidance is scheduled to be approved at Committee in February 2015.</p>	2015 +	



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11	<b>Measure M11:</b> DCC will ensure effective co-ordination between climate change and air quality strategies and action plan measures	<input type="checkbox"/> ► Strategy to be developed to improve co-ordination between climate change and air quality strategies and action plan measures	► DCC Corporate Planning Department ► DCC City Development - (Property Division) ► DCC Environment Department.		2011+	► Implementation of co-ordination strategy ► Reciprocal attendance of air quality and climate change working groups/steering committees	Small	Procedure implemented for exchange of information between the Climate Change Board & Corporate Air Quality Steering Group.	All matters (e.g. Action Plan updates) that the Climate Change Board & Corporate Air Quality Steering Group require attention in general, will be dealt with by the Director of Environment and / or the Strategic Management Team. In addition an update on Air Quality progress was presented to the Climate Change Board in December 2014.	2014+	
12	<b>Measure M12:</b> DCC will continue its active involvement and support of TACTRAN	<input type="checkbox"/> ► Regularly attend meetings ► Provide feedback ► Provide necessary support	► DCC City Development Department. (Transport Division)			► Number of TACTRAN policies and proposals implemented	n/a	DCC continue to support TACTRAN and focus on implementation of Regional Transport Strategy	Ongoing.	On-going	

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<b>LEADING BY EXAMPLE MEASURES</b>											
13	<p><b>Measure M13:</b> ► DCC will promote the uptake and use of cleaner and/or alternative fuels where possible for transport ► DCC will explore the development of electric charging point infrastructure</p>	<p>□ ► Determine strategy/advise note and annually review content ► Install Electric Charging Facilities in Car Parks</p>	DCC City Development Department (Transportation Division)			<p>► List of any promotion campaigns planned / implemented ► Number / proportion of cleaner vehicles within fleets or clean fuels infrastructure in each financial year ► Number of electric charging points installed</p>	Small	<p>► See also Measures 7 and 14 ► ► Electric vehicle charging station infrastructure for council vehicles has been implemented with Electric Charging points installed in underground car park (below City Square). ► Pool EVs now available for city centre DCC staff and expanded across several DCC Multi Storey Car Parks and out of city centre DCC offices. ► Also investigating alternative Low Carbon Vehicle technologies i.e. Hydrogen Fuel cells ► 8 Electric vehicle charging stations installed by DCC (double-headed)</p>	<p>Electric vehicle charging station infrastructure for council vehicles has been implemented with Electric Charging points installed in underground car park (below City Square). Pool EVs now available for city centre DCC staff and further expansion now being implemented across several DCC Multi Storey Car Parks and out of city centre DCC offices. Also investigating alternative Low Carbon Vehicle technologies i.e. Hydrogen Fuel cells Looking at City Wide rapid charger network to support individuals use, where they can't easily home charge and this will support a taxi fleet of EVs (over and above their home / depot charging infrastructure). Up to seven rapid chargers would be located in neighbourhoods city wide, SSE has been asked to assist also.</p>	2012+ on-going	
				See also Measure 7-	2013/14+						
14	<p><b>Measure M14:</b> DCC will establish and implement a rolling programme for replacing older more polluting vehicles with newer cleaner vehicles, which comply with the prevailing EURO standard</p>	<p>□ ► Development of Green Procurement Strategy</p>	► DCC Corporate Fleet Manager		2011+	<p>▣ Number / proportion of new/improved vehicles within fleets in each financial year</p>	Small	<p>► New Corporate Fleet Manager appointed December 2011. ► Procurement of vehicles through Scotland Excel Framework which gives consideration to Green Credentials. 2011 saw the introduction of 6 electric vehicles with a further 6 by end March 2012 ► The Fleet section has replaced 60 vehicles 2012/13 all with improved emissions standards ► See also Measure 7</p> <p>The oldest and some of the most polluting vehicles have been identified and will be replaced with the current Euro 5 engines in the 2013/14 replacement plan. ► 2 new Euro 6 engine refuse collection vehicles ordered and will add to the existing rolling programme of replacing older and more polluting vehicles. ► Over 80 vehicles were replaced in 2013</p>	<p>A draft asset management plan has been created providing details of the ongoing replacement plan. Due to financial restrictions and vehicle variations the replacement programme will be done on a cost and condition basis. The emphasis of the plan will remain however the oldest and most polluting vehicles.</p>	2014+	

