BMT Cordah Limited
ENVIRONMENTAL CONSULTANCY
AND INFORMATION SYSTEMS

LAQM Updating and Screening Assessment 2006

A Report for Clackmannanshire Council

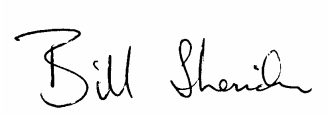
BMT Cordah Limited,
Pentlands Science Park,
Penicuik, Midlothian,
UK, EH26 0PZ.
Tel: +44(0)131 445 6120
Fax: +44(0)131 445 6110
Email: main@bmtcordah.com
Website: www.bmtcordah.com

Report No: BMT Cordah Ltd / E_CLA_015 / 2006
Status: Final
Version: 1
Date of Release: 31st August 2006

Approved and authorised for issue:

Stephen McKeown,
Consultant

Stuart McGowan,
Senior Consultant



Bill Sheridan,
Associate Director

Member of the BMT group of companies

CONTENTS

Table Contents List

Figure Contents List

EXECUTIVE SUMMARY

An Updating and Screening Assessment has been conducted for Clackmannanshire Council. The pollutants considered in this assessment are carbon monoxide, benzene, 1,3-butadiene, lead, nitrogen dioxide, sulphur dioxide and particulate material (PM_{10}).

The assessment has determined that there is no risk of exceeding any of the national air quality objectives for any of these pollutants. Accordingly, there is no requirement for Clackmannanshire Council to proceed to a Detailed Assessment for these pollutants. Clackmannanshire Council should continue to closely monitor PM_{10} concentrations at Alloa Ring Road, which is the location where exceedences of the 2010 PM_{10} objective are most likely.

1 INTRODUCTION

The Environment Act 1995 and subsequent regulations require local authorities to assess compliance of air quality in their area with the standards and objectives set out in the National Air Quality Strategy (NAQS) for England, Scotland, Wales and Northern Ireland 2000[1]. For local authorities within Scotland further regulations are set out in the Air Quality (Scotland) Regulations 2000 and Air Quality (Scotland) Amendment Regulations 2002. The pollutants contained within the NAQS and their relevant objectives are presented in Table 1.

The LAQM framework requires that local authorities carry out regular reviews of air quality concentrations in their area and assess the concentrations against the air quality objectives. The first round of Review and Assessment (R&A) commenced in 2000 and comprised a four stage approach to the assessment of air quality.

The Review and Assessment process was revised in 2003 and now comprises two phases. The first phase of the Review and Assessment is an Updating and Screening Assessment (U&SA). The U&SA considers any changes that have occurred in pollutant emissions and sources since the last round of Review and Assessment. The second phase can be either a Detailed Assessment or a Progress Report depending upon the outcome of the Updating and Screening Assessment.

BMT Cordah Ltd has been commissioned by Clackmannanshire Council to undertake the 2006 Local Air Quality Management (LAQM) Updating and Screening Assessment (U&SA). The report has been completed in conjunction with personnel from Clackmannanshire Council.

The aim of this U&SA is to provide an update on air quality issues within Clackmannanshire since the last U&SA in 2003. The assessment uses updated information for industrial, transport, commercial and domestic atmospheric emissions combined with current monitoring data to identify areas where there is potential for exceeding the NAQS air quality objectives.

The report follows guidance set out in LAQM.TG(03) technical guidance[2], LAQM.PG(04) policy guidance[3] and subsequent guidance amendments[4], hereafter referred to as the “technical guidance”.

[1] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, Working together for clean air, Defra, January 2000
[2] Part IV of the Environment Act 1995, Local air quality management technical guidance, LAQM.TG(03), Defra et al, January 2003.
[3] Part IV of the Environment Act 1995, Local air quality management policy guidance, LAQM.PG(03), Defra et al, January 2003.
[4] Part IV of the Environment Act 1995, Local air quality management technical guidance update, LAQM.TG(03) – update: January 2006, Defra et al, January 2006.

Table 1: Pollutant Objectives outlined in the National Air Quality Strategy

Pollutant	Air Quality Objective			Date to be achieved by
	Concentration	Measured as	Equivalent percentile	
Benzene	16.25 µg/m^3	running annual mean	-	31 / 12 / 2003
	3.25 µg/m^3	running annual mean	-	31 / 12 / 2010
1,3-butadiene	2.25 µg/m^3	running annual mean	-	31 / 12 / 2003
Carbon monoxide (CO)	10 mg/m^3	running 8 hour mean	-	31 / 12 / 2003
Lead	0.5 µg/m^3	annual mean	-	31 / 12 / 2004
	0.25 µg/m^3	annual mean	-	31 / 12 / 2008
Nitrogen dioxide (NO_2)	200 µg/m^3 not to be exceeded more than 18 times per year	1-hour mean	99.79th percentile of 1-hour mean concentrations	31 / 12 / 2005
	40 µg/m^3	annual mean	-	31 / 12 / 2005
Particulate (PM_{10})	50 µg/m^3 not to be exceeded more than 35 times a year	24-hour mean	90.4th percentile of 24-hour-mean concentrations	31 / 12 / 2004
	40 µg/m^3	annual mean	-	31 / 12 / 2004
	50 µg/m^3 not to be exceeded more than 7 times a year	24-hour mean	98th percentile of 24-hour-mean concentrations	31 / 12 / 2010
	18 µg/m^3	annual mean	-	31 / 12 / 2010
Sulphur dioxide (SO_2)	125 µg/m^3 not to be exceeded more than 3 times a year	24-hour mean	99th percentile of 24-hour mean concentrations	31 / 12 / 2004
	350 µg/m^3 not to be exceeded more than 24 times a year	1-hour mean	99.7th percentile of 1-hour mean concentrations	31 / 12 / 2004
	266 µg/m^3 not to be exceeded more than 35 times a year	15-minute mean	99.9th percentile of 15-minute mean concentrations	31 / 12 / 2005

