Second and Third Stage Review and Assessment of Air Quality

Larne Borough Council

CONTENTS

EXECUTIVE SUMMARY

Local air quality management was introduced by the first air quality strategy in 1997. Following review the UK National Air Quality Strategy was published in 2000, with the aim of improving air quality in the UK.

Local authorities have a major role in this process which was formalised as a statutory duty in the Environment (Northern Ireland) Order 2002.

The first stage of Larne Borough Councils review and assessment of air quality, which identified the main sources of seven key air pollutants, was published in July 2001. This report follows on from Stage 1 and completes the review and assessment for the Borough of Larne.

The pollutants assessed in this report are nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and particulate matter (PM_{10}). The report concludes that the air quality objectives set by the Government for nitrogen dioxide, sulphur dioxide and particulates are unlikely to be exceeded.

Where exceedances are predicted Local Authorities must declare an Air Quality Management Area and develop action plans to secure improvements in air quality.

As the air quality standards are likely to be met in Larne Borough it will not be necessary for Larne Borough Council to declare Air Quality Management Areas for the three pollutants considered in this report.

The next round of air quality reviews and assessments will be carried out in two steps. These steps will be an Updating and Screening Assessment followed by a Detailed Assessment to be completed no later than 2007.

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- Roads Service, Northern Division, Ballymena
- NETCEN, AEA Technology
- Cllr J. Drummond, Lynn Community Centre
- Hyder
- Premier Power Ltd
- Larne Harbour Ltd
- Carrickfergus Borough Council
- Northern Group Systems

MAPS REPRODUCED WITHIN THIS DOCUMENT

1. INTRODUCTION

The UK National Air Quality Strategy was published in 2000 and detailed the Governments plans to improve ambient air quality in the UK. The Environment (Northern Ireland) Order 2002 formalised the statutory duty for district councils in Northern Ireland to review and assess air quality within their district and designate air quality management areas where air quality objectives are likely to be exceeded.

Pollutant	Air Quality Objective		Date to be Achieved By
	Concentration [1]	**Measured As**	
Benzene	16.25 µg/m^3 (5ppb) 3.25 µg/m^3	Running annual mean Running annual mean	31.12 2003 31.12.2010
1,3 Butadiene	2.25 µg/m^3 1ppb)	Running annual mean	31.12.2003
Carbon monoxide	10 mg/m^3	Maximum daily running 8-hour mean	31.12.2003
Lead	0.5 µg/m^3 0.25 µg/m^3	Annual mean Annual mean	31.12.2004 31.12.2008
Nitrogen dioxide	200 µg/m^3 (105ppb) Not to be exceeded more than 18 times a year 40 µg/m^3 (21ppb)	1 hour mean Annual mean	31.12.2005
Particles (PM_{10})[2]	50 µg/m^3 (gravimetric) not be exceeded more than 35 times a year 40 µg/m^3 (gravimetric)	24 hour mean Annual mean	31.12.2004 31.12.2004
Sulphur dioxide	350 µg/m^3 (132ppb) not to be exceeded more than 24 times a year 125 µg/m^3 (47ppb) not to be exceeded more than 3 times a year 266 µg/m^3 (100ppb) not to be exceeded more than 35 times a year	1 hour mean 24 hour mean 15 minute mean	31.12.2004 31.12.2004 31.12.2005
1. The objectives for nitrogen dioxide are provisional 2. PM_{10} measured using the European gravimetric transfer sampler or equivalent.			

This second and third stage review and assessment of air quality has been produced as part of Larne Borough Councils obligations under the Environment (Northern Ireland) Order 2002. It supports the First Stage Review and Assessment of Air Quality completed in July 2001.

The purpose of review and assessment is to ascertain the quality of air within the borough with respect to seven pollutants known to be the cause of certain health effects, which are summarised below.

Pollutant	Main Sources	Health Effects
Benzene	Combustion and distribution of petrol	Genotoxic human carcinogen (leukaemia)
1,3-Butadiene	Combustion of petrol	Genotoxic human carcinogen (lymphomas and leukaemia's)
Carbon Monoxide	Incomplete combustion of carbon containing fuels (mainly petrol engined vehicles)	Formation of carboxyhaemoglobin, reducing the capacity of the blood to carry oxygen
Lead	Industrial applications. Use of leaded petrol.	Toxic. Can cause problems in synthesis of haemoglobin, effects on kidneys, gastrointestinal tract, joints and reproductive systems. Acute or chronic damage to nervous system.
Nitrogen Dioxide	All combustion processes including road transport	Can cause inflammation of the airways at high concentrations. Enhances the response to allergens in sensitive individuals
Particulate Matter (PM_{10})	Primary particles from combustion sources (mainly road traffic & residential coal burning). Secondary particles formed by chemical reactions in the atmosphere (mainly sulphates and nitrates). Coarse particles, eg suspended soils/dusts/sea salt	Affects respiratory and cardiovascular systems. Particularly significant for those with pre-existing lung or heart disease
Sulphur Dioxide	Combustion of sulphur containing fossil fuels, principally coal and heavy oils	Causes constriction of the airway. Particularly affects those suffering from asthma or chronic lung disease

The review and assessment process takes a three-stage approach, whereby each stage increases in detail and complexity. The first stage of the process is a desktop exercise which involves the compilation of data on emissions from transport, industrial and domestic sources and assessing the likelihood of air quality objectives being breached by 2005.

On completion of this stage, pollutants, which are unlikely to exceed the objectives, can be excluded from any further scrutiny. The remaining pollutants are then assessed at the second and third stages of the process using more sophisticated screening techniques including monitoring, air pollution dispersion modelling and predictions for the year 2005.

If, on completion of the third stage review and assessment it appears that any air quality objectives are not likely to be achieved in a local authority's district then the area affected **must**, by order, be designated as an Air Quality Management Area (AQMA).

Once on AQMA has been declared the local authority is required to carry out a further assessment of existing and likely future air quality and the respects in which it appears the objectives are not likely to be achieved. The local authority must then prepare a written action plan within 12 months with a view to achievement of the air quality objectives detailing related timescales.

The first stage review and assessment report for Larne Borough Council concluded that the air quality objectives for benzene, 1,3-butadiene, carbon monoxide and lead are likely to be achieved at all locations in Larne by the end of 2005.
This second and third stage report therefore addresses the following:

(i) Nitrogen dioxide emissions from road traffic and an industrial source in a neighbouring council area.
(ii) Sulphur dioxide emissions from domestic coal burning, an industrial source in the Larne area, an industrial source in a neighbouring council area and shipping movements at Larne Harbour.
(iii) Particulate matter (PM_{10}) emissions from road traffic, domestic coal burning, an industrial source in a neighbouring council area and shipping movements at Larne Harbour.

2. REVIEW AND ASSESSMENT OF NITROGEN DIOXIDE

2.1 Introduction

The government has adopted an annual mean of 40 µg/m^3 (21 ppb), and a 1-hour mean of 200 µg/m^3 (105 ppb) as the air quality standards for nitrogen dioxide. The objective for both standards are to be achieved by the end of 2005, with the 1-hour mean not to be exceeded more than 18 times per year (approximately equivalent to the 99.8th percentile of hourly means).

2.2 Sources of Nitrogen Dioxide

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

The principle source of nitrogen oxide emissions is road transport which accounted for about 49% of total UK emissions in 2000. Major roads carrying large volumes of high speed traffic (such as motorways and other primary routes) are a predominant source, as are city centres with congested traffic. Other significant sources of nitrogen oxides emissions include the electricity supply industry and other industrial and commercial sectors which account for approximately 24% and 23% respectively.

Nitrogen dioxide has a variety of environmental and health impacts. It is a respiratory irritant, may exacerbate asthma and possibly increase susceptibility to infections. In the presence of sunlight, it reacts with hydrocarbons to produce photochemical pollutants such as ozone. Nitrogen dioxide can also convert to nitric acid which is removed from the atmosphere by direct deposition to the ground or transfer to aqueous droplets (e.g. cloud or rainwater), thereby contributing to acid deposition.

2.3 Conclusions of First Stage Review and Assessment of Nitrogen Dioxide

The First Stage of the review and assessment process identified a number of sources of nitrogen dioxide which posed a risk of exceeding the 2005 objectives for NO_2.

A screening approach based upon the methodology set out in the Design Manual for Roads and Bridges (DMRB) identified several roads and junctions with the potential to emit significant quantities of NOX. This was assessed by taking account of factors such as the flow, speed, vehicle mix and distance to the nearest exposed population.

In addition, due to the lack of traffic data available for Main Street in Larne, this area was included for further assessment as a precautionary measure as it is a shopping area and could have potential exposure to the public.