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15	<p><b>Measure M15:</b> DCC will improve the Council's vehicle fuel consumption efficiency by better management of fleet activities</p>	<p>† ► Develop fleet management plan to improve fuel efficiency. ► Investigate fleet activities in relation to pollution hotspots e.g. waste management fleet routes</p>	<p>► DCC Corporate Fleet Manager ► DCC Environment Department</p>		2011+	<p>► Implementation of smarter driver programme ► Preparation / Implementation of Fleet management plan ► 10% reduction by 2013 for staff business travel and Corporate Fleet</p>	Small	<p>► New Fleet Section created (2012) ► Environment Department LGV drivers have undertaken SAFED (Safe &amp; Fuel Efficient Driving) as part of their decision driving training and there is a proposal to roll this out across all council drivers. ► New computerised Fleet Management Systems to be introduced will help monitor fuel use across the council. Fuel saving measures being trialled in vehicles including Throttle Intervention Systems and Gear Box Prognostics. Fleet Section are developing reports to help tackle idling issues, which will improve fuel efficiency. 25 of the new small vans are fitted with stop/start technology which will be monitored to ascertain benefits.</p> <p>See Also Measures 7,13,14</p> <p>► 2013 Summary - Fleet Section are working with other departments and telematics company to develop reporting tools to monitor mileage and driving styles. ► Fleet section is beginning to develop action plan for rolling out Routesmart to plan routes for all council vehicles to assist with reducing mileage. ► Fuel cards have been introduced to reduce mileage for RCV's in the east of the city. ►</p>	<p>The Routesmart officers introduced the 1st new route in January 2014 and have an extensive programme to look at all refuse collection routes.</p>	2014+	
				<p>Analysis of the information provided by the telematics system in relation to idling time etc.</p>	2014+			<p>A monthly review is undertaken of the telematics data that includes total mileage, idling time and drivers' behaviour. This data is used to identify any trends and help departments manage their fuel usage</p>			

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16	<b>Measure M16:</b> DCC will promote options for better travel planning amongst Dundee City Council employees	<ul style="list-style-type: none"> <li>▣ ▶ Review DCC Travel Plan</li> <li>▶ † DCC to investigate use of annual survey on how/what modes of transport employees use to travel to work</li> </ul>	DCC City Development (Transportation Division)		2011+	<ul style="list-style-type: none"> <li>▶ Implementation of DCC Travel Plan &amp; review of progress with targets</li> <li>▶ 10% reduction by 2013 in staff business travel</li> <li>▶ % DCC employees walking/cycling to work</li> </ul>	Small	<ul style="list-style-type: none"> <li>▶ Staff Travel Policy adopted Autumn 2011. This includes CO2 usages for lease vehicles</li> <li>▶ DCC senior managers monitor effectiveness of staff travel policy</li> </ul> <p>The staff travel policy is encouraging innovation in terms of pool fleet, public and active travel by DCC officers / management to support staff travel (2012).</p> <p>Sustainable Travel Officer (Fixed Term) unlikely to proceed in the short -term. Alternative mechanisms for All Staff Travel Habit Survey being considered (e.g. Survey Monkey or other short snap survey)</p>	<p>Current resources do not allow for the use of annual staff travel habits survey. Investigating a short snap survey to determine staff travel habits - staff employed through Graduate apprenticeship scheme will allow us to look into achieving a survey in summer 2015.</p>	2015+	
17	<b>Measure M17:</b> DCC will continue to promote and encourage their employees to consider the use of bicycles in their daily duties by providing cycle usage mileage	<ul style="list-style-type: none"> <li>† ▶ Continue to investigate and develop the use of various incentive schemes</li> <li>▶ Develop cycling strategies</li> <li>▶ DCC to investigate use of annual survey on how/what modes of transport employees use to travel to work</li> </ul>	DCC City Development (Transportation Division)		2011+	<ul style="list-style-type: none"> <li>▶ % DCC employees walking/cycling to work</li> <li>▶ Incorporate cycling measures within DCC Travel Plan in line with the new DCC Cycling Strategy to be developed</li> </ul>	Small	<ul style="list-style-type: none"> <li>▶ Get Cycling engaged to deliver cycling initiatives at DCC and other major employers in Dundee.</li> <li>▶ Improved cycling facilities provided at Dundee House (Dundee City Council Headquarters) and other Council properties.</li> <li>▶ Bike Boost and Cycle to Work initiatives delivered over the summer of 2012 to encourage staff to consider cycling.</li> <li>▶ Staff Travel Policy now fully implemented and walking and cycling modes are encouraged for shorter distances.</li> </ul>	No Change	2014+	