2 DESCRIPTION OF THE LOCAL AREA

Clackmannanshire

Clackmannanshire Council is the smallest local authority in Scotland, with a population of around 50,000. It is bounded by the River Forth to the south and the Ochil Hills to the north. Neighbouring local authorities are Fife Council to the east, Stirling Council to the west, Perth and Kinross Council to the north and Falkirk Council to the south.

The main town is Alloa where around half the Clackmannanshire population resides. The majority of industrial and commercial activities are within Alloa. The remainder of Clackmannanshire is rural, with several towns known as the Hillfoot towns located south of the Ochils. The Council area is shown in Figure 1.

Description of road network

There are several A class roads which pass through Clackmannanshire. The principal routes include the A91 from Junction 7 of the M90 to Stirling (passing through the Hillfoot towns), the A977 from Junction 6 of the M90 to the Kincardine Bridge and the A907 from Stirling which passes through Alloa and continues to Fife. There are other A roads and numerous B roads which link Alloa and the surrounding towns.

Clackmannanshire Council have provided information on the number of vehicles using these roads in 2005. These data are provided in the form of Annual Average Daily Traffic (AADT) flows. In addition, the Scottish Executive provided AADT flow data measured at two locations in Clackmannanshire. The locations of the road traffic counts are shown in Figure 2 and the measured AADT flows summarised in Table 2.

Description of industrial activity

There is little industrial activity in Clackmannanshire, with the majority of the county rural in nature. Most industrial activity that does exist is located in the Alloa area.

Summary of previous assessments

Clackmannanshire Council produced their last U&SA of air quality in May 2003[5]. The U&SA concluded that there was potential to exceed NAQS SO_2 objectives as a result of industrial emissions from a site in Alloa. Further assessment of emissions from this source in subsequent Progress Reports in 2004[6] and 2005[7] concluded that the SO_2 objectives would not be exceeded. The Progress Reports also identified that there was potential for 2010 PM_{10} objectives to be exceeded in Alloa as a result of road traffic emissions. Further PM_{10} monitoring, however, concluded that the 2010 PM_{10} objectives would not be exceeded.

[5] Local Air Quality Management Updating and Screening Assessment. Clackmannanshire Council, May 2003.
[6] Local Air Quality Management Progress Report and Local Air Quality Strategy. Clackmannanshire Council, July 2004
[7] LAQM Progress Report 2005. Clackmannanshire Council, April 2005.

Table 2: Road traffic count data in Clackmannanshire

Location	AADT	Source
1. Menstrie	10940	Clackmannanshire Council
2. Menstrie/Alva	11002	Clackmannanshire Council
3. Alva/Tillicoultry	7934	Clackmannanshire Council
4. Muckhart	3731	Clackmannanshire Council
5. Blackgrange	22229	Clackmannanshire Council
6. Tullibody bypass	7388	Clackmannanshire Council
7. Muirside	7611	Clackmannanshire Council
8. Cambus	9922	Clackmannanshire Council
9. Tullibody sign	9667	Clackmannanshire Council
10. Tullibody Road	10257	Clackmannanshire Council
11. Fairfield	5609	Clackmannanshire Council
12. Alloa Ring Road	21778	Clackmannanshire Council
13. Fishcross/Sauchie	11888	Clackmannanshire Council
14. Blackfaulds	8867	Clackmannanshire Council
15. Forrestmill	5815	Clackmannanshire Council
16. Gartarry	12109	Clackmannanshire Council
17. A907 Alloa Ring Road	11857	Scottish Executive
18. A977 north of Gartarry Roundabout	5787	Scottish Executive

3 CARBON MONOXIDE

The NAQS objective for CO is defined as a maximum 8-hour running mean concentration not to exceed 10mg/m^3. The compliance date for the objective was 31st December 2003.

The main source of CO emissions in the UK is from road traffic.

Monitoring data

Clackmannanshire Council does not undertake any monitoring for CO.

There are eight locations in Scotland which monitor for CO and are part of the national Automatic Urban and Rural Network (AURN). The measured CO concentrations at each of these sites were below the NAQS objective for CO in 2005[8]. Many of these sites are located in busy city centres, where traffic levels are considerably higher than traffic levels in Clackmannanshire.

