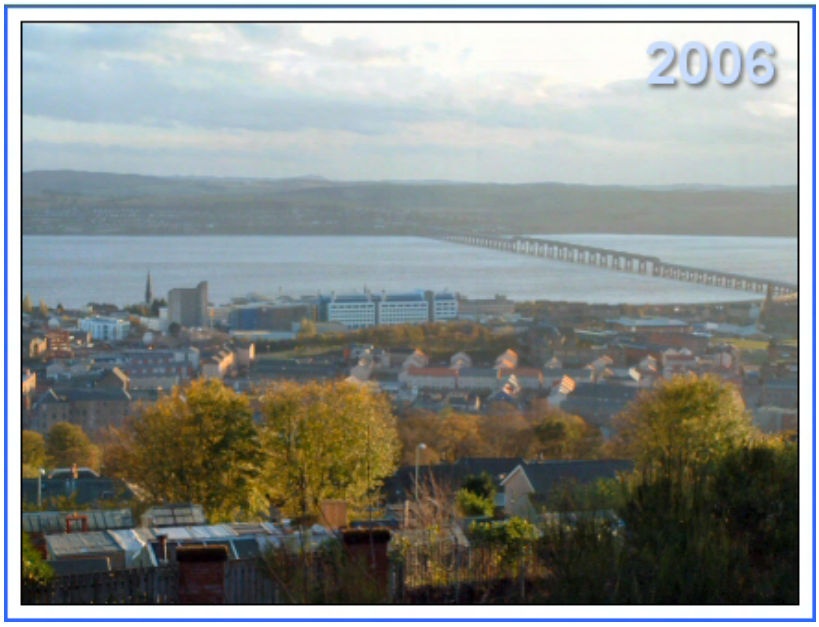
Dundee City Council

Local Authority Air Quality Updating and Screening Assessment

2006



Dundee City Council
www.dundeecity.gov.uk
CHANGING FOR THE FUTURE

CONTENTS

REFERENCES

All references appear as footnotes on the page on which they appear.

LIST OF TABLES

LIST OF FIGURES

GLOSSARY OF ACRONYMS AND DEFINITIONS

AADT	Annual Average Daily Traffic Flow
ADMS	An atmospheric dispersion model
AQ Archive	UK Air Quality Archive
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
AURN	Automatic Urban and Rural Network (Defra funded air quality monitoring network)
CHP	Combined Heat and Power
CO	Carbon Monoxide
Defra	Department for Environment, Food and Rural Affairs
DERL	Dundee Energy Recycling Ltd
DMRB	Design Manual for Roads and Bridges
EC	European Community
EHTS	Environmental Health and Trading Standards Department
EPA	The Environmental Protection Act 1990
EPAQS	Expert Panel on Air Quality Standards
EU	European Union
GF	Ground floor
GIS	Geographical Information System
HDV	Heavy goods vehicles and buses
HGV	Heavy Goods Vehicle
IPC	Integrated Pollution Control
kerbside	0 to 1 metre from the kerb
Limit Value	An EU definition for an air quality standard of a pollutant listed in the air quality directives
MW	Mega Watts
mg/kg	Milligrams per Kilogram
mg/m^3	Milligrams per cubic metre
NAEI	National Atmospheric Emission Inventory
NAQS	National Air Quality Standard
Netcen	Netcen are an operating division of AEA Energy & Environment who manage seven of the eight National Air Quality Monitoring Networks
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NO_X	Oxides of nitrogen
ng/m^3	Nanograms per cubic metre
NRTF	National Road Traffic Forecast
P&T	Planning and Transportation
$PM_{2.5}$	Particulate Matter less than 2.5μm aerodynamic diameter
PM_{10}	Particulate Matter less than 10μm aerodynamic diameter
Pb	Lead
percentile	The percentage of results below a given value
ppb	Parts per billion
ppm	Parts per million
receptor	In this study, the relevant location where air quality is assessed or predicted (for example, houses, hospitals and schools)

roadside	1 to 5 m from the kerb
SCA	Smoke Control Area
SEPA	Scottish Environment Protection Agency
SO_2	Sulphur Dioxide
TEA	Triethanolamine
TEOM	Tapered Element Oscillating Microbalance
UKAS	United Kingdom Accreditation Service
$\mu g/m^3$	Micrograms per cubic metre
VOC	Volatile Organic Compound
vpd	Vehicles per day
WASP	Workplace Analysis Scheme for Proficiency

SUMMARY

This report is the latest Updating and Screening Assessment (USA) of air quality in Dundee. The Environment Act 1995 requires all local authorities to periodically assess air quality against health-based objectives for the following seven pollutants:

- Carbon monoxide (CO)
- Benzene
- 1,3-Butadiene
- Lead
- Nitrogen Dioxide (NO_2)
- Sulphur Dioxide (SO_2)
- Particulate Matter (PM_{10})

The ongoing process to review and assess local air quality, begun in 1999, has led to the declaration of an Air Quality Management Area (AQMA), due to predicted exceedences of the annual mean objective for nitrogen dioxide, a pollutant primarily associated with vehicle exhaust emissions.

This report has been prepared in accordance with statutory guidance, and examines new data and any significant changes in pollutant sources or public exposure to pollutants.

The report concludes that for carbon monoxide, benzene, 1,3-butadiene, lead and sulphur dioxide there is no risk of the objectives for these pollutants being exceeded and hence there is no need to proceed to a detailed assessment.

The report confirms the need for the AQMA for nitrogen dioxide and identifies one new location at which the annual mean objective is exceeded (Meadowside). This forms part of the known area of exceedence at the Victoria Road/Hilltown junction and will be included in the further assessment of this area. No other exceedences of the NO_2 objectives were predicted and hence there is no requirement for detailed assessment of this pollutant.

For PM_{10} the report shows that the only monitored PM_{10} concentrations predicted to exceed the annual mean objective (2010) are in Union Street. However, this result will have been adversely influenced by major construction projects in the vicinity and may not truly represent ambient concentrations present at this location.

No exceedence of the PM_{10} objectives were predicted for any roads or junctions studied. However, an air quality assessment received by the Council indicates a potential exceedence of the annual mean objective (2010) close to the Kingsway/Forfar Road junction. This indicates that a detailed assessment of this junction is required, however there is uncertainty regarding the assumed traffic speeds and the background PM_{10} concentrations used in the developer's assessment.

Interim findings of the local gravimetric equivalence factor study suggest that the monitored and modelled PM_{10} exceedences may have been significantly over-estimated. Monitoring at the new background site (Mains Loan) and the co-location site will be continued in order to clarify whether this is the case.

The Council would like to seek the advice of the Scottish Executive about these issues and how to take forward, if necessary, the detailed assessment of the Kingsway/Forfar Road junction within the timescales set for the review and assessment process.

SECTION 1: INTRODUCTION

1.1 PURPOSE OF THE UPDATING AND SCREENING ASSESSMENT (USA)

Part IV of the Environment Act, 1995, places a statutory duty on local authorities to periodically review and assess the air quality within their area. This Updating and Screening Assessment (USA) is the first step in the Third Round of review and assessments undertaken by local authorities nationally.

Similar to previous Rounds of review and assessment, the USA considers the seven pollutants of concern to health and an assessment is made as to whether the National Air Quality Standards (NAQS) and Objectives, as defined in the Regulations[1], (see Table 1.1) will be met at relevant locations where the public may be exposed.

Each of the pollutants are assessed in turn (Sections 3 – 9) against the criteria in the 'Review and Assessment: Technical Guidance' (LAQM.TG(03))[2], published 2003, and the update to this guidance[3] published in January 2006. In this Round of assessment, sources of emission are reassessed to determine whether there have been any significant changes since the previous Rounds. These changes may include:

- New industrial plant with relevant emissions to air;
- Existing industrial plant with increased emissions to atmosphere;
- New roads or significant increases in traffic flow on existing roads;
- New areas of relevant public exposure not previously assessed;
- New air quality monitoring data; and
- New traffic count data for roads where none was previously available.

The Third Round of review and assessment is a two step process. This USA, updates the findings of the previous Rounds of review and assessment, undertaken for all pollutants identified in the Air Quality Regulations. The next step depends on the outcome of the USA. Where a significant risk of exceeding an Air Quality Objective is identified it will be necessary for the local authority to proceed to a Detailed Assessment. Where a local authority does not need to

1 The Air Quality (Scotland) Regulations 2000 and the Air Quality (Scotland) Amendment Regulations 2002

2 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.

3 LAQM.TG(03) – Updated 2006, published as a series of frequently asked questions on the review and assessment helpdesk (aqm-review@uwe.ac.uk).

undertake a Detailed Assessment, a progress report is required instead by the following year.

Table 1.1: Objectives included in the Air Quality Regulations 2000 and Amendment Regulations 2002 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 μg/m^3 3.25 μg/m^3	running annual mean running annual mean	31.12.2003 31.12.2010
1,3-butadiene	2.25 μg/m^3	running annual mean	31.12.2003
Carbon Monoxide (CO)	10.0 mg/m^3	running 8-hour mean[a]	31.12.2003
Lead	0.5 μg/m^3 0.25 μg/m^3	annual mean annual mean	31.12.2004 31.12.2008
Nitrogen Dioxide[b] (NO_2)	200 μg/m^3 not to be exceeded more than 18 times a year 40 μg/m^3	1-hour mean annual mean	31.12.2005 31.12.2005
Particles (PM_{10}) (gravimetric)	50 μg/m^3 not to be exceeded more than 35 times a year 40 μg/m^3 50 μg/m^3 not to be exceeded more than 7 times a year 18 μg/m^3	24-hour mean annual mean 24-hour mean annual mean	31.12.2004 31.12.2004 31.12.2010 31.12.2010
Sulphur Dioxide (SO_2)	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 Air Quality Objective in Scotland has been defined in Regulations as the running 8-hour mean, in practice this is equivalent to the maximum daily running 8-hour mean.
[b] The objectives for nitrogen dioxide are provisional.
[c] Measured using the European gravimetric transfer sampler or equivalent.

1.2 THE NATIONAL AIR QUALITY STRATEGY

The Government published the Air Quality Strategy for England, Scotland, Wales and Northern Ireland in January 2000 (DETR, 2000)[4] with an addendum issued in February 2003. This strategy is based on improvement measures agreed at national and international level (e.g. banning of lead from petrol). The Air Quality Strategy sets National Air Quality Standards (NAQS) and objectives against which air quality can be measured and assessed, and establishes the framework for air quality improvements. However, despite the national improvement measures, it is recognised that areas of poor air quality will remain, and that these should be dealt with more effectively using local measures implemented through the Local Air Quality Management (LAQM) regime. It should be noted that Defra and the Devolved Administrations are currently consulting on an update to the National Air Quality Strategy[5].

The strategy also provides the timescales for the achievement of objectives. The objectives are to be achieved between 2003 and 2010 (Table 1.1). Table 1.1 shows the objective values in mass concentrations (µg/m^3 or mg/m^3), the relevant averaging period and the number of exceedences that are permitted (where applicable). For each objective, local authorities have to consider present and likely future air quality, and assess whether the objectives are likely to be achieved by the prescribed dates. There is also a duty to continue to work towards meeting the air quality objectives beyond the deadlines set out in the regulations. An objective, for example which is due to be met by 2005, must also be met in every subsequent year.

1.3 PUBLIC EXPOSURE – WHERE THE OBJECTIVES APPLY

As the National Air Quality Standards (NAQS) have been set for the protection of human health, locations that the review and assessment must focus on are areas where members of the public are liable to be exposed to pollutants over the averaging period of the objective (see Table 1.2). The term 'relevant receptor' is used to describe public exposure in these locations.

Local Air Quality Management is not intended to take account of indoor air quality nor any outdoor location where public exposure over the relevant period would be unrealistic. Neither is it intended

[4] Department of the Environment, Transport and the Regions (2000):The Air Quality Strategy for England, Scotland, Wales and Northern Ireland.

[5] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland: A consultation document on options for further improvements in air quality. Volume 1, April 2006.

to protect persons at work (indoors or outdoors), as the health, safety and welfare of persons at work are covered under the Health and Safety at Work Act 1974.

Table 1.2: Locations where the air quality objectives apply

Averaging Period for Pollutants	Objectives should apply at …	Objectives should not generally apply at …
Annual mean • 1,3 Butadiene • Benzene • Lead • Nitrogen dioxide • Particulate Matter (PM_{10})	• All background locations where members of the public might be regularly exposed. • Building facades of residential properties, schools, hospitals, libraries etc.	• Building facades of offices or other places of work where members of the public do not have regular access. • Gardens of residential properties. • Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term
24 hour mean and 8-hour mean • Carbon monoxide • Particulate Matter (PM_{10}) • Sulphur dioxide	• All locations where the annual mean objective would apply. • Gardens of residential properties.	• Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term.
1 hour mean • Nitrogen dioxide • Sulphur dioxide	• All locations where the annual mean and 24 and 8-hour mean objectives apply. • Kerbside sites (e.g. pavements of busy shopping streets). • Those parts of car parks and railway stations etc. which are not fully enclosed. • Any outdoor locations to which the public might reasonably be expected to have access.	• Kerbside sites where the public would not be expected to have regular access.
15 minute mean • Sulphur dioxide	• All locations where members of the public might reasonably be exposed for a period of 15 minutes or longer.	

1.4 LAQM AND THE PHASED APPROACH TO REVIEW AND ASSESSMENT

The Technical Guidance LAQM.TG(03) (as updated in 2006) provides the framework to ensure that monitoring, modelling and review and assessments by local authorities are carried out in an appropriate and consistent fashion across the UK. This updating and screening assessment has been conducted in accordance with this statutory guidance and, where necessary, expert advice has been sought from the Air Quality Support and Review and Assessment Helpdesks that are funded by Defra and the Devolved Administrations.

The primary objectives of undertaking a review of air quality are to identify any areas that are unlikely to meet national air quality objectives and ensure that air quality is considered in local authority decision-making processes. The level of complexity required in a review is commensurate with the risk of failing to achieve air quality objectives and therefore it has been proposed that reviews should be carried out in a phased (two step) process. Every three years all local authorities must undertake the first step in the review and assessment process i.e. the Updating and Screening assessment (USA). Not every authority will need to progress beyond the first step to a Detailed Assessment, but all must produce Progress Reports in any intervening years. The steps are briefly described in Table 1.3.

Table 1.3: Summary of steps in the Air Quality Review and assessment process

Type of Assessment	Objective	Approach
Updating and Screening	To identify those matters that have changed since the last Review and Assessment, which might lead to a risk of an air quality objective being exceeded.	Use a checklist to identify significant changes that require further consideration. Where such changes are identified, then apply simple screening tools to decide whether there is sufficient risk of an exceedence of an objective to justify a Detailed Assessment.
Detailed Assessment	To provide an accurate assessment of the likelihood of an air quality objective being exceeded at locations with relevant exposure. This should be sufficiently detailed to allow the designation or amendment of any necessary AQMAs.	Use quality-assured monitoring and validated modelling methods to determine current and future pollutant concentrations in areas where there is a significant risk of exceeding an air quality objective.
Annual Progress reports	Local authorities have to prepare annual air quality Progress Reports between subsequent rounds of reviews and assessments. This should ensure continuity in the LAQM process.	The precise format of the progress report is left up to the local authority to decide, but guidance on what it should cover is available in LAQM.PRG(03)[6], published in 2003.

The Scottish Executive does not require local authorities to consult widely on the USA but its results must be made available to the public. However, this report will be submitted to the statutory consultees (e.g. Scottish Executive and the Scottish Environment Protection Agency, SEPA) for evaluation and appraisal of the decisions reached. Subsequent to its approval the report will be made available on the Dundee City Council website.

[6] Department for Environment Food and Rural Affairs and Scottish Executive 2003, 'Part IV of the Environment Act 1995 Local Air Quality Management Progress Report Guidance LAQM. PRG(03), DEFRA Publications.

SECTION 2: BACKGROUND INFORMATION

2.1 SUMMARY OF THE PREVIOUS ROUNDS OF REVIEW AND ASSESSMENT OF AIR QUALITY IN DUNDEE.

Dundee City Council has completed the following Review and Assessments of air quality to date:

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

The previous assessments of the air quality in Dundee City concluded that there were likely exceedences of the annual mean objective for NO_2 as a result of traffic sources in Dundee, in the following areas:

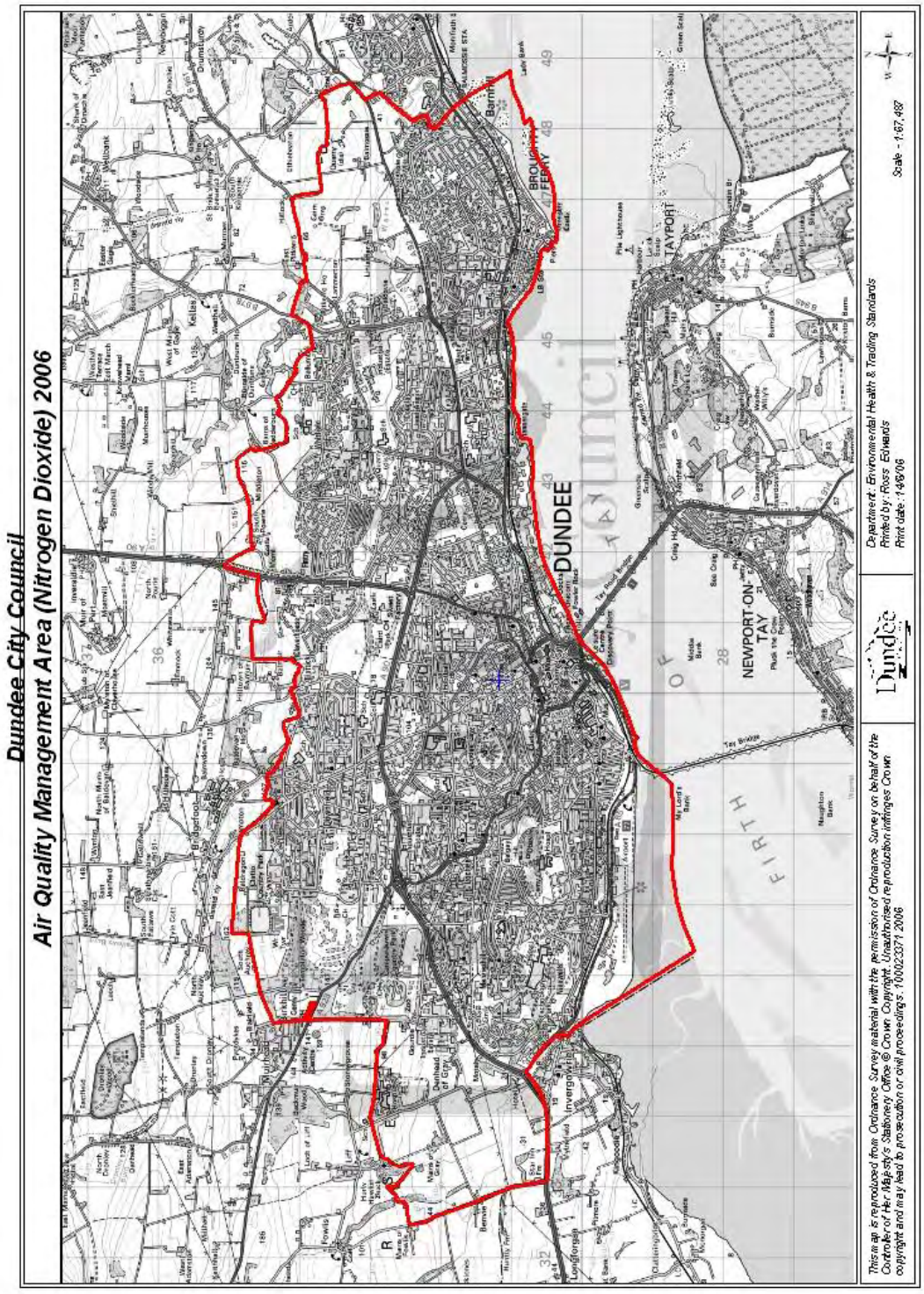
- Seagate
- Nethergate / Marketgait Junction
- Dock Street
- Commercial Street
- Victoria Road / Hilltown Junction
- Lochee Road / Rankine Street Junction
- Lochee Road / Dudhope Junction
- Logie Street / Loons Road Junction

Following the detailed modelling of the NO_2 and PM_{10} concentrations in Dundee, it was proposed that the whole of Dundee be declared as an Air Quality Management Area (AQMA) for NO_2 in July 2006. Figure 2.1 shows the extent of the AQMA for NO_2.

The results of the Detailed Assessment were inconclusive for PM_{10} as there was insufficent confidence in the verification of the modelled results for 2010. It was concluded that additional monitoring and modelling would be required to determine whether an AQMA for PM_{10} would be required.

Declaration of the AQMA is not the end of the process. The council has to undertake “Further Assessment” of the aforementioned areas in order to quantify how the various NO_2 sources contribute to the high pollutant levels identified and develop an “Action Plan” to try and improve the situation.

Figure 2.1: Dundee City Council Air Quality Management Area (Nitrogen Dioxide) 2006



2.2 PROPOSED DEVELOPMENTS WHICH MAY AFFECT AIR QUALITY

It is anticipated that there are a number of commercial, residential and transport developments in the local authority or in surrounding areas that may affect local air quality in the future.

2.3 GEOGRAPHIC INFORMATION SYSTEMS (GIS) AND SCREENING TOOLS

GIS

- Geographic Information Systems (GIS) are computer databases capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e. data identified according to their locations. At present, Dundee City Council utilises a GIS package called ArcGIS. It enables the user to display, control and analyse a diverse range of spatial information against a map background. This background is an Ordnance Survey (OS) Map. Distances between points, e.g. monitoring locations and receptors, can be accurately measured using GIS.

- Aerial photography, supplied by The GeoInformation Group, from photographs taken in 2001 and 2005, has been used to determine land usage at receptor locations.

- Building height data, also supplied by The GeoInformation Group, has been used in conjunction with OS data (Mastermap) and ArcGIS to determine the location of street canyons.

Other

A number of tools are also available to local authorities, provided on-line by Defra, these include:

- Design Manual for Roads and Bridges (DMRB). This is a screening model for roads which can calculate traffic emissions. The DMRB method requires information on vehicle flow, HDV mix, vehicle speed and the distance from receptor to road centre. It contains a database of vehicle emission factors for future year predictions of pollutant concentrations. The method calculates the annual mean traffic contribution of each pollutant. This is added to the relevant background pollutant concentration to give an annual mean. The model also estimates, from the annual mean PM_{10} prediction, the number of days where the PM_{10} concentration exceeds the 50µg/m^3 daily mean objective.

The latest version of the DMRB (v1.02, November 2003) has been used for this assessment.

- LAQM website data[7] provides maps of estimated background annual mean air pollutant concentrations at a 1 km x 1 km grid resolution for the relevant pollutants (see Appendix 1 for Dundee's background concentrations) Co-ordinates are given for the centre of each 1 km x 1 km grid square; and,

- Guidance Note for Projections - 2006 Update
  The 'Year Adjustment Calculator' is an Excel tool which incorporates updated year adjustment factors from those published in LAQM.TG(03) and are suitable for use with the LAQM.TG(03) update. It enables the user to choose a parameter, to type in a measured or modelled concentration for a given year, and to select a year for future projection. The tool then automatically does the calculation and presents the predicted concentration.

[7] www.airquality.co.uk

2.4 ROAD TRAFFIC DATA

Traffic data used in this report

New road traffic data has been obtained from the Planning and Transportation (P&T) Department (no new traffic data for Dundee was available from the National Atmospheric Emissions Inventory website) and Transport Scotland. This data has been used in conjunction (where necessary) with data from previous reports e.g. classified manual counts used for the Detailed Assessment. The new traffic data has been collated from a number of surveys undertaken between 2003 and 2006 and includes information from temporary and permanent sites, trunk road sites, safety camera sites, and Road Traffic Reduction Act sites (see Appendix 5). In addition, the Council's Paramics modelled traffic data (base year 2002) was used to supplement the new data for the modelling of roads and junctions as this data was unavailable for the previous USA. The Paramics model for Dundee covers the city centre, the inner ring road and proportion of the surrounding road network.

Percentage of HDVs (Heavy goods vehicles & buses/coaches)

The new traffic data provided by P&T did not include the proportion of HDVs. However it was possible to source this information from the classified counts undertaken for previous assessments and Transport Scotland and the Paramics model which includes percentage HDV factored from peak hour counts.

Traffic Growth

For local roads traffic growth has been based on the low National Road Traffic Forecast (NRTF) factor for projection to 2005 and 2010. For the Kingsway the central NRTF factor has been used. The P&T Department have advised that the low NRTF factor is likely to overestimate traffic projections in certain areas of the city, for example, within the city centre.

Speeds

Average speeds were available from the new temporary count site data. Where detailed traffic information has not been available, traffic has been assumed to be travelling at the applicable speed limit, except at junctions where the Technical guidance suggests that the average two-way speed is likely to be in the range 20-40kph. Speeds within this range have been chosen for the DMRB assessments of junctions (see results tables), with one exception where local knowledge suggested a reduction in speed to account for road gradient at a signalised junction.

2.5 INDUSTRIAL PROCESSES

There are a number of industrial processes, which are authorised under the Environmental Protection Act 1990 Part I, within Dundee. There are 10 Part A processes (processes regulated in respect of pollutant releases to air, controlled waters, sewers and land). Integrated pollution control applies to the most potentially polluting industrial processes, which tend to be large-scale processes. There are also 23 Part B processes, which are processes involving emissions to air alone, and tend to be generally less polluting processes. These authorisations are issued by the Scottish Environmental Protection Agency (SEPA).

Up-to-date information has been obtained from SEPA regarding authorised processes in Dundee, see Appendix 2. Since the previous round of Review and Assessment two new processes have been identified for assessment. These are a cement batching process and a roadstone coating process and are assessed in the relevant sections of this report.

SEPA also advised the council that, due to the increase in wholesale gas prices, Michelin Tyres PLC (a Part A process) have applied for a variation of their process authorisation to allow them to burn heavy fuel oil at times when gas prices are uneconomic for the plant. The company modelled the likely effect of the combustion of heavy fuel oil on local air quality. The results of this modelling are considered in the relevant sections of this report.

2.6 MONITORING METHODS

2.6.1 Continuous Monitoring sites within Dundee

Dundee City Council has 10 locations at which air pollutants are monitored continuously. A summary of these locations and the pollutants monitored is shown in Table 2.1. A map of these locations is shown in Appendix 3.

Table 2.1: Summary of continuous monitoring locations

Location	Site Type	Pollutants Monitored	Timescale
Groundhog DISC[$]	Periodic background	SO_2 / PM_{10} (TEOM) / NO_2	Periodic since 1999
Union Street Rollalong	Roadside (1.35m from the kerb)	PM_{10} (TEOM & OSIRIS)/ NO_2	Nov 2000 to present
Broughty Ferry Road. Rollalong* & Partisol	Downwind of Docks (approx. 350m from a petroleum refinery)	PM_{10}(TEOM) / SO_2	Jan 2002 to present
		PM_{10} (gravimetric)	Started June 2006
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
Victoria Road (Osiris)	Kerbside	PM_{10}	April 2005 to present
Logie Street (Osiris)	Kerbside	PM_{10}	April 2005 to present
Lochee Road (Osiris)	Kerbside	PM_{10}	April 2005 to present
Seagate (Osiris)	Kerbside	PM_{10}	April 2005 to present
Mains Loan	Background	PM_{10} (TEOM)	Started April 2006

Notes:
$ - The Groundhog is a mobile air quality station, which is shared with Angus and Fife Councils, spending approximately 6 months with each local authority. The Groundhog was not located in Dundee during 2005.
* - although the monitor referred to as being located on Broughty Ferry Road, it is located at the corner of Dock Street and Broughty Ferry Road, some of the graphs used in the report refer to the monitor as Dock Street.

2.6.2 Data Validation and Ratification

The basic principles of data management for automatic air quality monitors are presented in the technical guidance LAQM.TG(03), and in the Automatic Urban and Rural Network (AURN) Local Site Operators Manual[8]. Data for the Union Street and Broughty Ferry Road monitors have been screened and scaled in accordance with this guidance. The data presented for the Romon units has been screened but poor quality calibration data do not allow these datasets to be fully scaled and ratified.

[8] http://www.aeat.co.uk/netcen/airqual/reports/lsoman/lsoman.html

Dundee City Council have recently secured funding from the Scottish Executive, to commission Netcen[9] to assist with data management and ratification procedures in line with the advice given in the 2006 update to the LAQM.TG(03).

2.6.3 Explanation of the use of percentiles for reporting monitoring data

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.

2.6.4 Passive Diffusion Tube Monitoring Sites

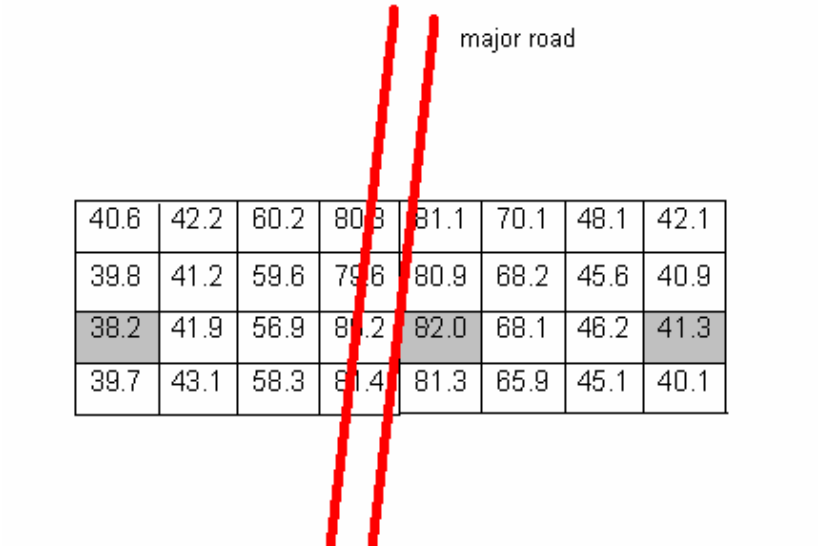
Dundee City Council had 87 passive diffusion tubes monitoring nitrogen dioxide throughout the city, during 2005. These were located at busy roads and junctions as well as urban background sites. A map of these locations is shown in Appendix 4.

2.7 NOTE ON USE OF BACKGROUND CONCENTRATIONS FOR MODELLING ROADS

The technical guidance recommends that when using the estimated mapped background pollutant concentrations, provided via the online UK Air Quality Archive (AQ Archive) database (see Appendix 1 for Dundee's background concentrations), that care be taken to avoid 'double counting'. It recommends that grid squares 4 either side of significant roads in suburban and rural areas be used to avoid counting the elevated background at the road as the background for an area, see Figure 2.2. Dundee City is a relatively small area with the major roads forming a bypass around the periphery of the City. Using background measurements 4 grid squares either side of these roads would not be representative as in most cases this would be a background for a rural site outwith the City or else a grid square over the Firth of Tay for which no data is available.

[9] Netcen are an operating division of AEA Energy & Environment who manage seven of the eight National Air Quality Monitoring Networks

Figure 2.2: Method for avoiding double counting the background NO_2 concentration of a major road suggested in the technical guidance



Using this technique from the guidance to avoid double counting the average of the two background 1km grid squares 4 either side of the square in question would be averaged, giving a background concentration of 39.8 µg/m^3 in place of the 'background' which includes the contribution of nitrogen dioxide from the road (82.0 µg/m^3).

To address this problem Dundee City Council have diffusion tubes sited close to the Kingsway at roadside (Mains Loan tube) and urban background (Woodside Avenue tube) locations. The 2005 diffusion tube results for these sites are compared to the estimated background NO_2 value from the online database in Table 2.2 below.

Table 2.2: Results of NO_2 diffusion tube sampling 2005 compared to the estimated background figures for 2005 from the AQ Archive database (revised 2006)

Monitoring tube location	Corrected diffusion tube results for 2005 (µg/m^3)	AQ Archive estimated background 2005 (µg/m^3)	Distance from major road (metres)
Woodside Avenue	**16.4**	**16.5**	250
Mains Loan	27.8	**16.6**	4

It is evident that there is a close correlation between the measured and estimated background concentrations in the vicinity of the Kingsway. Hence the actual AQ Archive database estimates of NO_x/NO_2 concentrations have been used as the background concentrations for modelling purposes.

In addition, annualised PM_{10} monitoring data for 2004 from the Groundhog (550m from the Kingsway), see Table 2.3, have been compared with AQ Archive's estimated values.

Table 2.3: Results of 2004 background PM_{10} monitoring compared to the estimated background figures for 2004 from the AQ Archive database (revised 2006)

Monitor Location	2004 Annual mean Grav. factor 1.3 ($\mu g/m^3$)	2004 Annual mean Grav. factor 1.14 ($\mu g/m^3$)	AQ Archive estimated 2004 background at Groundhog ($\mu g/m^3$)	AQ Archive estimated 2004 background at Kingsway ($\mu g/m^3$)
Groundhog at Mains Loan	15.3	13.4	15	15.1

There is a close correlation between the measured and predicted background concentrations in the vicinity of the Kingsway. Hence the actual AQ Archive database predictions of PM_{10} have been used as the background concentrations for modelling purposes. (This assumption may need to be reviewed once the local co-location study of gravimetric equivalence has been completed - see Section 9).

2.8 STREET CANYON CONSIDERATIONS

The technical guidance defines a street canyon as, "a relatively narrow street with buildings on both sides, where the height of the buildings is generally greater than the width of the road."

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

The nature of such a built urban environment tends to have a detrimental effect on the successful dispersion and dilution of pollutants generated by traffic at street level. Levels of traffic pollutants (e.g. NO_2, PM_{10}), monitored in Dundee city centre are much higher than the levels monitored at roads with similar traffic profiles situated in more open locations. The orientation of street canyons relative to the prevailing wind direction is significant in the efficiency of dispersion of traffic emissions. The worst scenario, when the direction of the street lies perpendicular to the prevailing wind direction, not only traps pollutants at street level but often

tends to concentrate them to the leeward side of the street. Monitoring and some complex air dispersion models are able to identify this phenomenon.

However, the DMRB model has been found to significantly under predict concentrations of nitrogen dioxide alongside urban city centre roads especially those classified as ‘street canyons'. To avoid missing potential exceedences of the objective in such locations, local authorities have been instructed to multiply the predicted annual mean NO_2 ‘road traffic component’ concentration, in the ‘local output’ sheet in the DMRB, by a factor of 2, to take account of the model under prediction. This should then be added to the background concentration to give the total concentration. Locations where this factor has been used are highlighted with an "*" in this report.

2.9 METEOROLOGICAL CONSIDERATIONS IN DUNDEE

In previous reports the prevailing wind direction for Dundee has been described as south-westerly. This is indeed true for the whole of the British Isles. Wind speed increases with height above the ground and most meteorological data is normalised and expressed as a speed at 10m above ground. However, wind speed and direction monitoring at two locations in Dundee in 2005 (see Figures 2.3 and 2.4 (not adjusted up to 10m)) highlight how topographical features such as hills (e.g. The Law in Dundee), and the built environment can influence local wind speed/direction. Such influences will effect the way pollutants are dispersed in different areas of the city, especially when the source of the emissions of concern are close to ground level (e.g. vehicle exhausts).

It should be noted that the DMRB screening model cannot take account of these local differences as no weighting for wind direction was included in its design (i.e. it assumes winds are evenly distributed around the compass). Consequently review and assessment of traffic pollutants in Dundee city centre and street canyons has largely relied on monitoring data.

Figure 2.3: **Wind Rose showing wind speed and direction at Broughty Ferry Road monitoring site for 2005, in an open location with rising ground to the north**

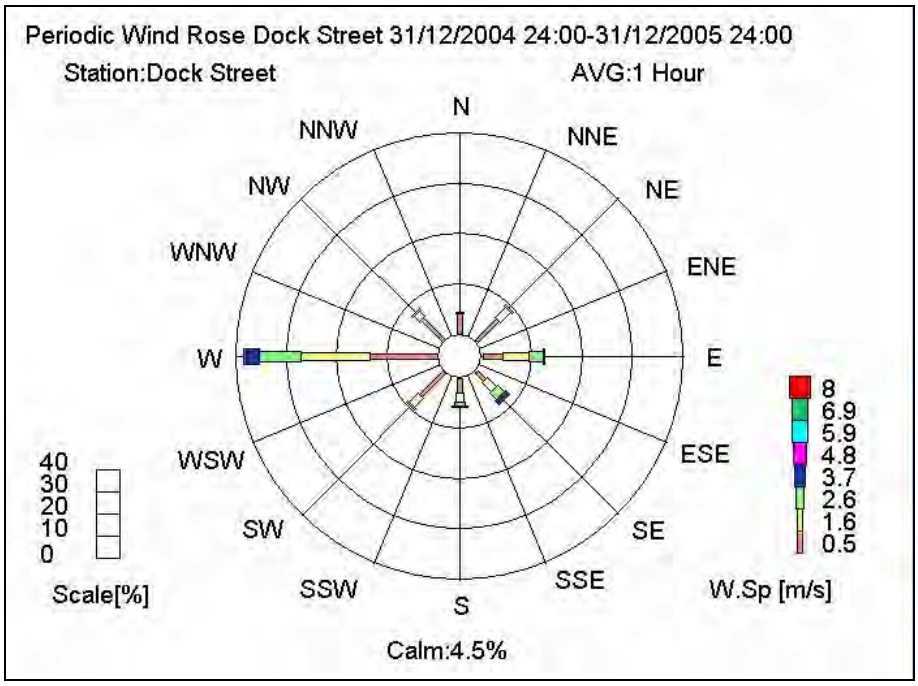
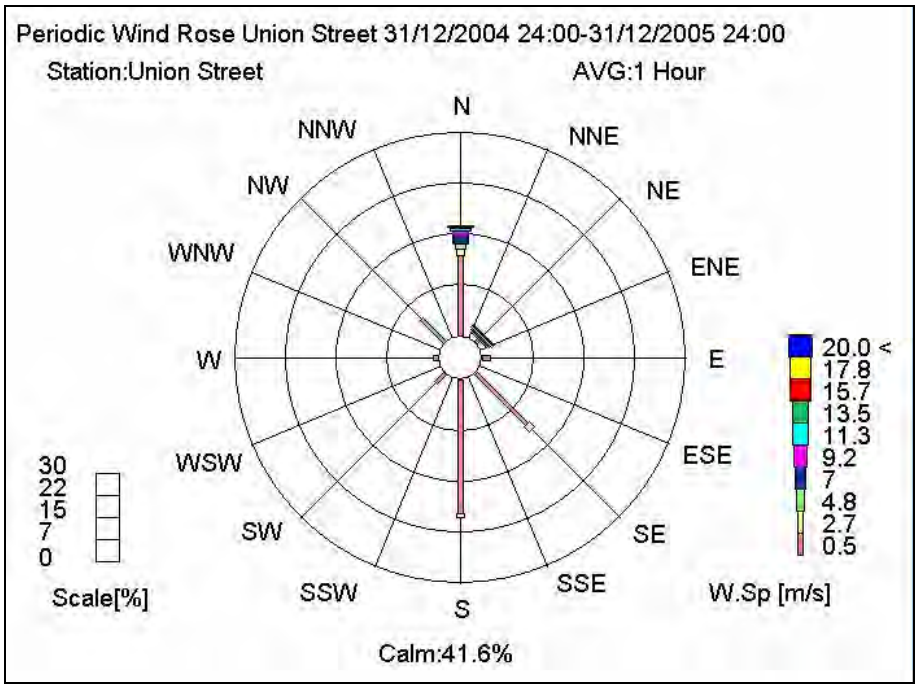


Figure 2.4: **Wind Rose showing wind speed and direction at Union Street monitoring site for 2005, within a street canyon**



SECTION 3: CARBON MONOXIDE

3.1 INTRODUCTION

The Government and the Devolved Administrations originally adopted an 8-hour running mean concentration of 11.6 mg/m^3 as the National Air Quality Standard (NAQS) for carbon monoxide. This was superseded by a new objective set at a slightly tighter level of 10 mg/m^3 as a maximum daily running 8-hour mean, to be achieved by the end of 2003, bringing it into line with the second Air Quality Daughter Directive limit value.

The main threats to human health from exposure to carbon monoxide (CO) are the formation of carboxyhaemoglobin, which substantially reduces the capacity of the blood to carry oxygen and deliver it to the tissues, and the blockage of important biochemical reactions in cells. People who have an existing disease that affects the delivery of oxygen to the heart or brain (e.g. coronary artery disease (angina)) are likely to be at particular risk if these delivery systems are further impaired by CO. The National Air Quality Standard (NAQS) is designed to protect people (including susceptible individuals) at residential premises, including gardens and public buildings such as schools and hospitals.

Carbon monoxide arises from incomplete fuel-combustion. The main source of carbon monoxide in the United Kingdom is road transport, particularly emissions from petrol engined vehicles and vehicles travelling at low speeds on urban roads. National monitoring of CO shows that concentrations have been declining since the early 1990's[10]. This is due to significant reductions in emissions from road transport because of the introduction of catalytic converters, the ban on agricultural stubble burning and the switch from coal to gas and electricity in the domestic sector. No measurements in the national monitoring network exceeded the objective in 2004 and the objective is expected to continue to be met in future years.

3.2 CONCLUSIONS FROM PREVIOUS REPORTS

The 2003 Updating and Screening Assessment concluded that the NAQS and objective for carbon monoxide would be achieved with no action required.

[10] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland- 'A Consultation document on options for further improvements in air quality' Volume 1, April 2006, **Defra Publications**. Chapter 2 para 108.

3.3 MONITORING DATA

No monitoring of CO was undertaken in Dundee in 2005. Monitoring carried out (and reported) previously indicated that all running eight hour mean concentrations were well below the NAQS for carbon monoxide.

3.4 VERY BUSY ROADS

The assessment of CO requires the identification of any 'very busy' roads or junctions in areas where the current background concentrations of CO are expected to be above 1mg/m^3.

Background concentrations for CO from the NAEI web-site[11] show the range of annual means for 1 km grid squares across the City for 2001 range from 0.154 to 0.246 mg/m^3 (see Appendix 1). Using the correction factor from the guidance[12] for the year 2006, this range becomes 0.098 to 0.156 mg/m^3. As the 2006 background for the city is expected to be less than 1 mg/m^3, further assessment of carbon monoxide is not required.

For the assessment of CO, 'very busy' roads are defined as:

- single carriageway roads with greater than 80,000 vehicles per day;
- dual carriageway roads with greater than 120,000 vehicles per day.

There are no roads falling into the classification of 'very busy' roads or junctions for CO within the city.

3.5 CONCLUSION

Having applied the checklist criteria for the assessment of carbon monoxide from the technical guidance it is concluded that the NAQS and objective for carbon monoxide and there is no need to proceed to a Detailed assessment for this pollutant.

[11] www.airquality.co.uk/archive/laqm/tools.php?tool=background
[12] www.airquality.co.uk/archive/laqm/tools/yearfactorslaqm2001.xls

Table 3.1: Checklist for Carbon monoxide

Item	Response
Monitoring data	No monitoring of CO was carried out in 2005
Very busy roads or junctions in built-up areas	No ‘very busy roads,’ and background concentration is below the threshold criteria for assessment

SECTION 4: BENZENE

4.1 INTRODUCTION

The Government and the Devolved Administrations adopted a running annual mean concentration of 16.25 μg/m^3 as the National Air Quality Standard (NAQS) for benzene, with an objective for the standard to be achieved by the end of 2003. However, in light of the health advice from EPAQS and the Department of Health's Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment to reduce concentrations of benzene in air to as low a level as possible, additional tighter objectives have also been set. Consequently in Scotland a running annual mean of 3.25 μg/m^3 has been adopted as an additional objective, to be achieved by the end of 2010. This is more stringent than the European Directive Limit Value (5 μg/m^3) which applies in England and Wales. The recent review of the National Air Quality Strategy indicates that 2010 objective in Scotland is expected to be met, at all background and roadside locations.[13]

It is recognised that benzene damages the genetic structure of cells and can cause cancer, that is, it is a genotoxic carcinogen. There is no absolutely safe level that can be specified for ambient air concentrations of benzene. It is recommended that exposure to benzene should be kept as low as possible, the NAQS for Scotland has been set accordingly. The NAQS is designed to protect people at residential premises (excluding gardens) and public buildings such as schools and hospitals.

Benzene has a wide variety of sources, mainly petrol-engined vehicles, petrol refining and distribution, and the domestic combustion of coal and wood for heating and industrial processes.

A number of policy measures already in place, or planned for future years, will continue to reduce some types of benzene emissions. Since January 2000, EU legislation has reduced the maximum benzene content of petrol to 1% from a previous upper limit of 5%. The European Auto-Oil programme will further reduce emissions for cars and light-duty vehicles, and emissions of benzene from the storage and distribution of petrol are controlled by vapour recovery systems. Therefore benzene emissions are expected to continue to decline until around 2015, but are likely to increase after that without further measures. This is due to predicted increases in the use of coal and wood for domestic fuel, as well as natural gas, to

[13] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland- 'A Consultation document on options for further improvements in air quality' Volume 1, April 2006, **Defra Publications**. Chapter 2 para 74

satisfy demand after 2010. There is also a predicted increase in the activity of the chemical industry in later years.[14]

4.2 CONCLUSIONS FROM PREVIOUS REPORTS

In previous reports the only potentially significant source of benzene in Dundee was identified as Nynas AB UK, East Camperdown Street, Dundee.

