

**DUNDEE CITY COUNCIL**

**LOCAL AIR QUALITY MANAGEMENT UPDATING AND SCREENING  
ASSESSMENT 2009**

**AGGX1376023/BV/AQ/DRAFT**

**OCTOBER 2010**



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## DOCUMENT CONTROL SHEET

Issue/Revision	Issue 1	Issue 2	Issue 3	Final
Remarks	1 <sup>st</sup> Draft	2 <sup>nd</sup> Draft	3 <sup>rd</sup> Draft	
Date	October 2009	February 2010	May 2010	October 2010
Submitted to	Jacqueline Baird Rachel Brooks	Jacqueline Baird Rachel Brooks	Jacqueline Baird Rachel Brooks	Jacqueline Baird Rachel Brooks
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Project number	AGGX1376023	AGGX1376023	AGGX1376023	
File reference	1376023/Q1	1376023/Q2		

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## Executive Summary

Part IV of the Environment Act 1995 places a statutory duty on local authorities to review and assess the air quality within their area and take account of Government Guidance when undertaking such work.

The Updating and Screening Assessment (USA) provides an update with respect to air quality issues within the City. There have been a number of changes since the last (third) round of review and assessments which have been taken into account in this assessment; including revised Local Air Quality Management (LAQM) Guidance, modelled background concentration maps, updated NO<sub>x</sub>:NO<sub>2</sub> conversion calculator, updated future year calculation tools and updates on specific sources (rail, poultry farms, biomass). The USA has included consideration of new monitoring data and emissions sources, in addition to any significant changes to existing emission sources identified in the previous rounds. The USA considers the seven priority health based air quality objectives as laid down in Regulations and assesses the likelihood that the air quality objectives will be met by their target dates. If the air quality objectives are unlikely to be met, a Detailed Assessment (DA) will be required.

Having considered and assessed (as necessary) each emission source, it is concluded that the air quality objectives for benzene, 1, 3-butadiene, carbon monoxide, lead, and sulphur dioxide will be met. The whole of Dundee is an Air Quality Management Area (AQMA), for nitrogen dioxide (NO<sub>2</sub>) due to exceedences of the annual mean air quality standard for this pollutant. Concentrations are increasing in some areas of the city. A Detailed Assessment for fine particles (PM<sub>10</sub>) undertaken in 2009 indicated a risk of exceeding the 2010 objectives. Dundee City Council will take forward the recommendations of the Detailed Assessment with respect to PM<sub>10</sub>, i.e. declare an AQMA for this pollutant.

There is currently insufficient information to adequately assess biomass combustion sources and these will require further investigation. Subsequent LAQM reports will report the outcome of assessments as information becomes available.

Proposed actions arising from the Updating and Screening Assessment are as follows:

- 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;
- Monitor at locations of relevant exposure for sites identified with potential exceedence of the hourly-mean NO<sub>2</sub> objective;
- Take forward the recommendations of the Detailed Assessment 2009 with respect to PM<sub>10</sub>, in the light of identified risk of exceedence of the 2010 PM<sub>10</sub> objectives; i.e. declare an AQMA for this pollutant; and
- Progress to a 2010 Annual Progress Report



## 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 6,300 hectares (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 and the most recent estimate of Dundee's population is 142,470 (General Register Office for Scotland (GROS) 2008 Mid year Population Estimate).

Dundee is connected to Fife by the Tay road and rail bridges and it is served by an airport, which has daily flights to London City. Dundee also has a modern deep-water port and large harbour area. A section of the centre of the city is pedestrianised.

Dundee has an inner ring road, the Marketgait, and five arterial routes - Broughty Ferry Road, Arbroath Road, Riverside, Lochee Road and Forfar Road. 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, an extinct volcano (height 174 metres above sea level).

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. Most of the industrial processes are located around the periphery of the city and in the port area.

Following the second round of review and assessment of air quality a number of areas within the city were expected to exceed the annual mean for nitrogen dioxide. A single AQMA covering the entire city area, rather than several connecting AQMAs, was declared in 2006. Exceedences of the standard have been identified around busy roads and junctions in the city centre and along arterial routes, largely due to road traffic emissions. Since 2006, a Detailed Assessment (DA) of these areas concluded that the particulate matter PM<sub>10</sub> annual mean objective would also be exceeded. In view of this, declaration of an AQMA for particulate matter will also be required.

### 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.

Bureau Veritas has been commissioned by Dundee City Council to undertake the USA 2009, as part of the fourth round of LAQM Review and Assessment.

The following information has been considered within this assessment:

- Relevant legislative background
- Dundee City Council Review and Assessment of air quality under the Local Air Quality Management (LAQM) regime
- Traffic data provided by Dundee City Council
- Industrial, domestic and other source data provided by Dundee City Council
- Monitoring data for 2007 and 2008 provided by Dundee City Council

- Background pollutant concentrations from the UK Air Quality Archive modelled maps
- Technical guidance and tools provided by Defra and the Devolved Administrations<sup>1</sup>

This report sets out the relevant air quality legislation for air quality, provides a review of local air quality management within the administrative area, assesses the air quality for all relevant sources and then summarises the findings of the assessment and potential need for further detailed assessment work.

### 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).

The locations where the Air Quality Strategy<sup>2</sup> (AQS) objectives apply are defined in the AQS as locations outside buildings or other natural or man-made structures above or below ground where members of the public are regularly present and might reasonably be expected to be exposed [to pollutant concentrations] over the relevant averaging period of the AQS objective. Typically these include residential properties and schools/care homes for longer period (i.e. annual mean) pollutant objectives and high streets for short-term (i.e. 1-hour) pollutant objectives. A 15-minute standard would apply to any location where members of public are regularly present and might be exposed for a single 15-minute period.

**Table 1– Air Quality Objectives included in the Air Quality Regulations for the purpose of Local Air Quality Management 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 35 times a year	24-hour mean	31.12.2004
	40 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2004
	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

<sup>1</sup> Local Air Quality Management Technical Guidance LAQM.TG(09). February 2009. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland

<sup>2</sup> The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volume 1), July 2007, Published by Defra in partnership with the Scottish Executive, Welsh Assembly Government and Department of the Environment Northern Ireland

## 1.4 Local Air Quality Management (LAQM)

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)<sup>3</sup> 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))<sup>4</sup> and Technical Guidance (LAQM.TG (09))<sup>5</sup>. 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 meet the air quality objectives.

Defra and the Devolved Administrations released the latest Guidance in February 2009, in anticipation of the fourth round of review and assessment. The fourth round begins with this Updating and Screening Assessment, required to be completed by local authorities by the end of April 2009, and builds upon the Council's previous work in the first three rounds.

## 1.5 Summary of Review and Assessment undertaken by Dundee City Council

Previous review and assessments have been reported as follows:

- Stage 1 (1998) and Stage 2 (2000)
- Updating and Screening Assessment (2003)
- Detailed Assessment (2005)
- Progress Report (2005)
- Updating and Screening Assessment (2006)
- Progress Report (2007)

A FA for NO<sub>2</sub> and a DA for PM<sub>10</sub> has been carried out in 2009. At the time of writing this report the findings of the FA/DA were not finalised and hence have not been discussed here.

The previous assessments of air quality in Dundee City concluded that concentrations of annual mean NO<sub>2</sub> exceed the national standard in the following areas of Dundee:

- Seagate
- Broughty Ferry Road (Stannergate)
- Arbroath Road / Albert Street Junction
- Kingsway/ Forfar Road Junction
- Nethergate / Marketgait Junction
- Dock Street

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<sup>3</sup> DoE, 1997, 'The United Kingdom National Air Quality Strategy', The Stationary Office

<sup>4</sup> Policy Guidance LAQM.PGS(09) (2009), Part IV of the Environment Act 1995, Local Air Quality Management, Published by the Scottish Government, The Stationery Office

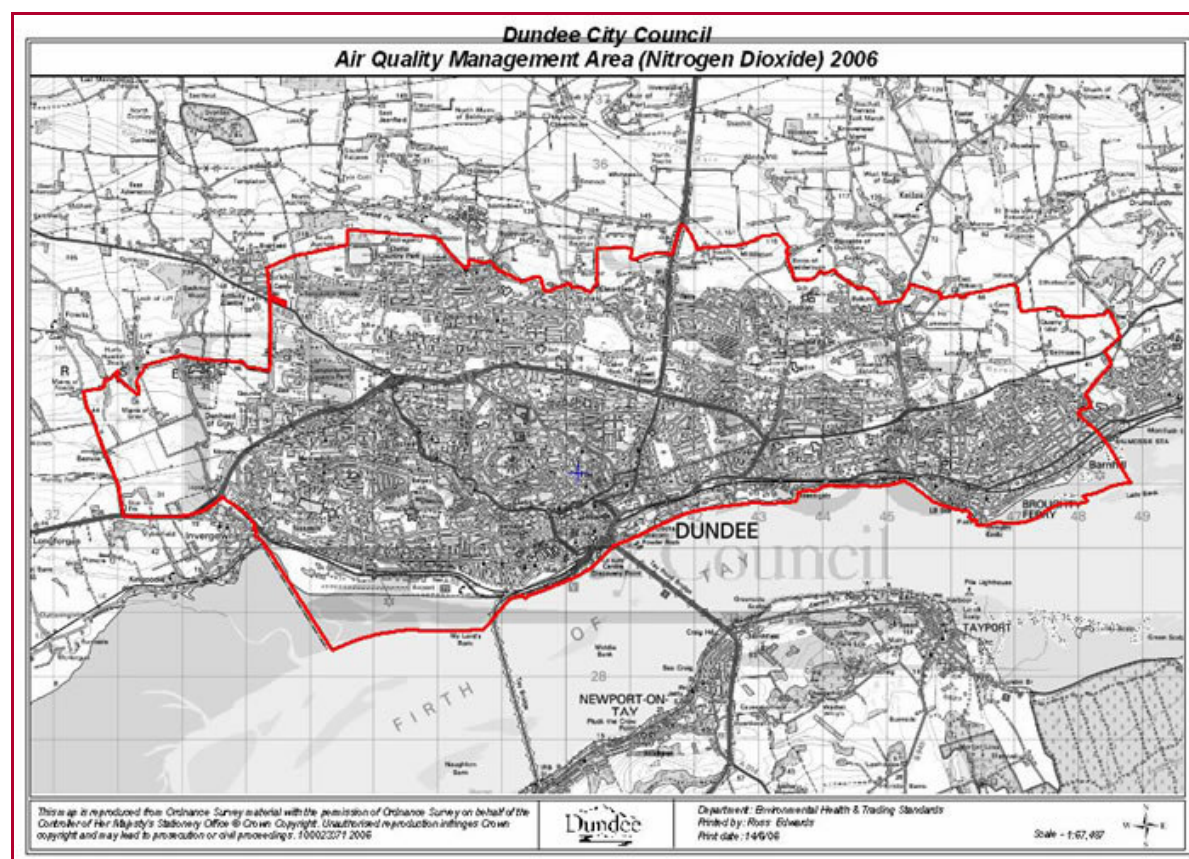
<sup>5</sup> Technical Guidance LAQM.TG (09) (2009), Part IV of the Environment Act 1995, Local Air Quality Management, Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland, The Stationery Office

- Commercial Street
- Victoria Road / Hilltown/ Meadowside Junction
- Lochee Road / Rankine Street Junction
- Lochee Road / Dudhope Junction
- Logie Street / Loons Road Junction
- Whitehall Street
- Union Street

The outcome of the 2005 DA led to the whole of Dundee being declared as an AQMA for NO<sub>2</sub> in July 2006. The Scottish Environment Protection Agency (SEPA) and the Scottish Government accepted the conclusions of the Detailed Assessment and funded the expansion of the PM<sub>10</sub> monitoring network. This included OSIRIS particulate monitoring in potential areas of exceedence, a new background site, a local gravimetric factor intercomparison study. The outcome of the Updating and Screening Assessment 2006 showed that the only monitored PM<sub>10</sub> concentrations predicted to exceed the annual mean objective (2010) were in Union Street. However, this result was adversely influenced by major construction projects in the vicinity and may not have been truly representative of ambient concentrations present at this location. The results of the monitoring studies are included in this assessment.

Dundee City Council has carried out a Further Assessment for NO<sub>2</sub> within the AQMA in order to provide technical input into the AQAP. In addition, a Detailed Assessment with regards to compliance with PM<sub>10</sub> objectives at busy roads and junctions has also been undertaken. The findings of these DA and FA are referred to in this report, but not reported in detail.

**Figure 1 – Dundee City AQMA**





## 2 Updating and Screening Assessment Methodology

The Updating and Screening Assessment is intended to identify any significant changes that may have occurred since the previous rounds of Review and Assessment were completed. This includes new monitoring data, new or changed emissions sources (either locally or in neighbouring authorities), or any other local changes that might affect air quality e.g. new relevant exposure. The assessment builds on the previous Review and Assessment work undertaken by local authorities.

The Updating and Screening Assessment involves a checklist approach that considers all significant emissions sources relevant to the Air Quality Objectives. The checklists are broadly the same as in the previous rounds, but have been re-ordered so that they follow a source-by-source rather than pollutant-by-pollutant approach. This is to reduce repetition within the screening process for those local authorities that do not have all the listed sources within their area. These can more easily be discounted at an early stage.

A summary of the emission source categories for the Updating and Screening checklists is provided in Table 3. The detailed checklists for each source type are then set out in the following sections, as per the methodology provided in Chapter 5 of the Technical Guidance LAQM.TG (09). For non-traffic sources, where required, the checklist approaches to screening and relevant LAQM.TG(09) nomograms have been used.

It should be noted that the mapped 1km x 1km background concentrations of NO<sub>2</sub>, NO<sub>x</sub>, and PM<sub>10</sub> used throughout this report were the 2008 base year maps and projections that were issued by the Air Quality Review and Assessment helpdesk on the 26th January 2010. (NB the 2006 base year maps and projections issued in 2009 had been found to be exceptionally inaccurate for the Dundee local authority area to the extent that PM<sub>10</sub> background concentrations themselves breached the annual mean 2010 standard in 12% of the local authority area).

### 2.1 Road Traffic Data

Since the last USA new traffic data has been collected from a number of different sources:

- manual 12-hour classified counts of junctions, collected for the Further and Detailed Assessments, (undertaken 2007);
- 24-hour automatic traffic count data from permanent and temporary sites (undertaken 2006-2009);and
- peak hour counts of city centre and some surrounding roads, collected to update the council's Paramics traffic model, (undertaken in 2007)

The peak hour counts (adjusted and supplemented with the manual 12-hour classified count data) were used for the air dispersion modelling of roads in the Further and Detailed Assessments of NO<sub>2</sub> and PM<sub>10</sub>, and therefore have been assessed previously.

Appendix 1 contains the manual 12-hour and 24-hour automatic traffic counts. The 12-hour survey data was factored to 24-hour using a factor of 1.15 that was derived from the council's 2007 Road Traffic Reduction Act monitoring sites.

2007 traffic data were projected to 2008 and 2010 using growth factors provided by Dundee City Council's traffic consultant, SIAS. Projection factors for 2006 data were interpolated from those given by SIAS. The factors used are presented in Table 2.

**Table 2 – Traffic Growth Factors Used for Projections**

Base Year	Projection Year	Growth Factor		Source
		Principal A Roads	Other Roads	
2007	2008	1.004	1.013	SIAS
2007	2010	1.011	1.037	SIAS
2006	2008	-	1.027	Linear Interpolation
2006	2010	-	1.027	Linear Interpolation
2005	2008	1.012	-	Linear Interpolation
2008	2010	1.007	-	Linear Interpolation

The road traffic data for the council's Paramics traffic model extends beyond the areas modelled in the Further and Detailed Assessment. The remaining peak hour counts will be examined in subsequent rounds of review and assessment and reported if any new areas of exceedence are identified.

