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Air Quality Review and Assessment - Stage 2

A report produced for Strabane District Council

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Executive Summary

The UK Government published its strategic policy framework for air quality management in 1995 establishing national strategies and policies on air quality which culminated in the Environment Act, 1995. The National Air Quality Strategy provides a framework for air quality control through air quality management and air quality standards. New national air quality standards have been proposed by the Expert Panel on Air Quality Standards (EPAQS) for the UK. These and other air quality standards and their objectives have been enacted through the Air Quality Regulations. The Environment Act 1995 requires Local Authorities to undertake an air quality review. In areas where air quality objectives are not anticipated to be met by the specified date, Local Authorities are required to establish Air Quality Management Areas to improve air quality.

The first step in this process is to undertake a review of current and potential future air quality. A minimum of two air quality reviews are recommended in order to assess compliance with air quality objectives, one to assess air quality at the outset of the Air Quality Strategy and a second to be carried out towards the end of the policy timescale (2005). The number of reviews necessary depends on the likelihood of achieving the objectives.

This report is equivalent to a stage two air quality review as outlined in the Government's published guidance. The air quality review investigates current and potential future air quality through an examination of the location and size of principal emission sources, emissions modelling exercises and by reference to monitored air quality data.

The conclusions of the report are as follows:

The PM_{10} air quality objective is unlikely to be met as a result of domestic coal burning and therefore a third stage review is recommended for this source.

In addition, sulphur dioxide concentrations arising from the following three industries may cause an exceedence of the SO_2 objectives:

Adria Ltd
Herdmans
Leckpatrick Dairies.

It is therefore recommended that these are studied further in a stage 3 review and assessment.

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Acronyms and definitions

AQS	Air Quality Strategy
AADTF	annual average daily traffic flow
APEG	Airborne Particles Expert Group
AQMA	Air Quality Management Area
AUN	Automatic Urban Network
CHP	Combined Heat and Power plant
CNS	central nervous system
CO	Carbon monoxide
CRI	Chemical Release Inventory (now the Pollution Inventory)
DEFRA	Department of the Environment, Food and Rural Affairs.
DMRB	Design Manual for Roads and Bridges
EA	Environment Agency
EPA	Environmental Protection Act
EPAQS	Expert Panel on Air Quality Standards
HA	Highways Agency
HFO	heavy fuel oil
HGV	heavy goods vehicle
IPPC	Integrated Pollution Prevention and Control
M	mega ($1x10^6$)
MoD	Ministry of Defence
NAEI	National Atmospheric Emission Inventory
NETCEN	National Environmental Technology Centre
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
PG	Process Guidance (notes)
PI	pollution inventory
ppb	parts per billion
ppm	parts per million
PSG	Pollutant Specific Guidance (see Reference section)
SDC	Strabane District Council
SO_2	Sulphur dioxide
SoS	Secretary of State
SSAQR	Second Stage Air Quality Review
TEOM	tapered element oscillating microbalance
VOC	volatile organic compound

1 Introduction

This chapter introduces the important elements of the government's air quality strategy. Chapters 2 onwards present the results of the air quality review and assessment.

1.1 THE NEED FOR A NATIONAL AIR QUALITY STRATEGY

During the early 1990s, the Department of Environment, Transport and the Regions' (DETR) investigated the need for a new framework for air quality control. This was fuelled by episodes of poor air quality in many of the UK's major urban areas and increasing concerns expressed by both the public and the scientific community. The need to reconcile rising demands in living standards with the maintenance of environmental quality has already been recognised in Agenda 21 and is now taken further with the development of the Air Quality Strategy (AQS)[1].

On the whole, air quality in the UK today is much improved compared to that of fifty years ago when the occurrence of high SO_2 and smoke concentrations as 'smog' in towns and cities resulted in acute health effects on the resident population. However, there is now some evidence of an association between ambient air quality and chronic health effects and discomfort for sensitive individuals. For example, health effects have been linked to particulate emissions from sources such as road transportation. A new approach to the control of air quality was sought to tackle these issues and to provide a further basis for the achievement of wider objectives in relation to sustainable development in the UK.

Part IV of the Environment Act 1995, the main elements of which are shown in Table 1.1, requires the formulation of a national strategy and provides for the further development of local air quality assessment and management. This Act and the subsequent AQS are the culmination of work surrounding a number of consultation documents issued by the Government, the most important of which was 'Air Quality: Meeting the Challenge' in 1995. The Strategy was also developed within the context of information provided by an ongoing programme of research conducted by Government Panels and Review Groups. A draft Strategy was produced in August 1996 and the first National Air Quality Strategy was adopted in April 1997 (DoE, 1997). In December 1997, Air Quality Regulations set out the process of air quality review and assessment.