Monitoring was undertaken using BTEX (benzene, toluene, xylene) tubes for any potential fugitive emissions from the Nynas storage facilities. The results indicated that benzene levels are significantly lower than the more stringent NAQS for benzene in 2010.

It was concluded that the NAQS for benzene would be achieved with no further action or monitoring required.

4.3 MONITORING DATA

Dundee City Council is currently not monitoring benzene concentrations.

4.4 VERY BUSY ROADS OR JUNCTIONS IN BUILT-UP AREAS

When assessing benzene concentrations 'very busy' roads are considered to be a significant source. For benzene these are defined as:

- single carriageway roads with daily average traffic flows which exceed 80,000 vehicles per day; or
- dual carriageway (2 or 3 lane) roads with daily average traffic flows which exceed 120,000 vehicles per day; or
- motorways with daily average traffic flows which exceed 140,000 vehicles per day.

There are few roads in the UK which meet these criteria and there are none falling into the classification of 'very busy' road or junction for benzene within Dundee[15]. In addition there are no areas in Dundee where the background concentration is expected to be above 2 µg/m^3. (AQ Background Benzene Concentrations in 2010 range from 0.102 – 0.267 µg/m^3).

[14] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland- 'A Consultation document on options for further improvements in air quality' Volume 1, April 2006, **Defra Publications**. Chapter 2 para 76

[15] LAQM.TG(03) Update- January 2006

4.5 NEW INDUSTRIAL SOURCES

The technical guidance lists 7 types of industrial processes (6 Part A and 1 Part B) that are potential sources of benzene. SEPA have provided a list of industrial processes operating within Dundee and the surrounding area in 2006 (see Appendix 2). Of these, only Nynas AB UK is classed as a potential source of benzene. The fugitive emissions from this process have been examined and screened out in previous assessments. There are no new industrial processes of relevance for benzene in the authority or any of the neighbouring authorities.

4.6 INDUSTRIAL SOURCES WITH SUBSTANTIALLY INCREASED EMISSIONS OR NEW RELEVANT EXPOSURE.

Only Nynas AB UK is classed as a potential source of benzene and there has been no increase in fugitive emissions from this source.

New residential premises (i.e. new relevant exposure) are to be built in the dock area closer to Nynas AB UK Ltd. (approximately 360 metres west) than existing properties. However, monitoring carried out and reported previously (see Dundee City Council LAQM Progress Report 2005) near the location of the new development indicates that ground level concentrations of benzene are well below the NAQS for Benzene (City Quay 0.62 $\mu g/m^3$)[16].

4.7 PETROL STATIONS

There is some evidence that petrol stations with an annual throughput greater than 2 million litres of petrol per annum could emit sufficient benzene to put the 2010 objective at risk of being exceeded, especially when situated close to busy roads (>30,000 vehicles per day), with relevant exposure within 10 metres of the pumps. Petrol stations fitted with Stage 2 vapour recovery can be ignored in the review and assessment process.

Since the last USA in 2003, the number of petrol stations in the city has fallen from 26 to 13 (see Appendix 2). There are no petrol stations within the City where benzene is considered to be significant in accordance with the screening checklist.

4.8 MAJOR FUEL STORAGE DEPOTS (PETROLEUM ONLY)

There are no major fuel depots in the City.

[16] Dundee City Council LAQM Progress Report 2005 Table 3.2, page 8

4.9 CONCLUSIONS

Having applied the checklist criteria for the assessment of benzene from the technical guidance it is concluded that the 2003 NAQS and objective for Benzene was achieved with no action required. It is anticipated that the 2010 NAQS will also be achieved therefore, Dundee City Council will not proceed to detailed assessment for Benzene.

Table 4.1: Checklist for Benzene

Item	Response
Monitoring data outside an AQMA	No monitoring of benzene has been carried out
Monitoring data within an AQMA	No AQMAs have been declared for benzene
Very busy roads or junctions in built up areas	No roads meeting the criterion 'very busy' have been identified in Dundee. In addition the background concentration is below the threshold for assessment.
New industrial sources.	None
Industrial sources with substantially increased emissions, or new relevant exposure	None present
Petrol stations	None meeting the criteria with relevant exposure
Major fuel storage depots (petrol only)	None present

SECTION 5: 1,3-BUTADIENE

5.1 INTRODUCTION

The Government and the Devolved Administrations adopted a maximum running annual mean concentration of 2.25 μg/m^3 as an Air Quality Standard for 1,3-butadiene. The objective was for the Standard to be achieved by the end of 2003.

The health effect, which is of most concern in relation to 1,3-butadiene exposure, is the induction of cancers of the lymphoid systems and blood-forming tissues, lymphomas and leukaemias. Like benzene, 1,3-butadiene is a genotoxic carcinogen, and so no absolutely safe level can be defined. The NAQS is designed to protect people at residential premises (excluding gardens) and public buildings such as schools and hospitals.

1,3-Butadiene in air derives solely from man-made sources. It is an important industrial chemical, although fugitive emissions from its production and use in the chemical industry are small and the majority of 1,3-butadiene in ambient air comes from combustion sources. The main combustion sources are associated with road transport, particularly petrol-engined vehicles but with a small contribution from diesel-fuelled vehicles.

The introduction of catalytic converters in 1991 has had a significant impact on the emissions from road vehicles due to their efficient removal of 1,3-butadiene from exhaust gases. Emissions from other significant combustion sources, such as other transportation and machinery, have not changed significantly in recent years. National monitoring of 1,3-butadiene shows that concentrations are well below the objective and continue to decline. There have been no exceedences of the objective for 2003[17]. Only those authorities with relevant locations in the vicinity of major industrial processes that handle, store or emit 1,3-butadiene are expected to proceed beyond the updating and screening assessment.

5.2 CONCLUSIONS FROM PREVIOUS REPORTS

Previously it was concluded that the National Air Quality Standard for 1,3-butadiene would be achieved with no further action required.

[17] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland- 'A Consultation document on options for further improvements in air quality' Volume 1, April 2006, **Defra Publications**. Page 48 para 84.

5.3 MONITORING DATA

No monitoring for 1,3-butadiene has been undertaken.

5.4 NEW INDUSTRIAL SOURCES

The technical guidance lists 4 types of industrial processes (3 Part A and 1 Part B) that are potential sources of 1,3-butadiene.

There are no new or proposed industrial sources with relevance to 1,3-butadiene within the City or close to the boundary in neighbouring authorities.

5.5 EXISTING INDUSTRIAL SOURCES WITH SIGNIFICANTLY INCREASED EMISSIONS

There are no industrial sources with significantly increased emissions that are likely to emit 1,3-butadiene.

5.6 CONCLUSIONS

Having applied the checklist criteria for the assessment of 1, 3-butadiene from the technical guidance it is concluded that the National Air Quality Standard and objective for 1,3-butadiene will continue to be achieved with no action required.

Table 5.1: Updating and Screening Assessment Summary Checklist for 1,3-butadiene

Item	Response
Monitoring data	No monitoring of 1,3-butadiene has been carried out
New industrial sources.	None present
Industrial sources with substantially increased emissions, or new relevant exposure	None present

SECTION 6: LEAD

6.1 INTRODUCTION

The Government and Devolved Administrations have adopted an annual mean concentration of 0.5 μg/m^3 as the National Air Quality Standard (NAQS) for lead, with an objective for the Standard to be achieved by the end of 2004. In addition, a lower Air Quality Standard of 0.25μg/m^3 to be achieved by the end of 2008 has also been set.

Exposure to high levels of lead may result in toxic effects in humans which, in turn, can cause problems in the synthesis of haemoglobin, effects on the kidneys, gastrointestinal tract, joints and reproductive system, and short or long term damage to the nervous system. The possible effect of lead on brain development in children, and hence their intellectual development, is the greatest cause of concern. Normally, only a small fraction of total lead intake occurs through inhalation. The NAQS are designed to protect people at residential premises (excluding gardens) and public buildings such as schools and hospitals.

The agreement reached between the European Parliament and the Environment Council on the Directive on the Quality of Petrol and Diesel Fuels (part of the Auto-Oil Programme) led to a ban on sales of leaded petrol in the United Kingdom which took effect from 1 January 2000. Emissions of lead are now restricted to a variety of industrial activities, such as battery manufacture, pigments in paints and glazes, alloys, radiation shielding, tank lining and piping.

Detailed assessments of the potential impact of lead emissions from industrial processes have been undertaken by the Government and the Devolved Administrations based upon both monitoring and sector analysis studies. The former has included a 12-month monitoring survey in the vicinity of 30 key industrial sites in the UK, which has been used to supplement information already provided from the non-automatic monitoring networks. These monitoring data have generally indicated no exceedences of the 2004 or 2008 objectives. In the ongoing Air Quality Strategy Review[18] the UK Government and the devolved administrations propose to retain the objectives set for lead.

[18] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland- 'A Consultation document on options for further improvements in air quality' Volume 1, April 2006, **Defra Publications**. Chapter 4 para 64

6.2 CONCLUSIONS FROM PREVIOUS REPORTS

In previous reports the only potentially significant source of lead in Dundee was identified as Dens Metals, a foundry that casts bronze alloys and gun metal.

At that time Dens Metals was situated on Dens Road in the city, close to residential properties. Monitoring and modelling carried out identified a potential exceedence of the NAQS for lead due to fugitive emissions from the factory. SEPA undertook to ensure that fugitive emissions of lead were adequately controlled through the process authorisation.

The company moved to the West Pitkerro industrial estate on the east edge of the city boundary in 2003. The new custom-built premises is significantly further from any relevant receptors, and the air quality assessment submitted as part of the authorisation process did not predict any potential exceedences of the NAQS for lead.

It was concluded that the NAQS and objective for lead would be achieved with no action required.

6.3 MONITORING DATA

Dundee City Council is currently not monitoring lead concentrations

6.4 NEW INDUSTRIAL SOURCES

Industrial processes likely to be potential sources of lead are listed in Appendix E of the Guidance LAQM.TG(03). There are no new industrial processes of relevance for lead within or close to the council boundary (see Appendix 2 for list of authorised industrial processes in Dundee).

6.5 INDUSTRIAL SOURCES WITH SIGNIFICANTLY INCREASED EMISSIONS, OR NEW RELEVANT EXPOSURE

The only industrial source, which is likely to emit lead is Dens Metals. Information from SEPA suggests that there has been no significant increase in emissions (i.e. greater than 30%) since production commenced at the West Pitkerro site. The West Pitkerro site is zoned for industrial use and there has been no new relevant exposure (e.g. residential development) in proximity to Dens Metals since it commenced production.

6.6 CONCLUSIONS

Having applied the checklist criteria for the assessment of lead from the technical guidance it is concluded that the NAQS and objective for lead will be achieved with no further action required.

Table 6.1: Updating and Screening Assessment Summary Checklist for lead

Item	Response
Monitoring data	No monitoring of lead has been carried out within Dundee
New industrial sources.	None
Industrial sources with substantially increased emissions, or new relevant exposure	None

SECTION 7: NITROGEN DIOXIDE

7.1 INTRODUCTION

The Government and the Devolved Administrations have adopted two National Air Quality Standards (NAQS) and objectives for nitrogen dioxide, as an annual mean concentration of 40 $\mu g/m^3$, and a 1-hour mean concentration of 200 $\mu g/m^3$ not to be exceeded more than 18 times per year. The objectives are to be achieved by the end of 2005. There are equivalent EU legally binding limit values to be achieved in 2010. The ongoing review of the national air quality strategy proposes that the current 2005 objectives be retained to stimulate progress at national and local level towards the EU limit values.[19]

Nitrogen Dioxide (NO_2) and nitric oxide (NO) are both oxides of nitrogen, and are collectively referred to as nitrogen oxides (NO_x). All combustion processes produce NO_x emissions, largely in the form of nitric oxide, which is then converted to nitrogen dioxide, mainly as a result of reaction with ozone in the atmosphere. It is nitrogen dioxide that is associated with adverse effects upon human health.

At relatively high concentrations, nitrogen dioxide causes inflammation of the airways. There is evidence to show that long term exposure to nitrogen dioxide may affect lung function and that exposure to nitrogen dioxide enhances the response to allergens in sensitised individuals. The annual average NAQS is designed to protect people at residential premises (excluding gardens) and public buildings such as schools and hospitals. In addition, the 1-hour mean NAQS is designed to protect people in residential gardens, car parks, bus/railway stations and pavements of busy shopping streets.

7.2 SOURCES

The principal source of NO_x emissions is road transport, which accounted for about 49% of total UK emissions in 2000. Major roads carrying large volumes of high speed-traffic (such as motorways and other primary routes) are a predominant source, as are conurbations and city centres with congested traffic. Within most urban areas, the contribution of road transport to local emissions will be much greater than for the national picture.

[19] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland- 'A Consultation document on options for further improvements in air quality' Volume 1, April 2006, **Defra Publications**. Chapter 4 para 28.

The contribution of road transport to NO_x emissions has declined significantly in recent years as a result of various policy measures, and further reductions are expected up until 2010 and beyond. For example, urban traffic NO_x emissions are estimated to fall by 46% between 2000 and 2010. Quantities of NO_2 emitted as a proportion of NO_x may however increase in the future.[20]

Other significant sources of NO_x emissions include the electricity supply industry and other industrial and commercial sectors, which accounted for about 24% and 23% respectively in 1999. Emissions from both sources have also declined dramatically, due to the fitting of low NO_x burners, and the increased use of natural gas plant. Industrial sources make only a very small contribution to annual mean nitrogen dioxide levels, although exceedences of the hourly nitrogen dioxide objective occur under rare, extreme meteorological conditions, due to emissions from these sources.

Additional measures have been proposed in the ongoing review of the national air quality strategy to reduce emissions from transport and industry (Measure Q)[21], these include;

- incentives for the early uptake of new euro standards for passenger cars, light duty vehicles and heavy duty vehicles (Measure C)
- incentives to increase the penetration of low emission vehicles (Measure E)
- reductions in emissions of harmful pollutants from small combustion plant (Measure L)

7.3 CONSIDERATIONS FOR LOCAL AUTHORITIES

In practice, meeting the annual mean objective in 2005, and the limit value in 2010, has proven to be considerably more demanding than achieving the one hour objective. Even if the proposed additional measures (Measure Q) were to be implemented it is still expected that there will be widespread exceedences of the EU limit value in 2010 at urban roadside locations, with some exceedences persisting until 2020.[22]

A report by the University of West of England on behalf of DEFRA (2002) concludes that outside major conurbations, exceedences of the annual mean objective are only likely to occur within about 10 metres of the kerbside of single carriageway roads. This includes

[20] AQEG (2004) Nitrogen Dioxide in the United Kingdom. Report by the Air Quality Expert Group. http://www.defra.gov.uk/environment/

[21] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland- 'A Consultation document on options for further improvements in air quality' Volume 1, April 2006, **Defra Publications**. Chapter 3 Section 3.2.17.

[22] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland- 'A Consultation document on options for further improvements in air quality' Volume 1, April 2006, **Defra Publications**. Chapter 4 para 23.

roads with relatively low traffic flows (10,000 to 20,000 vehicles/day) if they are within congested town centres. This is particularly significant where towns have narrow streets with residential properties within 5 metres of the kerb.

These locations, where local authorities can expect pollutant concentrations to be the highest are often referred to as 'hot spots'. Focussing on these areas should ensure that potential exceedences are not missed. If there are no exceedences of the objectives at the most polluted locations, then it can be reasonably concluded that there should be no exceedences elsewhere.

7.4 CONCLUSIONS FROM PREVIOUS REPORTS

7.4.1 Updating and Screening Assessment 2003

Dundee City Council completed its previous USA in May 2003, with the conclusion that further assessment was required for nitrogen dioxide (NO_2) at 17+ locations.. Consequently, the council was obliged to carry out additional monitoring, modelling and traffic counts throughout the city to determine if any areas, additional to those already identified in the USA, required detailed assessment. Of these, the USA and subsequent studies concluded that a Detailed Assessment was required for the following nine busy roads and junctions:

- Union Street/Nethergate
- Nethergate/West Marketgait
- Whitehall Street/High Street/Nethergate
- Dock Street
- Seagate
- Lochee Road
- Logie Street/Loons Road/Muirton Road junction
- Victoria Road/Hilltown
- Strathmore Avenue.

7.4.2 Detailed Assessment 2005

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 main finding of the Detailed Assessment in relation to NO_2 was that one or more Air Quality Management Areas (AQMAs) were required for NO_2 due to the predicted exceedences of the annual mean for 2005. These are shown in Figures 7.1-7.3, and described below.

The verified modelled annual mean NO_2 results for road traffic emissions in 2005 in the Dundee central assessment area along

Seagate, Nethergate/Marketgait, Dock Street and Commercial Street, Victoria Road indicated annual mean nitrogen dioxide concentrations at relevant receptor locations were predicted to exceed the annual mean objective of 40µg/m^3

There were also predicted exceedences of the annual mean NO_2 objective at relevant receptors in close proximity to the Lochee Road/Rankine Street and Lochee Road/Dudhope Terrace junctions.

Within the Logie Street and Loons Road assessment area, there were predicted exceedences of the annual mean objective of 40µg/m^3 largely to the north-east of the junction which was not reflected in the monitoring at the site. As model verification was based on 2003 monitoring data and the relevant monitoring sites within the Logie Street assessment area were started in September 2003, there was a degree of uncertainty in the predictions within this area. It was decided that the need to declare this area as an AQMA should be reassessed once 2004 monitoring data became available.

The verified modelled annual mean NO_2 results in 2005 in the Strathmore Avenue assessment area predicted that the objective would be met and no AQMA is required in this area.

7.4.3 Progress Report 2005

The Progress Report concentrated primarily on new monitoring data for 2004 and new local developments that have the potential to affect local air quality. Analysis of the 2004 data for nitrogen dioxide confirmed the need for an AQMA to include the area around the Logie Street/Loons Road junction.

It recognized that changes to the built environment, traffic flows, composition and speeds in the city centre may change NO_2 levels.

7.4.4 Declaration of Air Quality Management Area (AQMA) for the Nitrogen Dioxide Annual Mean Objective.

Dundee City Council submitted a preliminary timetable for declaration to the Scottish Executive in December 2005. This proposed making the AQMA Order in May 2006 with the AQMA coming into force in July 2006. The AQMA will cover the whole of Dundee.

Figure 7.1: Predicted Areas of Exceedance of Nitrogen Dioxide Annual Mean Objective in the City Centre.

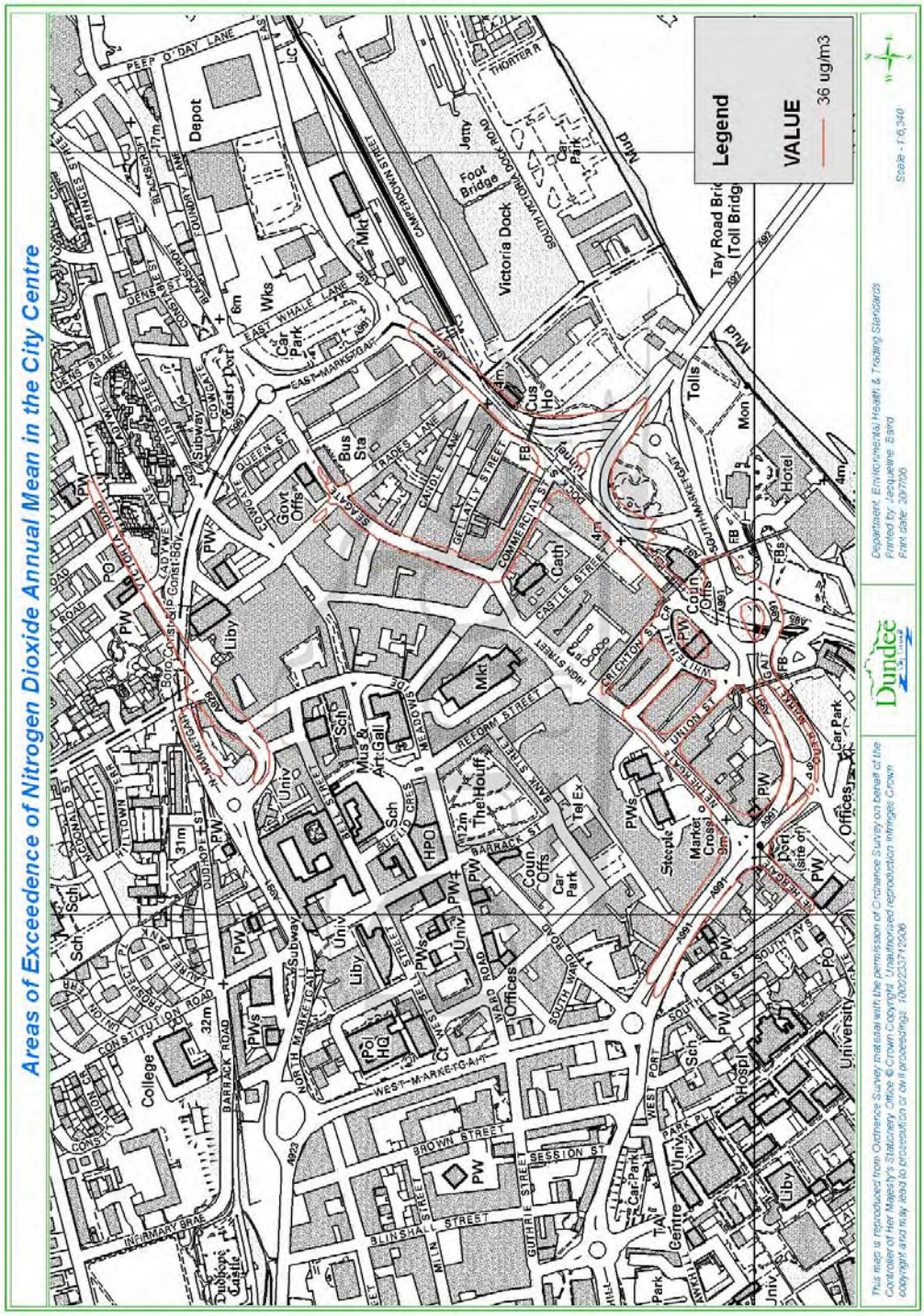


Figure 7.2: **Predicted Areas of Exceedance of Nitrogen Dioxide Annual Mean Objective in Lochee Road.**

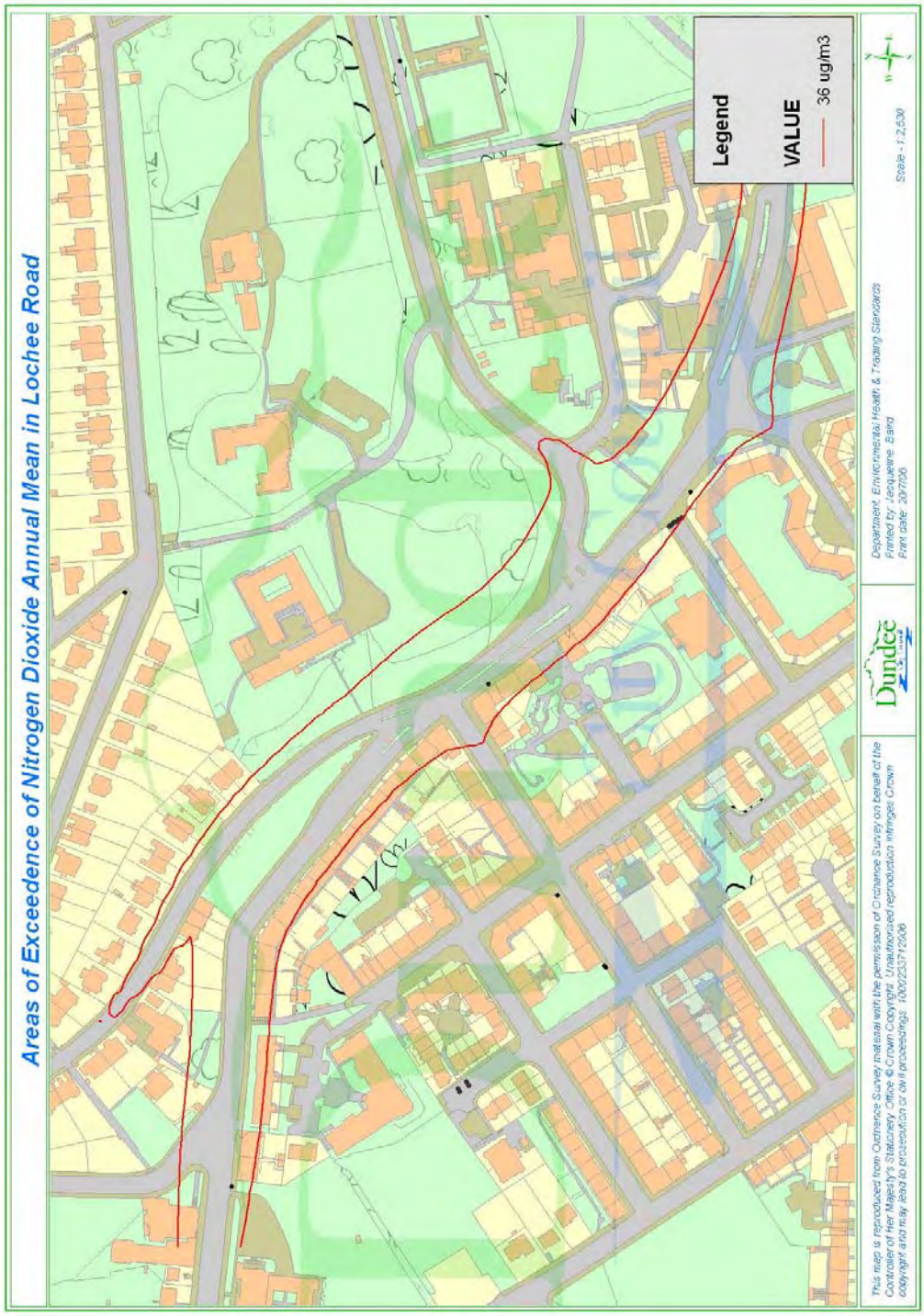
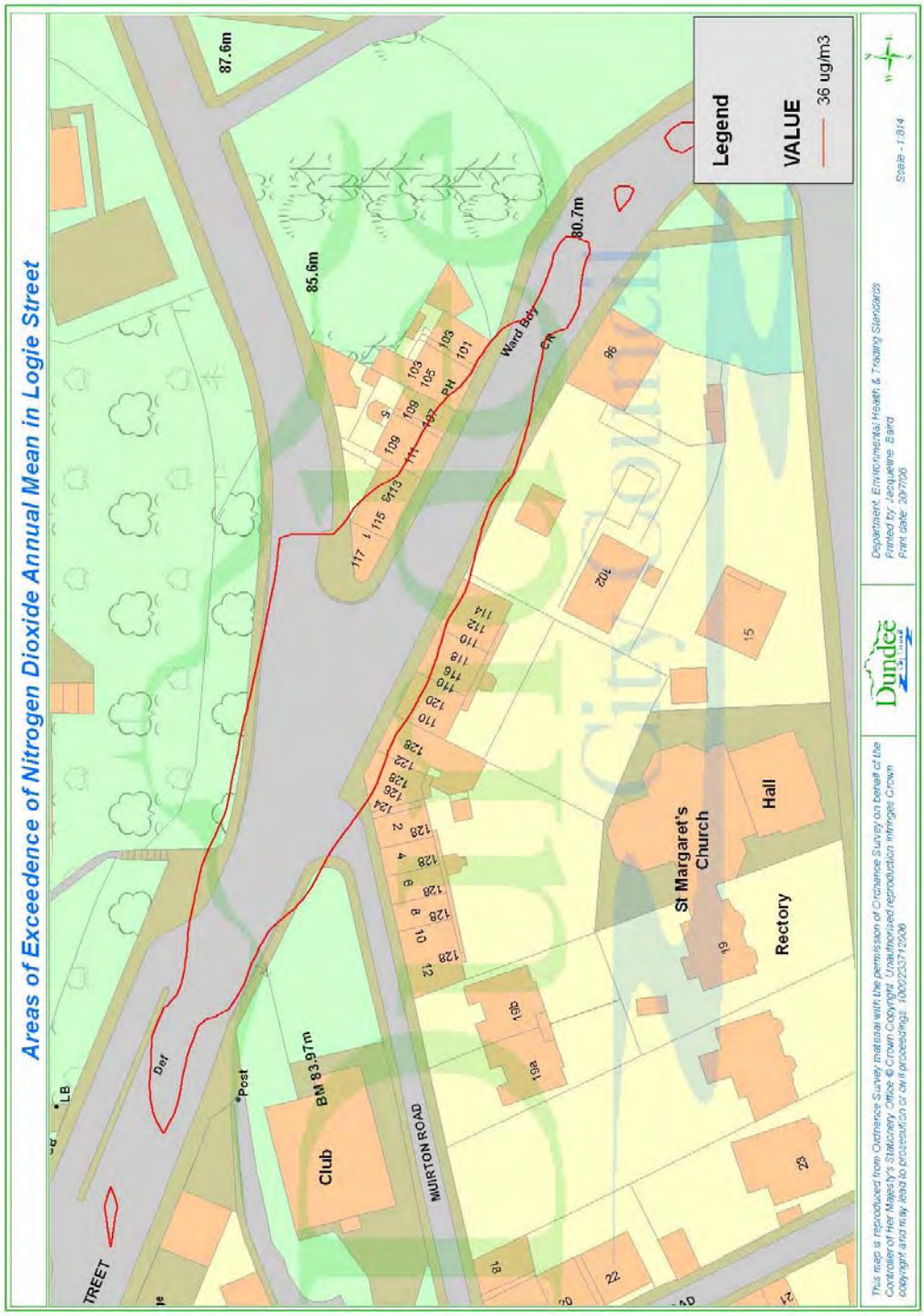


Figure 7.3: Predicted Areas of Exceedance of Nitrogen Dioxide Annual Mean Objective in Logie Street.



7.5. MONITORING DATA INSIDE AN AQMA

7.5.1 Continuous Monitoring Results

7.5.1.1 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.

7.5.1.2 Instrumentation

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

7.5.1.3 Data Quality Requirements

The basic principles of data ratification for automatic air quality monitors are presented in the LAQM.TG(03) and in the AURN Local Site Operators Manual[23]. Data for the Union Street monitor have been screened, scaled and ratified in accordance with guidance. The data presented for the Romon units has been screened, but poor quality calibration data did not allow these data sets to be fully scaled and ratified.

7.5.1.4 Summary of Annual Results

Automatic Monitoring results for the period 1 January to 31 December 2005 are shown in Table 7.1, along with results for previous years, where available.

[23] http:/www.aeat.co.uk/netcen/airqual/reports/Isoman/isoman.html

Table 7.1: 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)	2005 Annual Mean NO_2 (%data)
Union Street Rollalong	48.5 (93.3)	42.0 (86.6)	40.6 (86.8)	41.2 (85.5)	36.6^ (94.6)
Whitehall Street Romon	n/a	n/a	n/a	39.3 (60.0*)	39.4" (93.8)
Seagate Romon	n/a	n/a	n/a	64.5 (85.0)	59.9" (92.2)
Lochee Road. Romon	n/a	n/a	n/a	79.6 (96.0)	67.7" (93.5)
Groundhog DISC	n/a	n/a	n/a	16.0 (99.4)**	n/a

*Monitoring at Whitehall Street Romon had to be suspended during 2004 as a consequence of works associated with the bus interchange development in this street
** annualised 6-month monitoring period from 13/05/04 to 14/11/04
%data - percentage data capture
^ data scaled and ratified
" figures based on screened data

Table 7.2 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. The measured results in 2005 are included for comparison.

Table 7.2: Summary of Annual Mean NO_2 (μg/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	2005 Measured Annual Mean NO_2
Union Street Rollalong	43.3	38.7	38.5	40.2	36.6^
Whitehall St. Romon	n/a	n/a	n/a	38.3*	39.4"
Seagate Romon	n/a	n/a	n/a	62.9	59.9"
Lochee Road. Romon	n/a	n/a	n/a	77.6	67.7"
Groundhog DISC	n/a	n/a	n/a	15.7**	n/a

*Monitoring at Whitehall Street Romon had to be suspended during 2004 as a consequence of works associated with the bus interchange development in this street
** annualised 6-month monitoring period from 13/05/04 to 14/11/04
^ data scaled and ratified
" figures based on screened data

7.5.1.5 Summary of Hourly Average Concentrations in 2005

Table 7.3 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 7.3: Number of exceedences of the 1 hour Objective (no more than 18 exceedances of 200 µg/m³)

Location	2001		2002		2003		2004		2005	
	No. of ex	99.8th %ile (µg/m^3)	No. of ex	99.8th %ile (µg/m^3)	No. of ex	99.8th %ile (µg/m^3)	No of ex	99.8th %ile (µg/m^3)	No of ex	99.8th %ile (µg/m^3)
Union Street Rollalong	0	155	0	142	1	138	0	137	3	135
Whitehall St Romon	n/a	n/a	n/a	n/a	n/a	n/a	0	125	1	112
Seagate Romon	n/a	n/a	n/a	n/a	n/a	n/a	6	180	2	148
Lochee Road Romon	n/a	n/a	n/a	n/a	n/a	n/a	22	207	0	163
Groundhog DISC	n/a	n/a	n/a	n/a	n/a	n/a	0	62	n/a	n/a

The following Figures, 7.4 – 7.7, show the time series graphs of hourly average nitrogen dioxide concentrations for each site, for 2005. Data was lost from all monitors between 12/05/05-27/05/05 as the database had reached it's capacity and had to be reconfigured.

Figure 7.4: Time Series at Union Street of NO_2 Hourly Averages in 2005

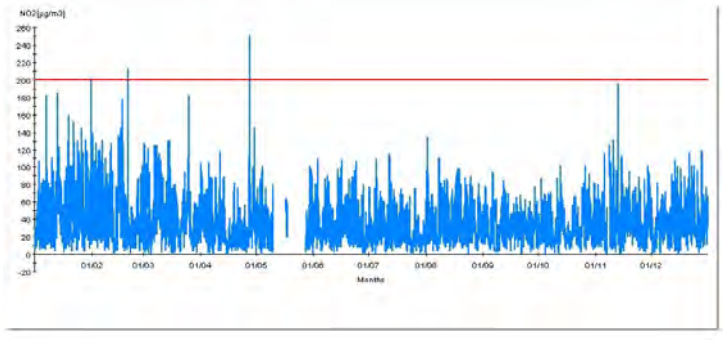


Figure 7.5: Time Series at Whitehall Street of NO_2 Hourly Averages in 2005

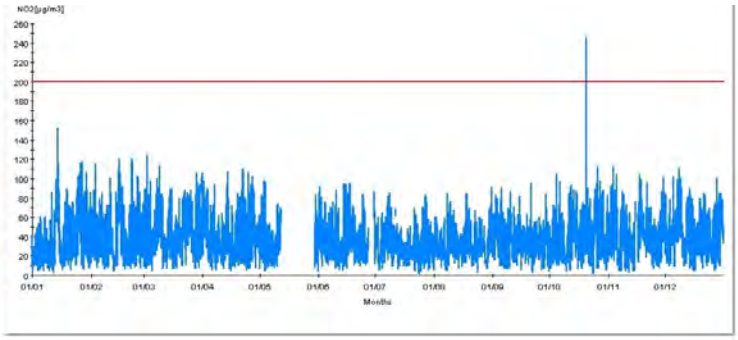


Figure 7.6: Time Series at Lochee Road of NO_2 Hourly Averages in 2005

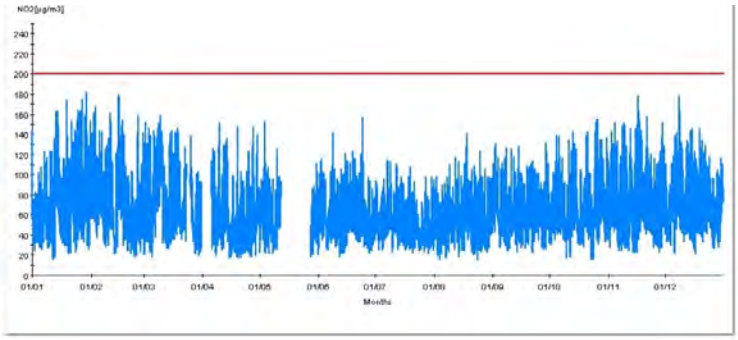
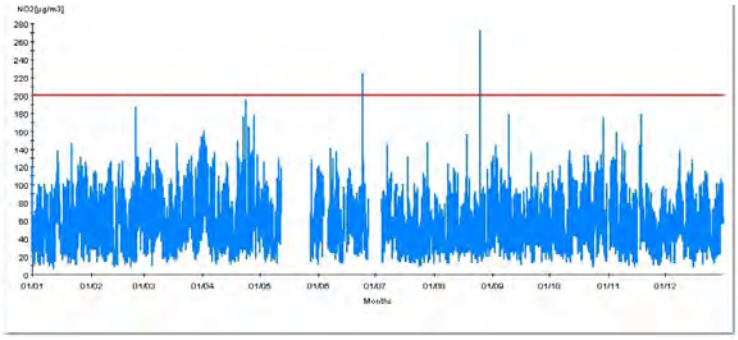


Figure 7.7: Time Series of Seagate Romon NO_2 Hourly Averages in 2005

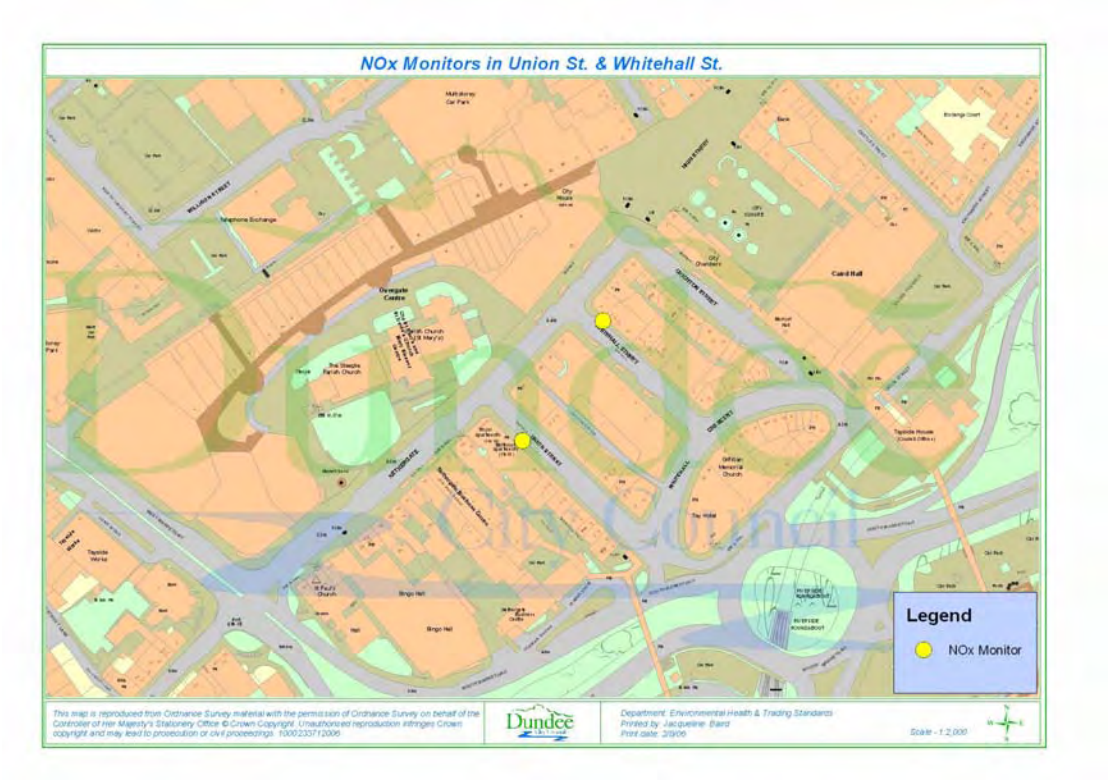


7.5.1.6 Discussion of Results

Union Street

Union Street is a street canyon and one of the main bus corridors in the city centre. There is residential exposure from first floor upwards in this street.

Figure 7.8: NO_x Monitors in Union Street & Whitehall Street



The monitor is located near the top of the street on the west side between two bus stops The measured 2005 annual mean (36.6 µg/m^3) is less than predicted in 2004 (40.2µg/m^3) and below the annual mean objective of 40 µg/m^3.

Pollutant levels can fluctuate from year to year for a number of reasons. This is the first year for which scaled and ratified data have been available with sufficient data capture (94.6%). It is important to note that for several months in 2005 Union Street was closed to southbound traffic due to ground works, associated with the construction of a temporary 120 space car park on Yeaman Shore at the bottom of Union Street. 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.

There were three recorded exceedences of the hourly objective for nitrogen dioxide (200 µg/m^3) at the Union Street monitor during 2005. Eighteen exceedences of the hourly objective are permitted.

Whitehall Street

Whitehall Street is a street canyon and one of the main bus corridors in the city centre and contains a newly constructed bus interchange. There is residential exposure from first floor upwards

in this street. The monitor is located near the top of the street on the east side, adjacent to a parking bay which is set back from the road.

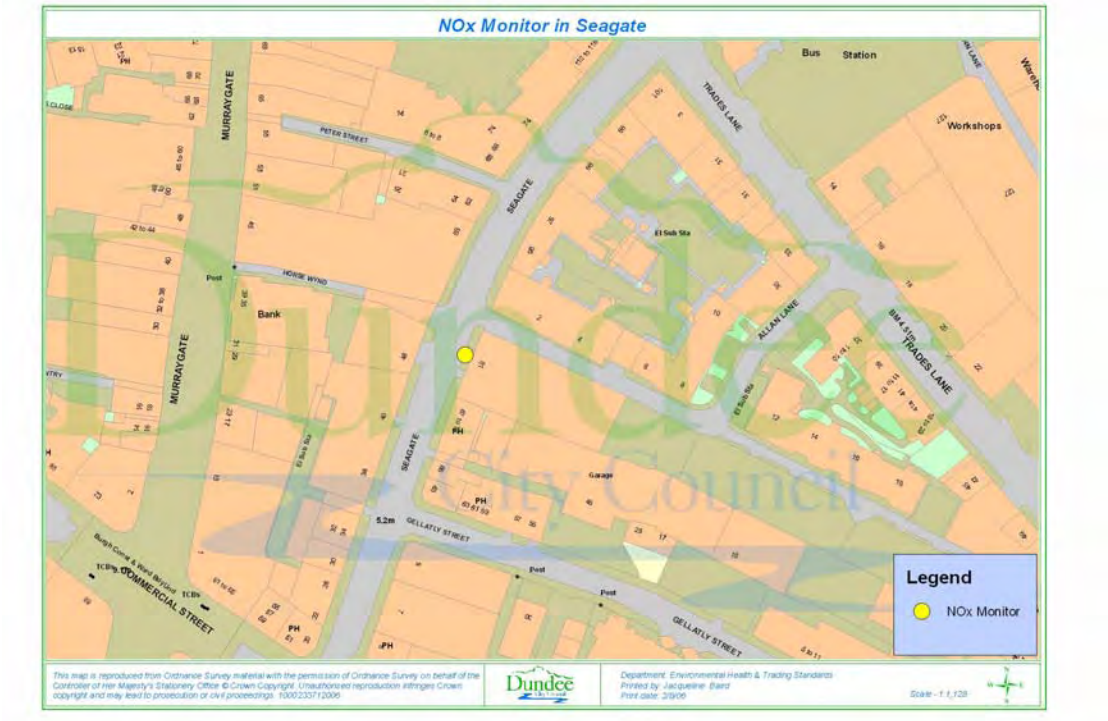
The measured annual mean in 2005 (39.4 µg/m^3) is slightly greater than that predicted in 2004 (38.3 µg/m^3) and below the annual mean objective of 40 µg/m^3. The data capture for this site was good (93.8%) but the quality of calibration data was poor and did not allow this data set to be fully scaled and ratified. The annual mean at this location should only be regarded as provisional and results treated with caution. It is hoped that results obtained in 2006 will provide a clearer picture.

There was one exceedence of the hourly objective for nitrogen dioxide (200 µg/m^3) recorded in 2005. Eighteen exceedences of the hourly objective are permitted.

Seagate

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.

Figure 7.9: NO_x Monitor in Seagate.