**Table 3– Summary of emission sources and relevant pollutants to be considered as part of the Updating and Screening Assessment**

Reference No.	Emission sources to be assessed	Relevant Pollutants
<b>A. Road Transport Sources</b>		
A.1	Narrow congested streets with residential properties close to the kerb	Nitrogen dioxide
A.2	Busy streets where people may spend 1-hour or more close to traffic	Nitrogen dioxide
A.3	Roads with a high flow of buses and/or HGVs.	Nitrogen dioxide, PM <sub>10</sub>
A.4	Junctions (including busy roads and junctions in Scotland and Northern Ireland)	Nitrogen dioxide, PM <sub>10</sub>
A.5	New roads constructed since the last round of review and assessment	Nitrogen dioxide, PM <sub>10</sub>
A.6	Roads/junctions identified as being close to the objective during the previous round of review and assessment	Nitrogen dioxide, PM <sub>10</sub>
A.7	Roads with significantly changed traffic flows	Nitrogen dioxide, PM <sub>10</sub>
A.8	Bus and coach stations	Nitrogen dioxide
<b>B: Other transport sources</b>		
B.1	Airports	Nitrogen dioxide
B.2	Railway (diesel and steam trains)	Sulphur dioxide, nitrogen dioxide
B.3	Ports (shipping)	Sulphur dioxide
<b>C: Industrial sources</b>		
C.1	Industrial processes (new processes and those with significantly increased emissions)	Benzene, 1,3-butadiene, lead, nitrogen dioxide, sulphur dioxide, PM <sub>10</sub>
C.2	Major petrol storage depots	Benzene
C.3	Petrol Stations	Benzene
C.4	Poultry farms	PM <sub>10</sub>
<b>D: Commercial and domestic sources</b>		
D.1	Biomass combustion	Nitrogen dioxide, PM <sub>10</sub>
D.2	Domestic solid-fuel burning	Sulphur dioxide
<b>E: Fugitive or uncontrolled sources</b>		
E.1	Quarries, landfill sites, opencast coal mining, waste transfer sites, materials handling (i.e. ports, major construction sites)	PM <sub>10</sub>

### 3 New Monitoring Data

Section 3 reviews and assesses all new monitoring data in order to determine whether the air quality standards and objectives are at risk of exceedence.

#### 3.1 Summary of Monitoring Undertaken

##### 3.1.1 Automatic Monitoring Sites

This section provides details of automatic monitoring carried out in 2007 and 2008, the years covered by this report.

Dundee utilise several methods for monitoring particulates within the city. The Partisol is a reference equivalent method and is used to determine a local correction factor for the TEOMs, which were designated as non-equivalent in 2006. In addition, five sites are monitored with Osiris analysers; these are also non-equivalent and are only indicative of particulate concentrations. Details of these monitoring locations can be found in Table 4. Siting automatic monitoring sites in urban areas is problematic and compromises mean that monitors cannot always be situated in the worst case location. Dundee commenced a yearly study in 2005 to compare the Osiris with the TEOM; determining that the Osiris consistently over-reads compared to the TEOM. A comparison has additionally been made with respect to the 2007 and 2008 data within this report.

Nitrogen dioxide chemiluminescence Monitor Labs 9841A analysers are employed at four locations within the city. Sulphur dioxide is monitored by UV fluorescence using a Monitor Labs 9850A. All analysers are audited twice yearly by an external consultant, AEA.

Dundee City Council secured funding from the Scottish Executive, to commission AEA to assist with data management and ratification procedures. Dundee joined the 'Calibration Club' run by AEA at the end of 2006 and AEA have ratified all the real-time monitoring data reported, and have provided the VCM -corrections used in this report.



**Table 4– Details of Automatic Monitoring Sites**

Site Name	Site Type	OS Grid Ref (x,y)	Pollutants Monitored	In AQMA? <sup>1</sup>	Relevant Exposure? (Y/N with distance (m) to relevant exposure) <sup>3</sup>	Distance to kerb of nearest road (N/A if not applicable)	Worst-case Location? <sup>2</sup>
Broughty Ferry Road Rollalong	Urban Industrial	x=341970, y=730977	SO <sub>2</sub> , PM <sub>10</sub> (TEOM)	Yes	Y - 0m	N/A	No
Broughty Ferry Road Partisol	Urban Industrial	x=341971, y=730978	PM <sub>10</sub> (Gravimetric - Partisol)	Yes	Y - 0m	N/A	No
Lochee Road Romon	Kerbside	x=338861, y=730773	NO <sub>2</sub>	Yes	Y-2.25m	0.6m	No
Lochee Road Osiris	Kerbside	x=338920, y=730694	PM <sub>10</sub> (Osiris)	Yes	Y-2.2	0.6m	Yes
Logie Street Osiris	Kerbside	x=338176, y=731298	PM <sub>10</sub> (Osiris)	Yes	Y-1.65m	0.57m	Yes
Mains Loan	Urban Background	x=340972, y=731893	PM <sub>10</sub> (TEOM)	Yes	N-0m	N/A	No
Seagate Romon	Kerbside	x=340487, y=730446	NO <sub>2</sub>	Yes	2.0m	0.2m	No
Seagate Osiris	Kerbside	x=340539, y=730528	PM <sub>10</sub> (Osiris)	Yes	1.64m	0.63m	No
Union Street Rollalong	Roadside	x=340235, y=730091	NO <sub>2</sub> , PM <sub>10</sub> (TEOM)	Yes	3.3m	1m	Yes
Union Street Osiris	Roadside	x=340235, y=730090	PM <sub>10</sub> (Osiris)	Yes	3.1m	1.12m	Yes
Victoria Road Osiris	Kerbside	x=340230, y=730673	PM <sub>10</sub> (Osiris)	Yes	2.7m	0.3m	No
Whitehall Street Romon	Roadside	X=340278, y=730156	NO <sub>2</sub>	Yes	1.25m	3.26m	No

<sup>1</sup> The entire Dundee is an AQMA for NO<sub>2</sub> only

<sup>2</sup> Explanation provided in Box 3.1 of LAQM.TG(09): *Where results are presented for new monitoring sites, then a description of the sites should be provided. This should include the reason they were set up, for example, to represent worst-case relevant exposure alongside a particular road.*

<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.*

### 3.1.2 Non-Automatic Monitoring Data

Details of the non-automatic monitoring undertaken in the city are shown below.

**Table 5– Details of Non- Automatic Monitoring Sites**

Site No.	Location	Site Type	X	Y	Pollutant monitored	In AQMA (Y/N)? <sup>1</sup>	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road (m) (N/A if not applicable)	Worst-case Location (Y/N)?
1	Abertay	kerbside	340047	730629	NO <sub>2</sub>	Y	N	0.66	N
4	Albert Street (Fish)	kerbside	341139	731476	NO <sub>2</sub>	Y	2.27	0.57	Y
5	Albert Street (Shandon Place)	roadside	341171	731574	NO <sub>2</sub>	Y	7.57	1.09	N
2	Albert Street 1	kerbside	341104	731210	NO <sub>2</sub>	Y	2.14	0.91	N
6	Arbroath Road (13)	kerbside	341111	731070	NO <sub>2</sub>	Y	2.52	0.73	Y
8	Arthurstone Terrace (10)	kerbside	341051	731203	NO <sub>2</sub>	Y	1.75	0.89	Y
9	Balgavies Place	urban background	343082	731465	NO <sub>2</sub>	Y	n/a	N/A	N
0	Bank St/ Reform St	kerbside	340228	730337	NO <sub>2</sub>	Y	1.31	0.51	Y
12	Birnam Place	urban background	337531	730914	NO <sub>2</sub>	Y	n/a	N/A	N
14	Brook Street (B.F.)	kerbside	346293	730872	NO <sub>2</sub>	Y	1.26	0.84	Y
16	Broughty Ferry Road (141)	roadside	343322	731073	NO <sub>2</sub>	Y	1.98	1.32	Y
18	Claypotts Junction	roadside	345315	732103	NO <sub>2</sub>	Y	12.00	8.00	N
19	Cleington Road/Forfar Road	kerbside	341385	732121	NO <sub>2</sub>	Y	8.28	0.78	Y
20	Commercial St	kerbside	340328	730431	NO <sub>2</sub>	Y	2.90	0.60	Y
21	Commercial Street (Waterstones)	roadside	340481	730325	NO <sub>2</sub>	Y	2.00	2.60	Y
24	Crichton St	kerbside	340331	730162	NO <sub>2</sub>	Y	4.08	0.53	Y
25	Dens Road Crossing	roadside	340725	731238	NO <sub>2</sub>	Y	2.49	1.20	Y
26	Dock St (14)	kerbside	340395	730086	NO <sub>2</sub>	Y	3.24	0.78	Y
29	Dock St (Unicorn)(No.60)	roadside	340659	730348	NO <sub>2</sub>	Y	1.74	3.86	Y
32	Dura Street (Forte) (No.98)	kerbside	341150	731576	NO <sub>2</sub>	Y	1.65	0.57	N
34	Earl Grey Place (Park)	urban background	340699	730019	NO <sub>2</sub>	Y	n/a	N/A	N
35	Eastport Roundabout	roadside	340651	730623	NO <sub>2</sub>	Y	1.56	1.00	Y
36	Harefield Road (35)	kerbside	338360	731855	NO <sub>2</sub>	Y	11.75	0.53	Y
42	Hilltown (Suites)	roadside	340088	731116	NO <sub>2</sub>	Y	0.50	1.66	N

<sup>1</sup> The entire Dundee is an AQMA for NO<sub>2</sub> only

**Table 5– Details of Non- Automatic Monitoring Sites (Continued)**

Site No.	Location	Site Type	X	Y	Pollutant monitored	In AQMA ? <sup>1</sup>	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road (m) (N/A if not applicable)	Worst-case Location ?
44	King St (12 & 14)	kerbside	340598	730757	NO <sub>2</sub>	Y	1.84	0.60	Y
45	Kingsway E. Roundabout	roadside	343107	731740	NO <sub>2</sub>	Y	14.30	2.90	N
46	Kingsway/ Mains Loan 1	roadside	341124	732468	NO <sub>2</sub>	Y	15.40	6.20	Y
48	Kingsway/ Pitkerro Rd	roadside	341963	732303	NO <sub>2</sub>	Y	18.00	6.70	N
49	Kingsway/ Strathmartine Rd (S)	kerbside	339221	732836	NO <sub>2</sub>	Y	16.80	0.64	N
51	Lochee Rd (138)	kerbside	338936	730680	NO <sub>2</sub>	Y	2.06	0.44	N
34	Lochee Rd (140) Traffic Lts	roadside	338927	730685	NO <sub>2</sub>	Y	0.25	2.22	Y
58	Lochee Rd (184)	kerbside	338767	730856	NO <sub>2</sub>	Y	3.19	0.73	Y
37	Lochee Rd (Romon 1)	kerbside	338861	730773	NO <sub>2</sub>	Y	2.25	0.60	Y
59	Lochee Rd/Polepark Rd	kerbside	339016	730586	NO <sub>2</sub>	Y	9.21	0.95	Y
61	Logie Street (114)	roadside	338184	731293	NO <sub>2</sub>	Y	0.53	1.73	Y
60	Logie Street (98)	kerbside	338252	731258	NO <sub>2</sub>	Y	1.26	0.86	N
63	Loons Road (1)	roadside	338211	731293	NO <sub>2</sub>	Y	0.50	1.90	Y
64	Marketgait	roadside	339953	730094	NO <sub>2</sub>	Y	3.50	1.30	Y
44	Meadowside	roadside	340245	730651	NO <sub>2</sub>	Y	1.26	1.00	Y
66	Muirton Road (6)	roadside	338152	731293	NO <sub>2</sub>	Y	0.30	1.11	Y
67	Myrekirk Road	kerbside	335420	731733	NO <sub>2</sub>	Y	16.40	0.95	N
68	Nethergate (B&B)(88)	kerbside	340163	730061	NO <sub>2</sub>	Y	5.00	0.86	Y
69	Nethergate (Bradford)	roadside	340274	730171	NO <sub>2</sub>	Y	2.51	1.25	Y
70	Nethergate (Charlie T)	kerbside	340033	729957	NO <sub>2</sub>	Y	1.84	0.86	Y
72	Nethergate (Trades House)	roadside	340230	730124	NO <sub>2</sub>	Y	2.72	1.26	Y
73	Nethergate/ Marketgait	roadside	340074	729984	NO <sub>2</sub>	Y	3.60	1.33	Y
54	Rankine St (2)	roadside	338768	730900	NO <sub>2</sub>	Y	0.40	1.76	Y
78	Seagate	roadside	340545	730532	NO <sub>2</sub>	Y	0.19	1.94	N
56, 57,58	Seagate (Romon 1)	kerbside	340487	730446	NO <sub>2</sub>	Y	1.76	0.66	Y
83	Seagate (Yates)(7-9)	roadside	340467	730388	NO <sub>2</sub>	Y	0.90	1.70	N
84	Soapwork Lane	roadside	340099	730650	NO <sub>2</sub>	Y	Facade	3.51	Y
87	St Andrews St (JAF)	kerbside	340516	730584	NO <sub>2</sub>	Y	1.77	0.71	Y

The entire Dundee is an AQMA for NO<sub>2</sub>

**Table 5– Details of Non- Automatic Monitoring Sites (Continued)**

Site No.	Location	Site Type	X	Y	Pollutant monitored	In AQMA ? <sup>1</sup>	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road (m) (N/A if not applicable)	Worst-case Location ?
88	St Andrews St (PB)	kerbside	340532	730551	NO <sub>2</sub>	Y	2.38	0.50	Y
63	St Mary Flats	roadside	339039	730624	NO <sub>2</sub>	Y	15.00	3.00	N
95	Strathmore Avenue (353)	kerbside	339609	731871	NO <sub>2</sub>	Y	1.45	0.67	Y
97	Trades Lane (31)	kerbside	340575	730500	NO <sub>2</sub>	Y	1.82	0.44	Y
98	Union St (Rollalong 1)	roadside	340235	730091	NO <sub>2</sub>	Y	3.25	1.20	Y
101	Union Street (Goodfellows)	kerbside	340274	730069	NO <sub>2</sub>	Y	1.60	0.46	Y
102	Union Street (Mcintyres)	kerbside	340293	730051	NO <sub>2</sub>	Y	1.60	0.73	Y
103	Victoria Road	roadside	340212	730633	NO <sub>2</sub>	Y	3.00	1.22	Y
73	Victoria Road (10)	roadside	340255	730667	NO <sub>2</sub>	Y	2.11	1.14	Y
60	Victoria Road (60)	roadside	340375	730779	NO <sub>2</sub>	Y	0.56	2.18	Y
104	Victoria Road / Cotton Road	kerbside	340740	730996	NO <sub>2</sub>	Y	1.30	0.82	Y
105	Victoria Road/Hilltown	roadside	340274	730714	NO <sub>2</sub>	Y	2.01	1.15	N
76	Victoria Street	kerbside	340071	731072	NO <sub>2</sub>	Y	1.70	0.75	Y
106	Westport (2)	roadside	339842	730122	NO <sub>2</sub>	Y	2.50	0.46	Y
107	Whitehall Cr (Xpresso)	kerbside	340376	730109	NO <sub>2</sub>	Y	3.00	0.88	Y
111	Whitehall St (Brj)	kerbside	340330	730106	NO <sub>2</sub>	Y	3.57	0.78	Y
112	Whitehall St (Bus)	roadside	340289	730128	NO <sub>2</sub>	Y	3.17	2.51	N
113	Whitehall St (Deb A)	kerbside	340265	730153	NO <sub>2</sub>	Y	5.57	0.88	N
114	Whitehall St (Deb E)	kerbside	340322	730098	NO <sub>2</sub>	Y	4.55	0.75	Y
82,83,84	Whitehall St (Romon 1)	roadside	340278	730156	NO <sub>2</sub>	Y	1.70	3.26	N
115	Whitehall St (Tiso)	roadside	340293	730142	NO <sub>2</sub>	Y	2.67	3.00	Y
116	Woodside Avenue	urban background	340776	732307	NO <sub>2</sub>	Y	N/A	N/A	Y
	Forfar Road	kerbside	341437	732360	NO <sub>2</sub>	Y	7.68	0.67	Y
	Commercial St / Dock St 2	roadside	340565	730263	NO <sub>2</sub>	Y	0.17	2.78	Y
	Dock St Carol Whyte (2)	roadside	340524	730216	NO <sub>2</sub>	Y	0.34	5.13	Y
	Perth Rd / Hawkhill	kerbside	338742	729828	NO <sub>2</sub>	Y	4.00	0.55	Y
	Nethergate / South Tay St	roadside	339987	729919	NO <sub>2</sub>	Y	0.38	2.24	Y
	Perth Rd 320	kerbside	338776	729798	NO <sub>2</sub>	Y	3.78	0.42	Y
	Queen St B/F	roadside	346207	731007	NO <sub>2</sub>	Y	0.00	2.85	Y
	Ward Rd	roadside	339893	730336	NO <sub>2</sub>	Y	0.64	2.24	Y
	West Bell St	roadside	339815	730395	NO <sub>2</sub>	Y	0.84	2.48	Y

<sup>1</sup> The entire Dundee is an AQMA for NO<sub>2</sub> only

### 3.1.2.1 Nitrogen Dioxide Diffusion Tube Data

Outside the continuous monitoring network, Dundee City Council operated 83 diffusion tube sites in 2008. Of, these 35 sites exceeded the annual mean NO<sub>2</sub> objective in 2008. These are all within the Dundee AQMA.