One Part A process in Carrickfergus Borough Council, namely Kilroot Power Station was also considered to be a potentially significant source of NO_2.

2.4 Second Stage Review and Assessment for Nitrogen Dioxide

To predict the levels of nitrogen dioxide at the locations identified as potentially exceeding the air quality objective, Air Quality Consultants were commissioned to model expected present and future levels of pollutant concentration from road traffic and assess the impact of industry. Modelling was carried out in accordance with GB Government Guidance LAQM TG4(00) by NETCEN who are certified to quality standard ISO 9001 and ISO14001.

2.4.1 Impact of Road Traffic on concentration of Nitrogen Dioxide

The concentrations at 12 roadside locations were estimated using the Design Manual for Roads and Bridges (DMRB) using traffic flow data provided by DOE Roads Service (NETCEN report 2002). The model was used to predict nitrogen dioxide concentrations for 2005. Concentrations were assessed at the traffic speeds relevant to each road based on information supplied by DOE Roads Service.

The findings of the consultant's model predictions are summarised in Table 2.1 which 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 in the Larne Borough Council area.

Table 2.1 Predicted Nitrogen Dioxide concentrations at roadside locations in the Larne Borough area

Location Description	NO_2 Annual Mean ($\mu g/m^3$) 2005	NO_2 99.8th percentile of hourly averages ($\mu g/m^3$) 2005
Antiville Road/A8 junction	53.6	187.5
Antiville Road/Mill Brae/Linn Road junction	25.2	88.2
Antiville Road/Lower Cairncastle Road/Upper Cairncastle Road junction	22.9	80.2
The Roddens	25.6	89.5
Station Road/Circular Road junction	24.7	86.5
Bank Road/Glynn Road junction	26.4	92.5
Victoria Road/ Old Glenarm Road/Agnew Street junction	30.7	107.3
Circular Road/Curran Road/Glenarm Road/Main Street junction	28.9	101.2
Thorndale Avenue/Pound Street junction	19.2	67.4
Main Street	16.1	56.4
Pound Street	14.7	58.8
Larne Harbour Roundabout	55.6	194.5

Following the advice given in GB Government Guidance LAQM TG4(00), the 99.8th percentile of hourly averages has been estimated as 3.5 times the annual mean for roadside locations. For 2005, annual average concentrations of nitrogen dioxide are predicted to exceed the 40 $\mu g/m^3$ objective at two sites, namely Antiville Road/A8 Junction and the Larne Harbour roundabout. This is as a result of the high percentage of HGV traffic to and from the harbour which is estimated to account for 26% of traffic along this route. At all other locations the air quality objectives are predicted to be met. (NETCEN 2002)

Larne Borough Council monitored monthly average concentrations of NO_2 with passive diffusion tube samplers at five sites in Larne in 1997. The Ruddock and Sherratt Analyst Laboratory carried out the analysis of the tubes. The results are summarised in Table 2.2. The monitoring period is representative of a full year and therefore the period average concentrations can be

compared with the annual mean objective. There was no NO_2 field intercomparison in 1996 or 1997. However, mean bias achieved by Ruddock & Sherratt in subsequent years' intercomparisons, were as follows:

1998: -23.8% with respect to chemiluminescent analyser, -18.2% relative to mean of all diffusion tubes.
1999: -23.7% with respect to chemiluminescent analyser.
2000: -13.7% with respect to chemiluminescent analyser, -27.0% relative to mean of all diffusion tubes.
2001: -46.5% with respect to chemiluminescent analyser.

There was a consistent under-reading of diffusion tubes from Ruddock & Sherratt laboratory relative to the reference method. For 1997 it has been assumed that the laboratory bias for the Ruddock & Sherratt laboratory in 1997 had a negative bias of 20%. The annual average NO_2 concentrations in 1997 and the levels predicted for 2005 based on those results are shown in table 2.2

Table 2.2 NO_2 Annual Average Concentration Measured at Roadside location in Larne

Location Description	1997 annual average ppb	Annual average µg/m^3	Corrected for bias µg/m^3	Projection for 2005 µg/m^3
Glenarm Road	11.0	21.0	25.2	20.5
Main Street, Larne	13.5	25.8	30.9	25.2
Circular Road	13.9	26.6	31.9	26.0
Cross Street	12.1	23.1	27.8	22.6
Upper Main Street	13.7	26.2	31.4	25.6

The diffusion tubes placed at the roadside locations did not exceed the annual mean objective for nitrogen dioxide of 40 µg/m^3 and are predicted to remain within the NO_2 annual mean objectives in 2005 at these locations. (NETCEN 2002 report)

2.4.2 Impact of Industry on Concentrations of Nitrogen Oxides

Ballylumford Power Generation Plant

An Environmental Impact Assessment has been carried out by Hyder for the CCGT power generation plant and showed that there is not likely to be an NO_2 objective exceedance.

This assessment involved the modelling of pollutant dispersion using ADMS. The model produced isopleth plots that indicated the geographical area where the highest ground level concentrations are predicted to occur and which are in the vicinity of Islandmagee and off shore in the Irish Sea (Hyder, 1999).

These locations are within a few hundred metres of the power station site. The worst-case scenarios for operating conditions were modelled and despite this the results of predictive modelling indicate that the air quality objectives will not be exceeded at any receptor location (Hyder, 1999). There is therefore, no need to progress further with review and assessment of nitrogen dioxide from this source. (NETCEN, 2002)

Kilroot Power Station, Carrickfergus

Carrickfergus Borough Council's First Stage Review and Assessment of air quality referenced the details of Kilroot Power Station to a monogram as advised in the GB Government Guidance and determined a second stage review necessary. In the second stage review and assessment undertaken by Carrickfergus Borough Council it was predicted that maximum concentration as a

result of emissions from Kilroot would not cause an exceedance of the objective for NO_2 (Carrickfergus Borough Council 2002). Consequently Larne Borough Council does not need to further consider the effects of Kilroot Power Station on concentrations within the Larne Area. (NETCEN 2002 report)

2.4.3 Conclusions of Model Predictions for Nitrogen Dioxide

Emissions from industrial sources are not predicted to lead to an exceedance of the nitrogen dioxide objectives in 2005. In addition, predictions from diffusion tube data from 1997 show that the objectives are likely to be met at the locations monitored.

However, emissions arising from road transport at two locations namely Larne Harbour Roundabout and Antiville Road/A8 Junction, where HGV percentage is high and receptors are in the close vicinity, are predicted to cause exceedances of the annual average objective. (NETCEN 2002 report)

2.5 Monitoring of Nitrogen Dioxide

Larne Borough Council monitored monthly average concentrations of nitrogen dioxide using passive diffusion tubes at 8 relevant locations including adjacent to Ballylumford Power Station as well as at roadsides.

A passive diffusion tube is a clear plastic tube open at one end with the closed containing an absorbent for the gas, in this case NO_2, to be monitored. Each tube is exposed for one month, resealed and then returned to the laboratory for analysis. Analysis was carried out by Lambeth Scientific Services, a UKAS accredited laboratory. Their trained staff operate rigorous quality control to UKAS standards ensuring the integrity of all results. The average ambient NO_2 concentration over the month is subsequently reported in $\mu g/m^3$ and ppb.

Diffusion tubes are subject to variance and bias (over read or under read) based on the methods of preparation and analysis by individual laboratories. Eight studies found the NO_2 tubes prepared and analysed by Lambeth Scientific Services to have a bias of 1.15 when compared to concentrations obtained from co-located automatic analysers. This bias factor is applied to the measured result to take account of the variance.

In accordance with GB Government Guidance LAQM. TG(03) where measured data has been collected the concentrations will need to be adjusted for the relevant year. The projected annual average NO_2 concentration for 2005 has been derived using the correction factors detailed in the technical guidance. Monitoring commenced in May 2002 and available results are summarised in Appendix 1.

Lambeth Scientific Services have advised that exceedance of the 105 ppb (200 $\mu g/m^3$) 1-hour mean standard is likely if the annual mean concentration exceeds 21 ppb (40 $\mu g/m^3$). This is applied only to the annual average concentration and not on month by month diffusion tube measurement. Defra guidance states that the 60 $\mu g/m^3$ annual mean can be used as an adequate proxy for the hourly mean objective (200 $\mu g/m^3$). The annual average concentrations for 2003 and projected concentrations for 2005 are shown in Table 2.3 over page.