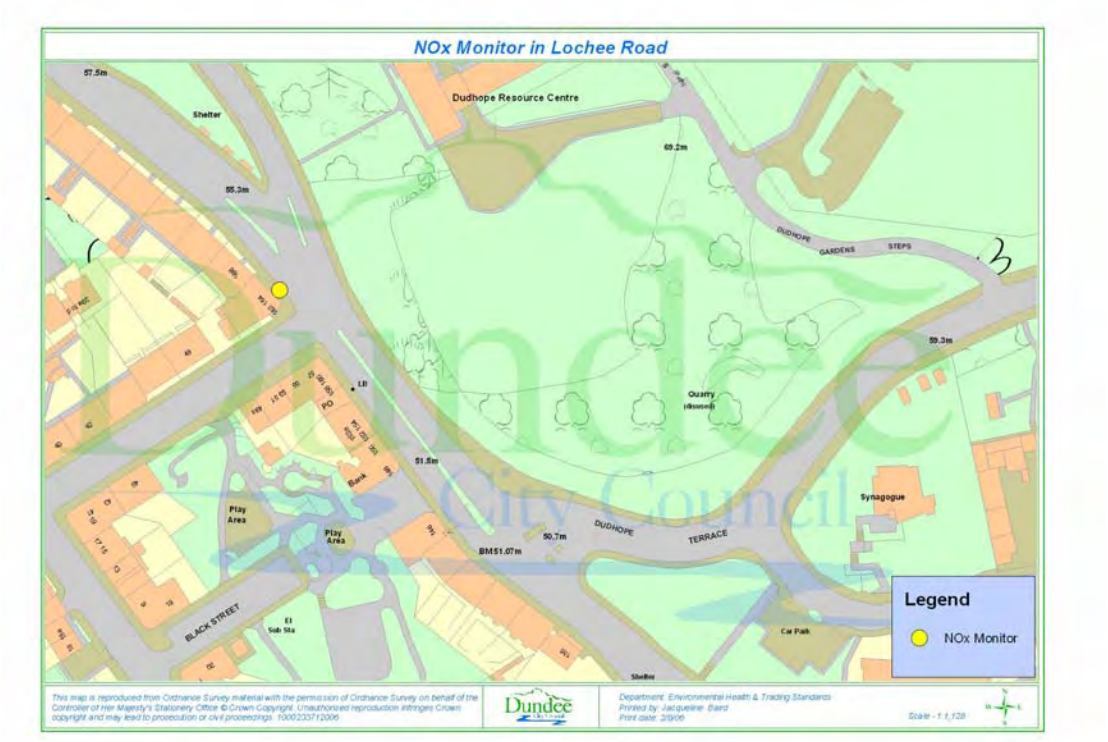
The monitor is located approx. half way along the Seagate on the east side and is adjacent to a loading bay. The measured annual mean in 2005 (59.9 µg/m^3) is slightly less than that predicted in 2004 (62.9 µg/m^3) and above the annual mean objective of 40 µg/m^3. The data capture for this site was good (92.2%) but the quality of calibration data was poor and did not allow this data set to be fully scaled and ratified. The annual mean at this location should only be regarded as provisional and results treated with caution. It is hoped that results obtained in 2006 will provide a clearer picture, although it is not expected that results will fall below the air quality objective as a result of data validation alone.

There were two exceedences of the hourly objective for nitrogen dioxide (200 µg/m^3) recorded at the Seagate monitor in 2005. Eighteen exceedences of the hourly objective are permitted.

Lochee Road

The Lochee Road monitor is situated on the main north-west arterial route close to the busy junctions with Rankine Street and Dudhope Terrace. There is residential exposure from ground floor upwards in this area. The road has a steep gradient and although not a classic street canyon it is bounded on the west side by 4 storey tenement buildings and on the east side by steeply rising ground.

Figure 7.10: NO_x Monitor in Lochee Road.



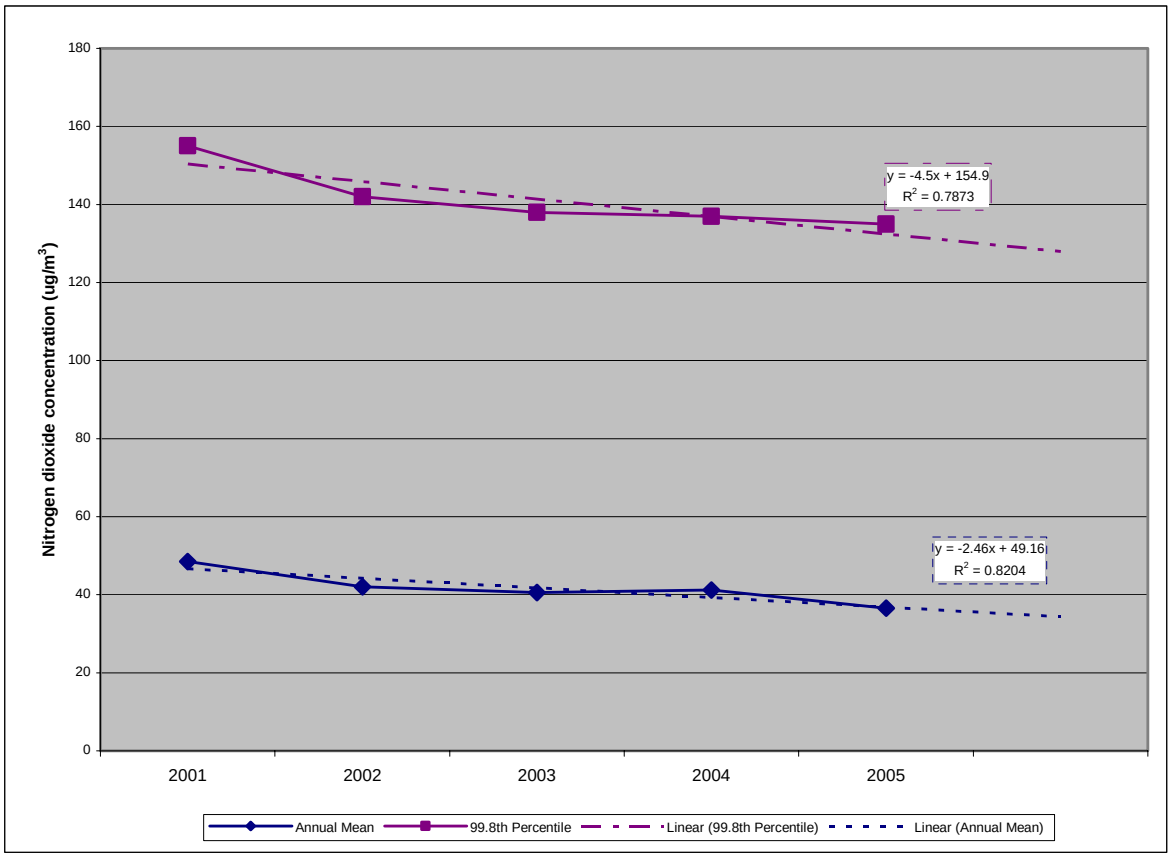
The measured annual mean in 2005 (67.7 µg/m^3) is less than that predicted in 2004 (77.6 µg/m^3) and above the annual mean objective of 40 µg/m^3. The data capture for this site was good (93.5%) but the quality of calibration data was poor and did not allow this data set to be fully scaled and ratified. The annual mean at this location should only be regarded as provisional and results treated with caution. It is hoped that results obtained in 2006 will provide a clearer picture, although it is not expected that results will fall below the air quality objective as a result of data validation alone.

There were no exceedences of the hourly objective for nitrogen dioxide (200 µg/m^3) recorded in 2005. Eighteen exceedences of the hourly objective are permitted. In 2004 there were 22 exceedences of the hourly objective, the majority of these were believed to be due to traffic congestion caused by water main rehabilitation works in the vicinity during the month of November.

7.5.1.7 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 five years at Union Street. A graph showing the trends in the annual mean and percentile values is shown in Figure 7.10.

Figure 7.11: Trends in NO_2 Annual means and 99.8th Percentiles at Union Street 2001- 2005



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

7.5.1.8 Discussion of Trends

Figure 7.11 shows a downward trend for both the measured annual mean and 99.8th percentile at the Union Street monitor. 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 7.11 is based on raw data for 2001-2004.

7.5.2 Diffusion Tube Results

7.5.2.1 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.

7.5.2.2 Data Quality Requirements

The laboratory method is UKAS[24] 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[25].

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.

7.5.2.3 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 9 months or less data. This was carried out in accordance with the statutory guidance[26]. Dundee City Council had two long-term background diffusion tube sites with 12 months data capture in 2005, at Balgavies Place and Birnam Place, these were used in the calculation of the period mean adjustment factors.

Table 7.4: Period mean adjustment factors for 2005 diffusion tube data

Background Site	Annual Mean	Period Mean Apr-Dec'05	Ratio	Period Mean Jan-Sep'05	Ratio	Period Mean Apr-Sep'05	Ratio
Balgavies Pl	**20.4**	18.9	1.081	17.9	1.140	14.4	1.421
Birnam Pl	**14.1**	13.4	1.051	12.0	1.176	9.9	1.423
		Average ratio	**1.066**	**Average ratio**	**1.158**	**Average ratio**	**1.422**

7.5.2.4 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 co-location study of three diffusion tubes sited with the continuous analyser on

[24] UKAS is the United Kingdom Accreditation Service

[25] UK Nitrogen Dioxide Network 2003 (AEAT/ENV/R/1926)

[26] 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.

Union Street allowed a bias adjustment factor to be calculated. For the period of this study (Jan 2005 to Dec 2005) the continuous analyser captured sufficient data (94.6%) to allow the bias calculation to be made. The bias correction factor based on this time period is 0.76.

NO_2 Annual means for 2005 have been reported using this bias correction factor in Table 7.5.

7.5.2.5 Summary of Annual Monitoring Results

The results in Table 7.5 are for the period 1 January to 31 December 2005 and are period adjusted (where necessary), bias corrected and corrected to building facade, to allow direct comparison with the NAQS (2005) annual mean for NO_2 (40 μg/m^3). The results were corrected to represent the level of exposure expected at the façade of the nearest receptor, using adjustment factors supplied by the Review and Assessment Helpdesk operated by Air Quality Consultants and University of West of England, Bristol[27].

Table 7.5: NO_2 Diffusion tube results for 2005, (NB Annual mean objective is 40 μg/m^3).

Location	Site type	Measured Annual Mean 2005	Bias corrected (*0.76)	Corrected to façade
Meadowside	R	**71.0**	**54.0**	**51.3**
Victoria Road/Hilltown	R	**61.0**	**46.4**	**44.1**
Seagate (Romon 3)	K	**58.5**	**44.5**	**42.2**
Lochee Rd (140) Traffic Lts	R	**57.5**	**43.7**	**43.7**
Seagate (Romon 2)	K	**57.2**	**43.5**	**41.3**
Seagate (Romon 1)	K	**57.0**	**43.3**	**41.2**
Lochee Road (Romon 1)	K	**56.7**	**43.1**	**40.9**
Lochee Road (Romon 2)	K	**56.6**	**43.0**	**40.9**
Lochee Road (Romon 3)	K	**56.1**	**42.6**	**40.5**
Abertay	K	**54.4**	**41.3**	**41.3**
Lochee Road (138)	K	**53.8**	**40.9**	**38.8**
Logie Street (114)	R	**53.5**	**40.7**	**40.7**
Whitehall Street (Bus)	K	**52.7**	**40.0**	**38.0**
Commercial Street/Dock St	R	**52.5**	**39.9**	**37.9**
Nethergate (B&B)(88)	K	**51.4**	**39.1**	35.2
Union Street (Rollalong 2)	R	**49.7**	**37.8**	**37.8**
Dock Street (14)	K	**48.4**	**36.8**	35.0
Commercial Street (Waterstones)	K	**47.9**	**36.4**	34.6
Whitehall Street (Deb A)	K	**47.6**	**36.1**	34.3

[27] www.uwe.ac.uk/aqm/review

Location	Site type	Measured Annual Mean 2005	Bias corrected (*0.76)	Corrected to façade
St Andrews Street (PB)	R	47.2	35.9	34.1
Seagate	R	47.2	35.8	35.8
Union Street (Rollalong 3)	R	47.1	35.8	35.8
Seagate (Yates)(7-9)	R	46.6	35.4	35.4
Dock Street (Carol Whyte)	K	46.4	35.3	33.5
Union Street (Rollalong 1)	R	46.3	35.2	35.2
Victoria Street	K	46.0	35.0	33.2
Kingsway/Strathmartine Road (S)	K	45.2	34.4	25.8
Rankine Street (2)	R	45.1	34.3	34.3
Victoria Road	R	43.6	33.1	31.5
Nethergate (Bradford)	R	43.4	33.0	31.3
Whitehall Street (Tiso)	R	43.3	32.9	31.3
Whitehall Street (Romon 3)	K	42.8	32.6	32.6
Westport (2)	R	42.8	32.5	30.9
Lochee Road (184)	K	42.7	32.5	30.8
Nethergate (Charlie T)	K	42.7	32.4	30.8
Dura Street (Forte)	K	42.6	32.4	30.8
Dock Street (Unicorn)	R	42.3	32.1	32.1
Arbroath Road (13)	K	42.2	32.1	30.5
Nethergate (Trades House)	R	42.2	32.0	30.4
Broughty Ferry Road 141	R	41.8	31.8	30.2
Whitehall Street (Deb E)	K	41.7	31.7	30.1
Whitehall Street (Romon 1)	K	41.6	31.6	31.6
Logie Street (98)	K	41.6	31.6	30.0
St Andrews Street (JAF)	K	41.1	31.2	29.7
Victoria Road (60)	R	41.1	31.2	31.2
Victoria Road / Cotton Road	K	40.9	31.1	29.5
Loons Road (1)	R	40.8	31.0	31.0
Albert Street 1	K	40.6	30.9	29.3
Strathmore Avenue (353)	R	40.3	30.6	29.1
Commercial Street	K	40.2	30.6	29.0
Albert Street (Shandon Pl)	R	40.0	30.4	27.4
Clep. Road/ Forfar Road	K	40.0	30.4	27.4
Kingsway East Roundabout	R	39.8	30.2	23.9
Dens Road (Crossing)	R	39.7	30.2	27.1
Whitehall Street (Romon 2)	K	39.0	29.7	29.7
Nethergate (Leonardos)	R	39.0	29.6	29.6
Whitehall Street (BRJ)	K	38.5	29.3	27.8
Soapwork Lane	R	38.1	29.0	29.0
Union Street (Mcintyres)	K	37.8	28.8	27.3
Eastport Roundabout	R	37.8	28.7	28.7
Trades Lane (31)	K	37.7	28.7	27.2
Victoria Road (10)	R	37.4	28.4	27.0

Location	Site type	Measured Annual Mean 2005	Bias corrected (*0.76)	Corrected to façade
Crichton Street	K	**37.1**	28.2	26.8
Kingsway/ Mains Loan	R	**36.6**	27.8	22.0
Union Street (Goodfellows)	K	35.8	27.2	25.9
Myrekirk Road	K	35.6	27.1	20.3
Hilltown (Suites)	R	35.5	27.0	27.0
Albert Street (Fish)	K	35.3	26.8	25.5
Nethergate/ Marketgait	R	35.2	26.7	26.7
Whitehall Cres. (Xpresso)	K	34.2	26.0	24.7
Muirton Road (6)	R	33.8	25.7	25.7
Marketgait	R	33.7	25.6	24.3
Perth Road (330)	R	33.4	25.4	22.8
King Street (12 & 14)	K	33.4	25.3	24.1
Kingsway/ Pitkerro Road	R	33.0	25.0	20.8
Lochee Road/Polepark Road	K	32.1	24.4	21.9
Harefield Road (35)	K	32.1	24.4	18.3
Bank Street/ Reform St	K	31.5	24.0	22.8
Claypotts Junction	R	27.9	21.2	21.2
Arthurstone Tce 10	K	27.9	21.2	20.1
Brook Street B/F	K	27.6	21.0	19.9
St Mary Flats	R	25.5	19.4	15.3
Earl Grey Pl (Park)	UB	24.8	18.8	18.8
Woodside Avenue	UB	21.6	16.4	16.4
Balgavies Place	UB	20.4	15.5	15.5
Birnam Place	UB	14.1	10.7	10.7

K = kerbside, R = roadside, B = urban background
Note: The coloured locations are highlighted to indicate the period adjustment factor used (see Table 7.6)

7.5.2.6 Discussion of Results

The measured annual mean results in 2005 are directly comparable with the NAQS annual mean for NO_2 (40 µg/m^3) and do not need to be predicted forward as the target date for achieving this NAQS was 31st December 2005.

The technical guidance advises that if the annual mean concentration exceeds 60 ug/m^3, it can be taken as a reliable indication that the 1-hour mean will be exceeded at that location. None of the bias corrected annual means exceed 60 ug/m^3 and hence no exceedences of the 1-hour mean are predicted.

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

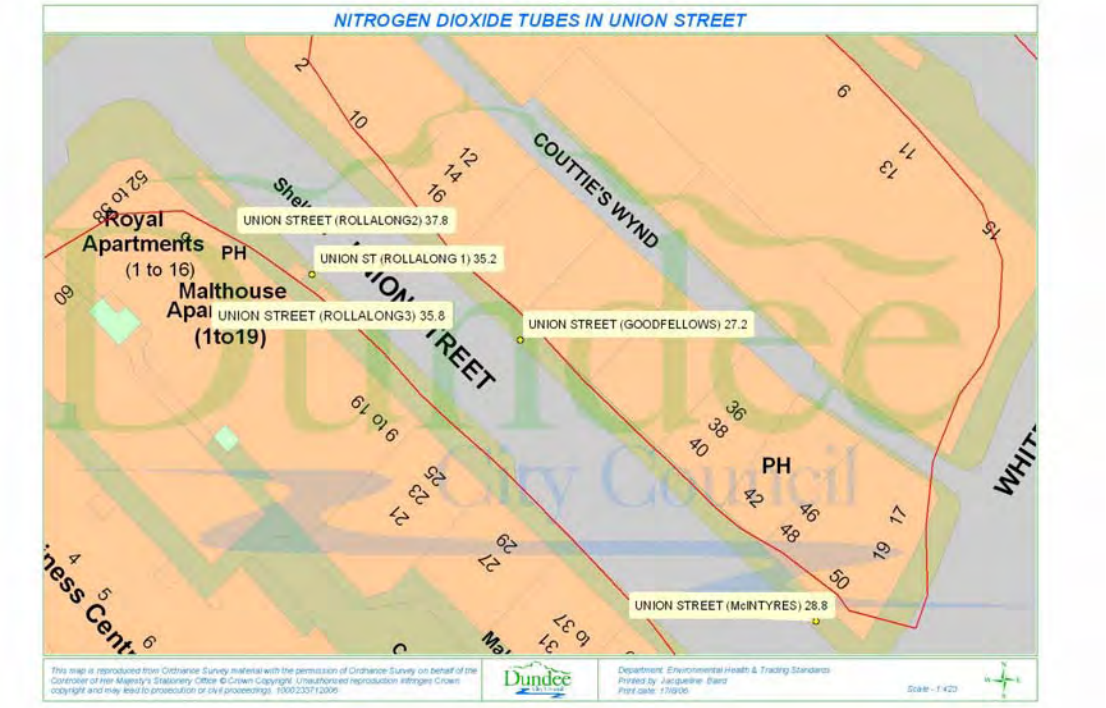
µg/m^3 have been considered as areas of potential exceedence: these are discussed below.

The figures below show the bias corrected annual mean results for 2005, measured at the tube locations along with the areas of exceedence of the NO_2 annual mean objective (the red lines) predicted in the council's detailed assessment (i.e. above 36 µg/m^3) (March 2005). Results are also compared, where relevant, with the 2004 results from the council's 'Progress Report' (2005) predicted forward to 2005.

Union Street

Union Street is a street canyon and one of the main bus corridors in the city centre. There is residential exposure from first floor upwards in this street.

Figure 7.12: Nitrogen Dioxide tubes in Union Street



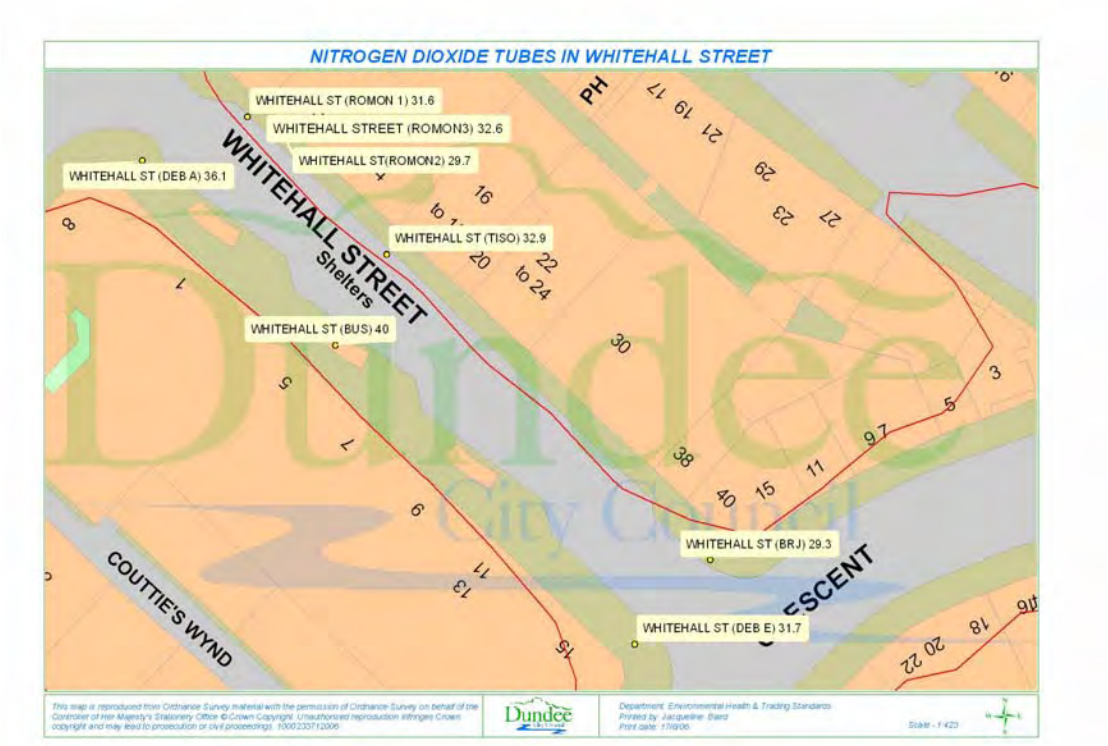
As the continuous monitor was used to determine the bias correction factor, the corrected Union Street Rollalong diffusion tube results (35.2, 37.8, 35.8 µg/m^3) are obviously in good agreement with the annual mean recorded by the continuous monitor (36.6 µg/m^3). Other tubes in Union Street are below the annual mean objective. All the Union Street tubes lie within the area of exceedence predicted in the detailed assessment but only the 'Rollalong 2' tube is above 36 µg/m^3. Union Street was closed to south-bound traffic for several months during 2005, and this may have contributed to results elsewhere in Union Street, being lower

than predicted in 2004 (Goodfellows (36.4 µg/m^3) & McIntyres (32.2 µg/m^3)). This area has been identified in previous assessments and is within the AQMA.

Whitehall Street

Whitehall Street is a street canyon and one of the main bus corridors in the city centre and contains a newly constructed bus interchange. There is residential exposure from first floor upwards in this street.

Figure 7.13: Nitrogen Dioxide tubes in Whitehall Street

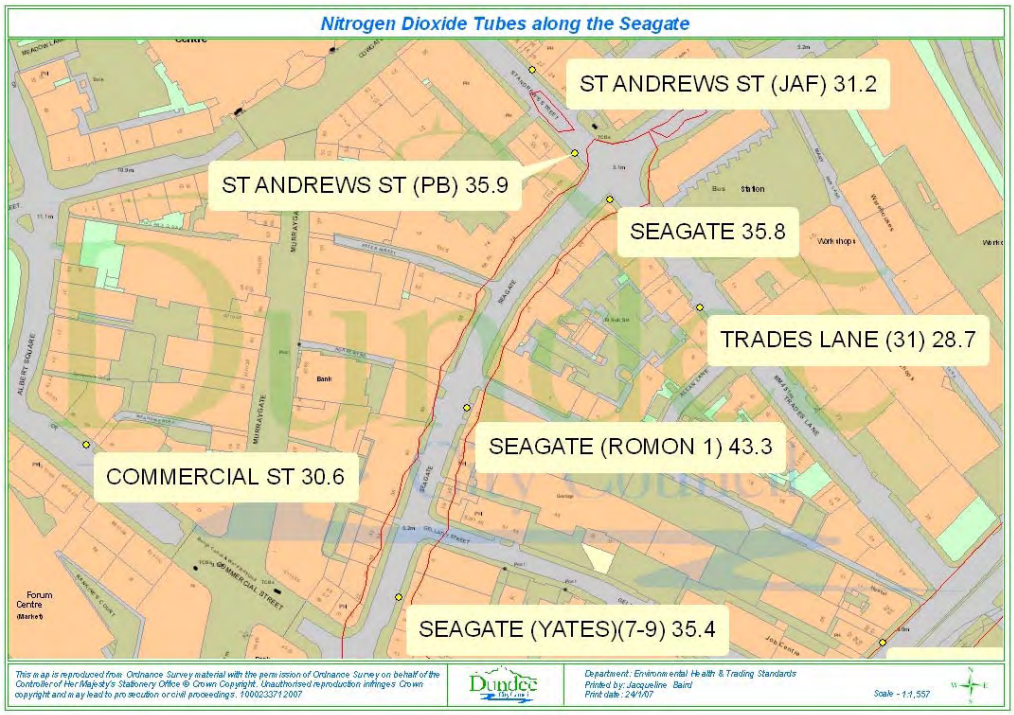


The 0.76 bias corrected annual mean diffusion tube results for the Whitehall Street tubes located with the monitor (Romon 1,2,3: 31.6, 29.7, 32.6µg/m^3) are below the annual mean recorded by the continuous monitor in Whitehall Street (39.4 µg/m^3). Of the Whitehall Street tubes located within the area of exceedence predicted in the detailed assessment, only 'Deb A' (36.1µg/m^3) and 'Bus' (40µg/m^3) are above 36µg/m^3. All the Whitehall Street tube results are below those predicted in 2004. This area has been identified in previous assessments and is within the AQMA.

Seagate

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.

Figure 7.14: Nitrogen Dioxide tubes in Seagate

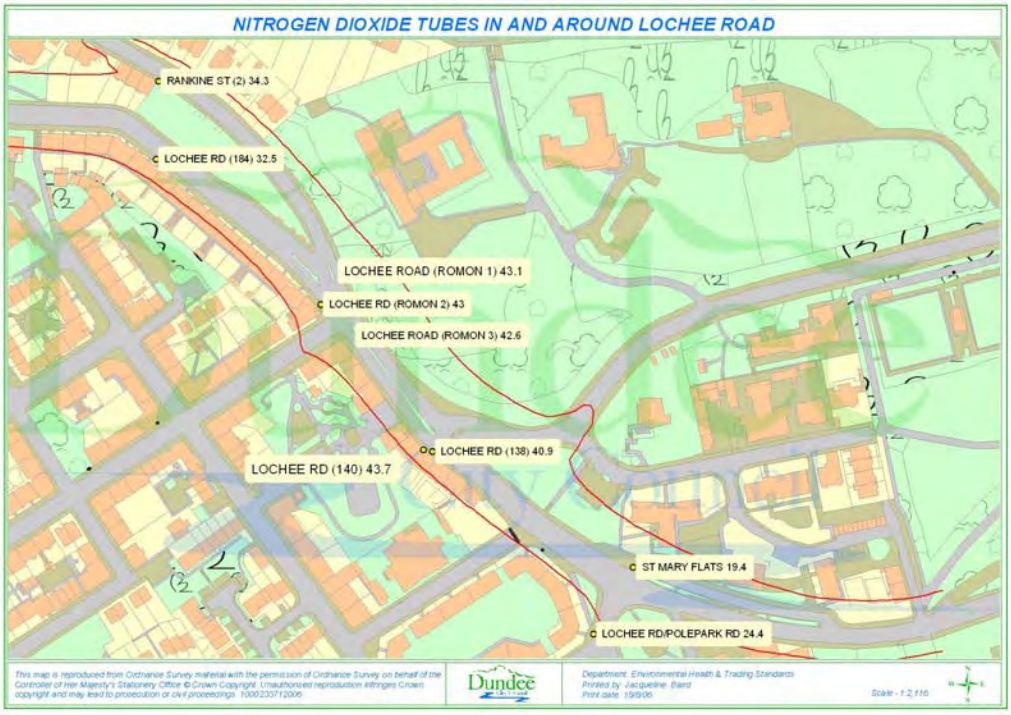


The average annual mean results of those diffusion tubes located with the monitor in the Seagate, (Romon1,2 & 3) is 43 µg/m^3 (0.76 bias corrected) and does not compare well with the annual mean recorded at the continuous monitor in Seagate (59.9 µg/m^3). The other Seagate tubes are situated closer to controlled junctions and record lower concentrations of NO_2 than those next to the monitor which is now situated adjacent to a loading bay. This is the first year of results for the Romon tubes. Other tubes along the Seagate are slightly lower than predicted in 2004, except for St. Andrews (PB) which at 35.9 µg/m^3 is slightly higher than predicted in 2004(34.9 µg/m^3). This area has been identified in previous assessments and is within the AQMA

Lochee Road

Lochee Road is part of the main north-west arterial route, and tubes are located close to the busy junctions with Rankine Street and Dudhope Terrace. There is residential exposure from ground floor upwards in this area. The road has a steep gradient and although not a classic street canyon it is bounded on the west side by 4 storey tenement buildings and on the east side by steeply rising ground.

Figure 7.15: Nitrogen Dioxide tubes in Lochee Road

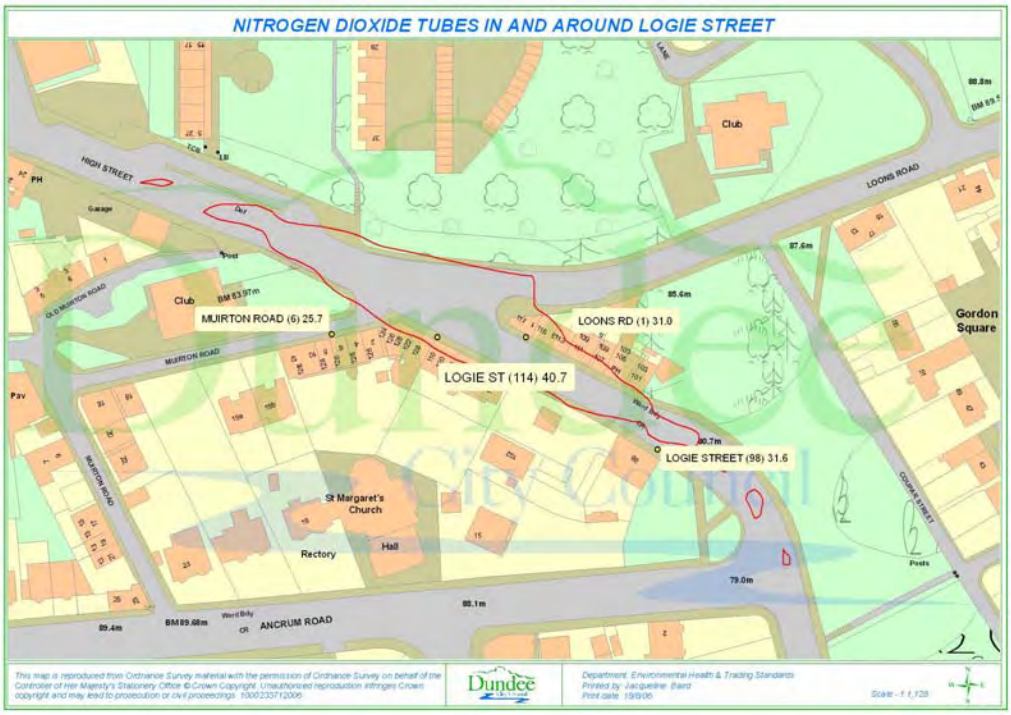


The average annual mean results of the Romon tubes located with the monitor in Lochee Road is 43 µg/m^3 (0.76 bias corrected) and does not compare well with the annual mean recorded at the continuous monitor in Lochee Road (67.7 µg/m^3). In order to determine the extent of the area of exceedence, a number 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, and only these tubes are greater than 36 µg/m^3, despite most of the tubes being within the predicted exceedence line. 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 area of exceedence. It is worth noting that the result for Lochee Road (140) 43.7µg/m^3, which is located at the building facade is greater than the result for Lochee Road (138) 40.9µg/m^3, which is located at the kerbside, and does not show the expected reduction from kerbside to façade. This area has been identified in previous assessments and is within the AQMA.

Logie Street/Loons Road

The Logie Street/Loons Road junction is a busy controlled junction on the north west arterial route for the city. There are 3-storey buildings on either side of the junction with residential exposure from first floor upwards and new ground floor residential proposed close to the junction.

Figure 7.16: Nitrogen Dioxide tubes in and around Logie Street

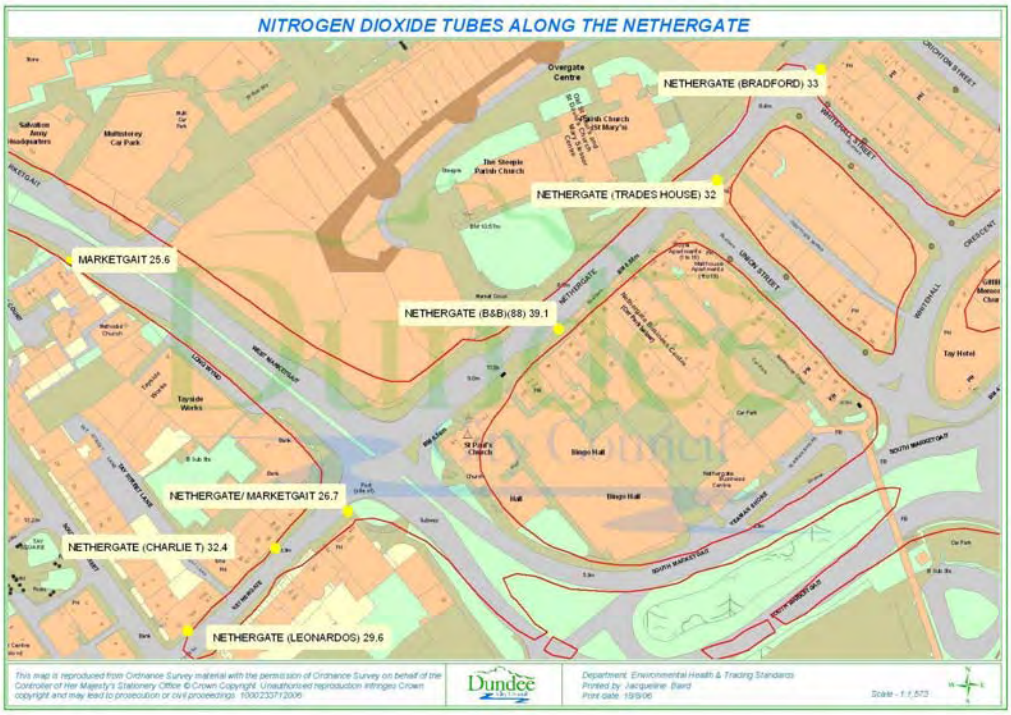


There are four NO_2 diffusion tubes located around this junction (Logie Street 114, Logie Street 98, Loons Road 1 and Muirton Road 6). Only one of these tubes recorded a concentration of NO_2 that exceeds the 2005 objective, (Logie Street 114, 40.7 µg/m^3). This tube is located at the façade of a building and is therefore directly representative of public exposure in this area. This area has been identified in previous assessments and is within the AQMA.

Nethergate

The Nethergate/Marketgait junction is a busy controlled junction and the Nethergate is part of the main bus corridor running through the city centre. There is residential exposure from first floor at various locations along the length of the Nethergate.

Figure 7.17: Nitrogen Dioxide tubes along the Nethergate

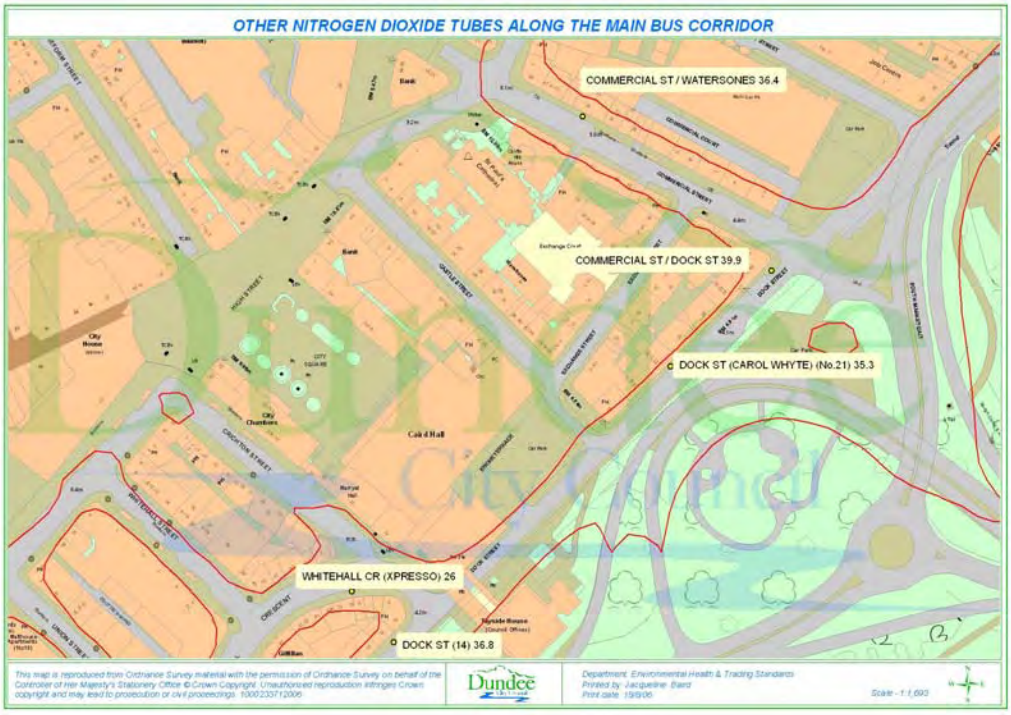


The 2004 results indicated potential exceedences of the 2005 objective for nitrogen dioxide along the Nethergate on either side of the Marketgait (City Centre Inner Ring Road). The 2005 results for the Nethergate tubes are lower than predicted in 2004 except for Nethergate (Bradford) and Nethergate (Leonardos) which have increased slightly. The highest concentration of NO_2 (39.1 µg/m^3) was measured at the Nethergate (B & B)(88) tube; only this result was greater than 36 µg/m^3. Those west of the junction are not significantly lower than predicted despite this stretch of the Nethergate being closed to all traffic for several months in 2005 due to major roadworks on the West and South Marketgait. This area has been identified in previous assessments and is within the AQMA.

Main City Centre Bus Corridor

As well as the Seagate, St Andrews Street, 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 Commercial Street (36.4, 39.9 µg/m^3) and Dock Street (36.8 µg/m^3)

Figure 7.18: Other Nitrogen Dioxide tubes along the Main Bus Corridor

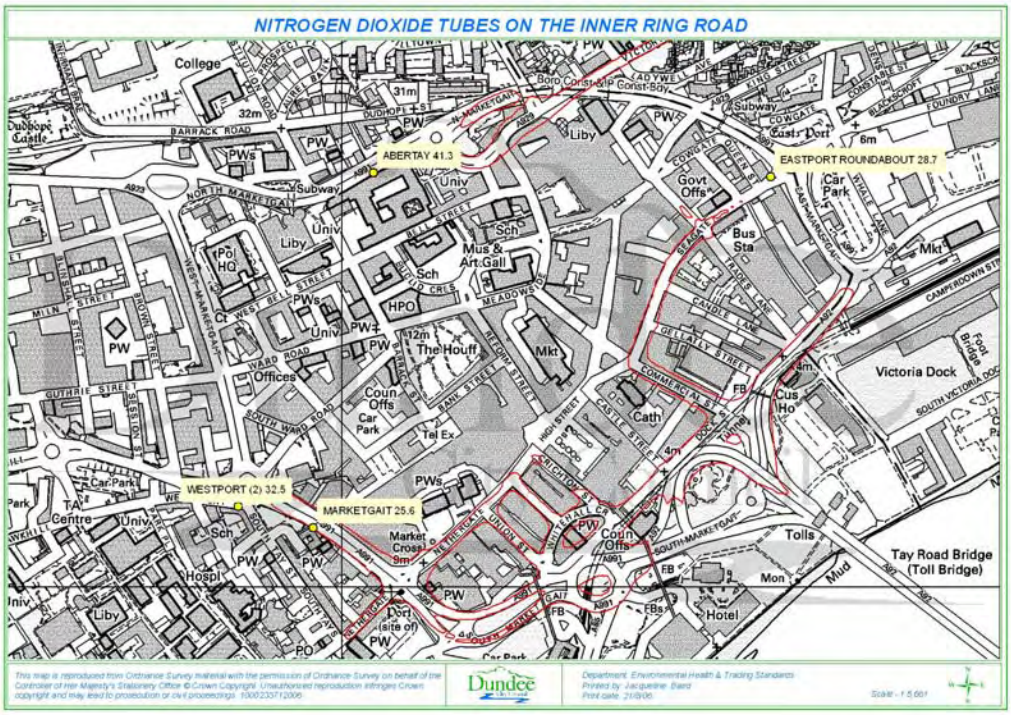


This area has been identified in previous assessments and is within the AQMA. There are major road works proposed along the length of Dock Street associated with the strengthening of the rail tunnel that runs beneath Dock Street. This will alter the route taken by many bus services in the city centre for some time, and hence may alter the future concentration of NO_2 measured at these locations.

Inner Ring Road

The inner ring road surrounds the city centre, and is comprised of the West, East, South and North Marketgait. Part of the South Marketgait includes the trunk road taking traffic to and from the Tay Road Bridge. There is relevant exposure at ground floor and first floor residences at various locations along the inner ring road.

Figure 7.19: Nitrogen Dioxide tubes along the Inner Ring Road



There were four tubes located around the inner ring road (Abertay, Marketgait, Westport 2, and Eastport Roundabout) in 2005. The only location that showed an exceedence of the 2005 objective was Abertay (41.3 µg/m^3). Fortunately, this is the only one of the four 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. All the Inner Ring tubes are lower than predicted in 2004 except for Abertay which has increased, this may have been caused by the re-routing of traffic that could not travel north-bound on the South and West Marketgait for several months due to major road works to re-align the carriageway during 2005. Similarly the same roadworks could have accounted for the significantly lower than expected values at the Marketgait tube 25.6 µg/m^3 instead of the 30.2 µg/m^3 predicted.

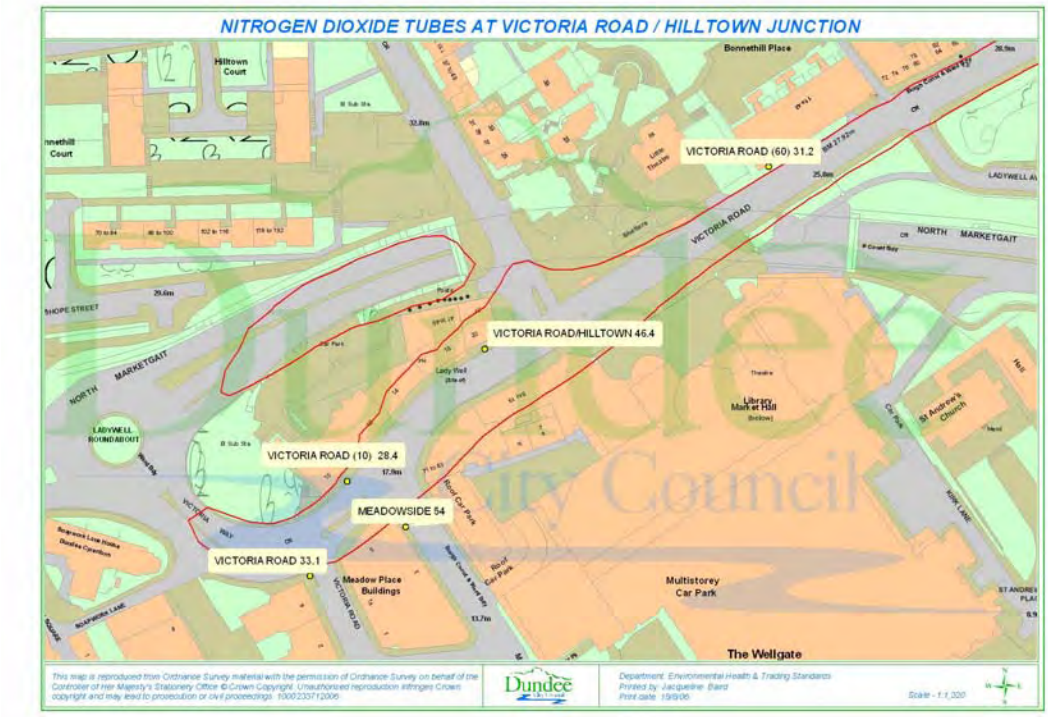
The plans to expand City Centre shopping facilities will necessitate the signalisation of the Dudhope roundabout which is located on the inner ring road where the West Marketgait meets the North Marketgait. This may have an effect on the NO_2 concentrations recorded elsewhere on the inner ring road and the surrounding road network.

Victoria Road

There are several controlled junctions on this part of the northeast arterial route for the city, which is also a major bus route. The road has a steep gradient that means vehicles passing through these

junctions produce increased emissions. There is also a multi-storey car park nearby that may increase the volume of cold-start emissions passing through this area. The area is also a street canyon which can further trap pollutants, and there is residential exposure at the roadside from ground level upwards.

