ENVIRONMENTAL HEALTH DEPARTMENT

AIR QUALITY REVIEW AND ASSESSMENT

INTERIM REPORT

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1. Introduction

Following agreement on a Common Position on the Air Quality Daughter Directives (AQDD), in June 1998 at the European Union Environment Council, the government published its proposals for a review of the National Air Quality Strategy (in 1999). Subsequently the Air Quality Strategy for England, Scotland, Wales and Northern Ireland was published in January 2000.

The NI Environment Order came into operation in January 2003 and implements both the European Air Framework Directive 96/62EC and the UK Air Quality Strategy. The Expert Panel on Air Quality Standards (EPAQS) has proposed new national air quality standards for the UK. The NI Environment Order 2002 provides the framework for district councils to review air quality and for implementation of an Air Quality Management Area (AQMA) if required. It was issued by the Department of the Environment in Northern Ireland under Article 16 of the Environment (NI) Order 2002. Under article 16 of the order, District Councils and other relevant authorities are required to have regard to this guidance when carrying out any of their duties under, or by virtue of Part III of the order. The guidance set out in this document is outlined in Table 1 below.

Table 1: NI Environment Order 2002 key Guidance:

- The statutory background and the legislative framework within which relevant authorities have to work
- The new principles behind reviews and assessments of air quality up to 2010 and the recommended steps that relevant authorities should take
- The timetable for reviews and assessments up to 2010
- How district councils should handle the designation of AQMAs
- How relevant authorities should handle the drawing up and implementation of action plans
- Recommendations and suggestions on taking forward the development of local and regional air quality strategies
- Suggestions of how relevant authorities should consult and liase with others
- Local transport measures which Roads Service might wish to consider
- The general principles behind air quality and land use planning; and
- How enforcing authorities should use powers of entry under Article 19 of the Order

Overview of the principles and main elements of the National Air Quality Strategy

The main elements of the Air Quality Strategy can be summarised as follows:

- The use of a health effects based approach using national air quality standards and objectives.
- The use of policies by which the objectives can be achieved and which include the input of important actors such as industry, transportation bodies and local authorities.
- The predetermination of timescales with target dates of 2003, 2004, 2005, 2008 and 2010 for the achievement of objectives and a commitment to review the Strategy every three years.

It is intended that the AQS will provide a framework for the improvement of air quality that is both clear and workable. In order to achieve this, the Strategy is based on several principles which include:

- the provision of a statement of the Government's general aims regarding air quality;
- clear and measurable targets;
- a balance between local and national action and
- a transparent and flexible framework.

Co-operation and participation by different economic and governmental sectors is also encouraged within the context of existing and potential future international policy commitments.

National Air Quality Standards

At the centre of the AQS is the use of national air quality standards to enable air quality to be measured and assessed. These also provide the means by which objectives and timescales for the achievement of objectives can be set. Most of the proposed standards have been based on the available information concerning the health effects resulting from different ambient concentrations of selected pollutants and are the consensus view of medical experts on the Expert Panel on Air Quality Standards (EPAQS). These standards and associated specific objectives to be achieved between 2003 and 2010 are shown in Table 2. The table shows the standards in $\mu g\ m^{-3}$ with the number of exceedences that are permitted (where applicable).

Specific objectives relate either to achieving the full standard or, where use has been made of a short averaging period, objectives are sometimes expressed in terms of percentile compliance. The use of percentiles means that a limited number of exceedences of the air quality standard over a particular timescale, usually a year, are permitted. This is to account for unusual meteorological conditions or particular events such as Halloween. For example, if an objective is to be complied with at the 99.9th percentile, then 99.9% of measurements at each location must be at or below the level specified.

Table 2: Proposed Objectives included in the Air Quality Regulations (NI) 2003 for the purpose of Local Air Quality Management.

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 μgm^{-3}	Running annual mean	31.12.2003
	3.25 μgm^{-3}	Running annual mean	31.12.2010
1,3 Butadiene	2.25 μgm^{-3}	Running annual mean	31.12.2003
Carbon Monoxide	10.0 mgm^{3}	Maximum daily running 8-hour mean	31.12.2003
Lead	0.5 μgm^{-3}	Annual mean	31.12.2003
	0.25 mgm3	Annual mean	31.12.2008
Nitrogen Dioxide[1]	200 μgm^{-3} no to be exceeded more than 18 times a year	1 hour mean	31.12.2005
	40 μgm^{-3}	annual mean	31.12.2005
Particles (PM_{10})[2] **Gravimetric**[3]	50 μgm^{-3} not to be exceeded more than 35 times a year	24 hour mean	31.12.2004
	40 μgm^{-3}	annual mean	31.12.2004
Sulphur Dioxide	350 μgm^{-3} not to be exceeded more than 24 times per year	1 hour mean	31.12.2004
	125 μgm^{-3} not to be exceeded more than 3 times per year	24 hour mean	31.12.2004
	266 μgm^{-3} not to be exceeded more than 35 times per year	15 minute mean	31.12.2005

Notes

1. The objectives for nitrogen dioxide are provisional.
2. There are likely to be new particles objectives for 2010, not in regulation at present, expected after the review of the EU's first Air Quality Daughter Directive (2004).
3. Measured using the European gravimetric transfer standard or equivalent.

Relationship between the UK National Air Quality Standards and EU air quality Limit Values

As a member state of the EU, the UK must comply with European Union Directives.

There are three EU ambient air quality directives that the UK has transposed in to UK law. These are:

- **96/62/EC** Council Directive of 27 September 1996 on ambient air quality assessment and management. (the Ambient Air Framework Directive)

- **1999/30/EC** Council Directive of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide, oxides of nitrogen, particulate matter and lead in ambient air. (the First Daughter Directive)

- **2000/69/EC** Directive of the European Parliament and the Council of 16 Nov 2000 relating to limit values for benzene and carbon monoxide in ambient air. (the Second Daughter Directive)

The first and second daughter directives contain air quality Limit Values for the pollutants that are listed in the framework directive. The United Kingdom (i.e. Great Britain and Northern Ireland) must comply with these Limit Values. The UK air quality strategy should allow the UK to comply with the EU Air Quality Daughter Directives, but the UK air quality strategy also includes some stricter national objectives for some pollutants, for example, sulphur dioxide.

The Government is ultimately responsibility for achieving the EU limit values. However, it is important that Local Air Quality Management is used as a tool to ensure that the necessary action is taken at local level to work towards achieving the EU limit values by the dates specified in those EU Directives.