Table 2.3 Annual Average NO_2 Concentrations Measured 2003

Location	Average Measured 2003 NO_2 (ppb)	Annual Average 2003 NO_2 concentration (ppb) Corrected for bias	Annual Average 2003 NO_2 concentration ($\mu g/m^3$) Corrected for bias	Projection for 2005 Annual Average NO_2 concentration ($\mu g/m^3$)
Antiville Road/A8 junction	9.75	11.2	21.39	20.28
Riverdale	13	14.95	28.55	27.06
Main Street	10.6	12.19	23.28	22.06
Victoria Road / Agnew St junction	12.7	14.61	27.9	26.45
Upper Cairncastle Road	10.3	11.85	22.63	21.45
Larne Harbour Roundabout	10.4	11.96	22.84	21.65
Coastguard Road	6.8	7.82	14.94	14.16
Ballylumford Road, Islandmagee	7.1	8.17	15.6	14.79

The levels measured by the diffusion tubes did not exceed the objective for nitrogen dioxide of 21 ppb (40 $\mu g/m^3$) and therefore the areas monitored are predicted to remain within the nitrogen dioxide objectives for 2005. Reference was made to GB Government Guidance LAQM TG4(00),

2.6 Conclusions of the Second Stage Review and Assessment of Nitrogen Dioxide

The modelling of nitrogen dioxide emissions from road traffic, the assessment of industrial sources and the use of historical and recent monitoring data have indicated that it is unlikely that the 1-hour mean or the annual mean will be exceeded for NO_2. It will not, therefore, be necessary to propose any air quality management areas for nitrogen dioxide in the borough of Larne.

3. REVIEW AND ASSESSMENT OF SULPHUR DIOXIDE

3.1 Introduction

The government has adopted a 1-hour mean of 350 µg/m^3 (132 ppb) not to be exceeded more than 24 times per year; a 24 hour mean of 125 µg/m^3 (47 ppb) not to be exceeded more than 3 times per year and 266 µg/m^3 (100 ppb) not to be exceeded more than 35 times per year as the air quality standards for sulphur dioxide. The objective for the 1-hour and 24 hour standards are to be achieved by the end of 2004 and the 15 minute standard to be achieved by the end of 2005.

3.2 Sources of Sulphur Dioxide

Sulphur dioxide is emitted during combustion of coal and oil. The main source of this pollutant in the United Kingdom is power stations which accounted for more than 71% of emissions in 2000. There are also significant emissions from other industrial combustion sources. Domestic sources now only account for 4% of emissions, but can be locally much more significant. Road transport currently accounts for less than 1% of emissions.

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.

3.3 Conclusions of Fist Stage Review and Assessment of Sulphur Dioxide

The First Stage of the review and assessment process identified a number of sources of sulphur dioxide which posed a risk of exceeding the air quality objectives for SO_2.

A screening approach, based on the density of coal burning houses within a 1km^2 grid, identified three areas, namely Craigyhill, Antiville and Townparks, where there was a risk of exceeding the objective due to domestic sources.

One Part A process in Larne Borough (Ballylumford Power Station) and one Part A process in Carrickfergus Borough (Kilroot Power Station) were considered to be potentially significant sources of SO_2.

Shipping movements and traffic associated with the port at Larne Harbour also had the potential to emit significant quantities of SO_2.

3.4 Second Stage Review and Assessment of Sulphur Dioxide

To predict the levels of sulphur dioxide at the locations identified as potentially exceeding the air quality objective, Air Quality Consultants were commissioned to assess the impact of industry and port activities. This assessment was carried out with reference to GB Government Guidance LAQM TG4(00) by NETCEN who are certified to quality standards ISO 9001 and ISO14001.

3.4.1 Impact of Industry on Concentrations of Sulphur Dioxide

Ballylumford Power Generation Plant

An Environmental Impact Assessment has been carried out by Hyder for the CCGT power generation plant and showed that there is not likely to be an SO_2 objective exceedance.

A worst-case scenario was modelled where the plant was operating full time on distillate and low sulphur oil, which is designed as a back up fuel supply in the event of gas supply interruption. This did indicate exceedances. However, this was worst case and a more realistic

scenario of operation on stand by fuel is unlikely to exceed 55 days. Dilution of the modelled full time use of stand by fuel with natural gas will bring the concentrations down below the objective level. The ADMS modelling undertaken by Hyder assumed 1% sulphur content which is the maximum allowed. They state that in practice the sulphur content will be lower than this. As the review and assessment process should be followed with realistic scenario predictions it is concluded that Ballylumford Power Station is not likely to result in an exceedance of the air quality objective and therefore a stage 3 review and assessment is not required for this plant. (NETCEN 2002).

Kilroot Power Station

Carrickfergus Borough Council's First Stage Review and Assessment of air quality references the details of Kilroot Power Station to a nomogram as advised in the GB Government Guidance. This determined a second stage review was necessary. In Carrickfergus Borough Council's second stage review and assessment it was predicted that maximum concentrations as a result of emissions from Kilroot would not cause an exceedance of the objective for SO_2 (Carrickfergus Borough Council, 2002).

Consequently Larne Borough Council does not need to further consider the effects of Kilroot Power Station on concentration within the Larne area. (NETCEN 2002)

3.4.2 Impact of Shipping on Concentrations of Sulphur Dioxide

Larne Harbour

Government Pollutant Specific Guidance advises that shipping movements can give rise to SO_2 emissions.

Other UK Councils with ports have assessed the effect of emissions from ships. For example, monitoring has been undertaken in the Southampton harbour area. Sulphur dioxide was continuously monitored at 3 sites including the harbour area. Southampton docks is a less busy port than Larne (4244 vessels compared to 4667 per year) and so it can be expected that the effect of shipping would be higher in Larne than Southampton. The Southampton Borough Council Stage 3 Review and Assessment found that shipping did cause short-lived peaks of SO_2 in area quite close to the docks but these were infrequent and very dependant upon wind direction. The plumes of SO_2 were very localised and rarely had an impact beyond 1km. Southampton Borough Council concluded that the sulphur dioxide objective would be met in 2005, as residential housing was not in the close vicinity of the docks.

The Port of Dover has been declared as an Air Quality Management Area by Dover District Council. The pollutant of concern in this area is sulphur dioxide from shipping emissions. Residential properties are within 500m of the docks area.

Larne is a busy port and there is residential housing within 500m of the docking area. It is recommended that Larne Borough Council consider monitoring in this area and proceeding to a third stage review and assessment. (NETCEN, 2002)

3.4.3 Conclusions of Consultant's Assessment of Sulphur Dioxide

Emissions from industrial sources are not predicted to lead to an exceedance of the sulphur dioxide objectives.

However, there is uncertainty over the effect that shipping may have on SO_2 concentrations in the direct harbour area where there is housing within 500m of the docking area. Therefore it is recommended that Larne Borough Council undertake some monitoring to further investigate this source of SO_2 in a third stage review and assessment.

3.4.4 Monitoring of Sulphur Dioxide using 8-Port Bubblers

To progress the second stage review and assessment process, two 8-Port smoke and SO_2 bubblers were installed in the Craigyhill and Townparks areas of Larne.

Of the three areas identified as possibly exceeding the objective for SO_2 due to domestic sources, Craigyhill and Townparks were selected for monitoring as they had the higher densities of residential coal burning. The monitoring equipment was installed in the following secure locations:

1. Craigyhill – Lynn Community Centre, Linn Road, Larne (Grid Ref. 3873 0365)

Photo 1 Sampler Inlet

2. Townparks – McGarel Cemetery, Old Glenarm Road, Larne (Grid Ref. 4025 0335)

Photo 2 Sampler Inlet

Approval was given by AEA Technology Plc for both sites to be included in the UK Smoke and SO_2 monitoring network. The equipment is maintained weekly with the results of daily titration's and smoke forwarded to AEA Technology Plc on a monthly basis for input into the national database. Training of officers responsible for the equipment has been conducted along with accompanied visits to ensure weekly maintenance and validation checks together with auditing of chemical preparation and analysis are carried out as part of internal quality assurance procedures. Procedures with the 'UK Smoke and SO_2 Networks instruction manual' are followed as the QA/QC protocols.

Monitoring using the bubbler apparatus at Carnegie Library, Victoria Road, Larne, had been ongoing since 1995, however this location was not an area of concern. This equipment was therefore relocated to the McGarel Cemetery site where it would be more representative of the highest levels of smoke and SO_2 in Larne.

Data Capture

The bubblers determine concentrations of sulphur dioxide by use of net acidity measurements. Due to the general tendency for bubblers to under-read at high concentrations the maximum daily mean concentration is multiplied by 1.25. This factor is open to uncertainty and may overestimate concentrations but this is consistent with the precautionary approach for the Second Stage Review and Assessment.