Figure 7.20: Nitrogen Dioxide tubes around the Victoria Road / Hilltown Junction

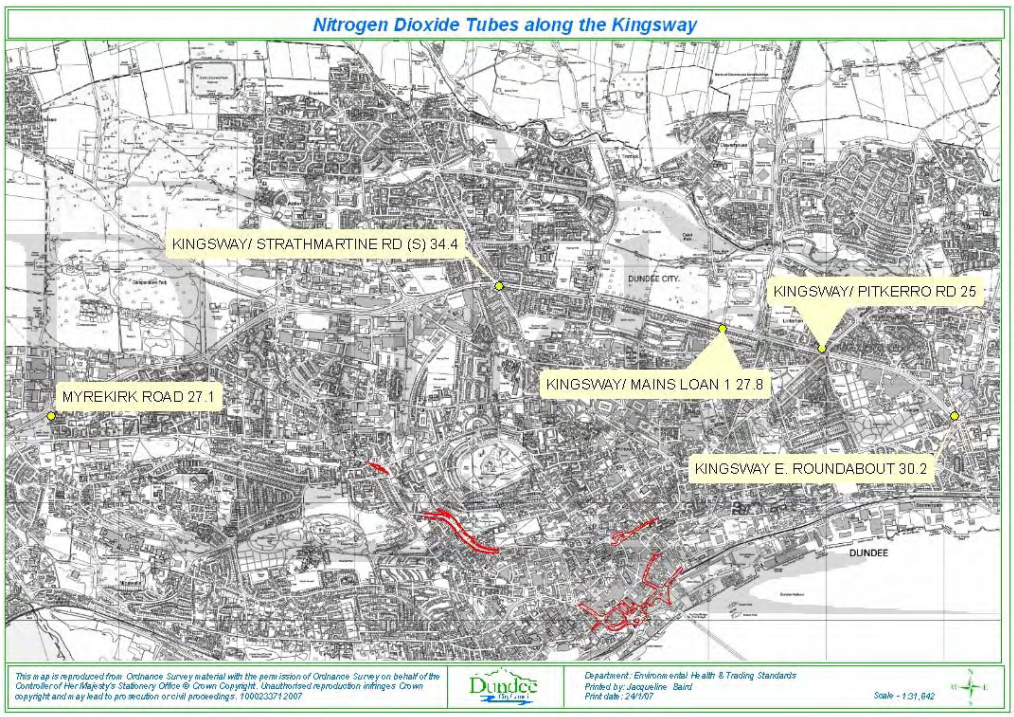


There were five tubes situated in the vicinity of this junction in 2005 (Victoria Road, Victoria Road/Hilltown, Victoria Road(10), Victoria Road(60), and Meadowside). The only locations that showed an exceedence of the 2005 objective were Victoria Road/Hilltown (46.4 µg/m^3) and Meadowside (54 µg/m^3). Additional tubes were deployed to help determine the geographic extent of this area of exceedence. This has indicated that the area may not extend as far to the west of the junction as predicted but should extend further down Meadowside.

Kingsway

The Kingsway is an outer ring road that by-passes the centre of Dundee and is part of the trunk road network carrying traffic to and from Aberdeen, Arbroath and Perth.

Figure 7.21: Nitrogen Dioxide tubes along the Kingsway



There were five tubes situated along Kingsway in 2005 (Kingsway East Roundabout, Kingsway/Mains Loan, Kingsway/Pitkerro Road, Myrekirk Road and Kingsway/Strathmartine Road S). The only location that showed a potential exceedence of the objective in 2004 was the Kingsway/ Strathmartine Road junction, but this dropped below 36 µg/m^3 in 2005. Fortunately, in all cases, the tubes are 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.

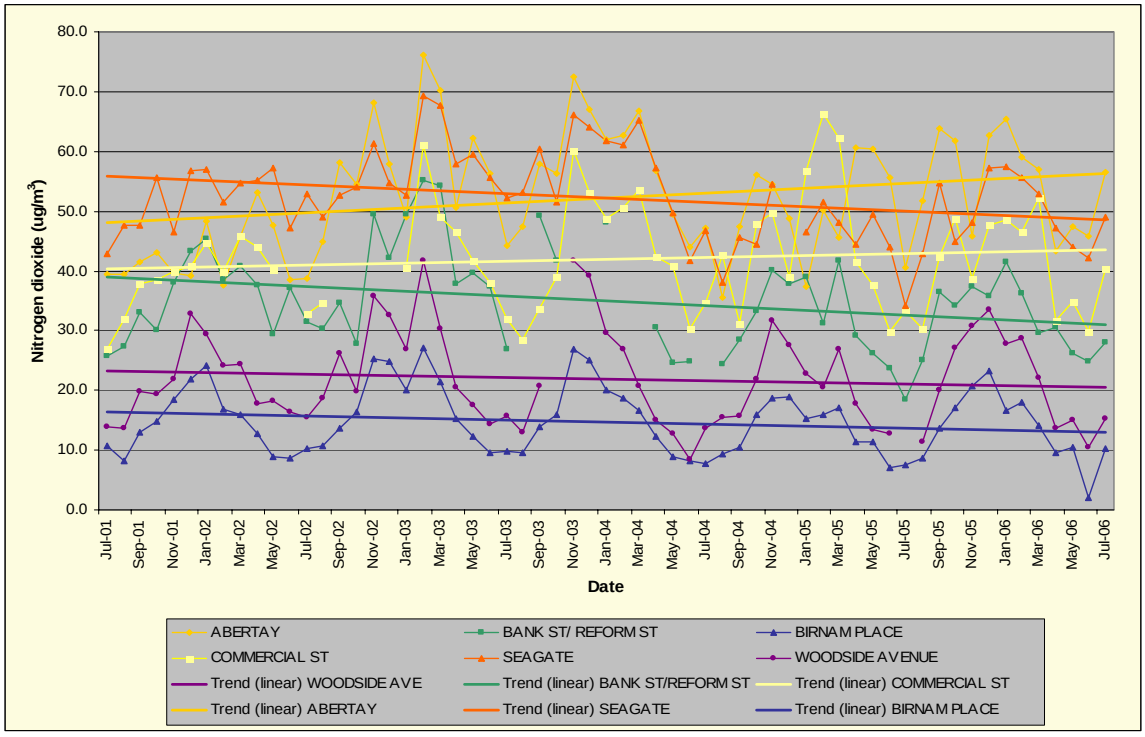
There are plans to signalise the roundabout at the junction of the Kingsway and the Forfar Road (trunk road A90(T)).. This may have an impact on the NO_2 levels recorded in the vicinity of this junction and the surrounding road network. The signalisation of this major junction may have an impact on traffic management along the Kingsway.

7.5.2.7 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

laboratory method used for diffusion tube analysis it is only possible to show trends from July 2001, see Figure 7.22.

Figure 7.22: Trends in monthly NO_2 concentrations at long-term diffusion tube locations, July 2001 – July 2006 (raw data)



7.5.2.8 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 two background sites (Birnam Place and Woodside Avenue), Bank Street/Reform Street and Seagate can be seen to be decreasing slightly. 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).

NO_2 diffusion tube monitoring has been undertaken in Dundee since 1993. In general, the annual mean NO_2 concentrations of the diffusion tube results exhibit a decreasing trend in accordance with national trends and government predictions. The NO_2 annual mean concentrations for 2005, at background monitoring sites were found to be in generally good agreement with the AQ Archive estimated background concentrations (see Table 7.6 below). This indicated that the ambient background NO_2 concentrations in Dundee were generally good.

Table 7.6: Comparison of Measured Background Results for 2005 with the new AQ Archive estimated background concentrations for 2005.

Location	Measured Annual Mean 2005 (0.76 Bias) (µg/m^3)	AQ Archive estimated Annual Mean (2005) (µg/m^3)
Balgavies Place	15.5	11.2
Birnam Place	10.7	10.9
Woodside Avenue	16.4	16.5

The measured NO_2 levels for the urban background sites compare well with the revised national background figures published in the AQ Archive. The NO_2 concentration recorded at Balgavies Place is higher than the revised predicted background concentration but is very close to the previous predicted background figure for this grid square which was 15.0 µg/m^3 (343500:731500).

7.5.2.9 Conclusion

In conclusion, although the measured 2005 Annual mean data from the diffusion tubes are generally lower than previously predicted, there continue to be areas of exceedences and hence the need for the AQMA. A new area of exceedence, Meadowside, was identified. This lies adjacent to one of the known areas of exceedence and will therefore be included in the further assessment of that area.

7.6 NARROW CONGESTED STREETS WITH RESIDENTIAL PROPERTIES CLOSE TO THE KERB

Such locations, are defined in the guidance as those which meet the following criteria:

- roads where the carriageway is less than 10 metres wide;
- with residential properties within 5 metres of the kerb; and
- and a traffic flow greater than 10,000 vehicles per day.

The majority of roads in Dundee have a carriageway less than 10m wide and, particularly in the architecturally older areas of the town have residential premises within 5m of the kerb. Figure 7.23 shows an analysis of buildings greater than 6m high in Dundee within 5m from adopted roads. Where roads are bounded on both sides by buildings (commonly termed a street canyon[28]) dispersion of street level pollutants can be hindered. This analysis helps identify

[28] A street canyon is defined as a narrow street with buildings on both sides, where the height of the buildings are greater than the width of the road

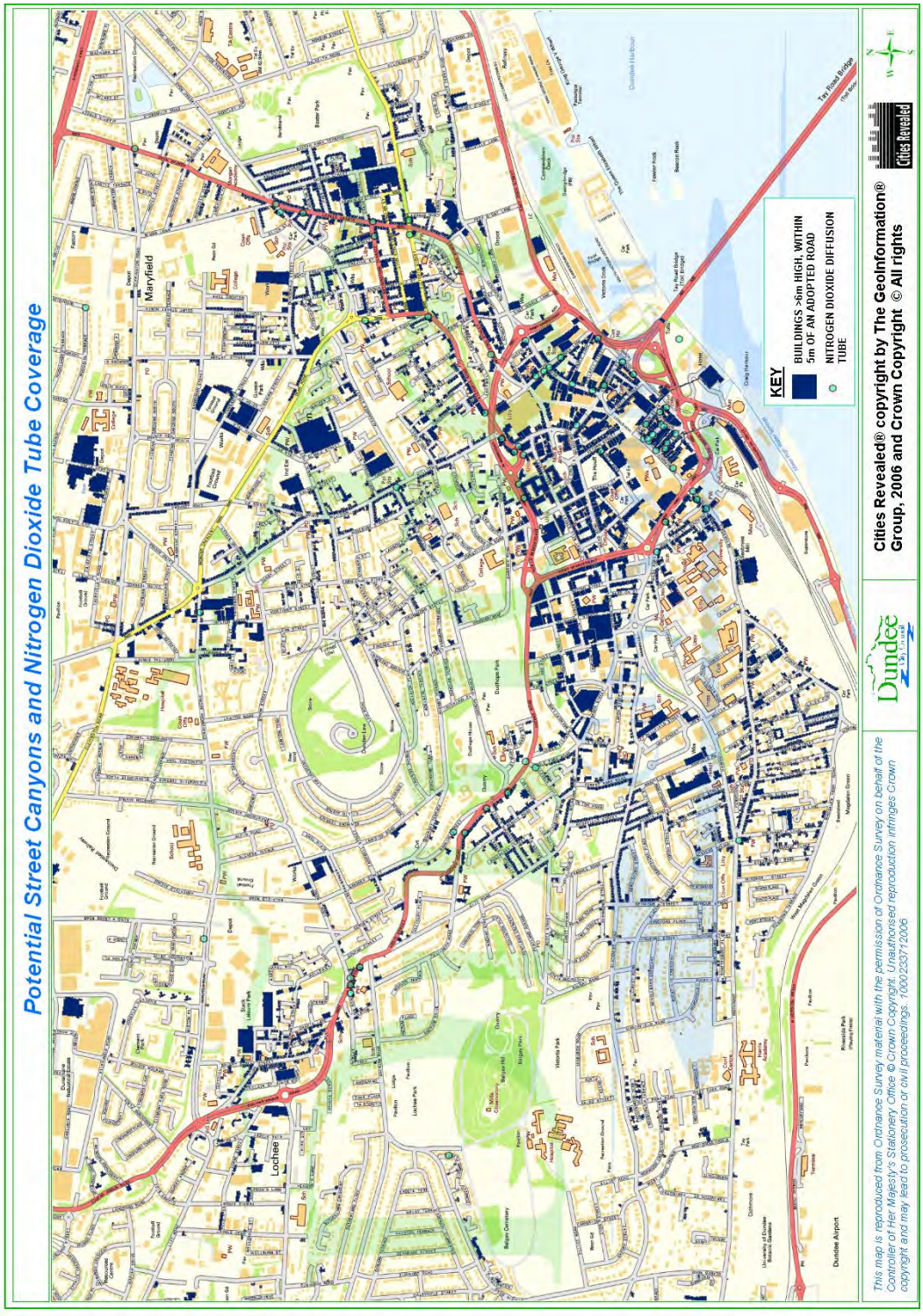
potential areas of street canyons but is likely to over-estimate them as a number of these roads do not carry more than 10,000 vehicles per day.

Narrow congested streets formed the majority of new sites identified as locations for additional NO_2 tubes in the last USA (2003). The outcome of this monitoring ruled out many of these locations and the remainder were examined in the detailed assessment (2005). The areas of NO_2 exceedence subsequently identified are included within the AQMA.

Since the detailed assessment a number of new residential receptors have been identified or received planning permission in street canyoned areas. Some of these developments are also close to road junctions and are discussed in Section 7.7 (Meadowside) and Section 7.11 (Victoria Street and Logie Street).

New flats proposed at first floor level on the south west of Whitehall Street have also been granted planning permission. Street level, kerbside monitored NO_2 levels at this location (below the proposed flat) are currently below the annual mean NAQS for NO_2.

Figure 7.23: Indicative location of street canyoned areas in Dundee.



7.7 ROADS AND JUNCTIONS IN DUNDEE

Roads and junctions in Dundee were comprehensively studied in previous reports. The DMRB screening model, recommended by the technical guidance, has been updated (to version 1.02) since the last USA (2003). Accordingly the modelled results presented during the previous updating and screening assessment have been reviewed and assessed under the following circumstances:

- Where new traffic counts are available;
- New data has revealed roads and junctions over 10,000 vehicles per day (vpd) which have not been previously assessed; and
- Where there is new relevant exposure closer to the road or junction than receptors previously assessed.

The results of the review of roads and junctions are shown in Table 7.7.

No new exceedences of the annual mean NO_2 objective are predicted.

Table 7.7: DMRB Results for Roads and Junctions showing predicted NO_2 results for 2005

Road/ Junction name	Traffic details for DMRB				Receptor location			Background level		DMRB Results
	No. of links	2005 AADT (combined, veh/day)	Annual average speed (km/h)	Total % HDV	Receptor to link centre (m)	Easting	Northing	NO_x (2005) (ug/m^3)	NO_2 (2005) (ug/m^3)	**NO_2 2005 Annual mean (ug/m^3)**
Meadowside/ Victoria Road	1	3073	5	23.5	5.32	340247	730646	19.3	16.0	**37.8***
	2	1350	30	22.4	10.64					
	3	12414	40	1.7	16.7					
Dens Road/ Alexander Street	1	13772	30	5.3	11.8	340686	731335	23.6	18.0	**33.0***
	2	7390	30	5.1	27.4					
	3	4506	40	5.2	51.2					
Dens Road/ Arthurstone Terrace	1	12677	48	8.6	9.93	340733	731135	23.6	18.0	**32.4***
	2	5877	45	3.9	20.1					
Dens Road/ Dura Street	1	15942	40	1.8	13.7	340746	731266	23.6	18.0	**30.6***
	2	8626	40	6.3	20.2					
Hilltown/ Alexander Street/ Constitution Street	1	12198	30	4.1	8.6	340115	731111	23.6	18.0	**29.0***
	2	2416	30	1.5	24.7					
	3	2225	30	2.2	29.7					
Kingsway/ Strathmartine Road	1	39195	40	13.1	29.86	339236	732825	17.9	15.4	**28.0**
	2	10150	30	5.7	14.17					
Strathmartine Road/ Canning Street	1	10530	39	9.8	7.1	339770	731705	23.9	18.2	**26.0**
	2	<5000	30	5	7					
Kingsway West	1	30214	80	13	18.9	336247	732132	15.3	12.0	**23.2**
Greendykes/ Broughty Ferry Road	1	13369	30	6	17.3	342710	731137	16.8	13.1	**21.7**
	2	31923	30	6	39.8					
Logie Street/ Ancrum Road	1	16245	30	2	33.37	338252	731198	21.0	16.8	**21.3**
	2	5137	30	4	9.96					
King Street/ North Marketgait	1	995	32	52.8	10	340528	730686	19.3	16.0	**21.0**
	2	17485	40	2.9	32.4					

Road/ Junction name	Traffic details for DMRB				Receptor location			Background level		DMRB Results
	No. of links	2005 AADT (combined, veh/day)	Annual average speed (km/h)	Total % HDV	Receptor to link centre (m)	Easting	Northing	NO_x (2005) (ug/m^3)	NO_2 (2005) (ug/m^3)	**NO_2 2005 Annual mean (ug/m^3)**
Dudhope Terrace/ Barrack Road	1	10291	48	2	10.4	339612	730881	20.2	16.4	**20.5**
	2	5189	30	1	14.5					
Coupar Angus Road	1	15352	45.9	7.5	7.6	337404	732142	16.2	12.7	**19.9**
South Road	1	10831	44.3	3.7	8.8	337422	731546	17.6	15.2	**19.1**
Drumgeith Road/ Ballumbie Road	1	13945	53	9	21	344704	733307	12.2	9.56	**17.6**
	2	4757	20	9	10.6					
Queen Street/ Fort Street	1	14673	40.5	7	8.6	346188	731099	11.0	8.6	**17.2**
	2	5436	30	7	37.5					
	3	3747	30	2	32.3					
Dalhousie Road	1	12696	48	4.7	7.6	347928	731539	9.63	7.54	**12.9**

***** **Denotes street canyon factor applied to DMRB assessment for NO_2**

7.8 BUSY STREETS WHERE PEOPLE MAY SPEND 1-HOUR OR MORE CLOSE TO TRAFFIC

The main areas where it is likely that pedestrians may spend one hour or more close to traffic are shopping centres, namely:

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

Dundee City Council have had diffusion tube results for all these locations. Diffusion tube monitoring results indicate that none of these areas have an annual mean greater than 60$\mu g/m^3$. This would indicate that there are no predicted exceedences of the 1-Hour mean for NO_2. The recent addition of continuous monitoring equipment at Whitehall Street and the Seagate confirm that there are no areas likely to exceed the 1-hour mean. The diffusion tube at High Street, Lochee, was re-deployed in 2005, as the levels were consistently well below the NAQS for 2005.

7.9 ROADS WITH HIGH FLOW OF BUSES AND/OR HGVS

There is a requirement to review roads where traffic flows are relatively low, i.e. below 20,000 vpd, but where there is a high proportion of HDV (buses and heavy goods vehicles). A 'high proportion' is defined as greater than 25% of the total vehicle flow. This reflects the identification of HDV as particularly significant NO_x sources. These roads are not required to be reviewed and assessed unless there is an excess of 2,500 HDV vpd and there is a relevant receptor within 10 metres of the kerb.

There are a number of roads that are known to have a high proportion of HDV. These areas include:

- Baird Avenue, access to the Tesco Distribution Centre;
- Claymore Street, access to DERL;
- Foundry Lane, buses leaving the depot; and
- Stannergate, access to the port area.

Classified counts for these roads were not undertaken as there is no relevant exposure within 10 metres of the kerb.

Other roads identified as having greater than 25% HDV are within the city centre along the main bus routes, and are shown in Table 7.8.

Table 7.8: Roads with greater than 25% Heavy Duty Vehicles

	Percentage HDV >25%	HDV Daily flow >2,500vpd	Junctions	Street canyon	Residences within 10m of kerb
King Street	✓	x	✓	x	✓ (1st Flr)
St. Andrews Street	✓	x	✓	✓	✓ (1st Flr)
Seagate	✓	x	✓	✓	✓ (Grd Flr)
Trades Lane	✓	x	✓	x	✓ (Grd Flr)
Commercial Street	✓	x	✓	✓	✓ (1st Flr)
Dock Street	✓	x	✓	x	✓ (Grd Flr)
Whitehall Street	✓	x	✓	✓	✓ (1st Flr)
Union Street	✓	x	✓	✓	✓ (1st Flr)
Nethergate	✓	x	✓	✓	✓ (1st Flr)
Meadowside	✓	x	✓	✓	✓ (Grd Flr)

None of these roads have a daily flow of HDV greater than 2,500. Despite this, all these areas, except Meadowside, were considered during the detailed assessment (2005). Meadowside is adjacent to one of the modelled areas of exceedence in the detailed assessment, and classified traffic counts have recently been carried out in this area to inform the further assessment of NO_2 in the vicinity of the Victoria Road / Hilltown Junction. This has been examined in Section 7.7 - Junctions.

7.10 NEW ROADS CONSTRUCTED OR PROPOSED SINCE THE PREVIOUS ROUND OF REVIEW AND ASSESSMENT.

There is a requirement to assess whether any new road is likely to result in exceedences of the NAQS for NO_2. There is also a requirement to assess whether traffic from the new road is likely to increase traffic flows on existing roads where pollutant levels are close to exceeding the NAQS.

There have been no new roads with traffic flows greater than 10,000 vehicles per day constructed since the previous round of review and assessment.

Existing roads, identified previously, where pollutant levels are close to exceeding the NAQS (i.e. where the annual mean exceeds 36 µg/m^3 or there are more than 15 exceedences of the 1-hour mean) are:

- Union Street
- Whitehall Street
- Whitehall Crescent
- Albert Street
- Forfar Road
- North Marketgait
- Victoria Road
- Commercial Street
- Dens Road
- Dock Street
- Kingsway
- Nethergate
- Lochee Road
- St. Andrews Street
- Seagate

There are no new roads constructed that are likely to increase the traffic flows on these roads.

There are a number of new roads proposed as part of the Central Waterfront Redevelopment Master-plan. These will meet both the above assessment criteria and an air quality modelling study has been commissioned to study the impact of these new roads.

7.11 ROADS WITH SIGNIFICANTLY CHANGED TRAFFIC FLOWS, OR NEW RELEVANT EXPOSURE.

Of the roads identified in Section 7.10 as being at risk of exceeding the NO_2 objectives none have undergone an increase in traffic flow of greater than 25% since the previous round of review and assessment. However, there has been new residential exposure identified or introduced close to roads with greater than 10,000 vehicles per day. These are highlighted in Table 7.9.

Table 7.9: DMRB Assessment of New Relevant Exposure for NO_2

Location	Receptor location		Link	Receptor distance to road centre (m)	% HDV	AADT 2005 (vpd)	NO_2 2005 Annual mean (ug/m^3)
	Easting	Northing					
Riverside Drive	339707	729459	1	10.00	3.3	17478	**20.3**
			2	15.00	0.4	5257	
Hawkhill	339184	729921	1	3.50	6	20042	**23.6**
Princes Street	340950	730815	1	7.72	7	13352	**20.0**
			2	15.50	5	16088	
Lochee Road	339330	730608	1	7.88	8	16290	**25.2**
Logie Street	*see map*		*see dispersion modelling output below*				
60 Victoria Road	340372	730778	1	8.50	10.3	14480	**24.0**
72 Victoria Road	340418	730807	1	9.00	10.3	14480	**23.6**
Strathmore Avenue	339755	731866	*new receptors are further from road than previously assessed site - which was below the objective*				
Hawkhill	339613	730218	1	10.34	6	16830	**24.9**
			2	60.97	10	9354	
Victoria Street	341074	731075	1	7.00	7.6	11910	**37.5***
			2	7.20	6.7	7420	
Dudhope Roundabout	339760	730644	1	32.3	1.63	31992	**33.6***
			2	14.8	3.59	23288	
Hawkhill	339537	730180	1	16.90	6	16830	**25.2**
			2	32.20	10	9354	
10 Victoria Road	340218	730664	1	10.80	1.7	14507	**24.6**
			2	20.30	24.1	4855	
			3	58.00	3.2	9432	
62-63 Dock Street	340670	730364	1	13.30	4.3	*diffusion tube result* **32.1**	
			2	15.70	16		
Johnson Street flats	339898	730336	*new receptors identified as part of the air quality assessment which is being prepared for the extension to a shopping centre*				
Strathmore Lodge	339812	730390					

Note: * denotes street canyon – road traffic emissions have been doubled

New housing is to be built in a gap site close to the Logie Street junction. The outcome of the detailed air dispersion modeling using ADMS-Roads is shown in Figures 7.24 and 7.25.

Figure 7.24: Predicted Annual Average NO_2 36 and 40µg/m^3 Contours in Logie Street Assessment Area in 2005 (without street canyon)

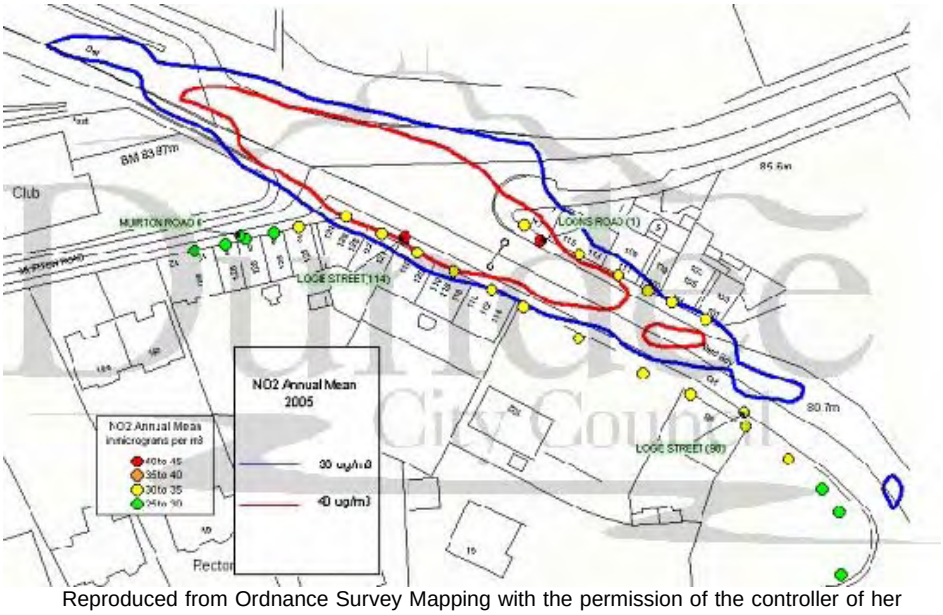
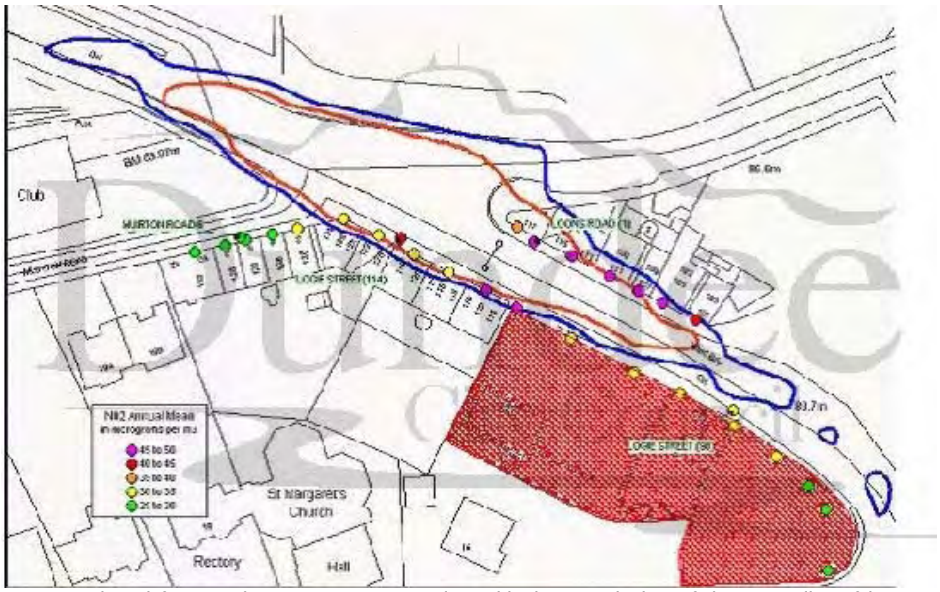


Figure 7.25: Predicted Annual Average NO_2 36 and 40µg/m^3 Contours in Logie Street Assessment Area in 2005 (with street canyon)



7.12 BUS STATIONS

The bus station is located on the south-west corner of the Seagate / Trades Lane Junction (see Figure 7.14 and is used primarily by bus companies travelling to destinations outwith Dundee. Local Dundee buses stop at streets within the city centre, in particular, St Andrews Street, Whitehall Street, Union Street, Nethergate, Seagate and Victoria Road. Bus movements to and from the station amount to approximately 590 movements per day.

The bus station waiting area is enclosed, therefore the waiting public is not exposed to emissions for a significant period of time, that is, the bus station is not considered a relevant assessment area for the 1-hour objective.

A nitrogen dioxide diffusion tube was placed opposite the bus station at the nearest residential premises. The bias corrected reading for 2005 was 28.7 $\mu g/m^3$ (Trades Lane).

However, housing is to be built closer to the bus station (within 10m). As the bus movements are currently well below the criteria for assessment (i.e. 1000 bus movements per day) there is no requirement to assess exposure levels at these receptors.

As there is no evidence of an exceedence of the annual mean in proximity to the bus station and the bus station waiting area is enclosed, Dundee City Council will not proceed to a detailed assessment for nitrogen dioxide in respect of the bus station.

7.13 NEW INDUSTRIAL SOURCES

The technical guidance lists 12 types of Part A and 1 type of Part B industrial processes that contribute to the total UK NO_x emissions. Table 7.10 lists those industries which fall into these categories and are present in, or close to Dundee. It was established during the detailed assessment (2005) that Nynas was not considered to be a significant source of nitrogen dioxide.

As there are no new industrial sources falling into the categories listed in the guidance, Dundee City Council will not proceed to detailed assessment for NO_2 in respect of any new industrial sources.

Table 7.10: Industrial sources of nitrogen dioxide in, or bordering Dundee City

Company Name	Location	Process
Michelin Tyres Plc	Baldovie Road, Dundee	Combustion process
Nynas AB UK	East Camperdown Street, Dundee	Crude oil handling
DERL	Claymore Street, Dundee	Incineration

7.14 INDUSTRIAL SOURCES WITH SUBSTANTIALLY INCREASED EMISSIONS, OR NEW RELEVANT EXPOSURE.

Information received from SEPA[29] during the First Round indicated that the authorised processes in Dundee would not be likely to cause an exceedence of the NAQS at any relevant receptor.

Dundee City Council was consulted by SEPA on the recent PPC Applications for DERL (PPC/A/1003157) and Nynas (PPC/A/1013015). In addition emissions from Michelin and DERL were examined as part of a planning application to erect 85m high wind turbines on Michelin's site. None of these industrial sources were found to have increased their emissions by greater than 30% since the previous round of review and assessment.

Due to the recent rise in gas prices Michelin have applied for a variation of their process authorisation to allow them to burn heavy fuel oil at times when gas prices are uneconomic for the plant. Dispersion modelling of stack emissions for natural gas and heavy fuel oil was carried out by consultants, BMT Cordah, on behalf of Michelin and deemed to be competent by SEPA's modelling staff. The dispersion modelling concluded that during heavy fuel oil firing of the boilers, in areas of relevant exposure, concentrations of NO_2 are predicted to be between 50-80% of the NAQS.[30]

7.15 AIRCRAFT

Dundee airport has approximately 50,000 passengers per year[31] and no freight. The requirement is to consider airports with more than 5 million passengers (or freight equivalent) per year therefore the airport is not considered to be a significant source of nitrogen

[29] Scottish Environmental Protection Agency - Additional Information for Stage 2 Air Quality Review and Assessment
[30] Draft Decision Document Variation to Part "A" permit - Form iPPC-DD-05, Section 2.1 page 3
[31] Dundee Economic Profile - October 2006

dioxide. It is not necessary to proceed to a detailed assessment for nitrogen dioxide in respect of the airport.

7.16 CONCLUSIONS

The diffusion tube results confirm the need for the AQMA for NO_2 and identify one new location at which the annual mean objective is exceeded (Meadowside). This site forms part of the known area of exceedence at the Victoria Road/Hilltown junction and will therefore be included in the further assessment of this location. No other exceedences of NO_2 objective have been identified, hence there is no requirement for detailed assessment of this pollutant.

Table 7.11: Checklist for Nitrogen Dioxide

Item	Response
Monitoring data within an AQMA	Only one additional exceedence of the annual mean objective has been identified within the AQMA, at Meadowside, this area will be included within the further assessment of the Victoria Road / Hilltown Junction. There are no areas identified as exceeding or likely to exceed the one- hour objective, using both automatic and diffusion tube monitoring
Narrow congested streets with residential properties close to the kerb	Narrow congested streets formed the majority of new sites identified as locations for additional NO_2 tubes in the last USA (2003). The outcome of this monitoring ruled out many of these locations and the remainder were examined in the detailed assessment (2005). The areas of NO_2 exceedence subsequently identified are included within the AQMA.
Roads and Junctions	A number of locations have been identified and assessed using DMRB. No new exceedences of the annual mean NO_2 NAQS were predicted.
Busy streets where people may spend 1-hour or more close to traffic	Relevant locations in Dundee have been identified and no exceedences were found.
Roads with high flow of buses and/or HGVs.	No roads with a high flow of HDVs have been identified
New roads constructed or proposed since the previous round of R&A	There are a number of new roads proposed as part of the Central Waterfront Redevelopment Master-plan. These will have >10,000 vpd and may increase traffic flow on existing roads with an annual mean NO_2 > 36$\mu g/m^3$. An air quality modelling study has been commissioned to study the impact of these new roads.
Roads with significantly changed traffic flows, or new relevant exposure	No roads with significantly increased flows were identified. Of the new relevant exposures within 10m of roads with > 10,000 vpd assessed, only the new development in Logie Street was estimated to exceed the annual mean objective for NO_2 and has already been identified for further assessment. The Council is awaiting results of an Air Quality Assessment for a Shopping Centre extension.

Item	Response
Bus Stations	Number of movements is below the criteria for assessment
New industrial sources.	None
Industrial sources with substantially increased emissions, or new relevant exposure	None
Aircraft	Annual throughput is below the criteria for assessment.

SECTION 8: SULPHUR DIOXIDE

8.1. INTRODUCTION

The Government and Devolved Administrations have adopted a 15-minute mean of 266 μg/m^3 as a National Air Quality Standard (NAQS) for sulphur dioxide, with an objective for the Standard not to be exceeded more than 35 times in a year by the end of 2005. Additional objectives have also been set which are equivalent to the EU limit values specified in the First Air Quality Daughter Directive. These are for a 1-hour mean objective of 350 μg/m^3, to be exceeded no more than 24 times per year, and a 24-hour objective of 125 μg/m^3, to be exceeded no more than 3 times per year, to be achieved by the end of 2004.

Sulphur dioxide causes constriction of the airways by stimulating nerves in the lining of the nose, throat and airways of the lung. The latter effect is particularly likely to occur in those suffering from asthma and chronic lung disease. The effects of sulphur dioxide on sensitive subjects appear almost immediately at the start of exposure.

The main source of sulphur dioxide in the United Kingdom is power stations, which accounted for more than 71% of emissions in 2000. There are also significant emissions from other industrial combustion sources. Domestic sources now only account for 4% of emissions, but can be locally much more significant. Road transport accounts for less than 1% of emissions. Emissions of sulphur dioxide are expected to continue to decrease under current legislation.[32]

Local exceedences of the objectives (principally the 15-minute mean objective) may occur in the vicinity of small combustion plant (less than 20 MW) which burn coal or oil, in areas where solid fuels are the predominant form of domestic heating, and in the vicinity of major ports.

The 24-hour mean NAQS is designed to protect people at residential premises, including gardens, and public buildings such as schools and hospitals. In addition the 1-hour mean NAQS is to reflect exposure in residential gardens, car parks, bus/railway stations and pavements of busy shopping streets. The 15-minute mean applies to all locations where members of the public may reasonably be exposed for a period of 15 minutes or longer.

[32] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland- 'A Consultation document on options for further improvements in air quality' Volume 1, April 2006, **Defra Publications**. Chapter 2 para 16

8.2. CONCLUSIONS FROM PREVIOUS REPORTS

8.2.1 Conclusions from the First Round

The SO_2 contributions of domestic sources and small combustion plant to air quality in Dundee were considered negligible. Information from SEPA suggested that there was no significant risk that emissions of sulphur dioxide from either DERL or Michelin Tyres Plc would exceed the objectives. Although SO_2 dispersion modelling of emissions from Nynas predicted relatively high ground level concentrations of the 15-minute mean SO_2, when combined with the predicted traffic SO_2 contribution, no exceedence of the NAQS for SO_2 was found. There were no known proposed developments which would be considered significant for SO_2 emissions in 2004/5. However, it was noted that the City Quay development, upwind of Nynas, included proposals for residential accommodation and this development required to be kept under review.

It was therefore concluded that the NAQS and objectives for sulphur dioxide would be achieved with no further action required.

8.2.2 Comments from Statutory Consultees

Further to the submission of the Stage 2 (first round) report the following comments were received via the Scottish Executive from the University of West of England Review and Assessment Appraisal Report[33]

> *The Nynas AB UK plant is a significant source of sulphur dioxide. The highest sulphur dioxide monitoring results were in the vicinity of this plant, although the technique was not suitable for identifying 15-minute concentrations. It is recommended that the authority carry out further assessment for this source, ideally using automatic monitoring at a location where the modelling suggests the maximum impact associated with relevant exposure.*

As a result of these comments Dundee City Council installed a continuous SO_2 monitoring equipment downwind of Nynas and the port.

[33] Scottish Executive, 15 March 2001 Air Quality Strategy: Dundee City Council - Second Stage Review and Assessment - including comments from UWE and SEPA

8.2.3 Conclusion from Updating and Screening Assessment 2003

Having applied the checklist criteria for the assessment of sulphur dioxide from the technical guidance, it was concluded that whilst it was not necessary to proceed to detailed assessment for the majority of the checklist criteria for sulphur dioxide, it was necessary to undertake further assessment in relation to the new housing in the proximity of Nynas AB UK for all SO_2 National Air Quality Standards.

8.2.4 Conclusion from Detailed Assessment 2005

The need for further assessment of the short-term (15 minute) Air Quality Objective for sulphur dioxide (SO_2) was examined in the vicinity of the port/harbour area and Nynas AB UK (point source) due to new residential development proposed on the waterfront. Dispersion modelling of SO_2 emissions from the stacks at Nynas AB UK concluded that no AQMA for SO_2 would be required.

8.3 MONITORING OUTSIDE AN AQMA

8.3.1 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.

8.3.2 Instrumentation

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

8.3.3 Data Quality Requirements

The analyser is calibrated every night using certified calibration gases. Data has been screened and scaled in accordance with the Technical Guidance (LAQM.TG03).

8.3.4 Summary of Annual Results

Automatic Monitoring results for the period 1 January to 31 December 2005 are shown in Tables 8.1, 8.2, and 8.3, along with results for previous years.

Table 8.1: 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)(%)	2005 15-min Mean SO_2(max) (ex)(%)
Broughty Ferry Road Rollalong	(288) **(1)** (90.4)	(392) **(6**) (95.4)	(395) **(5)** (97.9)	(281) **(2)** (93)
Groundhog DISC**	n/a	n/a	(83) **(0)** (97.4)	n/a

** 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 15 minute objective (no more than 35 ex/yr are allowed)
% - percentage data capture (should be >90%)

Table 8.2: 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)(%)	2005 1-hour Mean SO_2(max) (ex)(%)
Broughty Ferry Road Rollalong	(209) **(0)** (92)	(268) **(0)** (97.5)	(296) **(0)** (100)	(239) **(0)** (95)
Groundhog DISC**	n/a	n/a	(22) **(0)** (99.4)	n/a

** 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 1 hour objective (no more than 24 ex/yr are allowed)
% - percentage data capture (should be >90%)

Table 8.3: Summary of 24-hour mean SO_2 Results ($\mu g/m^3$) from Continuous Monitors (NAQS = 125$\mu g/m^3$)

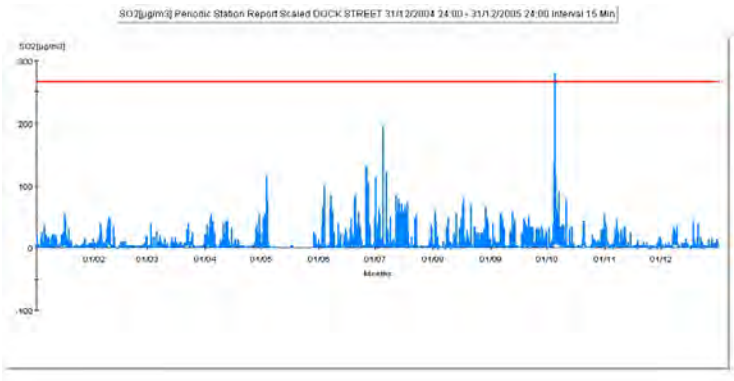
Location	2002 24-hour Mean SO_2(max) (ex)(%)	2003 24-hour Mean SO_2(max) (ex)(%)	2004 24-hour Mean SO_2(max) (ex)(%)	2005 24-hour Mean SO_2(max) (ex)(%)
Broughty Ferry Road Rollalong	(71) **(0)** (91.8)	(55) **(0)** (97.3)	(34) **(0)** (100)	(56) **(0)** (94.8)
Groundhog DISC**	n/a	n/a	(6) **(0)** (100)	n/a

** 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 (no more than 3 ex/yr are allowed)
% - percentage data capture (should be >90%)

8.3.5 15-minute Average Concentrations of SO_2 in 2004

The figure below shows the time series graph of 15-minute average SO_2 concentrations for the Broughty Ferry Road monitoring site only, as the Groundhog was not located in Dundee during 2005. Data was lost from all monitors between 12/05/05-27/05/05 as the database had reached its capacity and had to be reconfigured. 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 8.1: Time Series at Broughty Ferry Road of SO_2 15-Minute Averages in 2005 ($\mu g/m^3$)

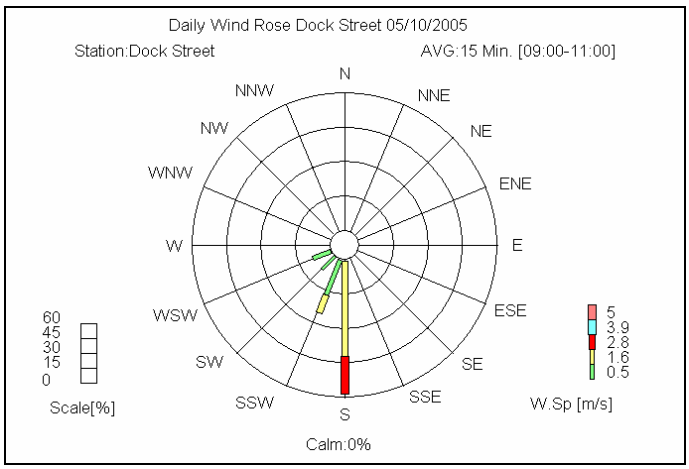


8.3.6 Discussion of Results

There were 2 exceedences of the 15-minute mean objective for sulphur dioxide (266µg/m^3) at the Broughty Ferry Road monitor

during 2005. These occurred on the morning of the 5th October 2005 between 09:00 and 11:00 hours. The cause is not known but the wind rose for this time (see Figure 8.2) indicates that the wind was predominantly from the south. This would suggest that the exceedence was associated with sources within the docks area. There are 35 exceedences permitted within each calendar year.

Figure 8.2: Wind Rose for Broughty Ferry Road Monitor 09:00 to11:00 on 5th October 2005.



There were no recorded exceedences of the one-hour nor the 24-hour objectives for sulphur dioxide at the Broughty Ferry Road monitor during 2005.

8.3.7 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 four years from the Broughty Ferry Road monitor, this is considered insufficient to show a reliable trend at the current time.

8.4 NEW INDUSTRIAL SOURCES

The technical guidance lists 13 types of industrial processes that are potentially significant sources of SO_2. The table below lists those industries which fall into this category and are present in, or close to, Dundee. (Table 8.4.).

Table 8.4: Potentially significant industrial sources of sulphur dioxide in or bordering Dundee City

Company Name	Location	Process
Michelin Tyres Plc	Baldovie Road, Dundee	Combustion
Nynas AB UK	East Camperdown Street, Dundee	Crude oil handling
DERL	Claymore Street, Dundee	Incineration
Ennstone Thistle	Ethiebeaton Quarry	Roadstone Coating Process

Of the processes listed in Table 8.4 , all but the roadstone coating process have been screened out in previous assessments. This process is located in Angus Council and received authorisation from SEPA in July 2004. No screening assessment for sulphur dioxide was carried out as part of the authorisation process, hence it is necessary for the local authority to carry out a screening assessment.

8.4.1 Screening assessment for SO_2 in respect of any new industrial sources

Ennstone Thistle: Roadstone Coating Process - Screening Assessment

The Technical Guidance (LAQM.TG03), for screening of SO_2 emissions from industrial sources, recommends using the UK Emissions Factor database (www.naei.org.uk) for industrial emission rates if information is unavailable from the process authorisation documents. There are no SO_2 emission factors available from the NAEI for this process.

