



Ellesmere Port and Neston Borough Council

Local Air Quality Management

Updating and Screening Assessment, 2003

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INTRODUCTION

This document reports on Ellesmere Port and Neston Borough Council's (EPNBC) Updating and Screening Assessment conducted in order to address the Authority's obligations under the Air Quality Regulations (2002) (made under the Environment Act 1995). Local Authorities are obliged to review and assess current (and future) local air quality, adopting a holistic view of industrial, transport and domestic sources of pollution.

The Government's Expert Panel on Air Quality Standards (EPAQS) has prescribed Health-based standards and objectives for seven key pollutants (see Table 1). Where, as an outcome of the Review and Assessment process, it is anticipated that objectives may not be achieved at a particular location the Local Authority must declare an Air Quality Management Area (AQMA).

During the last round of Review and Assessment (completed in 2000) the Stage 2/3 review (Ref. 9.4) - which entailed detailed monitoring and modelling - concluded that it was not necessary to declare any AQMAs locally.

The Updating and Screening Assessment is a continuation of the phased approach to Local Air Quality Management (LAQM), building on the work done in the last round. Guidance (TG03 - Ref. 9.3) issued in February 2003 favours a checklist approach to the Assessment. The checklists are structured such that emission sources, locations and data pertinent to each pollutant are fully assessed. This approach has been followed in order that due consideration was given to all potential source categories. Updating and Screening Assessments are intended to highlight any issues that have arisen since the first round, such as: new monitoring data; changes in emissions and any matters that were not adequately addressed initially. Where there is an indication that there may be a risk of objectives not being met at locations of relevant exposure, the Authority is required to proceed to a Detailed Assessment. Detailed Assessments need to be completed by April 2004, and a timetable of future review and assessment milestones is shown in Table 2.

SUMMARY

This Updating and Screening Assessment is a technical review of seven air quality pollutants in the Borough of Ellesmere Port and Neston. As a requirement of the Air Quality Regulations (2002), the review is a continuation of the three-stage review completed December 2000.

The rationale of the assessment is to consider the emissions from a diverse range of sources (transport, industry & domestic) that could potentially affect local air quality and consequently affect the public at large.

Local monitoring data indicates compliance with national air quality objectives at areas of relevant public exposure. Roads and junctions were not adequately addressed during the last review and assessment. The assessment has made use of basic screening tools which, in some cases, permit the future prediction of ambient concentrations of pollutants. Based on extrapolation of current data, indications are that, for the most part, objectives will be met by the target dates. However, a section of the A5032 (Whitby Road) may be close or above the NO₂ objective by the target date of 2005, and as such a detailed assessment will be conducted.

An updated emissions inventory for 2001 has been compiled by CERC consultants on behalf of EPNBC and five other Cheshire Authorities. Industrial emissions of a number of pollutants have declined since the last round of review and assessment. Others have remained fairly static. A suite of emissions tools such as on-line calculators and industrial nomograms (threshold charts) have been provided by DEFRA to assess the likelihood of exceedences of NAQS objectives. Due to the complexity of sources on the refinery complex it was found that an adequate judgement could not be made using these tools. A precautionary approach has therefore been adopted and as such the Authority will proceed to a detailed assessment for benzene, 1,3-butadiene, Lead, NO₂, PM₁₀ and SO₂.

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25µg/m ³ (5ppb)	running annual mean	December 31, 2003
	5µg/m ³ (1.5ppb)	annual mean	December 31, 2010
1, 3-Butadiene	2.25µg/m ³ (1ppb)	running annual mean	December 31, 2003
Carbon Monoxide	10 mg/m ³ (8.6ppm)	Maximum daily running 8-hour mean	December 31, 2003
Lead	0.5 µg/m ³	annual mean	December 31, 2004
	0.25µg/m ³	annual mean	December 31, 2008
Nitrogen Dioxide	200µg/m ³ (105ppb)	1 hour mean not to be exceeded more than 18 times a year	December 31, 2005
	40µg/m ³ (21ppb)	annual mean	December 31, 2005
Particulates (PM ₁₀)	50 µg/m ³ not to be exceeded more than 35 times a year	24 hour mean	December 31, 2004
	40µg/m ³	annual mean	December 31, 2004
Sulphur Dioxide	350µg/m ³ (132ppb) not to be exceeded more than 24 times a year	1 hour mean	December 31, 2004
	125µg/m ³ (47ppb) not to be exceeded more than 3 times a year	24 hour mean	December 31, 2004
	266µg/m ³ (100ppb) not to be exceeded more than 35 times a year	15 minute mean	December 31, 2005
NB. A provisional 24-hour mean PM ₁₀ objective of 50 µg/m ³ (not to be exceeded more than 7 times a year) for 2010 is not yet included in Regulations.			
Objectives included in the Air Quality Regulations 2000 and (Amendment) Regulations 2002.			

Table 1. National Air Quality Objectives.

LAQM Activity	Completion Date	Applies to:
Updating and Screening Assessment	End of May 2003	All authorities
Detailed Assessment	End of April 2004	Those authorities which have identified the need for a Detailed Assessment in their May 2003 Updating and Screening Assessment.
Progress Report	End of April 2004	Those authorities which have identified no need for a Detailed Assessment in their May 2003 Updating and Screening Assessment.
Progress Report	End of April 2005	All authorities
Updating and Screening Assessment	End of April 2006	All authorities
Detailed Assessment	End of April 2007	Those authorities which have identified the need for a Detailed Assessment in their April 2006 Updating and Screening Assessment.
Progress Report	End of April 2007	Those authorities which have identified no need for a Detailed Assessment in their April 2006 Updating and Screening Assessment.
Progress Report	End of April 2008	All authorities
Updating and Screening Assessment	End of April 2009	All authorities
Detailed Assessment	End of April 2010	Those authorities which have identified the need for a Detailed Assessment in their April 2009 Updating and Screening Assessment.
Progress Report	End of April 2010	Those authorities which have identified no need for a Detailed Assessment in their April 2009 Updating and Screening Assessment.

Table 2. Recommended timescale for the completion of assessments / reports.

DESCRIPTION OF ELLESMERE PORT & NESTON

The Borough of Ellesmere Port and Neston extends across the southern part of the Wirral peninsula from the Mersey to the Dee, covering 33 square miles and having a population of approximately 81,200. The town of Ellesmere Port is the largest urban area in the Borough and started where the Shropshire Union Canal joins the Manchester Ship Canal and the Mersey. The Borough itself is largely smoke controlled, with 19 Smoke Control Areas (see Figure 6) being set up between 1952 and 1982 leaving Neston and the villages of Willaston, Hooton, Ince and Burton able to burn coal and other solid fuels.

The M53 motorway runs around the north and east of Ellesmere Port, close to residential and shopping areas. The M56 motorway skims the Borough boundary to the Southeast and runs Northeasterly. To the north and east of Ellesmere Port there are a number of industrial sites including an oil refinery and associated petro-chemical complex, a car assembly plant, and a chemical waste incinerator.

In the Borough there are approximately 57 Authorised industrial processes which, under the provisions of the Environmental Protection Act 1990, are authorised for integrated pollution control requirements by the Environment Agency for pollution control purposes by the Borough Council. Industrial sources are therefore a key air quality consideration.

There remains a significant potential for development within the Borough of Ellesmere Port and Neston. The developments relate mainly to retail employment and residential use. The effect of these planned developments will have to be taken into account, particularly the potential for an increase in industrial emissions and vehicle movements.

A map of the Borough is presented as Figure 1.