Policies in place to allow these objectives to be achieved

The policy framework to allow these objectives to be achieved is one that that takes a local air quality management approach. This is superimposed upon existing national and international regulations in order to effectively tackle local air quality issues as well as issues relating to wider spatial scales. National and EC policies which already exist provide a good basis for progress towards the air quality objectives set for 2003 to 2010. For example various EC Directives have ensured that road transport emission and fuel standards are in place. These policies are being developed to include more stringent controls. Developments in the UK include the announcement by the Environment Agency in January 2000 on controls on emissions of SO_2 from coal and oil fired power stations. This system of controls means that by the end of 2005 coal and oil fired power stations will meet the air quality standards set out in the AQS. Northern Ireland now has in place the Air Quality Limit Value regulation (NI) 2002, the Air Quality (Amended) Limit Value Regulations (NI) 2002 and the Air Quality (Ozone) Regulations (NI) 2003. The Government has recognised the problems associated with achieving the standard for ozone, a secondary pollutant and trans-boundary in nature and it is recognised that local authorities themselves can exert little influence on concentrations when they are the result of regional primary emission patterns.

Local air quality management provides a strategic role for local authorities in response to particular air quality problems experienced at a local level. This builds upon current air quality control responsibilities and places an emphasis on bringing together issues relating to transport, waste, energy and planning in an integrated way. This integrated approach involves a number of different aspects. It includes the development of an appropriate local framework that allows air quality issues to be considered alongside other issues relating to polluting activity. It should also enable co-operation with and participation by the general public in addition to other transport, industrial and governmental authorities.

An important part of the Strategy is the requirement for local authorities to carry out air quality reviews and assessments of their area against which current and future compliance with air quality standards can be measured. Over the longer term, these will also enable the effects of policies to be studied and therefore help in the development of future policy. The Government has prepared guidance to help local authorities to use the most appropriate tools and methods for conducting a review and assessment of air quality in their Borough. This is part of a package of guidance being prepared to assist with the practicalities of implementing the AQS. Other guidance covers air quality and land use planning, air quality and traffic management and the development of local air quality action plans and strategies.

Timescales to achieve the objectives

In most local authorities, objectives will be met for most of the pollutants within the timescale of the objectives shown in Table 2. It is important to note that the objectives for NO_2 remain provisional.

Air Quality Reviews

Technical Guidance has been issued to enable air quality to be monitored, modelled, reviewed and assessed in an appropriate and consistent fashion. This includes the Technical Guidance LAQM.TG(03), and the previous version LAQM.TG4(00) May 2000, on 'Review and Assessment: Pollutant Specific Guidance'. The primary objective of undertaking a review of air quality is 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 complexity and detail required in a review depends on the risk of failing to achieve air quality objectives.

At present Northern Ireland District Councils are engaged in the 3 staged approach of review and assessment. Stage 1 equates to an 'updating and screening' assessment, and a stage 2 and 3 equates to a 'detailed assessment'. The Stages are briefly described in Table 3. The latest technical guidance LAQM.TG(03) is based on a revised '2 step' approach. The Steps are briefly described in Table 3. Whilst district councils have commenced using the old technical guidance (LAQM. TG4 (00)) the methodology has been cross-referenced with the new revised guidance.

Table 3:Brief details of Stages in the Air Quality Review and Assessment process

Stage	Objective	Approach	Outcome
First Stage Review and Assessment	• Identify all significant pollutant sources within or outside of the authority's area.	• Compile and collate a list of potentially significant pollution sources using the assessment criteria described in the Pollutant Specific Guidance	
	• Identify those pollutants where there is a **risk** of exceeding the air quality objectives, and for which further investigation is needed.	• Identify sources requiring further investigation.	• Decision about whether a Stage 2 Review and Assessment is needed for one or more pollutants. If not, no further review and assessment is necessary.
Second Stage Review and Assessment	• Further screening of significant sources to determine whether there is a significant risk of the air quality objectives being exceeded.	• Use of screening models or monitoring methods to assess whether there is a risk of exceeding the air quality objectives.	
	• Identify those pollutants where there is a **risk** of exceeding the objectives, and for which further investigation is needed.	• The assessment need only consider those locations where the highest likely concentrations are expected, and where public exposure is relevant.	• Decision about whether a Stage 3 Review and Assessment is needed for one or more pollutants. If, as a result of estimations of ground level concentrations at suitable receptors, a local authority judges that there is no significant risk of not achieving an air quality objective, it can be confident that an Air Quality Management Area (AQMA) will not be required. • However, if there is doubt that an air quality objective will be achieved a third stage review should be conducted.

Table 3 contd.

Brief details of Stages in the first Review and Assessment process

Stage	Objective	Approach	Outcome
Third Stage Review and Assessment	• Accurate and detailed assessment of both current and future air quality. Assess the **likelihood** of the air quality objectives being exceeded.	• Use of validated modelling and quality-assured monitoring methods to determine current and future pollutant concentrations.	
	• Identify the geographical boundary of any exceedences, and description of those areas, if any, proposed to be designated as an AQMA.	• The assessment will need to consider all locations where public exposure is relevant. For each pollutant of concern, it may be necessary to construct a detailed emissions inventory and model the extent, location and frequency of potential air quality exceedences.	• Determine the location of any necessary Air Quality Management Areas (AQMAs). Once an AQMA has been identified, there are further sets of requirements to be considered. • A further assessment of air quality in the AQMA is required within 12 months which will enable the degree to which air quality objectives will not be met and the sources of pollution that contribute to this to be determined. A local authority must also prepare a written action plan for achievement of the air quality objective. Both air quality reviews and action plans are to be made publicly available.

Table 3.1:

Brief details of Steps in the revised Air Quality Review and Assessment process

Level of Assessment	Objective	Approach
Updating and Screening Assessment (USA)	• 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 changers 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.

Table 3.1 contd:

Typical locations where the objectives should and should not apply

Averaging Period	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 offices or other places of work where members of the public do not have regular access.
		• Building facades of residential properties, schools, hospitals, libraries etc.	• 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.	• Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term.
		• Gardens of residential properties.	

Table 3.1 contd:

Typical locations where the objectives should and should not apply

Averaging Period	Pollutants	Objectives should apply at …	Objectives should generally not apply at …
1 hour mean	• Nitrogen dioxide • Sulphur dioxide	• All locations where the annual mean and 24 and 8-hour mean objectives apply.	• Kerbside sites where the public would not be expected to have regular access.
		• 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 expected to have 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.	

It is unnecessary to consider exceedences of the objectives at any location where public exposure over the relevant averaging period would be unrealistic, and the locations should represent non-occupational exposure.

Key Points

- The Environment (Northern Ireland) Order 2002 has required the development of a National Air Quality Strategy for the control of air quality
- A central element in the Strategy is the use of air quality standards and associated objectives based on human health effects that have been included in the Air Quality Regulations.
- The Strategy uses a local air quality management approach in addition to existing national and international legislation. It promotes an integrated approach to air quality control by the various actors and agencies involved.
- Air quality objectives, with the exception of ozone, are to be achieved by specified dates up to the end of 2010.

A number of air quality reviews are required in order to assess compliance with air quality objectives. The number of reviews necessary depends on the likelihood of achieving the objectives.