Background Concentrations

Estimated background air pollutant concentration maps for NAQS pollutants are available from the LAQM website[9]. A map of background CO concentrations in Clackmannanshire is presented in Figure 3. This figure demonstrates that background CO concentrations in Clackmannanshire are low, typically between 0.1-0.15mg/m^3 across the council area.

Transport sources

LAQM technical guidance advises that exceedences of the CO objectives are only likely at locations close to “very busy” roads or junctions in built up areas. “Very busy” is defined as roads with a daily traffic flow of at least 80,000 vehicles per day. The traffic flow data presented in Table 2 shows that the highest daily traffic flow in Clackmannanshire is 22,229 at Blackgrange, considerably less than 80,000 vehicles per day. It is therefore unlikely that there would be an exceedence of the CO objective due to emissions from road traffic.

Based on the available data it is concluded that it is unlikely that the NAQS objective for CO will be exceeded in Clackmannanshire.

[8] http://www.airquality.co.uk/archive/data_and_statistics.php
[9] http://www.airquality.co.uk/archive/laqm/tools.php?tool=background04

4 BENZENE

There are two objectives for benzene, one which required to be met by the end of 2003 and one to be met by the end of 2010. A more stringent objective applies in Scotland in 2010 compared to the objective in England and Wales. The objectives for benzene in Scotland are:

- running annual mean concentration not to exceed 16.25µg/m^3 (5ppb) by 31st December 2003; and

- annual mean concentration not to exceed 3.25µg/m^3 (1ppb) by 31st December 2010.

The main sources of benzene in the UK are road traffic and from petrochemical sites and storage depots. As there are no petrochemical sites or storage depots in Clackmannanshire, the main source of benzene is road traffic.

Monitoring data

Clackmannanshire Council do not undertake any monitoring of benzene. The measured annual mean benzene concentrations at the nearest AURN site, Glasgow Kerbside, in 2005 was 1.4µg/m^3, below the 2010 objective level[10]. It is likely that benzene concentrations in Clackmannanshire are lower than concentrations in Glasgow.

Background Concentrations

Estimated background air pollutant concentration maps for NAQS pollutants are available from the LAQM website[11]. A map of background benzene concentrations in Clackmannanshire is presented in Figure 4. This figure demonstrates that background benzene concentrations in Clackmannanshire are low, typically between 0.2-0.3µg/m^3 in the south-west, and between 0.1-0.2µg/m^3 in the rest of the council area.

Transport sources

LAQM technical guidance advises that exceedences of the benzene objectives may occur at locations close to “very busy” roads or junctions in built up areas. “Very busy” is defined as roads with a daily traffic flow of at least 80,000 vehicles per day. The measured traffic flow levels presented in Table 2 shows that the highest daily traffic flow in Clackmannanshire is 22,229 at Blackgrange, considerably less than 80,000 vehicles per day. It is therefore highly unlikely that there would be an exceedence of the benzene objectives at any location in Clackmannanshire.

Industrial sources

Based on consultation with the Scottish Environment Protection Agency (SEPA) no new industrial processes which are significant emitters of benzene have commenced operation in Clackmannanshire Council since the last round of Review and Assessment. There are no existing significant industrial sources of benzene in Clackmannanshire.

[10] www.airquality.co.uk/archive/data_and_statistics.php
[11] http://www.airquality.co.uk/archive/laqm/tools.php?tool=background04

Petrol stations

LAQM technical guidance advises that there is potential for exceedence of the NAQS objective for benzene at locations around petrol stations which are close to "busy roads". "Busy roads" are defined as roads with a traffic volume of greater than 30,000 vehicles per day. There are no roads in Clackmannanshire with a traffic volume of greater than 30,000 vehicles per day.

Major fuel storage depots (petroleum only)

There are no major fuel depots located in Clackmannanshire.

Based on the available data it is concluded that it is unlikely that the NAQS objectives for benzene will be exceeded in Clackmannanshire.

5 1,3-BUTADIENE

The NAQS objective for 1,3-butadiene is a running annual mean concentration not to exceed 2.25µg/m^3 (1ppb). The date for compliance with the objective was 31st December 2003.

The main source of 1,3-butadiene in the UK is road traffic emissions.

Monitoring data

Clackmannanshire Council do not undertake any monitoring of 1,3-butadiene. The highest measured running annual mean 1,3-butadiene concentration at the nearest AURN site, Glasgow Kerbside, in 2005 was 0.21µg/m^3, below the 2003 objective level[12]. It is likely that 1,3-butadiene concentrations in Clackmannanshire will be lower than concentrations in Glasgow.

Background Concentrations

Estimate background air pollutant concentration maps for NAQS pollutants are available from the LAQM website[13]. A map of background 1,3-butadiene concentrations in Clackmannanshire is presented in Figure 5. This map demonstrates that background 1,3-butadiene concentrations in Clackmannanshire are low, with the highest concentrations being between 0.06-0.08µg/m^3 in the south of the council area.

Industrial sources

Based on consultation with SEPA no new industrial processes which are significant emitters of 1,3-butadiene have commenced operation in Clackmannanshire Council since the last round of Review and Assessment. There are no existing significant industrial sources of 1,3-butadiene in Clackmannanshire.