It is therefore necessary to estimate SO_2 emissions (in tonnes per annum) from the sulphur content of the fuel and the volume used. The type of fuel used in the process is gas oil (with a sulphur content of 0.2% wt/wt). The volume used in 2005 has been estimated by the operator to be 1 million litres. Using the atomic weights of sulphur and sulphur dioxide along with the density of gas oil (0.96kg/litre) it is possible to estimate the SO_2 emissions in tonnes per annum. The result of this calculation is 3.84 tonnes per annum.

An emission rate this low is not included in the screening nomogram in Figure 7.1 of the Technical Guidance. Therefore it is assumed that emissions of SO_2 from this process will not give rise to a 99.9^{th} percentile 15-minute ground level concentration of

53.2 µg/m^3 and the process can be screened out at this stage without the requirement for detailed assessment.

8.5 INDUSTRIAL SOURCES WITH SIGNIFICANTLY INCREASED EMISSIONS, OR NEW RELEVANT EXPOSURE

Dundee City Council was consulted by SEPA on the recent PPC Applications for DERL (PPC/A/1003157) and Nynas (PPC/A/1013015). In addition emissions from Michelin and DERL were examined as part of a planning application to erect 85m high wind turbines on Michelin's site. None of these industrial sources were found to have increased their emissions by greater than 30% since the previous round of review and assessment.

Due to the recent rise in gas prices Michelin have applied for a variation of their process authorisation to allow them to burn heavy fuel oil at times when gas prices are uneconomic for the plant. Dispersion modelling of stack emissions for natural gas and heavy fuel oil was carried out by BMT Cordah on behalf of Michelin and deemed to be competent by SEPA's modelling staff. The dispersion modelling concluded that during heavy fuel oil firing of the boilers, in areas of relevant exposure, concentrations of SO_2 are predicted to be between 50-80% of the NAQS.[34]

A new 14-storey residential block is to be built at city quay approx 380m upwind from the nearest of the stacks at Nynas (see Figure. 8.3). SEPA carried out dispersion modelling of the stacks, which predicted than none of the NAQSs for sulphur dioxide would be exceeded at the proposed floor levels within the development.

8.6 AREAS OF DOMESTIC COAL BURNING

Dundee City Council has declared smoke control areas encompassing the whole city. However, for the purposes of assessing sulphur dioxide emissions from domestic coal burning, it is recommended that smokeless fuel be treated as solid fuel as the sulphur content is similar.

Domestic coal burning was assessed for the last round of Review and Assessment, based on knowledge of council and housing association stock and the House Condition Survey 2001. It was considered unlikely that there were any areas of the city with more than 100 houses in a 500 metre square using coal. Solid fuel use is expected to have declined since 2003, and all local authority and housing association stock in Dundee now have central heating. It is

[34] Draft Decision Document Variation to Part "A" permit - Form iPPC-DD-05, Section 2.1 page 3

not considered necessary to proceed to a detailed assessment for sulphur dioxide in relation to domestic coal burning.

8.7 SMALL BOILERS (>5MW$_{(THERMAL)}$)

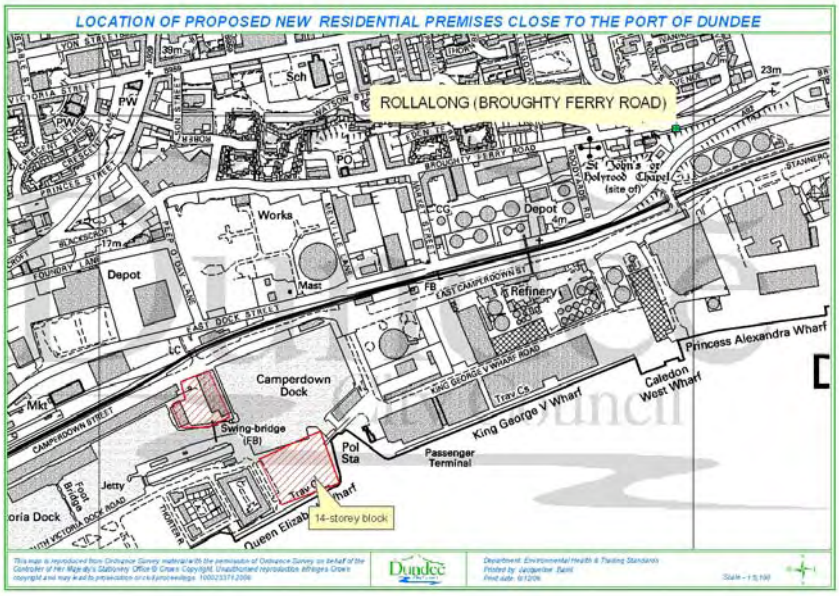
All small boilers >5MW$_{(thermal)}$ burning coal or oil were identified during the First Round of assessment in Dundee. It was concluded that these boilers would not be significant sources of SO_2 in 2004.

No new small boilers have been identified within Dundee and no changes to existing sources have been reported.

8.8 SHIPPING

Since the previous review and assessment new housing is to be built within 250m of the operational wharfs of the port of Dundee (see Figure 8.3 below).

Figure 8.3: New Residential Premises proposed close to the port of Dundee.



Forth Ports (the Port Management) indicate that there were approximately 1,000 total shipping movements (every visit from a ship is classed as two movements) in 2005 at Dundee Port. This is not close to the threshold of 5,000 movements requiring detailed assessment. Accordingly, a detailed assessment in respect of shipping movements is not required.

8.9 RAILWAY LOCOMOTIVES

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. Four trains stop daily at this station, however, these trains are not stationary for periods in excess of 15 minutes, therefore, this is not considered significant.

8.10 CONCLUSIONS

Having applied the checklist criteria for the assessment of sulphur dioxide from the technical guidance, it is concluded that it is not necessary to proceed to detailed assessment for sulphur dioxide.

Table 8.5: Checklist for Sulphur Dioxide

Item	Response
Monitoring data outside an AQMA	Monitoring of SO_2 has been carried out downwind of the docks area and no exceedences of the NAQSs for SO_2 have been detected.
Monitoring data within an AQMA	No AQMAs declared for SO_2
New industrial sources.	New roadstone coating process at Ethiebeaton Quarry in Angus, screening assessment showed that SO_2 emissions were not significant.
Industrial sources with substantially increased emissions, or new relevant exposure	No significant increase in industrial emissions. New high-rise residential development is to be built upwind of point source within the docks. Assessed by SEPA as not likely to exceed the NAQSs for SO_2.
Areas of domestic coal burning	No areas of high density coal use identified
Small Boilers > 5 MW (thermal).	No new processes identified
Shipping	Shipping movements at Dundee Harbour are below the criteria for assessment
Railway Locomotives	No relevant locations identified

SECTION 9: PARTICLES (PM_{10})

9.1. INTRODUCTION

The Government and Devolved Administrations have adopted two National Air Quality Standards (NAQS) and objectives for fine particles (PM_{10}), which are equivalent to the EU Stage 1 limit values in the first Air Quality Daughter Directive. The objectives are 40μg/m^3 as the annual mean, and 50 μg/m^3 as the fixed 24-hour mean to be exceeded no more than 35 days per year, to be achieved by the end of 2004. The objectives are based on measurements carried out using the European gravimetric transfer reference sampler or equivalent.

The EU has also set indicative limit values for PM_{10} which are to be achieved by 1 January 2010. These Stage 2 limit values are considerably more stringent, and are 20 μg/m^3 as the annual mean, and 50 μg/m^3 as the 24-hour mean to be exceeded no more than 7 days per year.

The Scottish Executive has incorporated new objectives for 2010 into their Regulations, and authorities in Scotland are required to review and assess air quality against them. These objectives are a 24-hour mean of 50 μg/m^3 not to be exceeded more than 7 times per year, and an annual mean of 18 μg/m^3 to be achieved by the end of 2010.

Particulate air pollution is associated with a range of effects on health including effects on the respiratory and cardiovascular systems, asthma and mortality. It has been concluded that particulate air pollution episodes are responsible for causing premature mortality among those with pre-existing lung and heart disease, and that there is a direct relationship between concentrations of PM_{10} and health effects, such that the higher the concentration of particles, the greater the effect on health. (NB: PM_{10} is that fraction of particulate matter which is less than 10μm aerodynamic diameter and is capable of entering the lungs during respiration)

Since the National Air Quality Strategy was issued in 2000, the evidence of the health impacts of particulate matter has strengthened. The two main points are that:

a) particulate matter is a non-threshold pollutant. Therefore a reduction of 1μg.m^3 even in areas where the pollution level is below the objective continues to generate the same level of benefit as a 1μg/m^3 reduction in areas where the objective is exceeded; and

b) studies of the relative toxicity of different fractions of the PM_{10} mix have lead the WHO to conclude that $PM_{2.5}$ is more strongly associated with health impacts than PM_{10}.

Consequently the European Commission has proposed[35] a new set of objectives for $PM_{2.5}$ Defra and the Devolved Administrations are currently consulting on how best to implement these new proposals.

9.2 SOURCES

There is a wide range of emission sources that contribute to PM_{10} concentration in the UK. The APEQ report[36] has confirmed that these sources can usefully be divided into 3 main categories. *Primary particle* emissions are derived directly from combustion sources, including road traffic, power generation, industrial processes etc. *Secondary particles* are formed by chemical reactions in the atmosphere, and comprise principally of sulphates and nitrates. *Coarse particles* comprise of emissions from a wide range of sources, including re-suspended dusts from road traffic, construction works, mineral extraction processes, wind-blown dusts and soils, sea salt and biological particles.

A significant proportion of the current annual mean PM_{10} is derived from regional (including long distance transport from Europe) background sources. The exact regional background contribution at any site is variable, and will be greatly dependant upon the precise geographic location. Typical regional annual mean background contributions are currently within the range of about 14-21 $\mu g/m^3$, gravimetric and are outside of the control of local authorities.

9.3 CONSIDERATIONS FOR LOCAL AUTHORITIES

The expected reduction in particle emissions in future years is different for each source type. For example, emissions from road transport will be governed by legislation on vehicle emission standards; emissions of secondary particles will be largely governed by controls on power generation, industrial and transport SO_2 and NO_x emissions, both in the UK and Europe. Emissions of coarse particles are largely uncontrolled, and in general are not expected to decline in future years.

[35] Com (2005) 447.
[36] AQEG (1999)- 'Source Apportionment of Airborne Particulate Matter in the uk

9.4. CONCLUSIONS FROM PREVIOUS REPORTS

9.4.1 Updating and Screening Assessment 2003

Dundee City Council completed its previous USA in May 2003, with the conclusion that further assessment was required for particles (PM_{10}) at 17+ locations. Consequently, the council was obliged to commission additional monitoring, modelling and traffic counts throughout the city to determine if any areas, additional to those already identified in the USA, required detailed assessment. Of these, the USA and subsequent studies concluded that a Detailed Assessment was required for the following nine busy roads and junctions:

- Union Street/Nethergate
- Nethergate/West Marketgait
- Whitehall Street/High Street/Nethergate
- Dock Street
- Seagate
- Lochee Road
- Logie Street/Loons Road/Muirton Road junction
- Victoria Road/Hilltown
- Strathmore Avenue.

9.4.2 Detailed Assessment 2005

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. In relation to PM_{10} the results of the detailed assessment were inconclusive because there was insufficient confidence in the verification of the modelled results for 2010. It was concluded that additional monitoring and modelling would be required to determine whether an AQMA for PM_{10} is required.

9.4.3 Progress Report 2005

The Progress Report concentrated primarily on monitoring data for 2004. It concluded that both the daily and annual mean PM_{10} objectives for 2004 were met at all monitoring locations in Dundee.

The predicted results indicated 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 indicated 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

concluded that it would continue to monitor the situation regarding the levels of fine particles in Dundee.

9.5 MONITORING DATA OUTSIDE AN AQMA

9.5.1 Measurement Methods - TEOM and OSIRIS

The tapered element oscillating microbalance (TEOM) system determines particulate concentrations by continuously weighing particles that are deposited on a filter. The OSIRIS uses a nephalometer, which sizes individual particles as they pass through a laser beam.

9.5.2 Instrumentation

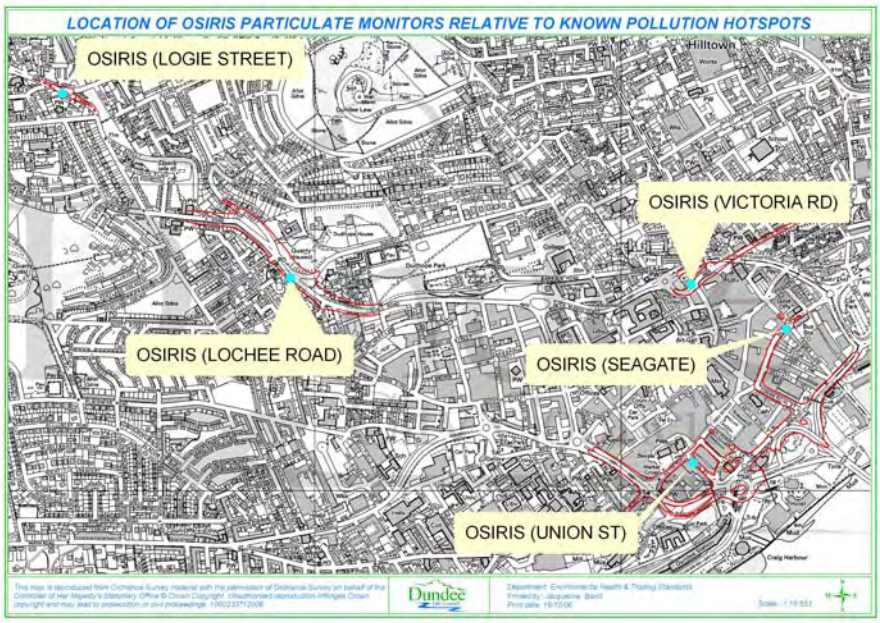
Each of the three TEOM PM_{10} monitoring sites is equipped with an R&P TEOM series 1400ab Ambient Particulate Monitor. The five nephalometer sites are equipped with OSIRIS particulate monitors supplied by Turnkey Instruments.

9.5.3 Data Quality Requirements

Each TEOM 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. The OSIRIS Units are serviced and calibrated annually, and receive quarterly filter change and flow checks as per the manufacturer's instruction.

Dundee City Council obtained funding from the Scottish Executive for the five OSIRIS units to carry out a screening assessment of PM_{10} levels in Dundee. These have been deployed at various known areas of exceedence as shown in Figure 9.1.

Figure 9.1: Location of OSIRIS Units Relative to Known Areas of Exceedence

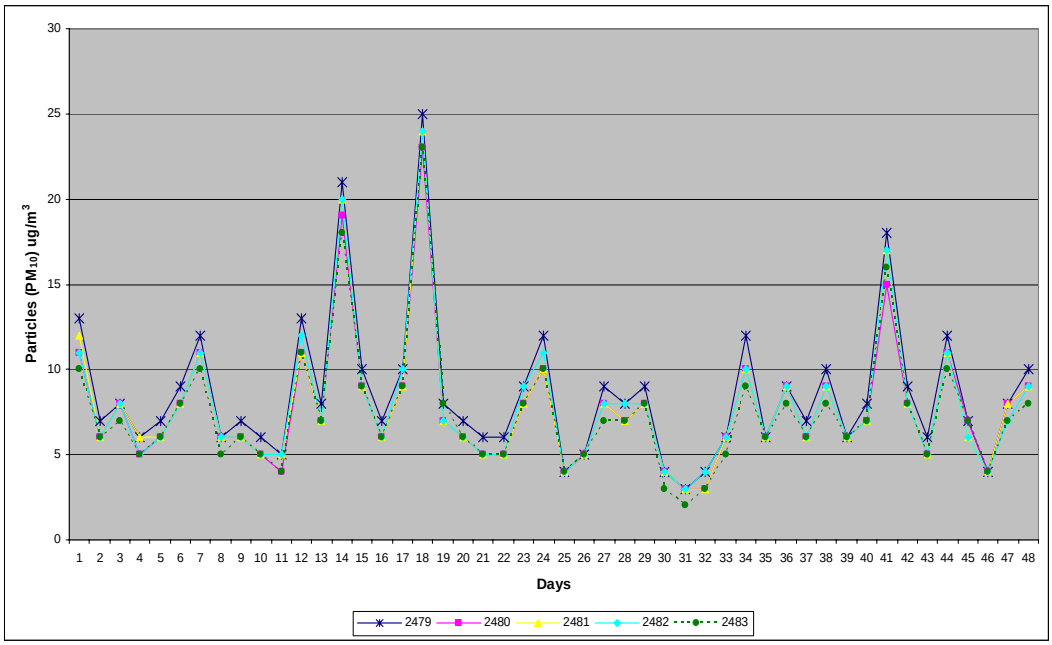


There was insufficient data for 2005 from the OSIRIS to report. For part of the year they were used in an inter-comparison study in our offices (see Figure 9.2) to establish how each unit compares with the designated 'master' which was to be co-located with the TEOM at Union Street.

Figure 9.2: OSIRIS Inter-comparison Study 2005

Figure 9.3 below shows how each of the monitors performed during the inter-comparison test.

Figure 9.3: OSIRIS Inter-comparison Time Series 2005



Analysis of the data from the inter-comparison study allowed correction factors to be calculated for each OSIRIS units when compared with the 'master'. These are shown in Table 9.1 below.

Table 9.1: OSIRIS Inter-comparison Correction Factors

	PM10 particles (ug/m^3)				
OSIRIS Monitors	**2479**	**2480**	**2481**	**2482**	**2483**
Mean	8.51	7.61	7.88	7.85	7.38
Max	67.8	64.7	65.8	63.8	62.9
Min	1.1	1	1.1	1	0.9
Std deviation	7.22	6.51	6.72	6.78	6.38
Coeff of Variation	48.24	42.81	45.21	45.18	38.98
As 2481 is collocated with the TEOM in Union St Rollalong, 2481 should be considered the local 'MASTER'	2479 over-reads so multiply by	2480 under-reads so multiply by	MASTER	2482 under-reads (slightly) so multiply by	2483 under-reads so multiply by
FACTOR to adjust to Union Street	**0.925**	**1.035**	**1**	**1.003**	**1.068**

The above factors will be used along with a factor to be derived from the ongoing OSIRIS / TEOM and Partisol / TEOM co-location studies to give an estimate of gravimetric equivalence at each site.

9.5.4 Summary of TEOM Annual Results for 2005

The TEOM results for the period 1 January to 31 December 2005 have been converted to gravimetric equivalent results using the multiplier of 1.3 (in accordance with the technical guidance), and are shown in Table 9.2, along with results for previous years. Recent guidance from the Scottish Executive[37] advised that, in light of the co-location study carried out by Edinburgh City Council, the annual mean TEOM results 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 9.3. The Groundhog was not located at the urban background site in Dundee during 2005. It should be noted that a local gravimetric equivalence co-location study is ongoing. The results from this study could change the factor applied to the monitoring data in Dundee in the future.

Table 9.2: Summary of TEOM PM_{10} Results for 2005 ($\mu g/m^3$) (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)	2005 Annual Mean PM_{10} (%data)
Union Street Rollalong	22.3 (95.6)	23.1 (87.6)	24.3 (98.1)	23.7 (79.1)	23.0 (94)
Broughty Ferry Road Rollalong	n/a	21.1 (89.5)	21.9 (99.3)	18.5 (100)	18.4 (93.6)
Groundhog DISC	n/a	n/a	n/a	15.3** (88.9)	n/a

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

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

Table 9.3: Summary of 2005 TEOM PM_{10} Results ($\mu g/m^3$) (Gravimetric Factor 1.14)

Location	2004 Annual Mean PM_{10} (%data)	2005 Annual Mean PM_{10} (%data)
Union Street Rollalong	20.7 (79.1)	20.2 (94)
Broughty Ferry Road Rollalong	16.3 (100)	15.8 (93.6)
Groundhog DISC	13.4** (88.9)	n/a

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

Tables 9.4 and 9.5 and Figure 9.4, 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 'residual' previously 'coarse') and treated separately. Only the 'primary' component is important in terms of local emissions. The 'secondary' and 'residual' 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 update to the Technical Guidance in 2006.[38].

[38] Updated 2006 Guidance for Use of the Year Adjustment Factors for Background and Roadside Annual Mean Pollutant Concentrations'. - Yvonne Brown/Lucy Parkin 07/02/06

Table 9.4: 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	2005 Annual Mean PM_{10} Predicted to 2010
Union Street Rollalong	20.0	20.9	22.2	22.0	21.4
Broughty Ferry Road Rollalong	n/a	19.2	20.2	17.4	17.1
Groundhog DISC	n/a	n/a	n/a	14.6**	n/a

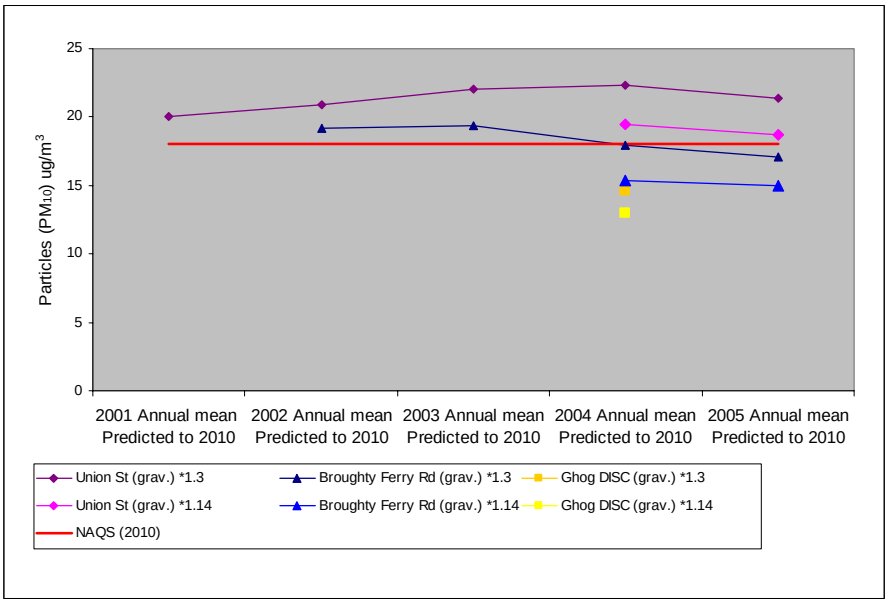
** annualised 6-month (13/05/04 -14/11/04) monitoring results

Table 9.5: 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	2005 Annual Mean PM_{10} Predicted to 2010
Union Street Rollalong	19.4	18.7
Broughty Ferry Road Rollalong	15.5	15.0
Groundhog DISC	13.0**	n/a

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

Figure 9.4: Measured Annual Means (factored by both 1.3 and 1.14 grav.) predicted forward to 2010 for comparison with the NAQS (2010)



9.5.5 24-Hour Mean TEOM Concentrations in 2005

The Table 9.6 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 2005 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 9.6: Number of exceedences of the 24-hour objective (50 µg/m^3) (no more than 35 allowed by 2004)

Location	2001		2002		2003		2004		2005	
	No. of ex	90th Percentile (µg/m^3)	No. of ex	90th Percentile (µg/m^3)	No. of ex	90th Percentile (µg/m^3)	No. of ex	90th Percentile (µg/m^3)	No. of ex	90th Percentile (µg/m^3)
Union Street Rollalong	4	33	5	33	18	40	11	36	5	34
Broughty Ferry Road Rollalong	n/a	n/a	4	32	17	39	4	29	3	27
Groundhog DISC	n/a	n/a	n/a	n/a	n/a	n/a	2	23	n/a	n/a

The Table 9.7 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 2005 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 9.7: Number of exceedences of the 24-hour objective (50 µg/m^3) (no more than 7 allowed by 2010)

Location	2001		2002		2003		2004		2005	
	No. of ex	98th Percentile (µg/m^3)	No. of ex	98th Percentile (µg/m^3)	No. of ex	98th Percentile (µg/m^3)	No. of ex	98th Percentile (µg/m^3)	No. of ex	98th Percentile (µg/m^3)
Union Street Rollalong	4	44	5	42	18	62	11	60	5	49
Broughty Ferry Road Rollalong	n/a	n/a	4	48	17	61	4	43	3	42
Groundhog DISC	n/a	n/a	n/a	n/a	n/a	n/a	2	36	n/a	n/a

The following Figures (9.5, 9.6) show time series graphs of 24-hour average PM_{10} concentrations for each site, measured during 2005. Note the red line shows the 24-hour objective limit (50 µg/m^3). Data was lost from all monitors between 12/05/05-27/05/05 as the database had reached its capacity and had to be reconfigured. Data was lost from the Broughty Ferry Road monitor from 25/03/05-30/03/05 due to a faulty filter change.

Figure 9.5: Time Series at Union Street of PM_{10} 24-Hour Mean in 2005 (in µg/m^3 grav.(1.3))

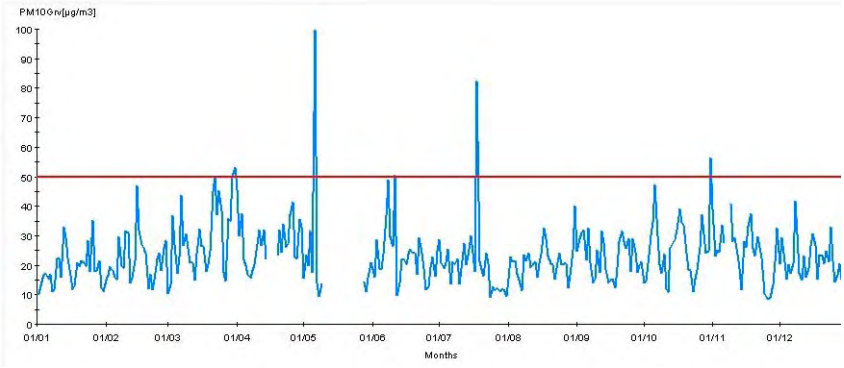
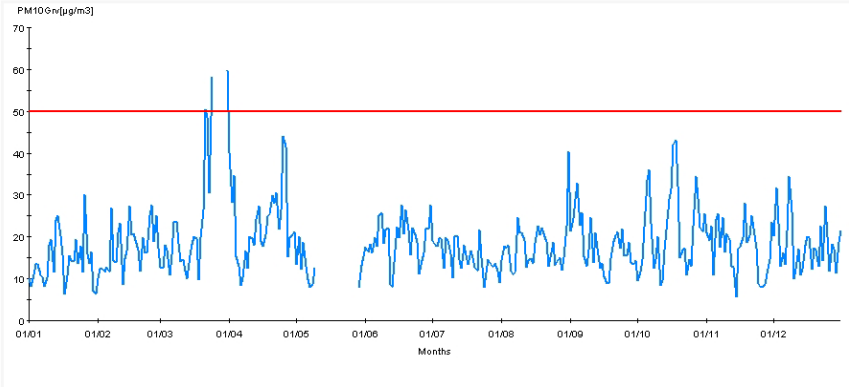


Figure 9.6: Time Series at Broughty Ferry Road of PM_{10} 24-Hour Mean in 2005 (in µg/m^3 grav.(1.3))



9.5.6 Discussion of Results

Annual means

The measured results for 2005, shown in Table 9.2, 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 2005 measured results with the 2010 annual mean objective (18 µg/m^3), the results were predicted forward and are shown in Tables 9.4, 9.5 and Figure 9.4. The 2010 annual mean objective is predicted to be achieved at the Broughty Ferry Road site (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). The Union Street monitor is co-located with the NO_x monitor shown in Figure 7.8, and is located within a street canyon between two bus stops. The TEOM sampling head is approx. 1.35m from the kerb and 3.1m from the building facade.

However, it is important to note that major infrastructure works associated with the Central Waterfront re-development in Dundee took place close to the bottom of Union Street, during 2005. This included removal of the pedestrian walkway to the railway station, construction of a temporary carpark and realignment of the inner ring road. These construction projects will have had an influence on the PM_{10} levels recorded at this location.

Daily Means

The measured results for 2005 in Table 9.6 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 2005 results indicate that this objective was also achieved at all the monitoring locations in Dundee, (see Table 9.7).

Figure 9.7 shows a comparison of the Union Street results from March to the middle of May 2005 with the other Dundee sites and some National network sites in Scotland. The graph suggests that the exceedences in Dundee recorded at all monitors in March was reflected in raised levels throughout Scotland, and was possibly due to transboundary sources. The exceedence recorded at the Union Street monitor in May was a local event and is thought to have been caused by the aforementioned construction projects.

Figure 9.8 shows a comparison of the Union Street monitoring sites and other Dundee sites with a variety of other sites in Scotland throughout June and most of July 2005. This indicates that the PM_{10} peaks recorded at Union Street were due to local events. Analysis of the Dundee City Council road reports for this period indicate that gas and water main rehabilitation works were being carried out in Union Street around the time of the exceedence in June.

Figure 9.7: Comparison of 24-hour averages of PM_{10} in Aberdeen, Edinburgh, Glasgow, Grangemouth and Dundee sites for 1/3/05 – 15/5/05

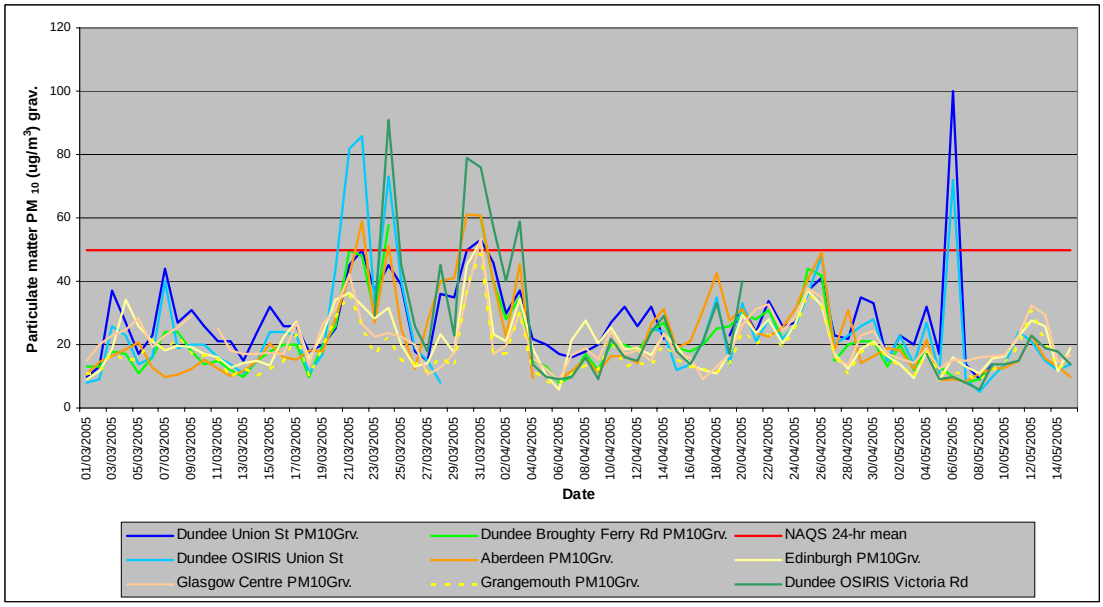
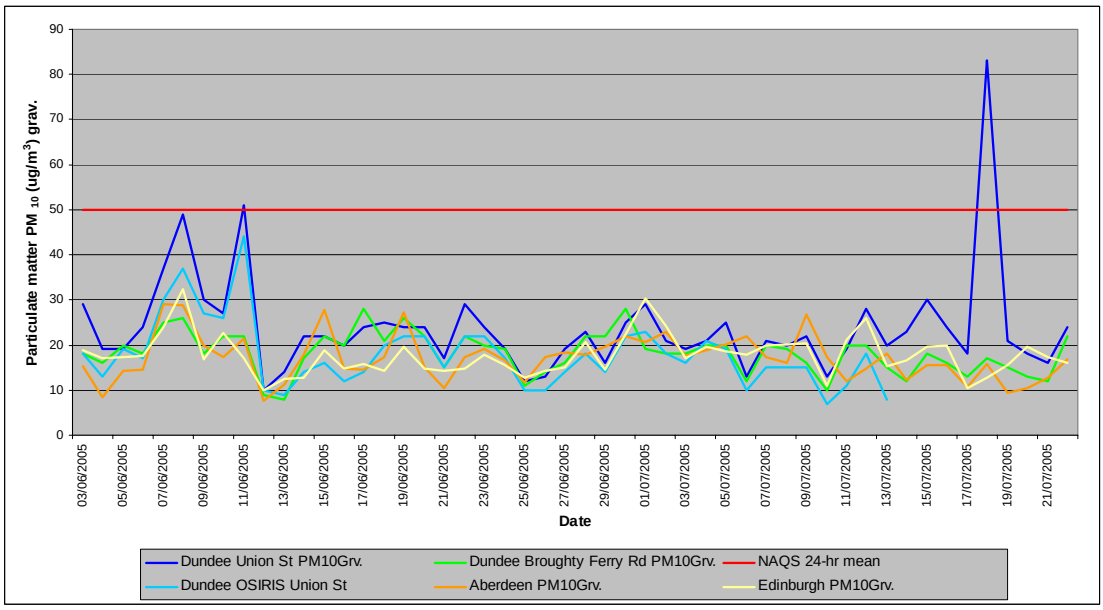


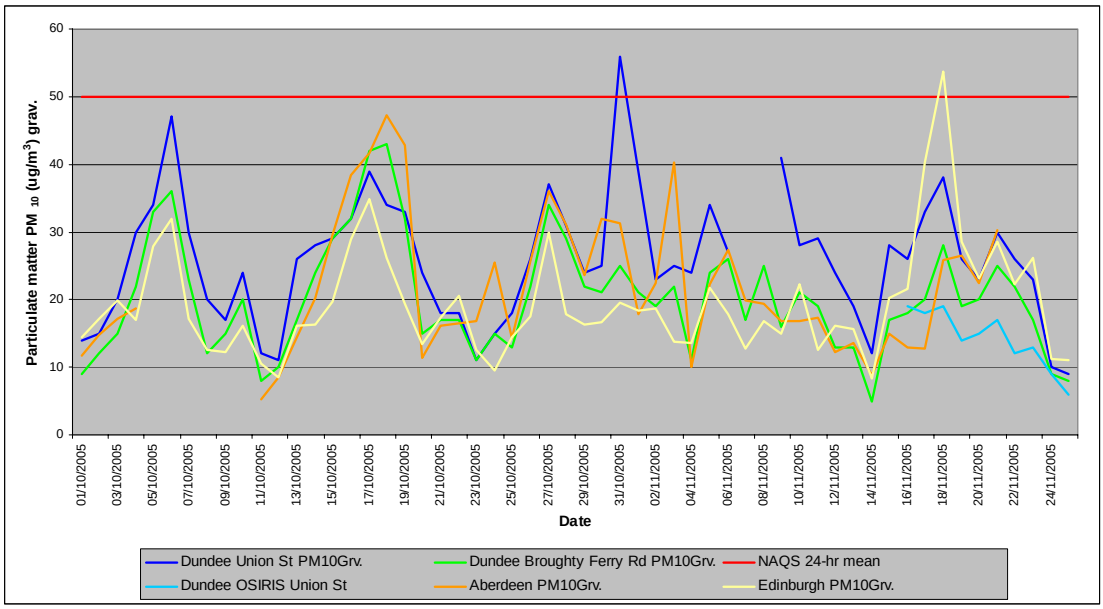
Figure 9.8: Comparison of 24-hour PM_{10} levels in Scotland 3/6/05 – 22/7/05



There was one other exceedence recorded at the Union Street monitor at the end of October 2005. This was compared with the background sites at Aberdeen and Edinburgh (see Figure 9.9) and other sites in Dundee. The PM_{10} levels along the east coast of Scotland can generally be seen to rise and fall in unison, until 31st October when the level at Union Street departs from the trend. This exceedence is thought to be caused by local construction activity.

Analysis of the Dundee City Council road reports for this week indicate that 'tie-in' works associated with the re-alignment of the South Marketgait were taking place at the bottom of Union Street during this week. The monitor's anemometer recorded wind directions that support this assumption.

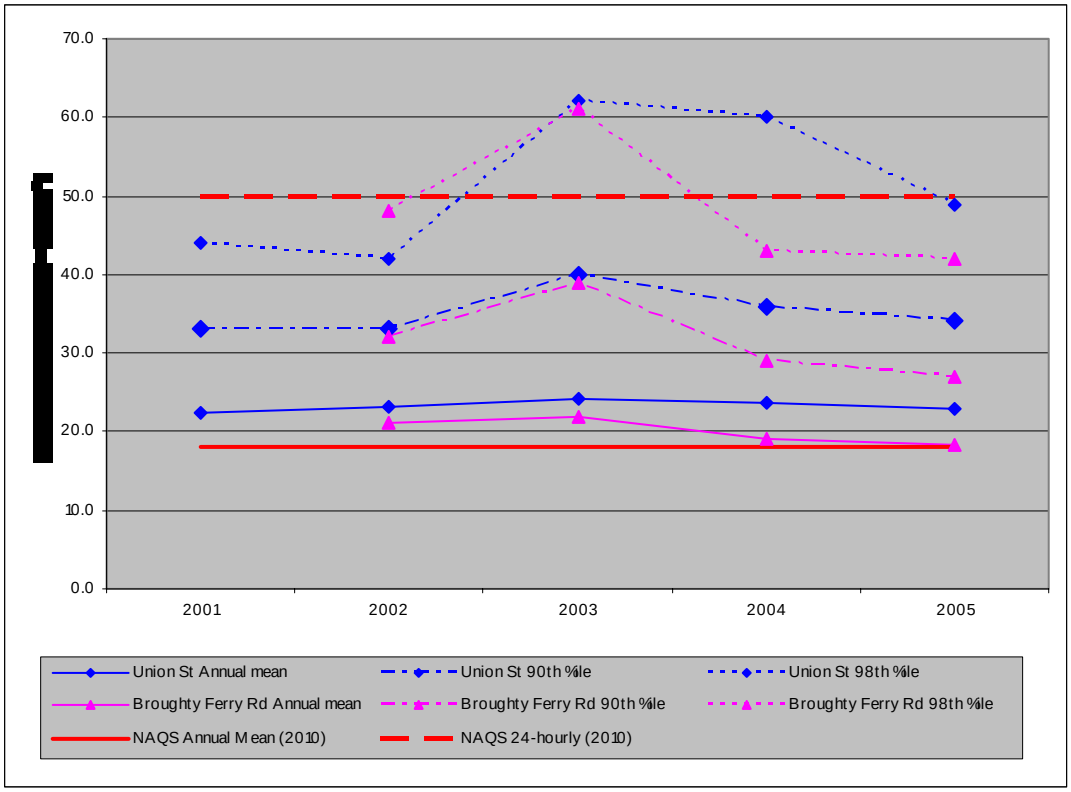
Figure 9.9: Comparison of 24-hour averages of PM_{10} in Aberdeen, Edinburgh and Dundee for 1/11/05 – 15/12/05



9.5.7 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 five 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 9.10.

Figure 9.10: **Trends in PM_{10} Annual Means (1.3 Grav.) and Percentiles (90^{th} %ile and 98^{th} %ile) measured at Union Street and Broughty Ferry Road Rollalongs**



9.5.8 Discussion of Trends

The trend of PM_{10} results is difficult to determine as the results are skewed 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 and 2005 PM_{10} levels at the Broughty Ferry Road monitor for both annual mean and percentiles show a steady decline from 2002 levels. Union Street levels are thought to have remained high due to demolition works in the area during 2004 and construction projects in 2005.

9.6 BUSY ROADS AND JUNCTIONS IN DUNDEE

The DMRB screening model, recommended by the technical guidance, has been updated (to version 1.02) since the last USA (2003). Accordingly, the modelled results presented during the previous updating and screening assessment have been reviewed, and re-assessed under the following circumstances:

- where new traffic counts are available and show an increase in traffic flows of 10% over that previously assessed;
- new data has revealed roads and junctions over 10,000 vpd which have not been previously assessed; and
- where there is new relevant exposure, closer to the road or junction than receptors previously assessed.

The estimated background PM_{10} concentrations taken from the on-line database for 2010 (shown in Appendix 1) indicate that there will be no areas within Dundee City where the background will be above 15 $\mu g/m^3$. Therefore, it is only necessary to undertake DMRB screening modelling for roads or junctions where traffic flows are greater than 10,000 vpd and, where there is a relevant receptor within 10 metres of the kerb. Residential gardens are included as a relevant receptor for this screening model as the NAQS is for a 24-hour mean.

The results of the review of roads and junctions are shown in Table 9.8.

Table 9.8: DMRB results for roads and junctions for 2010 showing number of exceedences 24-hour Mean objective and predicted annual mean PM_{10} concentration in 2010 ($\mu g/m^3$)

Road/Junction name	Traffic details for DMRB assessment				Receptor location			Background	DMRB Results	
	No. of links	2010 AADT (combined, veh/day)	Annual average speed (km/h)	Total % HDV	Receptor to link centre (m)	Easting	Northing	PM_{10} (2010) (ug/m^3)	PM_{10} 2010 Annual mean (ug/m^3)	PM_{10} 2010 No.of days > 50ug/m^3 (days)
Kingsway/Strathmartine Road	1	41721	40	13.1	29.86	339236	732825	13.6	**17.2**	**1**
	2	10804	30	5.7	14.17					
Strathmartine Road/Canning Street	1	11208	39	9.8	7.1	339770	731705	14.8	**17.0**	**1**
	2	<5000	30	5	7					
Dens Road/Alexander Street	1	14659	30	5.3	11.8	340686	731335	14.1	**16.6**	**1**
	2	7866	30	5.1	27.4					
	3	4797	40	5.2	51.2					
Logie Street/Loons Road/ Muirton Road	1	17299	20	2	7.8	338207	731279	14.2	**16.5**	**0**
	2	1570	20	1.3	50.7					
	3	2716	20	2	30.4					
Meadowside/Victoria Road	1	3274	5	23.5	5.32	340247	730646	13.0	**16.3**	**0**
	2	1437	30	22.4	10.64					
	3	13214	40	1.7	16.7					
Kingsway West	1	32907	80	13	18.9	336247	732132	13.7	**16.2**	**0**
Lochee Rd/Polepark Road	1	22472	30	8	19.4	339001	730603	13.7	**16.2**	**0**
	2	7277	30	2	19.8					
Dens Road/Dura Street	1	16969	40	1.8	13.7	340746	731266	14.1	**16.1**	**0**
	2	9182	40	6.3	20.2					

Road/Junction name	Traffic details for DMRB assessment				Receptor location			Background	DMRB Results	
	No. of links	2010 AADT (combined, veh/day)	Annual average speed (km/h)	Total % HDV	Receptor to link centre (m)	Easting	Northing	PM_{10} (2010) (ug/m^3)	PM_{10} 2010 Annual mean (ug/m^3)	PM_{10} 2010 No.of days > $50ug/m^3$ (days)
Hilltown/Alexander Street/Constitution Street	1	12984	30	4.1	8.6	340115	731111	14.1	**16.0**	**0**
	2	2572	30	1.5	24.7					
	3	2368	30	2.2	29.7					
Dens Rd/Arthurstone Terr	1	13494	48	8.6	9.93	340733	731135	14.1	**16.0**	**0**
	2	6256	45	3.9	20.1					
Logie St/Ancrum Road	1	17292	30	2	33.37	338252	731198	14.2	**15.7**	**0**
	2	5468	30	4	9.96					
A92 Dock St/Trades Lane	1	37078	40	4.3	13.3	340670	730364	13.0	**15.6**	**0**
	2	1778	30	16	15.7					
Greendykes/Broughty Ferry Road	1	14231	30	6	17.3	342710	731137	12.7	**15.4**	**0**
	2	33981	30	6	39.8					
Sinderins	1	10590	30	7	9.46	338749	729843	12.5	**15.2**	**0**
	2	2748	30	8	14.8					
	3	8637	30	8	18.5					
Dudhope Terr/Barrack Rd	1	10954	48	2	10.4	339612	730881	13.7	**15.0**	**0**
	2	5523	30	1	14.5					
Coupar Angus Road	1	16342	45.9	7.5	7.6	337404	732142	13.1	**14.9**	**0**
South Road	1	11529	44.3	3.7	8.8	337422	731546	13.6	**14.7**	**0**
Drumgeith Rd/Ballumbie Road	1	14841	53	9	18.1	344704	733307	12.3	**14.3**	**0**
	2	5064	20	9	15.7					
King Street/N. Marketgait	1	1059	32	52.8	10	340528	730686	13.0	**14.3**	**0**
	2	18612	40	2.9	32.4					

Road/Junction name	Traffic details for DMRB assessment				Receptor location			Background	DMRB Results	
	No. of links	2010 AADT (combined, veh/day)	Annual average speed (km/h)	Total % HDV	Receptor to link centre (m)	Easting	Northing	PM_{10} (2010) (ug/m^3)	PM_{10} 2010 Annual mean (ug/m^3)	PM_{10} 2010 No.of days > $50ug/m^3$ (days)
A92 Broughty Ferry Road	1	33981	64	6	15.1	342376	731069	12.7	**14.3**	**0**
Queen Street/Fort Street	1	15619	40.5	7	8.6	346188	731099	11.6	**14.0**	**0**
	2	5787	30	7	37.5					
	3	3988	30	2	32.3					
Arbroath Road/Fairfield Pl	1	29001	48	10	13.37	344363	731822	12.2	**14.0**	**0**
	2	4136	30	2	61.27					
Dalhousie Road	1	13515	48	4.7	7.6	347928	731539	11.3	**12.6**	**0**

The DMRB modelling predicted no new exceedences of the annual mean or 24-hour mean NAQS for 2010 at roads and junctions for PM_{10}. Consequently no exceedences of the 2004 objective are expected. However, the unverified ADMS-Roads modelled results in the 2005 detailed assessment predicted potential exceedences of the 2010 annual mean standard at a number of roads and junctions, namely:

- Seagate
- Lochee Road/Dudhope Terrace
- Victoria Road/Hilltown
- Nethergate/Marketgait
- Logie Street Junction
- Dock Street

Additional monitoring has been undertaken at 4 of the above locations using OSIRIS particulate monitors and it is hoped that results of this monitoring exercise will be available shortly.