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18	<p><b>Measure M18:</b> DCC will assess the Council's energy needs, make recommendations and implement reductions of carbon emissions which result in corresponding reductions of NO<sub>2</sub> and PM<sub>10</sub>.</p>	<p>† ► DCC to implement annual energy reduction action plan</p>	<p>DCC City Development (Property Division)</p>			<p>► 10% reduction by 2013</p>	<p>Small</p>	<p>The Climate Change Board continues to implement the Council's Carbon Management Plan and current energy management projects. However, while there are a number of initiatives that when fully implemented should realise reductions in our CO<sub>2</sub> emission, the current performance is not consistently improving. The agreed procedural arrangements to enable the Council to comply with the new mandatory UK-wide Carbon Reduction Commitment - Energy Efficiency Scheme have been implemented. The Council's reported Total Footprint Emissions for property were 36,506 tonnes of CO<sub>2</sub> (2011/12), 40,308 tonnes (2012/13), 35,485 tonnes of CO<sub>2</sub> (2013/14).</p> <p>Fleet transport baseline figure of 5,976 (i.e. reported 2007 estimate) has seen a 5.7% overall reduction (4,164 in 2013/14).</p>	<p>The Climate Change Board continues to implement the Council's Carbon Management Plan and current energy management projects. The Councils reported CRC emissions from properties are 35,485 tonnes of CO<sub>2</sub> in 2013/14. The figure for 2014/15 will not be available until the end of June 2015.</p> <p>Fleet transport baseline figure of 5,976 (i.e. reported 2007 estimate) has reduced to 3,965 in 2014/15</p>	<p>On-going</p>	
				<p>New annual aspirational reduction target of 5% until 2020</p>	<p>2013+</p>						

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<b>EDUCATION AND COMMUNITY MEASURES</b>											
19	<b>Measure M19:</b> DCC to promote and support localised energy generation that doesn't compromise Air Quality in private households	<ul style="list-style-type: none"> <li>† Determine strategy/advice note and annually review content</li> </ul>	<ul style="list-style-type: none"> <li>▶ DCC Housing Department</li> <li>▶ Solar Cities</li> </ul>		2011+	<ul style="list-style-type: none"> <li>▶ List of any promotion campaigns planned/ implemented</li> </ul>	Small	<p>▶ In 2012 Solar PV – Annual 25,055kg CO2 (nominated installers calculated figures) ▶ Solar thermal – Annual 197 kg CO2 (nominated installers calculated figures)The above figures are all annual savings as not all installation dates have been collected yet to allow calculation of the actual amount saved within the project period. ▶ Participant in Maryfield and Coldside areas CO<sub>2</sub> reduction ▶ Groups pending start date = 59 ▶ Groups working with = 23 ▶ Groups Complete= 2 ▶ Total number of people engaged = 853</p> <p>Summary 2013 City-wide Solar PV review carried out following the Westminster Government's resolution of the Feed In tariff (FIT). 25 DCC locations are FIT compliant. A further 18 additional locations being considered based on energy generation and pay back periods. Financial assessment complete. Report to be brought forward recommending approval to proceed.</p>	PV Scheme business plan is being prepared for 28 Feb 2015	2012+	