Based on the available data it is concluded that it is unlikely that the NAQS objectives for 1,3-butadiene will be exceeded in Clackmannanshire.

[12] www.airquality.co.uk/archive/data_and_statistics.php
[13] http://www.airquality.co.uk/archive/laqm/tools.php?tool=background04

6 LEAD

There are two NAQS objectives for lead:

- annual mean concentration not to exceed 0.5µg/m^3 by 31st December 2004; and
- annual mean concentration not to exceed 0.25µg/m^3 by 31st December 2008.

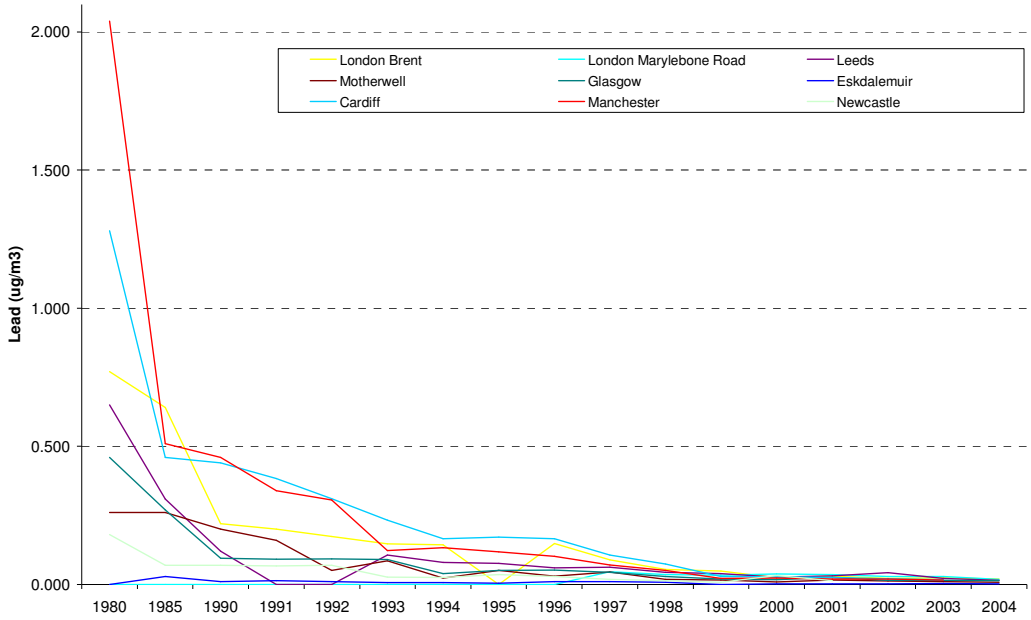
Since the use of lead within petrol was banned in 2000, the principal emission lead emission source in the UK is from a small number of industrial processes.

Monitoring data

There is no monitoring for lead carried out within Clackmannanshire. Monitoring of lead does occur at a number of locations across the UK. The results from this monitoring can be obtained from the national air quality website[14]. Monitoring sites are located at places where ambient lead concentrations may have been elevated in the past. Such locations include areas with high road traffic volumes or close to traditional heavy industries with high heavy metal emissions. There are two monitoring sites in Scotland at Glasgow and Motherwell.

Monitored lead concentrations at UK sites since 1980 are presented in Chart 1. The chart indicates that there has been a significant decrease in ambient lead concentrations since 1980. Measured ambient lead concentrations in 2004, the last year for which data are available, are below 0.1µg/m^3 at all locations. Ambient concentrations of lead in Clackmannanshire are likely to be below 0.1µg/m^3, under the NAQS objective.

Chart 1: UK Lead Concentrations, 1980 – 2004



[14] http://www.airquality.co.uk/archive/data_and_statistics.php

Industrial sources

Based on consultation with SEPA no new industrial processes which are significant emitters of lead have commenced operation in Clackmannanshire Council since the last round of Review and Assessment. There are no existing significant industrial sources of lead in Clackmannanshire.

Based on the available data it is concluded that it is unlikely that the NAQS objective for lead will be exceeded in Clackmannanshire.

7 NITROGEN DIOXIDE

There are two NAQS objectives for NO_2:

- annual mean concentration not to exceed 40µg/m^3 (21ppb); and
- 1-hour mean concentration not to exceed 200µg/m^3 (105ppb) on more than 18 occasions.

The date for compliance with the objectives was 31st December 2005.

Background Concentrations

Estimated background air pollutant concentration maps for NAQS pollutants are available from the LAQM website[15]. A map of background NO_2 concentrations in Clackmannanshire is presented in Figure 6. The map indicates that highest background NO_2 concentrations in Clackmannanshire are found around Alloa. Background NO_2 concentrations here are up to 12µg/m^3, while background NO_2 concentrations in the more rural parts of the region fall to between 2-4µg/m^3.

Monitoring data

Clackmannanshire Council operate a network of 10 passive diffusion tubes for NO_2. Three sites have monitored since 2000, one since 2001 while the remaining six sites commenced monitoring in 2002. The locations of the diffusion tube monitoring sites are presented in Figure 7 with descriptions of type of site in Table 3.