The Government published its proposals for review of the National Air Quality Strategy in early 1999 (DETR, 1999). These proposals included revised objectives for many of the regulated pollutants. A key factor in the proposals to revise the objectives was the agreement in June 1998 at the European Union Environment Council of a Common Position on Air Quality Daughter Directives (AQDD).

Following consultation on the Review of the National Air Quality Strategy, the Government prepared the Air Quality Strategy for England, Scotland, Wales and Northern Ireland for consultation in August 1999. It was published in January 2000 (DETR, 2000).

Table 1.1 Major elements of the Environment Act 1995

Part IV Air Quality	Commentary
Section 80	Obliges the Secretary of State (SoS) to publish a National Air Quality Strategy as soon as possible.
Section 81	Obliges the Environment Agency to take account of the strategy.
Section 82	Requires local authorities, any unitary or district, to review air quality and to assess whether the air quality standards and objectives are being achieved. Areas where standards fall short must be identified.
Section 83	Requires a local authority, for any area where air quality standards are not being met, to issue an order designating it an air quality management area (AQMA).
Section 84	Imposes duties on a local authority with respect to AQMAs. The local authority must carry out further assessments and draw up an action plan specifying the measures to be carried out and the timescale to bring air quality in the area back within limits.
Section 85	Gives reserve powers to cause assessments to be made in any area and to give instructions to a local authority to take specified actions. Authorities have a duty to comply with these instructions.
Section 86	Provides for the role of County Councils to make recommendations to a district on the carrying out of an air quality assessment and the preparation of an action plan.
Section 87	Provides the SoS with wide ranging powers to make regulations concerning air quality. These include standards and objectives, the conferring of powers and duties, the prohibition and restriction of certain activities or vehicles, the obtaining of information, the levying of fines and penalties, the hearing of appeals and other criteria. The regulations must be approved by affirmative resolution of both Houses of Parliament.
Section 88	Provides powers to make guidance which local authorities must have regard to.

1.2 OVERVIEW OF THE PRINCIPLES AND MAIN ELEMENTS OF THE NATIONAL AIR QUALITY STRATEGY

The main elements of the AQS 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 a target dates of 2003, 2004 and 2005 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.

1.2.1 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 2008 are shown in Table 1.2. The table shows the standards in ppb and $\mu g\ m^{-3}$ with the number of exceedences that are permitted (where applicable) and the equivalent percentile.

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 November 5th. 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 1.2 Air Quality Objectives in the Air Quality Regulations (2000) for the purpose of Local Air Quality Management

Pollutant	Concentration limits		**Averaging period**	**Objective** [number of permitted exceedences a year and equivalent percentile]	
	($\mu g\ m^{-3}$)	(ppb)		($\mu g\ m^{-3}$)	date for objective
Benzene	16.25	5	**running annual** mean	**16.25**	by 31.12.2003
1,3-butadiene	2.25	1	**running annual** mean	**2.25**	by 31.12.2003
CO	11,600	10,000	**running 8-hour** mean	**11,600**	by 31.12.2003
Pb	0.5	-	**annual** mean	**0.5**	by 31.12.**2004**
	0.25	-	**annual** mean	**0.25**	by 31.12.**2008**
NO_2 (see note)	200	105	**1 hour** mean	**200** [maximum of 18 exceedences a year or equivalent to the 99.8th percentile]	by 31.12.2005
	40	21	**annual** mean	**40**	by 31.12.2005
PM_{10} (**gravimetric**) (see note)	50	–	**24-hour** mean	**50** [maximum of 35 exceedences a year or ~ equivalent to the 90th percentile]	by 31.12.2004
	40	–	**annual** mean	**40**	by 31.12.2004
SO_2	266	100	**15 minute** mean	**266** [maximum of 35 exceedences a year or equivalent to the 99.9th percentile]	by 31.12.2005
	350	132	**1 hour** mean	**350** [maximum of 24 exceedences a year or equivalent to the 99.7th percentile]	by 31.12.2004
	125	47	**24 hour** mean	**125** [maximum of 3 exceedences a year or equivalent to the 99th percentile]	by 31.12.2004

Notes

1. Conversions of ppb and ppm to ($\mu g\ m^{-3}$) correct at 20°C and 1013 mb.
2. The objectives for nitrogen dioxide are provisional.
3. PM_{10} measured using the European gravimetric transfer standard or equivalent. The Government and the devolved administrations see this new 24-hour mean objective for particles as a staging post rather than a final outcome. Work has been set in hand to assess the prospects of strengthening the new objective.

This Stage 2 review and assessment compares the air quality in the Strabane District Council area with those standards in the Air Quality Regulations (2000). On September 17th 2001 new guidelines were issued, however these are yet to come official.

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 2008. For example, the Environmental Protection Act 1990 allows for the monitoring and control of emissions from industrial processes and 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. Recent 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.

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 District. 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.