The diffusion tubes are supplied by Gradko and analysed by Dundee Scientific Services utilising the 20% Triethanolamine (TEA) in water preparation method. Dundee 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 of a high calibre. The lab follows the procedures set out in the Working Group on Harmonisation of Diffusion Tubes Practical Guidance which was released in February 2008<sup>6</sup>, and is UKAS accredited for the analysis of nitrogen dioxide.

With regard to the application of a bias adjustment factor for the diffusion tubes, the technical guidance LAQM.TG (09) and Review and Assessment Helpdesk recommends use of a local bias adjustment factor where available and relevant to diffusion tube sites.

Four local co-location studies were undertaken in 2007 - with good data capture, which generated the following bias adjustment factors:

- Dundee Lochee Road - 0.92
- Dundee Seagate - 0.89
- Dundee Union Street - 0.71
- Dundee Whitehall Street - 0.94

These were provided to the Review and Assessment Helpdesk, who calculated the overall local bias for the four sites as:

- Dundee City Council - 0.86

Four local co-location studies were undertaken in 2008 - with good data capture for three sites, which generated the following bias adjustment factors:

- Dundee Lochee Road - 0.89
- Dundee Seagate - 0.88
- Dundee Union Street - 0.84

These were provided to the Review and Assessment Helpdesk, who calculated the overall local bias for the three sites as:

- Dundee City Council - 0.87

The full calculation of bias adjustment for the roadside local co-location studies in 2007 and 2008 is shown in Appendix 2.

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<sup>6</sup> AEA Energy & Environment (2008), Diffusion Tubes for Ambient NO<sub>2</sub> Monitoring : Practical Guidance for Laboratories and Users

## 3.2 Comparison of Monitoring Results with AQ Objectives

### 3.2.1 Nitrogen dioxide (NO<sub>2</sub>)

#### 3.2.1.1 Automatic Monitoring Data

**Table 6 – Results of Automatic Monitoring for Nitrogen dioxide: Comparison with Annual Mean Objective**

Location	Within AQMA?	Description	Annual mean concentrations (µg/m <sup>3</sup> )	
			2007	2008
Lochee Road	Yes	Hourly Mean > 200 µg/m <sup>3</sup> (18 times per year permitted)	0	4
		Annual mean (Objective 40µg/m <sup>3</sup> )	<b>52.8</b>	<b>52.9</b>
		%Data capture	93.0	92.0
		99.8th Percentile	157.5	175.6
Seagate	Yes	Hourly Mean > 200 µg/m <sup>3</sup> (18 times per year permitted)	1	0
		Annual mean (Objective 40µg/m <sup>3</sup> )	<b>49.1</b>	<b>51.4</b>
		%Data capture	93.9	(81.6)
		99.8th Percentile	141.2	141.3
Union Street	Yes	Hourly Mean > 200 µg/m <sup>3</sup> (18 times per year permitted)	0	11
		Annual mean (Objective 40µg/m <sup>3</sup> )	35.8	<b>42.9</b>
		%Data capture	99.3	99.7
		99.8th Percentile	132.1	182.3
Whitehall Street	Yes	Hourly Mean > 200 µg/m <sup>3</sup> (18 times per year permitted)	0	0
		Annual mean (Objective 40µg/m <sup>3</sup> )	<b>42.0</b>	<b>46.7</b>
		%Data capture	90.6	(75.6)
		99.8th Percentile	136.8	139.4

\*Data for all years has been fully ratified.

Exceedences of the air quality objectives are shown in bold. Data capture less than the recommended 90% is shown in brackets.

#### 3.2.1.2 Diffusion Tube Monitoring Data

The nitrogen dioxide diffusion tube data are summarised in the table below. The full dataset (monthly mean values) are included in Appendix 4. The results have been annualised where necessary using factors derived from the urban background diffusion tube monitoring (Appendix 3 show the factors used). Local Bias factors were used in 2007 and 2008; the Whitehall co-location site was omitted from the overall local correction factor in 2008 due to low data capture.

The 2008 data show that concentrations measured at 35 diffusion tube sites exceeded the annual mean NO<sub>2</sub> Standard. As Dundee is entirely an AQMA all 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 16 sites. All of these locations are in known hotspots. Uncertainties associated with the distance calculator tool suggest that Strathmore Avenue, may be a new potential hotspot location. This will be kept under review.

**Table 7– Results of nitrogen dioxide diffusion tubes ( $\mu\text{g}/\text{m}^3$ )**

Site ID	Location	Within AQMA?	Annual mean concentrations 2007 ( $\mu\text{g}/\text{m}^3$ ) adjusted for bias	Data Capture 2007 %	Annual mean concentrations 2008 ( $\mu\text{g}/\text{m}^3$ ) adjusted for bias	Data Capture 2008 %
1	Abertay	Y	<b>46.5</b>	92	<b>48.5</b>	100
4	Albert Street (Fish)	Y	30.7	100	32.8	100
5	Albert Street (Shandon Place)	Y	34.3	100	39.0	100
2	Albert Street 1	Y	33.0	100	37.9	100
6	Arbroath Road (13)	Y	38.0	100	<b>40.2</b>	100
8	Arthurstone Terrace (10)	Y	23.1	100	25.4	100
9	Balgavies Place	Y	17.6	100	18.9	83
0	Bank St/ Reform St	Y	29.4	92	28.2	100
12	Birnam Place	Y	10.8	100	11.7	92
14	Brook Street (B.F.)*	Y	22.9	100	23.1	25
16	Broughty Ferry Road (141)	Y	<b>40.4</b>	100	<b>45.3</b>	100
18	Claypotts Junction	Y	24.6	100	28.0	100
19	Cleington Road/Forfar Road	Y	36.8	100	38.5	100
20	Commercial St	Y	33.5	100	36.2	100
21	Commercial Street (Waterstones)	Y	<b>40.2</b>	100	<b>47.4</b>	100
24	Crichton St	Y	31.6	100	34.0	100
25	Dens Road Crossing	Y	35.2	100	36.0	100
26	Dock St (14)	Y	<b>46.7</b>	100	<b>43.8</b>	92
29	Dock St (Unicorn)(No.60)	Y	37.6	92	<b>40.8</b>	100
32	Dura Street (Forte) (No.98)	Y	39.4	100	<b>41.6</b>	100
34	Earl Grey Place (Park)	Y	20.6	100	20.7	100
35	Eastport Roundabout	Y	35.5	100	35.9	100
36	Harefield Road (35)	Y	32.6	92	36.0	100
42	Hilltown (Suites)	Y	33.2	100	35.4	100
44	King St (12 & 14)	Y	28.7	100	30.1	92
45	Kingsway E. Roundabout	Y	40.0	83	<b>42.6</b>	100
46	Kingsway/ Mains Loan 1	Y	34.1	100	37.8	83
48	Kingsway/ Pitkerro Rd*	Y	30.7	100	26.7	25

\*Less than 9 months data capture, annualisation undertaken as shown in Appendix 3.  
Exceedences of the annual mean objective are highlighted in bold.



**Table 7 (Continued) – Results of nitrogen dioxide diffusion tubes ( $\mu\text{g}/\text{m}^3$ )**

Site ID	Location	Within AQMA?	Annual mean concentrations 2007 ( $\mu\text{g}/\text{m}^3$ ) adjusted for bias	Data Capture 2007 %	Annual mean concentrations 2008 ( $\mu\text{g}/\text{m}^3$ ) adjusted for bias	Data Capture 2008 %
49	Kingsway/ Strathmartine Rd (S)	Y	<b>43.3</b>	100	<b>45.0</b>	100
51	Lochee Rd (138)	Y	<b>52.6</b>	100	<b>57.4</b>	100
34	Lochee Rd (140) Traffic Lts	Y	<b>53.4</b>	100	<b>57.0</b>	100
58	Lochee Rd (184)	Y	38.1	100	39.1	100
37,38,39	Lochee Rd (Romon 1) TriPLICATE Average	Y	<b>49.2</b>	100	<b>51.4</b>	100
59	Lochee Rd/Polepark Rd	Y	30.9	100	32.3	100
61	Logie Street (114)	Y	<b>52.2</b>	100	<b>58.2</b>	100
60	Logie Street (98)	Y	35.2	83	34.5	92
63	Loons Road (1)	Y	39.1	100	<b>45.3</b>	100
64	Marketgait	Y	33.0	100	35.8	100
44	Meadowside	Y	<b>61.4</b>	100	<b>63.5</b>	100
66	Muirton Road (6)	Y	28.4	100	29.2	100
67	Myrekirk Road	Y	32.9	100	32.3	100
68	Nethergate (B&B)(88)	Y	<b>43.1</b>	100	<b>49.1</b>	92
69	Nethergate (Bradford)	Y	37.4	100	<b>43.2</b>	100
70	Nethergate (Charlie T)	Y	39.1	100	38.4	100
72	Nethergate (Trades House)	Y	39.6	100	<b>44.6</b>	100
73	Nethergate/ Marketgait	Y	36.0	100	35.2	100
54	Rankine St (2)	Y	39.9	100	<b>42.6</b>	92
78	Seagate	Y	<b>42.3</b>	100	<b>45.9</b>	100
56,57,58	Seagate(Romon 1) TriPLICATE Average	Y	<b>47.5</b>	100	<b>50.8</b>	100
83	Seagate (Yates)(7-9)	Y	<b>40.5</b>	100	38.3	100
84	Soapwork Lane	Y	35.0	100	35.8	92
87	St Andrews St (JAF)	Y	34.8	100	<b>40.4</b>	100

\*Less than 9 months data capture, annualisation undertaken as shown in Appendix 3.  
Exceedences of the annual mean objective are highlighted in bold.



**Table 7 (Continued) – Results of nitrogen dioxide diffusion tubes ( $\mu\text{g}/\text{m}^3$ )**

Site ID	Location	Within AQMA?	Annual mean concentrations 2007 ( $\mu\text{g}/\text{m}^3$ ) adjusted for bias	Data Capture 2007 %	Annual mean concentrations 2008 ( $\mu\text{g}/\text{m}^3$ ) adjusted for bias	Data Capture 2008 %
88	St Andrews St (PB)	Y	<b>41.5</b>	100	<b>41.6</b>	100
63	St Mary Flats*	Y	20.6	100	19.8	25
95	Strathmore Avenue (353)	Y	38.0	100	<b>42.6</b>	92
97	Trades Lane (31)	Y	36.3	100	33.3	100
98	Union St (Rollalong) Triplicate Average	Y	<b>43.4</b>	100	<b>44.7</b>	100
101	Union Street (Goodfellows)	Y	32.4	100	34.1	100
102	Union Street (Mcintyres)	Y	32.7	100	33.2	100
103	Victoria Road	Y	36.7	100	38.4	100
73	Victoria Road (10)	Y	32.9	100	34.0	100
60	Victoria Road (60)	Y	<b>41.1</b>	100	<b>43.8</b>	100
104	Victoria Road / Cotton Road	Y	36.6	100	37.4	100
105	Victoria Road/Hilltown	Y	<b>55.8</b>	100	<b>60.9</b>	100
76	Victoria St	Y	34.1	100	35.2	100
106	Westport (2)	Y	38.9	100	<b>41.3</b>	100
107	Whitehall Cr (Xpresso)	Y	30.3	100	30.6	100
111	Whitehall St (Brj)	Y	36.3	100	37.8	100
112	Whitehall St (Bus)	Y	<b>48.6</b>	100	<b>51.7</b>	92
113	Whitehall St (Deb A)	Y	<b>43.4</b>	100	<b>50.3</b>	100
114	Whitehall St (Deb E)	Y	36.9	92	39.6	100
82,83,84	Whitehall St (Romon 1) Triplicate Average	Y	38.5	100	<b>42.7</b>	92
115	Whitehall St (Tiso)	Y	38.8	100	<b>42.6</b>	100
116	Woodside Avenue	Y	18.1	92	18.5	100
	Forfar Road	Y	<b>45.7</b>	100	<b>50.2</b>	83
	Commercial St / Dock St 2	Y	38.6	100	<b>41.9</b>	100
	Dock St Carol Whyte (2)	Y	37.8	100	37.5	100
	Perth Rd / Hawkhill*	Y	25.0	100	22.9	25
	Nethergate / South Tay St	Y	29.6	100	30.1	83
	Perth Rd 320*	Y	n/a	n/a	36.5	67
	Ward Rd	Y	n/a	n/a	34.5	75
	West Bell St	Y	n/a	n/a	36.0	75
	Queen St B/F*	Y	n/a	n/a	29.8	50

\*Less than 9 months data capture, annualisation undertaken as shown in Appendix 3. Exceedences of the annual mean objective are highlighted in bold.

The diffusion tubes monitoring sites exceeding the annual mean objective were assessed for relevant exposure using the procedures set out in LAQM.TG(09) (Box2.3) and the tool available from the Review and Assessment website. The average of three urban-background monitoring locations (Balgavies Place, Earl Grey Place and Woodside Avenue) was used to provide the background concentration ( $19.4\mu\text{g}/\text{m}^3$ ) for these comparisons. Of the 35 sites, which recorded an exceedance in 2008, all were located within the AQMA. Sites at Kingsway East and the junction of Kingsway / Strathmartine Road have no relevant exposure ( $>10\text{m}$  from site to nearest receptor).

The calculated concentrations at the relevant receptors achieve the annual mean standard at the following sites (the concentration at relevant exposure are shown):

- Abertay –  $38.0\mu\text{g}/\text{m}^3$ ,
- Arbroath Road –  $34.3.0\mu\text{g}/\text{m}^3$ ,
- Dock St (Sheridans) –  $36.1\mu\text{g}/\text{m}^3$ ,
- Dock St (Unicorns) –  $38.6\mu\text{g}/\text{m}^3$ ,
- Dura St (Fortes) -  $36.1\mu\text{g}/\text{m}^3$ ,
- Forfar Rd –  $35.7\mu\text{g}/\text{m}^3$ ,
- Kingsway E. Roundabout)–  $32.0\mu\text{g}/\text{m}^3$
- Kingsway/ Strathmartine Rd (S) –  $29.4\mu\text{g}/\text{m}^3$ ,
- Nethergate (B&B)(88) –  $38.0\mu\text{g}/\text{m}^3$ ,
- Nethergate (Bradford) –  $37.7\mu\text{g}/\text{m}^3$ ,
- Nethergate (Trades House) –  $38.5\mu\text{g}/\text{m}^3$ ,
- St Andrews St (JAF) –  $35.4\mu\text{g}/\text{m}^3$ ,
- St Andrews St (PB) –  $34.7\mu\text{g}/\text{m}^3$ ,
- Strathmore Ave –  $37.6\mu\text{g}/\text{m}^3$ ,
- Union Street (Rollalong) –  $37.8\mu\text{g}/\text{m}^3$ ,
- Westport 2–  $34.2\mu\text{g}/\text{m}^3$ ,
- Whitehall St (Deb A)–  $38.2\mu\text{g}/\text{m}^3$ ,
- Whitehall St (TISO) –  $38.8\mu\text{g}/\text{m}^3$ ,

Sixteen sites exceeded the standard when relevant exposure was considered:

- Broughty Ferry Rd –  $45.3\mu\text{g}/\text{m}^3$ , relevant exposure  $40.2\mu\text{g}/\text{m}^3$ ,
- Commercial Street / Dock St –  $41.9\mu\text{g}/\text{m}^3$ , relevant exposure  $41.6\mu\text{g}/\text{m}^3$ ,
- Commercial Street (Waterstones)–  $47.4\mu\text{g}/\text{m}^3$ , relevant exposure  $43.4\mu\text{g}/\text{m}^3$ ,
- Lochee Rd (138) –  $57.4\mu\text{g}/\text{m}^3$ , relevant exposure  $46.0\mu\text{g}/\text{m}^3$ ,
- Lochee Rd Traffic lights (140),  $57.0\mu\text{g}/\text{m}^3$  – relevant exposure  $56.0\mu\text{g}/\text{m}^3$ ,
- Lochee Road ROMON 1,  $51.4\mu\text{g}/\text{m}^3$  – relevant exposure  $42.3\mu\text{g}/\text{m}^3$ ,
- Logie St (114) –  $58.2\mu\text{g}/\text{m}^3$ , relevant exposure  $55.9\mu\text{g}/\text{m}^3$ ,
- Loons Rd –  $45.3\mu\text{g}/\text{m}^3$ , relevant exposure  $43.9\mu\text{g}/\text{m}^3$ ,
- Meadowside –  $63.5\mu\text{g}/\text{m}^3$ , relevant exposure  $56.3\mu\text{g}/\text{m}^3$ ,
- Rankine St –  $42.6\mu\text{g}/\text{m}^3$ , relevant exposure  $41.5\mu\text{g}/\text{m}^3$ ,
- Seagate –  $45.9\mu\text{g}/\text{m}^3$  – relevant exposure  $45.3\mu\text{g}/\text{m}^3$ ,
- Seagate ROMON 1 -  $50.8\mu\text{g}/\text{m}^3$ , relevant exposure  $43.2\mu\text{g}/\text{m}^3$ ,
- Victoria Road (60) –  $43.8\mu\text{g}/\text{m}^3$ , relevant exposure  $42.5\mu\text{g}/\text{m}^3$ ,
- Victoria Rd / Hilltown –  $60.9\mu\text{g}/\text{m}^3$ , relevant exposure  $52.2\mu\text{g}/\text{m}^3$ ,
- Whitehall St (Bus) –  $51.7\mu\text{g}/\text{m}^3$ , relevant exposure  $45.2\mu\text{g}/\text{m}^3$ ,
- Whitehall St Romon 1 –  $42.7\mu\text{g}/\text{m}^3$ , relevant exposure  $40.1\mu\text{g}/\text{m}^3$ .

