DUNDEE CITY COUNCIL

LOCAL AIR QUALITY MANAGEMENT

PROGRESS REPORT 2005

Ref: Air Quality 2005 Progress Report October 2005

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EXECUTIVE SUMMARY

This document contains the 2005 Progress Report on air quality within the Dundee City Council area. The report focuses on each of the pollutants listed in the Air Quality Regulations that were monitored within the council area during 2004, these were; benzene, nitrogen dioxide, sulphur dioxide, and fine particulate matter (PM_{10}).

Local authorities are required to assess the levels of seven pollutants, on a three yearly basis, to determine if the pollutant levels that the public are exposed to can be achieved by the set target dates, or if additional measures will need to be taken to address locally polluted areas.

Dundee City Council carried out an Updating and Screening Assessment in 2003 which concluded that there was no problem with the levels of some of the pollutants listed in the regulations namely; carbon monoxide, 1,3-butadiene, and lead, but further work was recommended for nitrogen dioxide, benzene, sulphur dioxide and particles (PM_{10}).

The subsequent 2005 Detailed Assessment concluded that, despite national measures to reduce vehicle emissions, additional local measures would be required to reduce levels of traffic pollutants and one or more Air Quality Management Areas (AQMAs) should be designated for nitrogen dioxide. The AQMAs must include areas of Lochee Road and the City Centre. No AQMA was recommended for sulphur dioxide but further work was required to clarify the situation regarding particulates.

This Progress Report concentrates primarily on new monitoring data and new local developments that have the potential to affect local air quality. It also provides information to assist in other policy areas, such as transport and land use planning within the council. Each pollutant has been assessed in conjunction with the relevant guidance and the conclusions reached are:

1. **Benzene -** no AQMA is currently required for benzene;
2. **Nitrogen dioxide –** analysis of the 2004 data for nitrogen dioxide has confirmed the need for an AQMA in the area around the Logie Street/Loons Road junction. Planned developments and changes to the road network in and around the city centre will influence traffic movements and may result in new areas of exceedence in the city centre;
3. **Particulates (PM_{10})** – the results for 2004 indicate that the 2004 and 2010 objectives will be met at the Broughty Ferry Road and background monitoring sites but are inconclusive for the Union Street monitoring location. The situation regarding PM_{10} will be kept under review. The infrastructure and construction works associated with the Central Waterfront Development may increase ambient particulate levels in the city centre over several years; and
4. **Sulphur dioxide –** no AQMA is currently required for sulphur dioxide.

SECTION 1: INTRODUCTION

The Air Quality Strategy for England, Scotland, Wales and Northern Ireland[1], and subsequent regulations[2] establishes the framework for air quality improvements. Despite measures agreed nationally and internationally, it is recognised that areas of poor air quality will remain, and that these will best be dealt with by using local measures implemented through the Local Air Quality Management (LAQM) regime. As part of this regime, local authorities are charged with the responsibility of assessing the presence and amount of seven key pollutants (1,3-butadiene, benzene, carbon monoxide, lead, nitrogen dioxide, fine particulate matter and sulphur dioxide) in their area. A summary of the statutory standards and objectives for the pollutants that are referred to in this report is shown in Table 1.1. The air quality standards are based purely on medical evidence of the effects of particular pollutants on health. The objectives provide a measure for each of the pollutants against which future progress can be judged.

Table 1.1 - Summary of UK Air Quality Objectives

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	3.25 μg/m^3	Running annual mean	31.12.2010
Nitrogen dioxide [a]	200 μg/m^3 not to be exceeded more than 18 times a year	1 hour mean	31.12.2005 [b]
	40 μg/m^3	annual mean	31.12.2005 [b]
Particles (PM_{10}) (gravimetric)[c] (All authorities)	50 μg/m^3 not to be exceeded more than 35 times a year	24 hour mean	31.12.2004
	40 μg/m^3	annual mean	31.12.2004
Particles (PM_{10}) (gravimetric)[c] (Scotland)	50 μg/m^3 not to be exceeded more than 7 times a year	24 hour mean	31.12.2010
	18 μg/m^3	annual mean	31.12.2010
Sulphur dioxide (All authorities)	350 μg/m^3 not to be exceeded more than 24 times a year 125 μg/m^3 not to be exceeded more than 3 times a year 266 μg/m^3 not to be exceeded more than 35 times a year	1 hour mean 24 hour mean 15 minute mean	31.12.2004 31.12.2004 31.12.2005

a The UK objectives for nitrogen dioxide are termed provisional within the Regulations, as they bring forward the requirement to meet the EU target date for health benefits.
b The EU Air Quality Standards (99/30) target date is 01/01/2010.
c Measured using the European gravimetric transfer sampler or equivalent.

[1] DETR (2000) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland – Working together for Clean Air, The Stationery Office
[2] DETR (2000) The Air Quality Regulations 2000 (Scotland), The Stationery Office, Scottish Executive (2002) Air Quality (Scotland) Amendment Regulations 2002

Progress Reports form part of the local air quality management (LAQM) regime, which was introduced by the Environment Act 1995 and subsequent regulations. Each local authority is required to prepare a Progress Report in the years when they are not carrying out their three yearly Updating and Screening Assessment (USA) or carrying out a Detailed Assessment.

The council published an Updating and Screening Assessment in May 2003. The USA concluded that several areas of the city were unlikely to meet the National Air Quality Standards (NAQS) and Objectives. In addition, changes to the statutory guidance[3] required the assessment of new areas where potential pollution hotspots may occur, e.g. street canyons[4] and roads with high proportions of heavy-duty vehicles. Few of such areas had been studied before, and in many situations there was insufficient information to fulfil the assessment criteria. Consequently, the council was obliged to carry out additional monitoring, modelling and traffic counts throughout the city, to assess:

1. nitrogen dioxide (NO_2) in narrow congested streets (street canyons) and busy roads and junctions (>10,000 vehicles/day);
2. particulates (PM_{10}) [5] at busy roads and junctions;
3. elevated levels of PM_{10} measured downwind of the docks and;
4. sulphur dioxide (SO_2) emissions from Nynas AB UK Ltd., with respect to the new and proposed residential premises on the waterfront.

The Scottish Environmental Protection Agency (SEPA) and the Scottish Executive, who are the statutory consultees for the LAQM regime, both accepted the conclusions of the USA.

Dundee City Council's Detailed Assessment was carried out during 2004, and examined the issues raised in the USA in more detail, although the Detailed Assessment was not finalised until early 2005, the council is still obliged to submit a Progress Report at this time. The main findings of the Detailed Assessment are summarised as follows:

- one or more Air Quality Management Areas (AQMAs) are required for NO_2 due to the predicted exceedences of the annual mean for 2005.

- no AQMAs for PM_{10} are recommended at this stage of the review and assessment process. Predictions for 2010 are based on 2003 data (a higher than normal pollution year) and are currently reliant on estimated projected reductions in background concentrations which themselves are likely to have a degree of uncertainty. Current monitoring shows that in typical years the 24-hour mean Objectives for 2004 and 2010 is met in Dundee. Funding for continued and expanded monitoring of PM_{10} to include a background site, and speciation of

[3] Department for Environment Food and Rural Affairs and Scottish Executive 2003, 'Part IV of the Environment Act 1995 Local Air Quality Management Technical Guidance LAQM. TG(03), DEFRA Publications.
[4] A street canyon is defined as a narrow street with buildings on both sides where the height of the buildings is generally greater than the width of the road.
[5] PM_{10} is respirable particulate material with an aerodynamic diameter of less than 10 microns

particles has been approved by the Scottish Executive from the Capital Grant Scheme for 2005/06, and should help determine whether an AQMA for PM_{10} is required;

- dispersion modelling of SO_2 emissions from the stacks at Nynas AB (UK) concluded that no AQMA for SO_2 would be required. However it should be noted that some of the maximum hourly and 15-minute concentrations have not reduced significantly indicating that certain activities at the site are not related to operations where low sulphur fuels are used.

SEPA, and the Scottish Executive have accepted the conclusions of the Detailed Assessment.

SECTION 2 : PURPOSE OF THE PROGRESS REPORT

Following consultation on the LAQM process, the Government concluded that it was too 'stop-start' and that gaps of several years might occur between air quality reviews. Updating and Screening Assessments are now required at intervals of three years whilst Progress Reports maintain continuity and are to be produced in the intervening years.

Progress Reports are designed to ensure continuity in the LAQM process and are intended to assist local authorities by:

- providing a means for communicating air quality information to members and the public;
- maximising the usefulness and interpretation of the monitoring effort being carried out;
- maximising the value of the investment in monitoring equipment;
- helping local authorities respond to requests for up-to-date information on air quality;
- providing information to assist in other policy areas, such as transport and land use planning;
- providing a source of baseline data for strategic environmental assessments;
- providing a ready source of information on air quality for developers carrying out environmental assessments for new schemes;
- demonstrating progress with implementation of air quality Action Plans and/or air quality strategies; and
- providing a timely indication of the need for further measures to improve air quality, rather than delaying until the next full round of review and assessment.

SECTION 3 : NEW MONITORING RESULTS

3.1 MONITORING METHODS

3.1.1 Continuous Monitoring sites within Dundee

Dundee City Council has 6 locations at which air pollutants are monitored continuously. A summary of these locations and the pollutants monitored is shown in Table 3.1. A map of these locations is shown in Appendix 1.

Table 3.1 - Summary of continuous monitoring locations

Location	Site Type	Pollutants Monitored	Timescale
Groundhog DISC	Periodic background	SO_2 / PM_{10} / NO_2	Periodic since 1999
Union Street Rollalong	Roadside (1.35m from the kerb)	PM_{10} / NO_2	Nov 2000 to present
Broughty Ferry Rd. Rollalong	Downwind of Docks (approx. 350m from a petroleum refinery)	PM_{10} / SO_2	Jan 2002 to present
Seagate Romon	Kerbside	NO_x/NO_2	Jan 2004 to present
Lochee Road Romon	Kerbside	NO_x/NO_2	Jan 2004 to present
Whitehall Street Romon	Kerbside	NO_x/NO_2	July 2003 to present

3.1.2 Data Validation and Ratification

Due to the retiral of key staff from Dundee Scientific Services, the data presented in this report can only be considered as provisional at the present time. The council has been advised by the Scottish Executive to produce this report with the existing raw data.

3.1.3 Explanation of Percentiles

The short-term air quality objectives (e.g.15 minute, 1 hour, 24 hour) are framed in terms of the number of occasions in a calendar year on which the objective concentration should not be exceeded (see Table 1.1). Wherever possible, authorities are encouraged to express the results of their monitoring and modelling in terms of the number of hours, days etc above the objective level. This is the clearest basis for strict comparison with the objectives set out in the 2000 and 2002 Regulations. However, for a strict comparison on this basis, there must be a minimum of 90% data capture throughout a calendar year. In certain circumstances, where measured data capture is less than 90%, it is considered appropriate to express short-term concentrations as percentile values that approximate to the permitted number of exceedences.

3.1.4 Passive Diffusion Tube Monitoring Sites

Dundee City Council also had 95 passive diffusion tubes monitoring nitrogen dioxide throughout the city, during 2004. These were located at busy roads and junctions as well as urban background sites. A map of these locations is shown in Appendix 2.

In addition benzene was monitored using passive diffusion tubes throughout 2004 at four locations around Nynas AB (UK). A map of these locations is shown in Appendix 3.

3.2 BENZENE

OBJECTIVE : 3.25 micrograms per cubic metre or less, when expressed as a Running annual mean, to be achieved by 31st December 2010.

3.2.1 Measurement Method

Benzene is monitored using passive BTEX (benzene, toluene, ethylbenzene and xylene) diffusion tubes that are exposed on a monthly basis.

3.2.2 Data Quality Requirements

The BTEX tube supplier Gradko stipulates an uncertainty in the results of $^{+}$/- 21%. The results are corrected for the uptake rate of the absorbent used in the tubes. Gradko, an international company, participate in WASP (Workplace Analysis Scheme for Proficiency) accreditation and have in-house laboratory quality assurance procedures.

3.2.3 Monitoring Programme

The continued monitoring of benzene in 2004 was intended to confirm the observations made by SEPA with respect to findings in the USA, i.e. that elevated benzene levels (compared to the background levels predicted by Netcen[6]) detected around Nynas AB (UK) are related to road traffic, and are not associated with the process or fugitive emissions. The BTEX tube monitoring locations (see Appendix 3) were chosen to reflect different combinations of the potential sources of benzene in the area (see Table 3.2).

3.2.4 Annual Results for 2004

Passive BTEX diffusion tube results for the period 1 January to 31 December 2004 are shown in Table 3.2, and in Figure 3.1.

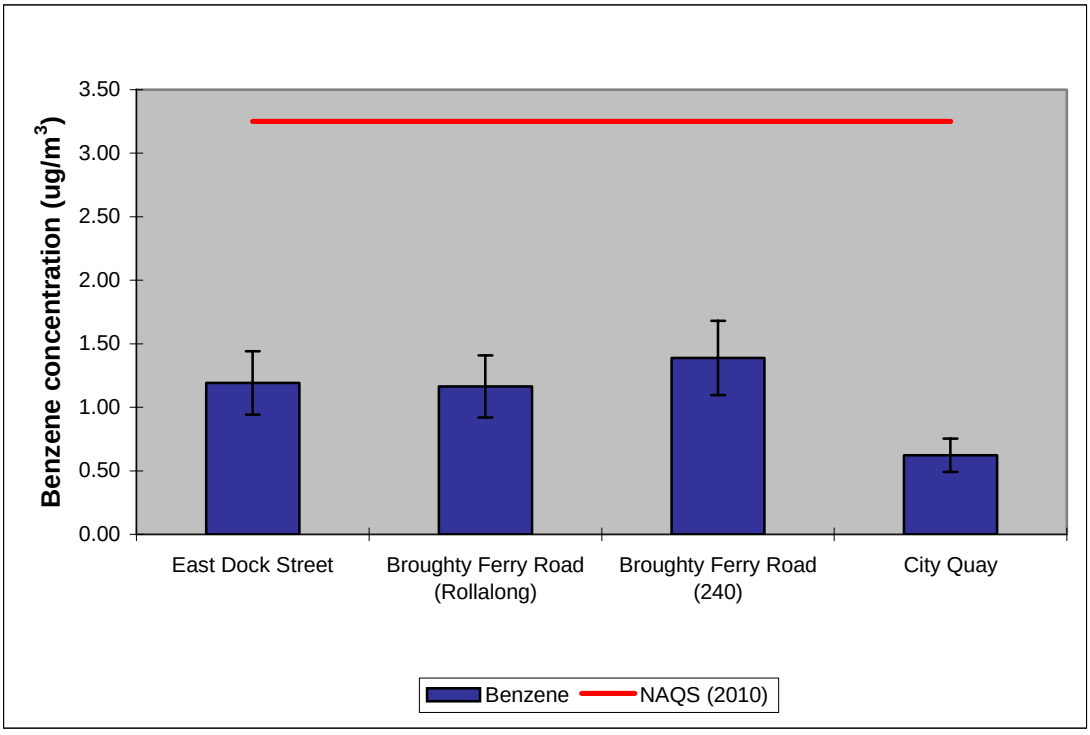
[6] Throughout this document reference is made to the use of background pollutant concentration maps published on the internet by Netcen, see www.airquality.co.uk

Table 3.2 - Summary of Running Annual Mean Results for Benzene (μg/m^3) in 2004, and where applicable, predicted forward to 2010 to compare with the Objective.