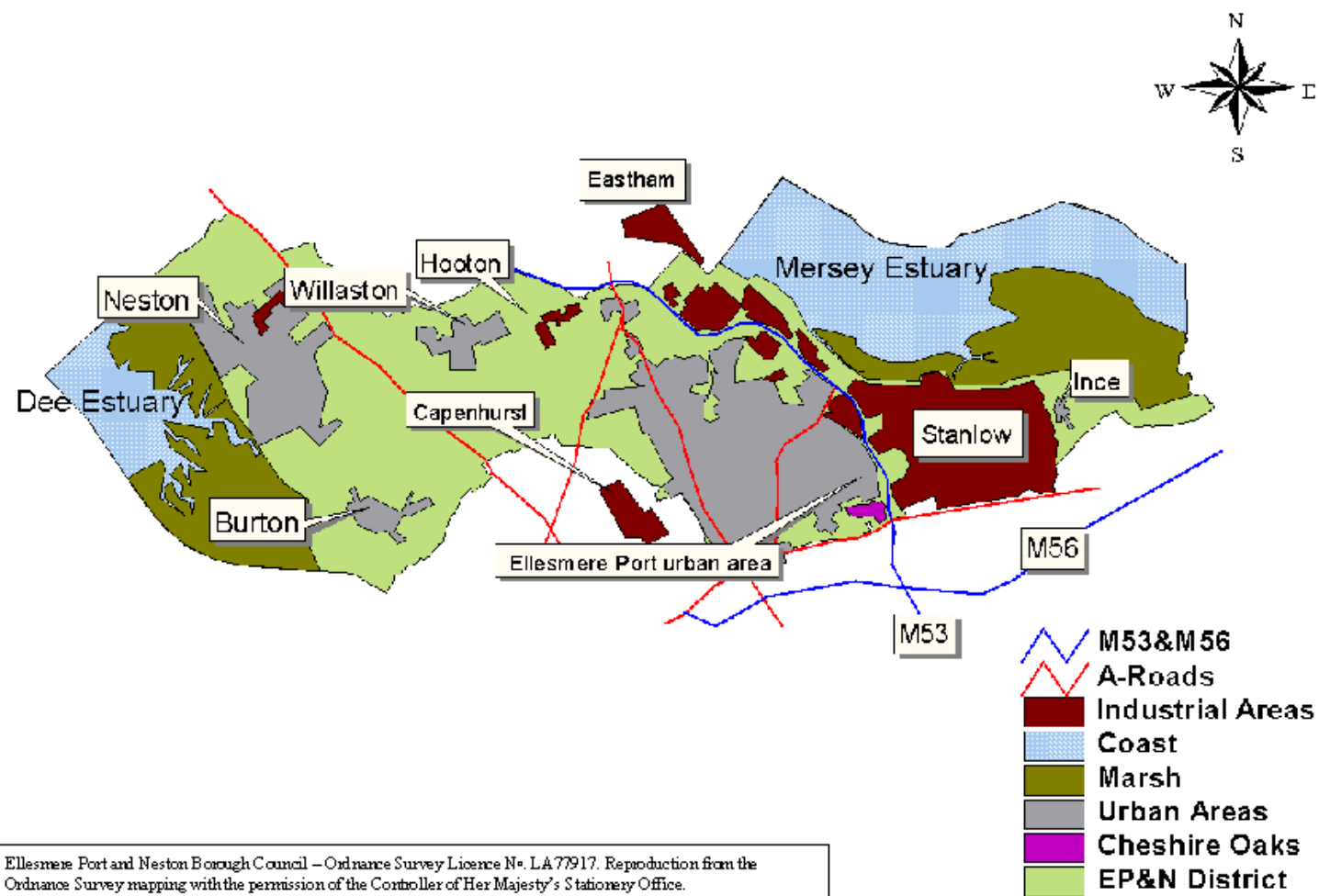


Figure 1. Map of the borough showing major roads, industrial and urban areas

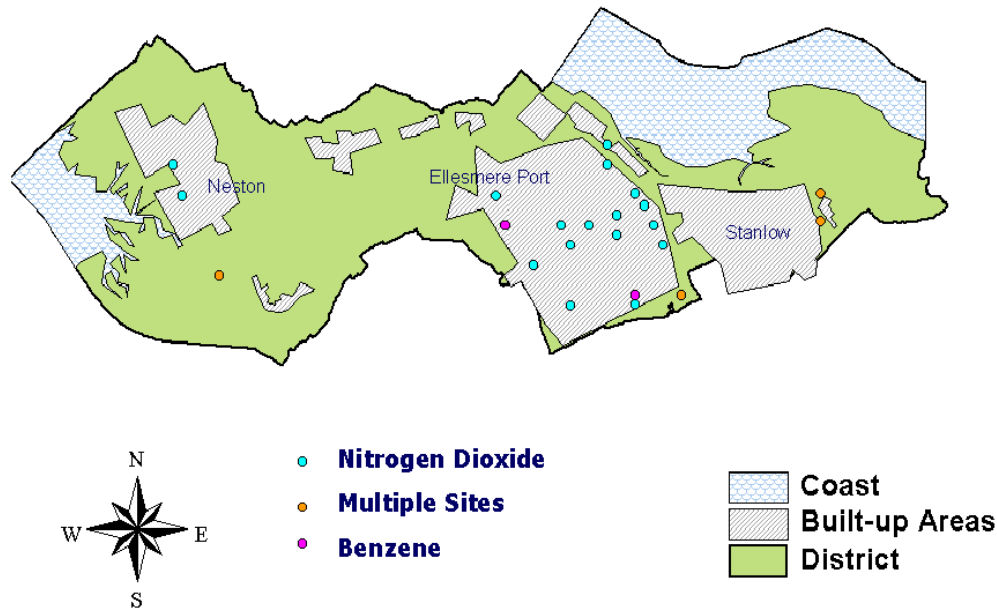
MONITORING

Ellesmere Port and Neston Borough Council currently operates 34 air pollution monitors at strategic locations across the borough using both passive and active techniques. Twenty-six diffusion tubes are used to monitor NO₂, benzene and 1,3-butadiene (see Table 7), analytical details for which are presented in Appendix 3. Of the four tubes which form part of the UK network, three have been in continual operation since 1990, and therefore provide useful information on temporal trends in ambient NO₂. Approximate locations of these tubes can be seen in below Figure 2.

A net acidity sulphur dioxide bubbler, which previously formed part of a much larger local network, continues to operate at the council offices providing information which goes back almost 40 years.

Local air quality monitoring has been greatly enhanced by the addition of automatic real-time analysers and meteorological equipment which was first installed in late 1995. The council operates 2 Opsis beams, 3 TEOMs and five API instruments monitoring a range of NAQS pollutants (see Table 8). An indication of the locations of these analysers is given in Figure 3. Data is polled automatically four times a day by the Enviman system based at the council offices. Enviman is also used for the purposes of data scaling / ratification and publishing data on the council's web-site. All real-time monitoring equipment is serviced and calibrated by Enviro-Technology limited. Span tests are performed by council staff using BOC 'Spectra-seal' span gases (quoted analytical accuracy 1%).

Locations of Diffusion tubes

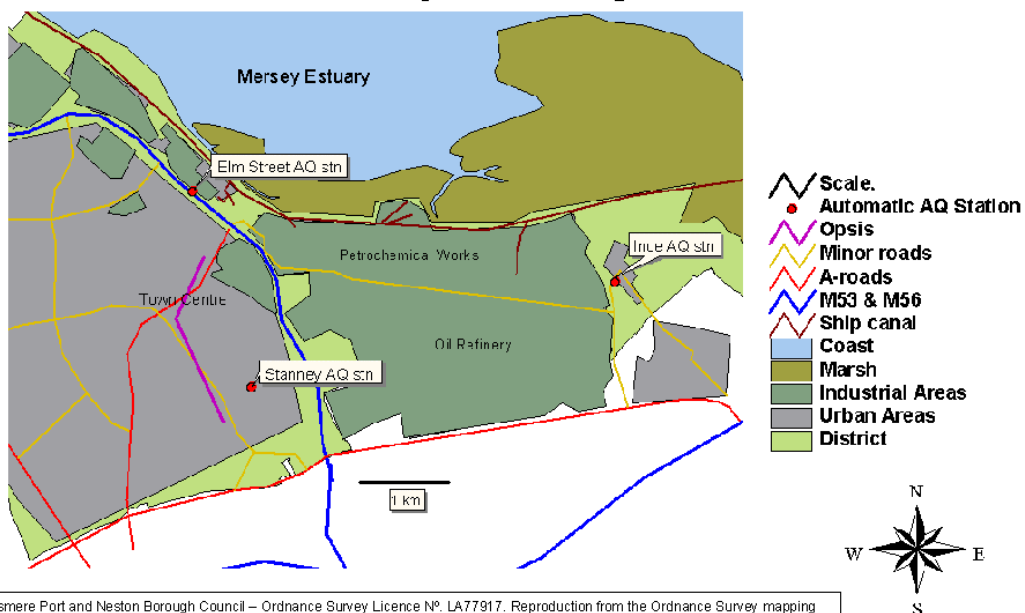


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Figure 2. Map showing locations of diffusion tubes

Locations of real-time analysers

Ellesmere Port Air Quality Monitoring Stations



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Figure 3. Map showing locations of automatic monitoring stations

REVIEW OF STRATEGY POLLUTANTS

1. BENZENE (C₆H₆)

1.1. Introduction

Atmospheric benzene is present almost entirely as a result of human activities. In the UK road transport emissions (both from evaporative emissions and from the combustion of petrol) predominate. The introduction of petrol vapour recovery systems at filling stations; tighter limits on the benzene content of petrol (less than 1% benzene) and the introduction of catalytic converters has resulted in significant reductions in recent years. Fugitive emissions from the manufacture and use of benzene are also important.

Benzene is a recognised genotoxic human carcinogen; it is therefore not possible to state an absolute safe level for ambient air concentrations of benzene. The EPAQS standard is, however, designed to reflect a level at which there is an exceedingly small risk to health.

The National Air Quality objective is

- **A running annual mean level of 16.25µg/m³ (5ppb)
This must be met by December 2003.**

**A revised objective of 5µg/m³ (1.5ppb) as an annual mean has been set.
This must be achieved by December 2010.**

1.2. Conclusions of round one review and assessment

- Benzene is emitted from vehicles and industry. There is a significant industrial source of benzene within the Borough.
- The Model predicts benzene exceedences from an industrial source, however these are not in areas of relevant public exposure. There are no exceedences related to roads and vehicular transport.
- Monitoring data in areas relevant to public exposure confirm that the NAQS (National Air Quality Strategy) objective is not exceeded in those areas.

- The Model is slightly under predicting the level due to no background benzene levels being included in the Model.

Air Quality Management Areas not required.

1.3. Monitoring Data

Benzene monitoring, using passive diffusion tubes, has been carried out since 2000 (established in response to the need to produce data for dispersion model verification). Details of analysis and uncertainty of measurement are contained in Appendix 3. Monitoring results are presented in Table 21, Appendix 2.

Data presented as estimated UK background air pollution concentrations on the NETCEN (National Environmental Technology Centre) LAQM web site <http://www.airquality.co.uk/archive/laqm/tools.php> indicates that there will be no grid squares in 2010 with background benzene in excess of $2\mu\text{g}/\text{m}^3$ (see Appendix 4). The monitoring station at DL (see Table 7), established as a rural background site, has an annual mean of around $1\mu\text{g}/\text{m}^3$, whilst the predicted 2010 background for this grid square is $0.3\mu\text{g}/\text{m}^3$ (see Table 28). It is recognised, however that there may be a tendency for passive diffusion tubes to under-read at very low ambient concentrations.

The technical guidance (TG03) advocates co-location of tube(s) with a UK Hydrocarbon Network site to provide information on tube performance. While this has not been possible to date, it is the aim of this Authority to co-locate a tube at the recently established Speke site (GR SJ438835) in the near future. As such, all benzene diffusion tube data is presently unadjusted.

The highest running annual mean was recorded at monitoring station VI in 2002 with a reading of $3.9\mu\text{g}/\text{m}^3$ (see Table 21). As this is a site representative of industrial emissions - and given that benzene emissions are likely to remain constant for the foreseeable future - it is not possible to

present 2010 projections for this site. An additional site of relevant exposure that is closer to the industrial site has recently been established.

There are no annual means greater than $5\mu\text{g}/\text{m}^3$ and it is not, therefore, necessary to proceed to a detailed assessment for this category.

1.4. *Very busy roads or junctions in built up areas*

There are no roads within the borough whose Annual Average Daily Traffic Flow exceeds any of the following thresholds:

80,000 vehicles per day on single carriageways;

120,000 vehicles per day on dual carriageways;

140,000 vehicles per day on motorways.

Data Source: CCC Annual Monitoring Report. Ref. 9.1

It is not necessary to proceed to a detailed assessment for this category.

1.5. *Industrial sources*

Compilation of the local emissions inventory (Ref. 9.2) identified 57 point sources of benzene emissions located on the Stanlow petrochemical complex. In 2001, the combined emissions of these sources equated to some 94 tonnes of benzene. Of this, the majority originates from tank vents associated with the Shell UK refinery site. During the first round of review and assessment 48 point sources of benzene were modelled with emissions totalling 99.74 tonnes per annum. There is also a major source of benzene outside the borough at Castle Cement, Flintshire some 10 km South of the borough, whose emissions in 2001 totalled 62 tonnes (Ref. <http://www.environment-agency.gov.uk/>).

The petrol distribution terminal located within the Stanlow refinery complex (GR 342796 376335) does not exceed the nomograms threshold. The vent stack is 1.9km distant from the nearest relevant location and has an annual

benzene emission of 1.5 tonnes per annum (based on the VOC (Volatile Organic Compound) to benzene conversion factor provided by the emissions helpdesk).

The complex nature of these industrial sources precludes the use of the nomograms provided on page 3-22 of the technical guidance TG03 (Ref.9.3). Current indications from the process operator are that benzene emissions are likely to remain constant for the foreseeable future.

It has been decided, therefore, to adopt a precautionary approach and proceed to a detailed assessment of benzene from industrial sources.

1.6. Petrol Stations

Of the 14 petrol stations authorised under Part1 of the Environmental Protection Act 1995, seven have an annual throughput of petroleum in excess of 2 million litres (see Table 3 below). However, none of these is close to roads having an AADF (Annual Average Daily Traffic Flow) greater than 30,000 vehicles per day, nor with relevant locations within 10 metres of the pumps.