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20	Measure M20: DCC will provide the public with relevant air quality information.	<ul style="list-style-type: none"> <li>▶ Investigating the potential for uptake of an air pollution information system, such as Air Alert</li> <li>▶ Improvements to AQ website information</li> <li>▶ Make up to date air quality information available to the public through Councils digital website</li> </ul>	<ul style="list-style-type: none"> <li>▶ DCC Environment Department</li> <li>▶ DCC City Development (Transportation Division)</li> </ul>			<ul style="list-style-type: none"> <li>▶ Investigate funding sources</li> <li>▶ Implement Air Alert or similar service</li> <li>▶ Improved rating of website in peer review</li> <li>▶ Make AQ information available through Council's website</li> <li>▶ Real Time Travel Information</li> </ul>	Small	<p>▶ Funding to improve air quality pages on the Council Website identified. The Scottish Government took forward their "Know &amp; Respond" service linked to the new air quality index in 2012. This allows people with respiratory conditions to be alerted when moderate and high pollution levels are forecast. The Council have provided a link and information about this service on the website. ▶ The existing website achieved a higher rating in the 2012 peer review than the previous year. ▶ Real-time pollutant monitoring concentrations are available from the Scottish Air Quality Website (<a href="http://www.scottishairquality.co.uk">www.scottishairquality.co.uk</a>). The Council have provided a link on the web-site to this service. ▶ No progress on provision of real-time information on pollution levels to assist traffic management through pollution hotspots.</p> <p>In 2013 -the new air quality webpages completed apart from section on Air Quality Planning due to Supplementary Planning Guidance not yet being finalised. Historical data for all monitoring points for 2006 to 2012 available via interactive map while address search function for smoke control areas also available. LAQM reports available for download including 2013 Progress report. Previous air quality pages have been removed. Air quality information was included on new bus route map that was delivered to 75000 residences in Dundee at end of June to start of July 2013. Workshops held at four primary schools in Broughty Ferry in April / May which included discussions on air quality.</p>	<p>The air quality webpages on the DCC website have been updated however the section on Air Quality and Planning is still to be finalised as the Supplementary Planning Guidance is awaiting Committee approval. The DCC AQ pages were ranked at number 7 in the UK for local authority AQ webpages in the 2014 peer review, with top marks of 5 stars awarded for the AQ content available on the DCC website. The Air Quality pages of the DCC website allow the public to view historical data for the 2006 - 2012 periods for all monitoring stations via an interactive map. Data for the 2013 period only became available for inclusion in December 2014 and will be included on the interactive map early in 2015. Graphs can also be created for the monitoring results for the years that monitoring data is available to demonstrate trends at monitoring</p>	2012+	
				<ul style="list-style-type: none"> <li>▶ Complete improvements to AQ website</li> </ul>	2013/15				Almost completed (see above)		
				<ul style="list-style-type: none"> <li>▶ Develop Database to enable DCC staff to better manage large volume of AQ data and make it more readily available to stakeholders</li> </ul>	2013/15			<p>Initial discussions held with IT Department in regards to development of a database for the handling and retrieval of air quality monitoring data.</p>	<p>Development of the AQ database has progressed with the DCC IT Department building a specification for the database for AQ monitoring data. However the proposed period for development of the database in November to December 2014 delayed , due to be undertaken in early 2015.</p>		

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21	<p><b>Measure M21:</b> DCC will continue its work to increase uptake and implementation of School and Workplace Travel Plans, particularly where likely to impact on the AQMA</p>	<p>►DCC to ensure all relevant commercial planning applications have travel plan conditions applied in accordance with current best practice. ► DCC to produce Travel Plan Strategy which: ► Details procedure for tracking &amp; possible requirement for enforcement of planning conditions requiring travel plans. ► Details procedure for Travel Plan Information storage at DCC</p>	<p>►DCC City Development Department, (Planning Division, Transportation Division) ►DCC Education Department</p>			<p>►Develop Business Case for Travel Co-ordinator &amp; identify potential funding streams. ►Number of new travel plans (need to show in terms of walking cycling - % of journeys saved). ►Identify &amp; report on any Air Quality related Travel Plan targets from travel plan strategy and any relevant Travel Planning Team targets. ► Promotion of Travel Plan initiatives e.g. Sustrans' Travel Smart ► Implement &amp; regularly review Travel Plan Strategy</p>	Small	<p>►Work in 2011 focussed on reducing the impacts of school traffic on the Lochee Road hotspots. (See AQAP 2012 Appendix 1) ► Further work to promote sustainable travel in primary schools across Dundee scheduled for 2012. ► Planning applications for significant developments are required to submit travel plans. The submission of travel plans is actively pursued and approved, if appropriate.  ► In 2012 investigated development of city wide programme of pupil involvement (P5 - 7) in travel behaviour change. Education Department also encouraged to refresh all school travel plans  In 2013 Funding secured to commence a city wide programme of pupil involvement (P5 - 7) in travel behaviour change. Education Department agreed that all school travel plans would be reviewed over 13/14. Tender issued 22 November 2013</p>	<p>Contract Awarded and in class sessions commenced March through to September 2014, all P5 pupils in Dundee reached through in class sessions; now delivered and looking to repeat annually  No Update provided re travel plans / travel planning.</p>	2014+	