Location	Potential Benzene sources at monitoring site	2004 Running Annual Mean Benzene	2010 Running Annual Mean Benzene (predicted)
Broughty Ferry Rd. Rollalong	Fugitive emissions from storage tanks / Road	1.16	not applicable (n/a)*
Broughty Ferry Rd. (240)	Road / junction	1.39	1.10
East Dock St.	Fugitive emissions from storage tanks / Road	1.19	(n/a)
City Quay	Upwind of industrial point source	0.62	(n/a)

* n/a = not applicable as only road sources can be predicted forward to 2010, and these measurements potentially include industrial emissions.

Figure 3.1 - Annual mean benzene concentrations for 2004 shown +/- 21% and plotted against the 2010 Objective



3.2.5 Discussion of Results

When adjusted for the uncertainty (see the bars on Figure 3.1 showing the $^{+}$/- 21%) the above results fall well below the NAQS (2010) for benzene. The monitoring location at 'Broughty Ferry Rd (240)' was not considered to be effected by fugitive emissions from the process. The results at this location are the highest of all four sites. Moreover, due to this site's proximity to a busy junction it has the highest traffic flow of the three roadside sites. The City Quay site has the lowest readings recorded over the measurement period; this is the only site that does not have a roadside component. Taken alone, these findings support SEPA's observations that road traffic is the source of benzene in the area. However, it is worth noting that all the results are approx 3 or 4 times the estimated background concentrations for these locations (0.217-0.286 µg/m^3), including the City Quay site where there is no roadside component. If the Netcen background predictions are accurate, then it is possible that emissions from NYNAS or other sources in the docks area contribute slightly to raising the ambient benzene levels in this area.

In conclusion, the monitoring results for 2004 support the conclusions reached in previous assessments, that no AQMA is currently required for benzene. Assuming no new sources of benzene are introduced, the council do not anticipate that it will be necessary to continue monitoring for benzene within the council area.

3.3 NITROGEN DIOXIDE

OBJECTIVES :

200 micrograms per cubic metre or less, when expressed as an hourly mean, not to be exceeded more than 18 times a year to be achieved by 31st December 2005.

40 micrograms per cubic metre or less, when expressed as an annual mean, to be achieved by 31st December 2005.

3.3.1 Continuous Monitoring Results

3.3.1.1 Measurement Method

The determination of oxides of nitrogen is based on the chemiluminescent energy emitted when nitric oxide (NO) is reacted with ozone (O_3) in an evacuated chamber to form chemiluminescent nitrogen dioxide (NO_2). The chemiluminescent analyser is the reference method specified in the EU First Air Quality Daughter Directive, and is widely used for continuous monitoring of NO_2 concentrations in the UK.

3.3.1.2 Instrumentation

The type of instrument used at each location is the Monitor Labs 9841A.

3.3.1.3 Summary of Annual Results

Automatic Monitoring results for the period 1 January to 31 December 2004 are shown in Table 3.3, along with results for previous years, where available.

Table 3.3 - Summary of Annual Mean NO_2 Results ($\mu g/m^3$) from Continuous Monitors

Location	2001 Annual Mean NO_2 (%data)	2002 Annual Mean NO_2 (%data)	2003 Annual Mean NO_2 (%data)	2004 Annual Mean NO_2 (%data)
Union St. Rollalong	48.5 (93.3)	42.0 (86.6)	40.6 (86.8)	41.2 (85.5)
Whitehall St. Romon	n/a	n/a	n/a	39.3 (60.0*)
Seagate Romon	n/a	n/a	n/a	64.5 (85.0)
Lochee Rd. Romon	n/a	n/a	n/a	79.6 (96.0)
Groundhog DISC	n/a	n/a	n/a	13.9 (99.4)**

*Monitoring at Whitehall St. Romon had to be suspended during 2004 as a consequence of works associated with the bus interchange development in this street
** 6-month monitoring period from 13/05/04 to 14/11/04
%data - percentage data capture

Table 3.4 below shows a summary of the predicted annual means for 2005 in each of the years for which monitoring results are available. This information is helpful to illuminate trends in the data and determine whether national measures to reduce pollutant concentrations are actually taking effect.

Table 3.4 - Summary of Annual Mean NO_2 ($\mu g/m^3$) Predicted to 2005 for comparison with the Annual Mean Objective (40 µg/m³

Location	2001 Annual Mean NO_2 Predicted to 2005	2002 Annual Mean NO_2 Predicted to 2005	2003 Annual Mean NO_2 Predicted to 2005	2004 Annual Mean NO_2 Predicted to 2005
Union St. Rollalong	43.3	38.7	38.5	40.2
Whitehall St. Romon	n/a	n/a	n/a	38.3*
Seagate Romon	n/a	n/a	n/a	62.9
Lochee Rd. Romon	n/a	n/a	n/a	77.6
Groundhog DISC	n/a	n/a	n/a	13.6**

*Monitoring at Whitehall St. Romon had to be suspended during 2004 as a consequence of works associated with the bus interchange development in this street
** 6-month monitoring period from 13/05/04 to 14/11/04

3.3.1.4 Summary of Hourly Average Concentrations

Table 3.5 shows the number of exceedences of the one-hour objective for nitrogen dioxide, and the relevant percentile values (to allow comparison between sites with less than 90% data capture).

Table 3.5 - Number of exceedences of the 1 hour Objective (no more than 18 exceedences of 200 µg/m³)

Location	2001		2002		2003		2004	
	No. of exceedences	99.8th Percentile (µg/m^3)	No. of exceedences	99.8th Percentile (µg/m^3)	No. of exceedences	99.8th Percentile (µg/m^3)	No. of exceedences	99.8th Percentile (µg/m^3)
Union St Rollalong	0	155	0	142	1	138	0	137
Whitehall St Romon	n/a	n/a	n/a	n/a	n/a	n/a	0	125
Seagate Romon	n/a	n/a	n/a	n/a	n/a	n/a	6	180
Lochee Rd Romon	n/a	n/a	n/a	n/a	n/a	n/a	22	207
Groundhog DISC	n/a	n/a	n/a	n/a	n/a	n/a	0	62

The following Figures show the time series graphs of hourly average nitrogen dioxide concentrations for each site, for 2004.

Figure 3.2 - Time Series at Union Street of NO_2 Hourly Averages in 2004

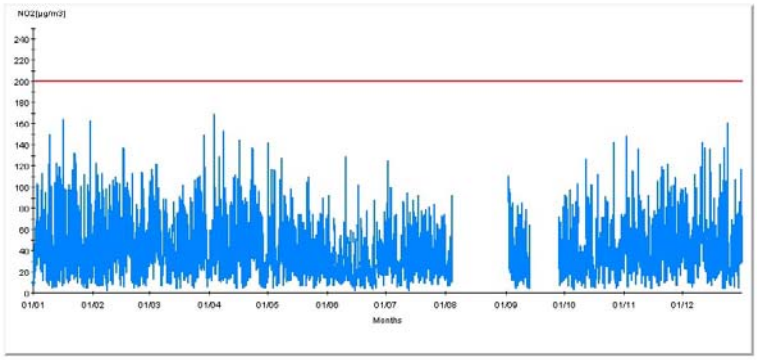


Figure 3.3 - Time Series at Whitehall Street of NO_2 Hourly Averages in 2004

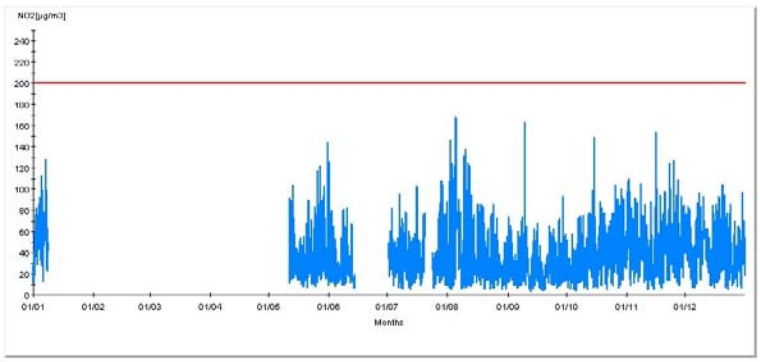


Figure 3.4 - Time Series at Lochee Road of NO_2 Hourly Averages in 2004

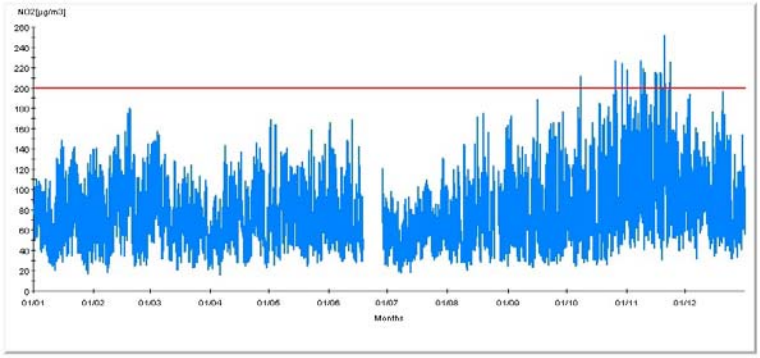


Figure 3.5 - Time Series of Seagate Romon NO_2 Hourly Averages in 2004

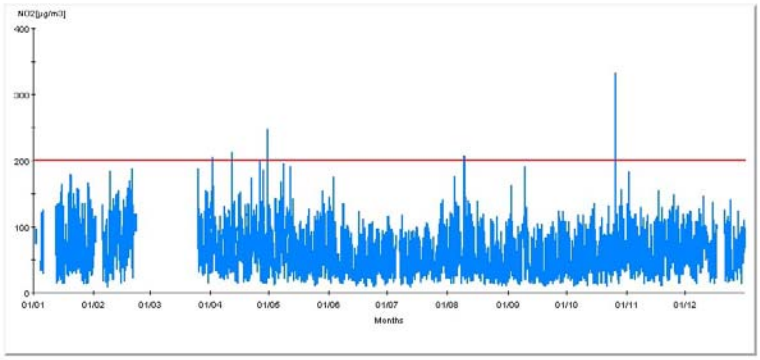
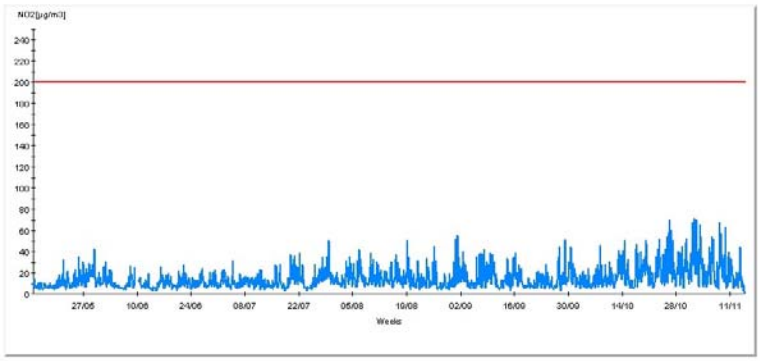


Figure 3.6 - Time Series of Groundhog DISC Hourly Averages 13/05/04-14/11/04



3.3.1.5 Discussion of Results

Union Street

The measured 2004 annual mean (41.2 µg/m^3) is slightly higher than that measured in 2003 (40.6 µg/m^3). Based on the 2004 monitoring data the

predicted annual mean in 2005 for nitrogen dioxide at the Union Street monitor (40.2 µg/m^3) is above the annual mean objective of 40 µg/m^3.

Union Street is a street canyon and one of the main bus corridors in the city centre. Pollutant levels can fluctuate from year to year for a number of reasons. It is generally accepted that 2003 was a year in which pollution levels throughout the UK were higher than those observed in the previous years. This was not found to be the case in Union Street. It is important to note that for much of 2004 Union Street was closed to southbound traffic due to demolition works associated with a dangerous building. In addition ground works in Whitehall Street, associated with the construction of the bus interchange, will have displaced traffic into Union Street for several months. It seems likely that a combination of these factors will have contributed to the increase in the levels recorded in 2004. Unfortunately, as it is difficult to locate automatic traffic counters in busy city centre streets it is not possible to directly equate the fluctuating traffic flows in this area with the locally recorded nitrogen dioxide level.

However, data capture for this monitor was below the 90% required to fully ratify the data so caution should be exercised when drawing conclusions, it is hoped that results obtained in 2005 will provide a clearer picture.

There were no recorded exceedences of the hourly objective for nitrogen dioxide at the Union Street monitor during 2004.

Whitehall Street

Based on the 2004 monitored data the predicted annual mean in 2005 for nitrogen dioxide at the Whitehall Street monitor (38.3 µg/m^3) is slightly below the annual mean objective of 40 µg/m^3. However, the data capture for this site is extremely low as the monitoring site had to be removed during construction works associated with the new bus interchange. The annual mean at this location should only be regarded as provisional and results treated with caution. It is hoped that results obtained in 2005 will provide a clearer picture. Whitehall Street is a street canyon on the main bus corridor through the city centre.

There were no exceedences of the hourly objective for nitrogen dioxide recorded at the Whitehall Street monitor during the time it was operating in 2004.

Seagate

Based on the 2004 monitoring data the predicted annual mean in 2005 for nitrogen dioxide at the Seagate monitor (62.9 µg/m^3) is well above the annual mean objective of 40 µg/m^3. Seagate is a narrow congested street canyon, on the main bus corridor through the city centre, with residential exposure at ground level in several locations. Data capture for this monitor was below the 90% required to fully ratify the data, and although the data presented is

provisional it is not expected that results will fall below the air quality objective as a result of data validation alone.

There were 6 exceedences of the hourly objective for nitrogen dioxide (200 µg/m^3) recorded at the Seagate monitor in 2004. Eighteen exceedences of the hourly objective are permitted.