2. LIMAVADY BOROUGH

The Borough of Limavady is situated in the north-west of the Province. It covers an area of approximately 239 square miles and has a resident population of almost 32,000 people.

The main centre of population within the Borough is Limavady town itself. Its population is in the region of 13,000 and is mainly residential in character with a small commercial base. Limavady was previously a market town but in recent years has developed into a commuter base for those persons working in the neighbouring towns of Coleraine and Londonderry.

Outside Limavady town are the smaller communities of Dungiven, Ballykelly, Greysteel, Bellarena and Drumsurn. These smaller areas predominately rely on farming (both arable and pasture) as a source of revenue.
Limavady Borough Council is bounded to the west by Derry City Council, one of the largest authorities in Northern Ireland. Coleraine Borough Council to the east and Magherafelt District Council to the south.

Summary of Limavady Borough Council's stage one review and assessment

Good air quality is essential for human health and the well being of the environment as a whole. In 1997 the government issued the National Air Quality strategy as part of its commitment to sustainable development. This document set out its ambient air quality policy for the UK for eight priority pollutants, namely benzene, 1-3 butadiene, carbon monoxide, lead, nitrogen dioxide, sulphur dioxide, particulate matter and ozone, with the aim of delivering significant improvements in the next few years.

Responsibility has been placed on local authorities in England, Scotland and Wales under the terms of the Environment Act 1995 to regularly review their local air quality. The process involves a three stage phased approach.
Stage 1 - An initial screening of industrial, transport and other sources of pollution that could have a significant impact within the authority area.
Stage 2 - A more detailed assessment of those pollutants identified in stage one as having a potential impact on air quality. Monitoring of these pollutants is required to assess concentration.
Stage 3 - An accurate detailed review of significant pollutants to predict the likelihood of concentrations exceeding the thresholds stated in the Air Quality Strategy. Determination of the extent of any problems is also required.

In Northern Ireland provisions similar to those detailed in the Environment Act 1995 have recently been introduced to bring it into line with the rest of the UK. The Air Quality Limit Value Regulations (NI) 2002 as amended now place a statutory obligation on District Councils in Northern Ireland to review air quality. Council's first stage review and assessment was completed in August 2001. This first stage review and assessment highlighted that Council would have to proceed to stage 2/3 of the review process with regard to three of the major pollutants, namely nitrogen dioxide, sulphur dioxide and particulate matter.

3. Summary of health effects of pollutants

Nitrogen Dioxide

National Air Quality Objective:
200ug/m^3 (105ppb) 1 hour mean not to be exceeded more than 18 times per year (2005),
21 ppb annual mean (2005)

Health Effects

Nitrogen Dioxide (NO_2) and nitric oxide (NO) are both oxides of nitrogen and are collectively referred to as NOx. Nitrogen dioxide is produced by the oxidation of nitric oxide in the atmosphere and there is a complex relationship between emissions of NOx and the resulting concentration of NO_2. Nitrogen dioxide is associated with adverse effects on human health. It can at certain levels affect lung function. Repetitive exposure causes changes in lung structure, lung metabolism and the lungs ability to fight bacterial infection. Animal toxicological studies suggest that peak

concentrations contribute more to the toxicity than does the duration of exposure although the latter is relevant. For this reason the Government have set two national air quality objectives; both hourly means and an annual mean.

Sources of NOx

The main sources of NOx in the United Kingdom are

- road transport which accounted for 50% of total emissions in 1995
- the generation of electricity (20%)
- commercial and industrial operations (12%)

The technical guidance required Council to examine NOx levels at relevant locations close to roads used by more than 10000 vehicles per day.

Sulphur dioxide

National Air Quality Objective
350μg/m^3 (132ppb) 1hour mean to be achieved by end 2004 (not to be exceeded more than 24 times per year)

125μg/m^3 (43.7ppb) 24 hour mean to be achieved by end 2004 (not to be exceeded more than three times per year)

267μg/m^3 (1000 ppb) 15 minute mean to be achieved by end 2000 (not to be exceeded more than 25 times per year)

Health Effects
Sulphur dioxide is a colourless corrosive acidic gas with a choking taste. At high concentrations it is a strong irritant to the eyes and mucus membranes. At very low concentrations sulphur dioxide is an acute respiratory irritant causing airways to narrow and inducing coughing. Whilst these effects are reversible in healthy individuals the consequences can be more severe in those persons who have ailments of the cardio-respiratory system. Recent studies have shown that individuals who suffer from asthma may be particularly susceptible to those concentrations which are experienced during pollution episodes. Sulphur dioxide may also be converted through chemical reactions in the atmosphere to form sulphate particulate matter. Sulphur dioxide combines with water vapour in the atmosphere to produce acid rain. This acidic solution is very corrosive and damages the stone work of buildings.

Sources of Sulphur Dioxide
Throughout the UK the main sources of sulphur dioxide (1996) are
- coal fired power stations (66%)
- industry
- road transport (<2%)

With regard to potential sources of SO_2 emissions the burning of coal/smokeless fuel within the Borough was carried through to stage two.

Particulate Matter (PM_{10})

National air quality objective
The Government has set two air quality objectives for PM_{10}, these being:

40μg/m^3 as the annual mean, and,
50μg/m^3 as the fixed 24- hour mean to be exceeded no more than 35 days per year.

These objectives are to be achieved by the end of 2004

Health effects
PM_{10} emissions contain a wide range of particles all with a diameter less than 10 microns (10 μm). At this size they are inhalable and can enter the respiratory tract. PM_{10} and particles in general have been linked to increases in morbidity and premature mortality. Its effects extend throughout the respiratory system. Department of Health assessments suggest that in Great Britain particles may contribute to more than 8000 premature deaths annually and 10 - 20000 hospital admissions.

Sources of PM_{10}
There are several emission sources which contribute to PM_{10} concentrations in the UK. They can be divided into three main categories:

- Primary combustion particles - particles emitted directly from combustion processes such as road traffic, power generation and industry. The diameter of these particles ranges from 1μm to 2.5μm.
- Secondary particles - particles formed in the atmosphere after release in their gaseous phase. These include sulphates and nitrates formed from emissions of sulphur dioxide and nitrogen dioxide. These particles are generally less than 2.5um in diameter.
- Coarse particles - these include a wide range of emissions from non-combustion sources e.g. dust from construction and mineral extraction processes. These particles are generally greater than 2.5μm in diameter.

As with $S0_2$, the fuel use survey was used to determine if PM_{10} concentrations were likely to be exceeded within the borough.
Passive monitoring was also carried out for both NO_2 and SO_2.

The findings of these exercises are summarised in the following sections.