8 port bubbler apparatus has been used extensively throughout the UK in order to determine sulphur dioxide concentrations and whilst their use had declined in recent years, the data can still be of use in review and assessment.

The bubbler technique is used to measure daily mean sulphur dioxide concentration which can be directly compared to the 24-hour mean objective. For comparison with the 15-minute and 1-hour objectives, authorities may use correction factors based upon empirical relationships with the measured maximum daily mean. These relationships can be expressed by the following functions:

1. Calculation of 15-minute mean
   99.9^{th} percentile of 15-minute mean = 1.8962 x maximum daily mean

2. Calculation of 1-hour mean
   99.7^{th} percentile of 1-hour means = 1.3691 x maximum daily mean.

Following GB Government Guidance LAQM TG4(00), to take account of uncertainty in the relationships, it may be assumed that the 15-minute mean objective is unlikely to be exceeded if the maximum daily mean concentration is less than 80 $\mu g/m^3$, and the 1-hour mean objective is unlikely to be exceeded if the maximum daily concentration is less than 200 $\mu g/m^3$.

Results

Monitoring commenced in Craigyhill and Townparks in July 2002 and Table 3.1 over page summarises the results obtained.

Table 3.1 – SO_2 Maximum Daily Means (µg/m^3)

Month And Year	(A) SO_2 Measured Maximum Daily Mean (µg/m^3)		SO_2 (Maximum Daily Mean (µg/m^3) (A X1.25 Correction Factor)	
	Craigyhill	Townparks	Craigyhill	Townparks
July 2002	30	32	37.5	40
August 2002	30	32	37.5	40
September 2002	30	33	37.5	41.5
October 2002	30	33	37.5	41.5
November 2002	30	33	37.5	41.5
December 2002	30	28	37.5	35
January 2003	**36**	**34**	**45**	**42.5**
February 2003	**36**	**40**	**45**	**50**
March 2003	24	27	30	33.75
April 2003	24	27	30	33.75
May 2003	24	27	30	33.75
June 2003	24	20	30	25
July 2003	24	33	30	41.25
August 2003	24	20	30	25
September 2003	30	27	37.5	33.75
October 2003	24	27	30	33.75
November 2003	18	27	22.5	33.75
December 2003	24	20	30	25
January 2004	30	20	37.5	25
February 2004	30	27	37.5	33.75
March 2004	24	21	30	26.25

The highest daily mean concentration measured at the Craigyhill site was 45 µg/m^3 and at the Townparks site the highest daily mean was 50 µg/m^3 during the period of measurement.

No co-location studies have been carried out using SO_2 diffusion tubes adjacent to the bubblers so no further correction factor has been applied.

The 24 hour mean objective of 125 µg/m^3 (47 ppb) was therefore not exceeded during the 14 months of measurement at either the Craigyhill or Townparks sites.

Comparison with the 15-minute and 1-hour objectives for each site is detailed in Table 3.2. The highest levels measured are worst-case scenarios at each monitoring location.

Table 3.2 Comparison of Maximum Daily Mean, 15-minute and 1-Hour Standards

Location	**Maximum Daily Mean (µg/m^3)**	**> 80 µg/m^3**	**> 200 µg/m^3**
Craigyhill	45	No	No
Townparks	50	No	No

As the maximum daily means did not exceed 80 µg/m^3 it is unlikely that the 15-minute mean objective will be exceeded in either area.

As the maximum daily means were less than 200 µg/m^3 it is unlikely that the 1-hour mean objective will be exceeded in either area.

Conclusion of Smoke and SO_2 Bubbler Monitoring Data

The monitoring data from the 8-port smoke and SO_2 bubblers indicate that the air quality standard for sulphur dioxide will be met in relation to residential coal burning.

3.4.5 Monitoring of Sulphur Dioxide Using SO_2 Diffusion Tubes

Passive diffusion tube samplers have also been developed for sulphur dioxide, but their use is not recommended for review and assessment according to LAQM TG(03). These diffusive samplers are only able to measure concentrations over a relatively long average period which cannot easily be compared with short-term objectives.

Not withstanding this, seven diffusion tubes were located by Larne Borough Council in areas of residential coal burning in Larne Town and in Glenarm. These were positioned in areas some distance from the bubbler monitoring sites to give an indication of likely concentrations of sulphur dioxide, elsewhere in the borough. An additional diffusion tube was sited adjacent to Ballylumford Power Station.

The SO_2 diffusion tube consists of a clear plastic tube, open at one end with the closed end containing the absorbent for the gas to be monitored. Each tube is exposed for one month, resealed and returned to the laboratory for analysis. Analysis of the diffusion tubes is carried out at Ruddock & Sherratt which acts as the Public Analyst for Northern Ireland and is a member of the Association of Public Analysts. The average SO_2 concentration over the month is subsequently reported in $\mu g/m^3$ and ppb.

Monitoring commenced in June 2002 and all available results are summarised in Appendix 2.

The two months in which the highest concentrations sulphur dioxide at all sites were measured are shown in Table 3.3.

Table 3.3 Maximum Average Hourly SO_2 Concentrations Measured by Diffusion Tubes ($\mu g/m^3$)

Month	Coastguard Road, Larne	Dromaine Drive, Larne	Green Way, Larne	Loran Avenue, Larne	St. John's East, Larne	Recreation Road, Larne	Balllylumford Road, Islandmagee	Channel Vista, Glenarm
February 2003	55.6	82.4	78.5	118.6	72.7	187.7	60.9	67.1
February 2004	8.2	6.2	234.4	15.4	30.4	-	230.8	3.1
August 2003	11.5	19.0	6.8	518.9	4.9	-	8.6	-

A very high result was obtained at Loran Avenue, Larne in August 2003 and the laboratory was of the opinion that this diffusion tube appeared to be contaminated. This spurious result will consequently be disregarded.

The maximum concentrations measured at each site did not exceed the 1-hour mean objective of 350 $\mu g/m^3$ however, two results were in the region of 230 $\mu g/m^3$. Although SO_2 diffusion tube measurements may be unreliable and cannot be easily compared with short-term objectives, it does create an element of uncertainty, albeit small, as to whether the air quality standards for sulphur dioxide will be met. It is also possible that the bubblers are not located in correct position to measure the highest concentration of SO_2 in Larne.

3.4.6 Domestic Emissions of Sulphur Dioxide

At the First Stage review and assessment a screening approach contained within GB Government Guidance TG4(00) was used to determine the likelihood of SO_2 objectives being exceeded. This was based upon fuel use data. Limited fuel use data was provided by Northern Ireland Housing Executive on their housing stock however, data on owner occupied properties was based on the assumption that 25% burned coal. A fuel use survey of privately owned houses was undertaken in February 2002 to obtain a more accurate percentage of coal burning private properties.

Rerunning the screening methodology used at Stage 1 with the accurate data for owner occupied properties concluded that there was a risk that the SO_2 objective would be exceeded.

3.5 Conclusions of the Second Stage Review and Assessment of Sulphur Dioxide

Emissions from Ballylumford and Kilroot Power Stations are not likely to cause an exceedance of the air quality objective and therefore a stage 3 review and assessment is not necessary for these industrial sources.

Exceedances of the SO_2 objectives from activities at Larne Harbour cannot be ruled out therefore a third stage review and assessment of this source is necessary.

Bubbler monitoring data has indicated that air quality standards will be met in areas of highest density domestic coal burning. However, diffusion tube monitoring data has indicated higher SO_2 concentrations approaching the objectives elsewhere. In addition rerunning the screening method used at stage 1 indicates that there is a risk that the SO_2 objective may not be met.

To eliminate the uncertainty on the risk of residential coal burning emissions causing an exceedance of the SO_2 objective, a third stage review and assessment is required.

3.6 Third Stage Review and Assessment for Sulphur Dioxide

3.6.1 Emissions of Sulphur Dioxide from Larne Harbour

To determine whether emissions from Larne Harbour exceed the air quality objectives for SO_2, in accordance with LAQM TG4(00), monitoring of the pollutant was carried out in the vicinity of the port. A site was selected on the basis that it was representative of levels at the nearest sensitive receptors which were domestic dwellings on Coastguard Road. The equipment was located at a distance of approximately 25m from said domestic properties and 235 m from the closest mooring quay. An automatic UV fluorescent SO_2 analyser was installed which could provide real time data on short-term objectives. The analyser is housed in an air-conditioned enclosure within the confines of Larne Harbour to provide enhanced security. (Grid Ref 41320175).