1.2.2 Timescales to achieve the objectives

In most local authorities in the UK, objectives will be met for most of the pollutants within the timescale of the objectives shown in Table 1.2. The Government has recognised the problems associated with achieving the standard for ozone and this will not therefore be a statutory requirement. Ozone is a secondary pollutant and transboundary 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.

1.3 AIR QUALITY REVIEWS

A range of 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.TG4(00) May 2000, on 'Review and Assessment: Pollutant Specific Guidance[2]. This review and assessment has considered the procedures set out in the 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 and it has been proposed therefore that reviews should be carried out in three stages. All three stages of review and assessment may be necessary and every authority is expected to undertake at least a first stage review and assessment of air quality in their authority area. The Stages are briefly described below.

Stage 1 A Stage 1 review is expected to have considered all sources of pollutants which could have a significant impact in the authority's locality, either due to the emission of significant quantities of the pollutant(s) of concern, or for which there is potential for exposure of the general public to poor air quality. The review should include details of any significant existing or planned transportation, industrial or other sources in and around the District. If no sources are identified, or the size of the emissions are small, the local authority can conclude that the risk of failing to meet set air quality objectives is negligible and it is it therefore not necessary to conduct a second stage review. Alternatively, if the local authority can identify a significant source for one or more pollutants, it is necessary to proceed to a second stage air quality review.

Stage 2 The second stage air quality review provides a further screening of pollutant concentrations in local authority areas. This involves estimating, through the use of monitored or modelled data, the highest likely concentrations of air pollutants within its area and the localities where this may occur in order to assess whether there is a significant risk of an air quality objective not being met. If, as a result of estimations of ground level concentrations at roadside, industrial and background sites, 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.

Stage 3 A third stage review is an accurate and detailed review and assessment of current and future air quality in a particular district. The approaches requires more sophisticated modelling and monitoring techniques than those applied at Stage 2. This enables a local authority to predict the likelihood of meeting the objective and so determine the location of any necessary Air Quality Management Areas (AQMAs). 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. Once an AQMA has been identified, there is further set of requirements to be considered. Firstly, 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.

The review and assessment process is not compulsory for authorities in Northern Ireland and therefore there is no date by which the reports should be completed.

1.3.1 Which locations should the review and assessment concentrate on?

For the purpose of review and assessment, the authority should focus their work on locations where members of the public are likely to be exposed over the averaging period of the objective. Therefore for objectives with short averaging periods (the 15-minute and 1-hour objective for sulphur dioxide and the 1-hour objective for nitrogen dioxide) the review and assessment should focus on any non-occupational, near ground level outdoor location where members of the public might reasonably be expected to be present over the relevant averaging time. For NO_2, examples might include a pavement of a busy shopping street, a path running close to a busy road, playing fields close to a busy road. For SO_2, examples would be locations downwind of a point source.

For objectives with longer averaging periods (benzene, 1,3-butadiene, carbon monoxide, lead, PM_{10}, the 24-hour objective for sulphur dioxide and the annual mean for nitrogen dioxide) the review and assessment should focus on the following near ground level outdoor locations:

- background locations
- roadside locations (sites close to the façade of a building) where there is housing
- other areas where members of the public might reasonably be expected to be regularly exposed to outdoor air for a substantial part of the day (for example near housing, schools or hospitals)

It is unnecessary to consider exceedences of the objectives at any location where public exposure over the relevant averaging period would be unrealistic.

Key Points

- The Environment Act 1995 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 2005 (2008 for one lead objective).
- 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 Introduction to the air quality review

Part IV of the Environment Act, 1995, establishes a national framework for air quality management, and requires all local authorities in Wales, and Scotland and London borough, district and unitary councils in England to conduct local air quality reviews. Where the reviews indicate that objectives set out in the Air Quality Regulations, 2000[3], will not be met by the prescribed dates, the relevant authority is required to designate an Air Quality Management Area. Further work is then required to investigate ways to ensure compliance of the area by the prescribed dates.

2.1 PURPOSE OF THE STUDY

NETCEN was commissioned by Strabane District Council (SDC) to complete a Second Stage Air Quality Review (SSAQR) within their area. The review:

- Investigates present and potential future air quality in the SDC area
- Recommends actions, if necessary, to control the subsequent air quality within the SDC area

2.2 APPROACH TAKEN

The approach taken in this study was to:
1. Identify the principal sources of pollutant emissions affecting air quality in the SDC area.
2. Model expected present and potential future levels of pollutant concentrations in the SDC area and identify the areas of the district which are likely to experience the highest concentrations of pollutants.
3. Indicate whether present and predicted future air quality in the City is likely to comply with the requirements of the Air Quality Strategy.
4. Identify areas for further investigation.

In preparing this report the latest version of the Pollutant Specific Guidance has been used LAQM TG4(00).