Authorisation Number	Annual throughput of petrol (m ³)	Adjacent to busy road?	Relevant exposure within 10 metres of pumps?
1.4 / 91	>2000	No	No
1.4 / 93	>2000	No	No
1.4 / 95	>2000	No	No
1.4 / 96	>2000	No	No
1.4 / 97	>2000	No	No
1.4 / 102	>2000	No	No
1.4 / 103	>2000	No	No
1.4 / 329	<2000	No	No
1.4 / 330	<2000	No	No
1.4 / 331	Not determined	No	No
1.4 / 405	~2000	No	No
1.4 / 406	Not determined	No	No

Table 3. Petrol filling stations authorised under the Environmental Protection Act 1995, Part 1.

1.7. *Major Fuel Storage Depots*

The major fuel storage depot associated with the petrochemical complex has been considered under section (1.5) above and will be included in the detailed assessment required for industrial sources.

1.8. *Conclusion*

A detailed assessment is required for industrial sources.

2. 1,3-BUTADIENE (C₄H₆)

2.1. *Introduction*

Nationally, about 80% of atmospheric 1,3-butadiene is present as a result of the combustion of petrol. With the introduction of catalytic converters, however, ambient concentrations are now 60% lower than those in 1990. Some specific petro-chemical processes, such as the production of synthetic rubber for tyres, can be locally important.

As it is a recognised genotoxic carcinogen, there is no absolutely safe level of 1,3-butadiene. However the Government's EPAQS set a health based air quality objective below which the risks are likely to be exceedingly small and detection impractical. A recent review of available evidence by EPAQS concluded that the original limit continues to be appropriate for the purposes of protection of public health (Ref. 9.8).

The National Air Quality objective is

- **A running annual mean level of 2.25µg/m³ (1ppb)**
This must be met by December 2003.

2.2. *Conclusions of round one review and assessment*

- 1,3-butadiene is emitted from vehicles and Industry. There is a significant industrial source of 1,3-butadiene within the Borough.
- The model does not predict exceedences of 1,3-butadiene at any point within the Borough.
- Verification of the modelling predictions using accurate monitoring techniques is required.
- Limited monitoring data indicates that the model is over predicting the level.
- **Air Quality Management Areas not required.**

2.3. Monitoring Data

Butadiene monitoring, using passive diffusion tubes, has been carried out since 2000 (established in response to the need to produce data for dispersion model verification). Details of analysis and uncertainty of measurement are contained in Appendix 3. Monitoring results are presented in Table 22, Appendix 2.

Data presented as estimated UK background air pollution concentrations on NETCEN's LAQM web site <http://www.airquality.co.uk/archive/laqm/tools.php> indicates that there will be no grid squares in 2003 with background 1,3-butadiene in excess of $0.21\mu\text{g}/\text{m}^3$ (see Appendix 4, Table 27). DL, established as a rural background site, had an annual mean (in 2002) of around $0.15\mu\text{g}/\text{m}^3$ (see Table 22), which compares favourably with the predicted 2003 background for this grid square.

The highest running annual mean was $1.66\mu\text{g}/\text{m}^3$ in Ince during 2001. This declined to $0.92\mu\text{g}/\text{m}^3$ in 2002, and is less than half of the NAQS objective. An additional site of relevant exposure that is closer to the industrial site has recently been established.

A detailed assessment is not required in respect of this category.

2.4. Industrial Sources

Two point sources on the refinery site emitted a combined total of 8.5 tonnes of 1,3-butadiene during 2001. Overall, this represents a 76% decrease in comparison to the first round. As there are two point sources of 1,3-butadiene the nomograms provided on page 4-9 of the technical guidance TG03 cannot be used unless it is assumed that all emissions originate from the lowest stack. In this instance the combined total emissions exceed the threshold of 3.9 tonnes per annum stated on the industrial nomogram calculator (see

<http://www.airquality.co.uk/archive/laqm/tools/IndustrialEmissionsScreeningToolsv2.xls>) provided for this purpose. It is therefore necessary to proceed to a detailed assessment of 1,3-butadiene from industrial sources.

2.4.1. New industrial sources

There have been no new industrial sources of 1,3-butadiene in the borough since the first round of review and assessment.

2.4.2. Industrial sources with substantially increased emissions

There have been no substantial increases in industrial emissions since the last round of review and assessment.

2.5. Conclusion

A detailed assessment is required for industrial sources.

3. CARBON MONOXIDE (CO)

3.1. *Introduction*

Carbon monoxide is formed from the incomplete combustion of carbon-containing fuels. The main source is currently road transport, and poorly maintained idling vehicles are important sources in urban areas.

At today's typical ambient levels the effect is slight, but carbon monoxide can interfere with the delivery of oxygen to the heart or brain. It can therefore exacerbate the pre-existing medical conditions such as cardio-vascular disease.

The National Air Quality objective is

- **A maximum daily running 8-hour mean level of 10 mg/m³ (8.6ppm)**
This must be met by December 2003.

3.2. *Conclusions of round one review and assessment*

- Vehicles and industry make significant contributions to carbon monoxide within the Borough.
- The model does not predict exceedences of carbon monoxide at any point within the Borough.
- **Air Quality Management Areas not required.**

3.3. *Monitoring Data*

The authority does not currently operate any real-time monitoring equipment for carbon monoxide. Attempts to generate pseudo-real-time indicative monitoring have proved unsuccessful due to issues with the reliability of data. Furthermore, none of the national network stations recorded exceedences of the objective between 1999 and 2001.

3.4. *Very busy roads or junctions in built up areas*

Data presented as estimated UK background air pollution concentrations on NETCEN's LAQM web site <http://www.airquality.co.uk/archive/laqm/tools.php> indicates that the maximum background annual mean grid square for 2001 was 0.4mg/m³ (see Appendix 4). Using the correction factor contained in TG03 (p2-3) results in a predicted maximum concentration of 0.33mg/m³ by 2003. This is well below the 2mg/m³ threshold (p2-4 TG-03) above which there is a likelihood of exceeding the maximum daily running 8-hour mean objective.

There are no roads within the borough whose AADF (Annual Average Daily Traffic Flow) exceeds any of the following thresholds:

80,000 vehicles per day on single carriageways;

120,000 vehicles per day on dual carriageways;

140,000 vehicles per day on motorways.

Data Source: CCC Annual Monitoring Report. Ref. 9.1

3.5. *Conclusion*

There is no need to proceed to a detailed assessment for Carbon Monoxide.

4. LEAD (Pb)

4.1. *Introduction*

The main sources of airborne lead include the manufacture of batteries, pigments, alloys, and ammunition as well as industrial combustion processes. In the past it was widely mixed with organic compounds within petrol, however, this has now largely ceased with the increase in the use of unleaded petrol.

Airborne lead is absorbed into the body through the lungs and accumulates particularly in bone, teeth, skin and muscle. The effects of low levels of exposure to lead on health relate to effects on the central nervous system and, in particular, on the development of the brain.

The National Air Quality objectives are:

- **An annual mean level of $0.5\mu\text{g}/\text{m}^3$ which must be met by December 2004**
- **An annual mean level of $0.25\mu\text{g}/\text{m}^3$ must be met by December 2008.**

4.2. *Conclusions of round one review and assessment*

- Industry is the main contributor of lead within the Borough.
- The model does not predict exceedences of lead at any point within the Borough for 2004.
- Model predictions for 2008 show exceedences of the NAQS objective, however these areas located within an industrial area
- There is only limited monitoring data to confirm the model predictions.
- The model is over predicting levels and as such gives a worse case scenario.
- Further verification will require monitoring closer to the source.

- Manufacturing of lead at the main local source is likely to decrease in future years.
- **Air Quality Management Areas are not required.**

4.3. *Monitoring Data*

Limited lead monitoring data is available locally. During the first round of review and assessment use was made of data generated as part of a national heavy metals survey conducted by Stanger Science and Environment (Ref. 9.5). A monitoring station at Elton (GR 345635 375580), located 3.75km East of the Associated Octel site was in operation between December 1999 and May 2000. The maximum weekly concentration was $0.03\mu\text{g}/\text{m}^3$, and the running annual mean $0.016\mu\text{g}/\text{m}^3$ - which is about 6% of the 2008 objective.

It was recognised in the first round that there was a need to perform lead monitoring close to the main emitter - both for the purposes of model verification and in order to establish local baseline concentrations - as there are residential properties about 1km distant. Samples have been collected at two sites (LR and SG. See Table 8), 1.8km from Associated Octel, but these were unfortunately lost during analysis. Further monitoring is currently being undertaken.

4.4. *Industrial Sources*

The local emissions inventory identified seven industrial sources of lead within the borough, which emit a total of 13.3 tonnes per annum; and a further source of 1 tonne outside the borough at Castle Cement, Flintshire some 10 km South of the borough boundary. Emissions from the predominant lead source, Associated Octel (GR 341700 376750), have fallen from 84 tonnes in 1998 to 12.7 tonnes in 2001.

The LAQM tools industrial source nomograms on the following website:
<http://www.airquality.co.uk/archive/laqm/tools/IndustrialEmissionsScreeningToolsv2.xls> estimates the emission rate which would produce a maximum annual mean ground level concentration of $0.025\mu\text{g}/\text{m}^3$ (equivalent to 10% of the 2008 objective). Using the stack parameters for Associated Octel, this screening tool indicates that the above threshold is exceeded and it is necessary to proceed to a detailed assessment for this source category.

4.4.1. New industrial sources

No new industrial sources of lead have been established in the borough since the last round of review and assessment.

4.4.2. Industrial sources with substantially increased emissions

There have been no substantial increases in industrial emissions since the last round of review and assessment.

4.5. Conclusions

A detailed assessment is required for industrial sources.

5. NITROGEN DIOXIDE (NO₂)

5.1. *Introduction*

Most nitrogen dioxide (NO₂) in ambient air results from the atmospheric transformation of nitric oxide (NO) which itself is produced during high temperature combustion processes. Road transport accounts for about 50% of the total UK emissions, although power stations are also important. The introduction of catalytic converters along with tighter controls on industrial emissions has resulted in a halving of emissions since 1990.

Nitrogen dioxide is an irritant gas, and high exposures can affect the way that the lungs and airways function - aggravating asthma, for example. It can have short and long-term health affects; a one-hour and annual mean objective has therefore been specified as well as an annual mean.

The National Air Quality objectives are

- **A 1-hour mean of 200µg/m³ (105ppb) not to be exceeded more than 18 times a year**
- **An annual mean level of 40µg/m³ (21ppb)**

These objectives must be met by December 2005.

5.2. *Conclusions of round one review and assessment*

- NO₂ is emitted from vehicles and industrial sources within the Borough. Raised levels are noted along the M53 motorway.
- The Model does not predict Nitrogen dioxide exceedences at any point within the Borough.
- The Model prediction for 1 hour NO₂ correlates well with estimated monitoring data.
- The model is under predicting annual Nitrogen dioxide levels.

Air Quality Management Areas not considered appropriate.