The SO_2 analyser is calibrated manually every fortnight by trained Larne Borough Council staff. The calibration is performed with zero air from a zero air cylinder and span checks using a certified gas cylinder. NETCEN, a UKAS accredited laboratory, are appointed to provide QA/QC and data management services. Data is downloaded by NETCEN daily thus any faults or unusual results are detected early and brought to attention of Larne Borough Council. NETCEN carry out 6 monthly site audits and issue a UKAS certificate of calibration. Full ratification of data is provided which is comparable to that produced within the national network.

The equipment is US EPA approved and also approved in the DEFRA Automatic Urban Network. In addition, Envirotechnology Services plc, the supplier of the equipment, service and calibrate the equipment annually and provide emergency call out visits in the event of technical faults.

Photo 3 - Air Quality Monitoring Station Larne Harbour

Results

Monitoring commenced in April 2003 and the results from the first 12 months of operation are summarised in Tables 3.4 and 3.5.

Tables 3.4 Sulphur Dioxide Concentrations at Larne Harbour
01 April 2003 – 31 March 2004

Number Very High	0
Number High	0
Number Moderate	1
Number Low	33260
Maximum 15-Minute Mean	295 µg/m^3
Maximum Hourly Mean	128 µg/m^3
Maximum running 8-Hour Mean	83 µg/m^3
Maximum running 24-Hour Mean	58 µg/m^3
Maximum Daily Mean	42 µg/m^3
Average	4 µg/m^3
Data Capture	96.7%

Tables 3.5 Sulphur Dioxide Concentrations at Larne Harbour
01 April 2003 – 31 March 2004

Pollutant	Air Quality Regulations (NI) 2003	Exceedances	Days
Sulphur Dioxide	15-minute mean > 266 µg/m^3	1	1
Sulphur Dioxide	Hourly mean > 350 µg/m^3	0	0
Sulphur Dioxide	Daily mean > 125 µg/m^3	0	0

Table 3.4 shows details on the concentration of SO_2 measured at Larne Harbour including information on the health based bandings into which the levels can be categorised. The Air Pollution Information Service uses these Air Pollution Bands and Indexes to provide more detail on air pollution levels in a simple way similar to the sun or pollen index. When air pollution is rated LOW, effects are unlikely to be noticed even by those who are sensitive to air pollution. When MODERATE, sensitive people may notice mild effects but these are unlikely to need action. When HIGH, sensitive people may notice significant effects and action may need to be taken and when VERY HIGH, effects on sensitive people may worsen. The Air Pollution Information Service provides such information via a freephone service, teletext and on website www.airquality.co.uk/archive/standards.

As shown in Table 3.4 during the period of measurement there was one excursion into the MODERATE band with the remainder of the year in the LOW band.

Table 3.5 shows the concentrations measured did not exceed either the 1-hour mean or 24-hour mean standard for SO_2.

One 15-minute mean measurement was above 266 µg/m^3. The 15-minute mean standard for SO_2 is 266 µg/m^3 not to be exceeded more than 35 times in a year. Therefore the 15-minute mean objective has not been exceeded.

3.6.2 Domestic Emissions of Sulphur Dioxide

To predict the levels of SO_2 in the three areas of Larne identified as having the highest density of coal burning households, Air Quality Consultants were commissioned to model the concentrations of the pollutant and assess the likelihood of air quality standards being met. Modelling was carried out by NETCEN who are certified to quality standard ISO 9001 and ISO14001.

Fuel Use Surveys

To model SO_2 concentrations, information on the extent of coal burning in the Craigyhill, Antiville and Townparks areas was required. A fuel use survey of privately owned houses was carried out in February 2002. Due to the lack of similar detailed information for Northern Ireland Housing Executive properties, a fuel use survey was carried out in November 2003.

The surveys determined:

- The types and quantities of fuels used in the domestic sector
- Seasonal use of heating fuels
- The types of heating appliances used
- Any proposed change in fuel usage
- The total number of houses that burn coal in each of the survey areas.

The surveys combined sampled the following percentage of properties in each area:

Survey Area	Total Number of Houses	Number of houses Surveyed	%
Craigyhill	1537	291	19
Antiville	1163	292	25
Townparks	1461	319	22

As the three 1km^2 areas to be assessed were adjacent, the emissions sourced from each grid could potentially impact on the pollutant concentration in the neighbouring grid, i.e. emissions from Antiville could effect the pollutant concentrations in Craigyhill when the meteorological conditions were right. Thus modelling the areas separately may have lead to underestimation of

the actual concentrations. Therefore, it was determined that the three grids should be modelled as one larger grid area. (NETCEN 2004)

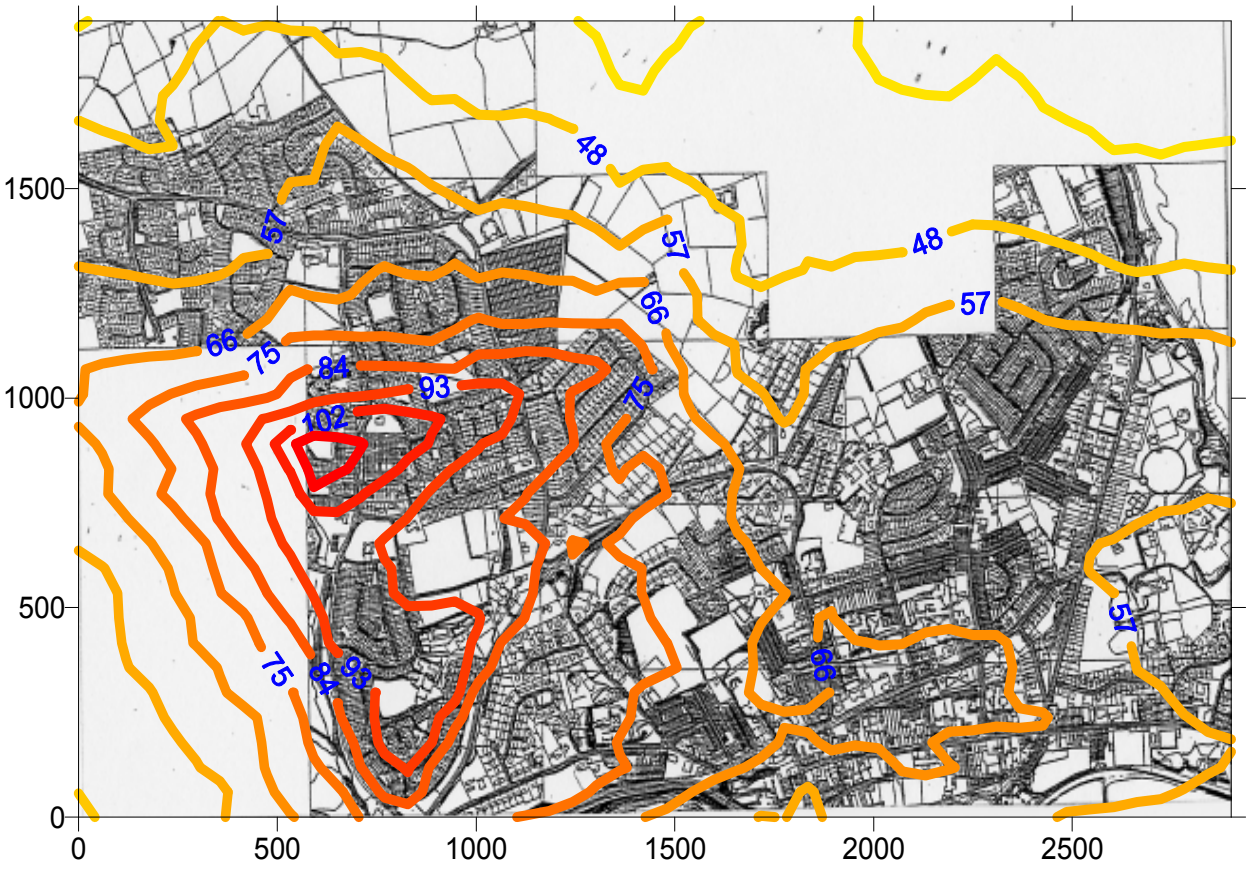
Modelling Approach

The dispersion model ADMS 3.1 was used to predict the SO_2 levels in Larne with reference LAQM.TG(03). 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 model results have been bias corrected using relevant real time monitoring data from residential coal burning sources in Carrickfergus Borough Council. This was necessary because there was no continuous monitoring of SO_2 at a location suitable for model verification in a residential area in Larne.

Modelling Results

Figure 1a shows predicted SO_2 concentrations in the Larne area. The model predicts that the 99.9th percentile of the 15-minute mean SO_2 concentration objective will not be exceeded and no further assessment of domestic sources is required.