4. Effect of traffic emissions on NO_2 and PM_{10} concentrations

Design Manual for Roads and Bridges model (DMRB)

To establish if traffic emissions contributed significantly to levels of NO_2 in the borough the design manual for roads and bridges (DMRB) was used. The Stage one review and assessment identified six roads as requiring assessment. These were roads used by more than 10,000 vehicles per day. This screening exercise estimated pollutant concentrations at relevant kerbside locations on the basis of:

- traffic flow data obtained from the DOE, the speed of the vehicles,
- the distance from the receptor to the centre of the road and from the receptor to the kerb of the road,
- the percentage of HGV's using these stretches of road.
- traffic speeds
- predicted traffic growth

The screening exercise predicted pollutant concentrations for the years 2005 (NO_2) and 2004 (PM_{10}).

Table 4 below lists the annual average and 99.8th percentile of maximum hourly average kerbside concentrations (equivalent to 18 exceedences per year) of nitrogen dioxide predicted for 2005 within the borough. The 99.8th percentile of hourly averages has been estimated as 3.5 times the annual mean for roadside locations as advised in LAQM TG4 (00).

Table 4:
Nitrogen dioxide concentrations at roadside locations in Limavady Borough Council

Description of Link	Distance to nearest receptor from kerbside (m)	NO_2 Annual mean (µg m^{-3}) 2005	NO_2 99.8th percentile of hourly averages (µg m^{-3}) 2005
Roe Bridge (Catherine St) / Linenhall St	1	31.6	110.5
Main St / Garvagh Rd Dungiven	4	25.1	87.8
Main St / Ballyquin Rd Dungiven	2	30.7	107.4
Rathmore Rd / Bell's hill	10	29.8	104.2
Main St, Ballykelly	2.5	29.2	102.2
Clooney Rd, Greysteel	4	24.7	86.4

Particulate Matter (PM_{10}.)

Estimates of background concentrations were obtained for the borough using maps on the UK National Air Quality Information archive website. The maximum background concentration was 17.7 ug/m^3.

As recommended in LAQM.TG4 (00) DMRB was used to predict PM_{10} concentrations for 2004. The guidance states that the 24-hour objective is highly unlikely to be exceeded if the annual mean concentration is below 28ug/m^3, gravimetric. Table 5 shows the 2004 predictions. For 2004 the method predicts annual average concentrations of PM_{10} less than 28ug/m^3 at all of the locations modelled.

Table 5:
Predicted PM_{10} concentrations at roadside locations in the Limavady Borough Council region.

Description of Link	PM_{10} Annual mean (µg m^{-3}) 2004
Roe Bridge (Catherine St) / Linenhall St	19.5
Main St / Garvagh Rd Dungiven	18.9
Main St / Ballyquin Rd Dungiven	19.4
Rathmore Rd / Bell's hill	19.2
Main St, Ballykelly	19.3
Clooney Rd, Greysteel	18.9

Conclusion.

With regard to traffic emissions and in terms of the DMRB assessment predicted levels of NO_2 and PM_{10} are not expected to exceed the air quality strategy objectives. In addition completion of a bypass in Limavady in 2003 has also reduced traffic volumes at relevant locations in the town. Application of the DMRB model would suggest that it is therefore not necessary to undertake a stage 3 review and assessment for either of these pollutants. (However passive monitoring of NO_2 in the Limavady and Dungiven areas would tend to suggest that levels are impinging on the annual average threshold of 40ug/m^3 . This will be discussed in detail below).

5. Survey of domestic fuel use within Limavady Borough.

Council's first stage review and assessment highlighted the possibility that consumption of solid and smokeless fuel may be contributing to elevated levels of SO_2 and PM_{10}. To establish if this was the case Council commissioned a fuel use survey to be carried out in both Limavady and Dungiven.

Scope of survey
The areas surveyed were three residential areas, two in Limavady town and one in Dungiven. The three areas examined were 1km x 1km in size and comprised both private and public sector. Housing densities and age of dwellings within the areas varied. The survey comprised a 25% sample and a 75% response rate was achieved. Table 5 below summarises the area densities and response levels.

Table 5
Summary of fuel use survey

Area No.	Area	Area Density	Sample (25%)	Target Response rate	Achieved rate	Not at home/ refused
1	Limavady	1471	368	276	276	518
2	Limavady	663	166	126	128	290
3	Dungiven	841	210	158	164	389
	Total	2975	744	560	568	1197

Results

Area 1: Limavady

- 29% of households surveyed within this area used coal/ solid fuel as their primary fuel. This equates to approximately 426 households over the whole of area 1.
- 66% of dwellings used oil and,
- the remaining 5% used electricity

Area 2: Limavady

- 5% of dwellings used solid/smokeless fuel as their primary source of heating which equates to only 31 dwellings in the entire 1km x 1km area.
- 93% of properties used oil as their primary heating source, and
- 2% used electricity

Area 3: Dungiven

- 87% of dwellings used oil as their primary source of fuel
- 13% used coal/ smokeless fuel as their main means of heating. This equates to approximately 108 dwellings in the area burning coal or smokeless fuel.

The former pollutant specific guidance for SO_2 stated that where the density of households burning coal/ smokeless fuel exceeds 300 per $1km^2$ there was likely to be an exceedence of the air quality objective for SO_2. The revised technical guidance

which was issued in 2003 stated that this exceedence may occur where densities of coal/ smokeless fuel burning properties were greater than 50 in a 500m x 500m area. On the basis of primary fuel use only it was evident that the thresholds as set out in the technical guidance were possibly exceeded in two areas, namely area 1 in Limavady and area 3 in Dungiven. With this guidance in mind it was felt that dispersion modelling for SO_2 should be undertaken within area 1 in Limavady and in area 3 in Dungiven. This modelling would predict pollutant concentrations for 2005.

With regard to PM_{10} and domestic solid fuel use the first stage review and assessment suggested that further investigation was required to establish if levels were likely to be exceeded and to establish if the air quality objective could be achieved by 2005. The pollutant specific guidance for PM_{10} (as revised) advised that the risk of exceedence of the 2005 objective may arise where significant coal/smokeless fuel burning occurs. It recommends that areas where more than 50 dwellings in 500m x 500m burn solid fuel as their primary source of heating further investigation is required. Details pertaining to the modelling which was carried out are considered is section 6.

6. Dispersion modelling

In light of the fuel use survey results dispersion modelling was then carried out by NETCEN on Council's behalf to establish if significant levels of SO_2 and PM_{10} were present in area 1 in Limavady and area 3 in Dungiven.

Overview of the modelling approach
The dispersion model ADMS 3.1 developed by CERC was used to predict the PM_{10} and SO_2 levels in Limavady Borough. ADMS is a PC-based model that includes an up-to-date representation of the atmospheric processes that contribute to pollutant dispersion and has been deemed suitable for use in the review and assessment process.

The emissions arising from each survey area have been modelled as volume sources 10m high. Emissions have been weighted with both seasonal and diurnal emission patterns. The seasonal pattern was calculated on a degree day basis to weight emissions to the colder periods of the year following the BREDEM model (BREDEM, BRE, 1985). Temperature data for each hour was taken from the 1999 Aldergrove meteorological data.