5.3. Monitoring Data

Ellesmere Port & Neston Borough Council monitors NO₂ using both passive (diffusion tubes) and real-time (chemiluminescent and differential optical absorption) techniques at a total of 25 sites (see Appendix 1). Real-time results are presented in Table 10 to Table 12 (Appendix 2) whilst diffusion tube results are shown in Table 20. Analytical details can be found in Appendix 3.

Diffusion tubes have been co-located alongside the chemiluminescent analyser at Elm Street (GR 340117 377346) since May 2001 for the purposes of traceability against recognised standards. The first full year of co-location was 2002 and this has been used in order to derive a diffusion tube adjustment factor - following the approach detailed on p 6-7 of the technical guidance (see Table 19).

With the exception of 2002 Opsi results all real-time monitoring data used for the updating and screening assessment has been scaled and ratified in accordance with the guidance in Annex 1(p A1-32) of the technical guidance TG03.

There have not been any 1-hour exceedences of 200µg/m³ (105ppb) recorded in either 2001 or 2002. The highest 99.8th percentile recorded was 131.16µg/m³ (68.67ppb) at Elm Street - which is in proximity to the M53 motorway - during 2001 (see Table 10).

With reference to Appendix 2, the majority of the Borough's NO₂ monitoring stations currently show compliance against the 2005 annual mean objective (40µg/m³, or 21ppb). Most sites have experienced a reduction in NO₂ concentrations over the period 2001-2002, and this can be viewed as a continuation of the general trend locally in recent years (see Figure 4). However, three road / kerbside stations - ES, SK & WV - showed readings in excess of the objective in 2001.

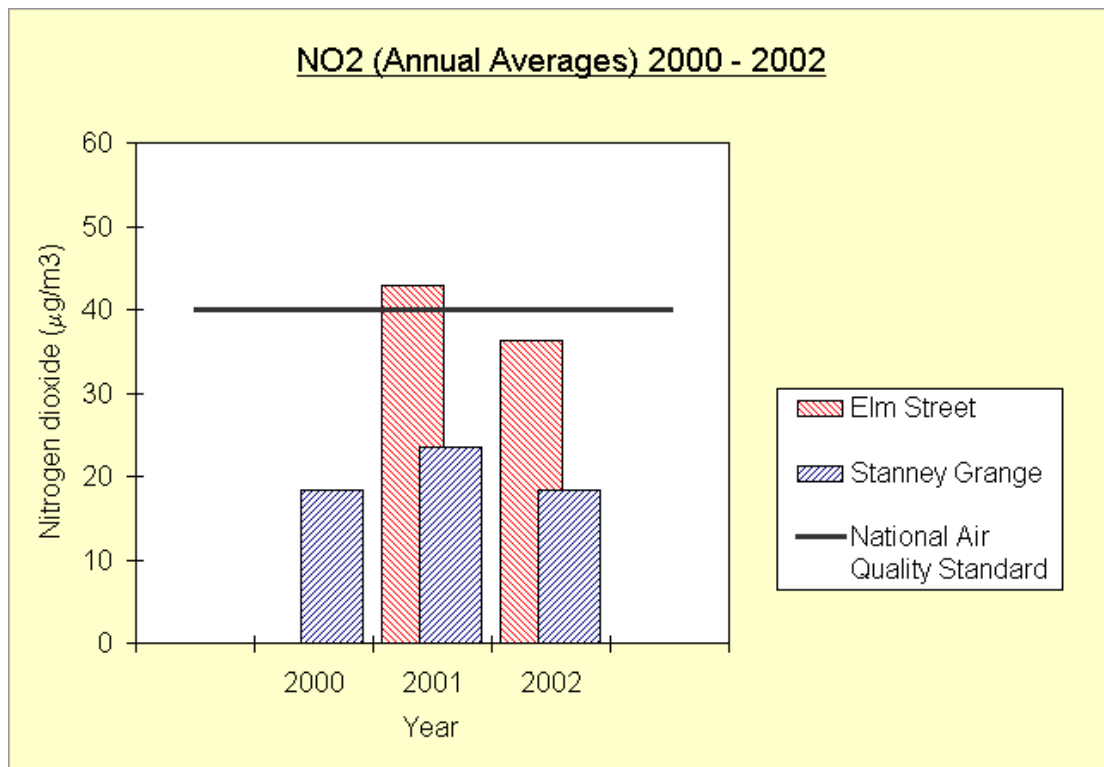


Figure 4. Annual mean NO₂ trends, 2000 - 2002

Applying the adjustment factors given in Box 6.6 of the technical guidance these levels are predicted to fall below the annual objective by 2005 (See Table 4, column 3 below). A number of stations recorded elevated NO₂ in 2002 (as compared with 2001) and, adjusting these values in the same way, both SK and WV are predicted to be close to or slightly above the objective by 2005 (See Table 4, column 5 below). On this basis it is necessary to proceed to a detailed assessment for NO₂ along a section of the A5032.

Note: with effect from July 2003, SK has been relocated from the kerbside to the façade of a roadside building.

Site Code	Nitrogen Dioxide Annual Means ($\mu\text{g}/\text{m}^3$)			
	Annual Mean 2001	Predicted Annual Mean 2005	Annual Mean 2002	Predicted Annual Mean 2005
CL	34.2	30.6	32.9	30.2
CO	31.3	27.9	31.1	28.7
CS	30.2	26.9	31.7	29.2
ES	30.9	27.7	36.5	33.6
ES(rt)	42.8	38.2	36.5	33.6
NH	32.7	29.2	32.7	30.0
NT	34.2	30.6	32.9	30.2
PP	28.3	25.2	27.5	25.4
PW	37.1	33.0	low capture	-
RA	23.3	20.8	low capture	-
SK	42.2	37.6	47.4	43.5
SN	32.1	28.7	31.7	29.2
SP	32.1	28.7	26.7	24.6
WV	40.7	36.3	42.2	38.8

Table 4. Predicted NO₂ concentrations at road/kerbside locations for 2005.

5.4. Road Traffic

5.4.1. Narrow streets with residential properties close to the kerb

The Screening Assessment has identified a single street that meets the criteria for this source category. A section of the A5032, Whitby Road (GR 340070 376200 to 340230 376410) which is less than 10m wide with 1st floor flats within 5m of the kerb, had an average speed of 48kph and an AADF of 13300 in 2002. The DMRB (Design Manual for Roads and Bridges) spreadsheet predicts that 2005 annual means will be less than 40 $\mu\text{g}/\text{m}^3$, although the technical guidance advocates multiplying the output by a factor of 2 to avoid missing potential exceedences. However, as monitoring station is already in place a more appropriate judgement has been taken on the basis of NO₂ diffusion tube results (see 5.3).

5.4.2. Junctions

Five busy junctions (with traffic flows greater than 10,000 vehicles per day), with relevant exposure less than 10m from the kerb, have been earmarked for

further investigation (see Table 5). At present, however, there is insufficient traffic flow data with which to conduct an adequate assessment of these using the DMRB tool <http://www.highways.gov.uk/contracts/index.htm> - 2. Traffic counts have been requested of the joint highways department, and the assessment will be done as soon as these are available.

Road Junction	Relevant exposure within 10m of kerb?	Predicted annual mean for 2005 >40µg/m ³ ?
A540 - B5134	Yes	Not determined
A41 - B5133	No	N/A
A41 - A550	Yes	Not determined
A41 - B5463	Yes	Not determined
A41 - B5132	No	N/A
A41 - Hope Farm Rd	No	N/A
A41 - A5117	No	N/A
A5032 - A5117	No	N/A
A5032 - Overpool Rd	No	N/A
A5032 - B5132	No	N/A
A5032 - Princes Rd	Yes	Not determined
A5032 - Meadow Lane	Yes	Not determined
A5032 - M53	No	N/A
B5463 - Overpool Rd	No	N/A
B5132 - Overpool Rd	No	N/A
A5117 - B5132	No	N/A

Table 5. Summary of relevant NO₂ exposure near busy junctions.

5.4.3. Busy streets where people may spend 1-hour or more close to traffic

There are no busy streets (with a daily traffic flow in excess of 10,000 vehicles) where members of the public may be regularly exposed within 5m of the kerb for 1-hour or more. (The primary shopping area of Ellesmere Port is an indoor arcade.) It is not necessary, therefore, to proceed to a detailed assessment for this source.

5.4.4. Roads with high flow of buses and/or HGV's

Data obtained from Cheshire County Council indicates that the typical HGV component of traffic flows in the borough ranges from 1% to 14%. Figures for

1998 suggested that the split on Oil Sites Road was around 22%. This falls below the 25% threshold of p6-20 TG03 (Ref. 9.3). Furthermore, as the road is wholly within the industrial complex, there is no relevant exposure as judged against either objective.

It is not necessary to proceed to a detailed assessment for this source.

5.4.5. New roads constructed or proposed since the first round of review and assessment

There have been no newly constructed roads in the borough since the first round of review and assessment. This authority is unaware of proposals to construct further roads in the borough. It is not necessary to proceed to a detailed assessment for this source.

5.4.6. Roads close to the objective during the first round of review and assessment

Modelling studies conducted during the first phase of review and assessment (see Ref. 9.4) had its focus on a borough-wide scale and as such did not adequately address localised emissions. It is not possible, therefore, to assess temporal changes in relation to this source category. Current monitoring data (see 5.3) suggests that parts of the A5032 may be close to the objective, and a detailed assessment will be undertaken.

5.4.7. Roads with significantly changed traffic flows

There are no roads of more than 10,000 (AADF) vehicles per day in the borough for which traffic flows have increased more than 25% since the last round. It is not necessary to proceed to a detailed assessment for this source.

5.4.8. Bus Stations

Transport Co-ordination Section (Cheshire County Council) records show that vehicle movements at Ellesmere Port bus station do not exceed 600 vehicle movements per day (where arrivals and departures both contribute to the total). This is below the threshold defined on p6-24 of TG03 (Ref. 9.3) and the location, therefore, does not need to be considered further.

5.5. Industrial Sources

The local emissions inventory (Ref.9.2) identified 36 industrial sources of oxides of nitrogen for which the combined total in 2001 were around 6 kilotonnes. This represents a slight decrease of about 500 tonnes in comparison to emissions modelled during the first round. However 23 industrial sources were considered during the first round, whilst the updated emissions inventory details 36 sources. The complex nature of these industrial sources precludes the use of the nomograms provided on page 6-35 of the technical guidance TG03 (Ref.9.3).

It has been decided, therefore, to adopt a precautionary approach and proceed to a detailed assessment of NO₂ from industrial sources.

5.5.1. New industrial sources

A CHP plant built to replace out-dated boiler plant at Bridgewater paper mill has been brought on-line since the last round of review and assessment. The air quality impact assessment carried out in support of the application for authorisation predicted that the worst-case 99.8th percentile NO_x concentrations would fall well below the NAQS hourly objective (Ref. 9.7). The impact of this source will be considered in conjunction with other point sources (see 5.5 above) as part of the detailed assessment.