Figure 1 a: 99.9 percentile 15 minute mean SO_2 concentrations for the Craigyhill, Antiville and Town Parks grid areas (modelled as one larger grid, model results corrected for bias using monitoring data from Carrickfergus)



3.7 Conclusion of the Third Stage Review and Assessment of Sulphur Dioxide

The SO_2 monitoring at Larne Harbour and the modelling of SO_2 from domestic sources in Larne indicate that it is unlikely that the 15-minute, hourly and daily air quality objectives will be exceeded. It will therefore not be necessary to propose any air quality management areas for sulphur dioxide in the borough of Larne.

4.0 REVIEW AND ASSESSMENT OF PM_{10}

4.1 Introduction

The government has adopted two Air Quality Objectives for fine particles (PM_{10}). These objectives are an annual mean of 40 $\mu g/m^3$ and a 24-hour mean of 50 $\mu g/m^3$ to be exceeded on no more that 35 days per year. This standard is to be achieved by the end of 2004.

The EU has also set indicative limit values for PM_{10} which are to be achieved by 01 January 2010. These stage 2 limit values are a 24-hour mean of 50 $\mu g/m^3$ not to be exceeded more than 7 days per year and an annual mean of 20 $\mu g/m^3$ to be achieved by 2010. These new particle objectives are not currently included in Regulations for the purpose of Local Air Quality Management and there is no requirement for local authorities to achieve the 2010 standards. Reference to them at this stage may assist with longer-term planning.

4.2 Sources of PM_{10}

Airborne particulate matter varies widely in its physical and chemical composition, source and particle size. Particles are often classed as primary, secondary or coarse particles.

Primary particle emissions are derived directly from combustion, sources including road traffic particularly diesel combustion, power generation, industrial sources etc. Secondary particles are formed by chemical reactions in the atmosphere and comprise principally of sulphates and nitrates. Coarse particles comprise of emissions from a wide range of sources including re-suspended dusts from road traffic, construction works, mineral extraction processes, wind-blown dusts and soils.

PM_{10} particles (the fraction of particulates in air of very small size, < 10 µm in diameter) can potentially cause significant health risk as they are small enough to penetrate deep into the lungs. Larger particles are not readily inhaled.

4.3 Conclusions of First Stage Review and Assessment of PM_{10}

The First Stage of the review and assessment process identified a number of sources of PM_{10} which posed a risk of exceeding the 2004 objectives.

A screening approach based upon the methodology set out in the Design Manual for Roads and Bridges (DMRB) identified several roads and junctions with the potential to emit significant quantities of PM_{10} based upon knowledge of traffic flow, vehicle speed and distance to the nearest exposed population.

A further screening approach based on the number of coal burning households identified three areas, namely Craigyhill, Antiville and Townparks which posed a risk of exceeding the 2004 objective.

One Part A process in Carrickfergus Borough Council, i.e. Kilroot Power Station and the shipping movements at Larne Harbour were considered to be potentially significant sources of PM_{10}.

4.4 Second Stage Review and Assessment

To predict the levels of PM_{10} at the locations identified as potentially exceeding the air quality objective, Air Quality Consultants were commissioned to model expected present and future levels of pollutant concentration associated with road traffic and assess the impact of industry and port activities. Modelling was carried out in accordance with GB Government Guidance LAQM TG4(00) by NETCEN who are certified to quality standard ISO 9001 and ISO14001.

4.4.1 Impact of Road Traffic on Concentration of PM_{10}

The findings of the consultant's model prediction for 2004 are summarised in Table 4.1.

Table 4.1 Predicted PM_{10} Concentrations at Roadside Locations in the Larne Borough Council Area

Location Description	PM_{10} Annual Mean ($\mu g/m^3$) 2004
Antiville Road/A8 junction	22.0
Antiville Road/Mill Brae/Linn Road junction	19.9
Antiville Road/Lowere Cairncastle Road/Upper Cairncastle Road junction	19.7
The Roddens	20.0
Station Road/Circular Road junction	19.8
Bank Road/Glynn Road junction	20.0
Victoria Road/Old Glenarm Road/Agnew Street junction	20.3
Circular Road/Curran Road/Glenarm Road/Main Street junction	20.2
Thorndale Avenue/Pound Street	19.4
Main Street	19.1
Pound Street	19.0
Larne Harbour Roundabout	23.1

GB Government Guidance LAQM.TG4(00) states that the 24-hour objective is highly unlikely to be exceeded if the annual mean concentration is below 28 $\mu g/m^3$. For 2004, the model predicts annual average concentrations of PM_{10} less than 28 $\mu g/m^3$ at all of the locations modelled in Larne. Therefore the objectives for PM_{10} are not likely to be exceeded. (NETCEN, 2002).

4.4.2 Impact of Industry on Concentrations of PM_{10}

Kilroot Power Station

The specifications of combustion processes at Kilroot Power Station are detailed in Table 4.2.

Table 4.2 Kilroot Power Station

	Kilroot Power Station
Temperature of emissions (°C)	120
Stack height	200
Stack diameter	8
PM10 tonnes per annum	226

The height of the tallest building within 5 stack heights is 57 metres. The nomogram in GB Pollutant Specific Guidance provides the annual PM_{10} emission which will give rise to a 90^{th} percentile of the 24-hour ground level concentration of 1 $\mu g/m^3$. Using this nomogram, the permitted PM_{10} emission rate with an industry of the above dimensions is 1,800 tonnes per annum. This is well above the actual emission of 226 tonnes per annum and therefore there is no need to proceed to a Stage Three Review and Assessment for this source. (NETCEN 2002)

4.4.3 Impact of Larne Port on Concentrations of PM_{10}

Larne Port was used by 5591 vessels in 1999 (Source NAEI 1999) the majority of which are roll on-roll off vessels. The nearest residential housing is within 500m of the berthing area. Pollutant specific guidance states that 'shipping movements can give rise to PM_{10} emissions but there is only the potential for significant impact where there are a large number of ships e.g.

major ports with properties within close proximity'. However, it also states "due to the uncertainties in emissions for uncontrolled or fugitive dust release there is no suitable screening approach which can be confidently applied to the second stage review and assessment. In the absence of local monitoring data it is necessary to assess this source further as part of a stage three review and assessment. (NETCEN, 2002)

4.4.4 Conclusion of Model Prediction and Assessments for PM_{10}

Emissions from industrial sources and road traffic are not predicted to lead to an exceedance of the PM_{10} objective in 2004. However, there is a possibility that there could be significant emissions of PM_{10} associated with the shipping movements in Larne Harbour.

4.4.5 Domestic Emissions of PM_{10}

At the First Stage review and assessment a screening approach contained within GB Government Guidance TG4(00) was used to determine the likelihood of PM_{10} objectives being exceeded. This was based upon fuel use data. Limited fuel use data was provided by Northern Ireland Housing Executive on their housing stock however, data on owner occupied properties was based on the assumption that 25% burned coal. A fuel use survey of privately owned houses was undertaken to obtain a more accurate percentage of coal burning, private properties.

Rerunning the screening methodology used at Stage 1 with the accurate data for owner occupied properties concluded that the PM_{10} objective would be met.

4.4.6 Monitoring of Domestic Coal Burning Emissions

An assessment of the impact of domestic solid fuel use can be carried out from existing black smoke data, based upon the empirical relationship described in Appendix 2.

Black smoke data has been collected since June 2002 using Smoke and SO_2 8-Port bubblers located in the Craigyhill and Townparks area. As detailed in section 3.4.4 the equipment was installed in the following secure locations:

1. Craigyhill – Lynn Community Centre, Linn Road, Larne
2. Townparks – McGarel Cemetery, Old Glenarm Road, Larne

Black smoke data is determined by measuring the staining to filters in conjunction with the 8-port bubbler apparatus. The equipment is maintained weekly with the results of filter reflectance forwarded to AEA Technology Plc on a monthly basis for input into the national database. Training of officers responsible for the equipment has been conducted along with accompanied visits to ensure weekly maintenance and validation checks together with auditing of chemical preparation and analysis are carried out as part of internal quality assurance procedures. Procedures with the 'UK Smoke and SO_2 Networks instruction manual' are followed as the QA/QC protocols. The black smoke monthly average and annual average for 2003 are shown in Table 4.3 over page.

Table 4.3 Black Smoke Monthly Averages 2003 (µg/m^3)

Month	Craigyhill Site	Townparks Site
January	5	7
February	12	14
March	10	13
April	6	8
May	5	6
June	3	4
July	5	3
August	2	3
September	4	5
October	4	6
November	8	12
December	8	9
ANNUAL AVERAGE	**6**	**7.5**

The 1996 annual mean background secondary PM_{10} concentrations for the area using the internet maps (previously available on www.airquality.co.uk) for Larne was estimated as 7 - 8 µg/m^3. To determine the worst-case scenario a background of 8 µg/m^3 will be used for the purpose of this assessment.