The diffusion tubes used by Clackmannanshire Council are prepared and analysed by Glasgow Scientific Services, who are accredited by the UK Accreditation Service (UKAS) to undertake analysis of NO_2 diffusion tubes. The diffusion tubes are prepared in 20% triethanolamine (TEA) in water.

The technical guidance recommends that diffusion tubes be co-located with continuous chemiluminesence monitoring sites in order to compare the results and validate the performance of the diffusion tubes and the laboratory analysis technique. A bias correction factor is calculated based on the difference between results from the chemiluminesence analyser and the co-located diffusion tubes. This bias adjustment factor can then be applied to the results from all diffusion tubes across the Council area.

Glasgow Scientific Services reported a bias correction factor of 0.74 in 2005 based on monitoring data obtained by Glasgow City Council[16]. This bias adjustment factor has therefore been applied to all diffusion tube monitoring results. The results from NO_2 monitoring in 2005 in Clackmannanshire Council are presented in Table 3. Historical monitoring data for each of the sites since 2002 are presented in Table 4.

[15] http://www.airquality.co.uk/archive/laqm/tools.php?tool=background04
[16] http://www.uwe.ac.uk/aqm/review/guidance_05.html

Table 3 NO_2 Diffusion Tube Monitoring Results 2005

Site	Grid Reference	Site Category	Date Capture (%)	NO_2 Annual Mean Concentration ($\mu g/m^3$)
1. Norwood Avenue, Alloa	NS 876 936	Urban Background	100	9
2. Shaftesbury Street, Alloa	NS 884 935	Kerbside	83	12
3. Clackmannan Road, Alloa	NS 893 929	Kerbside	100	19
4. Stirling Road, Tullibody	NS 860 951	Kerbside	100	25
5. Bus Station, Alloa	NS 888 929	Kerbside	92	18
6. Bus Station, Tillicoultry	NS 920 969	Kerbside	100	15
7. High Street, Tillicoultry	NS 915 971	Kerbside	100	17
8. South Ring Road, Alloa	NS 887 931	Kerbside	100	29
9. Glasshouse Loan, Alloa	NS 882 926	Kerbside	92	29
10. Shillinghill/Bridge Terrace, Alloa	NS 888 929	Kerbside / Industrial	100	19

Table 4: NO_2 Diffusion Tube Monitoring 2002 - 2005

Site	NO_2 annual mean concentration ($\mu g/m^3$)						
	2002	2003	2004	2005	% change between 2005 and 2004	2002-2005 mean	% change between 2005 and 2002-2005 mean
1. Norwood Avenue, Alloa	12	16	12	9	-27%	12	-29%
2. Shaftesbury Street, Alloa	19	17	10	12	30%	14	-14%
3. Clackmannan Road, Alloa	33	38	34	19	-45%	31	-39%
4. Stirling Road, Tullibody	23	34	24	25	6%	27	-8%
5. Bus Station, Alloa	29	42	37	18	-50%	32	-42%
6. Bus Station, Tillicoultry	18	26	19	15	-23%	20	-24%
7. High Street, Tillicoultry	21	27	20	17	-15%	21	-19%
8. South Ring Road, Alloa	22	28	23	29	25%	26	13%
9. Glasshouse Loan, Alloa	21	31	20	29	45%	25	14%
10. Shillinghill/Bridge Terrace, Alloa	31	43	32	19	-41%	31	-39%

The monitoring results show that there were no measured exceedences of the NO_2 annual mean objective of 40µg/m^3 in 2005. The highest measured NO_2 annual mean concentration was 29µg/m^3 at South Ring Road, Alloa and Glasshouse Loan, Alloa. The lowest measured NO_2 annual mean concentrations were at Norwood Avenue and Shaftesbury Street, Alloa.

There is no consistent trend in NO_2 concentrations across Clackmannanshire. The measured concentrations presented in Table 4 shows that between 2005 and 2004, NO_2 concentrations increased at four sites and decreased at six sites. The most significant increase in concentrations occurred at Glasshouse Loan, where 2005 concentrations had increased by 45% on 2004 levels. The largest decrease in concentrations was a 50% decrease at Alloa Bus Station between 2004 and 2005.

2005 concentrations at eight out of the ten locations were lower than the 2002-2005 mean concentration, with the concentrations measured at the remaining two locations (South Ring Road and Glasshouse Loan) higher than the 2002-2005 mean.

Transport sources

Narrow congested streets with residential properties close to the kerb

The last U&SA[17] included a DMRB assessment of Shillinghill, a road located in Alloa close to the ring road, which is often congested and which also has potential street canyon effects. This road is considered to be the worst-case example of a narrow, congested road in Clackmannanshire. The DMRB assessment concluded that there was no risk of exceeding the air quality objectives for NO_2 in Shillinghill. Diffusion tube monitoring in Shillinghill has also shown that the NO_2 annual mean objective was not exceeded in 2005 indicating that it is unlikely that the NO_2 objective will be exceeded in narrow congested streets in Clackmannanshire.