Also, planning permission has been granted for the construction of new plant at the Stanlow refinery site to enable the production of very low sulphur petroleum. The air quality impact assessment (Ref. 9.6) carried out in support of this development indicates that the increment to ground level concentrations of NO₂ is likely to be minimal. For example, the modelled 99.8th percentile for the boilers operating under maximum load was 15.9µg/m³. The impact of this source will be considered in conjunction with other point sources (see 5.5 above) on the refinery site as part of the detailed assessment.

5.5.2. Industrial sources with substantially increased emissions

There have been no substantial increases in industrial emissions since the last round of review and assessment.

5.6. Aircraft

Liverpool Airport is located 5km North of the borough and is therefore unlikely to make a significant contribution to NO₂ levels locally. It is not necessary to proceed to a detailed assessment for this source.

5.7. Conclusion

A detailed assessment is required for industrial sources and road traffic sources on sections of the A5032.

6. PARTICULATES (PM₁₀)

6.1. *Introduction*

Airborne particulate matter originates from a variety of sources. Primary sources include combustion processes, mineral extraction, wind-blown surface dust and sea salt whilst chemical transformations of sulphates and nitrates can produce secondary particulates. Episodes of particulate pollution can occur on regional and even continental scales.

PM₁₀ - that is particulate matter with an aerodynamic diameter less than 10 microns - can be readily inhaled and is associated with a range of effects on health including lung function, exacerbation of asthma and cardiovascular diseases.

The National Air Quality objectives are

- **A 24-hour mean of 50µg/m³ not to be exceeded more than 35 times a year**
- **An annual mean level of 40µg/m³.**

These objectives must be met by December 2004.

New objectives not currently in regulations are

- **A 24-hour mean of 50µg/m³ not to be exceeded more than 7 times a year**
- **An annual mean level of 20µg/m³.**

These objectives must be met by December 2010.

6.2. *Conclusions of round one review and assessment*

- There are significant industrial sources of particulates within the Borough.
- The Model does not predict particulate exceedences at any point within the Borough. The Model predicts that the standard is not exceeded in relevant areas of public exposure.
- Monitoring data in relevant areas of public exposure confirm the model predictions in those areas.
- **Air Quality Management Areas not required.**

6.3. Monitoring Data

Data presented as estimated UK background air pollution concentrations on NETCEN's LAQM web site <http://www.airquality.co.uk/archive/laqm/tools.php> indicates that there will be no grid squares in 2004 with background PM₁₀ in excess of 28µg/m³ (see Appendix 4, Table 31). Town centre annual mean PM₁₀ in 2002 was 20.13µg/m³ which compares favourably with the predicted 2004 background for grid square (SJ 339 375).

After converting readings to their gravimetric equivalent, the annual mean NAQS objective of 40µg/m³ was complied with at both TEOM (Tapered Element Oscillating Microbalance) monitoring stations during 2001 (see Table 16 & Table 17). Indications are that this was also the case during 2002, although the data are not as yet ratified. Ellesmere Port library monitoring station recorded marginally higher readings (20.13µg/m³) than those at Stanney Grange (19.95µg/m³). Annual trends are shown in Figure 5.

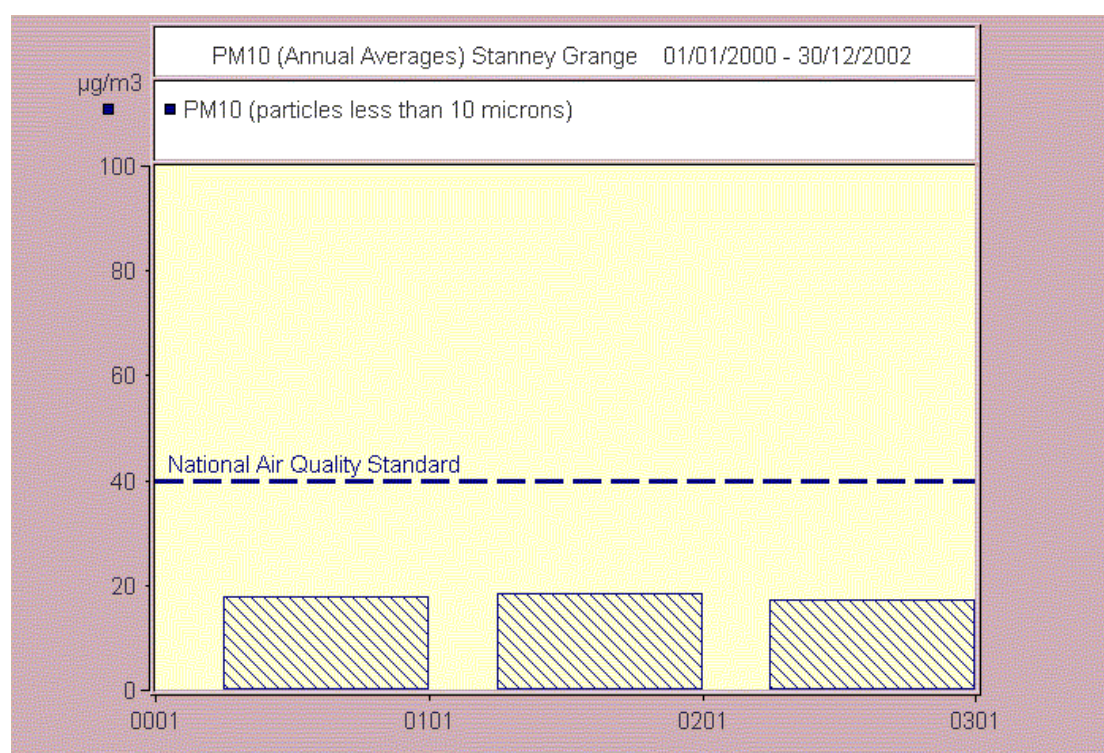


Figure 5. Annual mean PM₁₀ trends, 2000 - 2002.

Although PM₁₀ levels in excess of 50µg/m³ were experienced on five occasions during 2001 at both stations, this is well below the 35 exceedences allowed in compliance with the 24-hour NAQS objective. Early indications are that there has been an increased number of exceedences during 2003 due to warm, dry conditions coupled with regional episodic events such as moor fires and wind-blown dust.

Progress to a detailed assessment is not necessary in respect of PM₁₀ monitoring.

6.4. Traffic

6.4.1. Junctions

Five busy junctions (with traffic flows greater than 10,000 vehicles per day), with relevant exposure less than 10m from the kerb, have been earmarked for further investigation (see Table 5, section 5.4.2). At present, however, there is insufficient traffic flow data with which to conduct an adequate assessment of these sources using the DMRB tool:

<http://www.highways.gov.uk/contracts/index.htm> - 2.

Traffic counts have been requested of the joint highways department, and the assessment will be done as soon as these are available.

6.4.2. Roads with high flow of buses and/or HGV's

Data obtained from Cheshire County Council indicates that the typical HGV component of traffic flows in the borough ranges from 1% to 14%. Figures for 1998 suggested that the split on Oil Sites Road was around 22%. This is above the 20% threshold of p8-26 TG03 (Ref. 9.3). However, as the road is wholly within the industrial complex, there is no relevant exposure as judged against either objective.

6.4.3. New roads constructed or proposed since the first round of review and assessment

There have been no newly constructed roads in the borough since the first round of review and assessment. This authority is unaware of proposals to construct further roads in the borough.

6.4.4. Roads close to the objective during the first round of review and assessment

Modelling studies conducted during the first phase of review and assessment (see Ref. 9.4) had its focus on a borough-wide scale and as such did not adequately address localised emissions. It is not possible, therefore, to assess temporal changes in relation to this source category.

6.4.5. Roads with significantly changed traffic flows

There are no roads of more than 10,000 (AADF) vehicles per day in the borough for which traffic flows have increased more than 25% since the last round.

It is not necessary to proceed to a detailed assessment for this source.

6.5. Industrial Sources

The local emissions inventory (Ref. 9.2) identified over 600 tonnes of particulate emissions emanating from 24 industrial sources in 2001. Whilst this represents a decrease of about 500 tonnes in comparison to emissions modelled during the first round, just 8 industrial sources were considered initially. Reductions are due to, for example, conversion of large boiler plant to gas. It has not been possible to quantify size fractions of particulate matter

from a number of industrial processes, thus it has been decided to adopt a precautionary approach and treat total suspended particulates as PM₁₀.

The complex nature of these industrial sources precludes the use of the nomograms provided on page 6-35 of the technical guidance TG03 (Ref.9.3).

A detailed assessment will be carried out in respect of PM₁₀ from industrial sources.

6.5.1. *New industrial sources*

No new industrial sources with PM₁₀ emissions have been established in the borough since the last round of review and assessment.

6.5.2. *Industrial sources with substantially increased emissions*

There have been no substantial increases in industrial emissions since the last round of review and assessment, although emissions were not well defined at that time for some industrial processes (see 6.5).

6.6. *Domestic Sources*

This Authority has declared 19 Smoke Control Areas, which cover most of the urban area of Ellesmere Port itself, in the eastern part of the borough (see Figure 6 below). Domestic emission of PM₁₀ is not likely, therefore, to be problematic in these areas.

Information required for the assessment of domestic fuel usage could not be gathered according to the guidelines advised by the Technical Guidance (TG-03). The local housing energy survey does not have the necessary details in order to estimate the number of households burning solid fuel as their primary source of fuel. However, on the basis of local knowledge and complaint history, usage is now thought to be very low.

Discussions with local solid fuel merchants indicate that there are unlikely to be any areas in which primary fuel use exceeds 5 in 500 properties. National fuel-use statistics (obtained during compilation of the local emissions inventory) estimate this figure to be slightly higher, at around 3%. Using a conservative estimate (5%) of solid fuel use, for the purposes of the screening assessment, there are not likely to be any 500x500m grid squares in which there are more than 50 houses using solid fuel as their primary source of heating (see Table 6).

Grid reference on which residential area centred	Number of domestic address points	Estimated solid fuel use (at 5%)
341040 375150	823	41
340200 376830	802	40
337300 376780	798	40
339960 376300	780	39
329300 377700	751	37
329290 376690	595	30

Table 6. Estimates of domestic solid fuel use.

It is not necessary to proceed to a detailed assessment for this category.

This Authority is advised by MPHA that the operations for which it is responsible are strictly controlled. Process controls for a particularly dusty product include vacuum transfer unloading, enclosed conveyors and storage facilities maintained under negative pressure fitted with filtered ventilation. Handling procedures for cargoes not directly controlled through permits are strictly monitored by MPHA and best practice, such as minimisation of drop heights is used for unloading vessels.

Neither this Authority nor MPHA have received any dust complaints in respect of the dockside operations for over 2 years.

It is not necessary to proceed to a detailed assessment for this source category.

6.7.2. Airports

Liverpool Airport is located 5km North of the borough and is therefore unlikely to make a significant contribution to PM₁₀ levels locally.

It is not necessary to proceed to a detailed assessment for this source.

6.8. Conclusions

A detailed assessment is required for industrial sources.