9.6.1 Kingsway/Forfar Road Junction

The construction of a new superstore adjacent to the A90 Trunk Road will necessitate the replacement of the double roundabout by a signalised junction.

The council have recently received a revised air quality screening assessment which indicates potential exceedences of the annual mean NAQS for PM_{10} (2010) at relevant receptors close to this junction. However, the potential exceedence is highly dependant on the assumed annual average speeds through the junction, which are very difficult to estimate.

Paragraph A2.11 of the Technical Guidance suggests it would be reasonable to assume average two-way speeds for all vehicles of between 20-40 kph at junctions. Using DMRB to scenario test the junction for different speeds gives a range of predicted annual mean PM_{10} (2010) of 17.45 - 19.2 $\mu g/m^3$ at the nearest receptor. Given that the Scottish Executive are anxious to ensure that traffic is not held up on the trunk road network there is concern that there will be increased congestion on the local road which forms one of the links to the junction and is nearest to the receptors.

In addition the background PM_{10} concentration, used in the DMRB assessment, are from the AQ Archive website (published 2006). No adjustment has been made for possible 'double counting' of PM_{10} concentrations for reasons explained in section 2.7. The AQ Archive estimated concentration correlated well with 1.3 factored background TEOM data. However, the results of the ongoing local gravimetric equivalence study (1.022 factor) suggest that the AQ Archive concentrations are significantly over-estimated locally.

Based on the current assumptions of background concentrations and speeds, it will be necessary to proceed to a detailed assessment in respect of this junction for PM_{10} in relation to the 2010 annual mean NAQS. This may not be practicable until the development is in place and the new junction is complete and the timing of the lights has been optimised. The Council would wish to discuss with the Scottish Executive how best to proceed with a detailed assessment within the timescales set for review and assessment.

9.7. ROADS WITH HIGH FLOW OF BUSES AND/OR HGVS

In relation to PM_{10}, there is a requirement to review roads where traffic flows are relatively low, that is below 20,000 vpd, but where there is a high proportion of HDV (buses and heavy goods vehicles). A 'high proportion' is defined as greater than 20% of the total vehicle flow. This reflects the identification of HDV as particularly significant sources of PM_{10}. These roads are not required to be reviewed and assessed unless there is an excess of 2,500 HDV vpd and there is a relevant receptor within 10 metres of the kerb.

There are a number of roads where it is known that there is a high proportion of HDVs. These areas include:

- Baird Avenue, access to the Tesco Distribution Centre;
- Claymore Street, access to DERL;
- Foundry Lane, buses leaving the depot; and
- Stannergate, access to the port area.

Classified counts for these roads were not undertaken as there is no relevant exposure within 10 metres of the kerb.

Other roads identified as having greater than 20% HDV are within the city centre along the main bus routes, and are shown in Table 9.9.

Table 9.9: Roads with greater than 20% Heavy Duty Vehicles

	Percentage HDV >20%	HDV Daily flow >2,500vpd	Junctions	Street canyon	Residences within 10m of kerb
King Street	✓	x	✓	x	✓ (1st Flr)
St. Andrews Street	✓	x	✓	✓	✓ (1st Flr)
Seagate	✓	x	✓	✓	✓ (Grd Flr)
Trades Lane	✓	x	✓	x	✓ (Grd Flr)
Commercial Street	✓	x	✓	✓	✓ (1st Flr)
Dock Street	✓	x	✓	x	✓ (Grd Flr)
Whitehall Street	✓	x	✓	✓	✓ (1st Flr)
Union Street	✓	x	✓	✓	✓ (1st Flr)
Nethergate	✓	x	✓	✓	✓ (1st Flr)
Meadowside	✓	x	✓	✓	✓ (Grd Flr)

None of these roads have a daily flow of HDV greater than 2,500 (see Table 9.9). Despite this, all these areas, except Meadowside, were considered during the detailed assessment (2005). The unverified modelled results from the detailed assessment predicted exceedences of the 2010 annual mean PM_{10} objective at the following locations:

- Nethergate/Marketgait (1st Floor)
- Seagate (Ground Floor)

Classified traffic counts were undertaken for Meadowside in 2005, to aid the further assessment of the Victoria Road/Hilltown junction NO_2 area of exceedence. A DMRB screening assessment of this count data for Meadowside found no exceedences of the PM_{10} objectives (see Section 9.6).

9.8 NEW ROADS CONSTRUCTED OR PROPOSED SINCE THE LAST ROUND OF REVIEW AND ASSESSMENT

There is a requirement to assess whether any new road is likely to result in exceedences of the NAQS for PM_{10}. There is also a requirement to assess whether traffic from the new road is likely to increase traffic flows on existing roads where pollutant levels are close to exceeding the NAQS.

There have been no new roads with traffic flows greater than 10,000 vehicles per day constructed since the previous round of review and assessment.

No existing roads have been identified where pollutant levels are close to exceeding the NAQS (i.e. as having more than 6 exceedences of the 24-hour objective (50 µg/m^3)). No new roads constructed, therefore, are likely to impact significantly on the existing road network.

There are a number of roads proposed as part of the Central Waterfront Redevelopment Master-plan. These will meet the first of the above criteria and an air quality modelling study has been commissioned to study the impact of these new roads.

9.9 ROADS WITH SIGNIFICANTLY CHANGED TRAFFIC FLOWS OR NEW RELEVANT EXPOSURE.

There were no roads that were previously identified as being at risk of exceeding the objectives, i.e. roads with more than 30 24-hour concentrations above 50 µg/m^3, which have undergone an increase in traffic flow of greater than 25% since the previous round. However, there has been new relevant exposure identified or introduced close to roads with greater than 10,000 vehicles per day. The results of DMRB assessments of these new receptors are shown in Table 9.10. No potential exceedences of the PM_{10} objectives were identified.

Table 9.10: DMRB Assessments of New Relevant Exposure for PM_{10}

Location	Receptor location		Link	Receptor distance to road centre (m)	% HDV	AADT 2010 (vpd)	PM_{10} 2010 Annual mean (ug/m^3)	PM_{10} 2010 No.of days >50ug/m^3 (days)
	Easting	Northing						
Riverside Drive	339707	729459	1	10.00	3.3	18515	**14.6**	**0**
			2	15.00	0.4	5560		
Hawkhill	339184	729921	1	3.50	6	21334	**15.6**	**0**
Princes Street	340950	730815	1	7.72	7	14213	**15.8**	**0**
			2	15.50	5	17125		
Lochee Road	339330	730608	1	7.88	8	17340	**15.9**	**0**
Logie Street	338270	731279	1	7.8	2	17299	**16.5**	**0**
			2	50.7	1.3	1570		
			3	30.4	2	2716		
60 Victoria Road	340372	730778	1	8.50	10.3	15413	**15.1**	**0**
72 Victoria Road	340418	730807	1	9.00	10.3	15413	**14.8**	**0**
Strathmore Avenue	339755	731866	*new receptors are further from road than previously assessed site - which was below the objective*					
Hawkhill	339613	730218	1	10.34	6	17915	**16.0**	**0**
			2	60.97	10	9957		
Victoria Street	341074	731075	1	7.00	7.6	12678	**17.0**	**1**
			2	7.20	6.7	7898		
Dudhope Roundabout	339760	730644	1	32.3	1.63	32787	**16.4**	**0**
			2	14.8	3.59	23867		
Hawkhill	339537	730180	1	16.90	6	17915	**16.1**	**0**
			2	32.20	10	9957		
10 Victoria Road	340218	730664	1	10.80	1.7	15442	**15.6**	**0**
			2	20.30	24.1	5168		
			3	58.00	3.2	10040		
62-63 Dock Street	340670	730364	1	13.30	4.3	37078	**15.6**	**0**
			2	15.70	16	1778		
Johnson Street flats	339898	730336	*new receptors identified as part of the air quality assessment which is being prepared for the extension to a shopping centre*					
Strathmore Lodge	339812	730390						

9.10 ROADS CLOSE TO THE OBJECTIVE (2010) DURING THE PREVIOUS ROUND OF REVIEW AND ASSESSMENT

The Technical Guidance was updated in January 2006, and included updates to the background pollution maps and future year calculation tools. In relation to particles (PM_{10}) some of the revised background values are higher than previously predicted. Where roads were considered during the second round of Review and Assessment, and the results were close to, but just below the 2004 objective (and the 2010 objective in

Scotland), it is recommended that these locations should be re-considered in the 2006 USA.

An examination of the updated background figures for the Dundee City Council area revealed that very few locations are predicted to have increased background PM_{10} concentrations. Of these the highest predicted increase is 0.9 $\mu g/m^3$. Hence, those roads and junctions with relevant exposure where the predicted annual mean (2010) was predicted to be above 17 $\mu g/m^3$ last time, have been re-examined using new traffic data where this is available. The results of this exercise are shown in Table 9.11. below.

Table 9.11: Roads and Junctions predicted to be close to the PM_{10} (2010) annual mean objective during the previous round of review and assessment

Junction name	PM_{10} 2010 predicted in 2003 USA (DMRB)		PM_{10} 2010 predicted in 2005 DA (ADMS)		Change in background conc.^{n} (ug/m^3)	PM_{10} 2010 predicted in 2006 USA (DMRB)	
	Annual mean	No. of ex	Annual mean	No. of ex		Annual mean	No. of ex
Seagate	not assessed		**21.0**	5	-0.8	monitoring/ further assessment ongoing	
Nethergate/Marketgate	not assessed		**19.9**	3	-0.7		
Dock Street	**16.3**	0	18.0	1	-0.8		
Loons Road/Logie Street (1)	**19.2**	1	**18.1**	1	**up 0.3**		
Loons Road/Logie Street (2)	**19.2**	2					
Lochee Road/Dudhope Terrace	**18.7**	1	**20.2**	4	-0.5		
Victoria Road/Hilltown	**18.2**	4	**19.9**	3	-0.8		
Logie Street/Ancrum Road	17.9	2	no assessment required		**up 0.3**	15.7	0
Lochee Road/Polepark Road	17.4	2			-0.1	16.2	0
Sinderins	18.0	1			-0.9	15.2	0
North Marketgait/King Street	**18.3**	2	14.1	0	-0.8	14.3	0
Kingsway/Strathmartine Road	not assessed		17.5	1	-0.4	17.2	1
Victoria Road/Dens Road	**20.2**	1	16.8	0	**up 0.1**	no assessment required	
Ladywell roundabout	**18.3**	2	16.4	0	-0.8		
West Marketgait/Nethergate	**19.0**	1	16.7	1	-0.8		
Allen Street roundabout	**18.2**	2	17.4	1	-0.8		
Forfar Road/Clepington Road	18.0	1	17.4	1	-0.2		
Macalpine Road/Staffa Place	17.1	1	no assessment required		-0.7		
Strathmartine Rd/Clepington Rd	17.3	1			-0.6		
West Marketgait/Ward Road	17.7	2			-0.1		
Pitkerro Road/Madiera Street	17.0	2			-0.2		
Queen Street/Claypotts Road	17.4	1			-1.6		

The results of the DMRB screening model suggest there are no new areas of predicted exceedence of PM_{10} (2010) annual mean objective other than those identified in the unverified modelled results from the detailed assessment.

9.11 NEW INDUSTRIAL SOURCES

The Technical Guidance lists 19 processes as being potentially significant sources of PM_{10}. Those identified as being present in or bordering Dundee are listed in Table 9.12.

Table 9.12: Potentially significant industrial sources of PM_{10} present in or bordering Dundee City

Company Name	Location	Process
Michelin Tyres Plc	Baldovie Road, Dundee	Combustion
Nynas AB UK	East Camperdown Street, Dundee	Crude oil handling
DERL	Claymore Street, Dundee	Incineration
Dens Metals	West Pitkerro Industrial Estate	Foundry process
Ennstone Thistle	Ethiebeaton Quarry	Roadstone Coating Process

Of the processes listed in Table 9.12 , all but Ennstone have been screened out in previous assessments. The roadstone coating process operated by Ennstone Thistle is within Angus Council, and received authorisation from SEPA in July 2004. This process is close to the boundary with Dundee City Council. There are no relevant receptors within Dundee that are within 10 stack heights (365m) of the roadstone coating process, hence no assessment is required.

From the information provided by SEPA in Appendix 2, a new cement processes has received Part B Authorisation since the last USA, SPS Operations Ltd. (see Table 9.13). This process is not considered to be significant source of PM_{10}, (see Annex 2 of LAQM TG.03), but a screening assessment has been carried out in relation to potential fugitive emissions.

Table 9.13: New industrial sources of fugitive PM_{10}

Company Name	Location	Process
SPS Operations Ltd	Stannergate	Cement Process

9.11.1 Screening assessment for PM_{10} in respect of any new industrial sources.

<u>SPS Operations Ltd: Screening Assessment</u>

The Technical Guidance (LAQM.TG03), for screening of PM_{10} fugitive emissions from industrial sources, recommends using the UK Emissions Factor database (www.naei.org.uk) for industrial emission rates if

information is unavailable from the process authorisation documents. For an average process of this type the emission factor given is 0.146 tonnes per annum.

LAQM.TG(03) (para 8.53) requires that this emission rate should be scaled to take account of the 'available headroom' which gives a scaled emission rate of 0.13 tonnes per annum. With this rate, and assuming a fugitive emission height of 0m (as the main source of PM_{10} is likely to be resuspended dust from the roadways), the nomogram (LAQM.TG(03) Figure 8.7) gives a distance of 53m. The process is farther than 53m from the nearest receptors. Hence it is assumed that the process will not cause an increase in the annual mean ground level concentration of 1$\mu g/m^3$ at the receptors, and so no further assessment is required at this time.

9.12 INDUSTRIAL SOURCES WITH SUBSTANTIALLY INCREASED EMISSIONS OR NEW RELEVANT EXPOSURE

Information received from SEPA[39] during the First Round indicated that the authorised processes in Dundee would not be likely to cause an exceedence of the NAQS at any relevant receptor.

Dundee City Council was consulted by SEPA on the recent PPC Applications for DERL (PPC/A/1003157) and Nynas (PPC/A/1013015). In addition emissions from Michelin and DERL were examined as part of a planning application to erect 85m high wind turbines on Michelin's site. Emissions from Dens Metals were examined when a nursery (new relevant exposure) was proposed within the industrial estate. The nursery did not receive planning consent and none of these industrial sources were found to have increased their emissions substantially (i.e. by greater than 30%) since the previous round of review and assessment.

Due to the recent rise in gas prices Michelin have applied for a variation of their process authorisation to allow them to burn heavy fuel oil at times when gas prices are uneconomic for the plant. Dispersion modelling of stack emissions for natural gas and heavy fuel oil was carried out by consultants, BMT Cordah, on behalf of Michelin and deemed to be competent by SEPA's modelling staff. The dispersion modelling concluded that during heavy fuel oil firing of the boilers, in areas of relevant exposure, concentrations of PM_{10} are predicted to be between 50-80% of the NAQS[40].

9.13 AREAS WITH DOMESTIC SOLID FUEL BURNING

Dundee City Council has declared smoke control areas encompassing the whole city. Domestic solid fuel burning was assessed for the last round of review and assessment, based on knowledge of council and housing

[39] Scottish Environmental Protection Agency - Additional Information for Stage 2 Air Quality Review and Assessment
[40] Draft Decision Document Variation to Part "A" permit - Form iPPC-DD-05, Section 2.1 page 3

association stock and the House Condition Survey 2001. It was considered unlikely that there were any areas of the city with more than 50 houses in a 500m x 500m square using solid fuel. Solid fuel use is expected to have declined since 2003, and all local authority and housing association stock in Dundee now have central heating. It is not considered necessary to proceed to a detailed assessment for PM_{10} in relation to domestic solid fuel burning.

9.14 QUARRIES, LANDFILL SITES, OPENCAST COAL, HANDLING OF DUSTY CARGOES AT PORTS, ETC

There are no quarries, active landfill sites or opencast coal mines within Dundee City. However, Ethiebeaton Quarry lies within Angus Council, on the eastern boundary of Dundee. The background PM_{10} concentration for this area is predicted to be 11.5 $\mu g/m^3$ (2010). At this background concentration, the guidance stipulates that receptors within 200 metres must be considered. There are no receptors within Dundee that are within 200 metres of this quarry at this time. Land to the west of Ethiebeaton Quarry has been granted outline planning permission for housing development, this will be kept under review.

There is a grain handling process at the port in Dundee. This seasonal activity is not regulated by SEPA, occurs predominantly in late summer/autumn. There is no residential exposure within 200m of this process but historically there have been a number of complaints to the Council regarding dust from this process (none in 2005), typically during periods of relatively low wind speed. However, the process is located upwind of the Dock Street continuous monitoring unit, and no exceedences of the 24-hour mean have been recorded at this location at the times corresponding to grain handling activity.

It is not believed that these sources of PM_{10} are significant in Dundee, therefore, Dundee City Council will not proceed to a detailed assessment in relation to these sources.

9.15 AIRCRAFT

Dundee airport has approximately 50,000 passengers per year and no freight. The requirement is to consider airports with more than 5 million passengers (or freight equivalent) per year therefore the airport is not considered to be a significant source of PM_{10}. It is not necessary to proceed to a detailed assessment for PM_{10} in respect of the airport.

9.16 CONCLUSIONS

It will be challenging for Scottish Local Authorities to achieve the stricter 2010 NAQS for PM_{10}.

Having applied the checklist criteria for the assessment of PM_{10} from the technical guidance, it is concluded that further action is required in respect of PM_{10}.

In 2005 continuous monitoring at Union Street indicated that the 24-hour mean for PM_{10} was not exceeded for 2004 (35 exceedences) or 2010 (7 exceedences). The exceedences of the 24-hour mean that occurred in 2005 were identified as trans-boundary, being recorded elsewhere in Scotland for the same monitoring period, or due to nearby construction projects. The former suggests that there are national issues relating to PM_{10} which are beyond the control of local authorities.

The annual mean results for the continuous monitors showed that the annual mean of 40 $\mu g/m^3$ (2004) would be achieved. However, the annual mean of 18 $\mu g/m^3$ (2010) PM_{10} is predicted to be exceeded at the Union Street monitor regardless of the gravimetric equivalence factor used (1.3 or 1.14). The TEOM sampling head at this location is approximately 1.35m from the kerb and 3.1m from the building facade. PM_{10} levels at the Union Street monitor are thought to have remained elevated due to major construction projects in the vicinity during 2005 and may not truly represent ambient PM_{10} concentrations in that street.

Roads and junctions have been reviewed, and re-assessed under the following circumstances:

- where new traffic counts are available and show an increase in traffic flows of 10% over that previously assessed;
- new data has revealed roads and junctions over 10,000 vpd which have not been previously assessed; and
- where there is new relevant exposure, closer to the road or junction than receptors previously assessed.

The DMRB modeling assessment of roads and junctions did not identify any new exceedences of the PM_{10} objectives.

A recent air quality screening assessment received by the Council indicates a potential exceedence of the PM_{10} annual mean objective (2010) at existing receptors close to the Kingsway/Forfar Road junction (see Section 9.6). In view of the interim findings of the local gravimetric equivalence study, the Council wish to discuss with the Scottish Executive how best to take forward the detailed assessment of this junction within the timescales set for review and assessment.

No AQMAs for PM_{10} were recommended at the detailed assessment stage of the review and assessment process. Predictions for 2010 were based on 2003 data (a year when pollution levels were higher than in preceding or succeeding years) and were reliant on estimated projected reductions in background concentrations which themselves were likely to have a degree of uncertainty.

SEPA, and the Scottish Executive accepted the conclusions of the Detailed Assessment and funding continued and expanded monitoring of PM_{10}, to include OSIRIS particulate monitoring in areas of exceedence, a new background site, a local gravimetric equivalence co-location study and speciation of particles. Information from these monitors should help determine whether an AQMA for PM_{10} is required.

Accordingly, it would seem prudent to delay the decision in relation to PM_{10} until the results of this additional monitoring is available. Interim results from the first 6 months co-location study of the Partisol and the TEOM gives a local equivalence factor of 1.022. If this factor were reflected in the annual results this could significantly alter the position regarding PM_{10} in Dundee.

Table 9.14: Checklist for PM_{10}

Item	Response
Monitoring data outside an AQMA	No exceedences of 2004 objectives were measured in 2005, but projected concentrations for 2010 indicate one exceedence of the 2010 annual mean objective at the Union Street monitor. The sampling inlet is approx. 3.1m from the building facade at this location. PM_{10} levels at the Union Street monitor are thought to have remained elevated due to major construction projects in the vicinity during 2005 and may not truly represent the ambient PM_{10} concentrations in that street.
Monitoring data within an AQMA	No AQMAs declared for PM_{10}
Busy roads and junctions in Scotland	The screening assessment of busy roads and junctions predicted no exceedences of the PM_{10} objectives. A recent air quality screening assessment received by the Council indicates a potential exceedence of the PM_{10} annual mean objective (2010) at existing receptors close to the Kingsway/Forfar Road junction (see Section 9.6). The Council wish to discuss with the Scottish Executive how best to take forward the detailed assessment of this junction within the timescales set for review and assessment and in view of the interim findings of the local gravimetric equivalent study.
Roads with high flow of buses and/or HGVs.	No roads with a high flow of HDVs have been identified

Item	Response
New roads constructed or proposed since last round of R&A	No new roads meeting the assessment criteria have been constructed since the last round of Review and Assessment. There are a number of new roads proposed as part of the Central Waterfront Redevelopment Master-plan. These will meet the criteria and an air quality modelling study has been commissioned to study the impact of these new roads.
Roads with significantly changed traffic flows, or new relevant exposure.	No roads at risk of exceeding the PM_{10} objectives have undergone a 25% increase since the previous round. New receptors have been identified close to roads and junctions with greater than 10,000 vpd none have been identified which are likely to exceed the objectives. The Council is awaiting the results of an air quality assessment for a shopping centre extension.
Roads close to the objective during the second round of Review and Assessment	All roads have been reassessed with new traffic data, where available, and no new exceedences were found.
New industrial sources.	New sources of industrial and fugitive emissions have been identified and assessed to be insignificant with no detailed assessment required.
Industrial sources with substantially increased emissions, or new relevant exposure	None
Areas of domestic solid fuel burning	No areas with a high density of homes using solid fuel have been identified
Quarries / landfill sites / opencast coal / handling of dusty cargoes at ports etc.	None of the quarries and landfill sites and dusty cargoes have relevant public exposure within 200m. No complaints of dust nuisance were received by the council in 2005 from these activities.
Aircraft	Dundee Airport is below the criterion for assessment.

SECTION 10: CONCLUSIONS

10.1 CARBON MONOXIDE

There are no roads within Dundee that meet the classification of 'very busy' as defined in the technical guidance. Hence no detailed assessment is required.

10.2 BENZENE

There are no roads that meet the classification of 'very busy' as defined in the guidance for Benzene. There are no petrol stations within Dundee where benzene is considered to be significant in accordance with the screening checklist. Hence no detailed assessment is required.

10.3 1,3-BUTADIENE

Having applied the checklist criteria for 1,3-Butadiene, there is no requirement to proceed to detailed assessment of this pollutant.

10.4 LEAD

Emissions from industrial processes in Dundee are not predicted to exceed the objectives for lead to be achieved by 2004 and 2008. Hence no detailed assessment is required.

10.5 NITROGEN DIOXIDE (NO_2)

Monitoring of NO_2 using automatic monitors and diffusion tubes, indicates a number of exceedences of the annual mean and confirms the need for an AQMA. One new exceedence was identified through monitoring at Meadowside. The DMRB modelling exercise did not predict any new exceedences of the objective at busy roads and junctions in Dundee. All measured exceedences are located within the existing AQMA and will be subject to further assessment in the near future. Hence a detailed assessment is not required at this stage.

10.6 SULPHUR DIOXIDE (SO_2)

There were no significant industrial or domestic sources of SO_2 identified in Dundee. Monitoring downwind of the docks area has not detected any exceedences of the objectives for SO_2. Hence, there is no requirement to proceed to a detailed assessment for SO_2.

10.7 PARTICLES (PM_{10})

Monitoring data indicated that there were no exceedences of the 2004 objective in Dundee. Monitoring also identified one potential exceedence of the 2010 objective at the Union Street monitor. This monitor is located between two bus stops in a busy street canyon in the city centre which is part of the main bus corridor. PM_{10} levels at the Union Street monitor are thought to have remained high due to major construction projects in the vicinity during 2005.

The DMRB modelling exercise of roads and junctions did not identify any new exceedences of the PM_{10} objectives.

A recent air quality screening assessment received by the Council indicates a potential exceedence of the PM_{10} annual mean objective (2010) at existing receptors close to the Kingsway/Forfar Road junction (see Section 9.6). In view of the interim findings of the local gravimetric equivalence study, the Council wish to discuss with the Scottish Executive how best to take forward the detailed assessment of this junction within the timescales set for review and assessment.

No AQMAs for PM_{10} were recommended at the detailed assessment stage of the review and assessment process. Predictions for 2010 were based on 2003 data (a year when pollution levels were higher than in preceding or succeeding years) and were reliant on estimated projected reductions in background concentrations which themselves were likely to have a degree of uncertainty.

SEPA, and the Scottish Executive accepted the conclusions of the Detailed Assessment and funded continued and expanded monitoring of PM_{10}, to include OSIRIS particulate monitoring in potential areas of exceedence, a new background site, a local gravimetric equivalence co-location study and speciation of particles. Information from these monitors should help determine whether an AQMA for PM_{10} is required.

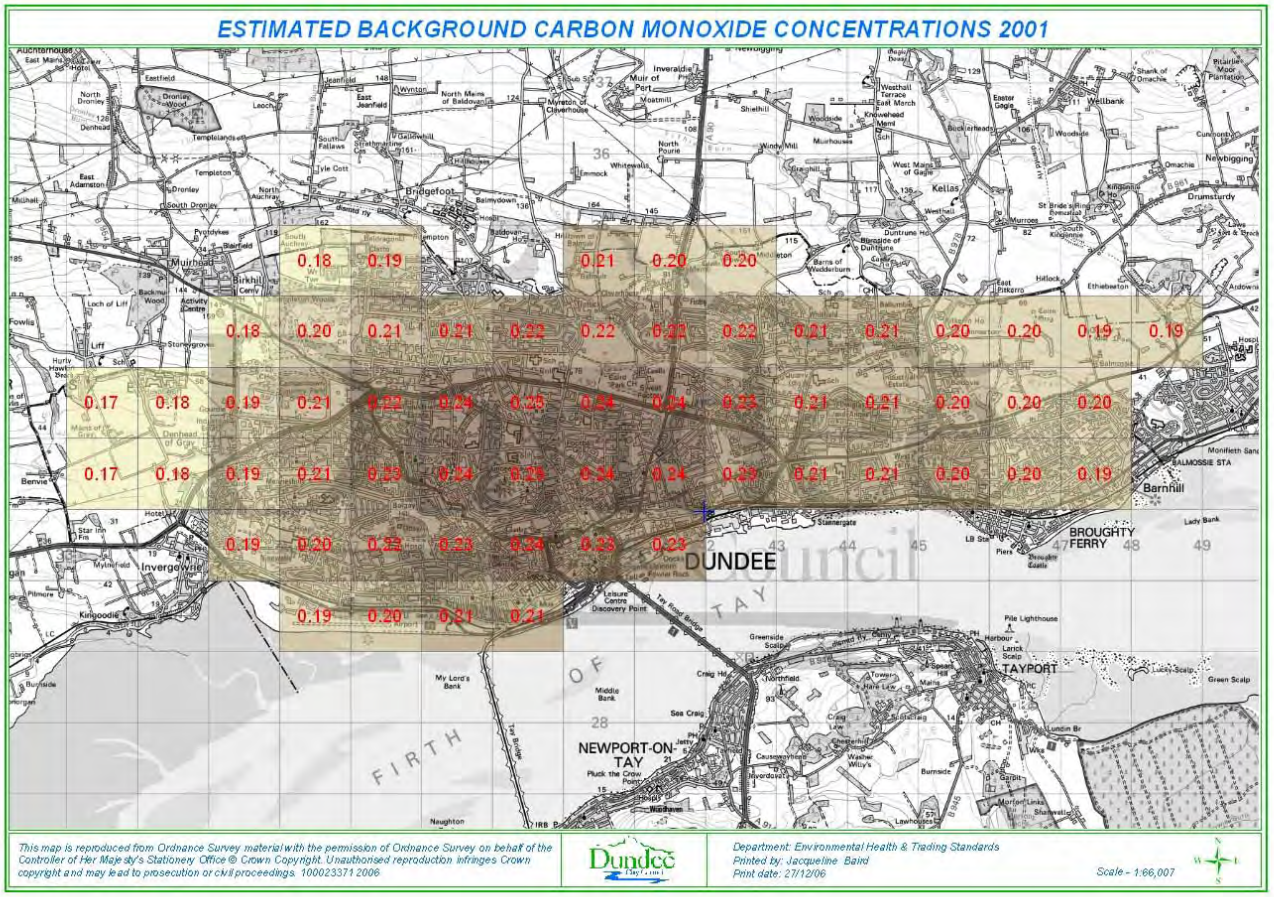
Accordingly, it would seem prudent to delay the decision in relation to PM_{10} until the results of this additional monitoring is available. Interim results from the first 6 months co-location study of the Partisol and the TEOM gives a local equivalence factor of 1.022. If this factor were reflected in the annual results this could significantly alter the position regarding PM_{10} in Dundee.

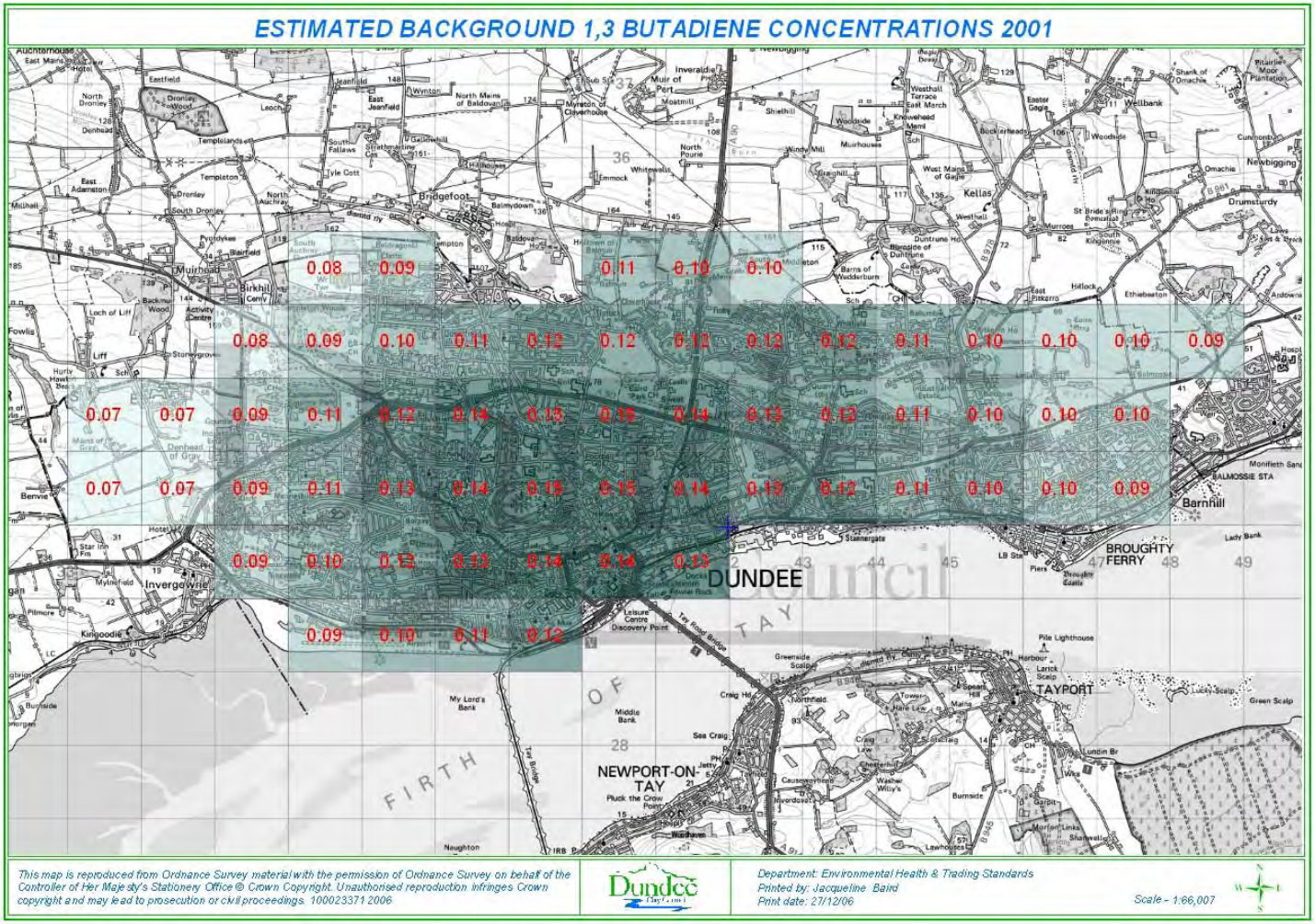
10.8 SUMMARY AND RECOMMENDATIONS

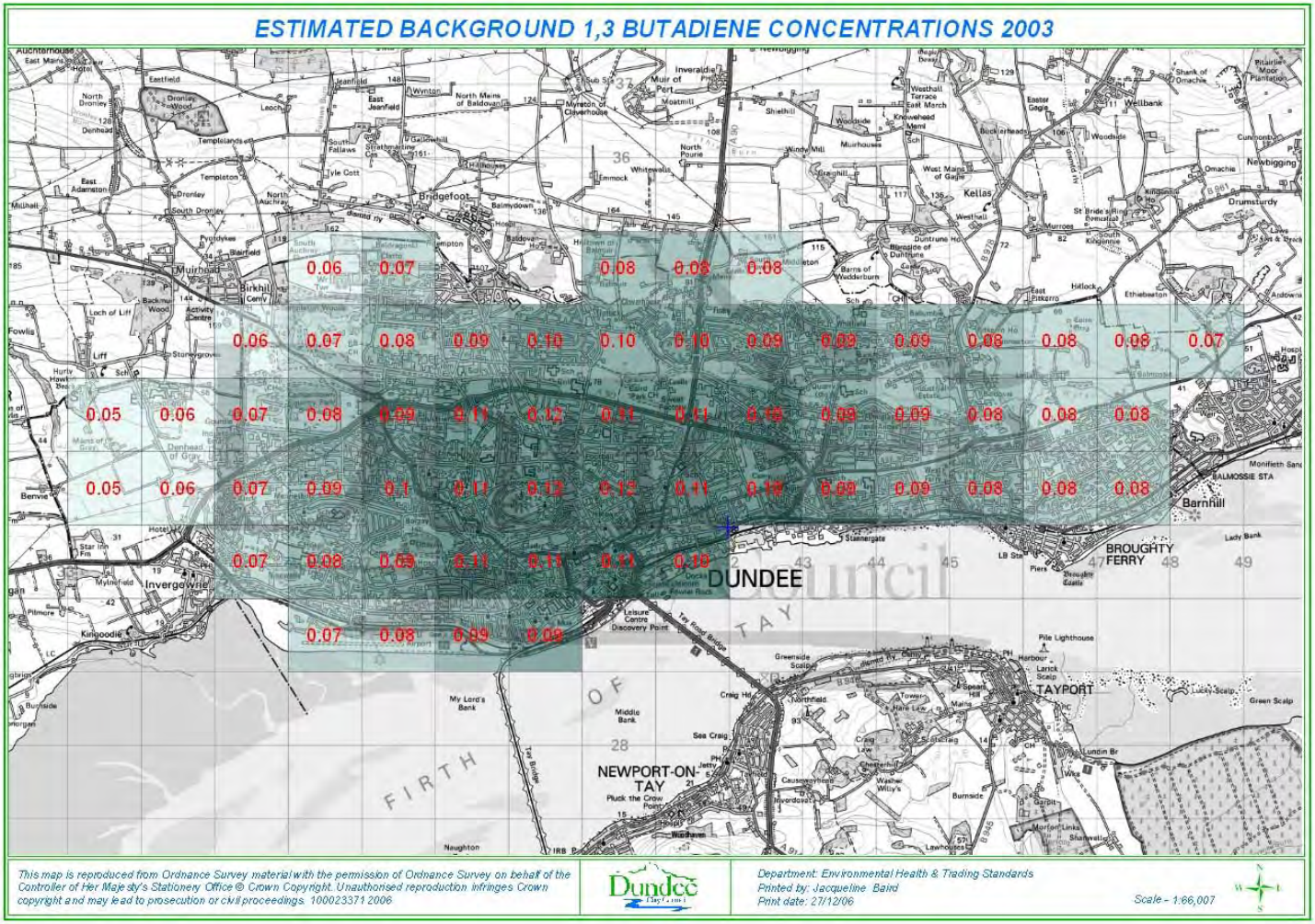
A detailed assessment is not required for carbon monoxide, benzene, 1,3-butadiene, lead and nitrogen dioxide.

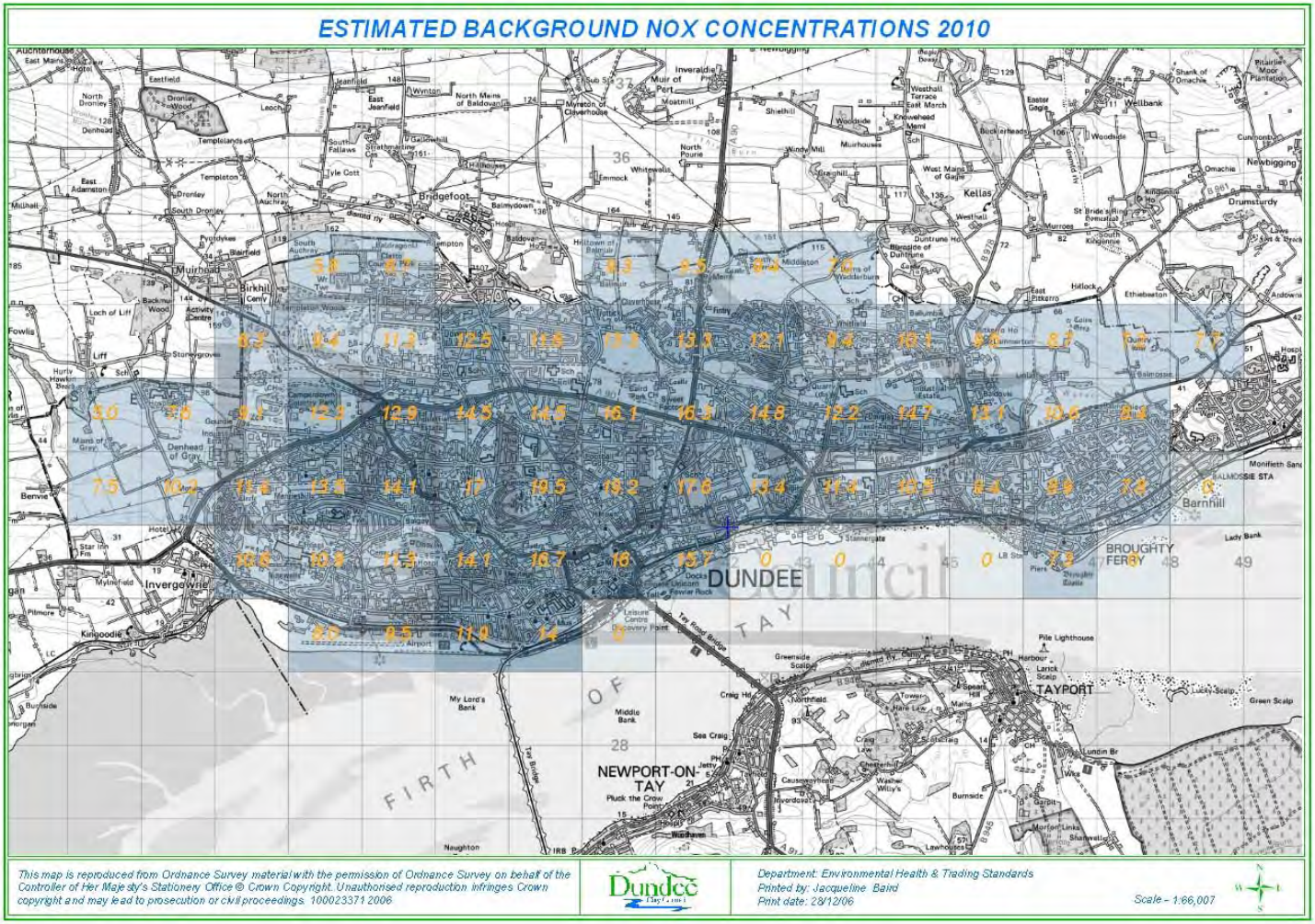
Dundee City Council would wish to discuss with the Scottish Executive how best to take forward the detailed assessment of PM_{10} within the timescales set for review and assessment and in view of the findings of the ongoing local gravimetric equivalence study.