Lochee Road

Based on the 2004 monitoring data the predicted annual mean in 2005 for nitrogen dioxide at the Lochee Road monitor (77.6 µg/m^3) is well above the annual mean objective of 40 µg/m^3. The Lochee Road monitor is situated on the main north-west arterial route close to the busy junctions with Rankine Street and Dudhope Crescent. Data capture for this monitor was above the 90% required to fully ratify the data, and although the data presented is provisional it is not expected that results will fall below the air quality objective as a result of data validation alone.

There were 22 exceedences of the one-hour objective for nitrogen dioxide recorded at the Lochee Road monitor. The NAQS for 2005 only permits 18 exceedences of the hourly objective (200 µg/m^3). Failure to meet the objective in 2004 maybe due to traffic congestion problems as a consequence of water main rehabilitation works in the vicinity throughout the month of November 2004. Eighteen of the twenty-two exceedences of the hourly objective were observed during the month of November. This is the first full year of real-time results obtained from this monitor, and the results are provisional. Hence it is too early to determine if the hourly objective will be exceeded at this location in 2005.

Groundhog DISC

The Groundhog is a mobile air quality station, which is shared with Angus and Fife Councils, spending approximately 6 months with each local authority. During 2004 the Groundhog was located at an urban background location in Dundee between May and November. The period mean for nitrogen dioxide at the Groundhog DISC monitor (13.6 µg/m^3) requires to be annualised using an adjustment factor derived from nearby AURN[7] sites. The urban background sites in Edinburgh and Aberdeen were used for this purpose and a factor of 1.154 was obtained. This gives an estimated annual mean of 16 µg/m^3 for 2004 at the Groundhog DISC site.

Predicting forward to 2005, using the background correction factors in the Technical Guidance[8], gives an estimated annual mean of 15.7 µg/m^3 which can be compared with the NAQS (2005) annual mean of 40 µg/m^3 and the background level predicted by Netcen. The Netcen background maps[9]

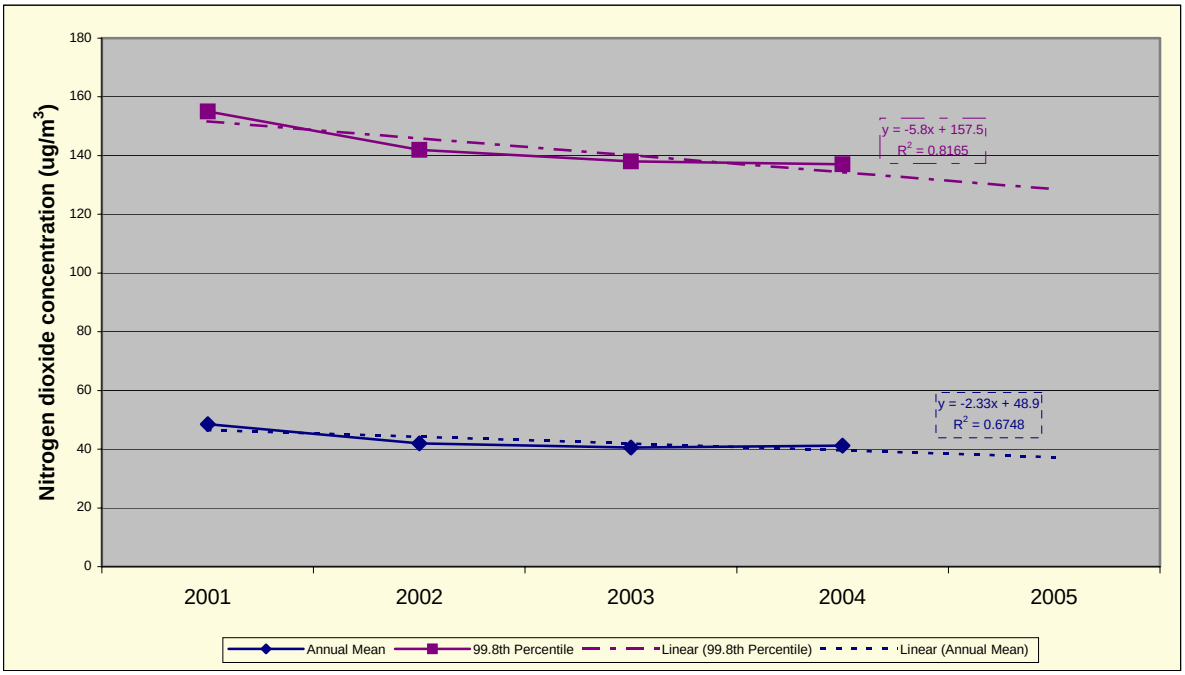
[7] AURN = The Automatic Urban and Rural Network, these are the national network sites funded by DEFRA and the Devolved Administrations.
[8] Department for Environment Food and Rural Affairs and Scottish Executive 2003, 'Part IV of the Environment Act 1995 Local Air Quality Management Technical Guidance LAQM. TG(03), DEFRA Publications. Pg 6-29, Box 6.7
[9] Throughout this document reference is made to the use of background pollutant concentration maps published on the internet by Netcen, see www.airquality.co.uk

predict an annual mean for nitrogen dioxide of 18.1 µg/m^3 at this location in 2005.

3.3.1.6 Trends in Annual concentrations

Trends in concentrations are normally shown for sites with at least five years of measurement data; the longest period of measurement available in Dundee is the four years at Union Street. A graph showing the trends in the annual mean and percentile values is shown in Figure 3.7.

Figure 3.7 - Trends in NO_2 Annual means and 99.8th Percentiles at Union St 2001- 2004



R^2 - Is the coefficient of determination and is an indicator that ranges in value from 0 to 1. It reveals how closely the estimated values for the trendline correspond to the actual data. A trendline is most reliable when its R-squared value is at or near 1

3.3.1.7 Discussion of Trends

Figure 3.7 shows a downward trend for both the measured annual mean and 99.8th percentile at the Union Street monitor. The linear regression trendline for the annual mean has been extended to 2005 for comparison with the annual mean objective (40 µg/m^3). If monitored results follow this trend the annual mean in 2005 would be below the objective. However, using the correction factors in the technical guidance (Box 6.6), the average predicted annual mean for 2005 (from Table 3.4) at Union Street is 40.2 µg/m^3. This prediction is based on the expected year-on-year effects of the national measures to reduce NOx emissions from vehicle exhausts. It should be noted that changes in concentrations occur from year to year due to weather conditions and fluctuations in traffic flows. It is normal practice to only consider a trend as being significant when five years worth of data are available.

It should be noted that the Figure 3.7 is based on raw data. Data validation and ratification may influence this conclusion.

3.3.2 Diffusion Tube Results

3.3.2.1 Measurement Method

The diffusion tubes are supplied by Gradko International and analysed by Dundee City Council Scientific Services using the 20% Triethanolamine (TEA) in water method.

3.3.2.2 Data Quality Requirements

The laboratory method is UKAS[10] accredited and, as the laboratory carries out diffusion tube analysis for the UK NO_2 Network, it is required to participate in the Health and Safety Laboratory's Workplace Analysis Scheme for Proficiency (WASP). The WASP scheme is an independent, internationally recognised performance testing programme. The results achieved by Dundee City Council Scientific Services were found to be consistently "good", in the most recent Network report[11].

Removing any results that visually appear to be spurious, i.e., significantly outwith the expected range, has been carried out during the ratification of the diffusion tube results. The Dundee City Council Scientific Services diffusion tubes results are typically found to over-read compared with results from continuous analysers.

3.3.2.3 Period Mean Adjustment

To annualise the data so that comparison with the annual mean objective can be made, a period mean adjustment factor has been calculated for each site with less than 12 months data. This was carried out in accordance with the statutory guidance[12]. Dundee City Council has three long-term background diffusion tube sites at Balgavies Place, Birnam Place, and Woodside Avenue and these were used in the calculation of the period mean adjustment factor.

3.3.2.4 Calculation of Bias

Dundee City Council has four chemiluminescent analysers measuring NO_2 continuously at various points throughout the city. This is the reference method for measuring NO_2. A collocation study of three diffusion tubes sited with the continuous analyser on Union Street allows a bias adjustment factor to be calculated. For the period of this study (Jan 2004 to Dec 2004) the continuous analyser captured insufficient data (<90%) to allow the bias

[10] UKAS is the United Kingdom Accreditation Service
[11] UK Nitrogen Dioxide Network 2002 (AEAT/ENV/R/1578)
[12] Department for Environment Food and Rural Affairs and Scottish Executive 2003, 'Part IV of the Environment Act 1995 Local Air Quality Management Technical Guidance LAQM. TG(03), DEFRA Publications. Page A1-16.

calculation to be made[13]. However, there is sufficient data capture for the 9 months from Nov 03 to July04. The bias correction factor based on this time period is 0.77.

In addition, two valid bias correction studies of tubes analysed by Dundee City Council Scientific Services exist and have been collated by Air Quality Consultants Ltd (AQC) on behalf of Defra and the devolved administrations[14]. AQC have calculated an overall factor using orthogonal regression to allow for uncertainty in both the automatic monitor and diffusion tube (the uncertainty of the diffusion tube has been assumed to be double that of the automatic monitor). Using this information the bias adjustment factor was taken to be 0.81. This was the bias adjustment factor used in the Detailed Assessment (March 2005).

NO_2 Annual means for 2004 have been reported using both bias correction factors (Table 3.6).

3.3.2.5 Prediction Forward to 2005

Bias corrected results of kerbside monitoring sites (those within 1 metre of the kerb) and roadside monitoring sites (sites more than 1metre but less than 5 metres from the kerb) were adjusted to the relevant future year using correction factors supplied in the Technical Guidance[15]. Background site data were also predicted forward to 2005 using correction factors from elsewhere in the Technical Guidance[16].

3.3.2.6 Summary of Annual Monitoring Results

The results in Table 3.6 are for the period 1 January to 31 December 2004 and are period adjusted (where necessary), bias corrected and predicted forward to 2005, to allow direct comparison with the NAQS (2005) annual mean for NO_2 (40 $\mu g/m^3$). A graph of the raw data for 2004 is shown in Appendix 4.

[13] New collocation studies have commenced at each of the ROMONS, it is hoped these will be able to provide additional data for future review and assessments.
[14] www.uwe.ac.uk/aqm/review/diffusiontube240904.xls
[15] Department for Environment Food and Rural Affairs and Scottish Executive 2003, 'Part IV of the Environment Act 1995 Local Air Quality Management Technical Guidance LAQM. TG(03), DEFRA Publications. Page 6-8
[16] Department for Environment Food and Rural Affairs and Scottish Executive 2003, 'Part IV of the Environment Act 1995 Local Air Quality Management Technical Guidance LAQM. TG(03), DEFRA Publications. Pg 6-29, Box 6.7

Table 3.6 - NO_2 Diffusion tube results for 2004, predicted to 2005 for comparison with the Annual mean objective (40 μg/m^3).

Location	Site Type	2004 Annual Mean	Bias corrected by 0.81	Predicted to 2005	Bias corrected by 0.77	Predicted to 2005
Abertay	K	**52.6**	42.6	**41.5**	40.5	**39.5**
Albert Street (Shandon Pl)*	R	39.7	32.1	31.3	30.6	29.8
Albert Street 1	K	**42.8**	34.7	33.8	33.0	32.2
Albert Street Fish (164)	K	39.3	31.8	31.0	30.2	29.5
Arbroath Road (13)	K	**45.5**	36.9	35.9	35.0	34.2
Arthurstone Tce 10	K	29.7	24.0	23.4	22.8	22.3
Balgavies Place	B	21.9	17.7	17.3	16.8	16.5
Bank St/ Reform St	K	32.5	26.3	25.6	25.0	24.4
Birnam Place	B	13.8	11.2	11.0	10.6	10.4
Brook Street B/F	K	28.9	23.4	22.8	22.3	21.7
Broughty Ferry Road 141	R	**42.1**	34.1	33.3	32.4	31.6
Broughty Ferry Road 240	R	37.5	30.4	29.6	28.9	28.1
Claypotts Junction	R	28.1	22.8	22.2	21.6	21.1
Clep Rd/ Forfar Rd	K	**42.2**	34.2	33.3	32.5	31.7
Commercial St	K	**42.6**	34.5	33.7	32.8	32.0
Commercial St /Dock St	R	**56.5**	45.7	**44.6**	43.5	42.4
Commercial St /Waterstones	K	**51.9**	42.1	**41.0**	40.0	**39.0**
Crichton St	K	**40.3**	32.7	31.8	31.0	30.3
Dens Road Crossing	R	**43.3**	35.1	34.2	33.4	32.5
Dock St (Unicorn)	R	**45.1**	36.5	**35.6**	34.7	33.8
Dock Street 14 (Sheridans)	K	**51.3**	41.6	**40.5**	39.5	**38.5**
Dura Street (Fortes)	K	**40.8**	33.1	32.3	31.4	30.6
Dykehead Place	B	19.8	16.0	15.7	15.2	14.9
Eastport Roundabout	R	39.6	32.1	31.3	30.5	29.7
Harefield Road 35	K	36.3	29.4	28.7	27.9	27.2
Hawick Drive	R	24.5	19.8	19.3	18.8	18.4
High Street Lochee 95	K	27.6	22.4	21.8	21.3	20.7
Hilltown 207/209	R	32.3	26.2	25.5	24.9	24.3
Hilltown Suites	R	**40.3**	32.6	31.8	31.0	30.3
Hilltown/Kinghorn Road	R	30.4	24.6	24.0	23.4	22.8
King Street 12 & 14	K	34.8	28.2	27.5	26.8	26.1
Kingsway East Roundabout	R	39.3	31.8	31.0	30.3	29.5
Kingsway/ Mains Loan 2	R	39.6	32.1	31.3	30.5	29.7
Kingsway/ Pitkerro Rd	R	35.4	28.7	28.0	27.3	26.6
Kingsway/ Strathmartine Rd N	R	**47.8**	38.7	**37.8**	36.8	**35.9**
Kingsway/ Strathmartine Rd S	K	**48.2**	39.0	**38.0**	37.1	**36.2**
Lochee Road (179)	K	35.5	28.8	28.1	27.4	26.7