7. SULPHUR DIOXIDE (SO₂)

7.1. *Introduction*

The main source in the UK is the combustion of sulphur-containing fossil fuels, principally coal and heavy oils. The shift of domestic heating away from coal fires (aided by the imposition of smoke control areas), conversion of large industrial plant to gas and improvements in pollution abatement technologies has resulted in a dramatic reduction in ambient SO₂ over the last 40 years.

Sulphur dioxide acts as an irritant when it is inhaled, because of its acidic nature, and high concentrations may cause breathing difficulties. People suffering from respiratory ailments may be especially susceptible to the adverse effects of sulphur dioxide and, within the range of concentrations that occur in pollution episodes, it may provoke attacks in asthma sufferers.

The National Air Quality objectives are:

- **A 1 hour mean of 350 µg/m³ (132ppb) not to be exceeded more than 24 times per year,**
- **A 24 hour mean of 125µg/m³ (47ppb) not to be exceeded more than 3 times a year,**
- **A 15 minute mean of 266µg/m³ (100ppb) not to be exceeded more than 35 times a year.**

The objectives for the 1 hour and 24 hour mean must be met by December 2004. The objective for the 15-minute mean must be met by December 2005.

7.2. *Conclusions of round one review and assessment*

- There are significant industrial sources of sulphur dioxide within the Borough.
- The Model does not predict sulphur dioxide exceedences at any point of relevant public exposure within the Borough.

- Monitoring data in areas relevant to public exposure confirm the model predictions in those areas.
- **Air Quality Management Areas not required.**

7.3. *Monitoring Data*

Local sulphur dioxide monitoring, which is obtained using a variety of techniques (UV fluorescence, differential optical absorption and net acidity titration), is presented in Table 13, Table 14, Table 15, and Table 18. With the exception of 2002, all data has been scaled and ratified. Site details are shown in Table 8 and Table 9.

There have been no exceedences of either the 1-hour mean or the 24-hour mean at any monitoring station during the period January 2001 - December 2002.

In 2001 there was a single exceedence of the 15-minute objective at Ince (See Table 13), although the 99.9th percentile was just 125µg/m³ (47ppb). Table 18 shows that the 15-minute objective is unlikely to be exceeded in the town centre (Civic Way) as the maximum daily mean concentration is less than 80µg/m³ (Ref. P7-3 TG03). This is corroborated by Opsi results (see Table 15) which indicate that there were no such exceedences in either 2001 or 2002. Short term maxima of SO₂ have declined markedly over the last decade due to, for example: a shift from coal and oil-fired industrial plant to gas and improvements in abatement technologies (See Figure 7 below).

Stanney Grange monitoring station, however, experienced a number of exceedences of the 15-minute mean objective in 2002, in particular during early April and mid-September (see Table 14). At present the data for this site is not ratified, but indications are that there were no more than 13 exceedences (i.e. less than the 35 exceedence threshold above which a detailed assessment would be required in respect of monitoring alone). Winds

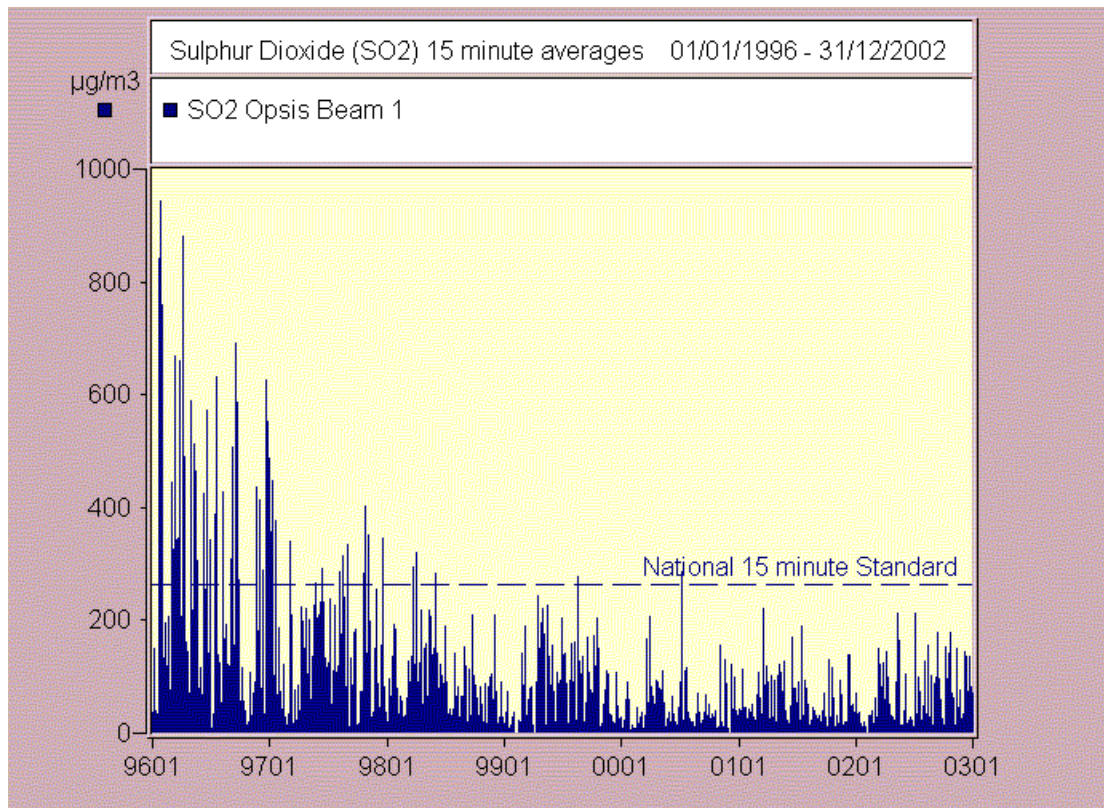


Figure 7. Trends of 15-minute SO₂ 1996 - 2002

arriving at Stanney from the 90° sector NE to SE were roughly twice as prevalent during 2002 (15%) as compared with typical years. As a result, emissions from the refinery complex would tend to impact on the area with a greater frequency than normal.

A detailed assessment is not required in respect of available monitoring data.

7.4. Industrial Sources

Overall sulphur dioxide emissions from industrial sources have declined by ~25% from over 17,000 tonnes in 1999 to less than 13,000 tonnes in 2001 as a result of e.g. the use of low-sulphur crude oil and conversion of large boiler plant to gas. The local emissions inventory (Ref.9.2) identified 29 industrial sources of SO₂ although 20 industrial sources were considered during the first

round. A further 66,000 tonnes of SO₂ emissions have been identified originating from relevant sources outside the borough. The complex nature of these industrial sources precludes the use of the nomograms provided on page 7-17 of the technical guidance TG03 (Ref.9.3).

It has been decided, therefore, to adopt a precautionary approach and proceed to a detailed assessment of SO₂ from industrial sources.

7.4.1. New industrial sources

No new industrial sources of SO₂ have been established in the borough since the last round of review and assessment.

However, planning permission has been granted for the construction of new plant at the Stanlow refinery site to enable the production of very low sulphur petroleum. The air quality impact assessment (Ref. 9.6) carried out in support of this development indicates that the increment to ground level concentrations of SO₂ is likely to be minimal. For example, the modelled 99.9th percentile for the boilers operating under maximum load was 30.6µg/m³. The impact of this source will be considered in conjunction with other point sources on the refinery site as part of the detailed assessment.

7.4.2. Industrial sources with substantially increased emissions

There have been no substantial (>30%) increases in sulphur dioxide emissions for any point sources identified during the last round.

7.5. Domestic Sources

Information required for the assessment of domestic fuel usage could not be gathered according to the guidelines advised by the Technical Guidance (TG-03). The local housing energy survey does not have the necessary details in order to estimate the number of households burning solid fuel as their primary

source of fuel. However, on the basis of local knowledge and complaint history, usage is now thought to be very low.

Empirical relationships (TG03, p7-3) show that the 15-minute means objective is unlikely to be breached if the maximum daily mean is less than $80\mu\text{g}/\text{m}^3$. The maximum daily mean for Neston (GR 329191 377567) in 2000 was just $59.48\mu\text{g}/\text{m}^3$ (see Table 18, Appendix 4).

Discussions with local solid fuel merchants indicate that there are unlikely to be any areas in which primary fuel use exceeds 5 in 500 properties. National fuel-use statistics (obtained during compilation of the local emissions inventory) estimate this figure to be slightly higher, at around 3%. Using a conservative estimate (5%) of solid fuel use, for the purposes of the screening assessment, there are not likely to be any 500x500m grid squares in which there are more than 100 houses using solid fuel as their primary source of heating (see Table 6, Section 6.6).

It is not necessary to proceed to a detailed assessment for this source category.

7.6. *Boilers*

With the exception of boiler plant associated with part A processes, the local emissions inventory (Ref. 9.2) lists twelve small boilers in the borough. However, none of these is rated above 5MW. Consultation with neighbouring authorities indicates that there is no boiler plant likely to impact upon air quality within the borough.

It is not necessary to proceed to a detailed assessment for this source category.

7.7. *Shipping*

The Manchester Ship Canal passes through the North-Eastern portion of the borough (GR 338200 379500 to 347400 377700) providing a shipping corridor between the Mersey Estuary and inland destinations. The local emissions inventory (Ref. 9.2) identified over 3000 shipping movements through the borough for the year 2001. Five per cent of this traffic was recorded as entering Ellesmere Port itself. The main manoeuvring area is located to the north of the refinery site at GR342500 377300. As such it is some 1.8km distant from the nearest relevant receptor for comparison with the 15-minute mean.

There is no need to proceed to a detailed assessment for this source category.

7.8. *Railway locomotives*

Four passenger routes operate within the borough, two of which are electric and two are diesel. Diesel services run from Ellesmere Port to Helsby, and through Neston. Both of these are trafficked by small 1 or 2 car Sprinter/Pacer type locomotives. Local knowledge, an assessment of the layout of sidings, goods loops, stations etc. and complaint history suggests that the potential for regular outdoor public exposure within 15m of stationary locomotives is very low.

It is not necessary to proceed to a detailed assessment for this source category.

7.9. *Conclusions*

A detailed assessment is required for industrial sources.

8. CONCLUSIONS

- **Benzene**

A detailed assessment is required for industrial sources.

- **1,3-Butadiene**

A detailed assessment is required for industrial sources.

- **Carbon monoxide**

A detailed assessment is not required.

- **Lead**

A detailed assessment is required for industrial sources.

- **Nitrogen dioxide**

A detailed assessment is required for industrial sources and road traffic sources on sections of the A5032.

- **PM₁₀**

A detailed assessment is required for industrial sources.

- **Sulphur dioxide**

A detailed assessment is required for industrial sources.