The Technical Guidance considers that there could be a potential risk of breaching the hourly  $\text{NO}_2$  standard, where the annual mean  $\text{NO}_2$  concentration is  $>60\mu\text{g}/\text{m}^3$ . There were two monitoring sites in the City with concentrations above  $60\mu\text{g}/\text{m}^3$  – Meadowside roadside diffusion tube site ( $63.5\mu\text{g}/\text{m}^3$ ) and (nearby) the junction of Victoria Road/Hilltown ( $60.9\mu\text{g}/\text{m}^3$ ). These monitoring sites are located in a street canyon close to a car park and adjacent to a busy junction. Neither of these kerbside locations are areas where members of the public are likely to be exposed for 1-hour or more. However, there is nearby residential exposure at the ground floor level. Projected to façade, the  $\text{NO}_2$  annual mean concentration falls below the  $60\mu\text{g}/\text{m}^3$  threshold at which a risk of exceedance may occur. Keeping in view the local knowledge and uncertainties associated with façade correction, the Council is recommended to monitor  $\text{NO}_2$  at locations appropriate to relevant exposure to identify if the hourly-mean objective for  $\text{NO}_2$  has been exceeded.

### 3.2.2 Particles (PM<sub>10</sub>)

Dundee City Council undertakes automatic monitoring of PM<sub>10</sub> at seven sites in the city centre. These are all located within the Dundee AQMA (NO<sub>2</sub>).

Dundee City Council uses three 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 is not gravimetric equivalent
- The OSIRIS particulate monitors supplied by Turnkey Instruments use a nephelometer, which sizes and counts individual particles as they pass through a laser beam. This is an indicative analyser, which is suitable as a screening tool for LAQM, but results should be treated with some caution.

Locations of the analysers across the city are:

- Partisol at Broughty Ferry Road (with TEOM co-location);
- TEOM at Union Street (with OSIRIS co-location);
- TEOM at Mains Loan, and
- Four Osiris monitors located at Seagate, Victoria Road, Lochee Road and Logie Street.

The Partisol is considered as a gravimetric equivalent analyser in the "*UK Equivalence Programme for Monitoring of Particulate Matter*" and as such can be compared directly with the prescribed objectives. The TEOM and Osiris monitors are not gravimetric equivalent, and as such data is required to be adjusted to enable comparison with the prescribed objectives. In the absence of suitable sites to enable adjustment of TEOM results using the LAQM.TG(09) recommended methodology of applying the volatile correction model; Dundee City Council has derived their own local factors from co-location studies to enable adjustment of both TEOM and Osiris data. The Scottish Executive prescribed an interim factor of 1.14 until a VCM correction could be extended to Scotland. AEA were commissioned by the Scottish Government to provide VCM correction for TEOMs; from 2008, hence this dataset is also corrected using the AEA VCM correction factors.

Comparison of the equivalent daily averages in 2007 for the Partisol and TEOM co-location study at Broughty Ferry Road showed that the TEOM was under-reading compared to the Partisol and the TEOM results have therefore been factored by the local factor of 1.054. The co-location study in 2008 showed the TEOM under-reading compared to the Partisol and the TEOM data have been corrected by local factor 0.997.

Comparing equivalent daily averages in 2007 for the TEOM and OSIRIS at Union Street found that the OSIRIS was over-reading compared to the TEOM. This meant the OSIRIS would need to be divided by a factor of 1.1 to be equivalent to the TEOM. In 2008, the Osiris was also shown to over-read compared to the TEOM, and would correction by dividing by factor 1.1. Hence, the annual mean OSIRIS results presented in this report have been adjusted prior to gravimetric correction factors being applied. The factored results for 2007 and 2008 are shown in Table 8, along with projected 2010 concentrations using the updated LAQM background concentrations provided in early 2010 (2008 base year maps).

Monitoring results indicate the 2004 PM<sub>10</sub> Objectives are being met. However, there is a risk of exceedence of the 2010 PM<sub>10</sub> objectives at the Osiris roadside sites. A detailed assessment has been undertaken in 2009 for PM<sub>10</sub>, which has similarly identified a risk of exceedence of the 2010 objectives adjacent to busy roads and junctions in the city centre.

**Table 8– Results of PM<sub>10</sub> Automatic Monitoring: Summary Comparison with Annual Mean Objective using all Gravimetric equivalence factors**

Location	Correction Factor	Within AQMA? <sup>1</sup>	Annual mean concentrations (µg/m <sup>3</sup> ) 2007	Data Capture 2007 %	Annual mean concentrations (µg/m <sup>3</sup> ) 2008	Data Capture 2008 %	Projected Concentration 2010 (from 2008 data)
Union Street TEOM PM <sub>10</sub>	1.3	N/A	<b>22.1</b>	90	<b>20.3</b>	100	<b>18.8</b>
	1.14		<b>19.3</b>		17.8		16.5
	Local 2007–1.054 2008-0.997		17.9		15.6		14.5
	VCM		n/a		16.9		15.7
Broughty Ferry TEOM PM <sub>10</sub>	1.3	N/A	<b>18.0</b>	99	<b>18.1</b>	96	16.9
	1.14		15.8		15.8		14.8
	Local 2007–1.054 2008-0.997		14.6		13.9		13.1
	VCM		n/a		15.2		14.3
Broughty Ferry Partisol	1.3	N/A	14.7	100	13.9	97	13.1
	1.14		14.7		13.9		13.1
	Local 2007–1.054 2008-0.997		14.7		13.9		13.1
	VCM		n/a		13.9		13.1
Mains Loan TEOM PM <sub>10</sub>	1.3	N/A	14.7	100	13.3	100	12.4
	1.14		12.9		11.6		10.8
	Local 2007–1.054 2008-0.997		11.9		10.2		9.5
	VCM		n/a		11.4		10.6
Osiris Victoria Road	1.3	N/A	<b>22.0</b>	91	<b>21.3</b>	93	<b>19.7</b>
	1.14		<b>19.3</b>		<b>18.6</b>		17.3
	Local 2007–1.054 2008-0.997		17.9		16.3		15.2
	VCM		n/a		17.6		16.3
Osiris Logie Street	1.3	N/A	<b>25.0</b>	(87)	<b>23.0</b>	92	<b>21.0</b>
	1.14		<b>21.9</b>		<b>20.2</b>		18.6
	Local 2007–1.054 2008-0.997		<b>20.3</b>		17.7		16.4
	VCM		n/a		<b>19.0</b>		17.5

Location	Correction Factor	Within AQMA? <sup>1</sup>	Annual mean concentrations (µg/m <sup>3</sup> ) 2007	Data Capture 2007 %	Annual mean concentrations (µg/m <sup>3</sup> ) 2008	Data Capture 2008 %	Projected Concentration 2010 (from 2008 data)
Osiris Union Street	1.3	N/A	<b>22.2</b>	90	<b>20.3</b>	92	<b>18.8</b>
	1.14		<b>19.4</b>		17.8		16.5
	Local 2007–1.054 2008–0.997		18.0		15.6		14.5
	VCM		n/a		16.9		15.7
Osiris Lochee Road	1.3	N/A	<b>27.5</b>	91	<b>25.8</b>	93	<b>23.5</b>
	1.14		<b>24.1</b>		<b>22.6</b>		<b>20.6</b>
	Local 2007–1.054 2008–0.997		<b>22.3</b>		<b>19.8</b>		<b>18.2</b>
	VCM		n/a		<b>21.1</b>		<b>19.3</b>
Osiris Seagate	1.3	N/A	<b>20.3</b>	92	<b>24.6</b>	93	<b>22.7</b>
	1.14		17.8		<b>21.6</b>		<b>20.0</b>
	Local 2007–1.054 2008–0.997		16.5		<b>19.0</b>		17.6
	VCM		n/a		<b>20.3</b>		<b>18.6</b>

<sup>1</sup> Currently there is no AQMA for PM10 in Dundee

**Table 9– Results of PM<sub>10</sub> Automatic Monitoring: Comparison with 24-hour Mean Objective**

Location	Correction Factor	Within AQMA? <sup>1</sup>	Number of Exceedences of 24-hour mean (50 µg/m <sup>3</sup> ) 2007	Data Capture 2007 %	Number of Exceedences of 24-hour mean (50 µg/m <sup>3</sup> ) 2008	Data Capture 2008 %
Union Street TEOM PM <sub>10</sub>	1.3	N/A	7 (50.3)	90	0 (38.1)	98
	1.14		5 (44.1)		0 (33.4)	
	Local 2007– 2008- 0.997		3 (41.0)		0 (29.2)	
	VCM		n/a		0 (40.3)	
Broughty Ferry TEOM PM <sub>10</sub>	1.3	N/A	4 (37.9)	99	0 (38.0)	96
	1.14		3 (33.2)		0 (33.3)	
	Local 2007– 2008- 0.997		2 (30.9)		0 (29.2)	
	VCM		n/a		0 (37.8)	
Broughty Ferry Partisol Gravimetric	1.3	N/A	4 (38.1)	100	1 (35.6)	98
	1.14		4 (38.1)		1 (35.6)	
	Local 2007– 2008- 0.997		4 (38.1)		1 (35.6)	
	VCM		n/a		1 (35.6)	
Mains Loan TEOM PM <sub>10</sub>	1.3	N/A	4 (32.2)	100	0 (29.2)	100
	1.14		2 (28.2)		0 (25.6)	
	Local 2007– 2008- 0.997		2 (26.3)		0 (22.4)	
	VCM		n/a		0 (30.7)	
Osiris Victoria Road	1.3	N/A	11 (53.9)	91	7 (50.1)	93
	1.14		5 (47.2)		4 (43.9)	
	Local 2007– 2008- 0.997		5 (43.7)		4 (38.4)	
	VCM		n/a		7 (50.4)	
Osiris Logie Street	1.3	N/A	10 (65.7)	(87)	9 (58.2)	92
	1.14		8 (57.6)		7 (51.1)	
	Local 2007– 2008- 0.997		8 (53.3)		4 (44.7)	
	VCM		n/a		9 (54.9)	
Osiris Union Street	1.3	N/A	12 (67.0)	90	5 (47.6)	93
	1.14		11 (58.8)		4 (41.8)	
	Local 2007– 2008- 0.997		9 (54.4)		2 (36.5)	
	VCM		n/a		4 (47.0)	
Osiris Lochee Road	1.3	N/A	17 (57.0)	91	11 (59.8)	93
	1.14		7 (50.0)		7 (52.4)	
	Local 2007– 2008- 0.997		4 (46.2)		6 (45.9)	
	VCM		n/a		10 (57.9)	

Location	Correction Factor	Within AQMA?1	Number of Exceedences of 24-hour mean (50 µg/m3) 2007	Data Capture 2007 %	Number of Exceedences of 24-hour mean (50 µg/m3) 2008	Data Capture 2008 %
Osiris Seagate	1.3	N/A	11 (52.7)	92	13 (64.7)	93
	1.14		3 (46.2)		10 (56.8)	
	Local 2007– 2008- 0.997		1 (42.7)		7 (49.7)	
	VCM		n/a		12 (56.6)	

<sup>1</sup>Currently there is no AQMA for PM10 in Dundee

The 98<sup>th</sup> percentiles are shown in brackets next to number of 24-hour mean exceedences. When data capture is less than 90% the percentiles should be consulted in preference to the reported number of exceedences.

### 3.2.3 Sulphur dioxide (SO<sub>2</sub>)

Dundee City Council measures SO<sub>2</sub> at one location within the city, at Broughty Ferry Road. The UV fluorescence analyser is operated under similar protocols to the AURN and the unit is audited twice yearly by AEA. Data are ratified with reference to the Technical Guidance (LAQM.TG09).

Data for 2007 and 2008 are shown in Table 10 below. Concentrations of SO<sub>2</sub> are very low and the objectives were met. Percentiles for each objective are given alongside the number of exceedences in brackets.

**Table 10– Results of Automatic Monitoring for Sulphur dioxide: Comparison with Objectives**

Location	Within AQMA?	Description	2007 µg/m <sup>3</sup>	2008 µg/m <sup>3</sup>
Broughty Ferry Road	Yes (For NO <sub>2</sub> only)	15 Minute mean > 266 µg/m <sup>3</sup> for more than 35 15-minute periods	0 (51.0)	0 (56.0)
		Hourly mean > 350 µg/m <sup>3</sup> for more than 24 hours	0 (35.5)	0 (36.0)
		Daily Mean > 125 µg/m <sup>3</sup> for more than 3 days	0 (15.7)	0 (16.8)
		Corresponding % Data Capture	97.5 99.6 99.7	95.6 97.5 97.5

\*Data for all years has been fully ratified.

Exceedences are highlighted in bold. Percentiles 99.9<sup>th</sup> for 15min, 99.7<sup>th</sup> for hourly and 99.2<sup>nd</sup> percentile for 24-hour means in brackets next to exceedences.

## 4 Road Traffic Sources

As mentioned in Section 2.1, additional 2007 peak hour counts used to update the council's Paramics traffic model remain to be analysed. This will be reported in subsequent review and assessment reports as necessary.

### 4.1 Narrow congested streets with residential properties close to the kerb

These are streets where buildings on either side reduce dispersion of ground-level pollutants. The thresholds for assessing narrow, congested streets have changed since the previous Updating Screening and Assessment.

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 (Most recently in the Further Assessment 2009).

Dundee City Council confirms that there are currently 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 or examined in the DA/FA 2009.

### 4.2 Busy streets where people may spend 1-hour or more close to traffic

Since the last USA, 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 street where people may spend 1 hour or more close to traffic.

### 4.3 Roads with a high flow of buses and/or Heavy Goods Vehicles

Traffic data assessed for the Updating and Screening Assessment show no newly identified roads with high flows of buses and heavy goods vehicles >20%. The traffic counts since the last USA (Appendix 1) indicate the following streets have heavy goods 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%. All but the latter have also been considered within the Further Assessment (NO<sub>2</sub>) and Detailed Assessment (PM<sub>10</sub>) reports undertaken in 2009.

Dundee City Council confirms that there are no new/newly identified roads with high flows of buses and/or heavy goods vehicles that require detailed assessment.



#### 4.4 Junctions (Including busy roads and junctions in Scotland)

Dundee City Council has declared the whole of the administrative area as an AQMA for NO<sub>2</sub> annual mean and the main busy roads and junctions have been assessed in the Further Assessment 2009. With respect to PM<sub>10</sub>, the previous USA highlighted five busy roads and junctions that were predicted to exceed the PM<sub>10</sub> annual mean objective., these were: Seagate, Nethergate/Marketgait, Loons Road/Logie Street, Lochee Road/Dudhope Terrace and Victoria Road/Hilltown. These junctions and busy roads have been assessed within the Detailed Assessment 2009. In addition the technical guidance (LAQM.TG(09)) introduced new requirement for PM<sub>10</sub> for Scottish local authorities: to assess roads and junctions with more than 5,000 vehicles per day (AADT), where the annual mean background in 2010 is expected to be above 15µg/m<sup>3</sup>. Only one mapped background 1kmx1km grid square meets this criteria, it is located at 335500E 731500N and the expected concentration is 15.4µg/m<sup>3</sup> (based on the background maps issued in January 2010). A proposed development in the area prompted the need for local road counts and PM<sub>10</sub> monitoring as there is relevant exposure within 10m of the kerb. The monitoring is ongoing and will be used to verify advanced air dispersion modelling of busy roads and junctions in this area. Any predicted exceedences will be examined in the future review and assessment reports.