Figure 8.8 from GB Government Guidance TG4(00) indicates that exceedances above an annual mean threshold of 18 µg/m^3 shows a need to progress to third stage review.

Results

Applying the annual average black smoke data to figure 8.8 from GB Government Guidance TG4(00) does not exceed the threshold for third stage review.

Conclusion

Further investigation with respect to PM_{10} is not necessary and there is no need to progress to third stage review and assessment with respect to domestic solid fuel use.

4.5 Conclusions of Second Stage Review and Assessment for PM_{10}

The modelling of PM_{10} concluded that emissions from road traffic are not likely to result in PM_{10} objectives being exceeded and no further assessment of this source is required.

Emissions from Kilroot Power Stations are not likely to cause an exceedance of the air quality objective and therefore a stage 3 review and assessment is not necessary for this industrial source.

Exceedances of the PM_{10} objectives from activities at Larne Harbour cannot be ruled out therefore a third stage review and assessment of this source is necessary.

Black smoke data has indicated that air quality standards will be met in areas of highest density domestic coal burning and rerunning the screening method used at stage 1 indicates that the air quality standard PM_{10} will be met. Although no further assessment of this pollutant is required, modelling of sulphur dioxide for domestic coal burning is necessary as part of the stage 3 assessment. It was considered worthwhile modelling for PM_{10} simultaneously at little extra cost.

4.6 Third Stage Reviews and Assessments for PM_{10}

4.6.1 Emissions of PM_{10} from Larne Harbour

To determine whether emissions from Larne Harbour exceed the air quality objective for PM_{10}, in accordance with LAQM TG4(00), monitoring of the pollutant was carried out in the vicinity of the Port.

A site was selected on the basis that it was representative of levels at the nearest sensitive receptors which were domestic dwellings on Coastguard Road. The equipment was located at a distance of approximately 25m from said domestic properties and 235 m from the closest mooring quay. A Beta-attenuation sampler (BAM 1020) was installed which could provide real time data on PM_{10} concentrations. The analyser is housed in an air-conditioned enclosure alongside the SO_2 analyser within the confines of Larne Harbour to provide enhanced security. (Grid Ref 4132 0175). See photo 3.

The BAM 1020 is operated in accordance with the operational manual. Sample flow rates are checked fortnightly by trained Larne Borough Council staff. The equipment also carries out it's own automatic calibration every hour and should the instrument fail to meet specification an error is logged in memory and data is flagged.

NETCEN, a UKAS accredited laboratory, are appointed to provide QA/QC and data management services. Data is downloaded by NETCEN daily thus any faults or unusual results are detected early and brought to attention of Larne Borough Council. NETCEN carry out 6 monthly site audits and issue a UKAS certificate of calibration. Full ratification of data is provided which is comparable to that produced within the national network.

The equipment is US EPA approved and also approved in the DEFRA Automatic Urban Network. In addition, Envirotechnology Services plc, the supplier of the equipment, service and calibrate the equipment annually and provide emergency call out visits in the event of technical faults.

Monitoring commenced in April 2003 and the results from the first 12 months of operation are summarised in Table 4.3 and Table 4.4

Table 4.3 PM_{10} concentrations at Larne Harbour 01 April 2003 – 31 March 2004

Number Very High	22
Number High	2
Number Moderate	187
Number Low	8459
Maximum Hourly Mean	737 µg/m^3
Maximum running 8-Hour Mean	494 µg/m^3
Maximum running 24-Hour Mean	198 µg/m^3
Maximum Daily Mean	189 µg/m^3
Average	22 µg/m^3
Data Capture	99.1%

Table 4.4 Exceedances of PM_{10} Objective at Larne Harbour 01 April 2003 – 31 March 2004

Pollutant	Air Quality Regulations (NI) 2003	Exceedances	Days
PM_{10} Particulate Matter	Daily mean > 50 µg/m^3	20	20
PM_{10} Particulate Matter	Annual mean > 40 µg/m^3	0	0

Table 4.3 shows details on the concentration of PM_{10} measured at Larne Harbour including information on the health based bandings into which the levels can be categorised. The Air Pollution Information Service uses these Air Pollution Bands and Indexes to provide more detail on air pollution levels in a simple way similar to the sun or pollen index. When air pollution is rated LOW effects are unlikely to be noticed even by those who are sensitive to air pollution. When MODERATE sensitive people may notice mild effects but these are unlikely to need action. When HIGH, sensitive people may notice significant effects and action may need to be taken and when VERY HIGH, effects on sensitive people may worsen. The Air Pollution Information Service provides such information via a freephone service, teletext and on website www.airquality.co.uk/archive/standards.

Table 4. 3 shows the number of excursions into the MODERATE, HIGH and VERY HIGH health based bandings. All the excursions to the VERY HIGH and HIGH bands and all but 5 of the excursions to MODERATE occurred during the measurement period 01 April 2003 to 31 August 2003. Similar results were found at the monitoring site in Belfast City Centre and this is understood to be the result of elevated PM_{10} levels regionally and UK wide. In 2003 several such episodes were attributable to the following:

1. Easterly winds bringing secondary pollution from Europe during warm settled weather in February, March and April 2003.
2. Poor dispersion due to low wind speeds and re-circulation of air over the UK with possible formation of secondary particulates from UK emissions in early April.
3. Dust clouds from Sahara dust storms tracking northwards over Europe and reaching the UK around 15 to 18 April. The influence of the Saharan dust storm events can be seen in the following images available on the following

http://earthobservatory.nasa.gov/NaturalHazards/natural_hazards_v2.php3?img_id=10181
http://earthobservatory.nasa.gov/NaturalHazards/natural_hazards_v2.php3?img_id=10183

Further information from NETCEN on each of these national episodes is presented at:

http://www.airquality.co.uk/archive/reports/cat12/ad-hoc_pm10_report_febmar03_episode.pdf
http://www.airquality.co.uk/archive/reports/cat12/marchapril03_episode.pdf

The concentrations measured did not exceed the annual mean of 40 µg/m^3. Twenty daily mean measurements were above 50 µg/m^3. The daily mean standard for PM_{10} is 50 µg/m^3 not to be exceeded more than 35 times in a year. Therefore the daily mean objective has not been exceeded.

4.6.2 Domestic Emissions of PM_{10}

To predict the levels of PM_{10} in the three areas of Larne identified as having the highest density of coal burning households, Air Quality Consultants were commissioned to model the concentrations of the pollutant and assess the likelihood of air quality standards met with reference to LAQM TG (03). Modelling was carried out by NETCEN who are certified to quality standards ISO 9001 and ISO14001.