Junctions

The last U&SA[17] included a Design Manual for Roads and Bridges (DMRB) assessment of the Alloa Ring Road, which was the road with the heaviest traffic volume at that time. The assessment found that the NO_2 objectives would not be exceeded at this location, nor at any other location in Clackmannanshire. It is considered that this conclusion remains valid, as traffic flows have not increased significantly since the last assessment.

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

The busiest streets where people may spend 1-hour or more close to traffic are found in Alloa town centre. Diffusion tube monitoring is undertaken at several of these locations including Clackmannan Road and Shillinghill, where there have been no recorded exceedences of the NO_2 annual mean objective in 2005.

Roads with high flows of buses and / or HGVs

There is a risk of exceeding the NO_2 objectives near roads where a significant proportion of the traffic is heavy duty vehicles. The technical guidance defines a significant proportion as greater than

[17] Local Air Quality Management Updating and Screening Assessment. Clackmannanshire Council, May 2003.

25%. Clackmannanshire Council have advised that there are no roads within the Council where such a high percentage of heavy duty vehicles would be expected so there is no risk of exceeding the NO_2 objectives.

New roads constructed or proposed since the previous round of R&A

The only new road constructed in Clackmannanshire since the last round of R&A is a bypass around Tullibody. While the road will reduce the volume of traffic passing through Tullibody town centre, with a resultant improvement in air quality in Tullibody the road should also be assessed to determine whether there may be negative air quality impacts on receptors along the route.

The U&SA guidance advises that there may be a risk of exceeding the NO_2 objectives if the road has a daily flow of greater than 10,000 vehicles per day with receptors located within 10m of the road. Table 2 shows that the AADT at this location was 7388 vehicles in 2005, and currently there are no receptors located within 10m of the road edge. There is therefore no risk of exceeding the NO_2 air quality objectives close to the Tullibody bypass.

Council officers from Clackmannanshire Council have advised that there are plans to construct residential premises alongside the bypass. While current traffic levels would not be expected to result in exceedences of the NO_2 objectives, if future traffic volume exceeded 10,000 vehicles per day, there may be a risk of exceeding air quality objectives where receptors are introduced within 10m of the roadside. This should be considered in evaluating any future planning applications in this area.

Roads with significantly changed traffic flows, or new relevant exposure

Clackmannanshire Council have advised that there are no known roads with significantly changed traffic flows, or new relevant exposure, that could result in exceedences of the NO_2 objectives.

Bus stations

There are two main bus stances in Clackmannanshire; at Alloa and Tillicoultry. The Council have had monitoring coverage using diffusion tubes at both locations. There were no measured exceedences of the NO_2 annual mean objective at these locations in 2005.

Industrial sources

Based on consultation with the SEPA no new industrial processes which are significant emitters of NO_2 have commenced operation in Clackmannanshire Council since the last round of Review and Assessment. There are no existing significant industrial sources of NO_2 in Clackmannanshire.

Based on the available data it is concluded that it is unlikely that the NAQS objective for NO_2 will be exceeded in Clackmannanshire.

8 SULPHUR DIOXIDE

There are three NAQS objectives for SO_2:

- 24-hour mean concentrations not to exceed 125µg/m^3 on more than 3 occasions, by 31st December 2004;
- 1-hour mean concentrations not to exceed 350µg/m^3 on more than 24 occasions, by 31st December 2004; and
- 15-minute mean concentrations not to exceed 266µg/m^3 on more than 35 occasions, by 31st December 2004.

Background Concentrations

Estimated background air pollutant concentration maps for NAQS pollutants are available from the LAQM website. A map of background SO_2 concentrations in Clackmannanshire are presented in Figure 8. This figure demonstrates that highest background SO_2 concentrations in Clackmannanshire are low, with the highest estimated concentrations around 2-3µg/m^3 in the south of the council area.

Monitoring data

Clackmannanshire Council monitor SO_2 using an 8-port bubbler analyser located at Alloa Town Hall. The location of the SO_2 bubbler is shown in Figure 7. Whilst it is recognised that SO_2 bubblers do not provide the most accurate measurement of SO_2 concentrations, and that their use is now being discontinued in national monitoring networks, monitoring using this technique has continued in Alloa for reference purposes.

Daily SO_2 concentrations are determined by net titration, and LAQM technical guidance states that the measured daily mean should be factored by 1.25 to account for the under-read of bubblers at high concentrations. The guidance also provides correction factors for calculating the 99.9th percentile of 1-hour means and the 99.7th percentile of 15-minute means based upon the maximum daily mean. These factors are:

- 99.9th percentile of 15-minute means = 1.8962 * maximum daily mean; and
- 99.7th percentile of 1-hour means = 1.3691 * maximum daily mean

Using these correction factors the SO_2 concentrations recorded at Alloa Town Hall in 2005 are presented in Table 5.