2.3 STRUCTURE OF THIS REPORT

Chapter 1 considers details of the Air Quality Strategy (AQS).

This chapter, Chapter 2, considers the extent of local air quality measurements made by SDC, Part A and B processes in the SDC region which might affect air quality. Chapters 3 to 4 consider the pollutants specified in the Stage one report produced for SDC and give an overview including the AQS objectives, the national perspective and the input required for this review. Data from national concentration maps, monitoring studies and local point sources are then considered. Each chapter closes with an indication of whether the relevant AQS objective is expected to be met, or whether further work is required. Chapter 5 summarises all the findings and recommendations of the work.

2.4 INFORMATION PROVIDED BY SDC TO SUPPORT THIS ASSESSMENT

NETCEN requested a range of information from SDC that was needed to complete this SSAQR. This information included details about:

- Local air quality monitoring data
- Proposed developments
- Part A and B processes under the Environmental Protection Act (EPA)
- Large combustion sources

The pollutants and their sources that have been studied in this Stage 2 Report for Strabane District Council (SDC) are:

- PM_{10}

In the Strabane Stage one review and assessment domestic coal burning was identified as needing further assessment. It is therefore considered further in this report.

- SO_2

Three industries identified in Strabane District Council's Stage 1 Report have been assessed further to decide whether it is necessary to proceed to a stage 3 review for this source. They are:

Adria Ltd
Herdmans
Leckpatrick Dairies

2.4.1 Strabane and its environs

This section has been summarised from the information provided in the Stage 1 Air Quality Review and Assessment report prepared by the Environmental Health Service of Strabane District Council (SDC).

The Strabane District covers some 922 square kilometres of largely unspoilt countryside, and is situated in north-west Tyrone, Northern Ireland on the border with County Denegal in the Republic of Ireland. The district has a population of approximately 37,000, the largest proportion of which reside in the main population centres of Strabane Town and smaller towns of Castlederg and Newtownstewart. A small number of villages also exist within the district.

A range of industry exists within the district, a number of which are authorised or maybe authorised in the future under the Industrial Pollution control (NI) order and subordinate regulations.

3 Review and assessment of PM_{10}

3.1 INTRODUCTION

Airborne particulate matter varies widely in its physical and chemical composition, source and particle size. Particles are often classed as either primary (those emitted directly into the atmosphere) or secondary (those formed or modified in the atmosphere from condensation and growth). PM_{10} particles (the fraction of particulates in air of very small size, <10 μm aerodynamic diameter) can potentially pose significant health risks as they are small enough to penetrate deep into the lungs. Larger particles are not readily inhaled.

A major source of fine primary particles is combustion processes, in particular diesel combustion, where transport of hot exhaust vapour into a cooler tailpipe or stack can lead to spontaneous nucleation of "carbon" particles before emission. Secondary particles are typically formed when low volatility products are generated in the atmosphere, for example the oxidation of sulphur dioxide to sulphuric acid. The atmospheric lifetime of particulate matter is strongly related to particle size, but may be as long as 10 days for particles of about 1 μm in diameter.

Concern about the potential health impacts of PM_{10} has increased very rapidly over recent years. Increasingly, attention has been turning towards monitoring the smaller particle fraction, $PM_{2.5}$, which is capable of penetrating deepest into the lungs, or to even smaller size fractions or total particle numbers.

3.1.1 Standards and objectives for particulate matter

The Air Quality Strategy objectives to be achieved by 31st December 2004 are:

- An annual average concentration of 40 μg m^{-3} (gravimetric);
- A maximum 24-hourly mean concentration of 50 μg m^{-3} (gravimetric) not to be exceeded more than 35 times a year.

3.1.2 The National Perspective

National UK emissions of primary PM_{10} have been estimated as totalling 184,000 tonnes in 1997. Of this total, around 25% was derived from road transport sources. It should be noted that, in general, the emissions estimates for PM_{10} are less accurate than those for the other pollutants with prescribed objectives, especially for sources other than road transport.

The Government established the Airborne Particles Expert Group (APEG) to advise on sources of PM_{10} in the UK and current and future ambient concentrations. Their conclusions were published in January 1999 (APEG, 1999)[5]. APEG concluded that a significant proportion of the current annual average PM_{10} is due to the secondary formation of particulate sulphates and nitrates, resulting from the oxidation of sulphur and nitrogen oxides. These are regional scale pollutants and the annual

concentrations do not vary greatly over a scale of tens of kilometres. There are also natural or semi-natural sources such as wind-blown dust and sea salt particles. The impact of local urban sources is superimposed on this regional background. Such local sources are generally responsible for winter episodes of hourly mean concentrations of PM_{10} above 100 $\mu g\ m^{-3}$ associated with poor dispersion. However, it is clear that many of the sources of PM_{10} are outside the control of individual local authorities and the estimation of future concentrations of PM_{10} are in part dependent on predictions of the secondary particle component.