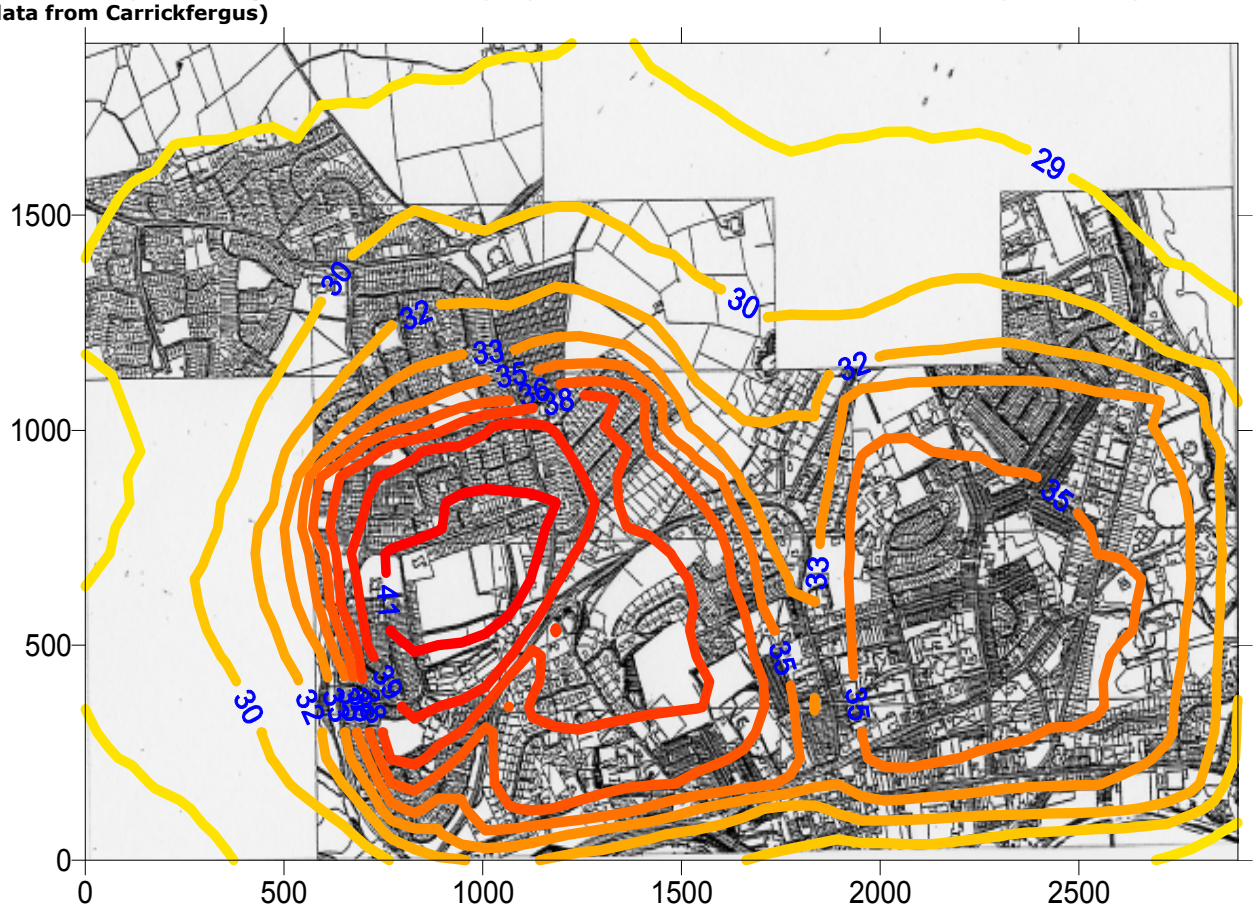
Details of the fuel use surveys undertaken and the modelling approach used are detailed earlier in section 3.6.2.

The model results have been bias corrected using relevant real time monitoring data from residential coal burning sources in Carrickfergus Borough Council. This was necessary because there was no continuous monitoring of PM_{10} at a location suitable for model verification in a residential area in Larne.

Modelling Results

Figure 2b shows the predicted PM_{10} concentrations in the Larne area. The model predicts that the 90.41 percentile of 24-hour PM_{10} concentration in 2004 will not be exceeded and no further assessment of domestic sources is required.

Figure 2 b: Predicted 90.4 percentile daily mean PM_{10} concentrations for the Craigyhill, Antiville and Town Parks grid areas (modelled as one larger grid, model results corrected for bias using monitoring data from Carrickfergus)



4.7 Conclusions of the Third Stage Review and Assessment of PM_{10}

The PM_{10} monitoring at Larne Harbour and the modelling of PM_{10} from domestic coal burning in Larne indicate that it is unlikely that the air quality objectives will be exceeded. It will therefore not be necessary to propose any air quality management areas for PM_{10} in the borough of Larne.

5. CONCLUSIONS & DISCUSSION

5.1 Conclusions of Second & Third Stage Review and Assessment

Larne Borough Council's review and assessment of air quality shows that no exceedances of the objectives are likely for benzene, 1,3 butadiene, carbon monoxide, lead, nitrogen dioxide, sulphur dioxide and PM_{10}. It will therefore not be necessary to declare any air quality management areas in the Borough of Larne.

5.2 The Next Step – Future Air Quality Review and Assessments

The next round of air quality review and assessments will be carried in two steps instead of the previous three staged approach:

- An **Updating and Screening Assessment** for identifying those aspects that have changed since the first round of reviews and assessments, including by way of lessons learnt from the first round, that may require further assessment.
- A **Detailed Assessment** of those pollutants and specific locations that have been identified as requiring further work- i.e. where members of the public are likely to be exposed over the averaging period of the air quality objective.

The Department of Environment expects District Councils should undertake reviews and assessments of air quality every three years and should complete their second rounds of reviews and assessments by April 2007

6.0 REFERENCES

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APPENDICES

Appendix 1 – NO_2 Diffusion Tube Monitoring Results

	Average Hourly NO_2 Concentration (ppb)							
	Location							
Month and Year	Antiville Rd/A8 (Grid Ref 3864 0212)	Riverdale (Grid Ref 3968 0249)	Main Street (Grid Ref 4016 0260)	Victoria Rd/Agnew Street (Grid Ref 4033 0285)	Upper Cairncastle Road (Grid Ref3920 0323)	Larne Harbour Roundabout (Grid Ref 4123 0196)	Coastguard Road (Grid Ref 4131 0171)	Ballylumford Road (Grid Ref 4206 0203)
May 2002	5	7	13	10	7	11	4	8
June 2002	20	7	11	19	11	9	12	13
July 2002	15	15	19	19	14	10	11	8
Aug 2002	2	5	5	12	4	3	2	4
Sept 2002	12	-	14	13	11	12	8	7
Oct 2002	15	21	14	20	16	20	9	12
Nov 2002	11	12	11	18	5	18	8	6
Dec 2002	19	9	17	19	17	21	12	10
Jan 2003	16	19	21	21	14	20	18	15
Feb 2003	16	20	-	15	18	18	15	10
Mar 2003	4	12	8	10	7	7	4	3
Apr 2003	6	8	10	12	8	4	2	2
May 2003	14	7	10	14	6	10	4	5
June2003	9	7	8	11	9	7	4	5
July 2003	3	-	4	4	7	7	3	54
Aug 2003	-	9	10	6	3	5	1	4
Sept 2003	-	13	13	13	11	5	5	4
Oct 2003	10	17	11	16	9	11	7	4
Nov 2003	-	19	6	-	19	16	8	15
Dec 2003	-	12	15	18	13	15	12	14
Feb 2004	7	4	7	5	5	13	6	8

Appendix 2 - SO_2 Diffusion Tube Monitoring Results

Average Hourly SO_2 Concentration ($\mu g/m^3$)								
	Location							
Month & Year	**Coastguard Road, Larne** (Grid Ref 4131 0171)	**Dromaine Drive, Larne (Grid Ref 3839 0389)**	**Green Way, Larne (Grid Ref 3903 0353)**	**Loran Avenue, Larne (Grid Ref 3896 0272)**	**St. John's Place East, Larne (Grid Ref 3992 0281)**	**Recreation Road, Larne (Grid Ref4053 0365)**	**Ballylumford Road, Larne** (Grid Ref 4206 0203)	**Channel Vista, Glenarm (Grid Ref3066 1561)**
June 2002	12.0	5.6	7.45	-	8.8	9.3	10.1	2.7
July 2002	5.9	11.7	8.8	-	38.3	30.9	23.1	12.5
August 2002	8.5	8.0	7.5	9.3	10.4	-	11.7	5.9
September 2002	11.2	10.4	20.2	13.6	24.5	-	36.5	22.1
October 2002	12.2	10.6	27.7	18.4	14.9	55.9	16.0	6.7
November 2002	19.4	30.9	23.7	45.5	30.3	74.5	22.1	16.8
December 2002	**46.8**	48.2	36.5	78.7	48.2	-	44.4	47.4
January 2003	15.6	12.2	24.8	20.9	15.5	99.7	12.0	4.5
February 2003	**55.6**	**82.4**	78.5	**118.6**	**72.7**	**187.7**	60.9	**67.1**
March 2003	23.8	48.7	35.2	58.3	47.3	85.0	60.1	14.0
April 2003	32.3	52.5	49.6	67.7	-	78.2	45.3	55.8
May 2003	4.5	10.7	7.8	11.0	8.9	14.0	10.6	3.6
June 2003	5.1	8.2	4.7	9.8	7.7	21.6	7.8	9.6
July 2003	-	4.9	13.2	10.8	5.7	-	5.3	3.0-
August 2003	11.5	19.0	6.8	**518.9**	4.9	-	8.6	-
September 2003	7.3	9.6	13.2	11.1	10.9	-	11.8	7.8
October 2003	12.3	7.8	9.6	16.0	-	24.0	22.0	10.6
November 2003	12.3	16.6	37.8	22.2	20.6	-	22.2	15.2
December 2003	5.1	9.8	0.4	17.2	14.1	48.4	45.7	4.2
January 2004	8.3	5.8	17.3	11.5	12.1	41.9	18.5	21.1
February 2004	8.2	6.2	**234.4**	15.4	30.4	-	**230.8**	3.1
March 2004	5.4	14.0	15.8	15.8	-	54.0	12.5	7.6