Location	Site Type	2004 Annual Mean	Bias corrected by 0.81	Predicted to 2005	Bias corrected by 0.77	Predicted to 2005
Lochee Road (184)	K	45.8	37.1	36.2	35.3	34.4
Lochee Road 138	K	60.3	48.9	47.6	46.5	45.3
Lochee Road 140 Traffic Lights*	R	54.8	44.4	43.3	42.2	41.1
Lochee Road 164 (1)	K	58.1	47.1	45.9	44.8	43.6
Lochee Road 164 (2)	K	56.6	45.9	44.7	43.6	42.5
Lochee Road 164 (3)	K	57.4	46.5	45.3	44.2	43.1
Lochee Road/Polepark Road	K	34.0	27.5	26.8	26.2	25.5
Logie Street (114)	R	60.3	48.8	47.6	46.4	45.2
Logie Street (98)	K	41.8	33.8	33.0	32.1	31.3
Longtown Road Rectory	R	30.5	24.7	24.1	23.5	22.9
Loons Road (1)	R	41.3	33.5	32.6	31.8	31.0
Marketgait	R	41.2	33.3	32.5	31.7	30.9
Morgan Street/Pitkerro Road*	K	32.6	26.4	25.7	25.1	24.5
Muirton Road 6	R	32.6	26.4	25.8	25.1	24.5
Myrekirk Road	K	34.8	28.2	27.5	26.8	26.1
N.Lindsay Street Fresh	K	36.4	29.5	28.8	28.1	27.3
Nethergate (Bradford)	R	41.6	33.7	32.8	32.0	31.2
Nethergate (Charlie T)	K	49.2	39.9	38.9	37.9	36.9
Nethergate (Leonardos)	R	38.1	30.8	30.1	29.3	28.6
Nethergate (Trades House)	R	45.1	36.6	35.6	34.7	33.9
Nethergate B&B 88	K	54.5	44.2	43.1	42.0	40.9
Nethergate/ Marketgait	R	39.1	31.7	30.9	30.1	29.4
Paradise Road	R	29.9	24.3	23.6	23.1	22.5
Perth Road 197	K	36.8	29.8	29.1	28.3	27.6
Perth Road 330	R	34.5	27.9	27.2	26.6	25.9
Seagate	R	51.4	41.7	40.6	39.6	38.6
Seagate (Yates)	R	50.1	40.6	39.6	38.6	37.6
Seagate Bond 1	R	46.0	37.2	36.3	35.4	34.5
Seagate Bond 2	R	44.0	35.6	34.7	33.8	33.0
Seagate Bond 3	R	45.0	36.4	35.5	34.6	33.7
Soapwork Lane	R	38.9	31.5	30.7	30.0	29.2
St Andrews St (JAF)	K	42.7	34.6	33.8	32.9	32.1
St Andrews Street (DD)	K	37.8	30.6	29.9	29.1	28.4
St Andrews Street (PB)	K	46.6	37.7	36.8	35.8	34.9
Strathmartine Road / Clep Road	K	32.9	26.7	26.0	25.3	24.7
Strathmartine Road / Main St	K	38.7	31.3	30.6	29.8	29.0
Strathmartine Road 204	K	36.6	29.6	28.9	28.2	27.5
Strathmartine Road Fiveways	K	35.6	28.8	28.1	27.4	26.7
Strathmore Avenue (Wellgate)	K	35.0	28.4	27.6	27.0	26.3
Strathmore Avenue 337	K	40.5	32.8	32.0	31.2	30.4

Location	Site Type	2004 Annual Mean	Bias corrected by 0.81	Predicted to 2005	Bias corrected by 0.77	Predicted to 2005
Strathmore Avenue 353	K	44.4	36.0	35.1	34.2	33.3
Union St Rollalong 1	R	51.4	41.6	40.5	39.5	38.5
Union St Rollalong 2	R	52.3	42.3	41.3	40.3	39.2
Union St Rollalong 3	R	51.6	41.8	40.7	39.7	38.7
Union Street (Goodfellows)	K	48.5	39.3	38.3	37.4	36.4
Union Street (Mcintyres)	K	42.9	34.7	33.8	33.0	32.2
Victoria Road	R	42.8	34.7	33.8	33.0	32.1
Victoria Road / Cotton Road	K	43.3	35.1	34.2	33.3	32.5
Victoria Road/Hilltown	R	66.8	54.1	52.7	51.4	50.1
Westport 2	R	45.0	36.5	35.5	34.7	33.8
Whitehall Cr (Xpresso)	K	37.3	30.2	29.5	28.7	28.0
Whitehall St (BBBS 3)*	R	47.1	38.2	37.2	36.3	35.4
Whitehall St (BRJ)*	K	46.4	37.6	36.6	35.7	34.8
Whitehall St (Bus)*	K/R	56.6	45.8	44.7	43.6	42.5
Whitehall St (Tiso)*	R	47.5	38.5	37.5	36.6	35.7
Whitehall Street Deb A*	K	49.6	40.2	39.2	38.2	37.2
Whitehall Street Deb E*	K	48.9	39.6	38.6	37.7	36.7
Woodside Avenue	B	19.9	16.1	15.8	15.3	15.0

K = kerbside, R = roadside, B = urban background, * = results have been period mean adjusted

3.3.2.7 Discussion of Results

Due to the inherent uncertainties in the measurement methods used to analyse the tubes and in the derivation of the bias correction factors, all tubes with a predicted annual mean above 36 µg/m^3 have been considered as areas of potential exceedence: these are discussed below.

Union Street

The 0.81 bias corrected annual mean diffusion tube results for the Union Street Rollalong tubes (41.6,42.3,41.8), located on the monitor, are in good agreement with the annual mean µg/m³ recorded by the continuous monitor (41.2 µg/m^3). Other tubes in Union Street are close to but below the annual mean objective.

Whitehall Street

The 0.81 bias corrected annual mean diffusion tube results for the Whitehall Street tubes located close to the monitor (BBBS3 38.2 µg/m^3) are in good agreement with the annual mean recorded by the continuous monitor in Whitehall Street (39.3 µg/m^3), despite the lack of data capture.

Seagate

The average annual mean results of those diffusion tubes located closest to the monitor in the Seagate, (uncorrected (45 µg/m^3) and 0.81 bias corrected (36.4 µg/m^3)) do not compare well with the annual mean recorded at the continuous monitor in Seagate (64.5 µg/m^3). However they are located further from the roadside and on a street corner where air turbulence is greater. The other Seagate tubes are situated closer to controlled junctions and record higher concentrations of NO_2 than those closer to the monitor as a result of vehicle emissions from queuing traffic.

Lochee Road

The average annual mean results of those diffusion tubes located closest to the monitor in Lochee Road (uncorrected (57.4 µg/m^3) and 0.81 bias corrected (46.4 µg/m^3)) do not compare well with the annual mean recorded at the continuous monitor in Lochee Road (79.6 µg/m^3). In order to determine the extent of this pollution hotspot a number of tubes have been located along this section of Lochee Road. The tube results show that the highest levels of pollution are found between the controlled junction with Dudhope Terrace and the Rankine Street junction. According to tube results, NO_2 concentrations return to acceptable levels by Polepark Road, to the south, and Tullideph Road to the north of the hotspot.

Logie Street/Loons Road

There are four NO_2 diffusion tubes located around this junction (Logie Street 114, Logie Street 98, Loons Road 1 and Muirton Road 6). One of these tubes is recording a concentration of NO_2 that is predicted to exceed the 2005 objective, (Logie St 114, 47.6-45.2 µg/m^3 depending on the bias adjustment factor used). This tube is located at the façade of a building and is therefore directly representative of public exposure in this area.

Nethergate

The 2004 results indicate potential exceedences of the 2005 objective for nitrogen dioxide along the Nethergate on either side of the Marketgait (City Centre Inner Ring Road). The Nethergate/Marketgait junction is a busy controlled junction and the Nethergate is part of the main bus corridor running through the city centre.

Main City Centre Bus Corridor

As well as the Seagate, Nethergate, Union Street and Whitehall Street, there are other potential exceedences of the 2005 objective for nitrogen dioxide predicted along the main city centre bus corridor, in St Andrews Street, Commercial Street and Dock Street.

Inner Ring Road

There were five tubes located around the inner ring road (Abertay, Marketgait, Westport 2, Paradise Road and Eastport Roundabout) in 2004. The only location that showed a potential exceedence of the 2005 objective was Abertay. Fortunately, this is the only one of the five locations where there is currently no relevant public exposure. Abertay is a long-term site and its results are useful in identifying trends in NO_2 levels.

Victoria Road

There were three tubes situated along Victoria Road in 2004 (Victoria Road, Victoria Road/Hilltown and Victoria Road/Cotton Road). The only location that showed a potential exceedence of the 2005 objective was Victoria Road/Hilltown. There is relevant public exposure to pollutants at this location and more tubes have been deployed to help determine the geographic extent of this pollution hotspot.

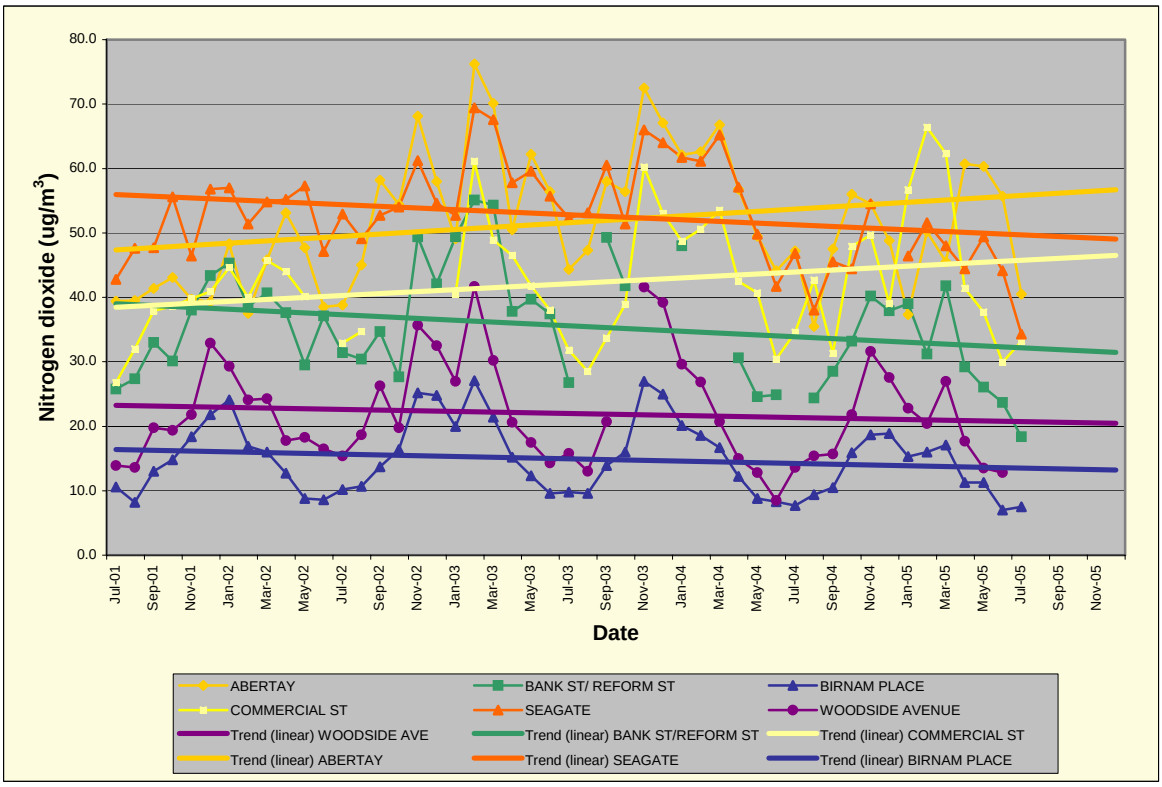
Kingsway

There were seven tubes situated along Kingsway in 2004 (Kingsway East Roundabout, Kingsway/Mains Loan 2, Kingsway/Pitkerro Road, Longtown Road Rectory, Myrekirk Road and Kingsway/Strathmartine Road N and S). The only location that showed a potential exceedence of the objective in 2005 was the Kingsway/ Strathmartine Road junction. Fortunately, in all cases, the tubes were located closer to the roadside than the housing (sites of relevant public exposure). The Kingsway is an open location and pollutants disperse with increasing distance from the roadside. There are no predicted exceedences of the NAQS at existing houses along the Kingsway.

3.3.2.8 Trends in NO_2 Concentrations

Trends in concentrations can normally be shown for sites with at least five years data, although ten years is preferable. There are six sites in Dundee that have been operational since 1995 (Abertay, Bank Street/Reform Street, Balgavies Place, Birnam Place, Commercial Street, Seagate and Woodside Avenue). Unfortunately, due to adoption of the recommended change to the method used for diffusion tube analysis it is only possible to show trends from July 2001, see Figure 3.8.

Figure 3.8 - Trends in monthly NO_2 concentrations at long-term diffusion tube locations, July 2001 – July 2005 (raw data)



3.3.2.9 Discussion of Trends

When viewing monthly data it is important to recognise that NO_2 results fluctuate through the year, with lower levels recorded during the summer months. By addition of trend lines, the levels at the background sites (Birnam Place and Woodside Avenue) and Bank Street/Reform Street and Seagate can be seen to be decreasing slightly. However in the case of the latter it is not likely to meet the objective by the end of 2005. The levels at Abertay and Commercial Street are increasing and as these are roadside locations this is likely to be due to changes in traffic flows (e.g. numbers or types of vehicles using the road).

3.4 SMALL PARTICLES (PM_{10})

OBJECTIVES :

50 micrograms per cubic metre or less, when expressed as a 24-hour mean, not to be exceeded more than 35 times a year to be achieved by 31st December 2004.

40 micrograms per cubic metre or less, when expressed as an annual mean, to be achieved by 31st December 2004.

50 micrograms per cubic metre or less, when expressed as a 24-hour mean, not to be exceeded more than 7 times a year to be achieved by 31st December 2010.

18 micrograms per cubic metre or less, when expressed as an annual mean to be achieved by 31st December 2010.

3.4.1 Measurement Method

The tapered element oscillating microbalance (TEOM) system determines particulate concentrations by continuously weighing particles that are deposited on a filter.

3.4.2 Instrumentation

Each of the three PM_{10} monitoring sites is equipped with a TEOM series 1400ab Ambient Particulate Monitor.

3.4.3 Data Quality Requirements

Each unit is calibrated under software support by using the single pre-weighed filter contained in the Mass Calibration Verification Kit. This verification is undertaken by the equipment suppliers on an annual basis as part of the maintenance contract.

3.4.4 Summary of Annual Results

The TEOM results for the period 1 January to 31 December 2004 have been converted to gravimetric equivalent results using the multiplier of 1.3 (in accordance with the technical guidance), and are shown in Table 3.7, along with results for previous years. Recent guidance from the Scottish Executive[17] advised that, in light of the collocation study carried out by Edinburgh City Council, the TEOM results for 2004 should also be multiplied by a factor of 1.14 and comparisons made between the two factored results and the objective. The TEOM results multiplied by the 1.14 factor are shown in Table 3.8. As the Groundhog was only located at the urban background site for six months (13 May – 14 Nov 2004), these results have been annualised by multiplying by a correction factor of 1.017, derived from AURN background sites at Edinburgh St Leonard's and Aberdeen.