Table 5: SO_2 Concentrations at Alloa Town Hall, 2005

Period	Mean concentration (µg/m^3)	Measured maximum 24-hour mean concentration (µg/m^3)	Factored maximum 24-hour mean concentration (µg/m^3)	99.7th percentile of 1-hour mean concentration (µg/m^3)	99.9th percentile of 15-minute mean concentration (µg/m^3)
January	1.3	2	2.5	3.4	4.7
February	1.0	2	2.5	3.4	4.7
March	1.3	2	2.5	3.4	4.7
April	1.7	3	3.8	5.1	7.1
May	1.6	3	3.8	5.1	7.1
June	1.4	3	3.8	5.1	7.1
July	0.9	2	2.5	3.4	4.7
August	1.0	4	5.0	6.8	9.5
September	1.8	3	3.8	5.1	7.1
October	1.1	3	3.8	5.1	7.1
November	4.9	19	23.8	45.0	32.5
December	2.0	2	2.5	3.4	4.7
2005	**1.7**	**19**	**23.8**	**45.0**	**32.5**

SO_2 monitoring in 2005 has indicated that ambient concentrations in Alloa are low. The maximum measured 24-hour mean concentration was 19µg/m^3 which occurred in November. After applying the appropriate factors, this gives a maximum 24 hour mean concentration in 2005 of 23.8µg/m^3, a 99.7th percentile of 1-hour mean concentration of 45µg/m^3 and a 99.9th percentile of 15-minute mean concentrations of 32.5µg/m^3. These values are all significantly lower than the NAQS objectives for SO_2.

The values measured in November were also significantly higher than concentrations measured in other months of the year. Maximum measured 24-hour mean concentrations in other winter months were no higher than 4µg/m^3. It is unclear what caused the elevated SO_2 concentration measured in November.

Industrial sources

Discussions between Clackmannanshire Council and SEPA indicated that emissions from United Glass Limited, Alloa have substantially increased since the last U&SA in 2003. United Glass applied to SEPA for a variation in their Pollution Prevention and Control (PPC) permit in 2004, allowing them to use heavy fuel oil as an alternate fuel to gas. SEPA requested that United Glass conduct an air quality impact assessment detailing the predicted impact on the local environment of increased SO_2 emissions. The assessment concluded that there would be no exceedences of the SO_2 objectives as a result of switching fuel and SEPA have accepted this assessment, issuing a variation to the permit, allowing United Glass to combust heavy fuel oil. It is considered that the conclusions of this report are valid.

Small boilers > 5MW(thermal)

LAQM technical guidance identifies a risk of exceeding the 15-minute mean SO_2 objective from emissions from boilers larger than 5MW burning fuel oil or coal. Since 2003, regulations have limited the sulphur content of fuel oil to a maximum of 1%, meaning that single sources are unlikely to have a significant impact. Previous assessment reports have concluded that it was unlikely that there would be any exceedences of this objective in Clackmannanshire, as there are few sources with such boilers in Clackmannanshire. It is considered that this conclusion remains valid.

Domestic sources

An assessment of the potential for exceeding SO_2 objectives as a result of domestic solid fuel burning has been conducted since the last U&SA[18]. The assessment concluded that the majority of towns and villages were supplied with mains gas, and that this was the preferred fuel for the majority of households. In those areas without mains gas supply, there is no population density with more than 100 households within 0.25km^2, the threshold given in the technical guidance for the potential to exceed NAQS objectives to exist. It is therefore concluded that it is unlikely that exceedences of the SO_2 NAQS objectives will occur in Clackmannanshire as a result of domestic fuel.

Transport sources

Shipping

There are no large harbours or ports within Clackmannanshire. It is therefore considered unlikely that emissions from shipping will results in an exceedence of NAQS objectives for SO_2 in Clackmannanshire.

Railway locomotives

Emissions form diesel railway locomotives may lead to exceedences of the SO_2 15 minute mean objective if they are regularly stationary for periods of 15 minutes or more.

There are currently no railway locomotives operating in Clackmannanshire, although work is in progress to reconstruct the Stirling-Alloa-Kincardine line. This line will carry passenger services between Alloa, Stirling and Glasgow, and also freight services, including transporting coal from the west of Scotland to Longannet power station in Fife. It is likely that there will be many diesel powered locomotives using this line. It is not known at this time whether there will be particular locations where locomotives will be regularly stationary along the route. This situation should be monitored once the line is operational to identify any locations where there is a risk of exceeding the SO_2 15-minute mean objective.

Based on the available data it is concluded that it is unlikely that the NAQS objective for SO_2 will be exceeded in Clackmannanshire.

[18] Local Air Quality Management Updating and Screening Assessment. Clackmannanshire Council, May 2003.

9 PARTICULATES

There are two objectives for PM_{10}, an annual mean objective and a 24-hour mean objective with separet objective which have to be achieved after 2004 and in 2010. The annual mean objective for 2010 in Scotland is more stringent than the objective in the rest of the UK. The objectives that apply in Scotland are:

- an annual mean objective of 40µg/m^3 not to be exceed after by 31st December 2004; and
- an annual mean objective of 18µg/m^3 not to be exceeded after 31st December 2010;
- the 24-hour mean concentration not to exceed 50µg/m^3 on more than 35 occasions after 31st December 2004; and
- the 24-hour mean concentration not to exceed 50µg/m^3 on more than 7 occasions after 31st December 2010.