Dundee City Council confirms that there are no new/newly identified busy junctions/busy roads that require Detailed Assessment at this time.

#### 4.5 New roads constructed or proposed since the last round of Review and Assessment

There are no newly constructed roads since the previous round of review and assessment, other than small roads serving new developments. These roads have flows that are significantly below 10,000 vehicles per day.

Dundee City Council confirms that there are no new/proposed roads that meet this criterion.

#### 4.6 Roads with significantly changed traffic

The automatic permanent and temporary traffic count data collected since the last USA has been factored and is shown in Appendix 1. This was compared with traffic data used for the previous Updating and Screening Assessment and no roads with greater than 10,000 vehicles per day were found to have experienced a large (25%) increase in traffic.. The council's Road Traffic Reduction Sites show an average reduction in annual average daily traffic flows since 2005., though, this reduction is not mirrored on the Kingsway.

Dundee City Council confirms that there are currently no new/newly identified roads with significantly changed traffic flows.

#### 4.7 Bus and coach stations

The assessment considers both the hourly and annual mean standards for nitrogen dioxide at bus stations with >2500 movements per day, where the travelling public are not enclosed and where residential properties are closer than 10m to the buses.. The assessment criteria have relaxed since the previous review when the threshold was >1000 movements. There are no new bus stations since the last review and the bus movements at the existing local bus station are estimated to be 294.

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

## 5 Other Transport Sources

### 5.1 Airports

The assessment for airports considers nitrogen dioxide. If there are no airports in the Local Authority area that meet the criteria, there is no need to proceed further with this part.

Although there is relevant exposure within 1000m of the Dundee Airport terminal, in 2008, scheduled chartered flights only carried approximately 61,000 passengers and there were no freight flights. This is well below the threshold for assessment of 10 million passengers per annum or equivalent freight.

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

### 5.2 Railways (Diesel and Steam trains)

The assessment for stationary trains considers sulphur dioxide emissions, while the assessment for moving diesel trains considers nitrogen dioxide emissions. 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.

#### 5.2.1 Stationary Trains

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

### 5.2.2 Moving Trains

The requirement to assess nitrogen dioxide emissions from moving diesel locomotives is new. 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.

### 5.3 Ports (Shipping)

The assessment for shipping considers sulphur dioxide emissions (for the 15minute standard) from busy ports, where the shipping movements range from 5,000 to 15,000 per year and where relevant exposure is within 250 metres of the berths. If there are no ports or shipping that meet these criteria, there is no need to proceed further with this part. Although there are both residential receptors and other outdoor relevant exposure within 250m (in some cases as close as ~130m), the estimated number of shipping movements for the local port were only 656 in 2008.

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

## 6 Industrial Sources

### 6.1 Industrial Installations

The technical guidance says that the assessment of industrial installations should consider all of the regulated pollutants, although those most at risk of requiring 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 5.

#### 6.1.1 New or Proposed Installations for which an Air Quality Assessment has been carried out

Since the previous review a clinical waste treatment facility became operational in April 2009.. An Air Quality Assessment accompanied the application for authorisation and no exceedences of the National Air Quality Standards or Objectives for the relevant LAQM pollutants were identified. The assessment did not examine PM<sub>10</sub> although it is not expected that emissions will lead to a breach of the objective at sensitive receptors due to the presence of a HEPA filter on the process stack. The operators have recently applied to SEPA for a variation to their permit and the council have requested that an air quality assessment including PM<sub>10</sub> be included with application. The need for a screening assessment or detailed assessment will be kept under review.

Dundee City Council has assessed new/proposed industrial installations, for which information is available, and concluded that it will not be necessary to proceed to a detailed assessment.

#### 6.1.2 Existing Installations where emissions have increased substantially or new relevant exposure has been introduced

Since the previous review, new residential exposure has been introduced closer to an industrial process in Kemback Street. This process has not been previously assessed as it was not listed in Annex 2 Appendix E of TG.03. According to the guidance provided in Figure A2.4 of TG.09 (page A2-18) this process does not require to be assessed. SEPA have confirmed that there has been no significant changes to the operation since previous rounds of review and assessment.

SEPA provided some emission monitoring data for CO, NO<sub>x</sub> and SO<sub>2</sub> for 2007( 0mg/m<sup>3</sup>, 7mg/m<sup>3</sup>, 2mg/m<sup>3</sup>, respectively). This information was used in conjunction with stack parameters (height 32m, effective height 20m diameter 1.8m and velocity 15m/s), activity data (08:00 to 14:00 5 days a week for 52 weeks), along with local background (98th Percentile Total oxidant Aberdeen 2006= 153 µg/m<sup>3</sup>), and ambient concentrations (36.1 µg/m<sup>3</sup> annual mean NO<sub>2</sub> at worst case receptor within 10 stack heights). This allowed a screening assessment to be carried out using the industrial emissions calculator (v.2), the estimated emissions from the process were well below the thresholds requiring further action.

No monitoring data for particulates was available and no suitable emission factor could be found on the NAEI emission factor database. SEPA have indicated that particulate monitoring will be required by the operator due to legislative changes and these results could be used in future review and assessments reports if suitable.

Dundee City Council has reviewed industrial installations with new relevant exposure in their vicinity, and concluded that a detailed assessment is not required.

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

There are several new processes listed in Appendix 5 as, 'Chapter 7- Solvent Emissions Directive',. This is due to a change in legislation although the majority of the premises themselves are not new. These processes, mostly dry cleaning establishments, do not appear in Annex 2 Appendix E of TG.03 and there is no updated guidance to suggest that these processes require review and assessment.

An industrial process in Balgray Street has been listed previously as a coating / lithographic process and according to Annex 2 Appendix E of TG.03 was not a process likely to require review and assessment and has not been previously assessed. The operators applied to SEPA for a substantial variation to their operating permit in June 2010, in this instance the process activity was described as 'rubber conversion' which according to Annex 2 Appendix E of TG.03 could potentially require review and assessment. During the consultation process the council requested that modelling be undertaken to determine if the National Air Quality Standards and Objectives for any relevant LAQM pollutants are likely to be breached at any sensitive receptors. The need for a screening assessment or detailed assessment of this process will be kept under review.

There is a cement batching process in Longtown Street, although this type of process is listed in Annex 2 Appendix E of TG.03 as not likely to require review and assessment, the potential for fugitive emissions has been examined. This has not been assessed previously. A screening assessment was carried out using the methodology described in TG.09 (paragraphs 5.51 to 5.52). The NAEI (2000) gives this type of process of an average emission factor of 0.146 tonnes per annum. TG.09 requires that this emission rate is scaled to take account of the available headroom which gives a scaled emission rate of 0.097 tonnes per annum (Background = 12 $\mu\text{g}/\text{m}^3$ , Target Value 1.5  $\mu\text{g}/\text{m}^3$ ). Using this scaled emission rate and the zero chimney height line in the nomogram provided in Figure 5.9 of TG.09 gives a distance of approx. 45m. The nearest receptors to this site are approx. 180m from the site and hence no further assessment is required. The NAEI (2008) emission factor for PM<sub>10</sub> from this process type is listed as 0.00 kilotonnes/Megatonne.

Dundee City Council has assessed new/proposed industrial installations, and concluded that it will not be necessary to proceed to a detailed assessment at the current time.

## 6.2 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.

## 6.3 Petrol stations

The assessment considers benzene, with respect to the 2010 objective. Large petrol stations, where annual throughput is more than 2000 m<sup>3</sup> of petrol (2 million litres per annum), and with a busy road nearby of >30000 annual average daily traffic flows, require consideration with respect to relevant exposure (e.g. residential properties) within 10m of the pumps.

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

## 6.4 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 in this assessment, to establish whether there is relevant 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 in the local authority area meeting the specified criteria.

## 7 Commercial and Domestic Sources

### 7.1 Biomass combustion

#### 7.1.1 Biomass combustion - individual installations

This item is a new requirement and the assessment considers both PM<sub>10</sub> and nitrogen dioxide objectives. Biomass burning can lead to an increase in PM<sub>10</sub> emissions, due 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.

Dundee City Council has not identified biomass combustion plants in the Local Authority area, which meet the criteria. However, these sources require further investigation, as there is insufficient information at present to adequately assess this. This will be assessed and reported in subsequent LAQM reports as information becomes available.

#### 7.1.2 Biomass and solid fuel combustion – combined impacts (PM<sub>10</sub> emissions)

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. The previous review 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. Since the last USA 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 smoke-less fuels. Anecdotally the council have received 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 the time of writing, but could become more important in future.

Dundee City Council has not identified any areas of the city which meet the criteria for assessment detailed in the LAQM FAQ<sup>7</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.

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[http://laqm2.defra.gov.uk/FAQs/Pollutant/Domestic/How\\_to\\_identify\\_area\\_where\\_burning\\_coal\\_etc\\_leads\\_to\\_PM10\\_exceedences.pdf](http://laqm2.defra.gov.uk/FAQs/Pollutant/Domestic/How_to_identify_area_where_burning_coal_etc_leads_to_PM10_exceedences.pdf)



## 7.2 Domestic solid-fuel burning (sulphur dioxide emissions)

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 the last USA. Previous rounds of review and assessment have not identified areas where domestic coal/solid fuel burning gives 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.

## 8 Fugitive or Uncontrolled Sources

The assessment of new fugitive and uncontrolled sources considers the PM<sub>10</sub> objectives. This includes consideration to 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 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 2004 objectives, near is within:

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

For 2010 objectives, near is within:

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

If the relevant exposure is within 50 m 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 1000 m 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.

Since the previous review there are new residences (i.e. relevant exposure) in the City Quay development that are within 200m of potential materials handling areas of the port. The flats have not been occupied very long and the council have not received any dust complaints about activities at the port. This will be kept under review.

Dundee City Council confirms that there are no new/newly identified fugitive or uncontrolled sources within the local authority area that require detailed assessment.

## 9 Conclusions and Proposed Actions

### 9.1 Conclusions from new monitoring data

New monitoring data for 2008 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 2007 and 2008.

PM<sub>10</sub> objectives for 2004 are being met at all monitoring locations within the city. The data from the Osiris PM<sub>10</sub> monitors are only indicative and not equivalent to the reference method, but largely shows agreement with the TEOM and Partisol data. The annual mean concentrations recorded at Osiris locations Victoria Road, Logie Street, Lochee Road and Seagate indicate a potential risk of exceedence of the 2010 objectives. A Detailed Assessment for PM<sub>10</sub> was undertaken in 2009, which similarly indicates a risk of exceedence of the 2010 objectives. Consequently, Dundee City Council will take forward the recommendations of the detailed assessment and declare an AQMA for PM<sub>10</sub>.

Exceedences of the nitrogen dioxide annual mean objective continued to occur within the existing AQMA in 2008 and, after façade projections were calculated, sixteen sites failed to meet the annual mean standard.

With respect to the hourly NO<sub>2</sub> objective, there were two monitoring sites in the city with annual mean concentrations above 60µg/m<sup>3</sup> – Meadowside roadside diffusion tube site (63.5µg/m<sup>3</sup>) and (nearby) the junction of Victoria Road/Hilltown (60.9µg/m<sup>3</sup>). Members of the public are not regularly present for more than 1-hour in these locations, however there are nearby ground floor residences on Meadowside. When projected to façade the concentrations calculated are below 60µg/m<sup>3</sup>. Keeping in view the uncertainties associated with façade projection methodology, the Council intend to monitor at sites of relevant exposure close to the identified locations to confirm if the hourly-mean of NO<sub>2</sub> is being exceeded.

### 9.2 Conclusions from assessment of sources

The Updating and Screening Assessment has reviewed new and significantly changed sources in the city. No significant roads or other sources have been identified which warrant detailed assessment. As discussed in Section 4 there is some additional road count information that requires to be screened, in addition busy roads and junctions in grid square 335500E 731500N are being modelled as a result of a proposed development in the area. In Section 6 some additional modelling of industrial sources has been requested by the council as part of the consultations carried out by SEPA on applications for variations to permits of two local industries. The findings of these additional works will be reported as necessary in future rounds of review and assessment.

With respect to biomass combustion, Dundee City Council has not identified sources in the area, which meets the criteria. However, it is considered that biomass combustion sources require further investigation, as that there is insufficient information at present to assess this adequately. This will be reported in subsequent LAQM reports as information becomes available.

### 9.3 Proposed Actions

Proposed actions arising from the Updating and Screening Assessment are as follows:

- Investigate further 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;
- Monitor at locations of relevant exposure for sites identified with potential exceedence of the hourly-mean NO<sub>2</sub> objective;
- Take forward the recommendations of the Detailed Assessment 2009 with respect to PM<sub>10</sub>, in the light of identified risk of exceedence of the 2010 PM<sub>10</sub> objectives; i.e. declare an AQMA for this pollutant; and
- Progress to a 2010 Annual Progress Report.

## 10 References

- The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Volume 1), July 2007. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland
- Highways Agency's Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 1 Air Quality, May 2007, and accompanying spreadsheet DMRB Screening Method V1,03.xls. July 2007
- Defra 2008, Diffusion Tubes for Ambient NO<sub>2</sub> Monitoring: Practical Guidance for Laboratories and Users
- Local Air Quality Management Technical Guidance LAQM.TG(09). February 2009. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland
- Local Air Quality Management Policy Guidance LAQM.PGS (09). February 2009. Published by the Scottish Government.
- Local Air Quality Management FAQ: "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)?" Published by Defra at:  
[http://laqm2.defra.gov.uk/FAQs/Pollutant/Domestic/How\\_to\\_identify\\_area\\_where\\_burning\\_coal\\_etc\\_leads\\_to\\_PM10\\_exceedences.pdf](http://laqm2.defra.gov.uk/FAQs/Pollutant/Domestic/How_to_identify_area_where_burning_coal_etc_leads_to_PM10_exceedences.pdf)
- Dundee City Council 2007 Local Air Quality Management Annual Progress Report
- Dundee City Council 2006 Local Air Quality Management Updating and Screening Assessment

## APPENDICES

### Appendix 1 - Traffic Data

Data Source	Location	%HDV	Year	AADT	AADT 2008	AADT 2010
12 Hour Junction Counts	A929 Forfar Road (North)	8.7	2007	9086	9118	9186
12 Hour Junction Counts	Clepington Road (West)	4.8	2007	12699	12871	13169
12 Hour Junction Counts	A929 Forfar Road (South)	7.8	2007	8684	8714	8779
12 Hour Junction Counts	Clepington Road (East)	4.1	2007	10807	10952	11206
12 Hour Junction Counts	A923 High Street (N)	6.5	2007	15818	15874	15992
12 Hour Junction Counts	Muirton Road	0.9	2007	1403	1422	1455
12 Hour Junction Counts	A923 High Street (S)	5.8	2007	17347	17407	17537
12 Hour Junction Counts	Loons Rd	2.7	2007	8231	8342	8535
12 Hour Junction Counts	B960 Dens Road	10.2	2007	10090	10226	10463
12 Hour Junction Counts	Cotton Road	2.2	2007	208	211	216
12 Hour Junction Counts	Victoria Street (S of Cotton Rd)	9.6	2007	14613	14664	14774
12 Hour Junction Counts	Victoria Street (N of Dens Rd)	7.6	2007	5322	5394	5519
12 Hour Junction Counts	A929 Victoria Road	3.7	2007	14797	14849	14960
12 Hour Junction Counts	A991 Victoria Way	3.8	2007	17234	17294	17423
12 Hour Junction Counts	Meadowside	3.8	2007	3221	3265	3340
12 Hour Junction Counts	A929 Victoria Road	9	2007	18796	18861	19002
12 Hour Junction Counts	A991 Victoria Way	3.7	2007	14797	14849	14960
12 Hour Junction Counts	Meadowside	<b>27.1</b>	2007	4272	4330	4430
12 Hour Junction Counts	Hilltown	3.5	2007	4748	4812	4924
12 Hour Junction Counts	A929 Victoria Road (S of Hilltown)	9	2007	18759	18824	18965
12 Hour Junction Counts	A929 Victoria Road (N of Hilltown)	10.9	2007	14017	14066	14172
12 Hour Junction Counts	High Street	<b>46.5</b>	2007	3158	3201	3275
12 Hour Junction Counts	Nethergate	<b>35.3</b>	2007	4724	4788	4899