9. REFERENCES

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10. Appendix 1

Monitoring Stations

Code	Grid Reference	NO ₂	Benzene	1,3 Butadiene	Type	Start Date	End date
CL	336990 376863	#			Kerbside	Sep-00	current
CO	339783 375934	#			Roadside	1990	current
CS	337582 375692	#			Kerbside	Sep-00	current
DL	329997 374825	#	#	#	Rural	Sep-00	current
ES1-3	340117 377346	#			Roadside	Dec-00	current
LP	337261 376449		#		Special - petrol station	May-01	current
MM	341893 374493	#	#	#	Urban industrial	Sep-00	current
MR	340843 375509	#			Urban background	1990	current
MW	340893 375892	#			Urban background	May-01	current
NH	329204 377438	#			Kerbside	Feb-99	current
NT	329128 377594	#			Kerbside	Feb-99	current
OS	344806 375992		#		Special - industrial	Feb-00	May-01
PP	338704 376570	#			Roadside	Jan-01	current
PW	340184 376430	#			Roadside	Feb-99	current
RA	339323 376363	#			Suburban	Feb-01	current
SK1-3	340439 376789	#			Kerbside	Sep-00	current
SN	340128 377283	#			Kerbside	Sep-00	current
SP	338935 375989	#			Kerbside	Jan-01	current
ST	339449 373766		#		Suburban	May-01	Jun-03
TR	341229 375555	#			Roadside	May-01	current
VI	344961 376311		#	#	Special - industrial	Sep-00	current
WF	344707 376850		#		Special - industrial	Jul-03	current
WL	338837 374776	#			Suburban	1990	current
WV	340133 376267	#			Kerbside	Sep-00	current

Table 7. Diffusion Tube Monitoring Stations.

Real-time Monitoring Stations					
Site	Pollutants	Grid Ref.	Date	Site Type	Monitor
Elm Street	NO, NO ₂ , NO _x	340117 377346	Dec 2000 – present	Roadside	API M200a
Stanney Grange	NO, NO ₂ , NO _x , SO ₂ , PM ₁₀	340742 375023	1999 – present	Urban Background	API M200a API M100a TEOM
Ince	NO, NO ₂ , NO _x , SO ₂ , PM ₁₀	344961 376311	Nov 2000 – Sep 2002	Industrial	API M200a API M100a TEOM
Opsis path 1	NO ₂ , SO ₂ , O ₃ (Benz)	340258 376602 to 339947 375889	Jan 1996 – present	Urban Background	DOAS Opsis AR500
Opsis path 2	NO ₂ , SO ₂ , O ₃	340482 374751 to 339947 375889	Jan 1996 – present	Urban Background	DOAS Opsis AR500
Central library	PM ₁₀	339947 375889	Jan 1996 – present	Urban Background	TEOM

Table 8. Real-Time Monitoring Stations.

SO ₂ and Smoke Bubblers					
Site	Pollutants	Grid Reference	Date	Site Type	Monitor
Neston Office	SO ₂ , smoke	329191 377567	1977 - 2000	Urban Background	8-port bubbler
Council Offices	SO ₂ , smoke	339783 375934	1964 - present	Urban Background	8-port bubbler

Table 9. SO₂ and smoke bubblers.

11. Appendix 2 Monitoring Data

Real-time monitoring

Elm Street NO ₂ hourly average				
Total period : 01/01/2001 00:00 - 31/12/2001 24:00		2002	2005	2005
Integration time : 1.0 Hours			Predicted from 2001	Predicted from 2002
	NO₂ (Nitrogen Dioxide) ratified [µg/m ³]	ratified		
Mean	42.84	36.39	38.2	33.5
Max	149.7	61.9		
Coverage (%)	96.97	97.51		
Observations	8495	8542		
Exceedance Limit	200	200		
Exceedance Count	0	0		
Perc:99.8 %	131.16	100.3		

Table 10. Elm Street NO₂ results, 2001 & 2002

NO ₂ Stanney Grange (Hourly Averages)		
Total period : 01/01/2001 00:00 - 31/12/2001 24:00		2002
Integration time : 1.0 Hours		
	Nitrogen Dioxide (NO₂) Ratified [µg/m ³]	ratified
Mean	23.51	20.51
Max	154.25	99.95
Coverage (%)	92.11	98.41
Observations	8069	8621
Exceedance Limit	200	200
Exceedance Count	0	0
Perc:99.79 %	93.40	78.46

Table 11. Stanney Grange NO₂ results, 2001 & 2002

OPSIS Hourly Averages		
Total period : 01/01/2001 00:00 - 31/12/2001 24:00		
Integration time : 1.0 Hours		
	NO ₂ Path 1 (Whitby Rd)	NO ₂ Path 2 (Stanney Lane)
	[µg/m ³]	[µg/m ³]
Mean	25.87	28.97
Max	117.6	132
Coverage (%)	98.72	98.71
Observations	8648	8647
Exceedance Limit	200	200
Exceedance Count	0	0
Perc:99.8 %	99.76	108.43

2002	
Unratified	
Path 1	Path 2
26.71	28.49
108.08	130.50
-	-
-	-
-	-
0	0
91.42	103.74

Table 12. Opsis NO₂ results, 2001 & 2002

SO ₂ Ince (Mobile 1)			
Total period : 01/01/2001 00:00 - 31/12/2001 24:00			
Integration time : 15.0 Minutes			
	SO ₂ (Sulphur dioxide) [µg/m ³]		
	15min	1hr	1day
Mean	9.84		
Max	287.55	163.86	51.82
Coverage (%)	91.61	93.25	95.89
Observations	32101	8169	350
Exceedance Limit	266	350	125
Exceedance Count	1	0	0
Perc:99.9 %	125.79	-	-
Perc:99.7 %	-	90.68	-
Perc:99.17 %	-	-	40.57

Table 13. Ince SO₂ results, 2001

SO ₂ Stanney Grange				
Total period : 01/01/2001 09:00 - 31/12/2001 11:00				2002
Integration time : 15.0 Minutes				Unratified
	Sulphur Dioxide (SO₂) [µg/m ³] 15min	1hr	1day	15min
Mean	7.02			12.5
Max	202.96	134.94	77.22	335.96
Coverage (%)	97.61	99.11	100	96.6
Observations	34117	8660	365	33855
Exceedance Limit	266	350	125	266
Exceedance Count	0	0	0	13
Perc:99.9 %	128.29	-	-	218.36
Perc:99.7 %	-	89.38	-	-
Perc:99.17 %	-	-	38.14	-

Table 14. Stanney Grange SO₂ results, 2001 & 2002

SO ₂ Opsis						
Total period : 01/01/2001 00:00 - 31/12/2001 24:00						
	Integration time : 15.0 Minutes		Integration time : 1.0 Hour		Integration time : 24 Hours	
	SO₂ Beam 1 (Whitby Rd) [µg/m ³] 15min	SO₂ Beam 2 (Stanney La) [µg/m ³] 15min	SO₂ Beam 1 (Whitby Rd) [µg/m ³] 1hr	SO₂ Beam 2 (Stanney La) [µg/m ³] 1hr	SO₂ Beam 1 (Whitby Rd) [µg/m ³] 1 day	SO₂ Beam 2 (Stanney La) [µg/m ³] 1 day
Mean	6.2(6.9)	6.7(7.6)				
Max	220(213)	225(242)	163	147	67.22	64.78
Coverage (%)	97.6(97)	98.35(97)	98.2	98.6	100	99.7
Observations	34203	34462	8603	8637	365	364
Exceedance Limit	266	266	350	350	125	125
Exceedance Count	0	0	0	0	0	0
Perc:99.9 %	127.2(133.1)	122.4(158.2)	-	-	-	-
Perc:99.7 %	-	-	46.53	48.15	-	-
Perc:99.17 %	-	-	-	-	59.19	57.75
Unratified 2002 data in brackets						

Table 15. Opsis SO₂ results, 2001 & 2002

Stanney Grange Daily Averages	
Total period : 01/01/2001 00:00 - 31/12/2001 24:00 Integration time : 24.0 Hours	
	PM₁₀ (gravimetric) [µg/m ³]
Mean	19.95
Max	81.15
Coverage (%)	100
Observations	365
Exceedance Limit	50
Exceedance Count	5
Perc:90.41 %	31.27

2002
Unratified
18.01
66.63
4
30.90

Table 16. Stanney Grange PM₁₀ results, 2001 & 2002

Ellesmere Port Library PM ₁₀	
Total period : 01/01/2002 00:00 - 31/12/2002 24:00 Integration time : 24.0 Hours	
	PM₁₀ (gravimetric) [µg/m ³]
Mean	20.13
Max	77.79
Coverage (%)	97.53
Observations	356
Exceedance Limit	50
Exceedance Count	5
Perc:90.41 %	34.89

Table 17. Ellesmere Port PM₁₀ results, 2002

8-port net acidity bubblers

	Neston 2000	Civic Way ¹ 2001	Civic Way 2002
	SO ₂ (µg/m ³)	SO ₂ (µg/m ³)	SO ₂ (µg/m ³)
Annual Mean	13.2	15.0	13.5
Adjusted Ann Mean (x 1.25)	16.4	18.8	16.8
Maximum Daily Mean	47.6	49.4	56.2
Adjusted Max Daily Mean (x 1.25)	59.5	61.8	74.4
99.9th percentile of 15min means	112.8	117.2	141.0

Table 18. Sulphur dioxide 8-port bubbler results.

¹ The Bubbler located at Civic Way forms part of the UK SO₂ network.

NO₂ Diffusion Tubes

NO ₂ Diffusion tube bias correction			
	Annual Mean (µg/m ³) 2002	Co-location factors (TG03 - p6-7)	
Diffusion Tube	35.55	Diffusion Tube Bias	-2.3%
Chemiluminescent	36.39	Bias adjustment factor	1.024

Table 19. Bias correction factors of NO₂ diffusion tubes.

NO ₂ Diffusion Tube Data						
	2001			2002		
Site Code	Annual Mean (µg/m ³)	Ann Mean (corrected)	number of months' data	Annual Mean (µg/m ³)	Ann Mean (corrected)	number of months' data
CL	33.4	34.2	12	32.1	32.9	11
CO ²	30.6	31.3	12	30.4	31.1	9
CS	29.4	30.2	12	30.9	31.7	12
DL	13.0	13.4	12	12.8	13.2	12
ES	30.2	30.9	8	35.6	36.5	11
MM	32.7	33.4	12	29.4	30.2	12
MR ²	28.3	29.0	12	26.2	26.7	11
MW	22.0	22.5	8	23.7	24.3	12
NH	31.9	32.7	11	31.9	32.7	12
NT ²	33.4	34.2	12	32.1	32.9	12
PP	27.7	28.3	12	26.9	27.5	11
PW	36.1	37.1	11	33.8	34.6	6
RA	22.7	23.3	11	24.3	24.8	9
SK	41.3	42.2	12	46.2	47.4	12
SN	31.3	32.1	12	30.9	31.7	12
SP	31.3	32.1	12	26.2	26.7	11
TR	28.8	29.6	8	28.3	29.0	12
WL ²	20.1	20.6	12	22.2	22.7	12
WV	39.7	40.7	12	41.3	42.2	11

'Corrected' mean values have been adjusted using the bias adjustment factor shown in Table 19 above.