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22	<b>Measure M22:</b> DCC will continue working in partnerships with TACTRAN and local active travel networks to ensure that walking and cycling initiatives are promoted and supported in Dundee	<ul style="list-style-type: none"> <li>▶ Identify walking &amp; cycling schemes (such as Park &amp; Cycle).</li> <li>▶ Identify walking &amp; cycling promotional opportunities around Dundee City</li> </ul>	DCC City Development (Transportation Division)		2011+	<ul style="list-style-type: none"> <li>▶ Number of walking and/or cycling initiatives in operation.</li> <li>▶ Establish the use of cycle monitoring counts at key points on cycle routes</li> </ul>	Small	<ul style="list-style-type: none"> <li>▶ Get Cycling engaged to undertake promotion of cycling and delivered Bike Boost.</li> <li>▶ Positive Steps implemented Dundee Travel Active Personal Travel Plans in Broughty Ferry</li> <li>▶ Cycle to Work Scheme promoted during august 2012</li> <li>▶ City Engineer currently implementing major cycling scheme at Douglas Terrace</li> </ul> <p>2013 Summary - Transportation Division have secured further funding from Sustrans for FY13/14, which will deliver several off and on road cycle schemes.</p>	<p>Working with City Engineers at Riverside Drive / Seabraes Pedestrian Bridge, including pedestrian crossing improvements on Riverside Drive Sustrans officer embedded in TACTRAN will encourage more focus on Community Based active travel initiatives</p> <p>Works all underway and additional 'Safer Routes to School' funds bid for to implement minor improvements to support active travel to and from school</p>	2014+	
				Preliminary Works to achieve off-road cycle route around the Port of Dundee	2013/14		<p>Permission to commence on Nynas land to undertake preliminary works to achieve off-road route around Port of Dundee</p>	On hold until resolution of land ownership			
				Provide Pedestrian Bridge over the railway at Riverside Drive / Seabraes	2013/14		<p>Transportation Division &amp; City Engineers at Riverside Drive / Seabraes Pedestrian Bridge, including pedestrian crossing improvements on Riverside Drive</p>	As above			

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23	<b>Measure M23:</b> DCC will continue to work with transport providers to support and promote increased uptake of public transport modes	<ul style="list-style-type: none"> <li>□ ► Promote schemes such as the SQUID card including Dundee and surrounding towns.</li> <li>► † Introduce smart and integrated ticketing</li> </ul>	<ul style="list-style-type: none"> <li>► DCC City Development (Transportation Division)</li> </ul>		2011+	<ul style="list-style-type: none"> <li>► % uptake schemes</li> <li>► Passenger numbers</li> </ul>	Small	<p>The development of Smart Card based integrated ticketing (National Entitlement Card) is being undertaken by DCC, National Express and Transport Scotland. .</p> <p>. This matter has the support of the Scottish Cities Alliance with a view to proof of concept for a Scottish roll out. Initial smart ticketing has been successfully deployed by National Express Dundee and Dundee College. DCC commenced discussion with other transport operators in support of the Scottish Cities Alliance priority for smart ticketing - Delivery action Group hosted by DCC 06 December 2013. .</p>	<p>Projects now being implemented nation wide, the new Green Buses and the EcoMobility SHIFT assessment, potential Bus Innovation Fund bid with Angus Council, Tactran and NHS Tayside and additional off peak bus services (funded by DCC) will raise profile and attractiveness of travelling by bus in Dundee. Scottish government review of Dundee rail fares will also attract new and retain existing passengers by making rail travel an attractive and more affordable option</p>	Ongoing	

## Dundee City Council

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				NEC SMART Ticketing to Go Live 2014	2014				Completed	July 2014	
24	<p><b>Measure M24:</b> DCC will continue to work in partnership with other organisations to promote and implement energy efficiency measures in Dundee</p>	<p>► To implement an Annual Action Plan of energy efficiency measures.</p>	<p>► DCC City Development (Property Division)</p>			<p>► Implementation of Annual Energy Efficiency Action Plan. ► Report reductions in energy use</p>	Small	<p>The Climate Change Board re-introduced the Carbon Management Action Plan in 2013</p> <p>Examples of partnership initiatives undertaken by DCC can be viewed in the Council's annual 'Scotland's Climate Change Declaration' Report: <a href="http://www.keepsotlandbeautiful.org/sustainability-climate-change/sustainable-scotland-network/climate-change/scotlands-climate-change-declaration/">http://www.keepsotlandbeautiful.org/sustainability-climate-change/sustainable-scotland-network/climate-change/scotlands-climate-change-declaration/</a></p> <p>Examples include: Dundee Energy Advice Project; European ENCLOSE project (Energy Efficiency in City Logistics Services).</p>	<p>The Climate Change Board's continuous review of the Carbon Management Action Plan has identified a number of revisions required to support the climate change aspirations and to improve work in partnership with other organisations to promote and implement energy efficiency measures.</p>	Ongoing	