[17] Letter from Scottish Executive dated 6th April 2005, 'Local Air Quality Management: Update on Particles'

Table 3.7 - Summary of TEOM PM_{10} Results ($\mu g/m^3$) (Gravimetric Factor 1.3)

Location	2001 Annual Mean PM_{10} (%data)	2002 Annual Mean PM_{10} (%data)	2003 Annual Mean PM_{10} (%data)	2004 Annual Mean PM_{10} (%data)
Union St. Rollalong	22.3 (95.6)	23.1 (87.6)	24.3 (98.1)	23.7 (79.1)
Broughty Ferry Rd. Rollalong	n/a	21.1 (89.5)	21.9 (99.3)	18.5 (100)
Groundhog DISC	n/a	n/a	n/a	15.3 (88.9)**

** annualised 6-month (13/05/04 -14/11/04) monitoring results
%data - percentage data capture

Table 3.8 - Summary of 2004 TEOM PM_{10} Results ($\mu g/m^3$) (Gravimetric Factor 1.14)

Location	2004 Annual Mean PM_{10} (%data)
Union St. Rollalong	20.7 (79.1)
Broughty Ferry Rd. Rollalong	16.3 (100)
Groundhog DISC	13.4 (88.9)**

** annualised 6-month (13/05/04 -14/11/04) monitoring results %data - percentage data capture

Tables 3.9 and 3.10 and Figure 3.9, below, show a summary of the predicted annual means for 2010 in each of the years for which monitoring results are available. The contribution from different PM_{10} sources does not remain constant between the current year and 2010. It is therefore not appropriate to apply a single correction factor to measured data in the current year, to estimate concentrations in the future year. The measured data must first be divided into the separate source categories ('primary', 'secondary' and 'coarse') and treated separately. Only the 'primary' component is important in terms of local emissions – the 'secondary' and 'coarse' components can therefore be removed and added back in once future predictions from local sources have been performed. The methodology followed and the factors used in these calculations can be found in the Technical Guidance[18].

[18] Department for Environment Food and Rural Affairs and Scottish Executive 2003, 'Part IV of the Environment Act 1995 Local Air Quality Management Technical Guidance LAQM. TG(03), DEFRA Publications. Pg 8-10 - 11, Box 8.6 + 8.7

Table 3.9 - Summary of Predicted Annual Mean PM_{10} ($\mu g/m^3$) in 2010 (Gravimetric Factor 1.3)

Location	2001 Annual Mean PM_{10} Predicted to 2010	2002 Annual Mean PM_{10} Predicted to 2010	2003 Annual Mean PM_{10} Predicted to 2010	2004 Annual Mean PM_{10} Predicted to 2010
Union St. Rollalong	20.0	20.9	22.2	22.0
Broughty Ferry Rd. Rollalong	n/a	19.2	20.2	17.4
Groundhog DISC	n/a	n/a	n/a	14.6**

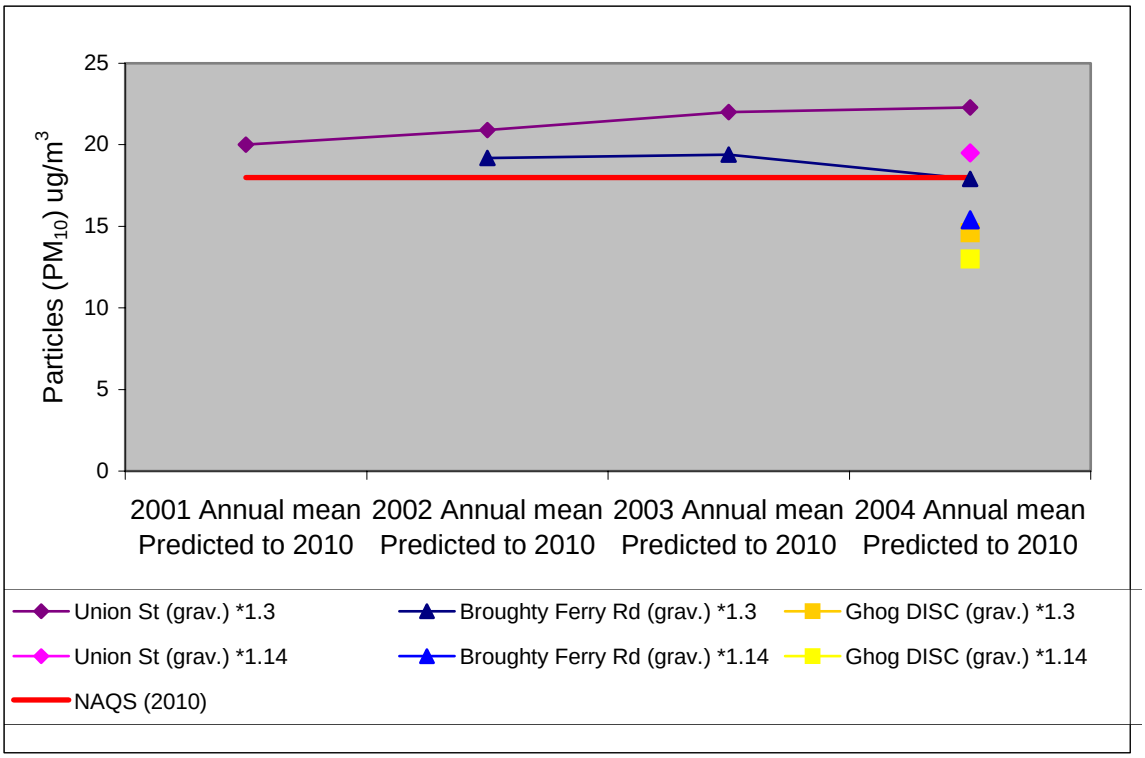
** annualised 6-month (13/05/04 -14/11/04) monitoring results

Table 3.10 - Predicted Annual Mean PM_{10} ($\mu g/m^3$) in 2010 based on 2004 data (Gravimetric Factor 1.14)

Location	2004 Annual Mean PM_{10} Predicted to 2010
Union St. Rollalong	19.4
Broughty Ferry Rd. Rollalong	15.5
Groundhog DISC	13.0**

** annualised 6-month (13/05/04 -14/11/04) monitoring results

Figure 3.9 - Measured Annual Means (factored by both 1.3 and 1.14 grav.) predicted forward to 2010 for comparison with the NAQS (2010)



3.4.5 24-Hour Mean Concentrations in 2004

The Table 3.11 below shows the number of exceedences of the 24-hour objective (50 µg/m^3) for 2004 recorded at each of the automatic monitors during 2004 and previous years, where applicable. Where measured data capture is less than 90% the 24-hour objective concentration is expressed as a 90th percentile value. This value aids comparison of monitoring data between different years and different monitors. All the following results are based on TEOM results that have been multiplied by the 1.3 gravimetric equivalence factor.

Table 3.11 - Number of exceedences of the 24-hour objective (50 µg/m^3) (no more than 35 allowed by 2004)

Location	2001		2002		2003		2004	
	No. of exceedences	90th Percentile (µg/m^3)	No. of exceedences	90th Percentile (µg/m^3)	No. of exceedences	90th Percentile (µg/m^3)	No. of exceedences	90th Percentile (µg/m^3)
Union St Rollalong	4	33	5	33	18	40	11	36
Broughty Ferry Rd Rollalong	n/a	n/a	4	32	17	39	4	29
Groundhog DISC	n/a	n/a	n/a	n/a	n/a	n/a	2	23

The Table 3.12 below shows the number of exceedences of the 24-hour objective (50 µg/m^3) for 2010 recorded at each of the automatic monitors during 2004 and previous years where applicable. Where measured data capture is less than 90% the 24-hour objective is expressed as a 98th percentile value. This value aids comparison of monitoring data between different years and different monitors.

Table 3.12 - Number of exceedences of the 24-hour objective (50 µg/m^3) (no more than 7 allowed by 2010)

Location	2001		2002		2003		2004	
	No. of exceedences	98th Percentile (µg/m^3)	No. of exceedences	98th Percentile (µg/m^3)	No. of exceedences	98th Percentile (µg/m^3)	No. of exceedences	98th Percentile (µg/m^3)
Union St Rollalong	4	44	5	42	18	62	11	60
Broughty Ferry Rd Rollalong	n/a	n/a	4	48	17	61	4	43
Groundhog DISC	n/a	n/a	n/a	n/a	n/a	n/a	2	36

The following three Figures show time series graphs of 24-hour average PM_{10} concentrations for each site, measured during 2004. Note the red line shows the 24-hour objective limit (50 µg/m^3).

Figure 3.10 - Time Series at Union Street of PM_{10} 24-Hour Mean in 2004 (in µg/m^3 grav.(1.3))

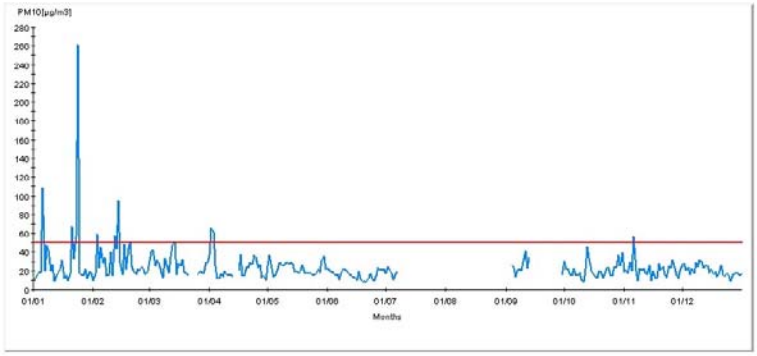


Figure 3.11 - Time Series at Broughty Ferry Road of PM_{10} 24-Hour Mean in 2004 (in µg/m^3 grav.(1.3))

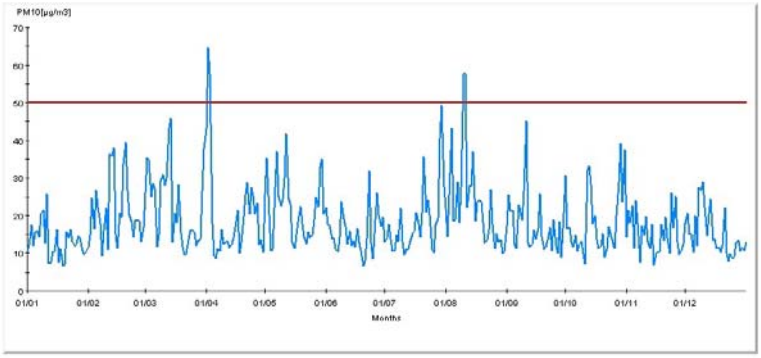
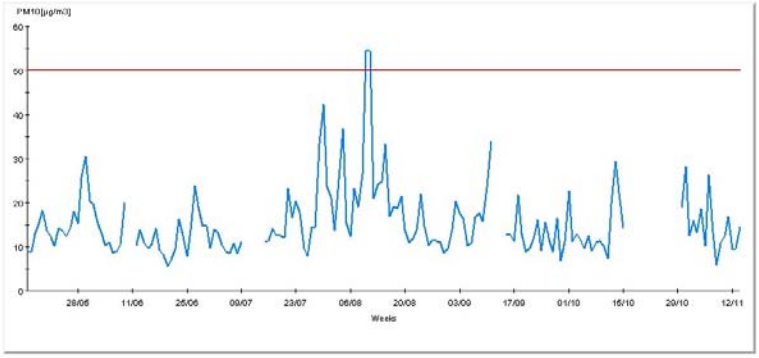


Figure 3.12 - Time Series at Groundhog DISC of PM_{10} 24-Hour Mean 13/05/04-14/11/04 (in µg/m^3 grav.(1.3))



3.4.6 Discussion of Results

Annual means

The measured results for 2004, shown in Table 3.7, demonstrate that the Annual Mean objective for PM_{10} (40 µg/m^3) in 2004 was achieved at all the monitoring locations in Dundee.

In order to compare the 2004 measured results with the 2010 Annual mean objective (18 µg/m^3), the results were predicted forward and are shown in Tables 3.9, 3.10 and Figure 3.9. The 2010 Annual mean objective is predicted to be achieved at both the Broughty Ferry Rd and background monitoring sites (regardless of the gravimetric equivalent factor used). The predicted concentrations at the Union Street monitor exceed the 2010 objective (regardless of the gravimetric equivalent factor used).

However, it is important to note that demolition works associated with a dangerous building in Union Street close to the monitor in early 2004 will have had an influence on the results at this location. In addition, data capture for the Union Street monitor was low (79.1%) in 2004, due to failure of the air conditioning unit and a subsequent problem with the TEOM later in the year. This meant that the unit was inoperable for over two months. It is possible that this lack of data capture has exaggerated the effects of the extra emissions generated by the demolition works on the annual mean. In addition several months of groundworks associated with the development of the bus interchange in Whitehall Street and Nethergate not only displaced traffic into Union Street but is likely to have increased the background level of PM_{10} in the area.

Daily Means

The measured results for 2004 in Table 3.11 show that the 2004 24-hour mean objective (50µg/m^3 not to be exceeded more than 35 times in a year) has been achieved at all the monitoring locations in Dundee.

However, the 2010 24-hour mean objective only allows 7 exceedences of the standard. The 2004 results indicate that this objective was exceeded only at the Union Street monitoring location, (see Table 3.12).

Figure 3.13 shows a comparison of the Union Street results for January and February 2004 with the Broughty Ferry Road site and the background sites in Aberdeen and Edinburgh. The 4 exceedences in January, and possibly some of those recorded in February, are thought to have been associated with the aforementioned demolition works.

Figure 3.14 shows a comparison of the Dundee monitoring sites with a variety of other sites in Scotland in early April 2004. This indicates that the PM_{10} peaks were echoed across Scotland and may have been transboundary in nature. One other exeedence occurred at the Union Street monitor on 6th November 2004 after bonfire night.