3.2 MONITORING OF PM_{10}

There has been no monitoring of PM_{10} concentrations in the SDC area. However there has been black smoke monitoring at one location as part of the national network operated by NETCEN.

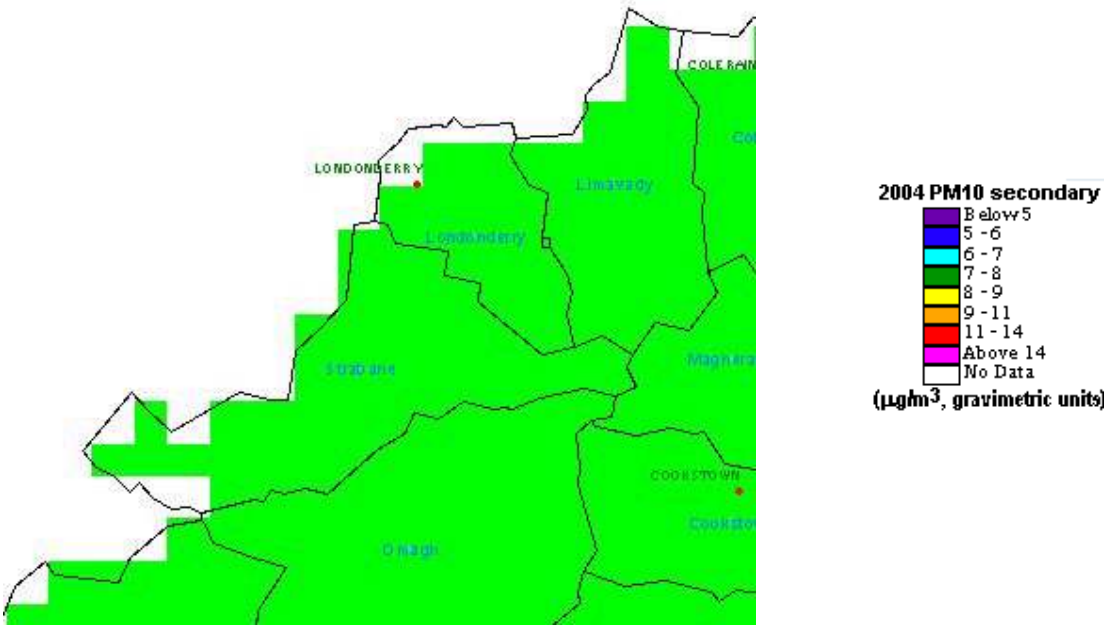
Table 2.2 Monthly average black smoke concentrations recorded in Strabane from April 2000 to April 2001.

Month	**Concentration ($\mu g/m^3$)**
April 2000	38.6
May 2000	21.6
June 2000	12.8
July 2000	10.3
August 2000	14.5
September 2000	21.3
October 2000	25.1
November 2000	42.8
December 2000	22.9
January 2001	60.8
February 2001	67.9
March 2001	44.5
Average	**31.9**

3.3 BACKGROUND CONCENTRATIONS OF PM_{10}

Estimates of background concentrations of secondary PM_{10} in 1996 were obtained for the SDC area using the maps on the UK National Air Quality Information Archive web site http://www.aeat.co.uk/netcen/airqual/home.html. The annual average background concentration of secondary PM_{10} in the SDC area was estimated to be 7.5 $\mu g/m^3$.

Figure 3.3 Secondary background PM_{10} concentrations in 1996



3.4 IMPACT OF DOMESTIC COAL BURNING

An assessment of the impact of domestic solid fuel burning can be carried out from existing black smoke data and the empirical relationship given in Figure 8.8 in the PSG. With an annual average black smoke reading of 31.9 µg/m^3 and an annual mean secondary PM_{10} concentration in 1996 of 7.5 µg/m^3 gravimetric, it is recommended that a stage 3 review and assessment is carried out for this source.

4 Review and assessment of sulphur dioxide

4.1 INTRODUCTION

Sulphur dioxide is a corrosive acid gas which combines with water vapour in the atmosphere to produce acid rain. Both wet and dry deposition have been implicated in the damage and destruction of vegetation and in the degradation of soils, building materials and watercourses. SO_2 in ambient air is also associated with asthma and chronic bronchitis.

The principal source of this gas is power stations burning fossil fuels which contain sulphur. Episodes of high concentrations of SO_2 now only tend to occur in cities in which coal is still widely used for domestic heating, in industry and in power stations. As some power stations are now located away from urban areas, SO_2 emissions may affect air quality in both rural and urban areas. Since the decline in domestic coal burning in cities and in power stations overall, SO_2 emissions have diminished steadily and, in most European countries, they are no longer considered to pose a significant threat to health.