Data Source	Location	%HDV	Year	AADT	AADT 2008	AADT 2010
12 Hour Junction Counts	Union Street	22.6	2007	2238	2268	2321
12 Hour Junction Counts	Whitehall Crescent (e)	27.3	2007	2529	2563	2622
12 Hour Junction Counts	Union Street (n)	22.9	2007	2214	2244	2296
12 Hour Junction Counts	Union Street (s)	3.5	2007	1569	1590	1627
12 Hour Junction Counts	Whitehall Crescent (w)	51	2007	2148	2177	2228
12 Hour Junction Counts	West Marketgait	7.1	2007	20249	20320	20472
12 Hour Junction Counts	Nethergate	13.4	2007	5153	5223	5344
12 Hour Junction Counts	South Marketgait	3.6	2007	17199	17260	17389
12 Hour Junction Counts	Nethergate	33.5	2007	4953	5020	5136
12 Hour Junction Counts	A929 Forfar Road	6.8	2007	9264	9297	9366
12 Hour Junction Counts	Mains Loan	2.4	2007	940	952	974
12 Hour Junction Counts	Dura Street	3	2007	10986	11134	11392
12 Hour Junction Counts	Albert Street	8.8	2007	7385	7485	7659
12 Hour Junction Counts	Pitkerro Road	3.5	2007	9175	9299	9514
12 Hour Junction Counts	Albert Street	6.6	2007	9842	9975	10206
12 Hour Junction Counts	Victoria Street	6.7	2007	5694	5771	5904
12 Hour Junction Counts	Princes Street	7.9	2007	12251	12294	12386
12 Hour Junction Counts	Arbroath Road	6.6	2007	11912	11953	12043
12 Hour Junction Counts	West Marketgait (N)	5.9	2007	18359	18423	18561
12 Hour Junction Counts	Hawkhill	4.3	2007	18067	18130	18265
12 Hour Junction Counts	West Marketgait (S)	7	2007	20184	20254	20406
12 Hour Junction Counts	South Ward Road	1	2007	6103	6185	6329
12 Hour Junction Counts	West Port/South Tay Road	3.3	2007	2394	2427	2483
12 Hour Junction Counts	West Port/South Tay Road	3.2	2007	2563	2598	2658
12 Hour Junction Counts	West Marketgait (n)	4.6	2007	25535	25624	25815
12 Hour Junction Counts	West Marketgait (s)	5.6	2007	21100	21174	21332

Data Source	Location	%HDV	Year	AADT	AADT 2008	AADT 2010
12 Hour Junction Counts	West Bell Street	8	2007	4975	5042	5159
12 Hour Junction Counts	North Lindsay Street (n)	8	2007	4485	4546	4651
12 Hour Junction Counts	Ward Road (w)	2.9	2007	4670	4733	4843
12 Hour Junction Counts	North Lindsay Street (s)	1.3	2007	5553	5628	5759
12 Hour Junction Counts	Ward Road (e)	10.3	2007	4552	4613	4720
12 Hour Junction Counts	Lochee Road	6.2	2007	17713	17775	17908
12 Hour Junction Counts	West Marketgait	4.6	2007	25547	25637	25828
12 Hour Junction Counts	A991 North Marketgait	2.8	2007	29376	29478	29699
12 Hour Junction Counts	Reform Street	2.6	2007	1006	1020	1043
12 Hour Junction Counts	Bank Street	2.9	2007	994	1007	1030
12 Hour Junction Counts	Rankine Street	1.8	2007	7581	7683	7861
12 Hour Junction Counts	A923 Lochee Road (n)	6.6	2007	13837	13885	13989
12 Hour Junction Counts	Cleghorn Street	1.5	2007	2842	2880	2947
12 Hour Junction Counts	A923 Lochee Road (s)	5	2007	20756	20829	20985
12 Hour Junction Counts	A923 Lochee Road (n)	5	2007	20756	20829	20985
12 Hour Junction Counts	A923 Lochee Road (s)	5.5	2007	18874	18940	19081
12 Hour Junction Counts	Dudhope Terrace	3.3	2007	6745	6836	6994
Air Traffic AQ 09 Perm	Ninewells Avenue (Nth of Ninewells Hosp)	-	2007	6340	6426	6575
Air Traffic AQ 09 Perm	Craigie Drive (Lavender St)	-	2006	8923	9164	9411
Air Traffic AQ 09 Perm	Arbroath Road (Monymusk)	-	2007	28290	28389	28601
Air Traffic AQ 09 Perm	Dalhousie Road (West of Kerrington Cres)	-	2008	12668	12668	12757
Air Traffic AQ 09 Perm	Coupar Angus Road (West of Templeton Rd)	-	2008	10431	10431	10504
Air Traffic AQ 09 Perm	Claverhouse Road (East of Caird Park Access Rd)	-	2008	11654	11654	11736
Air Traffic AQ 09 Perm	Riverside Avenue (East of Apollo Way)	-	2008	17405	17405	17527

Data Source	Location	%HDV	Year	AADT	AADT 2008	AADT 2010
Air Traffic AQ 09 Perm	South Marketgait	-	2008	11281	11281	11360
Air Traffic AQ 09 Perm	Riverside Drive (East of Airport)	-	2008	19054	19054	19187
Air Traffic AQ 09 Perm	Tay Road Bridge (Ramp 3)	-	2008	6379	6379	6424
Air Traffic AQ 09 Perm	Tay Road Bridge (Ramp 2)	-	2008	6607	6607	6653
Air Traffic AQ 09 Perm	Tay Road Bridge (Ramp 1)	-	2008	12433	12433	12520
Air Traffic AQ 09 Perm	Forfar Road (North of Janefield Place)	-	2008	8220	8220	8278
Air Traffic AQ 09 Perm	Pitkerro Road (Baxter Park Terr)	-	2008	10102	10102	10375
Air Traffic AQ 09 Perm	Hilltown (North of Stirling St)	-	2008	5598	5598	5749
Air Traffic AQ 09 Perm	Rankine Street	-	2008	7931	7931	8145
Air Traffic AQ 09 Perm	Lochee Road (North of Rankine St)	-	2008	13291	13291	13384
Air Traffic AQ 09 Perm	Blackness Road (West of Marchfield Rd)	-	2008	6193	6193	6360
Air Traffic AQ 09 Perm	Perth Road (East of Windsor St)	-	2008	7560	7560	7764
Air Traffic AQ 09 Perm	Arbroath Road (East of Kenilworth Ave)	-	2008	12957	12957	13048
Air Traffic AQ 09 Perm	Lower Princess Street (Blackscroft)	-	2005	19354	19586	19723
Air Traffic AQ 09 Perm	Dens Road (South of Hillbank Rd)	-	2008	11025	11025	11323
Air Traffic AQ 09 Temp	Ninewells Avenue (Sth of Hospital)	-	2008	8044	8044	8261
Air Traffic AQ 09 Temp	Monifieth Road (West of Reresmount Place)	-	2008	13937	13937	14035
Air Traffic AQ 09 Temp	Riverside Drive (Newhall Gdns)	-	2008	9256	9256	9321
Air Traffic AQ 09 Temp	Loons Road (East of Cobden St)	-	2008	6579	6579	6757
Air Traffic AQ 09 Temp	Balgillo Road (East of Kintail Place)	-	2007	9026	9148	9360
Air Traffic AQ 09 Temp	Johnston Avenue (Sth of Glenogil Ave)	-	2007	6505	6593	6746
Air Traffic AQ 09 Temp	Seagate (Horsewynd)	-	2007	4500	4561	4667
Air Traffic AQ 09 Temp	Clelington Road (East of Johnston Ave)	-	2007	11925	11967	12056
Air Traffic AQ 09 Temp	Perth Road (East of Millbay Gdns)	-	2007	9140	9263	9478



Data Source	Location	%HDV	Year	AADT	AADT 2008	AADT 2010
Air Traffic AQ 09 Temp	City Road (Sth of Cleghorn St)	-	2007	5226	5297	5419
Air Traffic AQ 09 Temp	Strips Of Craigie Road	-	2006	4714	4841	4972
Air Traffic AQ 09 Temp	Perth Road (Ninewells Garage)	-	2006	9052	9296	9547
Air Traffic AQ 09 Temp	Dundee Road (Christian Rd)	-	2006	17415	17885	18368
Air Traffic AQ 09 Temp	Camperdown Road (West of Frederick St)	-	2006	5317	5461	5608
Air Traffic AQ 09 Temp	Balunie Drive (East of Ballindean Rd)	-	2006	6487	6662	6842

## Appendix 2 - Bias Adjustment Factor Calculations

### Seagate 2007

Period	Start Date	End Date	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% Confidence Interval of mean	Automatic Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data Capture Check
1	03/01/2007	31/01/2007	51.6	54.2	44.6	50	5.0	10	12.3	51.5	95.5	Good	Good
2	31/01/2007	28/02/2007	62.6	60.8	47.8	57	8.1	14	20.1	63.4	95.7	Good	Good
3	28/02/2007	04/04/2007	62	65.4	64.6	64	1.8	3	4.4	51.0	81.8	Good	Good
4	04/04/2007	02/05/2007	50.4	52	58.2	54	4.1	8	10.2	49.9	92.1	Good	Good
5	02/05/2007	30/05/2007	55.4	57	58.8	57	1.7	3	4.2	39.5	95.5	Good	Good
6	30/05/2007	04/07/2007	57.9	61.5	60.6	60	1.9	3	4.7	42.9	95.2	Good	Good
7	04/07/2007	01/08/2007	49.7	54.3	51.7	52	2.3	4	5.7	38.2	95.2	Good	Good
8	01/08/2007	29/08/2007	53.6	54.3	56.1	55	1.3	2	3.2	45.3	95.7	Good	Good
9	29/08/2007	03/10/2007	51.9	48.3	46.5	49	2.7	6	6.8	38.1	95.5	Good	Good
10	03/10/2007	31/10/2007	54.1	58.8	58.6	57	2.7	5	6.6	56.5	95.8	Good	Good
11	31/10/2007	28/11/2007	46.6	47.6	58.2	51	6.4	13	16.0	52.6	95.8	Good	Good
12	28/11/2007	03/01/2008	57.2	54.3	62.1	58	3.9	7	9.8	61.0	94.8	Good	Good

Bias calculated using 10 periods of data	
Bias factor A	0.89
Bias B	12%
Diffusion Tubes Mean:	55 $\mu\text{g m}^{-3}$
Mean CV (Precision):	6
Automatic Mean:	49 $\mu\text{g m}^{-3}$
Data Capture for periods used:	94%
Adjusted Tubes Mean:	49 $\mu\text{g m}^{-3}$

**Whitehall Street 2007**

Period	Start Date	End Date	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% Confidence Interval of mean	Automatic Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data Capture Check
1	03/01/2007	31/01/2007	40.2	37.5	40.9	40	1.8	5	4.5	34.7	92.3	Good	Good
2	31/01/2007	28/02/2007	54.2	53.2	50	52	2.2	4	5.5	49.4	50.4	Good	Poor Data Capture
3	28/02/2007	04/04/2007	48.1	42.6	50.3	47	4.0	8	9.9	43.5	84.4	Good	Good
4	04/04/2007	02/05/2007	49.1	47.4	43.5	47	2.9	6	7.1	41.4	95.5	Good	Good
5	02/05/2007	30/05/2007	42.8	45.9	44.7	44	1.6	4	3.9	35.0	95.8	Good	Good
6	30/05/2007	04/07/2007	43.1	44.4	44.9	44	0.9	2	2.3	39.9	95.5	Good	Good
7	04/07/2007	01/08/2007	40.2	41.3	40.9	41	0.6	1	1.4	33.0	93.2	Good	Good
8	01/08/2007	29/08/2007	43.8	43	39.8	42	2.1	5	5.3	36.2	95.7	Good	Good
9	29/08/2007	03/10/2007	41.5	39.9	44.7	42	2.4	6	6.1	37.4	95.6	Good	Good
10	03/10/2007	31/10/2007	43.8	45.9	44.2	45	1.1	2	2.8	46.9	95.5	Good	Good
11	31/10/2007	28/11/2007	46.1	43.9	47.3	46	1.7	4	4.3	51.9	95.7	Good	Good
12	28/11/2007	03/01/2008	46.4	51.3	46	48	3.0	6	7.3	55.8	95.1	Good	Good

<b>Bias calculated using 10 periods of data</b>	
<b>Bias factor A</b>	0.94
<b>Bias B</b>	6%
<b>Diffusion Tubes Mean:</b>	44 $\mu\text{g/m}^3$
<b>Mean CV (Precision):</b>	4
<b>Automatic Mean:</b>	41 $\mu\text{g/m}^3$
<b>Data Capture for periods used:</b>	94%
<b>Adjusted Tubes Mean:</b>	41 $\mu\text{g/m}^3$

**Lochee Road 2007**

Period	Start Date	End Date	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% Confidence Interval of mean	Automatic Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data Capture Check
1	03/01/2007	31/01/2007	59.5	62.4	61.1	61	1.5	2	3.6	55.3	99.7	Good	Good
2	31/01/2007	28/02/2007	61.5	63.9	52.0	59	6.3	11	15.6	66.1	99.9	Good	Good
3	28/02/2007	04/04/2007	54.4	53.5	51.9	53	1.3	2	3.1	48.3	88.5	Good	Good
4	04/04/2007	02/05/2007	57.5	55.1	51.1	55	3.2	6	8.0	50.7	96.7	Good	Good
5	02/05/2007	30/05/2007	49.5	51.3	51.1	51	1.0	2	2.5	48.9	90.6	Good	Good
6	30/05/2007	04/07/2007	44.7	45.5	42.5	44	1.6	4	3.9	37.7	73.8	Good	Poor Data Capture
7	04/07/2007	01/08/2007	49.0	48.5	49.6	49	0.6	1	1.4	37.9	94.0	Good	Good
8	01/08/2007	29/08/2007	55.6	55.1	55.3	55	0.3	0	0.6	41.1	95.7	Good	Good
9	29/08/2007	03/10/2007	54.2	57.3	56.7	56	1.6	3	4.1	46.2	95.5	Good	Good
10	03/10/2007	31/10/2007	70.3	66.1	60.6	66	4.9	7	12.1	63.6	95.7	Good	Good
11	31/10/2007	28/11/2007	67.6	68.7	65.2	67	1.8	3	4.4	62.7	95.1	Good	Good
12	28/11/2007	03/01/2008	73.3	69.1	68.3	70	2.7	4	6.7	70.4	95.4	Good	Good

<b>Bias calculated using 10 periods of data</b>	
<b>Bias factor A</b>	0.92
<b>Bias B</b>	9%
<b>Diffusion Tubes Mean:</b>	58 $\mu\text{g/m}^3$
<b>Mean CV (Precision):</b>	4
<b>Automatic Mean:</b>	54 $\mu\text{g/m}^3$
<b>Data Capture for periods used:</b>	95%
<b>Adjusted Tubes Mean:</b>	54 $\mu\text{g/m}^3$

**Union Street 2007**

Period	Start Date	End Date	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% Confidence Interval of mean	Automatic Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data Capture Check
1	03/01/2007	31/01/2007	57.7	57.3	53.5	56	2.3	4	5.8	36.4	99.3	Good	Good
2	31/01/2007	28/02/2007	57.8	43.9	42.5	48	8.5	18	21.0	33.3	99.1	Good	Good
3	28/02/2007	04/04/2007	47.1	47.7	41.5	45	3.4	8	8.5	30.5	99.4	Good	Good
4	04/04/2007	02/05/2007	47.6	48.7	54.2	50	3.5	7	8.8	33.5	99.6	Good	Good
5	02/05/2007	30/05/2007	53.5	53.3	51.0	53	1.4	3	3.5	29.5	99.6	Good	Good
6	30/05/2007	04/07/2007	38.3	39.4	34.2	37	2.7	7	6.8	24.4	99.4	Good	Good
7	04/07/2007	01/08/2007	47.8	46.1	47.4	47	0.9	2	2.2	30.9	99.0	Good	Good
8	01/08/2007	29/08/2007	49.3	49.5	49.4	49	0.1	0	0.2	32.4	99.7	Good	Good
9	29/08/2007	03/10/2007	50.7	49.4	50.0	50	0.7	1	1.6	33.3	98.9	Good	Good
10	03/10/2007	31/10/2007	59.7	56.5	56.6	58	1.8	3	4.5	43.2	99.1	Good	Good
11	31/10/2007	28/11/2007	56.9	52.2	53.9	54	2.4	4	5.9	48.7	99.6	Good	Good
12	28/11/2007	03/01/2008	59.5	56.9	54.6	57	2.5	4	6.1	52.8	92.6	Good	Good