The modelled concentrations have then been added to estimated background concentrations (taken from the NAEI web site).

Model bias
As no continuous monitoring has been carried out within Limavady Borough a monitoring site at Springhill Park, Strabane was used as a reference site: e.g. model concentrations have been adjusted by taking the ratio between the modelled concentration at the site and the predicted measured value in 1999 from the modelled values at locations in Limavady. The purpose of this adjustment was to ensure that the modelled concentrations equalled the measured values at the monitoring site. A similar methodology was used in the Strabane study to Limavady.

Model validation
The calculations have not taken account:

- Uncertainties in the fuel use survey as only 15-20% of households were surveyed;
- Uncertainties in how the burning of domestic fuel might change in future years;
- Uncertainty resulting from year to year variations in atmospheric conditions;
- Model errors at the receptor sites;
- Model errors at the reference site;
- Uncertainty in the location of the monitor with respect to local sources
- Monitoring over a short time period
- Uncertainty in emission factors (See section 6.2)

Pollutant emissions are expected to decrease generally due to national measures (which will affect the background concentrations). However, for SO_2 in particular the background contribution is small. Concentration plots are therefore only shown for 1999 as this is the year for which modelling has been carried out and it is assumed

that the results of the survey are applicable to both 1999 and 2004/5. It is unlikely that housing stock/ fuel use within these areas will change significantly over the next few years.

Results of modelling

Limavady: Area 1

Figure 1 shows predicted SO_2 concentrations in the Limavady area. The model predicts that the 99.9 percentile of the 15 minute mean SO_2 concentration will not be exceeded in any parts of the Borough. It has been assumed that domestic fuel burning in the area will not change between when the survey was carried out and 2004/5.

Figure 1 –99.9 percentile 15 minute mean SO_2 concentrations for the Limavady grid (model results corrected for bias using monitoring data from Strabane)

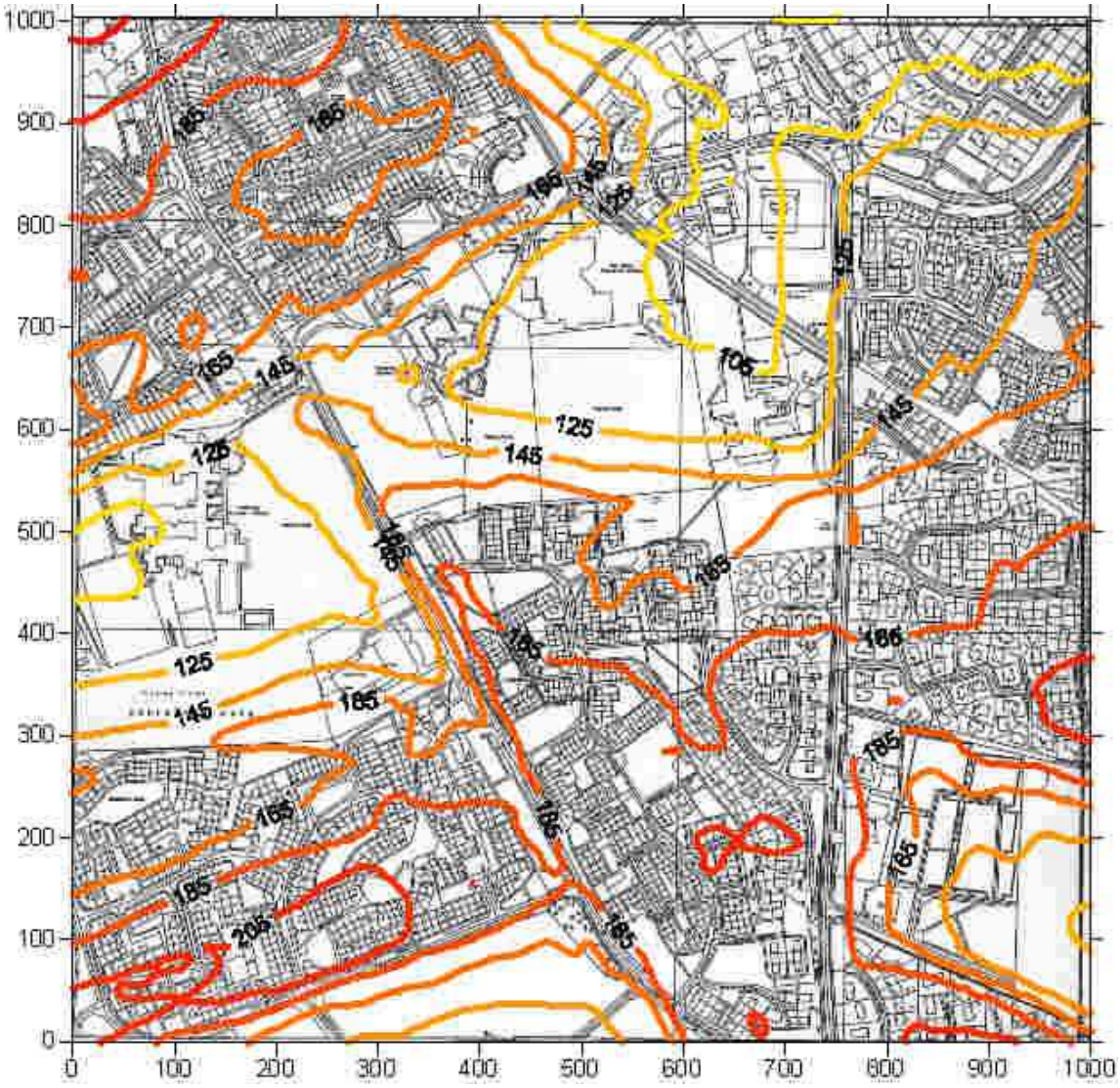
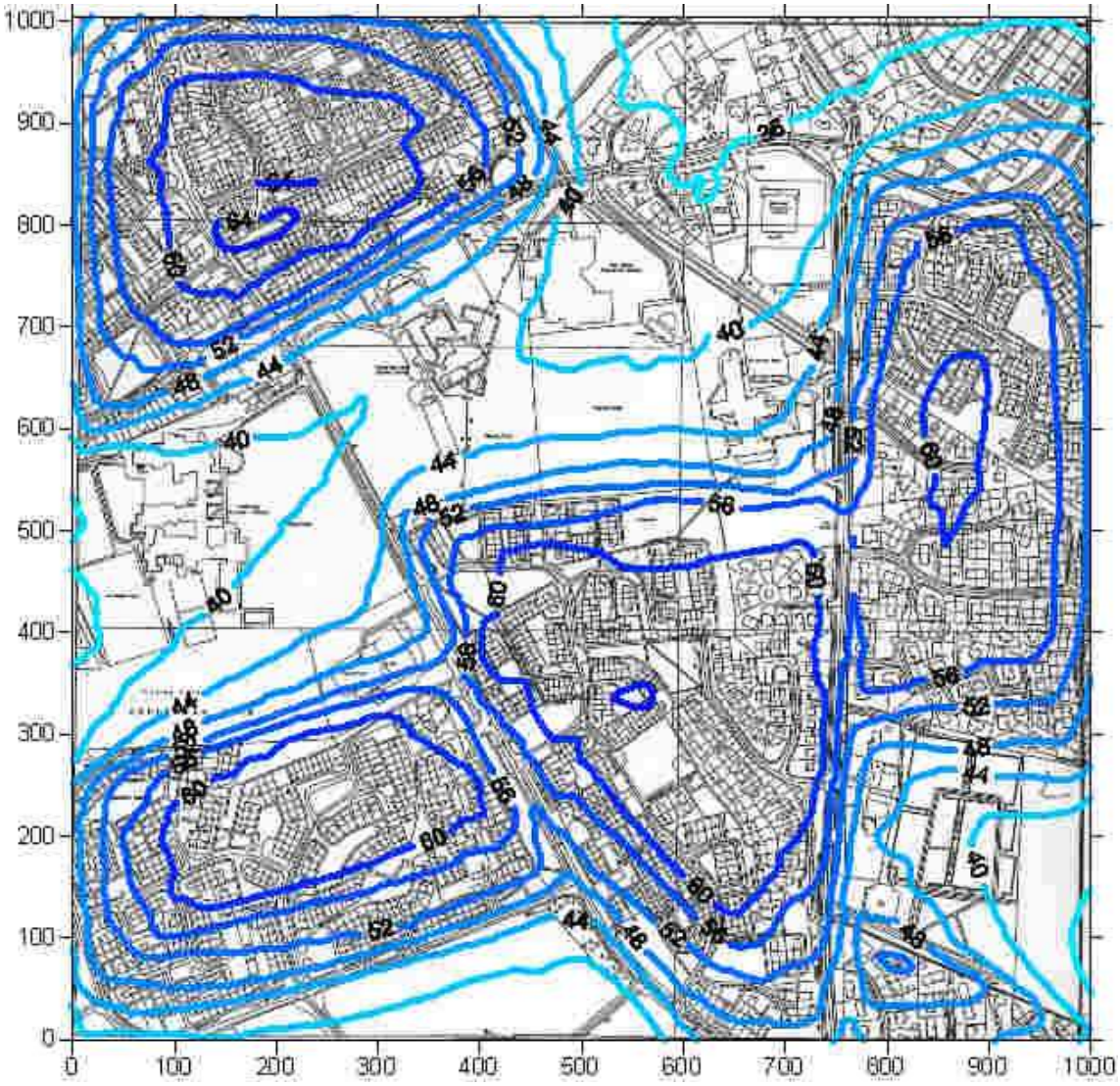