4.1.1 Standards and objectives for sulphur dioxide

Two new objectives have been introduced for SO_2 in the AQS based on the limit values in the Air Quality Daughter Directive, and the three objectives are:

- 266 μg m^{-3} as a 15 minute mean (maximum of 35 exceedences a year or equivalent to the 99.9th percentile) to be achieved by the 31st December 2005
- 350 μg m^{-3} as a 1 hour mean (maximum of 24 exceedences a year or equivalent to the 99.7th percentile) to be achieved by the 31st December 2004
- 125 μg m^{-3} as a 24 hour mean (maximum of 3 exceedences a year or equivalent to the 99th percentile) to be achieved by the 31st December 2004

The 15 minute mean objective is the most stringent; the other two objectives will not be exceeded if this objective is not exceeded.

4.1.2 The National Perspective

Sulphur dioxide is emitted in the combustion of coal and oil. Emissions today are dominated by fossil-fuelled power stations which in 1997 accounted for 62% of the national total emission. Emissions from road transport are a very small fraction of the national total: 2%.

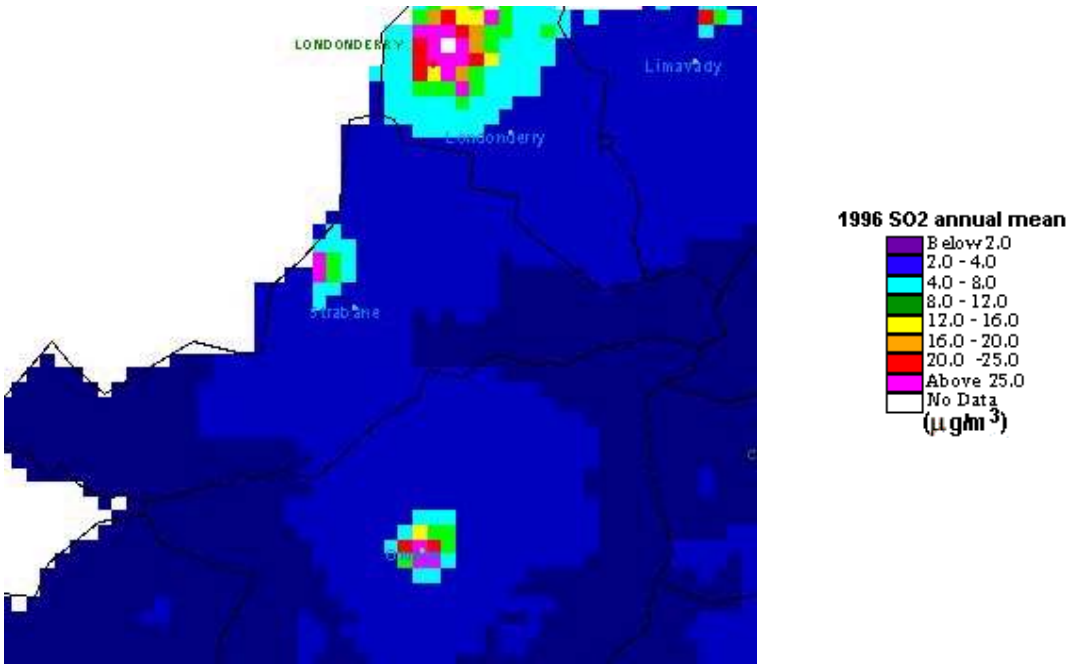
Exceedences of the 15-minute air quality standard currently occur near industrial processes for which the stack heights were designed to meet previous air quality standards and downwind of large combustion plant such as power stations. Exceedences are also possible in areas where significant

quantities of coal are used for space heating. These large combustion plant are currently regulated under BATNEEC and the EPA 1990, and will come under the provisions of the IPPC. The government considers that bearing in mind the envisaged change in fuel use, it does not expect exceedences of the 15-minute objective by 2005 from these sources. Sulphur dioxide concentrations are elevated at the kerbside but not sufficiently to exceed the air quality standard in the absence of other sources.

4.2 BACKGROUND CONCENTRATIONS OF SULPHUR DIOXIDE

Estimates of background concentrations were obtained for the SDC area using the maps on the UK National Air Quality Information Archive web site http://www.aeat.co.uk/netcen/airqual/home.html. Figure 4.2 shows the most recent estimates available, for 1996. The mean annual average background concentration for 1996 in the SDC area was 2.1 μg m^{-3}. The maximum annual average background concentration was 53.5 μg m^{-3}. Guidance TG4(00) assumes that the annual mean at the end of 2004 and 2005 will be half the 1996 annual mean. However, in Northern Ireland due to the high levels of domestic coal burning the background concentration in 2004/5 has been estimated to be the three-quarters of the 1996 concentration. Thus the mean annual mean background concentration in the SDC area in 2004 is estimated to be 1.6 μg m^{-3} and the maximum annual average background anywhere in the borough is estimated to be 40 μg m^{-3}.