Figure 3.13 - Comparison of 24-hour averages of PM_{10} in Aberdeen, Edinburgh and Dundee for 1/1/04 – 29/2/04

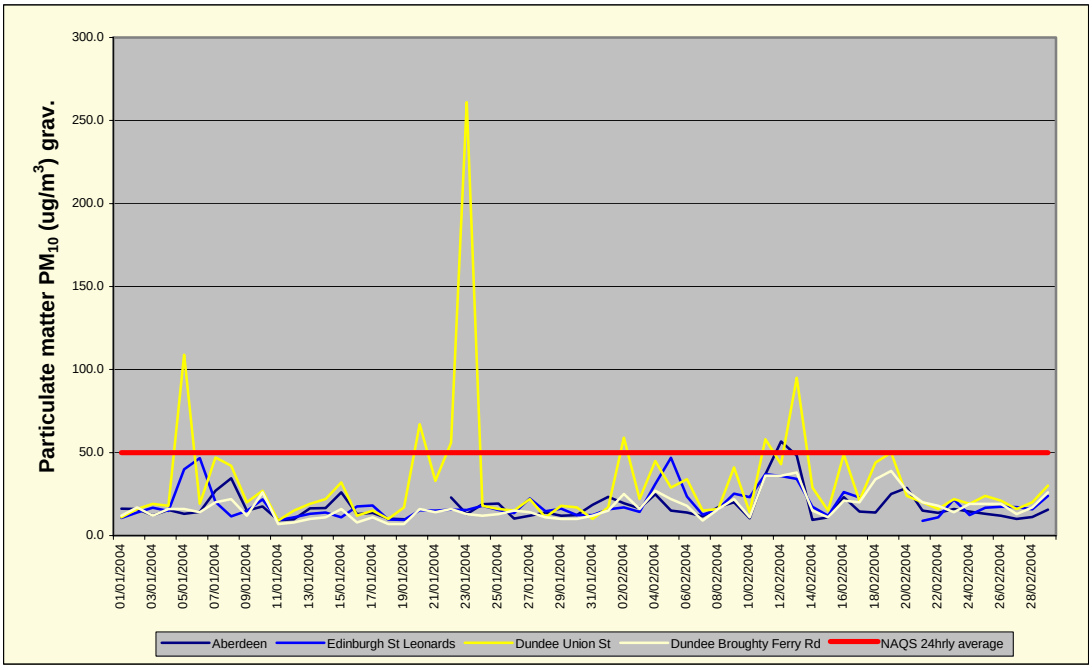
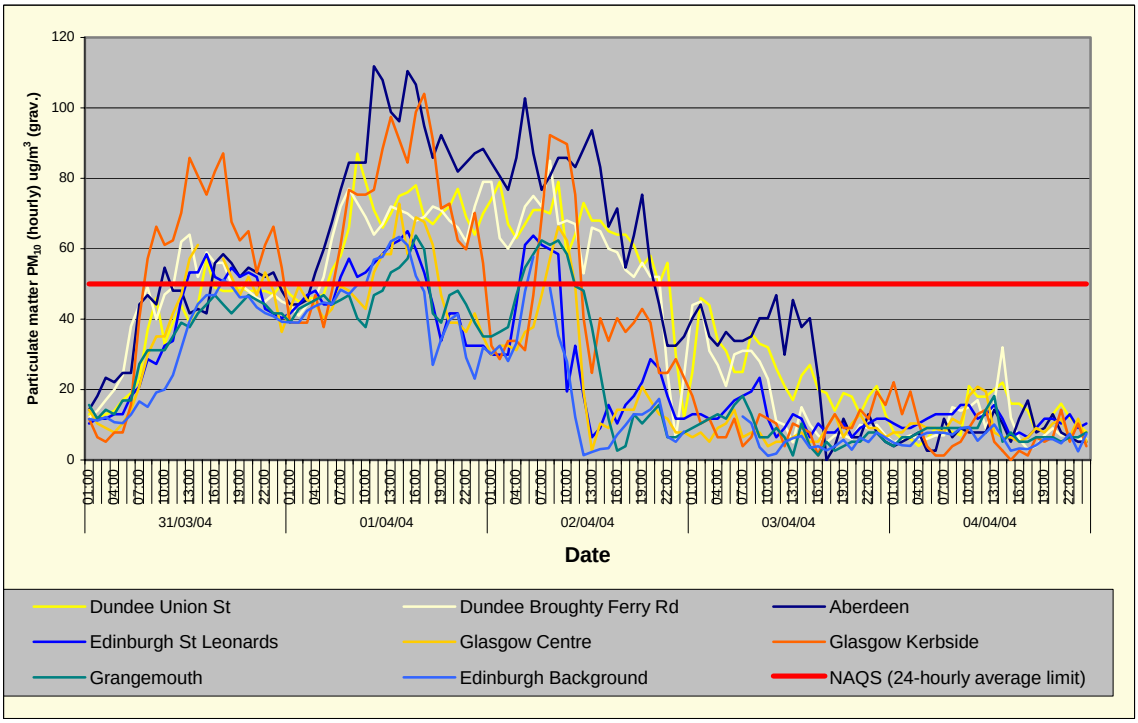
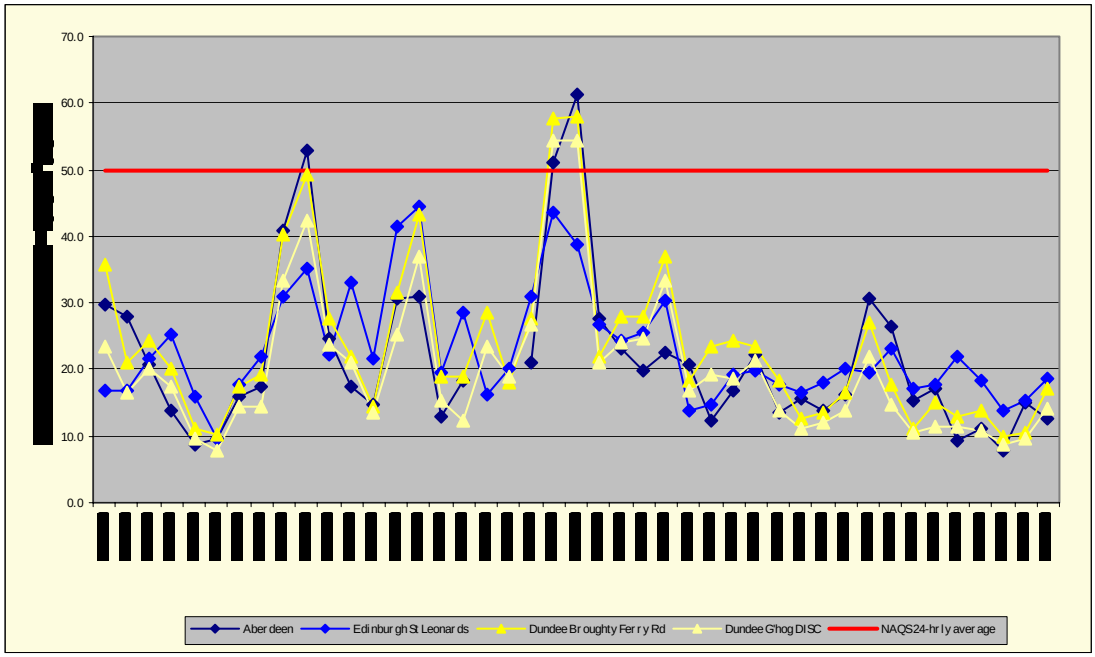


Figure 3.14 - Comparison of hourly PM_{10} levels in Scotland 31/3/04 – 4/4/04



There were two other exceedances recorded in Dundee while the Union Street monitor was not operating. These were compared with the background sites at Aberdeen and Edinburgh (see Figure 3.15) and are also thought to be transboundary in nature.

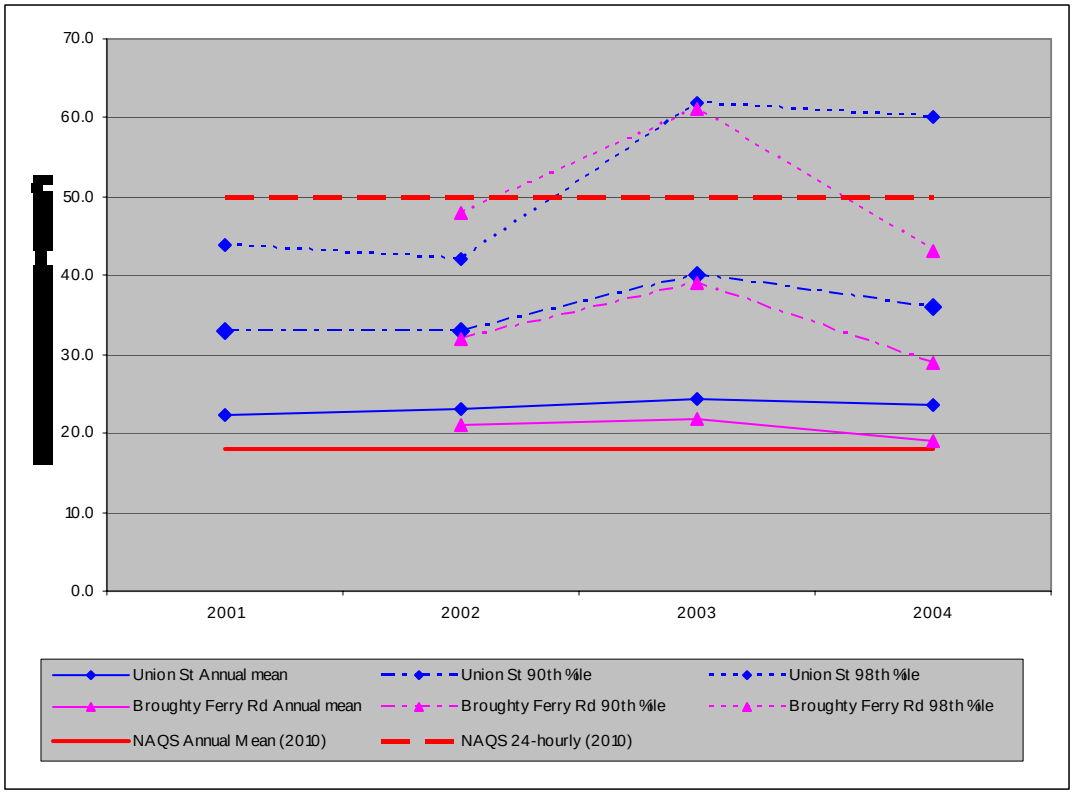
Figure 3.15 - Comparison of 24-hour averages of PM_{10} in Aberdeen, Edinburgh and Dundee for 20/7/04 – 31/8/04



3.4.7 Trends in Particulate matter (PM_{10}) Concentrations

Trends in concentrations are normally shown for sites with at least five years results, the longest period of measurement available in Dundee are the four years at Union Street. A graph showing the trends in the available measured data, (gravimetric equivalent 1.3) recorded at Union Street and Broughty Ferry Road, for both the annual means and the relevant percentile values for the 24-hour objective are shown in Figure 3.16.

Figure 3.16 - Trends in PM_{10} Annual Means and Percentiles (90th %ile and 98th %ile) measured at Union Street and Broughty Ferry Road Rollalongs



3.4.8 Discussion of Trends

The trend of PM_{10} results is difficult to determine as the results are scewed by the 2003 results. This was generally recognised as being a year in which pollutant levels throughout the UK were higher than those observed in previous years. The graph shows that the 2004 PM_{10} levels at the Broughty Ferry Road monitor for both annual mean and percentiles are lower than those in 2002. Union Street levels are thought to have remained high due to demolition works in the area during 2004.

3.5 SULPHUR DIOXIDE

OBJECTIVES :

266 micrograms per cubic metre or less, when expressed as a 15-minute mean, not to be exceeded more than 35 times a year to be achieved by 31st December 2005.

350 micrograms per cubic metre or less, when expressed as an hourly mean, not to be exceeded more than 24 times a year to be achieved by 31st December 2004.

125 micrograms per cubic metre or less, when expressed as a 24-hour mean, not to be exceeded more than 3 times a year to be achieved by 31st December 2004.

3.5.1 Measurement Method

The sulphur dioxide (SO_2) analyser works on the principle of ultra-violet (UV) fluorescence. SO_2 molecules are excited to energy states by UV radiation. These energy states decay causing emission of secondary fluorescent radiation with an intensity that is proportional to the concentration of SO_2 in the sample.

3.5.2 Instrumentation

Each site monitoring SO_2 is equipped with a Monitor Labs 9850 analyser.

3.5.3 Data Quality Requirements

The analyser is calibrated every night using certified calibration gases.

3.5.4 Summary of Annual Results

Automatic Monitoring results for the period 1 January to 31 December 2004 are shown in Tables 3.13, 3.14, and 3.15, along with results for previous years.

Table 3.13 - Summary of 15-minute mean SO_2 Results ($\mu g/m^3$) from Continuous Monitors (NAQS = 266$\mu g/m^3$)

Location	2002 15-min Mean SO_2(max) (ex)(%)	2003 15-min Mean SO_2(max) (ex)(%)	2004 15-min Mean SO_2(max) (ex)(%)
Broughty Ferry Rd. Rollalong	(288) **(1)** (90.4)	(392) **(6)** (95.4)	(395) **(5)** (97.9)
Groundhog DISC**	n/a	n/a	(83) **(0)** (97.4)

** 6-month monitoring period from 13/05/04 to 14/11/04
max – equals the maximum value recorded during the period
ex – number of exceedances of the 15 minute objective
% - percentage data capture (should be >90%)

Table 3.14 - Summary of 1-hour mean SO_2 Results ($\mu g/m^3$) from Continuous Monitors (NAQS = 350$\mu g/m^3$)

Location	2002 1-hour Mean SO_2(max) (ex)(%)	2003 1-hour Mean SO_2(max) (ex)(%)	2004 1-hour Mean SO_2(max) (ex)(%)
Broughty Ferry Rd. Rollalong	(209) **(0)** (92)	(268) **(0)** (97.5)	(296) **(0)** (100)
Groundhog DISC**	n/a	n/a	(22) **(0)** (99.4)

** 6-month monitoring period from 13/05/04 to 14/11/04
max – equals the maximum value recorded during the period
ex – number of exceedances of the 1 hour objective
% - percentage data capture (should be >90%)

Table 3.15 - Summary of 24-hour mean SO_2 Results ($\mu g/m^3$) from Continuous Monitors (NAQS = 125$\mu g/m^3$)

Location	2002 24-hour Mean SO_2(max) (ex)(%)	2003 24-hour Mean SO_2(max) (ex)(%)	2004 24-hour Mean SO_2(max) (ex)(%)
Broughty Ferry Rd. Rollalong	(71) **(0)** (91.8)	(55) **(0)** (97.3)	(34) **(0)** (100)
Groundhog DISC**	n/a	n/a	(6) **(0)** (100)

** 6-month monitoring period from 13/05/04 to 14/11/04
max – equals the maximum value recorded during the period
ex – number of exceedences of the 24 hour objective
% - percentage data capture (should be >90%)

3.5.5 15-minute Average Concentrations of SO_2 in 2004

These figures show time series graphs of 15-minute average SO_2 concentrations for each site. The 15-minute average is shown instead of the hourly as this is the strictest objective to meet, and is the only one for which there are recorded exceedences.