Figure 2 shows the predicted PM_{10} concentrations in the Limavady area. The model predicts that the 90.41 percentile of 24 hour PM_{10} concentrations in 2004 will be

exceeded in some parts of this area. It has been assumed that domestic fuel burning in the area will not change between when the survey was carried out and 2004/5

Figure 2 – Predicted 90.4 percentile daily mean PM_{10} concentrations for the Limavady grid (model results corrected for bias using monitoring data from Strabane in 1999)



Dungiven

Figure 3 shows modelled SO_2 concentrations in Dungiven. The model predicts that the 99.9 percentile of the 15 minute mean SO_2 concentrations will not be exceeded in 2004/5.

Figure 3 – 99.9 percentile 15 minute mean SO_2 concentrations for the Dungiven grid (model results corrected for bias using monitoring data from Strabane)

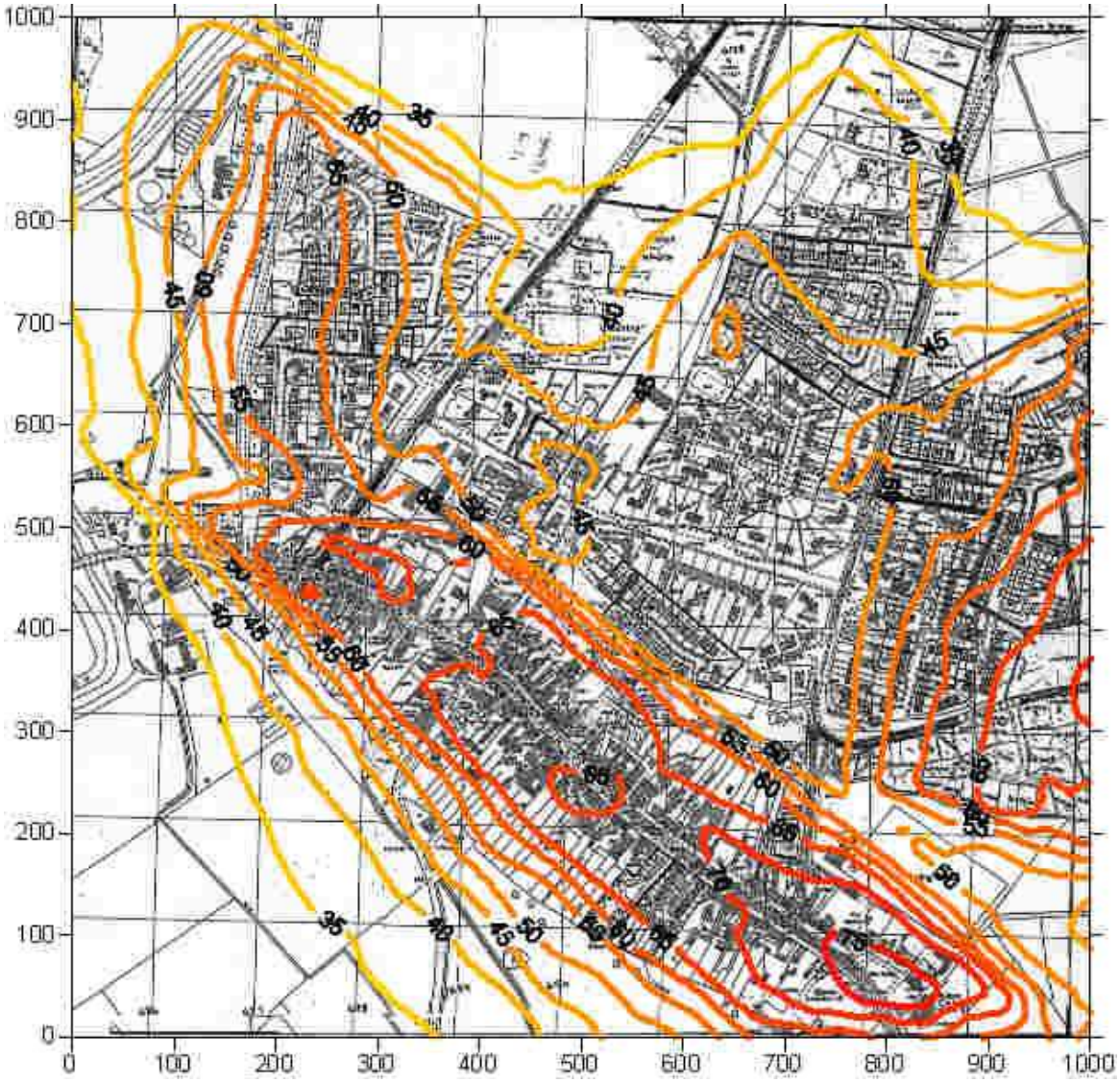
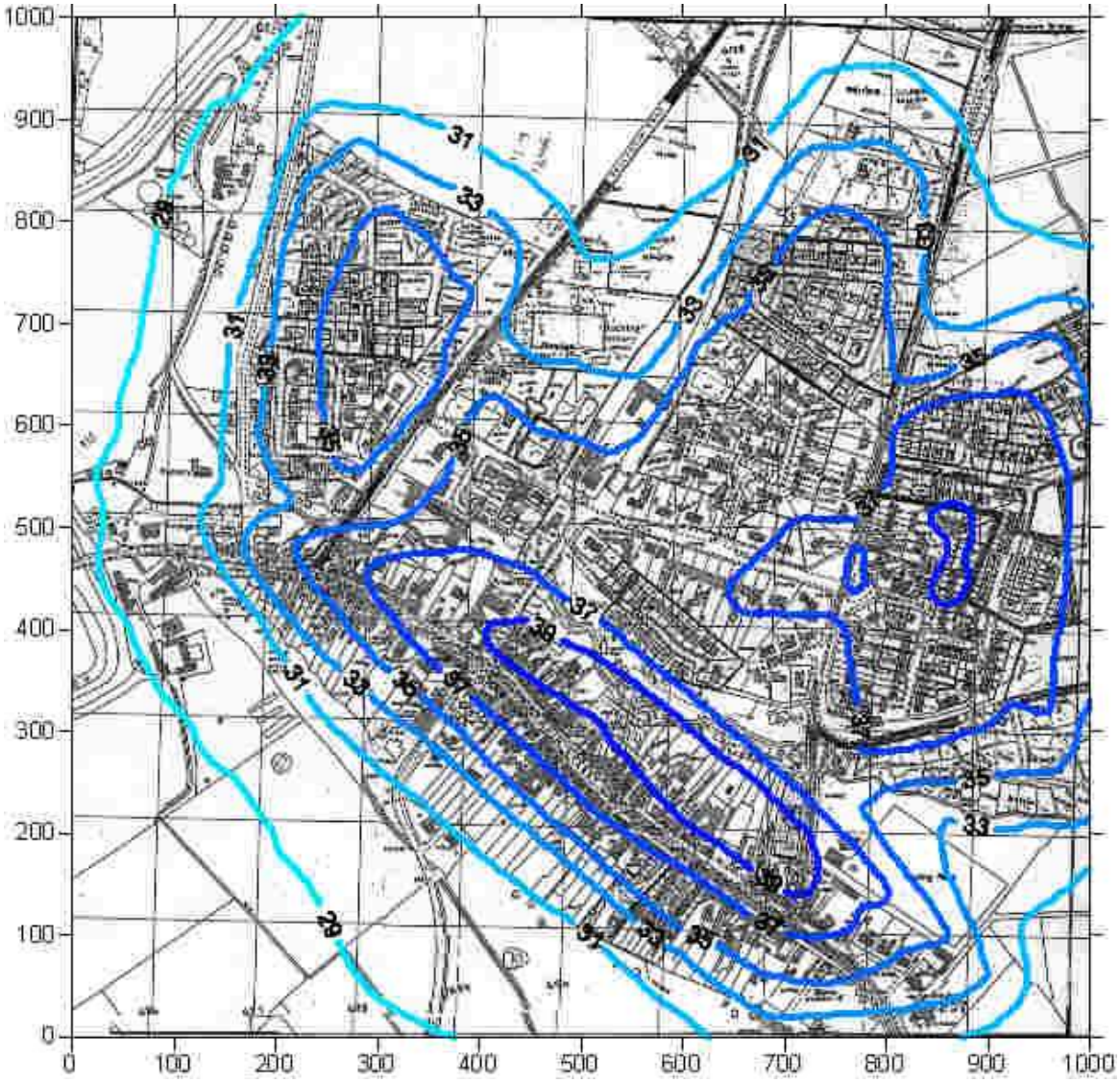


Figure 4 shows modelled PM_{10} concentrations in the Dungiven area in 1999. The model predicts that the 90.41 percentile of 24 hour PM_{10} concentrations will not be exceeded in this area.

Figure 4 – 90.4 percentile daily mean PM_{10} concentrations for the Dungiven grid (model results corrected for bias using monitoring data from Strabane in 1999)



Higher SO_2 and PM_{10} concentrations were predicted in the Limavady area because a greater proportion of households burn coal as their primary fuel source (29% of households) compared with in the Dungiven grid (13% of households) and because there is a greater total number of households situated in the Limavady area.