Figure 4.2 Background SO_2 concentrations 1996



~~1.24.3~~MONITORING OF SULPHUR DIOXIDE

There has been monitoring of sulphur dioxide since September 1999 at a site situated in Strabane town. This site is part of the national network operated by NETCEN. The monitor is situated in a residential area with a high proportion of solid fuel burning.

Table 2.4 Daily average SO_2 concentrations recorded in the Strabane town between April 2000 and April 2001 (μg/m^3).

Site code	SO_2
3111502	13.3

The data are presented here for completeness, but sulphur dioxide diffusion tube measurements have limited application in the review and assessment process because the Strategy objectives are for short-term exposure. However, the following conversion figures are provided in the PSG:

99.9th percentile (15 minute means) = 1.8962 x maximum daily mean
99.7th percentile (1 hour mean) = 1.3691 x maximum daily mean

The maximum daily mean recorded in Strabane town was 27 μg/m^3. Using the above figures this provides a 99.9th percentile of the 15 minute mean of 51 μg/m^3 and a 99.7th percentile of the 1 hour mean of 37 μg/m^3. These figures are well below the objectives for SO_2 (125 μg/m^3 as a 24 hour mean not to be exceeded more than 3 times a year, 266 μg/m^3 as a 15 minute mean not to be exceeded more than 35 times a year and 350 μg/m^3 as a 1 hour mean not to be exceeded more than 24 times a year).

4.4 IMPACT OF DOMESTIC COAL BURNING

The PSG recommends that when assessing the impact of domestic coal burning on SO_2 concentrations that a review of monitoring in the borough is carried out. As seen in Section 3.4 above monitoring in a residential area where there is a high proportion of domestic coal burning produced an annual average of 13 μg/m^3. Therefore it is recommended that a stage 3 review and assessment does not need to be carried out for this source.

4.5 IMPACT OF INDUSTRY ON CONCENTRATIONS OF SULPHUR DIOXIDE

The Stage 1 Review and Assessment Report prepared by SDC stated that the following industries have the potential to emit significant quantities of sulphur dioxide:

Adria Ltd
Herdmans
Leckpatrick Dairies

These are now considered further.

4.5.1 Adria Ltd

Adria Ltd is located on Beechmount Avenue in Strabane town. It produces Textiles (Grid Ref: 234225 396850). There are two boilers of which only one runs at a time.

This industry was considered in the Stage 1 review and assessment and the nomogram supplied in the PSG was used to determine whether a Stage 2 would be required. It was recommended that a stage 2 was carried out. Therefore in this assessment, nomograms in GSS (Guidance for estimating impacts from Stationary Sources) have been utilised.

Table 2.5.1 Specifications of combustion processes at Adria Ltd.

	Adria
Temperature of emissions (^{0}C)	110 - 120
Stack height (m)	30
Stack diameter (m)	1.94
SO_2 emissions (g/s)	22
Gas exit velocity (m/s)	13.2

The height of the boiler house is 8 metres. Emissions of sulphur dioxide shown in Table 2.5.1 above are if the two boilers are running at the same time. This information has been used in GSS and will therefore result in a conservative estimate and resulting concentrations are likely to be much lower than that predicted.

The background SO_2 concentration on Beechmount Avenue in Strabane town in 2004 has been estimated from the NETCEN maps to be 2.85 μg/m^3.

Using GSS, the following maximum ground level SO_2 concentrations are obtained:

8.8 μg/m^3 as an annual average
165 μg/m^3 as the 99.9 percentile of hourly means.

In order for these results to be compared against the objectives, PSG states the following conversion factors:

99th percentile of 24 hour means = 10 * annual mean
99.7th percentile of hourly means = 0.83* 99.9th percentile of hourly means
99.9th percentile of 15 minute means = 1.34 * 99.9th percentile of 1 hour means

These relationships are based upon a conservative estimate and will tend to over-predict concentrations in most cases.

Adding the background concentrations to those emitted from the boiler gives the following maximum ground level concentrations:

99th percentile of the 24 hour mean is 90.9 μg/m^3 (the 24 hour mean objective for SO_2 is 125 μg/m^3 as the 99th percentile);

99.7th percentile of the hourly mean is 142.7 μg/m^3 (the hourly objective for SO_2 is 350 μg/m^3 as a 99.7th percentile).