Figure 3.17 - Time Series at Broughty Ferry Road of SO_2 15-Minute Averages

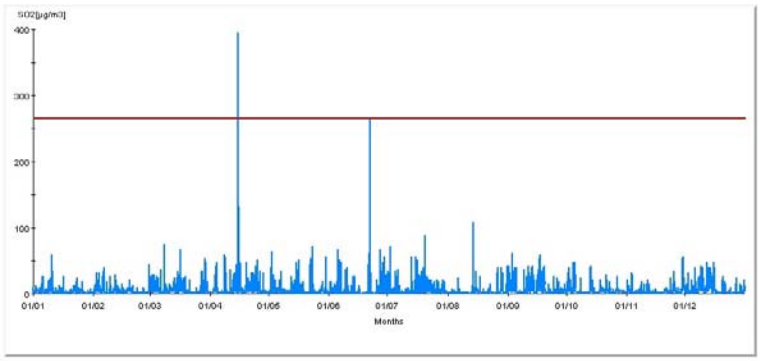
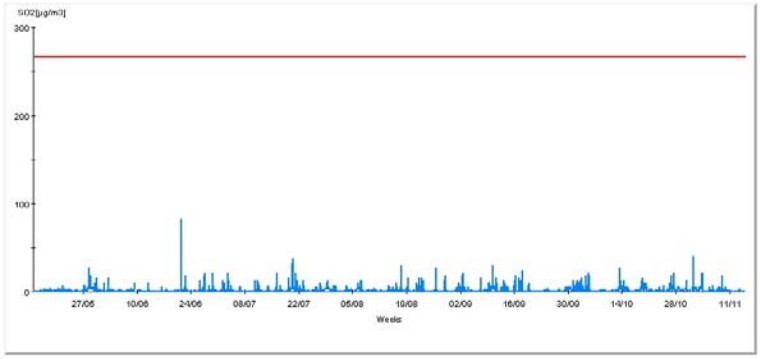


Figure 3.18 - Time Series at Groundhog DISC of SO_2 15-Minute Averages 13/05/04-14/11/04



3.5.6 Discussion of Results

There were no recorded exceedences of the 15-minute, one-hour or the 24-hour objectives for sulphur dioxide at the background monitor for the six month period from May to November 2004.

However, there were 5 exceedences of the 15-minute mean objective for sulphur dioxide (266µg/m^3) at the Broughty Ferry Road monitor during 2004. These all occurred on the morning of the 15th April 2004. The cause is not known but thought to be associated with sources within the docks area. There are 35 exceedences permitted within each calendar year. There was also a near exceedence with a value of 264µg/m^3 recorded early in the morning on 22nd June 2004.

There were no recorded exceedences of the one-hour nor the 24-hour objectives for sulphur dioxide at the Broughty Ferry Road monitor during 2004.

3.5.7 Trends in Annual Concentrations

Trends in concentrations are normally shown for sites with at least five years results. The longest period of measurement available in Dundee are the three years from the Broughty Ferry Road monitor, this is considered insufficient to show a reliable trend at the current time.

SECTION 4: NEW LOCAL DEVELOPMENTS

This section is included to highlight any changes that have taken place that may affect air quality. And includes :

- new industrial processes included in the list in Appendix 2 of TG(03), i.e. Part A, A2 or B processes;
- new developments with an impact on air quality, especially those that will significantly change traffic flows.
- new landfill sites, quarries etc. that have been granted planning permission, and which have nearby relevant exposure (see Box 8.4 in TG(03), page 8-33).

4.1 NEW PART A PROCESSES SINCE THE USA

REF NO.	LOCATION OF PROCESS	DESCRIPTION
PPC/E/20032	Danapak Flexibles, Kemback Street	Coating (flexible packaging)
PPC/E/20039	D.C. Thomson, 80 Kingsway	Printing
PPC/E/20050	Day International UK, Balgay Street	Coating (lithographic)

These processes were formerly listed as Part B processes, their re-categorization as Part A processes, is due to changes in legislation, and not due to any significant changes in emissions.

4.2 NEW PART B PROCESSES SINCE THE USA

REF NO.	LOCATION OF PROCESS	DESCRIPTION
PPC/E/30069	Tesco Stores Ltd, Kingsway	Petroleum

Petrol stations are a potential source of fugitive emissions of benzene. However, there is no relevant exposure at this location, and hence monitoring and assessment are not required.

4.3 NEW RETAIL DEVELOPMENT

An air quality assessment has been requested for the proposed new superstore on South Road.

In addition, an air quality assessment accompanied the proposed retail expansion of the Overgate Centre.

4.4 NEW ROAD SCHEMES

There is a new road infrastructure associated with the Central Waterfront Development (see section 4.7).

This will alter the existing road network to the south of the city centre including the bridge ramps. The existing high traffic flow associated with the Tay Road Bridge, which is part of the trunk road network (A92(T)), meets the inner city ring road (the A991) traffic at this point. The combination of these traffic flows and intermittent traffic queuing for the bridge tolls, inherently raises the ambient concentrations of traffic pollutants in this area. Fortunately, the current open aspect and layout aids the dispersion of these pollutants. However, despite this, the air dispersion modelling of the current road network, undertaken as part of the council's Detailed Assessment (March 2005), predicted exceedences of the NAQS for nitrogen dioxide in 2005 (40$\mu g/m^3$) in this area.

There are currently few residential receptors in the vicinity of the bridge ramps but the Central Waterfront Development Plan proposes new residential development in this area. The proposed changes in the road infrastructure, including the change in gradient of the bridge ramps and the increased number of controlled junctions may lead to an increase in vehicle emissions in this area. The effects of the changes are to be modelled as part of the Central Waterfront Development Plan. Effective traffic management of the new road network will be essential to provide a healthy environment for residents and visitors alike.

Once sufficient infrastructure is in place it will be necessary to monitor air pollution at key points within the new road network.

4.5 NEW MINERAL DEVELOPMENT

There have been no new mineral developments within or close to the Dundee City Council boundary since the USA.

4.6 NEW LANDFILL DEVELOPMENT

There have been no new landfill developments within or close to the Dundee City Council boundary since the USA.

4.7 NEW MIXED USE DEVELOPMENT

The main mixed-use development proposal likely to have an impact on air quality is the Central Waterfront Development. The Development Masterplan for the Central Waterfront area includes certain key components;

- the extension of the city centre's built form down to the waterfront;
- the creation of a new grid iron street pattern based on the historical routes to the north;
- improved provision of facilities for walking, cycling & buses;
- the reduction of the existing environmental effect of cars &parking;
- the removal and replacement of some of the Tay Road Bridge vehicle ramps;

- the creation of a pair of east/west tree lined boulevards to replace the existing inner ring road;
- the formation of attractive sites for a variety of new mixed use developments;
- the creation of a major new civic space & re-opened dock stretching from the Caird Hall to the river;
- the provision of a new rail station & arrival space at the western edge of the area.

The master plan's objective is, "to tame the negative environmental effects that the existing roads and ramps have on the area, but at the same time to allow for necessary vehicular access and through traffic. The proposed way of doing this will be to create a pair of matched east/west boulevards, which will carry external traffic through the area and channel the bridge traffic in and out of the City Centre. The bridge ramps themselves will be reconstructed to create a more compact and direct connection with the new road pattern. Within this basic pattern, smaller access streets will be formed to service the area and its associated new uses. Together this hierarchy of roads will create a much more understandable street pattern for residents and visitors alike. Pedestrian movement will be facilitated by the provision of light controlled crossing points at each junction in order to cater for the key desire lines from the city centre to the waterfront. A dedicated public transport corridor has been retained along the line of the existing route along Dock Street. This will ensure that easy bus access is maintained within the city centre while also easily serving the new Central Waterfront developments" (*Dundee Central Waterfront Development Masterplan 2001-2031*).

Despite its current open aspect, Dock Street is one of the areas identified in the council's Detailed Assessment as exceeding the NAQS for nitrogen dioxide. An air quality impact assessment has been requested for the central waterfront development plan, to help ensure that the air quality for new and existing residents of the city centre is not adversely affected by these proposals.

The infrastructure and construction works associated with the Central waterfront development may also increase ambient particulate levels in the city centre for several years.

SECTION 5 : ADDITIONAL INFORMATION

The Progress Report is designed to provide an update to stakeholders on the progress that is being made in addressing air quality issues within the Dundee City Council area, and to report on other aspects of the council's work relating to air quality. This includes:

- progress on implementation of Air Quality Managements Areas (AQMA) and action plans;
- an assessment of the monitoring data in relation to likely exceedences of the objectives;
- progress on local air quality strategies;
- a list of planning applications that have the potential to affect local air quality;
- progress on implementing those elements of the local transport strategies that might affect air quality; and
- any relevant updates on planning policies that relate specifically to air quality.

5.1 PROGRESS ON IMPLEMENTATION OF AIR QUALITY MANAGEMENTS AREAS AND ACTION PLANS

Dundee City Council has not as yet declared an AQMA, and therefore cannot report progress on the implementation of an action plan at this time. The council has recently had the conclusions of its Detailed Assessment of air quality accepted by the statutory consultees; this recommends that one or more AQMAs need to be declared for NO_2. Consultation regarding the extent of the AQMAs for NO_2 has commenced.

5.2 AN ASSESSMENT OF THE MONITORING DATA IN RELATION TO LIKELY EXCEEDENCES OF THE OBJECTIVES

5.2.1 Benzene

The 2004 monitoring results for benzene support the conclusions reached in previous assessments, that no AQMA is required for benzene. Assuming no new sources of benzene are introduced the council do not anticipate that it will be necessary to continue monitoring for benzene.

5.2.2 Nitrogen dioxide

The 2004 monitoring results for nitrogen dioxide support the conclusions of the Detailed Assessment regarding the requirement for AQMAs in parts of the city centre, Lochee Road and Victoria Road.

In addition, the Logie Street/Loons Road junction is a busy controlled junction on the main northwest arterial route of the city. The council's Detailed Assessment, which was produced in March 2005 and was based on 2003 data, recommended that the requirement for an AQMA in this area should be re-examined once 2004 data was available. The 2004 data confirm the need for an AQMA, to include this area.

5.2.3 Particulates (PM_{10})

The 2004 monitoring results for PM_{10} conclude that the 2004 objectives (both 24-hour and annual means) were met at all monitoring locations in Dundee.

The predicted results indicate that the 2010 objectives (both 24-hour and annual means) are met at the Broughty Ferry Road and background monitoring sites. The predicted results for the Union Street monitor indicate a potential exceedence of the 2010 annual mean objective, but this may have been due to demolition works and temporary traffic management changes during 2004. In addition, the number of exceedences of the 24-hour mean was greater than that allowed for the 2010 objective. The council will continue to monitor the situation regarding the levels of particulates in Dundee.

5.2.4 Sulphur dioxide

The 2004 monitoring results for sulphur dioxide support the conclusion of the Detailed Assessment that no AQMA is currently required for sulphur dioxide.

5.3 PROGRESS ON LOCAL AIR QUALITY STRATEGIES

The council does not intend to draw up a local air quality strategy at the present time but this will be reviewed annually in light of local circumstances.

5.4 A LIST OF PLANNING APPLICATIONS THAT HAVE THE POTENTIAL TO AFFECT LOCAL AIR QUALITY

Although most of the guidance relating to planning and air quality relates to the direct impact of the development through increased emissions, it is important to note that given the health related nature of air quality policy, increases in exposure are just as important, such as the introduction of new residential development into an area of poor air quality, e.g. close to busy roads and junctions, or industrial sources. Planning applications are screened by officers in the Environmental Health and Trading Standards Department and where necessary, an air quality impact assessment is requested.

Consequently, in addition to the developments already identified in Section 4, the following development proposals also require assessment for air quality.

1. South Victoria Dock High Rise Residential Development due to it's proximity to Nynas AB (UK) and the docks.
2. Logie Street Residential Development due to it's proximity to the busy Logie Street and Loons Road Junction which is also a proposed AQMA.
3. Greenmarket multi-storey car park: An air quality impact assessment is to be undertaken for the Greenmarket multi-storey car park. This car park will replace the loss of surface level car parking spaces in the city centre that will be occasioned by the Central Waterfront Development (see 4.7). The car park's proximity to the Nethergate/Marketgait junction, which is part of the proposed city centre AQMA, has potential implications for air quality as the volume of cold start emissions passing through this junction may increase.

5.5 PROGRESS ON IMPLEMENTING THOSE ELEMENTS OF THE LOCAL TRANSPORT STRATEGIES THAT MIGHT AFFECT AIR QUALITY

Dundee City Council's Local Transport Strategy (October 2000) has an important role to play in safeguarding the environment and promotes environmental protection as one of the five overarching transport objectives for the city, namely:

- To protect and enhance the built and natural environment

In terms of Air Quality, Emissions and Noise, the LTS contains the specific objective:

- To maintain Dundee's current good air quality, minimise intrusion from traffic noise and to respond to the Government's CO_2 reduction target.

Using the LTS as a basis for developing the transport network in Dundee, over these past few years the Council has pursued integrated and sustainable transport policies aimed at restraining traffic growth and congestion levels, and protecting the environment. Whilst promoting restrictive car parking measures to restrain the use of the private car, the focus continues to be on encouraging alternative means of transport other than the private car.

5.5.1 Public Transport

The Council has attracted over £14 million pounds of funding from the Scottish Executive since 1999 to provide a step change in public transport provision in Dundee. The majority of this has been targeted at improvements to the bus infrastructure and public transport information. Over the same period the local bus operators have invested over £20 million in new bus fleet.

As a result Dundee now has one of the most modern bus transport systems in the UK.

Improvements to local rail travel are also being studied. Proposals to upgrade local stations (including a new station at Dundee West) and provide a local service between Arbroath and Perth are being investigated in conjunction with the Scottish Executive and First ScotRail.

5.5.2 Walking & Cycling

The Council is keen to promote walking and cycling and has worked with a number of partners to develop a strategy that aims to provide a cohesive network of path and cycle routes, such as the Green Circular 'missing link' for cyclists through the docks. In addition road space has been reallocated away from the car, towards more environmentally benign modes of transport, most notably in the City Centre where a safe, high quality pedestrianised environment has been created which promotes walking and encourages people to live, work and relax in the area. This is now being extended to the Albert Square area.