In summary, detailed modelling using ADMS version 3.1 has been undertaken at two locations where large amounts of solid/smokeless fuel is burnt. The modelling (corrected for bias) predicts that in both the Limavady area and in Dungiven exceedences of the SO_2 objectives are unlikely.

A comparison of the monitoring data recorded at Belfast East during April 2002 to April 2003 (when the continuous monitor at Springhill Park, Strabane was in operation) with data recorded during 1999 showed that during the time that the Strabane site has been in operation, far lower values have been recorded than in previous years. Therefore the data recorded so far at Springhill Park may not be representative of future concentrations.

The modelling (corrected for bias) predicted that in area 1 in Limavady an exceedence of the PM_{10} objectives in 2004 was likely. In Dungiven the model did not predict an exceedence of the objectives.

It is not recommended that an AQMA is declared for PM_{10} for Dungiven as no exceedence is expected. It is not recommended that an AQMA is declared for SO_2 in either area. However with regard to PM_{10} levels in Area 1 Limavady it is proposed to carry out continuous monitoring over a six-month winter period. Whilst Council is not in a position as yet to declare an AQMA with regard to PM_{10} a decision on whether a declaration is required will be made on the completion of this monitoring.

7. Passive diffusion monitoring of NO_2 and SO_2

In light of the first stage review and assessment passive monitoring of NO_2 and SO_2 was carried out at various locations throughout the Borough. The diffusion tubes were set up in March 2002 and exposed on a monthly basis.