99.9th percentile of the 15 minute mean is 226.8 μg/m^3 (the 15 minute objective for SO_2 is 266 μg/m^3 as a 99.9th percentile);

The above results show that the maximum ground level concentrations are high when compared with the objectives for SO_2. However, the above figures are for when two boilers are in operation. If only one boiler is in operation the following results are obtained:

99th percentile of the 24 hour mean is 47 μg/m^3 (the 24 hour mean objective for SO_2 is 125 μg/m^3 as the 99th percentile);

99.7th percentile of the hourly mean is 74 μg/m^3 (the hourly objective for SO_2 is 350 μg/m^3 as a 99.7th percentile).

99.9th percentile of the 15 minute mean is 116 μg/m^3 (the 15 minute objective for SO_2 is 266 μg/m^3 as a 99.9th percentile);

The above results which are obtained if just one boiler is in operation are well within the objectives. It must therefore be decided which scenario is most likely (one or two boilers). The industry state that only one boiler is in operation at a time. If this is the case then there is no need to proceed to a stage 3 review and assessment.

4.5.2 Herdmans

This factory is involved in the processing and production of linen. The boiler plant consists of two boilers, both of which run continuously. The factory is not surrounded by residential properties, although a small development exists 180 metres away. (Grid Ref: 234350, 393250).

This industry was considered in the Stage 1 review and assessment and the nomogram supplied in the PSG was used to determine whether a Stage 2 would be required. It was recommended that a stage 2 was carried out. Nomograms in GSS (Guidance for estimating impacts from Stationary Sources) have not been utilised in this assessment as the stack discharge velocity is less than 10 m/s and the tallest nearby building is 24 metres (i.e. within 40% of the stack height). Instead information provided in NRBP - R91 has been used.

Table 2.5.2 Specifications of combustion processes at Herdmans.

	Herdmans
Temperature of emissions (^{0}C)	200
Stack height (m)	28
Stack diameter (m)	1.2

SO_2 emissions (g/s)	10.8
Gas exit velocity (m/s)	6.09

As a conservative estimate, Pasquill stability category D for 75% of the time has been used and as a conservative estimate and the effective stack height has been taken to be equal to the actual stack height.
NRBP - R91 provides a maximum annual average ground level concentration of 9.7 $\mu g/m^3$ from the stack.
In order for these results to be compared against the objectives, PSG states the following conservative conversion factor:

99^{th} percentile of 24 hour means = 10 * annual mean

Adding the predicted background concentration of 2.85 $\mu g/m^3$ to the 99^{th} percentile of the 24 hour mean in 2005 gives a concentration of 100 $\mu g/m^3$. NRPB does not predict the 99.9^{th} percentile of the hourly mean. However as the 24 hour mean result is high it is suggested that a stage 3 review and assessment is carried out for this source as the possibility of the 15 minute mean (the most stringent objective) being exceeded cannot be ruled out.

4.5.3 Leckpatrick Dairies, Artigarvan

This factory is involved in the processing of liquid mile and the production of dried milk powder and other milk concentrates. The boiler plant consists of 2 boilers, both of which run continuously. The factory is surrounded by residential properties the closest of which are approximately 30 metres away. (Grid Ref: 238370, 401080).

This industry was considered in the Stage 1 review and assessment and the nomogram supplied in the PSG was used to determine whether a Stage 2 would be required. It was recommended that a stage 2 was carried out. Therefore in this assessment, nomograms in GSS (Guidance for estimating impacts from Stationary Sources) have been utilised.

Table 2.5.3 Specifications of combustion processes at Leckpatrick Dairies.

	Leckpatrick Dairies
Temperature of emissions (^{0}C)	220
Stack height (m)	36
Stack diameter (m)	2
SO_2 emissions (g/s)	18.2
Gas exit velocity (m/s)	n/a

The discharge velocity from the stack was not available. Therefore the NRBP - R91 model has been used in this assessment. A maximum ground level annual average concentration of 12.7 $\mu g/m^3$ was obtained.

In order for these results to be compared against the objectives, PSG states the following conservative conversion factor:

99^{th} percentile of 24 hour means = 10 * annual mean

Adding the predicted background concentration of 2 $\mu g/m^3$ to the 99^{th} percentile of the 24 hour mean in 2005 gives a concentration of 129 $\mu g/m^3$. NRPB does not predict the 99.9^{th} percentile of the hourly mean. As the model predicts that the 24 hour mean objective may be exceeded it is recommended that a stage 3 review and assessment is carried out for this source.

4.6 CONCLUSIONS FOR SULPHUR DIOXIDE CONCENTRATIONS IN THE SDC AREA

It is recommended that a stage 3 review and assessment is carried out for both Herdmans and Leckpatrick Dairies and possibly for Adria Ltd.

5 Conclusions and recommendations for each pollutant

5.1 PARTICULATE MATTER (PM_{10})

It is recommended that concentrations arising from domestic coal burning under go further assessment.

5.2 SULPHUR DIOXIDE

It is recommended that a stage 3 review and assessment is carried out for Herdmans and Leckpatrick Dairies and possibly for Adria Ltd.

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