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<b>MEASURES SECURING AIR QUALITY BENEFITS THROUGH STATUTORY FUNCTIONS</b>											
25	<p><b>Measure M25:</b> DCC Environment Department will comment upon planning applications to ensure that all relevant air quality issues are highlighted and mitigation measures are considered wherever possible</p>	<p>►The Environment Department (Environmental Protection Division) will continue to work with City Development (Planning Division) as Statutory Consultees</p>	<p>►DCC City Development Department (Planning Division) ► DCC Environment Department</p>			<p>► Total number of planning applications consultations responded to in each calendar year (changed from financial year) ► Percentage of the total planning applications responded to with air quality conditions/ assessments</p>	Small	<p>► Environment Department Officers check weekly planning lists and comment on all applications which may adversely impact on local air quality.</p> <p>► In 2011 19 planning applications responded to. ► 16% had air quality conditions/ assessments (this included smoke control area informatives)</p> <p>: ► 19 planning applications in 2012. ► 38% of the planning applications determined in the calendar year had air quality conditions.</p> <p>► . 31 planning applications were responded to in 2013.</p>	<p>30 planning applications have been responded to in 2014.</p>	n/a	<p>Suggestions on best practice and mitigation measures advised accordingly.</p>
				see Measure 10 regarding the introduction of Supplementary Planning Guidance							

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26	<p><b>Measure M26:</b> DCC will enforce statutory legislation to control smoke, dust, fumes or gas emissions from commercial and domestic premises which are causing a nuisance or are prejudicial to health</p>	<p>☐ ► DCC will continue to monitor and enforce statutory legislation in this area</p>	<p>► DCC Environment Department.</p>			<p>► Number of relevant complaints in each financial year. ► % resolved</p>	<p>Small</p>	<p>► For period in 2010-11 financial year (01/01/11-31/03/11) a total of 15 relevant complaints were investigated of which 93% were resolved. ► For period in 2011-12 financial year (01/04/11 - 31/12/11), a total of 26 relevant complaints were investigated of which 69% had been resolved by 31/12/2011.</p> <p>In 2012, officers investigated 21 relevant complaints, of which 90% were resolved</p> <p>In 2013, officers investigated a total of 10 relevant complaints were investigated of which 90% have been resolved and one complaint is still being investigated.</p>	<p>In 2014, officers investigated a total of 22 relevant complaints of which 90.9% have been resolved and two complaints are still being investigated.</p>	n/a	

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27	<b>Measure M27:</b> DCC will enforce relevant legislation to reduce the burning of commercial and domestic waste	† ► DCC will continue to monitor and enforce legislation in this area	► DCC Environment Department			► Number of relevant complaints ► % resolved	Small	<p>► In 2011 - 1 complaint of the burning of commercial waste was investigated under the Environmental Protection Act 1990 (EPA) Section 33 requirements and was resolved. ► 7 complaints of smoke from commercial bonfires were investigated under EPA Section 79 and Clean Air Act legislation. ► 11 complaints of smoke from the burning of domestic waste (domestic bonfires) were investigated under EPA Section 79 and Clean Air Act legislation in 2011 of which 94% of these complaints had been resolved by 31/12/2011</p> <p>In 2012 Officers dealt with 9 complaints of smoke from commercial bonfires and 17 complaints of smoke from the burning of domestic waste. 92% of these complaints were resolved.</p> <p>In 2013, officers investigated 11 complaints of smoke from commercial bonfires under Environmental Protection and Clean Air legislation. 12 complaints of smoke from the burning of domestic waste (domestic bonfires) were investigated under the same legislation. 96% of these complaints were resolved.</p>	<p>During 2014 officers investigated 9 complaints of smoke from commercial bonfires under Environmental Protection and Clean Air legislation. 13 complaints of smoke from the burning of domestic waste (domestic bonfires) were investigated under the same legislation. 100% of these complaints have been resolved.</p>	n/a	