Nitrogen dioxide tubes are situated at:

TUBE	LOCATION
No: 1	Junction of Ballyquin Road / Main Street Dungiven
No: 2	Junction of Garvagh Road / Main Street Dungiven
No: 3	Clooney Road Greysteel
No: 4	Main Street Ballykelly
No: 5	Linenhall Street Limavady
No: 6	Junction of Broad Road / Scroggy Road
No: 7	Greystone Road roundabout
No: 8	Junction of Irish Green Street / Connell Street, Limavady
No: 9	Blank

Sulphur dioxide tubes at located at:

TUBE	LOCATION
No: 1	Junction of Station Road / Holmlea Park Dungiven
No: 2	143 Mount Eden
No: 3	108 Roemill Gardens Limavady
No: 4	Blank

The locations for the tubes were selected as they were in areas where daily traffic flows were in excess of 10000 vehicles per day (NO_2) and the predominant domestic fuel use was coal/ smokeless fuel (SO_2). The three SO_2 tubes were located in the three areas which were selected for inclusion in the fuel use survey. (The SO_2 tube at site number 2 was relocated to 7 Connell Street, Limavady in July 2003). With regard to the NO2 tubes tubes 1 and 2 were placed on the façade of buildings. This was not possible at the other six sites.

Both sets of diffusion tubes were supplied and analysed by Gradko International Limited on behalf of Envirotechnology Services plc of Kingfisher Business Park, Stroud, Gloucestershire. The laboratory used for analysis is accredited to ISO 17025 and their NO_2 diffusion tube analysis is carried out using AEA/NETCEN standards. The tube preparation was 20% TEA in water. Monitoring commenced in March 2001 and is due to be completed in March of 2004. The monitoring results are contained in Appendix 1.

Nitrogen Dioxide

In terms of the thresholds set out in the technical guidance it is felt that there may be exceedences of the limits within Dungiven (39.81ug/m^3) and on Irish Green Street,

Limavady (41.89ug/m^3). The annual means for all the sites are listed in appendix 2. When the bias was applied from a collocated study in Exeter (2003) it is felt that the values stated require adjustment (1.02)*. To establish if the thresholds are likely to be exceeded it is our intention to monitor further in these areas. It is would proposed to continue using passive diffusion tubes and to collocate three tubes at the continuous NO_2 monitor in Derry City to ascertain if adjustment of results is required. These results would tend to suggest that further investigation is required and whilst the DMRB assessment tended to suggest no further action was required it is felt closer attention needs to be paid to these two areas. NETCEN had identified Linenhall Street in Limavady as an area where exceedence was possible but traffic flows have reduced greatly in this area since a bypass was opened in July 2003. No traffic figures are available as yet to quantify this reduction but Council will request that such counts are carried out by DOE Roads Service.

* bias as stated in University of West England website www.uwe.ac.uk/aqm/review/links.html (overall factor 1.02 : 2 studies Dudley Metropolitan Council and Exeter City Council).

Sulphur dioxide

The results of passive monitoring are included in appendix 1. They would tend to suggest that there are no significant levels present in the three areas monitored and that the three thresholds as stated in the revised technical guidance are unlikely to be exceeded. No further action is therefore required.

8. Conclusion

Following our assessments it is felt that two areas of investigation remain:

- Continued passive monitoring of NO_2 levels and possibly continuous monitoring within the Dungiven area and area around Irish Green Street in Limavady to establish if traffic is likely to be contributing significantly to levels.

- Continuous monitoring over the forthcoming six-month winter period (Oct 2004-March 2005) of PM_{10} levels within Area 1 in Limavady.

This work will be undertaken over the next few months and upon completion Council will be in a position to determine if an AQMA has to be declared with respect to these pollutants.

Appendix 1

Results of analysis of NO_2 Passive diffusion monitoring (March 2002 – December 2003)

Year	Month	Tube 1	Tube 2	Tube 3	Tube 4	Tube 5	Tube 6	Tube 7	Tube8
2002	March - April	-	-	-	-	40.41	14.01	-	31.79
	April - May	35.38	30.18	17.67	-	38.45	-	-	33.30
	May - June	-	-	-	27.54	40.67	20.02	-	20.59
	June - July	-	-	-	25.08	36.91	24.20	15.00	37.15
	July- Aug	29.69	26.45	-	26.92	42.59	-	15.07	22.50
	Aug - Sept	40.05	44.50	20.88	32.37	47.86	28.61	19.83	46.27
	Sept - Oct	44.96	34.37	12.40	21.48	37.51	32.83	20.24	21.01
	Oct	38.93	38.93	-	26.50	-	28.31	18.90	-
	Nov - Dec	46.05	39.83	19.50	32.33	-	34.89	24.89	51.09
2003	Jan - Feb	33.49	32.82	11.39	26.12	48.14	25.41	19.39	43.46
	Feb - March	42.82	40.50	24.27	32.35	46.29	45.71	-	53.65
	March - April	35.02	37.41	14.24	27.10	39.24	24.50	-	-
	April - May	50.19	51.34	17.28	36.87	-	28.84	-	51.34
	May- June	36.59	34.64	15.61	26.35	44.40	20.49	18.54	35.62
	June- July	32.26	42.05	16.70	28.23	-	21.86	43.71	16.70
	July - Aug	39.60	33.86	-	-	-	-	18.23	37.51
	Aug- Sept	38.86	37.26	21.25	29.82	-	18.11	21.30	38.81
	Sept - Oct	40.16	37.22	17.95	30.21	-	21.02	21.02	-
	Oct - Nov	46.97	44.00	19.03	35.68	-	29.73	26.16	45.79
	Nov - Dec	42.01	46.81	14.40	28.21	-	27.01	23.41	45.01

* all figures in ug/m^3

- indicates missing tube

Appendix 1 contd.

Results of Analysis of SO2 Passive diffusion monitoring (March 2002 – December 2003)

Year	Month	Tube 1	Tube 2	Tube3
	March - April	1.65	1.94	7.76
2002	April - May	-	1.13	6.85
	May - June	-	1.40	4.20
	June - July	-	3.22	3.83
	July- Aug	-	0.34	4.24
	April - May	-	1.96	8.49
	Sept - Oct	1.43	1.43	6.69
	Oct	5.04	9.56	7.38
	Nov - Dec	-	1.82	11.22
2003	Jan - Feb	-	3.79	13.67
	Feb - March	3.09	2.73	14.50
	March - April	2.63	5.98	9.24
	April - May		0.54	7.07
	May- June	-	2.24	4.18
	June- July	4.23	3.72	6.63
	July - Aug	2.39	1.31	3.28
	Aug- Sept	-	1.47	2.76
	Sept - Oct	0.83	3.86	4.67
	Oct - Nov	1.87	6.92	4.02
	Nov - Dec	3.40	5.10	4.26

* All figures in ug/m^3
- indicates missing tube

Appendix 2

Annual average mean concentrations of NO_2

Tube	1	2	3	4	5	6	7	8
Annual mean	36.8	39.81	17.42	30.29	44.5	27.05	24.07	41.89

* All figures in ug/m^3