5.5.3 Other Initiatives

There are a number of other related and integrated initiatives that aim to reduce car dependence being developed in Dundee, such as demand responsive travel, community transport and vehicle brokerage, Travel Plans for Dundee City Council, Ninewells Hospital and Dundee University, travel awareness campaigns and School Travel Plans.

5.6 PLANNING POLICIES THAT RELATE SPECIFICALLY TO AIR QUALITY

Although air quality does not feature explicitly as a policy issue in the approved Dundee and Angus Structure Plan, it is referred to within one of ten guiding principles that underpin the approach to sustainable development within the Structure Plan area, thus

> "integrate land use and transport to improve accessibility for everyone between home, work, leisure and services with a view to maintaining air quality, reducing pollution and unnecessary travel" *(Dundee and Angus Structure Plan 2002, paragraph 2.19 refers).*

Similarly, the development strategy for the Finalised Dundee Local Plan Review 2003 refers to the need to "encourage an improvement in air quality through the promotion of appropriate transport choice and promotion of sustainable transport modes" and "consider air quality impacts when undertaking construction or management of the transport network" *(Finalised Dundee Local Plan Review 2003, paragraph 6.5, incorporating pre-Inquiry changes and proposed modifications).*

Given the wider synergistic effects of land use and transport on air quality and sensitive receptors, the Council is now considering the preparation of Supplementary Planning Guidance to ensure that the Finalised Local Plan Review supports air quality objectives and the delivery of air quality action plan requirements where appropriate.

SECTION 6 : CONCLUSIONS

The new monitoring results for 2004 indicate that:

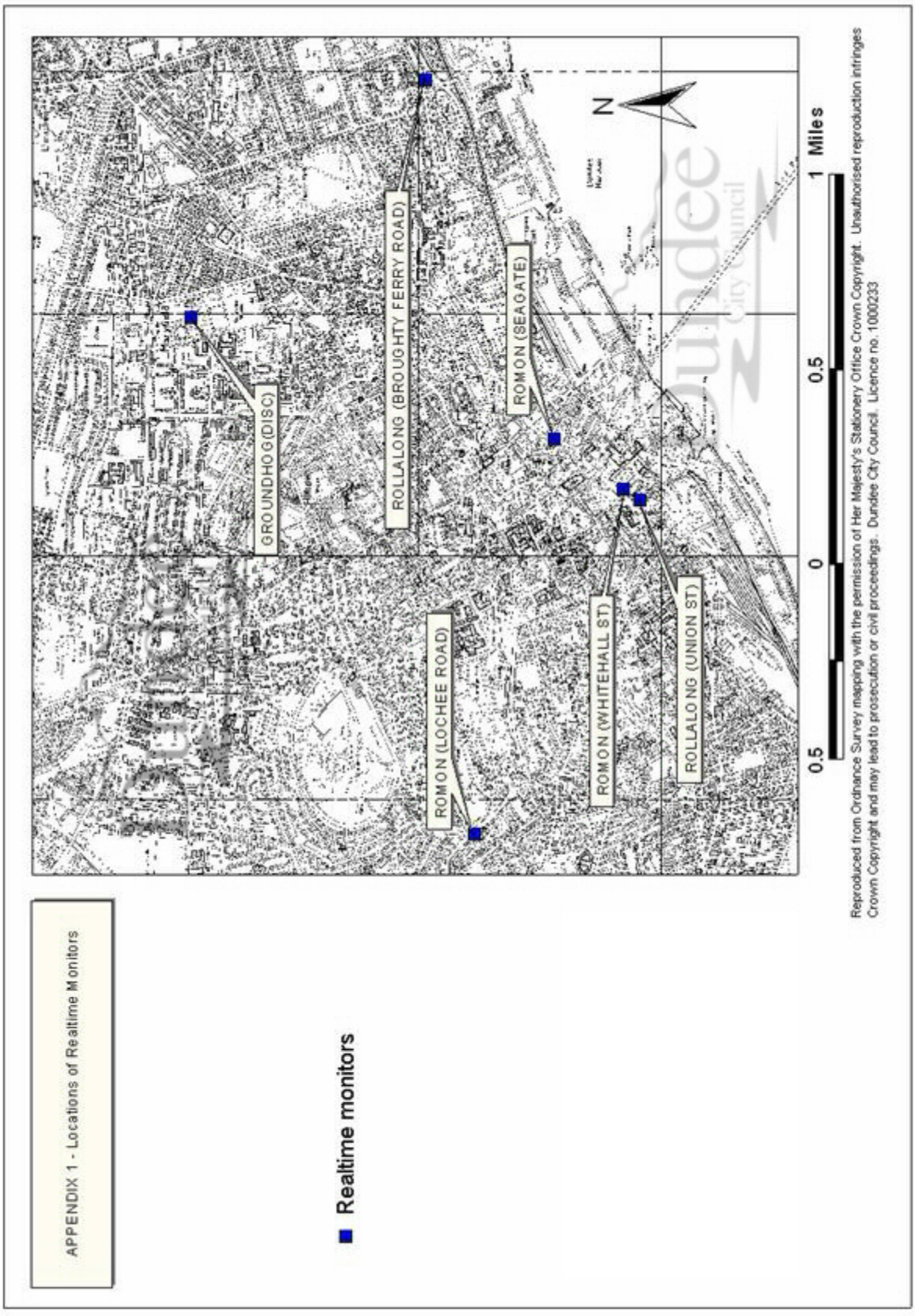
1. no AQMA is required for benzene;
2. an additional AQMA will be required for nitrogen dioxide at the Logie Street/Loons Road junction;
3. PM_{10} monitoring results for 2004 indicate that the 2004 and 2010 objectives will be met at the Broughty Ferry Road and background monitoring sites, but are inconclusive for the Union Street monitoring location. The situation with regard to PM_{10} will be kept under review. Dundee City Council was successful in obtaining funding from the Scottish Executive to install an urban background monitoring site and to undertake a co-location study to help inform the further assessment of PM_{10}.
4. no AQMA is currently required for sulphur dioxide.

New local developments with the potential to affect air quality have been identified in Sections 4 and 5. Of these, the ones that could potentially result in new areas of exceedence are:

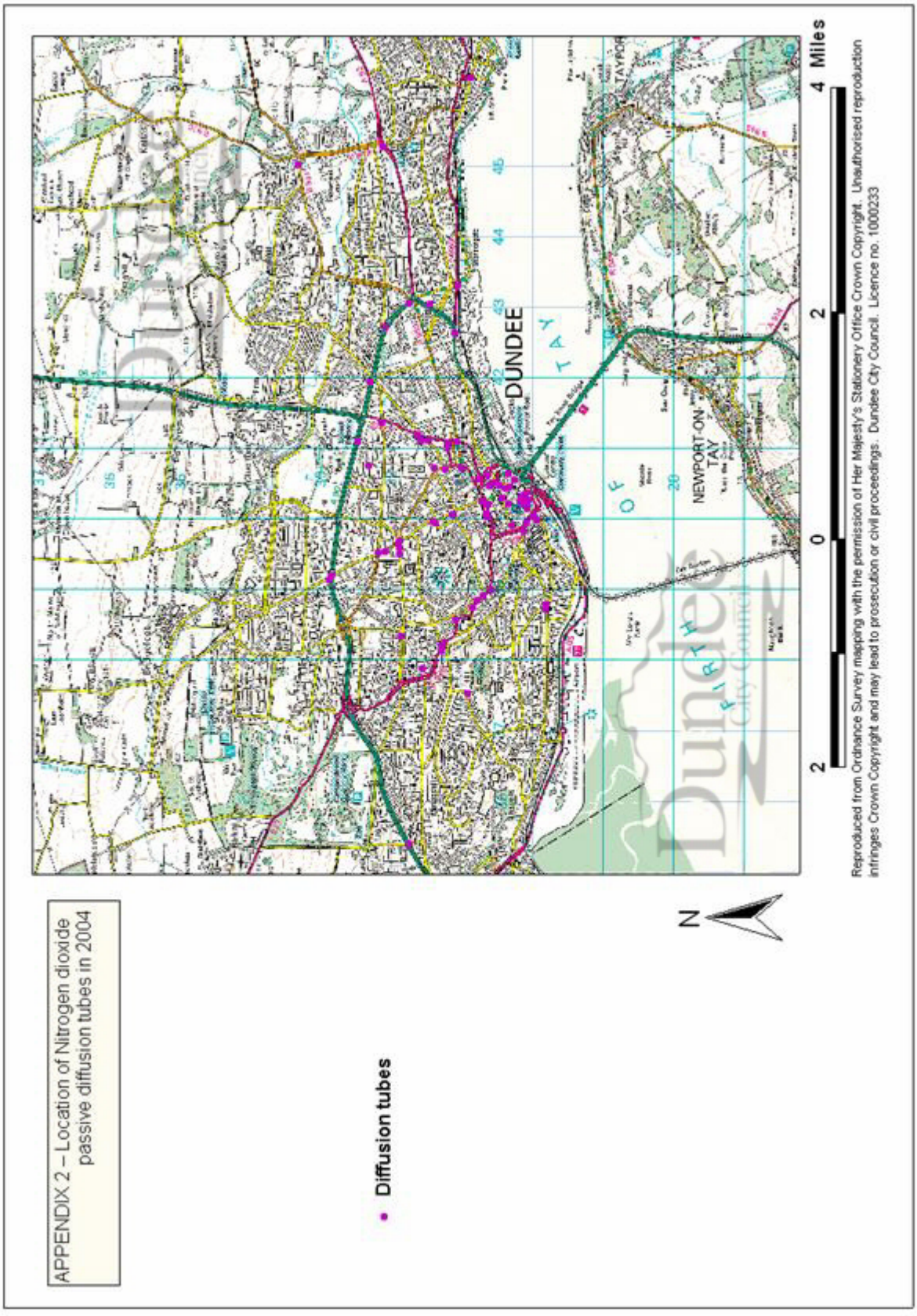
planned developments that create street canyons, and changes to the traffic flows and road network in and around the city centre that influence the way traffic moves and queues, potentially resulting in new areas of exceedence for nitrogen dioxide. In addition, the infrastructure and construction works associated with the above may increase ambient particulate levels in the city centre for several years. The central waterfront development plan will be modelled to help ensure that the air quality of new and existing residents of the city centre is not adversely affected by these proposals.

The creation of a new steering group to oversee the action plan for air quality should facilitate closer inter-departmental working to ensure new planned developments and infrastructure improvements are sensitive to air quality concerns and provide sufficient information to quantify the improvements already being made in air quality terms through local transport initiatives.

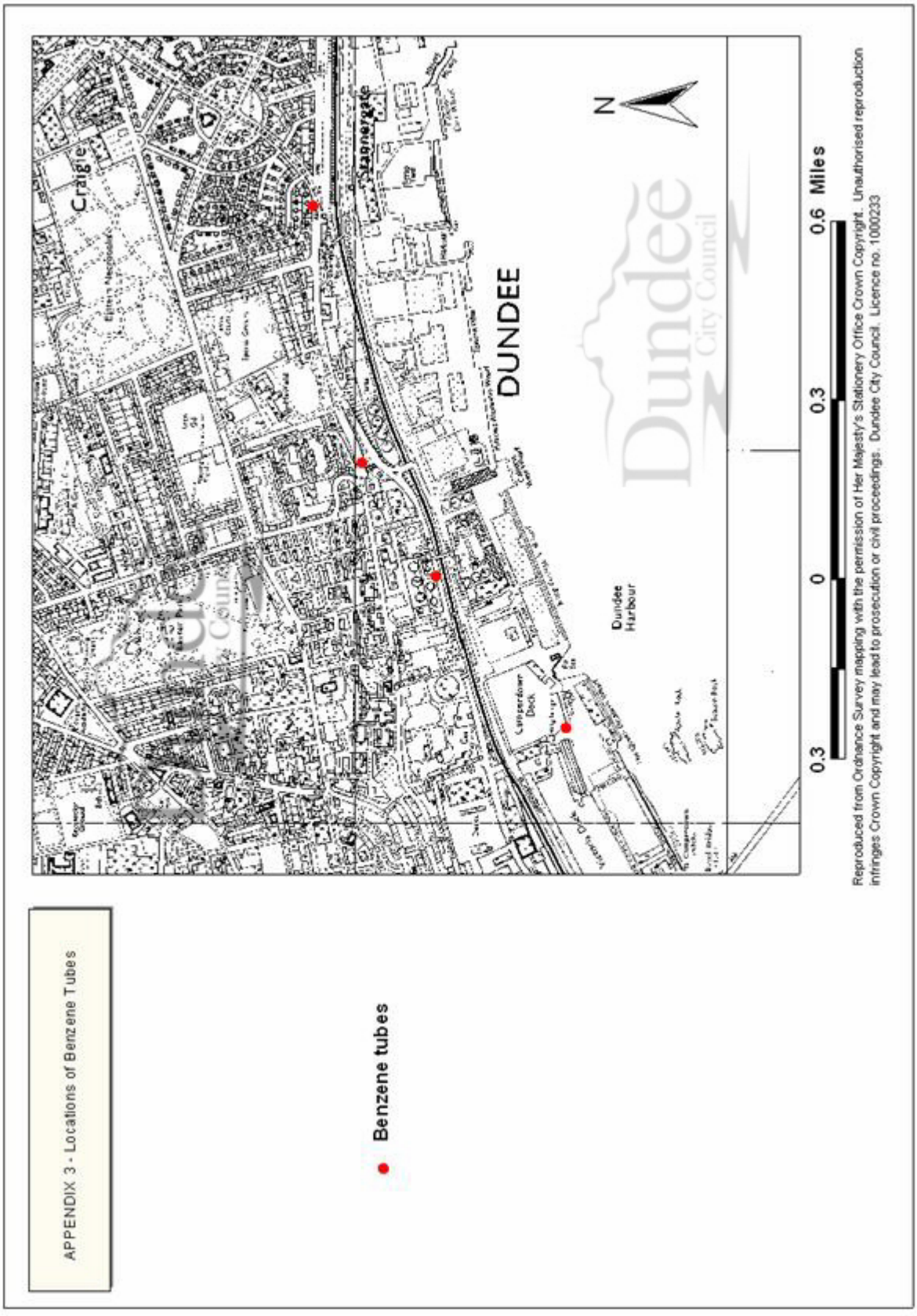
APPENDIX 1: Location of Realtime monitors



APPENDIX 2: Location of Nitrogen dioxide diffusion tube in 2004



APPENDIX 3: Location of Benzene tubes



APPENDIX 4: 2004 Annual Mean Nitrogen Dioxide Diffusion Tube Results (raw data) plotted against the NAQS for 2005