Bias calculated using 10 periods of data	
Bias factor A	0.71
Bias B	41%
Diffusion Tubes Mean:	50 $\mu\text{g m}^{-3}$
Mean CV (Precision):	5
Automatic Mean:	36 $\mu\text{g m}^{-3}$
Data Capture for periods used:	99%
Adjusted Tubes Mean:	36 $\mu\text{g m}^{-3}$

Seagate 2008

Period	Start Date	End Date	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% Confidence Interval of mean	Automatic Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data Capture Check
1	03/01/2008	30/01/2008	65.4	60.6	66.0	64	3.0	5	7.4	63.0	95.5	Good	Good
2	30/01/2008	27/02/2008	57.6	57.8	59.6	58	1.1	2	2.7	57.9	95.7	Good	Good
3	27/02/2008	02/04/2008	53.7	52.2	54.5	53	1.2	2	2.9	51.2	95.7	Good	Good
4	02/04/2008	30/04/2008	64.3	69.7	63.1	66	3.5	5	8.7	51.3	92.3	Good	Good
5	30/04/2008	28/05/2008	70.7	64.6	77.6	71	6.5	9	16.2	47.2	92.0	Good	Good
6	28/05/2008	02/07/2008	56.1	56.0	59.0	57	1.7	3	4.2	41.4	69.6	Good	Poor Data Capture
7	02/07/2008	30/07/2008	59.1	57.5	61.4	59	2.0	3	4.9	38.9	76.8	Good	Good
8	30/07/2008	03/09/2008	56.7	58.0	53.9	56	2.1	4	5.2	-	-	Good	-
9	03/09/2008	01/10/2008	55.4	54.8	60.9	57	3.4	6	8.4	49.4	85.4	Good	Good
10	01/10/2008	29/10/2008	44.6	46.0	51.7	47	3.8	8	9.3	47.5	95.5	Good	Good
11	29/10/2008	03/12/2008	55.9	54.3	57.9	56	1.8	3	4.5	55.4	96.6	Good	Good
12	03/12/2008	07/01/2009	53.7	59.4	54.1	56	3.2	6	7.9	57.5	99.4	Good	Good

Bias calculated using 10 periods of data	
Bias factor A	0.88
Bias B	13%
Diffusion Tubes Mean:	59 $\mu\text{g m}^{-3}$
Mean CV (Precision):	5
Automatic Mean:	52 $\mu\text{g m}^{-3}$
Data Capture for periods used:	92%
Adjusted Tubes Mean:	52 $\mu\text{g m}^{-3}$

## Appendix 2 (Continued)-Bias Adjustment Factor Calculations

### Union Street 2008

Period	Start Date	End Date	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% Confidence Interval of mean	Automatic Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data Capture Check
1	03/01/2008	30/01/2008	66.7	69.6	57.7	65	6.2	10	15.4	53.4	99.5	Good	Good
2	30/01/2008	27/02/2008	58.4	57.7	59.0	58	0.7	1	1.6	57.6	99.7	Good	Good
3	27/02/2008	02/04/2008	51.3	52.2	53.0	52	0.9	2	2.1	44.5	99.9	Good	Good
4	02/04/2008	30/04/2008	47.5	47.8	46.7	47	0.6	1	1.4	35.0	99.9	Good	Good
5	30/04/2008	28/05/2008	35.8	36.7	37.2	37	0.7	2	1.8	25.3	99.4	Good	Good
6	28/05/2008	02/07/2008	47.3	45.0	49.6	47	2.3	5	5.7	35.1	99.6	Good	Good
7	02/07/2008	30/07/2008	38.9	39.8	40.3	40	0.7	2	1.8	28.2	99.9	Good	Good
8	30/07/2008	03/09/2008	48.0	47.7	45.8	47	1.2	3	3.0	36.1	99.9	Good	Good
9	03/09/2008	01/10/2008	55.7	50.3	49.2	52	3.5	7	8.6	43.3	99.9	Good	Good
10	01/10/2008	29/10/2008	55.2	55.2	53.9	55	0.8	1	1.9	46.4	99.7	Good	Good
11	29/10/2008	03/12/2008	60.6	59.0	53.8	58	3.6	6	8.8	52.5	99.2	Good	Good
12	03/12/2008	07/01/2009	60.4	57.9	57.4	59	1.6	3	4.0	58.9	99.6	Good	Good

Bias calculated using 12 periods of data	
Bias factor A	0.84
Bias B	19%
Diffusion Tubes Mean:	51 $\mu\text{g/m}^3$
Mean CV (Precision):	3
Automatic Mean:	43 $\mu\text{g/m}^3$
Data Capture for periods used:	100%
Adjusted Tubes Mean:	43 $\mu\text{g/m}^3$

## Appendix 2 (Continued)-Bias Adjustment Factor Calculations

### Lochee Road 2008

Period	Start Date	End Date	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% Confidence Interval of mean	Automatic Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data Capture Check
1	03/01/2008	30/01/2008	72.9	75.1	77.2	75	2.2	3	5.3	66.0	91.4	Good	Good
2	30/01/2008	27/02/2008	64.6	62.6	67.5	65	2.5	4	6.1	55.4	89.0	Good	Good
3	27/02/2008	02/04/2008	61.7	50.8	52.8	55	5.8	11	14.4	56.1	91.6	Good	Good
4	02/04/2008	30/04/2008	53.5	58.9	57.1	57	2.7	5	6.8	47.2	91.2	Good	Good
5	30/04/2008	28/05/2008	49.5	42.1	43.5	45	3.9	9	9.8	40.3	91.4	Good	Good
6	28/05/2008	02/07/2008	58.0	56.3	57.6	57	0.9	2	2.2	45.6	91.3	Good	Good
7	02/07/2008	30/07/2008	48.7	49.1	46.3	48	1.5	3	3.8	39.2	91.5	Good	Good
8	30/07/2008	03/09/2008	56.9	54.1	50.6	54	3.2	6	7.8	39.0	95.1	Good	Good
9	03/09/2008	01/10/2008	59.3	55.4	59.9	58	2.4	4	6.1	51.5	91.7	Good	Good
10	01/10/2008	29/10/2008	60.7	64.6	58.1	61	3.3	5	8.1	53.5	89.9	Good	Good
11	29/10/2008	03/12/2008	49.7	67.0	72.0	63	11.7	19	29.1	66.0	92.6	Good	Good
12	03/12/2008	07/01/2009	70.2	72.4	69.5	71	1.5	2	3.8	73.1	97.6	Good	Good

Bias calculated using 12 periods of data	
Bias factor A	0.89
Bias B	12%
Diffusion Tubes Mean:	59 $\mu\text{g}/\text{m}^3$
Mean CV (Precision):	6
Automatic Mean:	53 $\mu\text{g}/\text{m}^3$
Data Capture for periods used:	92%
Adjusted Tubes Mean:	53 $\mu\text{g}/\text{m}^3$



### Appendix 3 – Nitrogen Dioxide Diffusion Tube Annualisation Factors and Annualised Means

Background Site	Annual Mean (ug/m <sup>3</sup> )	Period mean Jan-Mar'08	Ratio (Am/Pm)	Period mean Mar-Jul'08 & Sep-Dec'08	Ratio (Am/Pm)	Period mean Mar-Aug & Dec'08	Ratio (Am/Pm)
Birnam Place	13.5	15.6	0.864	12.9	1.042	12.0	1.127
Earl Grey Place (Park)	23.8	30.2	0.787	22.0	1.078	19.4	1.223
Woodside Ave	21.3	26	0.818	19.9	1.068	18.8	1.132
		<b>Average ratio</b>	<b>0.823</b>	<b>Average ratio</b>	<b>1.063</b>	<b>Average ratio</b>	<b>1.160</b>

Am = Annual Mean, Pm = Period Mean

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Period Mean	Adjusted Annualised Mean
BROOK ST B/F	39.2	31.5	26.2	-	-	-	-	-	-	-	-	-	32.3	26.6
KINGSWAY/ PITKERRO RD	40.8	41.5	29.7	-	-	-	-	-	-	-	-	-	37.3	30.7
PERTH RD/HAWKHILL	34.9	35.6	25.4	-	-	-	-	-	-	-	-	-	32.0	26.3
ST MARY'S FLATS	34.0	29.6	19.6	-	-	-	-	-	-	-	-	-	27.7	22.8
PERTH RD 320	-	-	-	40.5	32.7	31.2	26.8		47.9	43.3	47.4	46.3	39.5	<b>42.0</b>
QUEEN ST B/F	-	-	-	33.5	24.8	29.9	26.3	29.5				32.7	29.5	34.2

## Appendix 4 - Nitrogen Dioxide Diffusion Tube Results 2008

Site Ref	Location	X	Y	Site type	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Average	Corrected Annual Mean 2008
1	Abertay	340047	730629	K	67.6	62.6	50.1	51.3	57.0	54.7	50.0	63.8	48.4	46.5	59.4	58.5	55.8	<b>48.5</b>
4	Albert St (Fish)	341139	731476	K	49.4	40.7	35.2	33.8	22.5	29.3	24.9	34.8	39.5	42.8	49.9	49.0	37.7	32.8
5	Albert St (Shandon Pl)	341174	731578	R	49.5	47.0	33.1	56.1	59.9	39.9	43.9	45.1	50.7	32.0	44.3	36.8	44.9	39.0
2	Albert St (1)	341105	731210	K	53.0	47.0	34.8	45.2	49.2	38.0	35.9	45.0	46.1	36.5	48.0	43.9	43.6	37.9
6	Arbroath Rd (13)	341111	731070	K	65.2	57.4	44.6	33.4	29.7	41.0	33.3	44.6	46.9	45.5	54.2	58.0	46.2	<b>40.2</b>
8	Arthurstone Tce (10)	341051	731203	K	40.0	35.0	22.4	28.7	29.5	24.1	22.9	26.8	32.2	23.7	29.0	35.9	29.2	25.4
9	Balgavies Pl	343082	731465	UB	33.8	27.6	18.7	15.1	10.8	-	11.5	-	19.2	21.1	27.2	32.2	21.7	18.9
0	Bank St/ Reform St	340228	730337	K	46.2	37.3	32.1	30.2	25.7	27.5	24.2	28.4	30.8	29.1	37.8	39.5	32.4	28.2
12	Birnam Pl	337531	730914	UB	19.3	17.7	9.8	12.3	10.9	10.8	8.7	10.9	12.2		17.5	18.2	13.5	11.7
14	Brook St B/F	346293	730872	K	39.2	31.5	26.2	-	-	-	-	-	-	-	-	-	32.3	26.6
16	Broughty Ferry Road (141)	343322	731074	R	55.8	50.5	42.8	47.5	48.1	53.2	45.9	51.0	54.4	53.4	61.9	60.3	52.1	<b>45.3</b>
18	Claypotts Junction	345315	732103	R	41.5	34.9	21.8	33.5	43.0	27.7	28.7	32.3	34.5	23.5	28.4	36.9	32.2	28.0
19	Cleington Road/Forfar Road	341385	732121	K	55.9	49.1	42.2	49.4	40.5	33.6	24.7	35.7	44.0	45.6	52.7	58.2	44.3	38.5
20	Commercial St	340328	730431	K	51.1	41.2	32.7	41.6	51.1	36.4	39.8	42.4	44.6	34.1	40.9	43.4	41.6	36.2
21	Commercial St (Waterstones)	340481	730325	K	60.7	50.5	43.0	68.1	78.5	50.8	57.0	56.0	49.9	37.2	51.2	51.2	54.5	<b>47.4</b>
24	Crichton St	340481	730325	K	55.8	43.4	32.4	38.0	31.5	35.4	31.6	33.0	40.8	37.1	44.3	45.1	39.0	34.0
25	Dens Road Crossing	340331	730162	R	49.5	49.2	34.4	37.8	34.7	39.8	26.6	39.2	44.2	40.7	47.9	51.9	41.3	36.0
26	Dock St (14)	340726	731238	K	65.3		43.1	57.9	48.7	49.1	46.9	41.9	46.6	48.4	53.1	53.1	50.4	<b>43.8</b>
29	Dock St (Unicorn)(No.60)	340395	730086	R	55.0	55.0	47.6	42.7	33.8	44.6	40.1	47.2	45.4	43.1	53.6	55.1	46.9	<b>40.8</b>
32	Dura Street (Forte) (No.98)	340660	730348	K	55.2	46.3	41.5	48.5	47.6	43.2	38.7	44.7	49.2	47.3	55.2	56.4	47.8	<b>41.6</b>

R= Roadside, K=Kerbside, UB=Background. Exceedences of the annual mean objective are highlighted in bold.

## Appendix 4 (Continued) - Nitrogen dioxide diffusion tube results 2008

Site Ref	Location	X	Y	Site type	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Average	Corrected Annual Mean 2008
34	Earl Grey Place (Park)	340699	730019	UB	39.9	27.8	22.9	19.6	13.5	17.3	13.9	18.2	19.7	23.1	35.1	34.1	23.8	20.7
35	Eastport Roundabout	340651	730623	R	51.3	46.3	32.2	44.2	38.9	37.1	35.5	39.7	42.0	35.5	44.6	47.6	41.2	35.9
36	Harefield Road (35)	338360	731854	K	50.4	49.1	31.7	44.5	44.3	37.6	32.3	38.5	42.5	31.0	44.4	50.4	41.4	36.0
42	Hilltown (Suites)	340088	731117	R	50.5	44.0	36.1	43.2	37.0	40.0	33.6	30.3	43.1	37.5	45.3	47.8	40.7	35.4
44	King St (12 & 14)	340598	730757	K	47.5	44.3	26.9	29.6	23.7	26.8	23.8	28.7		35.3	46.6	48.0	34.7	30.1
45	Kingsway E. Roundabout	343107	731740	R	59.7	52.0	47.8	45.0	47.3	49.7	39.4	42.8	57.7	44.5	47.8	53.4	48.9	<b>42.6</b>
46	Kingsway/ Mains Loan 1	341123	732469	R	45.7	-	-	49.4	64.5	38.5	39.6	42.3	43.6	27.2	39.3	44.1	43.4	37.8
48	Kingsway/ Pitkerro Rd	341959	732300	R	40.8	41.5	29.7	-	-	-	-	-	-	-	-	-	37.3	30.7
49	Kingsway/ Strathmartine Rd (S)	339219	732832	K	63.7	53.2	53.5	51.5	42.3	45.7	44.2	46.7	48.0	49.1	66.0	56.5	51.7	<b>45.0</b>
51	Lochee Rd (138)	338936	730680	K	75.1	72.5	55.2	63.8	59.3	68.8	57.1	61.1	71.1	58.6	74.9	74.5	66.0	<b>57.4</b>
34	Lochee Rd (140) Traffic Lts	338927	730685	R	73.1	69.6	58.1	62.7	55.6	70.3	59.7	61.6	68.8	54.2	79.7	72.2	65.5	<b>57.0</b>
58	Lochee Rd (184)	338767	730856	K	52.5	51.3	43.8	41.6	34.2	40.7	33.8	42.6	47.3	44.4	51.5	56.2	45.0	39.1
36/37/38	Lochee Rd (Romon 1)	338861	730773	K	75.1	64.9	55.1	56.5	45.0	57.3	48.0	53.9	58.2	61.1	62.9	70.7	59.1	<b>51.4</b>
59	Lochee Rd/Polepark Rd	338360	731854	K	51.8	43.5	28.4	36.3	33.7	31.6	28.1	32.0	36.1	32.8	42.7	47.9	37.1	32.3
61	Logie Street (114)	340088	731117	R	73.2	69.6	58.9	62.9	63.0	65.9	62.7	65.0	67.1	60.9	72.2	81.7	66.9	<b>58.2</b>
60	Logie Street (98)	338252	731258	K	48.4	-	27.4	39.5	35.8	37.5	31.0	34.0	42.3	39.7	50.8	50.4	39.7	34.5
63	Loons Road (1)	338211	731293	R	54.1	46.1	37.4	58.7	66.9	48.3	46.6	52.0	55.7	44.5	57.6	57.1	52.1	<b>45.3</b>
64	Marketgait	339956	730090	R	48.4	40.6	31.8	45.1	53.3	40.5	36.6	42.9	40.7	33.3	38.9	42.3	41.2	35.8

R= Roadside, K=Kerbside, UB=Background. Exceedences of the annual mean objective are highlighted in **bold**.