## Dundee City Council

No.	Measure	Focus	Lead Authority	Planning Phase	Implementation Phase	Targets/ Indicators	Target Annual Emission Reduction in the AQMA	Progress to Date	Progress in Last 12 Months	Estimated Completion Date	Comments relating to emission reductions
28	<b>Measure M28:</b> DCC will promote composting in a bid to reduce pollution from domestic bonfires	► Reintroduce discount/promotion campaign for compost bins	► DCC Environment Department		2011+	► % uptake composting bins	Small	<p>► The Waste Resources Action Programme (WRAP) subsidised discount compost bins ended due to funding cuts in March 2011 with a total of 5243 discounted bins being sold in the DCC area in the period between 2006 and end 2010 representing 2% of the total discounted bins for Scotland. The promotion of home composting continues under the Zero Waste Scotland campaign banner with a Recycling Projects Officer employed in the Environment Department. ► Composting is undertaken at the Environment Department's green waste processing facility at Riverside Drive. 37,526 brown bins for garden waste have been issued.</p> <p>In 2013 - The area Zero Waste Scotland Volunteer Co-Ordinator helped to promote the home composting message across Dundee. DCC staff continue to utilise educational talks etc. to reaffirm the message.</p> <p>A total of 48 composting bins (and associated accessories) have been purchased through the home composting framework scheme during 2013</p>	<p>The Council continue to promote both the separate collection of garden waste for municipal composting operations, as well as home composting as a means of waste reduction. To that end, we continue to participate in the national home composting framework scheme - an online retail network of subsidised composting bins &amp; accessories to help encourage self-management of organic waste - as well as providing a fortnightly kerbside collection service for garden waste across the city with seasonal additional uplifts for real Christmas trees which may otherwise end up in domestic bonfires. A total of 28 composting bins have been purchased through the home composting framework scheme between January - Dec 2014</p>	On-going	

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29	<p><b>Measure M29:</b> DCC will continue to monitor a range of air pollutants throughout Dundee and make the monitoring information freely available to the public in an easily understandable form</p>	<p>† ► Continued support for Dundee Air Quality Monitoring Network</p>	<p>► DCC Environment Department.</p>			<p>► Number of monitoring sites ► Identification of sites in new hotspots ► Monitoring data via DCC website</p>	n/a	<p>► Dundee City Council operate an extensive network of real-time monitoring sites. The majority are located at roadside sites (Meadowside, Logie Street, Lochee Road, Seagate, Union Street, Whitehall St, Albert Street/Arbroath Road, Myrekirk Terrace and Stannergate). There is also a background monitoring site (Mains Loan), and an urban industrial location: (Broughty Ferry Road). The monitors at Albert Street/Arbroath Road, Myrekirk Terrace and Stannergate were installed at these locations in September 2012. One new real-time monitoring site added in 2011 for PM<sub>10</sub> and NO<sub>2</sub> in hotspot area (Meadowside). ► 2 additional PM<sub>10</sub> "reference equivalent" analysers installed at hotspot locations in Lochee Road and Seagate in 2011. ► New NOx analyser installed at background location in 2011.</p> <p>► DCC operate an extensive network of NO<sub>2</sub> diffusion tube sites across the city. Located at busy roads and junctions and a number of background locations. 14 new diffusion tube locations added in 2011. 2 new NO<sub>2</sub> diffusion tube locations were added in 2012 while one 2011 diffusion tube was stopped in 2012. One 2011 site has been moved at its location due to infrastructure changes. A comprehensive review of the diffusion tube network took place in 2013. The network was extended to investigate new potential exceedence areas and a large number of sites that were consistently below the objective were removed from the network. 25 new diffusion tube sites were added to the network in 2013 and 30 were discontinued.</p> <p>► One potential new hotspot identified for NO<sub>2</sub> in Strathmore Avenue based on 2009 data. Additional tubes deployed in the area in 2011 (see Measure 31). The potential new hotspot identified for NO<sub>2</sub> in Strathmore was assessed and it was determined that monitoring with the additional tubes in the area could cease. Additional potential exceedence area identified at South Road (Denbank) in 2012. A new exceedence of the annual mean NO<sub>2</sub> objective was identified at West Marketgait near Guthrie Street in 2013.</p> <p>► See also Measure 20 re monitoring data on the website.</p>	<p>2 new diffusion tube sites were added to the network in 2014 and a further 10 were discontinued.</p> <p>Sulphur Dioxide monitoring ceased at the urban industrial monitoring location at Broughty Ferry Road. Monitored levels were consistently below the air quality objectives.</p>	n/a	<p>Annual mean concentrations of NO<sub>2</sub> at Strathmore Avenue and South Road (Denbank) were below the NAQS in 2014 when predicted to façade. (see Table 2.10 for details of diffusion tube concentrations)</p>