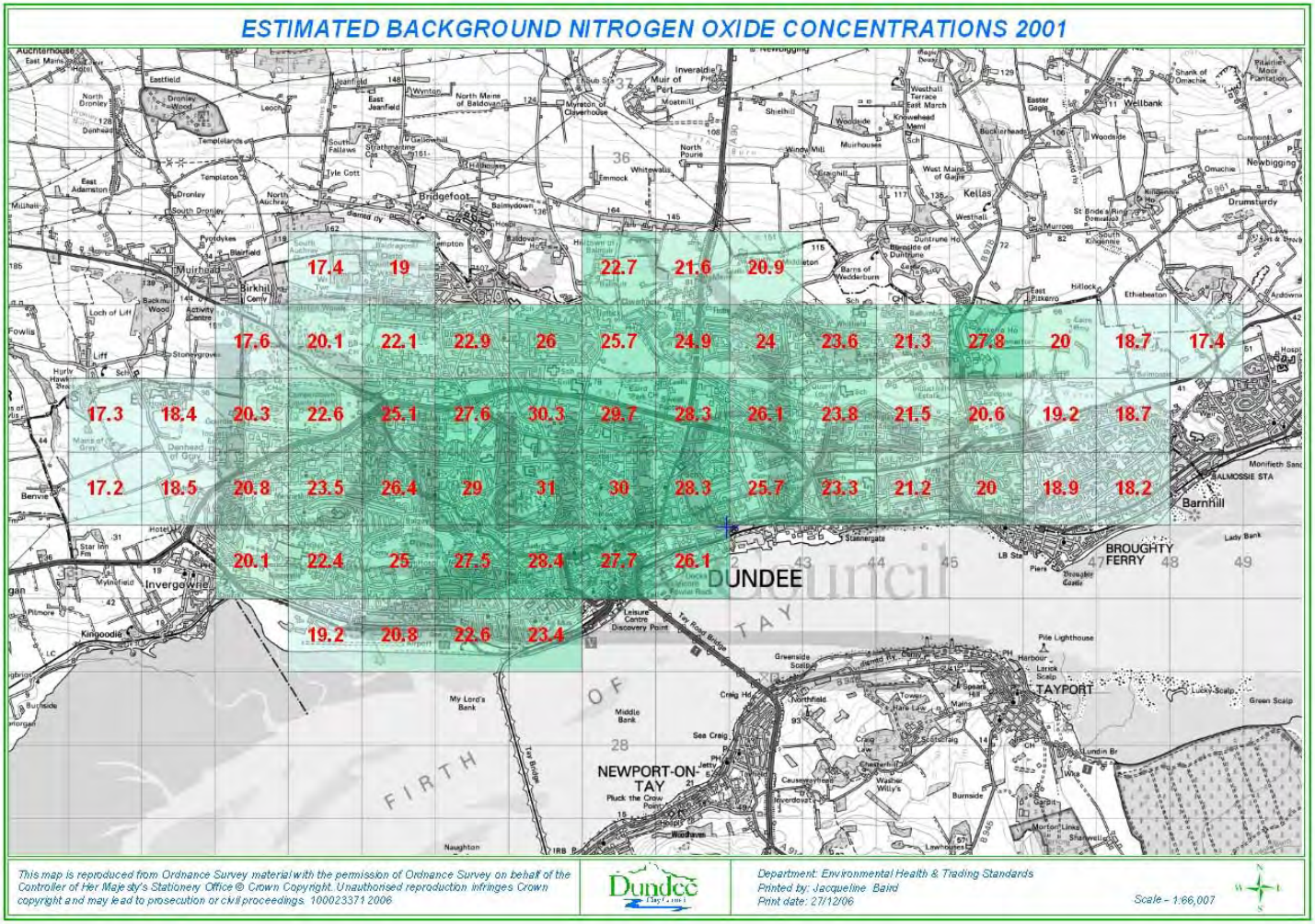
APPENDIX 1: AVERAGE BACKGROUND POLLUTANT CONCENTRATIONS PER 1KM X 1KM GRID IN DUNDEE

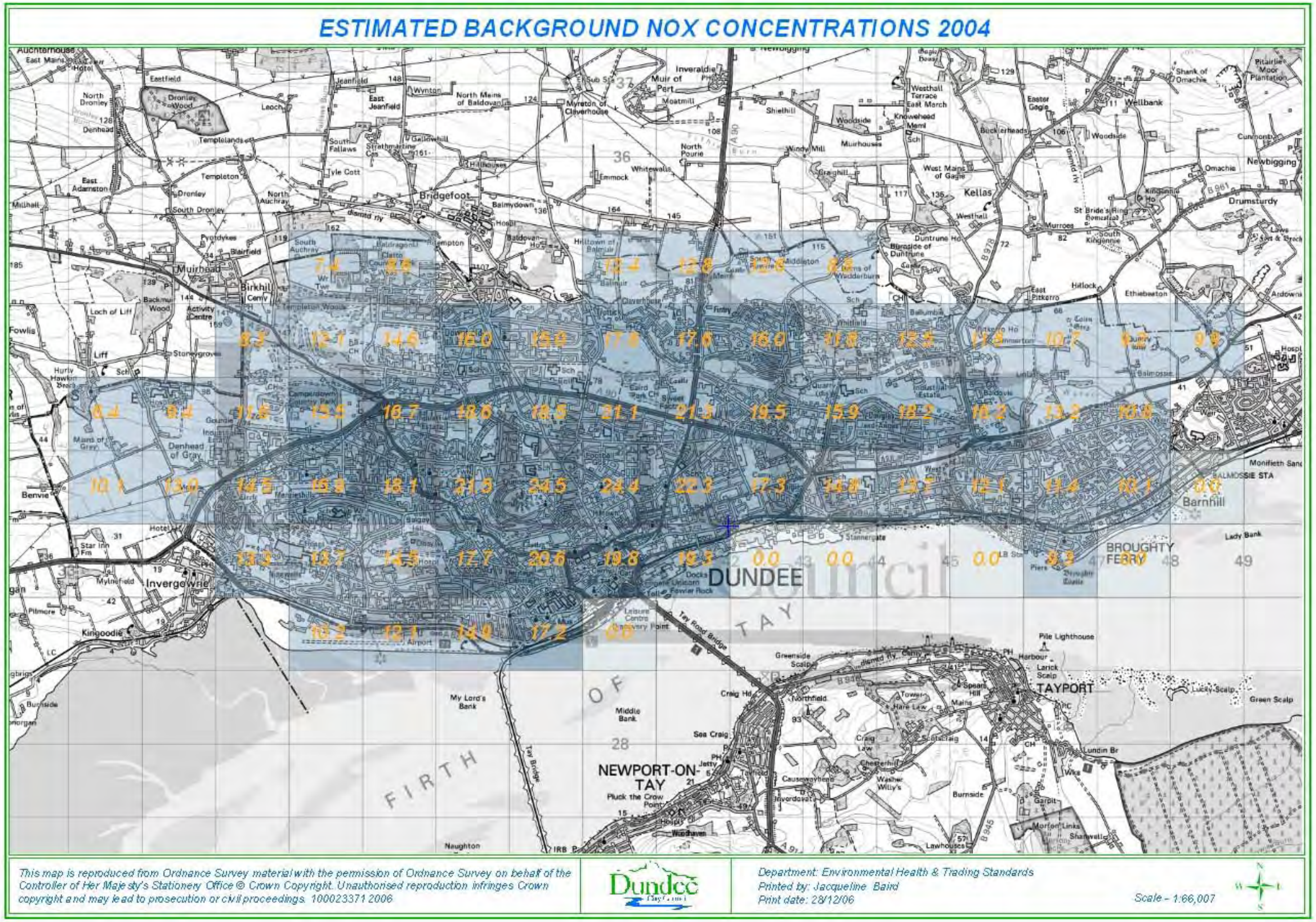


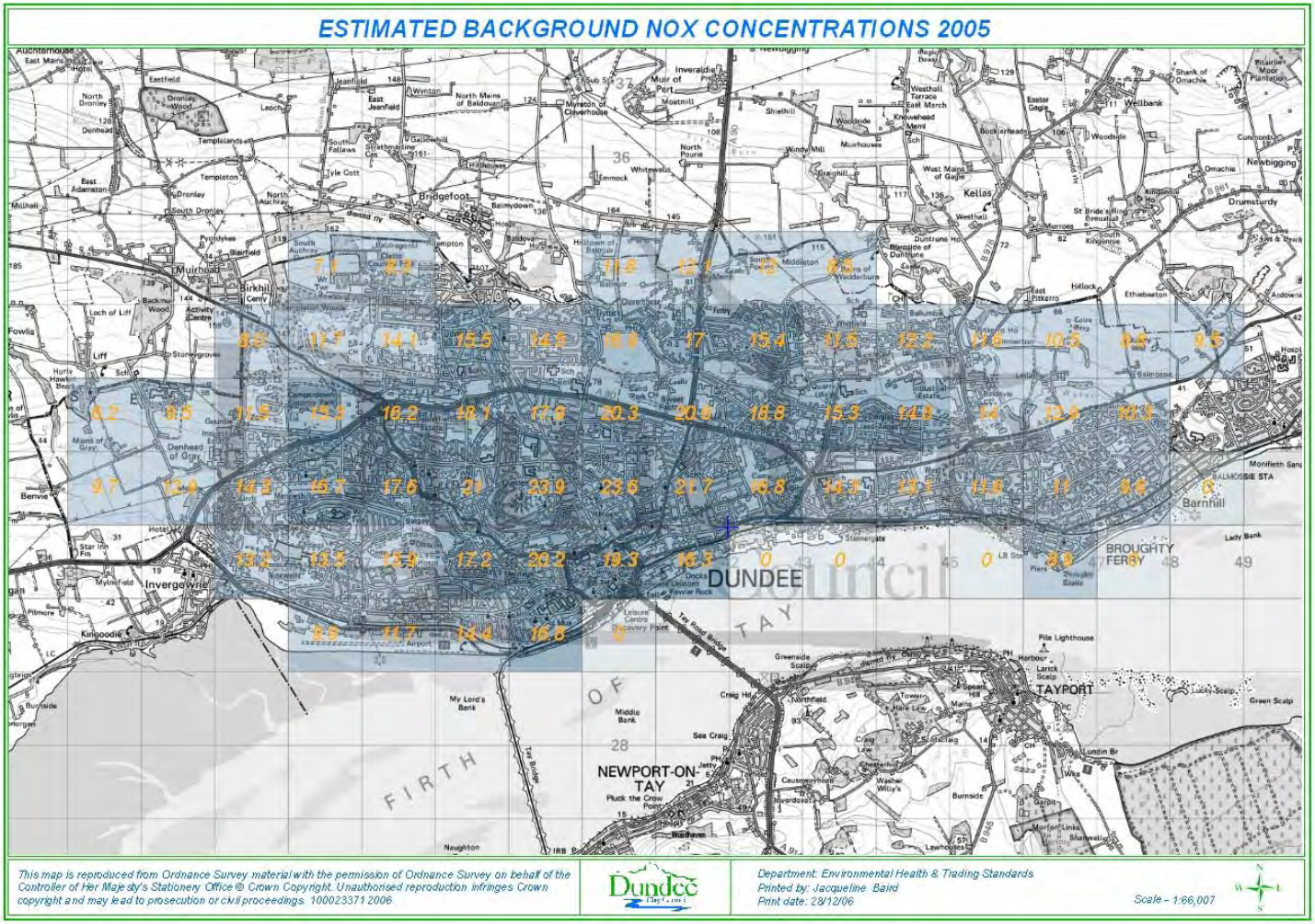

ESTIMATED BACKGROUND 1,3 BUTADIENE CONCENTRATIONS 2001
0.08 0.09 0.11 0.10
0.08 0.09 0.10 0.11 0.12 0.12 0.12 0.12 0.12 0.11 0.10 0.10 0.10 0.09
0.07 0.07 0.09 0.11 0.12 0.14 0.15 0.15 0.14 0.13 0.13 0.11 0.10 0.10 0.10
0.07 0.07 0.09 0.11 0.13 0.14 0.15 0.15 0.14 0.13 0.12 0.11 0.10 0.10 0.09
0.09 0.10 0.12 0.13 0.14 0.14 0.13
0.09 0.10 0.11 0.12
DUNDEE
BROUGHTY FERRY
Barnhill
TAYPORT
NEWPORT-ON-TAY
Invergowrie
Bridgefoot
Kellas
FIRTH OF TAY
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100023371 2006
Department: Environmental Health & Trading Standards
Printed by: Jacqueline Baird
Print date: 27/12/06
Scale - 1:66,007

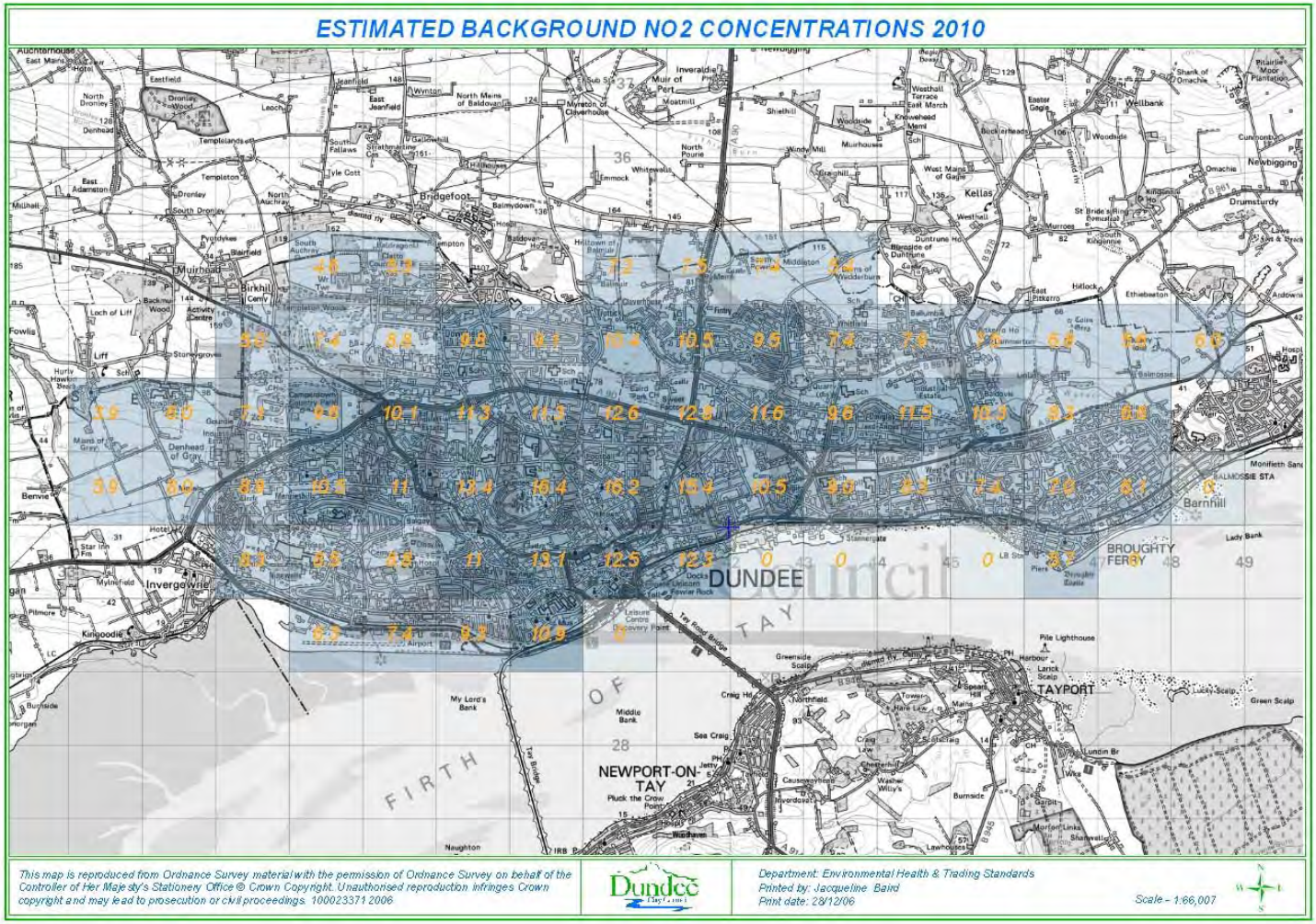

ESTIMATED BACKGROUND 1,3 BUTADIENE CONCENTRATIONS 2003
0.06 0.07 0.08 0.08 0.08
0.06 0.07 0.08 0.09 0.10 0.10 0.10 0.09 0.09 0.09 0.08 0.08 0.08 0.07
0.05 0.06 0.07 0.08 0.09 0.11 0.12 0.11 0.11 0.10 0.09 0.09 0.08 0.08 0.08
0.05 0.06 0.07 0.09 0.1 0.11 0.12 0.12 0.11 0.10 0.09 0.09 0.08 0.08 0.08
0.07 0.08 0.09 0.11 0.11 0.11 0.10
0.07 0.08 0.09 0.09
DUNDEE
BROUGHTY FERRY
TAYPORT
NEWPORT-ON-TAY
Barnhill
Invergowrie
Bridgefoot
Kellas
FIRTH OF TAY
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100023371 2006
Department: Environmental Health & Trading Standards
Printed by: Jacqueline Baird
Print date: 27/12/06
Scale - 1:66,007

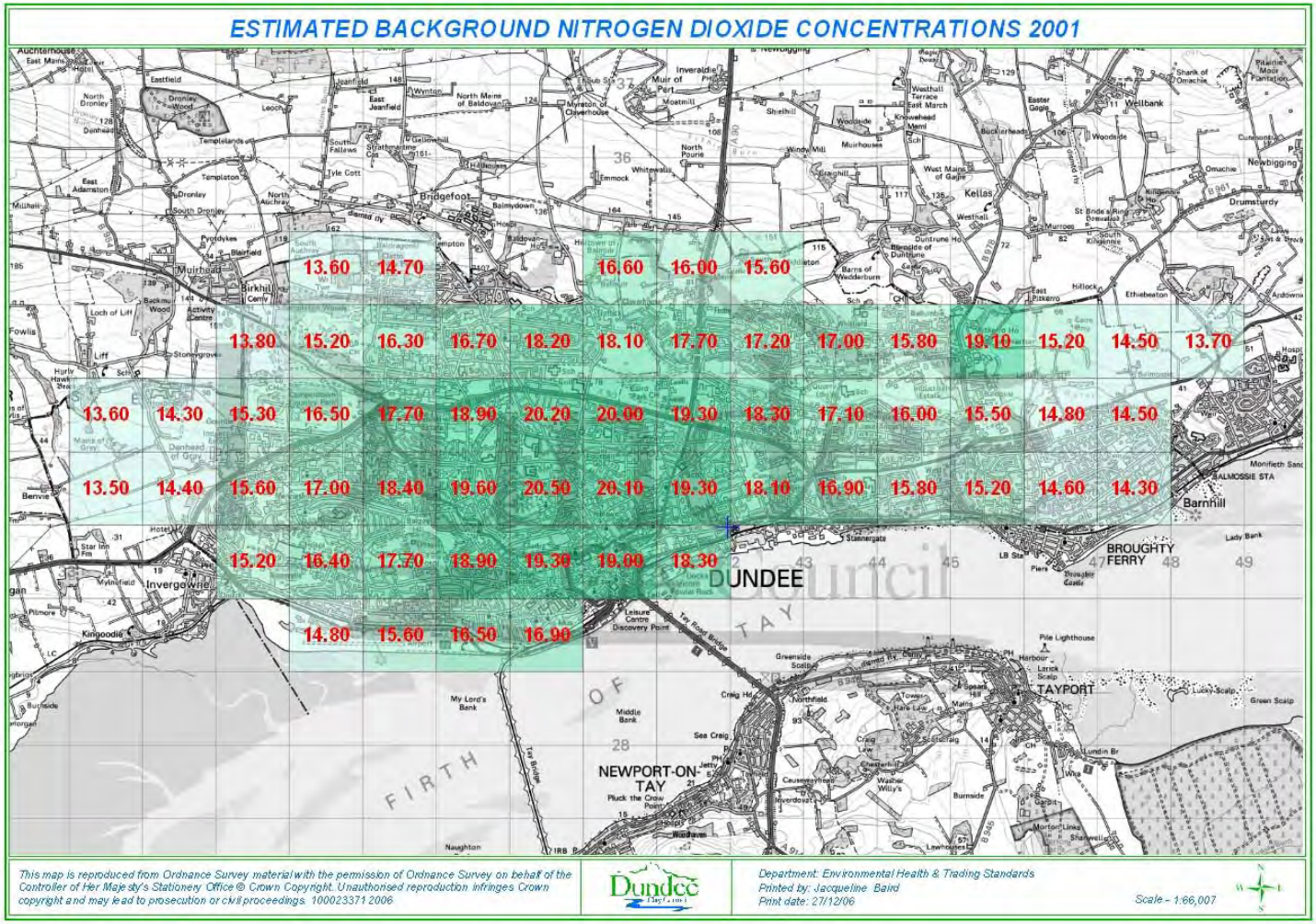

ESTIMATED BACKGROUND NOX CONCENTRATIONS 2010
DUNDEE
TAYPORT
NEWPORT-ON-TAY
BROUGHTY FERRY
Barnhill
Invergowrie
Bridgefoot
Kellas
FIRTH OF TAY
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100023371 2006
Department: Environmental Health & Trading Standards
Printed by: Jacqueline Baird
Print date: 28/12/06
Scale - 1:66,007

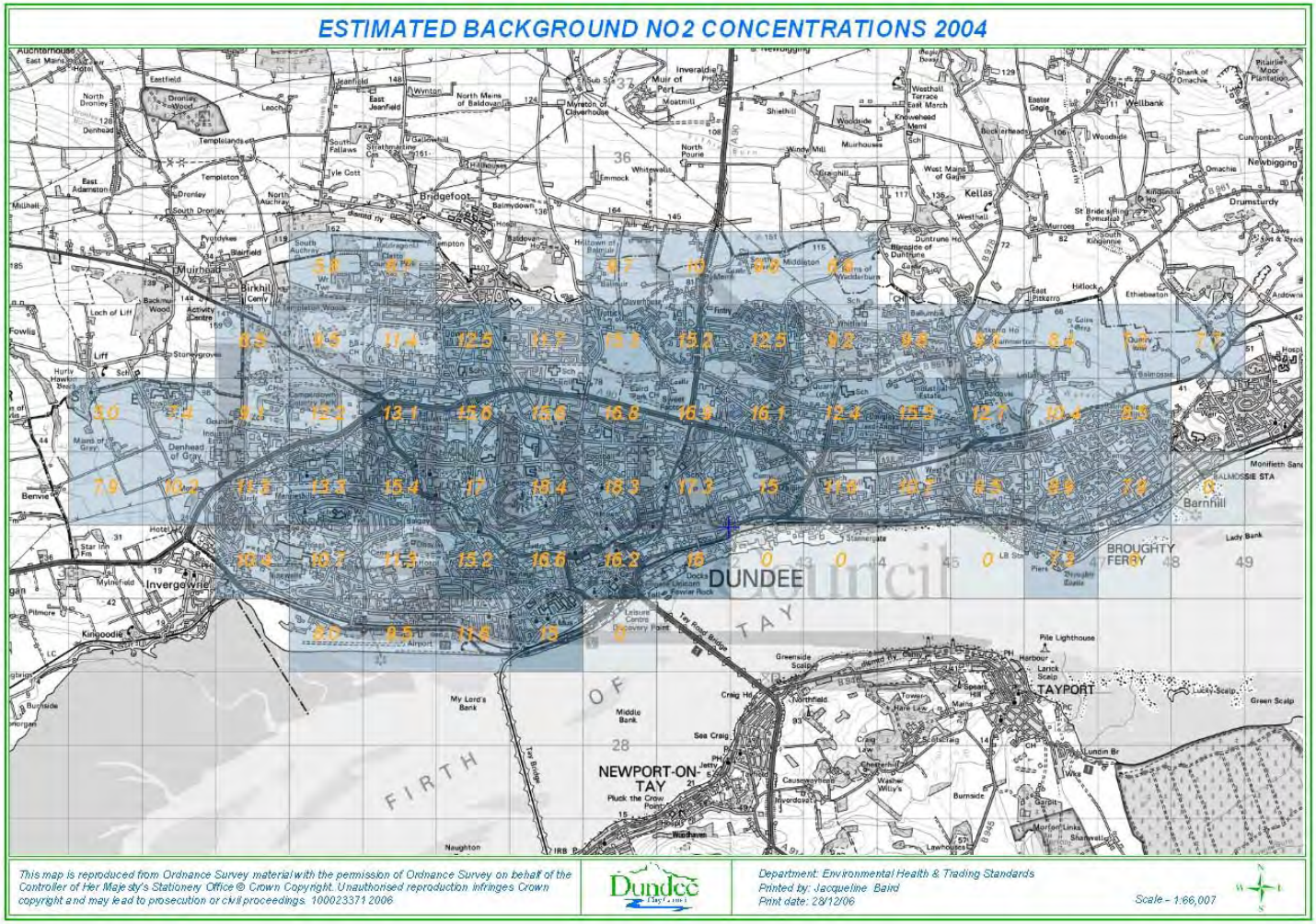

ESTIMATED BACKGROUND NITROGEN OXIDE CONCENTRATIONS 2001
17.4 19 22.7 21.6 20.9
17.6 20.1 22.1 22.9 26 25.7 24.9 24 23.6 21.3 27.8 20 18.7 17.4
17.3 18.4 20.3 22.6 25.1 27.6 30.3 29.7 28.3 26.1 23.8 21.5 20.6 19.2 18.7
17.2 18.5 20.8 23.5 26.4 29 31 30 28.3 25.7 23.3 21.2 20 18.9 18.2
20.1 22.4 25 27.5 28.4 27.7 26.1
19.2 20.8 22.6 23.4
DUNDEE
BROUGHTY FERRY
TAYPORT
NEWPORT-ON-TAY
Barnhill
BALMOSSIE STA
Invergowrie
Bridgefoot
Kellas
FIRTH OF TAY
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100023371 2006
Department: Environmental Health & Trading Standards
Printed by: Jacqueline Baird
Print date: 27/12/06
Scale - 1:66,007

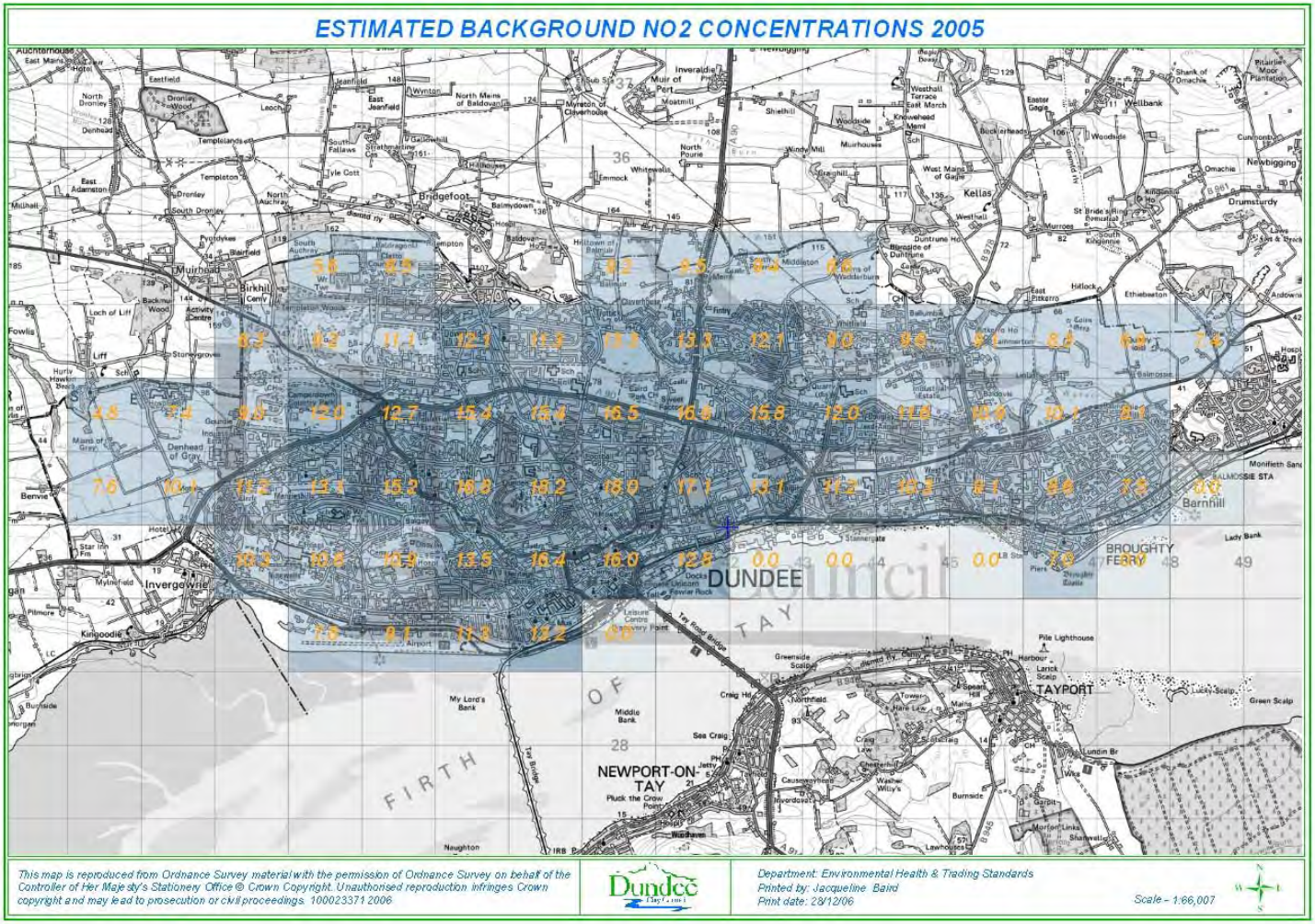

ESTIMATED BACKGROUND NOX CONCENTRATIONS 2004
DUNDEE
FIRTH OF TAY
NEWPORT-ON-TAY
TAYPORT
BROUGHTY FERRY
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100023371 2006
Department: Environmental Health & Trading Standards
Printed by: Jacqueline Baird
Print date: 28/12/06
Scale - 1:66,007


ESTIMATED BACKGROUND NOX CONCENTRATIONS 2005
DUNDEE
TAYPORT
NEWPORT-ON-TAY
BROUGHTY FERRY
Barnhill
Invergowrie
Bridgefoot
Kellas
FIRTH OF TAY
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100023371 2006
Department: Environmental Health & Trading Standards
Printed by: Jacqueline Baird
Print date: 28/12/06
Scale - 1:66,007

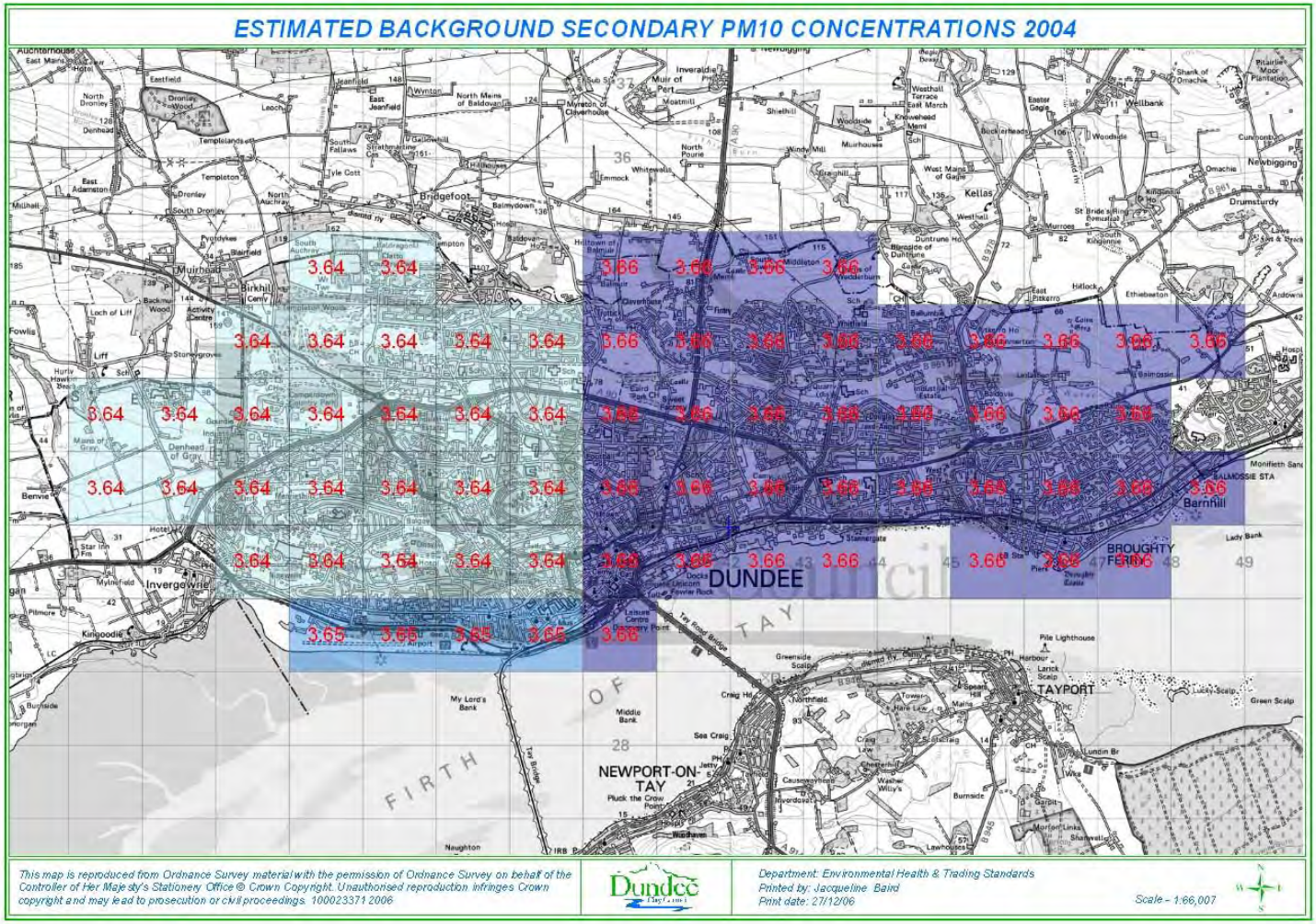

ESTIMATED BACKGROUND NO2 CONCENTRATIONS 2010
DUNDEE
TAYPORT
NEWPORT-ON-TAY
BROUGHTY FERRY
Barnhill
Invergowrie
Bridgefoot
Kellas
FIRTH OF TAY
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100023371 2006
Department: Environmental Health & Trading Standards
Printed by: Jacqueline Baird
Print date: 28/12/06
Scale - 1:66,007

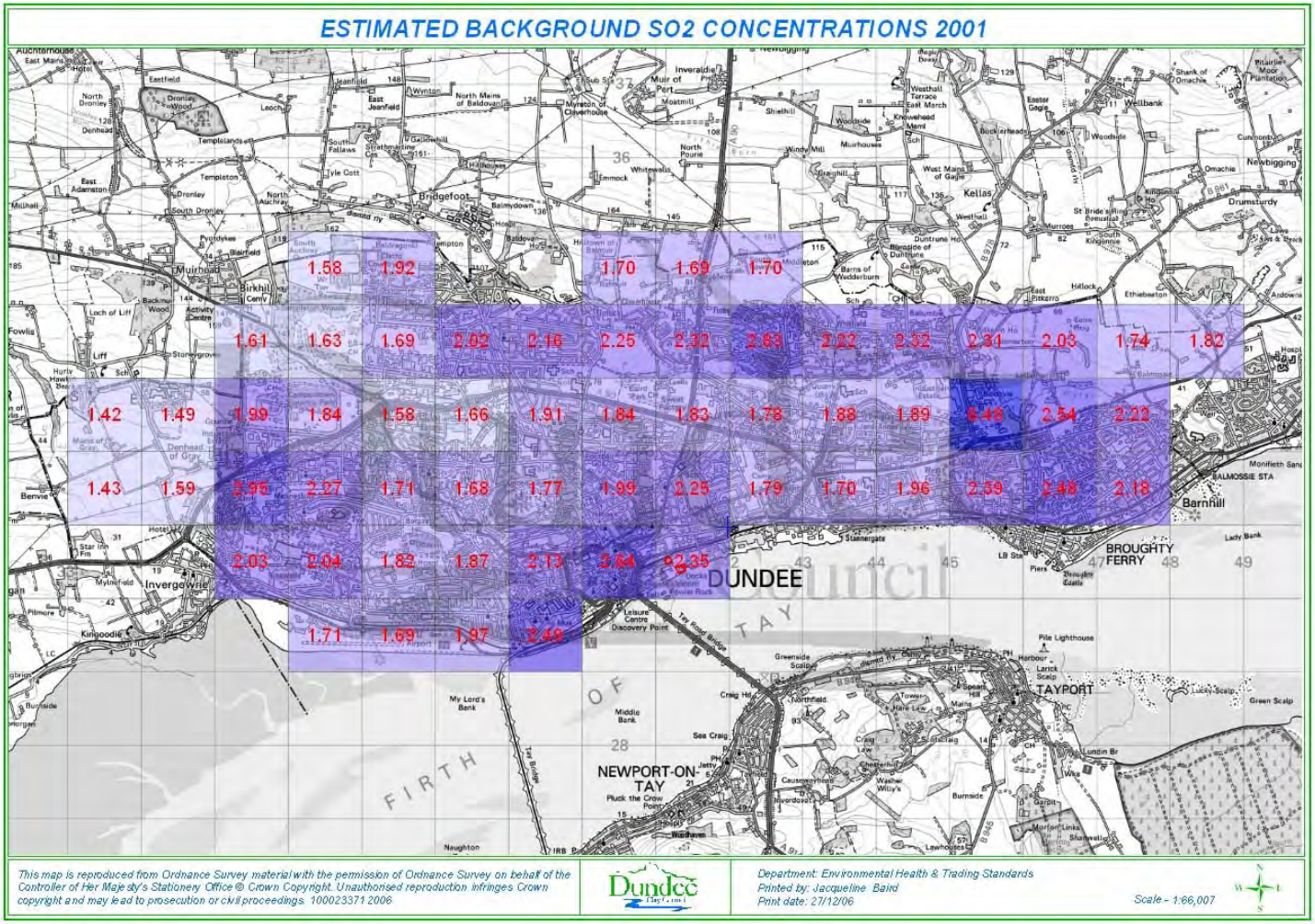

ESTIMATED BACKGROUND NITROGEN DIOXIDE CONCENTRATIONS 2001
13.60 14.70 16.60 16.00 15.60
13.80 15.20 16.30 16.70 18.20 18.10 17.70 17.20 17.00 15.80 19.10 15.20 14.50 13.70
13.60 14.30 15.30 16.50 17.70 18.90 20.20 20.00 19.30 18.30 17.10 16.00 15.50 14.80 14.50
13.50 14.40 15.60 17.00 18.40 19.60 20.50 20.10 19.30 18.10 16.90 15.80 15.20 14.60 14.30
15.20 16.40 17.70 18.90 19.30 19.00 18.30
14.80 15.60 16.50 16.90
DUNDEE
BROUGHTY FERRY
Barnhill
TAYPORT
NEWPORT-ON-TAY
Invergowrie
Bridgefoot
Kellas
FIRTH OF TAY
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100023371 2006
Department: Environmental Health & Trading Standards
Printed by: Jacqueline Baird
Print date: 27/12/06
Scale - 1:66,007

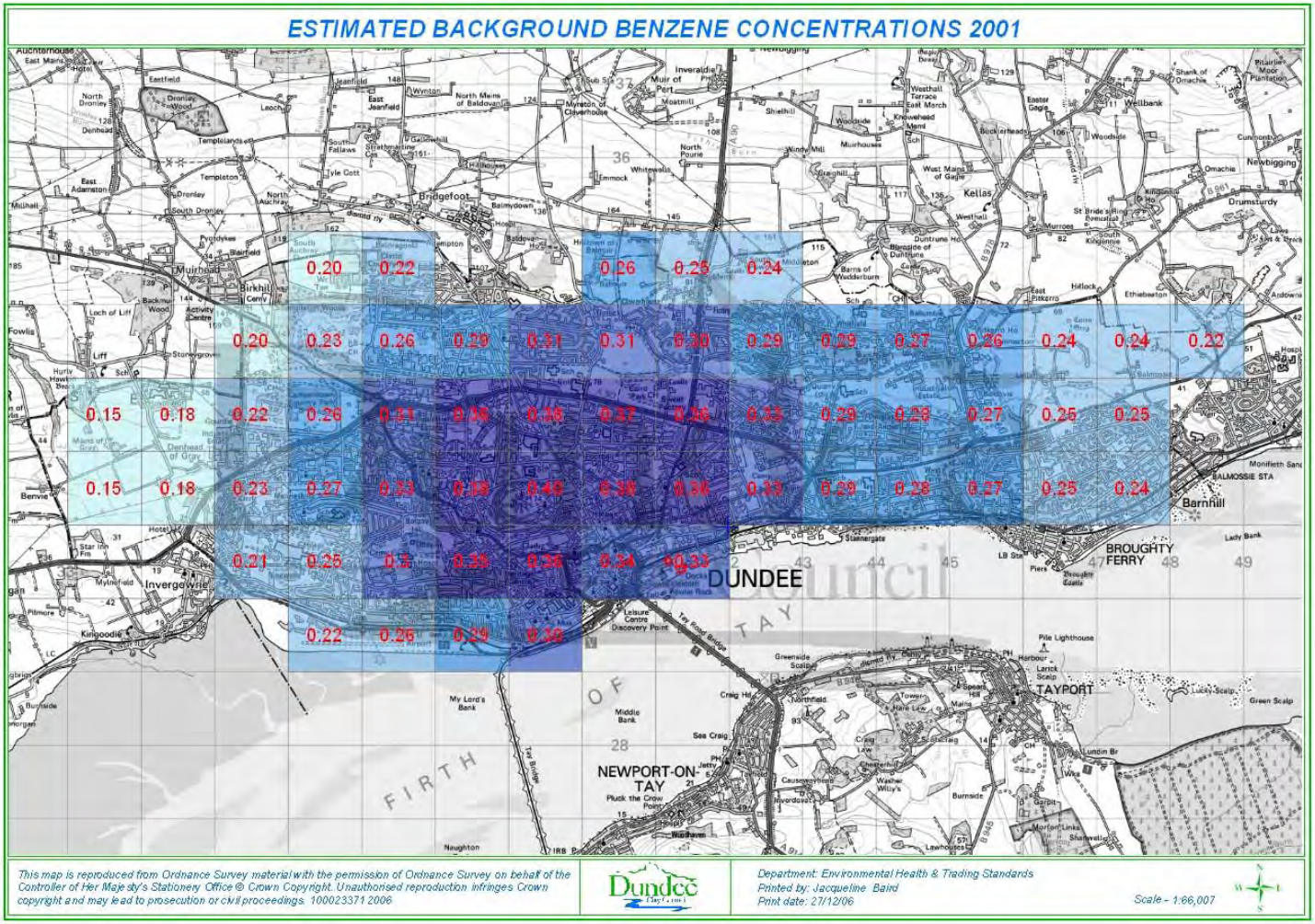

ESTIMATED BACKGROUND NO2 CONCENTRATIONS 2004
DUNDEE
TAYPORT
NEWPORT-ON-TAY
BROUGHTY FERRY
Barnhill
Invergowrie
Bridgefoot
Kellas
FIRTH OF TAY
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100023371 2006
Department: Environmental Health & Trading Standards
Printed by: Jacqueline Baird
Print date: 28/12/06
Scale - 1:66,007

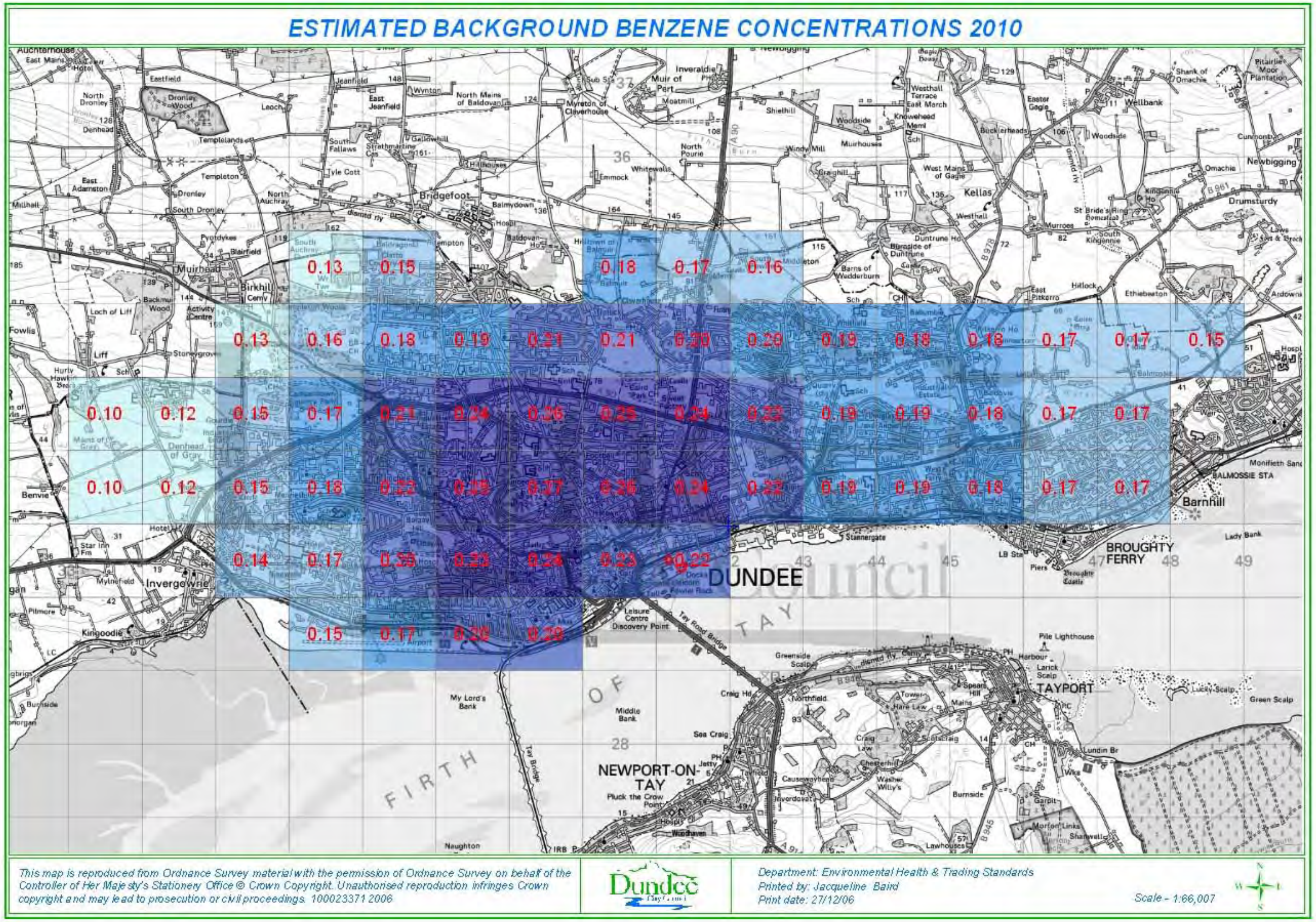

ESTIMATED BACKGROUND NO2 CONCENTRATIONS 2005
DUNDEE
TAYPORT
NEWPORT-ON-TAY
Invergowrie
BROUGHTY FERRY
Barnhill
FIRTH OF TAY
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100023371 2006
Department: Environmental Health & Trading Standards
Printed by: Jacqueline Baird
Print date: 28/12/06
Scale - 1:66,007