Table 20. NO₂ diffusion tube data 2001 & 2002.

² Four diffusion tubes forming part of the UK NO₂ network.

Benzene Diffusion Tubes

Benzene diffusion tube results				
	2001		2002	
Site Code	Annual Mean ($\mu\text{g}/\text{m}^3$)	Highest Running Annual Mean ($\mu\text{g}/\text{m}^3$)	Annual Mean ($\mu\text{g}/\text{m}^3$)	Highest Running Annual Mean ($\mu\text{g}/\text{m}^3$)
OS	3.1 ³	3.1	-	-
MM	2.0	2.0	-	-
VI	3.6	3.6	3.3	3.9
ST	1.4	N/A	1.5	1.9
LP	2.5	N/A	1.8	1.5
DL	0.9	0.9	1.1	1.1

Table 21. Benzene diffusion tube data 2001 & 2002.

1,3-Butadiene Diffusion Tubes

1,3-Butadiene diffusion tube results				
	2001		2002	
Site Code	Annual Mean ($\mu\text{g}/\text{m}^3$)	Highest Running Annual Mean ($\mu\text{g}/\text{m}^3$)	Annual Mean ($\mu\text{g}/\text{m}^3$)	Highest Running Annual Mean ($\mu\text{g}/\text{m}^3$)
MM	0.48	1.25	0.37	0.63
VI	1.00	1.66	0.21	0.92
DL	0.74	0.61	0.15	0.65

Table 22. 1-3,Butadiene diffusion tube data 2001 & 2002

³ Benzene results for 2001 at OS, ST & LP based on 8 months' data.

12. Appendix 3

Monitoring Techniques

Diffusion Tubes

Analytical Laboratory	
Prepared by	Gradko International Ltd. Winchester
Analysed by	Gradko International Ltd. Winchester
Laboratory Accreditation	UKAS testing No. 2187
Inter-laboratory participation	WASP performance: classification Good z-score range: -0.4 to 0.877. Ranked 1-3. UK NO ₂ interfield comparison
Tube Exposure	Monthly (in common with UK NO ₂ diffusion tube network calendar).

Table 23. Diffusion tube laboratory details

NO ₂ diffusion tubes	
Method of preparation	20% Triethanolamine in water
Analysis	UV Spectrophotometry
Blank Correction	Travel blank
Uncertainty of measurement	± 7.6%
Limit of Detection	0.01 µg/m ³

Table 24. NO₂ diffusion tube analytical data

Benzene diffusion tubes	
Absorbent	Chromasorb 106
Uptake rate	1.28 ng.ppm ⁻¹ min ⁻¹
Analysis	Thermal desorption / Gas chromatography
Peak identification	NIST reference library
Blank Correction	Laboratory blank
Uncertainty of measurement	± 21.00%
Limit of Detection	2.80ng

Table 25. Benzene diffusion tube analytical data

1,3-Butadiene diffusion tubes	
Absorbent	Molecular sieve 13x
Uptake rate	1.3 ng.ppm ⁻¹ min ⁻¹
Analysis	Gas chromatography / Mass Spectroscopy
Peak identification	NIST reference library
Blank Correction	Laboratory blank
Uncertainty of measurement	± 21.00%
Limit of Detection	2.80ng

Table 26. 1,3-Butadiene diffusion tube analytical data

13. Appendix 4

Background Data

Average of 1,3-butadiene 2003 $\mu\text{gm-3}$ annual mean																						
		Easting																				
		327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347
Northings	380																					
	379	0.14	0.14	0.15								0.20										
	378	0.13	0.13	0.14	0.15		0.16	0.17	0.18	0.19	0.20	0.20	0.20	0.19					0.17	0.16	0.16	
	377		0.13	0.13	0.14	0.15	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.20	0.20	0.19	0.18	0.17	0.17	0.16	0.17	
	376		0.13	0.13	0.14	0.14	0.14	0.15	0.16	0.17	0.19	0.20	0.20	0.21	0.20	0.19	0.18	0.17	0.17	0.17	0.18	0.18
	375			0.12	0.13	0.14	0.14	0.14			0.17	0.19	0.20	0.20	0.20	0.19	0.19	0.18	0.18			
	374		0.11	0.12	0.12	0.13	0.13						0.19	0.20	0.20	0.19						
	373		0.11	0.11	0.12	0.12							0.17									
Source: NETCEN LAQM tools.																						

Table 27. Predicted 2003 background concentrations of 1,3-butadiene

Average of benzene 2010 ugm-3 annual mean																						
		Eastings																				
		327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347
Northings	380																					
	379	0.33	0.35	0.35								0.72										
	378	0.33	0.35	0.35	0.38		0.38	0.41	0.43	0.71	0.74	0.75	0.75	0.74					0.88	0.47	0.46	
	377		0.33	0.34	0.37	0.38	0.36	0.39	0.41	0.69	0.74	0.76	0.77	0.77	0.97	0.93	0.90	0.88	0.87	0.46	0.46	
	376		0.32	0.33	0.36	0.37	0.35	0.36	0.37	0.46	0.52	0.56	0.58	0.59	0.97	0.92	0.88	0.86	0.85	0.46	0.46	0.46
	375			0.32	0.35	0.36	0.34	0.34			0.49	0.53	0.56	0.57	0.97	0.92	0.88	0.86	0.85			
	374		0.29	0.30	0.32	0.33	0.32						0.54	0.55	0.56	0.52						
	373		0.26	0.27	0.30	0.31							0.47									
Source: NETCEN LAQM tools																						

Table 28. Predicted 2010 background concentrations of benzene

Average of CO 2001 mgm-3 annual mean																									
		Eastings																							
		325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	
Northings	380																								
	379			0.29	0.30	0.30							0.37												
	378			0.28	0.29	0.30	0.31		0.32	0.33	0.34	0.36	0.37	0.38	0.38	0.37					0.33	0.32	0.32		
	377				0.28	0.29	0.30	0.31	0.31	0.32	0.33	0.35	0.37	0.39	0.39	0.39	0.38	0.36	0.35	0.33	0.33	0.33	0.33		
	376				0.28	0.29	0.29	0.30	0.30	0.31	0.31	0.34	0.36	0.38	0.39	0.40	0.38	0.36	0.35	0.34	0.33	0.33	0.34	0.34	
	375					0.28	0.29	0.29	0.29	0.30			0.35	0.37	0.38	0.39	0.38	0.37	0.36	0.35	0.34				
	374				0.27	0.27	0.28	0.28	0.29						0.37	0.38	0.38	0.36							
	373				0.26	0.26	0.27	0.27							0.34										
Source: NETCEN LAQM tools.																									

Table 29. Predicted 2001 background concentrations of Carbon monoxide.

Average of NO2 2005 ugm-3 annual mean																						
		Eastings																				
		327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347
Northings	380																					
	379	20.6	21.2	21.6								29.4										
	378	20	20.6	21.1	21.8		23.3	24.6	25.8	27.4	28.6	34	39.1	30.8					28.1	26.9	27.1	
	377		20.3	20.7	21.1	22	22.6	23.8	25	27	28.4	29.9	30.7	30.9	31	30.1	30.4	29.8	28.2	27.5	28.1	
	376		20	20.5	20.9	21.5	21.9	22.9	23.9	26	27.6	28.9	29.7	31.2	31.5	30.9	37.1	31.7	29.4	28.7	29.3	30.9
	375			20.1	20.6	21.1	21.7	22.4			25.9	27.1	28.4	31	31.6	31.7	40.4	32.7	30			
	374		19.3	19.7	21.2	21.8	22.6						27.2	29.8	31.1	31.4						
	373		18.9	19.2	20.8	21.5							25.9									

Table 30. Predicted 2005 background concentrations of Nitrogen dioxide.

Average of PM10 2004 ugm-3 gravimetric annual mean																						
		Eastings																				
		327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347
Northings	380																					
	379	17.2	17.4	17.5								21										
	378	17.4	17.5	17.8	18		17.9	18.4	18.5	18.9	19.6	19.7	19.6	19.4					19	18.4	18.5	
	377		17.4	17.7	17.9	18.1	17.8	18.2	18.3	18.8	19.6	19.7	19.8	19.8	20.2	19.7	19.4	19.1	18.9	18.4	18.5	
	376		17.4	17.7	17.9	18	17.7	17.8	17.9	18.4	19.3	19.6	19.8	20	20.6	20.6	20.7	19.5	19.1	18.6	18.7	18.8
	375			17.6	17.8	18	17.6	17.7			18.9	19.1	19.4	20	20.7	27.8	20.8	19.5	19.1			
	374		17.2	17.5	17.7	17.9	17.7						19.4	19.7	20.1	19.9						
	373		17	17.1	17.3	17.6							18.6									

Table 31. Predicted 2004 background concentrations of PM₁₀

Average of SO2 2001 ugm-3 annual mean																						
		Eastings																				
		327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347
Northings	380																					
	379	3.01	3.21	3.30								5.28									6.26	
	378	3.12	3.49	3.86	3.89		4.11	3.68	4.22	4.19	4.07	4.74	6.80	5.85	5.31					5.82	5.77	
	377	3.07	3.58	10.80	4.79	3.62	3.69	3.64	3.55	3.66	3.89	7.11	7.25	5.32	5.65	5.17	8.65	6.62	6.30	6.14	6.08	
	376		3.64	13.80	4.74	3.65	3.84	3.78	3.79	3.83	4.18	12.80	11.20	6.60	5.25	5.20	6.60	6.34	5.80	5.70	5.70	4.87
	375		3.37	3.59	3.56	3.38	3.72	3.75			3.99	4.90	10.90	9.23	5.48	4.82	5.86	5.69	5.64			
	374		3.23	3.18	3.18	3.23	3.63						4.73	7.71	4.87	5.84						
	373		3.09	3.03	3.02	3.06							4.20									

Table 32. Predicted 2001 background concentrations of SO₂

14. Glossary

$\mu\text{g}/\text{m}^3$	micrograms per cubic metre ($1\mu\text{g}/\text{m}^3 = 1$ millionth of a gram in a cubic metre of air)
mg/m^3	milligrams per cubic metre ($1\text{mg}/\text{m}^3 = 1$ thousandth of a gram in a cubic metre of air)
AADF	Annual Average Daily Traffic Flow
AQMA	Air Quality Management Area
CERC	Cambridge Environmental Research Consultants Ltd.
CO	Carbon monoxide
DEFRA	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges
EPAQS	Expert Panel on Air Quality Standards
EPNBC	Ellesmere Port & Neston Borough Council
LAQM	Local Air Quality Management
NAQS	National Air Quality Strategy
NETCEN	National Environmental Technology Centre
NO_2	Nitrogen dioxide
ppb	Parts per billion
ppm	Parts per million
PM_{10}	Particulate matter less than $10\mu\text{g}/\text{m}^3$ aerodynamic diameter
SO_2	Sulphur dioxide
TEOM	Tapered Element Oscillating Micro-balance
VOC	Volatile Organic Compound