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30	<p><b>Measure M30:</b> DCC will ensure that all air quality monitoring data reported to the public is both accurate and precise by implementing quality control measures</p>	<ul style="list-style-type: none"> <li>□ ►Regular calibrations and filter changing of continuous monitoring equipment in DCC's air quality stations</li> <li>►At least annual audit of air quality stations' equipment</li> <li>□►Appropriate use and care of NO<sub>2</sub> diffusion tubes regularly deployed around the City Council area.</li> </ul>	<ul style="list-style-type: none"> <li>► DCC Environment Department/ Tayside Scientific Services</li> </ul>			<ul style="list-style-type: none"> <li>► QA/QC measures adopted</li> <li>► Auditing reports</li> </ul>	n/a	<ul style="list-style-type: none"> <li>►External consultant undertakes calibrations and filter changing of the continuous monitoring equipment in the air quality monitoring stations. ►Osiris meters - indicative PM<sub>10</sub> meters - filter change undertaken on quarterly basis and annual calibration. ►Audits of continuous monitoring stations' equipment undertaken by external consultants and auditing reports received. ►Public Analyst participates in AIR PT Scheme and field inter-comparison study.</li> </ul>	<p>Ongoing, -AIR is an independent analytical proficiency-testing (PT) scheme, operated by LGC Standards and supported by the Health and Safety Laboratory (HSL). AIR PT is a new scheme, started in April 2014, which combines two long running PT schemes: LGC Standards STACKS PT scheme and HSL WASP PT scheme.</p> <p>AIR NO<sub>2</sub> PT forms an integral part of the UK NO<sub>2</sub> Network's QA/QC, and is a useful tool in assessing the analytical performance of those laboratories supplying diffusion tubes to Local Authorities for use in the context of Local Air Quality Management (LAQM)</p>	n/a	
				Develop Database to enable DCC staff to better manage large volume of AQ data and make it more readily available to stakeholders	2013/15			Initial discussions held with IT Department in regards to development of a database for the handling and retrieval of air quality monitoring data.	The DCC IT Department are in the process of development of a database for the handling and retrieval of air quality monitoring data. Specifications of database have been built by the IT Department which were discussed during a meeting held in August 2014. The development of the database was planned to be carried out in November - December 2014 however this has been delayed and is now planned to be carried out in early 2015	2015	

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31	<b>Measure M31:</b> DCC will establish additional monitoring sites across the City in locations where poor air quality is suspected	<ul style="list-style-type: none"> <li>□ ► DCC will continue to carry out and report on their statutory duties under the Review &amp; Assessment process for LAQM</li> </ul>	<ul style="list-style-type: none"> <li>► DCC Environment Department</li> </ul>			<ul style="list-style-type: none"> <li>► Poor air quality sites identified monitored and dealt with through the process of Review &amp; Assessment</li> <li>► Additional monitoring sites established as and when required</li> </ul>	n/a	<ul style="list-style-type: none"> <li>► See Measure 29 ► The potential new hotspot identified for NO2 in Strathmore was assessed and it was determined that monitoring with the additional tubes in the area could cease.</li> <li>► See Measure 29 ► A review of the diffusion tube locations was undertaken in 2012 and 21 new sites identified as requiring monitoring during 2013</li> </ul>	See Measure 29	n/a	
32	<b>Measure M32:</b> DCC will implement road traffic counts to inform the review and assessment process.	<ul style="list-style-type: none"> <li>† ► Undertake classified traffic counts</li> </ul>	<ul style="list-style-type: none"> <li>► DCC Environment Department</li> </ul>			<ul style="list-style-type: none"> <li>► Classified traffic counts undertaken</li> </ul>	n/a	<ul style="list-style-type: none"> <li>Classified Traffic Counts Undertaken at 18 junctions in 2011 ► Classified Traffic Counts undertaken at 18 junctions in Sept 2012.</li> <li>Classified Traffic Counts were undertaken at 9 junctions in 2013.</li> </ul>	There were no traffic counts undertaken for air quality purposes in 2014	On-going	