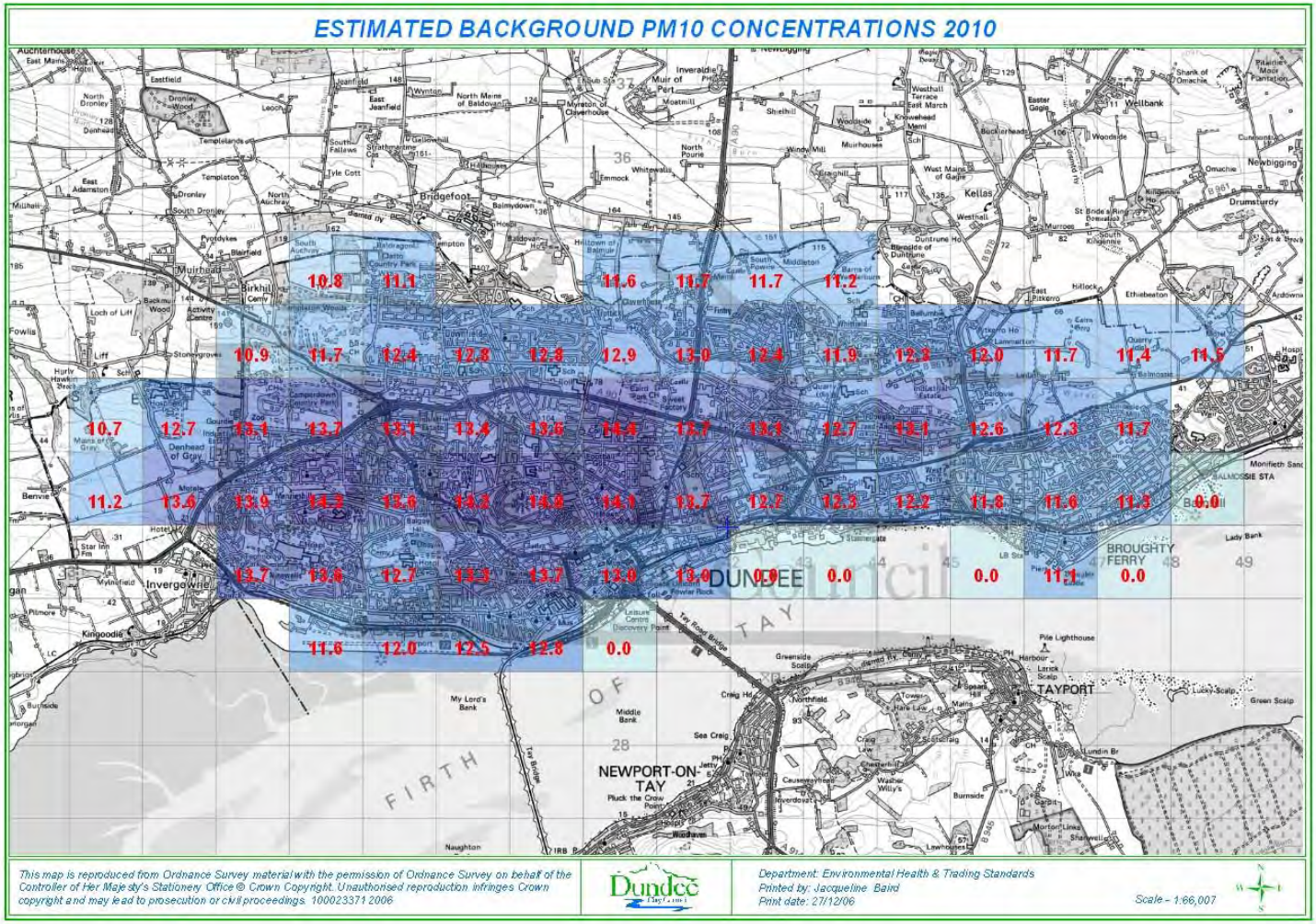
ESTIMATED BACKGROUND SECONDARY PM10 CONCENTRATIONS 2004

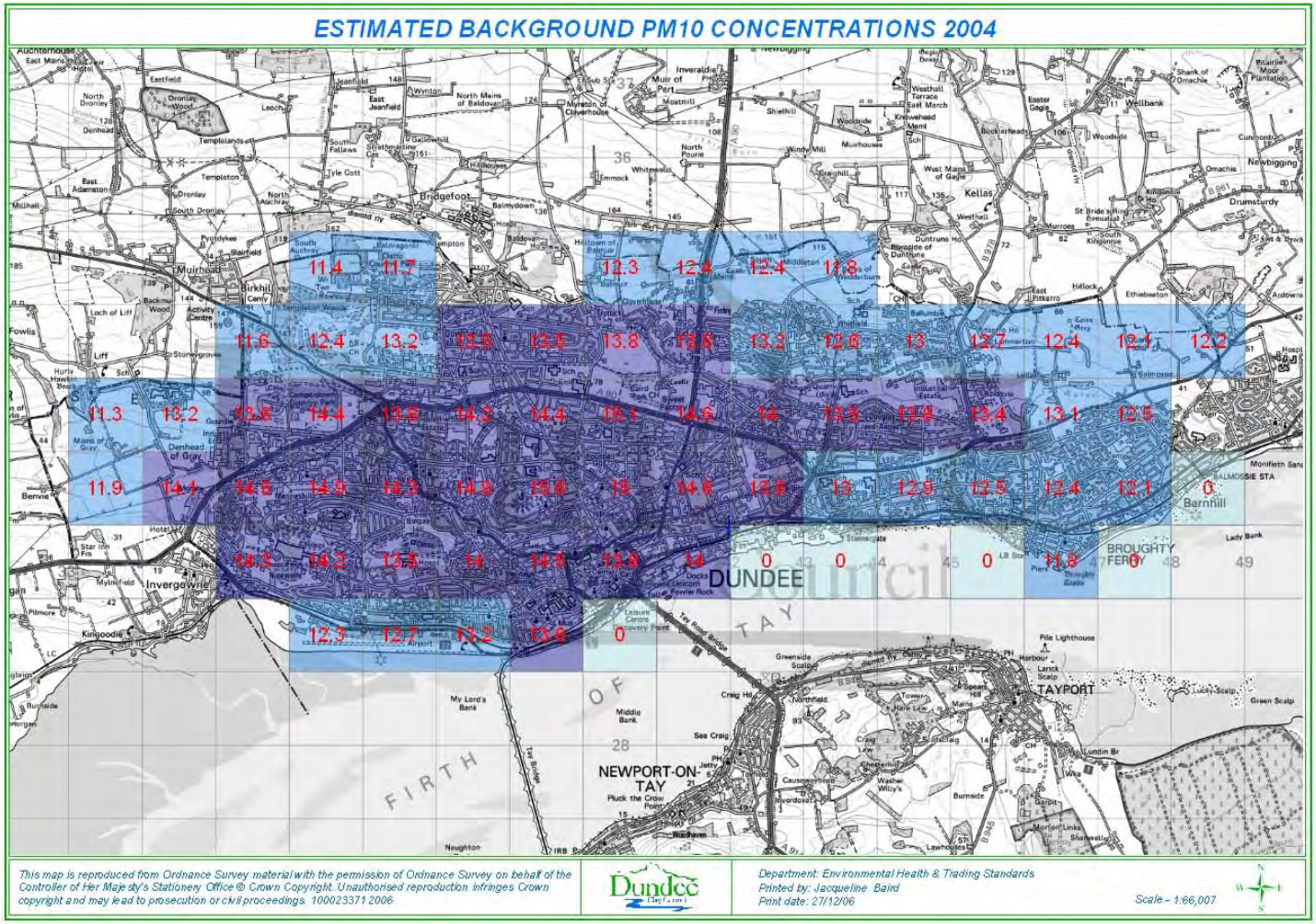


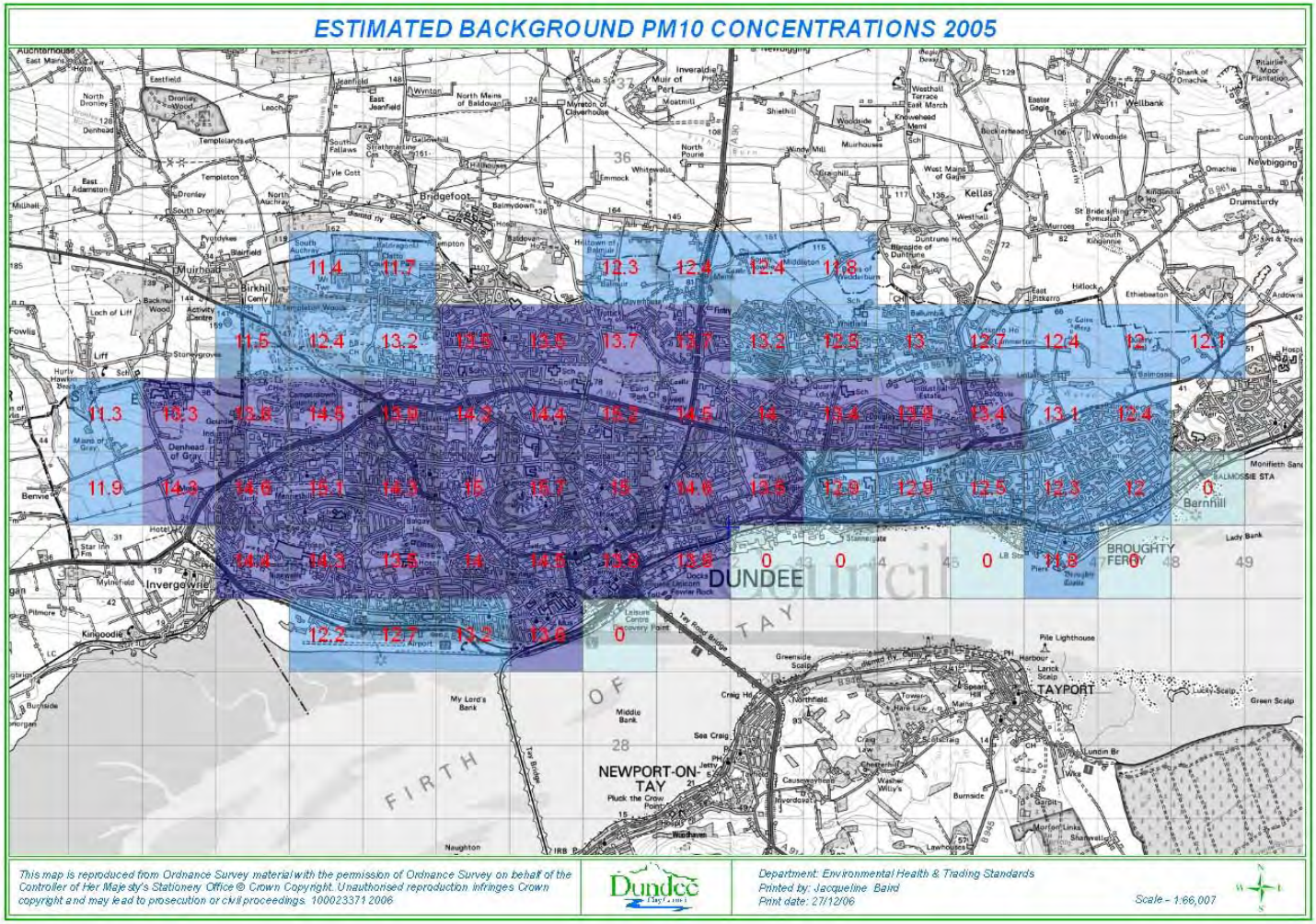

ESTIMATED BACKGROUND SO2 CONCENTRATIONS 2001
1.58
1.92
1.70
1.69
1.70
1.61
1.63
1.69
2.02
2.16
2.25
2.32
2.83
2.22
2.32
2.31
2.03
1.74
1.82
1.42
1.49
1.99
1.84
1.58
1.66
1.91
1.84
1.83
1.78
1.88
1.89
2.48
2.54
2.22
1.43
1.59
2.95
2.27
1.71
1.68
1.77
1.99
2.25
1.79
1.70
1.96
2.39
2.48
2.18
2.03
2.04
1.82
1.87
2.13
2.64
2.35
1.71
1.69
1.97
2.49
DUNDEE
BROUGHTY FERRY
Barnhill
TAYPORT
NEWPORT-ON-TAY
Invergowrie
Bridgefoot
Kellas
FIRTH OF TAY
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100023371 2006
Department: Environmental Health & Trading Standards
Printed by: Jacqueline Baird
Print date: 27/12/06
Scale - 1:66,007


ESTIMATED BACKGROUND BENZENE CONCENTRATIONS 2001
0.20
0.22
0.26
0.25
0.24
0.20
0.23
0.26
0.29
0.31
0.31
0.30
0.29
0.29
0.27
0.26
0.24
0.24
0.22
0.15
0.18
0.22
0.26
0.27
0.25
0.25
0.15
0.18
0.23
0.27
0.25
0.24
0.21
0.25
0.22
0.26
0.29
DUNDEE
BROUGHTY FERRY
Barnhill
TAYPORT
NEWPORT-ON-TAY
Invergowrie
FIRTH OF TAY
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100023371 2006
Department: Environmental Health & Trading Standards
Printed by: Jacqueline Baird
Print date: 27/12/06
Scale - 1:66,007


ESTIMATED BACKGROUND BENZENE CONCENTRATIONS 2010
DUNDEE
BROUGHTY FERRY
TAYPORT
NEWPORT-ON-TAY
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100023371 2006
Department: Environmental Health & Trading Standards
Printed by: Jacqueline Baird
Print date: 27/12/06
Scale - 1:66,007


ESTIMATED BACKGROUND PM10 CONCENTRATIONS 2010
DUNDEE
TAYPORT
NEWPORT-ON-TAY
BROUGHTY FERRY
Invergowrie
Bridgefoot
Kellas
FIRTH OF TAY
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100023371 2006
Department: Environmental Health & Trading Standards
Printed by: Jacqueline Baird
Print date: 27/12/06
Scale - 1:66,007


ESTIMATED BACKGROUND PM10 CONCENTRATIONS 2004
DUNDEE
TAYPORT
NEWPORT-ON-TAY
Bridgefoot
Invergowrie
Kellas
Bernhill
BROUGHTY FERRY
FIRTH OF TAY
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100023371 2006
Department: Environmental Health & Trading Standards
Printed by: Jacqueline Baird
Print date: 27/12/06
Scale - 1:66,007


ESTIMATED BACKGROUND PM10 CONCENTRATIONS 2005
11.4
11.7
12.3
12.4
12.4
11.8
11.5
12.4
13.2
13.5
13.6
13.7
13.7
13.2
12.8
13
12.7
12.4
12
12.1
11.3
13.3
13.6
14.5
13.9
14.2
14.4
15.2
14.5
14
13.4
13.8
13.4
13.1
12.4
11.9
14.3
14.6
15.1
14.3
15
15.7
15
14.6
13.6
12.9
12.9
12.5
12.3
12
0
14.4
14.3
13.5
14
14.3
13.8
13.8
0
0
0
11.8
0
12.2
12.7
13.2
13.6
0
DUNDEE
Invergowrie
NEWPORT-ON-TAY
TAYPORT
BROUGHTY FERRY
Bernhill
Kellas
Bridgefoot
FIRTH OF TAY
This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown Copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. 100023371 2006
Department: Environmental Health & Trading Standards
Printed by: Jacqueline Baird
Print date: 27/12/06
Scale - 1:66,007

X	Y	NOx 2004 ugm-3 as NO2 annual mean	NOx 2005 ugm-3 as NO2 annual mean	NOx 2010 ugm-3 as NO2 annual mean	NO2 2004 ugm-3 annual mean	NO2 2005 ugm-3 annual mean	NO2 2010 ugm-3 annual mean	PM10 2004 ugm-3 grav. annual mean	PM10 2005 ugm-3 grav. annual mean	PM10 2010 ugm-3 grav. annual mean	PM10 secondary 2004 ugm-3 grav. annual mean	SO2 2001 ugm-3 annual mean	Benzene 2001 ugm-3 annual mean	Benzene 2003 ugm-3 annual mean	Benzene 2010 ugm-3 annual mean	CO 2001 mgm-3 annual mean	1,3-butadine 2001 ugm-3 annual mean	1,3-butadine 2003 ugm-3 annual mean
333500	731500	10.1	9.65	7.48	7.88	7.56	5.86	11.9	11.9	11.2	3.64	1.43	0.151	0.133	0.102	0.168	0.067	0.053
333500	732500	6.35	6.16	4.96	4.98	4.83	3.88	11.3	11.3	10.7	3.64	1.42	0.153	0.135	0.104	0.169	0.068	0.054
334500	731500	13	12.9	10.2	10.2	10.1	8.02	14.1	14.3	13.6	3.64	1.59	0.176	0.155	0.119	0.176	0.075	0.06
334500	732500	9.44	9.46	7.6	7.39	7.41	5.95	13.2	13.3	12.7	3.64	1.49	0.177	0.157	0.12	0.177	0.074	0.059
335500	730500	13.3	13.2	10.6	10.4	10.3	8.3	14.3	14.4	13.7	3.64	2.03	0.212	0.186	0.142	0.189	0.087	0.069
335500	731500	14.5	14.3	11.4	11.3	11.2	8.94	14.5	14.6	13.9	3.64	2.95	0.225	0.198	0.15	0.194	0.091	0.072
335500	732500	11.6	11.5	9.11	9.06	8.98	7.14	13.6	13.8	13.1	3.64	1.99	0.222	0.195	0.149	0.193	0.09	0.071
335500	733500	8.3	7.97	6.31	6.5	6.25	4.95	11.6	11.5	10.9	3.64	1.61	0.196	0.173	0.132	0.181	0.079	0.063
336500	729500	10.2	9.92	8.02	8.03	7.77	6.28	12.3	12.2	11.6	3.65	1.71	0.217	0.191	0.146	0.189	0.089	0.07
336500	730500	13.7	13.5	10.9	10.7	10.6	8.52	14.2	14.3	13.6	3.64	2.04	0.249	0.219	0.167	0.203	0.102	0.08
336500	731500	16.9	16.7	13.5	13.3	13.1	10.5	14.9	15.1	14.3	3.64	2.27	0.271	0.238	0.181	0.21	0.109	0.085
336500	732500	15.5	15.3	12.3	12.2	12	9.6	14.4	14.5	13.7	3.64	1.84	0.261	0.229	0.174	0.207	0.105	0.082
336500	733500	12.1	11.7	9.41	9.47	9.2	7.37	12.4	12.4	11.7	3.64	1.63	0.231	0.204	0.155	0.195	0.092	0.073
336500	734500	7.43	7.14	5.81	5.82	5.59	4.55	11.4	11.4	10.8	3.64	1.58	0.197	0.174	0.133	0.182	0.08	0.064
337500	729500	12.1	11.7	9.46	9.48	9.14	7.41	12.7	12.7	12	3.65	1.69	0.255	0.225	0.172	0.199	0.1	0.079
337500	730500	14.5	13.9	11.3	11.3	10.9	8.82	13.5	13.5	12.7	3.64	1.82	0.3	0.264	0.201	0.218	0.119	0.093
337500	731500	18.1	17.6	14.1	15.4	15.2	11	14.3	14.3	13.6	3.64	1.71	0.326	0.287	0.218	0.227	0.128	0.1
337500	732500	16.7	16.2	12.9	13.1	12.7	10.1	13.8	13.9	13.1	3.64	1.58	0.309	0.272	0.207	0.221	0.12	0.094
337500	733500	14.6	14.1	11.3	11.4	11.1	8.84	13.2	13.2	12.4	3.64	1.69	0.264	0.232	0.177	0.205	0.104	0.082
337500	734500	8.6	8.26	6.74	6.74	6.47	5.28	11.7	11.7	11.1	3.64	1.92	0.22	0.193	0.148	0.19	0.089	0.071

X	Y	NOx 2004 ugm-3 as NO2 annual mean	NOx 2005 ugm-3 as NO2 annual mean	NOx 2010 ugm-3 as NO2 annual mean	NO2 2004 ugm-3 annual mean	NO2 2005 ugm-3 annual mean	NO2 2010 ugm-3 annual mean	PM10 2004 ugm-3 grav. annual mean	PM10 2005 ugm-3 grav. annual mean	PM10 2010 ugm-3 grav. annual mean	PM10 secondary 2004 ugm-3 grav. annual mean	SO2 2001 ugm-3 annual mean	Benzene 2001 ugm-3 annual mean	Benzene 2003 ugm-3 annual mean	Benzene 2010 ugm-3 annual mean	CO 2001 mgm-3 annual mean	1,3-butadine 2001 ugm-3 annual mean	1,3-butadine 2003 ugm-3 annual mean
338500	729500	14.9	14.4	11.9	11.6	11.3	9.33	13.2	13.2	12.5	3.65	1.97	0.294	0.26	0.199	0.211	0.112	0.088
338500	730500	17.7	17.2	14.1	15.2	13.5	11	14	14	13.3	3.64	1.87	0.347	0.305	0.232	0.232	0.134	0.105
338500	731500	21.5	21	17	17	16.8	13.4	14.9	15	14.2	3.64	1.68	0.379	0.333	0.253	0.243	0.144	0.112
338500	732500	18.6	18.1	14.5	15.6	15.4	11.3	14.2	14.2	13.4	3.64	1.66	0.361	0.317	0.242	0.237	0.136	0.106
338500	733500	16	15.5	12.5	12.5	12.1	9.76	13.5	13.5	12.8	3.64	2.02	0.286	0.251	0.192	0.212	0.112	0.087
339500	729500	17.2	16.8	14	15	13.2	10.9	13.6	13.6	12.8	3.65	2.49	0.302	0.266	0.204	0.214	0.117	0.092
339500	730500	20.6	20.2	16.7	16.6	16.4	13.1	14.5	14.5	13.7	3.64	2.13	0.356	0.313	0.237	0.237	0.141	0.11
339500	731500	24.5	23.9	19.5	18.4	18.2	16.4	15.6	15.7	14.8	3.64	1.77	0.398	0.35	0.267	0.25	0.154	0.12
339500	732500	18.5	17.9	14.5	15.6	15.4	11.3	14.4	14.4	13.6	3.64	1.91	0.384	0.338	0.258	0.246	0.148	0.115
339500	733500	15	14.5	11.6	11.7	11.3	9.1	13.5	13.5	12.8	3.64	2.16	0.312	0.274	0.21	0.222	0.124	0.097
340500	729500										3.66							
340500	730500	19.8	19.3	16	16.2	16	12.5	13.8	13.8	13	3.66	2.64	0.341	0.3	0.227	0.231	0.139	0.108
340500	731500	24.4	23.6	19.2	18.3	18	16.2	15	15	14.1	3.66	1.99	0.382	0.336	0.256	0.244	0.151	0.117
340500	732500	21.1	20.3	16.1	16.8	16.5	12.6	15.1	15.2	14.4	3.66	1.84	0.373	0.328	0.25	0.242	0.147	0.114
340500	733500	17.8	16.9	13.3	15.3	13.3	10.4	13.8	13.7	12.9	3.66	2.25	0.307	0.27	0.207	0.221	0.124	0.097
340500	734500	12.4	11.8	9.25	9.71	9.23	7.24	12.3	12.3	11.6	3.66	1.7	0.259	0.228	0.175	0.205	0.106	0.084
341500	730500	19.3	16.3	15.7	16	12.8	12.3	14	13.8	13	3.66	2.35	0.326	0.286	0.217	0.226	0.133	0.104
341500	731500	22.3	21.7	17.6	17.3	17.1	15.4	14.6	14.6	13.7	3.66	2.25	0.362	0.319	0.243	0.237	0.143	0.112
341500	732500	21.3	20.6	16.3	16.9	16.6	12.8	14.6	14.5	13.7	3.66	1.83	0.359	0.316	0.241	0.236	0.141	0.11
341500	733500	17.6	17	13.3	15.2	13.3	10.5	13.8	13.7	13	3.66	2.32	0.302	0.266	0.203	0.218	0.122	0.096
341500	734500	12.8	12.1	9.52	10	9.52	7.46	12.4	12.4	11.7	3.66	1.69	0.251	0.221	0.17	0.201	0.103	0.082

X	Y	NOx 2004 ugm-3 as NO2 annual mean	NOx 2005 ugm-3 as NO2 annual mean	NOx 2010 ugm-3 as NO2 annual mean	NO2 2004 ugm-3 annual mean	NO2 2005 ugm-3 annual mean	NO2 2010 ugm-3 annual mean	PM10 2004 ugm-3 grav. annual mean	PM10 2005 ugm-3 grav. annual mean	PM10 2010 ugm-3 grav. annual mean	PM10 secondary 2004 ugm-3 grav. annual mean	SO2 2001 ugm-3 annual mean	Benzene 2001 ugm-3 annual mean	Benzene 2003 ugm-3 annual mean	Benzene 2010 ugm-3 annual mean	CO 2001 mgm-3 annual mean	1,3-butadine 2001 ugm-3 annual mean	1,3-butadine 2003 ugm-3 annual mean
342500	730500										3.66							
342500	731500	17.3	16.8	13.4	15	13.1	10.5	13.6	13.5	12.7	3.66	1.79	0.326	0.287	0.219	0.226	0.13	0.103
342500	732500	19.5	18.8	14.8	16.1	15.8	11.6	14	14	13.1	3.66	1.78	0.329	0.289	0.22	0.227	0.131	0.103
342500	733500	16	15.4	12.1	12.5	12.1	9.49	13.2	13.2	12.4	3.66	2.83	0.291	0.256	0.195	0.215	0.119	0.094
342500	734500	12.6	12	9.44	9.84	9.4	7.39	12.4	12.4	11.7	3.66	1.7	0.242	0.213	0.164	0.198	0.099	0.079
343500	730500										3.66							
343500	731500	14.8	14.3	11.4	11.6	11.2	8.95	13	12.9	12.3	3.66	1.7	0.287	0.252	0.193	0.213	0.117	0.093
343500	732500	15.9	15.3	12.2	12.4	12	9.58	13.5	13.4	12.7	3.66	1.88	0.289	0.254	0.194	0.214	0.118	0.093
343500	733500	11.8	11.5	9.38	9.23	9.03	7.35	12.6	12.5	11.9	3.66	2.22	0.286	0.251	0.192	0.213	0.116	0.092
343500	734500	8.76	8.48	6.95	6.86	6.64	5.44	11.8	11.8	11.2	3.66							
344500	731500	13.7	13.1	10.5	10.7	10.3	8.26	12.9	12.9	12.2	3.66	1.96	0.279	0.245	0.187	0.208	0.11	0.087
344500	732500	18.2	14.8	14.7	15.5	11.6	11.5	13.8	13.8	13.1	3.66	1.89	0.279	0.245	0.187	0.208	0.11	0.087
344500	733500	12.5	12.2	10.1	9.75	9.56	7.9	13	13	12.3	3.66	2.32	0.27	0.238	0.181	0.206	0.108	0.085
345500	730500										3.66							
345500	731500	12.1	11.6	9.38	9.5	9.12	7.35	12.5	12.5	11.8	3.66	2.39	0.268	0.236	0.181	0.203	0.103	0.082
345500	732500	16.2	14	13.1	12.7	10.9	10.3	13.4	13.4	12.6	3.66	6.48	0.269	0.237	0.182	0.203	0.103	0.082
345500	733500	11.8	11.6	9.54	9.28	9.07	7.48	12.7	12.7	12	3.66	2.31	0.261	0.23	0.176	0.201	0.101	0.08
346500	730500	9.3	8.91	7.26	7.28	6.98	5.68	11.8	11.8	11.1	3.66							
346500	731500	11.4	11	8.87	8.94	8.6	6.95	12.4	12.3	11.6	3.66	2.48	0.25	0.22	0.169	0.197	0.097	0.078
346500	732500	13.2	12.9	10.6	10.4	10.1	8.32	13.1	13.1	12.3	3.66	2.54	0.251	0.221	0.17	0.197	0.097	0.078
346500	733500	10.7	10.5	8.74	8.38	8.26	6.84	12.4	12.4	11.7	3.66	2.03	0.243	0.214	0.165	0.195	0.095	0.077

X	Y	NOx 2004 ugm-3 as NO2 annual mean	NOx 2005 ugm-3 as NO2 annual mean	NOx 2010 ugm-3 as NO2 annual mean	NO2 2004 ugm-3 annual mean	NO2 2005 ugm-3 annual mean	NO2 2010 ugm-3 annual mean	PM10 2004 ugm-3 grav. annual mean	PM10 2005 ugm-3 grav. annual mean	PM10 2010 ugm-3 grav. annual mean	PM10 secondary 2004 ugm-3 grav. annual mean	SO2 2001 ugm-3 annual mean	Benzene 2001 ugm-3 annual mean	Benzene 2003 ugm-3 annual mean	Benzene 2010 ugm-3 annual mean	CO 2001 mgm-3 annual mean	1,3-butadine 2001 ugm-3 annual mean	1,3-butadine 2003 ugm-3 annual mean
347500	730500										3.66							
347500	731500	10.1	9.63	7.83	7.89	7.54	6.14	12.1	12	11.3	3.66	2.18	0.241	0.213	0.165	0.193	0.093	0.076
347500	732500	10.8	10.3	8.38	8.46	8.08	6.56	12.5	12.4	11.7	3.66	2.22	0.249	0.22	0.17	0.196	0.096	0.079
347500	733500	9.19	8.8	7.15	7.2	6.89	5.61	12.1	12	11.4	3.66	1.74	0.243	0.214	0.166	0.194	0.095	0.078
348500	731500										3.66							
348500	733500	9.87	9.45	7.68	7.74	7.41	6.02	12.2	12.1	11.5	3.66	1.82	0.223	0.197	0.154	0.187	0.088	0.073

APPENDIX 2: PROCESSES AUTHORISED UNDER PART I OF THE ENVIRONMENTAL PROTECTION ACT 1990 IN DUNDEE

Part A processes

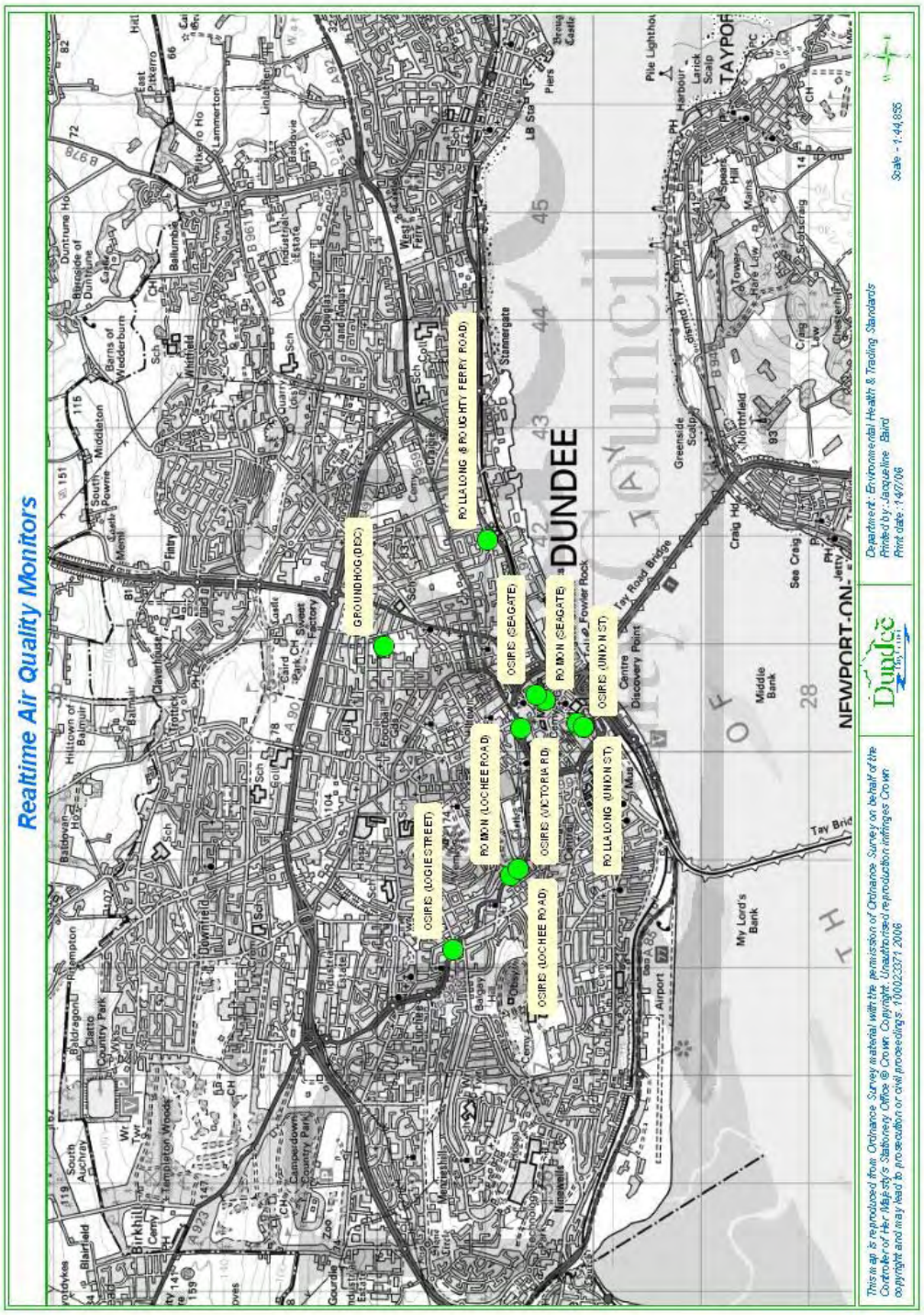
PPC NUMBER	COMPANY	LOCATION			DESCRIPTION OF PROCESS
PPC/E/20031	Halley Stevensons (Dyers & Finishers) Ltd	Baltic Works, Annfield Road	Dundee	DD1 5JH	Textile treatment
PPC/E/20032	Danapak Flexibles Ltd	Kemback Street	Dundee	DD4 6ET	Coating (flexible packing)
PPC/E/20033	J T Inglis & Sons Ltd	Riverside Works, Stannergate	Dundee	DD1 3LU	Textile treatment
PPC/E/20035	Michelin Tyre PLC	Baldovie Road	Dundee	DD4 8UQ	Combustion
PPC/E/20039	D C Thomson & Co Ltd	80 Kingsway East	Dundee	DD4 8SL	Printing
PPC/E/20050	Day International (UK) Ltd	Balgray Street	Dundee	DD3 8HN	Coating (lithographic)
PPC/E/20081	Matheson Jess Ltd	99 Broughty Ferry Road	Dundee	DD4 6JE	Slaughter of animals
PPC/A/1000059	Rockwell Solutions Ltd	Brunel Road, Wester Gourdie Industrial Estate	Dundee	DD2 4TG	Coating (flexible packing)
PPC/A/1003157	Dundee Energy Recycling Ltd	Forties Road	Dundee	DD4 ONS	Incineration
IPC/063/1993	Nynas AB UK	East Camperdown St	Dundee	DD1 3LG	Petroleum process

Part B processes

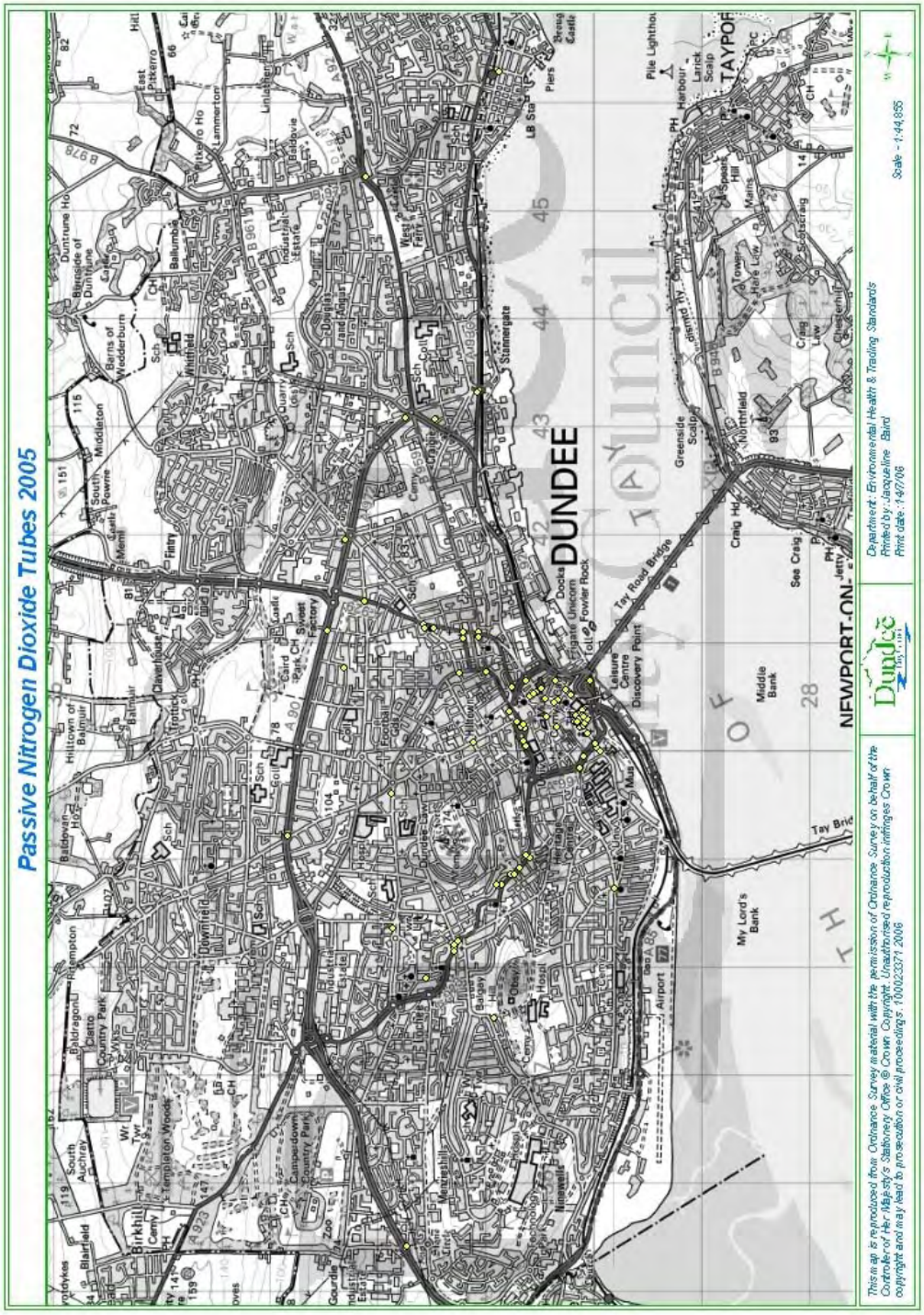
PPC NUMBER	COMPANY	LOCATION			DESCRIPTION OF PROCESS
PPC/E/30051	RMC Readymix Ltd	Dock Street	Dundee	DD1 3SS	Cement process
PPC/E/30052	Ennstone Thistle Ltd	Ethiebeaton Quarry, Monifieth,	Dundee	DD5 3RB	Rock crushing & Roadstone Coating process
PPC/E/30054	Brown & Tawse Steelstock Ltd	Fowler Road, West Pitkerro Industrial Estate	Dundee	DD5 3YN	Coating of metal process
PPC/E/30061	Armitages Pet Products Ltd t/a Wilson's of Dundee	Caledonian Mills, Stannergate	Dundee	DD1 3NN	Drying of grain process
PPC/E/30157	Joinery & Timber Creations (65) Ltd	27 Harrison Road	Dundee	DD2 3SN	Manufacture of timber and wood based products
PPC/E/30200	Broughty Ferry Auto Electrics	17 Panmure Street	Dundee	DD5 2ER	Road vehicle process
PPC/E/30201	Arnold Clark Automobiles Ltd	5 East Dock Street	Dundee	DD1 3HB	Road vehicle process
PPC/B/1000140	Nationwide Crash Repair Centres Ltd	Liff Road	Dundee	DD2 4UT	Respraying of road vehicles process
PPC/B/1000141	Hanson Quarry Products Europe Ltd	Piper Street	Dundee	DD4 ONT	Cement process
PPC/B/1000162	Halls Group Ltd	Subsea Protection Systems, Stannergate Road	Dundee	DD1 3NA	Cement batching process
PPC/E/30069	Tesco Stores Ltd	Tesco Dundee Extra PFS, Kingsway Retail Park	Dundee	DD3 8QB	Petroleum process
PPC/B/1004714	Shell Discovery Filling Station	Allan Street, East Marketgait	Dundee	DD1 3HE	Petroleum process

PPC NUMBER	COMPANY	LOCATION			DESCRIPTION OF PROCESS
PPC/B/1004716	Esso Petroleum Co Ltd	Brochtay Service Station, 14a Dalhousie Road, Broughty Ferry	Dundee	DD5 2SQ	Petroleum process
PPC/B/1004717	Asda Stores Ltd	7-9 Derwent Avenue, Kirkton	Dundee	DD3 0SZ	Petroleum process
PPC/B/1004851	Tesco Filling Station	Stacks Leisure Park, 16b Harefield Road	Dundee	DD2 3JT	Petroleum process
PPC/B/1004853	BP Oil UK Ltd	Kingsway West Service Stn, Kingsway West	Dundee	DD2 4TD	Petroleum process
PPC/B/1004857	Shell UK Ltd	Shell Caird Park Filling Station, 61 Forfar Road	Dundee	DD4 9BS	Petroleum process
PPC/B/1004861	Shell UK Ltd	Shell Kingsway East, East Kingsway	Dundee	DD4 7PY	Petroleum process
PPC/B/1004862	Asda Stores Ltd	Milton of Craigie Road	Dundee	DD4 7XE	Petroleum process
PPC/B/1004866	Tesco Stores Ltd	Riverside Drive	Dundee	DD2 1UG	Petroleum process
PPC/B/1004871	Somerfield Stores	Marketgait Filling Stn, Marketgait,	Dundee	DD1 1QP	Petroleum process
PPC/B/1004875	Sainsburys Supermarkets Ltd	Baldovie Road, Claypotts	Dundee	DD4 8UD	Petroleum process
PPC/B/1004879	Chevron Texaco Ltd	Jet Petrol Station, Forfar Road	Dundee	DD4 9BT	Petroleum process

APPENDIX 3: REAL TIME AIR POLLUTION MONITOR LOCATIONS



APPENDIX 4: PASSIVE NO_2 DIFFUSION TUBE LOCATIONS IN 2005



APPENDIX 5: DUNDEE CITY COUNCIL – NEW TRAFFIC DATA

Location	AADT vpd	Average Speed kph	Dates
Temporary Count Sites			
Albert Street (Park Avenue)	9727	31.5	8 - 15 Feb 05
Brantwood Avenue (Alpin Road)	8572	40.0	9 - 18 Sep 04
Charleston Drive (Charleston Bar)	9383	41.8	30 Apr- 8 May 03
Clepington Road (East of Forfar Road)	8725	38.1	24 - 31 Jan 03
Coupar Angus Road (Lansdowne Road)	15352	45.9	10 - 15 Nov 05
Drumgeith Road (Forties Road)	13763	53.1	19 -26 Feb 04
Dura Street (Balmore St)	11013	38.4	17 - 24 Sep 04
Happyhillock Road (Douglas Road)	11349	47.7	16 - 23 Nov 05
Monifieth Road (Orchar Park)	13523	53.3	5 - 21 Nov 03
Perth Road (Ninewells Garage)	8405	59.0	24 Sep- 3 Oct 03
Queen Street (Fort Street)	14673	40.5	9 - 23 Jun 05
South Road (Kirk Street)	10552	44.3	11 - 18 Dec 03
Strathmartine Road (Canning Street)	10394	39.0	3 - 6 Jun 04
Strathmore Avenue (Lawton Road)	12142	49.8	25 Aug- 9 Sep 04
Road Traffic Reduction Act Sites			
Arbroath Road (Kenilworth Avenue)	13189		2005
Dens Road (Hillbank Road)	10859		2005
Forfar Road (Maryfield Terrace)	9276		2005
Lochee Road (Rankine Street)	13018		2005
Perth Road (Windsor Street)	8343		2005
Pitkerro Road (Baxter Park Terrace)	9159		2005
Rankine Street (Lochee Road)	8098		2005
Riverside Drive (Airport)	18818		2005
Permanent Count Sites			
Arbroath Road (Monymusk)	27245		1 - 8 June 06
Blackscroft	20334		Sep-05
Coupar Angus Road (Templeton Road)	10973		May-06
Craigie Drive (Lavender Street)	8730		Feb-06
Dalhousie Road (Kerrington Crescent)	12860		May-06
Dundee Road (Christian Road)	18180		Sep-05
Riverside Avenue	18061		May-06
South Marketgait (Eastbound)	19469		2005
South Marketgait (Westbound)	9769		2005
Victoria Road (Wellington Street)	9046		May-06
Safety Camera Sites			
Drumgeith Road (St Saviours HS)	12378		9 - 15 July 06
Kings Cross Road	11347		9 - 15 July 06
Old Glamis Road	9059		9 - 15 July 06

Location	AADT vpd	Average Speed kph	Dates
Trunk Road Sites			
A90 Forfar Road (Fintry)	31687		2005
A90 Kingsway (East of Myrekirk Road)	30914		2005
A90 Kingsway (West of Myrekirk Road)	28762		2005
A90 Kingsway (East of Strathmartine Road)	36076		2005
A90 Kingsway (West of Strathmartine Road)	42314		2005
A90 Kingsway (East of Coupar Angus Road)	41737		2005
A90 Kingsway (West of Forfar Road)	40413		2005
A92 South Marketgait	34833		2005
A92 East Dock Street	27254		2005
A92 Broughty Ferry Road	31923		2005
A92 Greendykes Road	13369		2005
A972 Kingsway East (East of Forfar Road)	27394		2005
A972 Kingsway East (East of Pitkerro Road)	30359		2005
A972 Kingsway East (South of Longtown Rd)	28306		2005
A972 Kingsway East (North of Arbroath Rd)	27771		2005