## Appendix 4 (Continued) - Nitrogen dioxide diffusion tube results 2008

Site Ref	Location	X	Y	Site type	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Average	Corrected Annual Mean 2008
44	Meadowside	340245	730651	R	85.1	69.1	76.4	77.3	66.7	71.9	67.0	69.9	71.0	71.6	78.4	72.0	73.0	<b>63.5</b>
66	Muirton Road (6)	338152	731293	R	40.0	34.3	24.7	38.0	48.8	31.9	31.6	31.2	34.7	21.8	24.5	41.1	33.6	29.2
67	Myrekirk Road	335420	731733	R	47.0	41.6	37.1	36.1	25.7	34.5	26.8	33.5	36.2	36.4	47.9	42.4	37.1	32.3
68	Nethergate (B&B)(88)	340163	730061	K	-	59.2	49.5	64.8	67.1	53.3	54.9	57.4	55.6	49.4	54.4	55.6	56.5	<b>49.1</b>
69	Nethergate (Bradford)	340274	730171	R	61.4	58.2	40.3	42.7	51.0	48.5	44.8	47.2	50.5	46.2	50.7	54.1	49.6	<b>43.2</b>
70	Nethergate (Charlie T)	340033	729957	K	55.6	53.0	50.6	46.0	30.1	30.3	31.0	39.8	45.9	42.6	53.5	51.3	44.1	38.4
72	Nethergate (Trades House)	340230	730124	R	52.4	50.2	43.0	59.3	66.0	49.9	50.6	49.9	53.1	43.9	47.1	49.1	51.2	<b>44.6</b>
73	Nethergate/ Marketgait	340074	729984	R	48.0	44.8	38.8	46.7	35.8	30.2	34.6	34.2	38.9	39.7	47.8	45.5	40.4	35.2
54	Rankine St (2)	338768	730900	R	67.7	53.6	54.9	39.6	42.3	42.1	37.1	38.2	48.5	51.2	63.5		49.0	<b>42.6</b>
78	Seagate	340545	730532	R	62.3	56.0	50.4	54.9	57.4	48.9	46.3	52.5	52.2	44.4	53.4	54.7	52.8	<b>45.9</b>
56/57/58	Seagate (Romon 1 )	340487	730446	K	64.0	58.3	53.5	65.7	71.0	57.0	59.3	56.2	57.0	47.4	56.0	55.7	58.4	<b>50.8</b>
83	Seagate (Yates)(7-9)	340467	730388	R	49.0	51.9	34.6	36.1	49.4	39.2	43.2	46.1	41.0	38.6	47.4	51.6	44.0	38.3
84	Soapwork Lane	340100	730649	K	53.1	45.1	31.9	35.5	36.2	35.8	34.4	38.6		39.5	50.8	51.4	41.1	35.8
87	St Andrews St (JAF)	340514	730587	K	56.5	49.6	40.5	47.6	57.1	41.8	42.1	41.4	46.9	38.1	47.3	48.2	46.4	<b>40.4</b>
88	St Andrews St (PB)	340532	730551	K	56.0	56.7	45.0	48.7	46.7	45.7	42.9	45.2	47.0	38.6	52.1	48.8	47.8	<b>41.6</b>
63	St Mary Flats	339039	730624	R	34.0	29.6	19.6	-	-	-	-	-	-	-	-	-	27.7	22.8
95	Strathmore Avenue (353)	339609	731871	R	53.3	50.9	39.6	56.6	63.9	-	40.5	48.4	48.2	34.6	50.5	52.3	42.8	<b>42.6</b>
97	Trades Lane (31)	340584	730488	K	50.4	41.5	35.1	43.1	35.0	35.0	35.0	33.2	35.8	26.9	44.1	44.0	38.3	33.3
98/99/100	Union St (Rollalong)	340235	730091	R	47.8	40.3	34.9	44.8	43.3	33.8	29.7	37.2	41.1	33.1	41.2	42.6	51.3	<b>44.7</b>

R= Roadside, K=Kerbside, UB=Background. Exceedences of the annual mean objective are highlighted in **bold**.

### Appendix 4 (Continued) - Nitrogen dioxide diffusion tube results 2008

Site Ref	Location	X	Y	Site type	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Average	Corrected Annual Mean 2008
101	Union Street (Goodfellows)	339609	731871	R	42.4	41.0	34.7	39.5	41.5	34.8	33.7	37.0	43.2	28.8	37.7	44.3	39.2	34.1
102	Union Street (Mcintyres)	340584	730488	K	42.4	41.0	34.7	39.5	41.5	34.8	33.7	37.0	43.2	28.8	37.7	44.3	38.2	33.2
103	Victoria Road	340260	730083	R	69.6	57.7	52.2	47.8	36.7	45.0	39.8	47.7	50.3	55.2	59.0	57.9	44.1	38.4
73	Victoria Road (10)	340293	730051	R	47.0	38.5	31.4	47.2	41.6	35.1	33.8	36.0	39.6	29.1	44.3	45.1	39.1	34.0
60	Victoria Road (60)	340212	730634	R	54.9	55.6	41.7	47.6	58.5	46.8	47.3	50.4	52.0	42.3	51.9	54.9	50.3	<b>43.8</b>
104	Victoria Road / Cotton Road	340225	730667	K	51.1	53.4	38.8	37.0	30.4	42.4	32.6	41.2	46.2	44.4	47.6	50.2	42.9	37.4
105	Victoria Road/Hilltown	340375	730779	R	82.4	78.6	67.3	63.4	50.3	68.9	60.6	64.9	66.6	76.4	83.8	76.5	70.0	<b>60.9</b>
76	Victoria St	340740	730996	K	48.6	38.3	33.0	44.7	43.8	34.4	38.2	39.9	41.7	30.7	46.6	45.1	40.4	35.2
106	Westport (2)	339842	730122	R	64.4	60.9	49.1	46.6	35.4	45.3	37.2	38.0	48.9	40.8	53.0	49.9	47.5	<b>41.3</b>
107	Whitehall Cr (Xpresso)	340376	730109	K	45.5	39.4	37.4	34.6	30.2	32.1	29.7	30.2	36.2	32.4	35.8	39.1	35.2	30.6
111	Whitehall St (Brj)	340330	730106	K	52.6	43.4	41.8	47.8	40.4	41.2	36.1	40.6	42.1	38.4	48.6	48.1	43.4	37.8
112	Whitehall St (Bus)	340289	730128	R	75.6	66.7	45.4	63.1	51.2	-	55.2	55.3	58.2	62.9	57.2	62.3	59.4	<b>51.7</b>
113	Whitehall St (Deb A)	340265	730153	K	62.8	63.5	56.8	61.2	63.9	58.7	54.0	54.8	58.9	51.2	49.7	57.7	57.8	<b>50.3</b>
114	Whitehall St (Deb E)	340322	730098	K	57.3	47.4	42.9	46.8	41.4	41.3	38.2	41.9	44.8	43.5	51.2	49.9	45.6	39.6
82/83/84	Whitehall St (Romon 1) mean	340278	730156	R	56.7	49.9	45.9	56.2	58.9	45.7	46.9	-	47.4	40.0	44.3	48.1	49.1	<b>42.7</b>
115	Whitehall St (Tiso)	340293	730142	R	57.7	48.3	39.0	58.2	68.0	46.7	49.0	42.9	51.8	37.0	43.8	45.8	49.0	<b>42.6</b>
116	Woodside Avenue	340776	732307	UB	32.4	29.2	16.4	20.7	14.7	15.0	14.1	17.9	22.3	16.5	25.6	30.3	21.3	18.5

R= Roadside, K=Kerbside, UB=Background. Exceedences of the annual mean objective are highlighted in **bold**.

#### Appendix 4 (Continued) - Nitrogen dioxide diffusion tube results 2008

Site Ref	Location	X	Y	Site type	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Average	Corrected Annual Mean 2008
-	Forfar Road	341437	732360	K	66.6	69.8	45.2	58.5	40.6			47.3	60.7	58.5	66.9	63.0	57.7	<b>50.2</b>
-	Commercial St / Dock St 2	340565	730263	R	55.2	47.4	45.8	52.8	47.3	49.1	44.0	43.5	49.7	46.7	46.1	50.4	48.2	<b>41.9</b>
-	Dock St Carol Whyte (2)	340524	730216	R	52.1	43.0	41.3	47.6	40.6	39.0	36.5	41.8	41.0	31.0	53.3	50.0	43.1	37.5
-	Perth Rd / Hawkhill	338742	729828	K	34.9	35.6	25.4	-	-	-	-	-	-	-	-	-	32.0	26.3
-	Nethergate / South Tay St	339987	729919	R	40.7	35.4	33.0	39.8	34.7	29.5	28.8	31.4	35.7			36.6	34.6	30.2
-	Perth Rd 320	-	-	R	-	-	-	40.5	32.7	31.2	26.8		47.9	43.3	47.4	46.3	39.5	<b>42.0</b>
-	Ward Rd	-	-	R	-	-	-	36.9	44.1	40.2	33.3	40.6	43.3	38.7	38.8	40.9	39.6	34.7
-	West Bell St	-	-	R	-	-	-	45.5	48.6	37.5	31.9	39.5	42.1	36.7	44.2	46.7	41.4	36.2
-	Queen Street B/F	-	-	R	-	-	-	33.5	24.8	29.9	26.3	29.5	-	-	-	32.7	29.5	34.2

R= Roadside, K=Kerbside, UB=Background. Exceedences of the annual mean objective are highlighted in **bold**

## Appendix 5 - List of Industrial Processes

Process Name/Address	Process Type	PG Note	New source since USA 2006?	Existing process with new exposure?	Substantial change >30% ?	Process Potentially Requiring Review & Assessment~	Nomogram screening assessment required?	Detailed assessment Required?
Rockwell Solutions, Wester Gourdie, Dundee	Chapter 6: Other Activities Surface treating with organic solvents - Also Chapter 7 SED	6.4.b	No	No	No	No	No	No
Dundee Energy Recycling, Baldovie, Dundee	Chapter 5: Waste Management	5.1.c	No	No	No	Yes, previously assessed	No	No
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
Nationwide Crash Repair Centres Ltd, Liff Road, Dundee	Chapter 6: Other Activities vehicle respraying	6.4.b	No	No	No	No	No	No
Hanson Aggregates Piper Street, Dundee	Chapter 3: Mineral Industries cement batchers	3.1.a.(ii)	No	No	No	No	No	No
Subsea Protection Systems	Chapter 3: Mineral Industries cement batching	3.1.b	No	No	No	Yes, previously assessed	No	No
Discovery Filling Station	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No
Brochtay Filling Station	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No
Asda Stores Filling Station Kirkton	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No
Tesco Stores Ltd, Methven Street, Dundee	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No

Process Name/Address	Process Type	PG Note	New source since USA 2006?	Existing process with new exposure?	Substantial change >30% ?	Process Potentially Requiring Review & Assessment~	Nomogram screening assessment required?	Detailed assessment Required?
BP Kingsway West Filling Station	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No
Shell Caird Park	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No
Shell UK Ltd, East Kingsway Dundee	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No
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
Tesco Stores Ltd, Riverside Drive, Dundee	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No
Somerfield Ltd, Marketgait F/S, Dundee	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No
Sainsburys Supermarket Ltd, Dundee	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No
Jet Petrol Station, Forfar Road, Dundee	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	No	No	No	Yes, previously assessed	No	No
Dens Metals Ltd, West Pitkerro, Dundee	Chapter 2: Production and Processing of Metals	2.2.a	No	No	No	Yes, previously assessed	No	No
Mctavish Ramsay Ltd, Barlow Ave, West Pitkerro	Chapter 6: Other Activities Timber Activity	6.6.(i)	No	No	No	No	No	No
Johnsons, Asda Dundee	Chapter 7: SED Activities	Chapter 7: SED Activities	Yes*	N/A	N/A	No	No	No



Process Name/Address	Process Type	PG Note	New source since USA 2006?	Existing process with new exposure?	Substantial change >30% ?	Process Potentially Requiring Review & Assessment~	Nomogram screening assessment required?	Detailed assessment Required?
Aggregrate Industries, Longtown Street, Dundee	Chapter 3: Mineral Industries Cement Batching	3.1.a.(ii)	Yes*	No	No	No	Yes*	No
Aberdeen Valet Service Dundee	Chapter 7: SED Activities	Chapter 7: SED Activities	Yes*	N/A	N/A	No	No	No
Lochee Drycleaning Centre Dundee	Chapter 7: SED Activities	Chapter 7: SED Activities	Yes*	N/A	N/A	No	No	No
Ferry Laundrette Broughty Ferry	Chapter 7: SED Activities	Chapter 7: SED Activities	Yes*	N/A	N/A	No	No	No
Stay-Press Dry Cleaning Centre, Dundee	Chapter 7: SED Activities	Chapter 7: SED Activities	Yes*	N/A	N/A	No	No	No
Care Clean, Dundee	Chapter 7: SED Activities	Chapter 7: SED Activities	Yes*	N/A	N/A	No	No	No
Dignity Ltd, Dundee Crematorium, Dundee	Chapter 5: Waste Management	5.1c	No	No	No	No	No	No
Laundry On Line, Dundee	Chapter 7: SED Activities	Chapter 7: SED Activities	Yes*	N/A	N/A	No	No	No
Wm Morrison Supermarkets Plc, Dundee	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	Yes+	N/A	N/A	No	No	No
Wm Morrison Supermarkets plc, I Afton Way	Chapter 7: SED Activities	Chapter 7: SED Activities	Yes*	N/A	N/A	No	No	No
Tesco Filling Station, South Road, Dundee	Chapter 1: Energy Industries-Petrol Station	1.2.c.(ii)	Yes+	N/A	N/A	No	No	No
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

Process Name/Address	Process Type	PG Note	New source since USA 2006?	Existing process with new exposure?	Substantial change >30% ?	Process Potentially Requiring Review & Assessment~	Nomogram screening assessment required?	Detailed assessment Required?
Danpak Flexibles, Kemback St Dundee	Chapter 6: Other Activities surface treatment using organic solvents also Chapter 7 SED coating flexible packaging	6.4.b	No	Yes^	No	No	No	No
J T Inglis, Riverside Works, Dundee	Chapter 6: Other Activities Textile Treatment	6.4.d	No	No	No	No	No	No
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
Michelin Tyre Plant, Dundee	Chapter 1: Energy Industries, Combustion	1.1.a	No	No	No	Yes, previously assessed	No	No
D C Thomson Printers, Dundee	Chapter 6: Other Activities printing process	6.4.b	No	No	No	No	No	No
Day International Ltd, Balgray St, Dundee	Chapter 6: Other Activities surface treatment of rubber with organic solvents	6.4.b	No	No	No	Yes*?, not previously assessed	?	?
RMC Readymix Ltd, Dundee	Chapter 3: Mineral Industries, Cement Batching	3.1.a.(ii)	No	No	No	No	No	No
Brown & Tawse Steelstock Ltd, Fowler RD West Pitkerro - Dundee	Chapter 6: Other Activities, paint spraying	6.4.a	No	No	No	No	No	No
Armitages Pet Products Ltd, Broughty Ferry Road- Dundee	Chapter 6: Other Activities, Pet Food Manufacture	6.8.a	No	No	No	No	No	No
Tesco Stores Ltd, Kingsway Retail Park Dundee	Chapter 1: Energy Industries, Petrol Station	1.2.c.(ii)	No	No	No	No	No	No

Process Name/Address	Process Type	PG Note	New source since USA 2006?	Existing process with new exposure?	Substantial change >30% ?	Process Potentially Requiring Review & Assessment~	Nomogram screening assessment required?	Detailed assessment Required?
Joinery and Timber Creations (65) Ltd,	Chapter 6: Other Activities, Timber Process	6.6.(i)	No	No	No	No	No	No
Ethiebeaton Quarry	Chapter 3 Mineral Activities - cement batching process 3.1 a(ii), roadstone coating 3.5e, crushing and grinding 3.5c	3.1a(ii), 3.5e, 3.5c	No	No	No	No	No	No
Health Care Environmental Services, Nobel Road, Wester Gourdie Ind. Estate	Chapter 5 Waste Management PartA Treatment of Clinical waste	5.3a	Yes <sup>o</sup>	N/A	N/A	No	?	?

Yes\* see Section 6.1.3

Yes+ see Section 6.3

Yes^ see Section 6.1.2

Yes<sup>o</sup> see Section 6.1.1

~ with reference to Annex 2 Appendix E TG.03