Background Concentrations

Estimated background air pollutant concentration maps for NAQS pollutants are available from the LAQM website[19]. A map of background PM_{10} concentrations in Clackmannanshire in 2005 are presented in Figure 9. This figure shows that background PM_{10} concentrations in Clackmannanshire are highest in the Alloa area, and lowest in the north of the council area. Background concentrations in Alloa reach a maximum of 22µg/m^3 while in the north they are between 12-14µg/m^3.

Monitoring data

Clackmannanshire Council monitor for PM_{10} on the Ring Road around Alloa town centre. The location of the site is shown in Figure 7. While this monitoring station has been operational for a number of years, the site has experienced ongoing technical problems, and much data have been lost. These problems have been resolved in recent years, and the data capture rate was high in 2005.

PM_{10} monitoring was conducted using a Tapered Element Oscillating Microbalance (TEOM) monitoring device. Following the technical guidance, a factor of 1.3 was applied to the raw monitoring results, to account for the loss of volatile particulate material which is lost due to the use of a heated inlet in the TEOM.

Monitoring results for PM_{10} at the Alloa Ring Road are presented in Table 6. PM_{10} concentrations are projected to 2010, when the more stringent objective comes into force, using the methodology given in the technical guidance.

Table 6: Measured PM_{10} concentrations at Alloa Ring Road, 2005

Data capture (%)	Annual mean concentration (µg/m^3)	Number of exceedences of 50µg/m^3	98th percentile of 24-hour mean concentrations (µg/m^3)	Predicted 2010 Annual Mean Concentration (µg/m^3)
91	18.5	1	34.8	17.1

[19] http://www.airquality.co.uk/archive/laqm/tools.php?tool=background04

The measured annual mean PM_{10} concentration in 2005 was below the 2004 objective of 40µg/m^3 but above the 2010 objective of 18µg/m^3 when the 1.3 factor is applied. When this concentration is projected forward to 2010, using the method defined in LAQM technical guidance, the PM_{10} concentration at this location is predicted to be below the 2010 objective. Based on the measured PM_{10} concentrations in 2005 it is unlikely that the 2010 annual mean objective will be exceeded.

Transport sources

Busy roads and junctions in Scotland

The technical guidance advises that there is a risk of exceeding the annual mean PM_{10} objectives at receptors within 10m of busy roads and junctions, with "busy" defined as more than 10,000 vehicles per day if the background is less than 15µg/m^3, and more than 5,000 vehicles if the background is greater than 15µg/m^3. It is clear from Figure 9 that background concentrations in Clackmannanshire are more than 15µg/m^3 across wide areas, and based on the traffic flows reported in Table 2 there are a number of roads where the AADT flow is greater than 5,000. Accordingly, DMRB assessments have been conducted at a number of these locations.

Required input data for a DMRB assessment are the year of assessment (2005), background PM_{10} concentration, the AADT, the average vehicle speed, the road type, the percentage of light and heavy vehicles on the road and the distance from the road centre to the receptor points.

The road types are either DMRB class A, "motorways and A roads", or class B, "urban roads…neither motorways nor A roads". DMRB uses an internal database to provide a more detailed breakdown of the type of vehicles using each road class.

The average vehicle speed is set at 30mph (48kph), since these roads are most likely to pass receptors in urban areas where this speed limit applies.

In the absence of local data the percentages of heavy vehicles and light vehicles using the roads were taken from road transport statistics published by the Department of Trade and Industry[20]. These show that across the UK, approximately 8% of vehicles are HGVs.

Background PM_{10} concentrations were taken from the LAQM website. The concentration of pollutants in each grid square is calculated from emission estimates from all sources within that grid, so care must be taken to avoid double counting of road emissions during the DMRB assessment. For example, the background concentration for the grid square which contains a major road should not be used, as road emissions from this junction were already included when the background grid square concentration was calculated.

The input data used for the DMRB assessments and the predicted annual average PM_{10} concentrations are presented in Table 7.

[20] http://www.dft.gov.uk/stellent/groups/dft_transstats/documents/sectionhomepage/dft_transstats_page.hcsp

Table 7: Results from DMRB assessments

Location	Road type	AADT	Background PM_{10} concentration ($\mu g/m^3$)	PM_{10} contribution from road traffic ($\mu g/m^3$)	Predicted PM_{10} concentration 10m from road centre ($\mu g/m^3$)
Menstrie/Alva	A	11002	15.9	1.5	17.4
Blackgrange	A	22229	15.7	2.4	18.1
Tullibody Bypass	B	7388	15.7	0.8	16.5
Tullibody Road	B	10257	16.1	1.1	17.2
Alloa Ring Road	A	21778	17.1	2.4	19.5
Fishcross/Sauchie	A	11888	17.0	1.6	18.6
Blackfaulds	A	8867	16.1	1.2	17.3

The results from the DMRB assessment indicate that annual mean PM_{10} concentrations in excess of the 2010 objective of $18\mu g/m^3$ could within 10m of three roads in Clackmannanshire. These roads are the A907 at Blackrange, the A908 at Fishcross/Sauchie and the Alloa Ring Road. Predicted annual mean PM_{10} concentrations at the other road locations are below the NAQS objective level.

The high background PM_{10} concentrations contribute to the high predicted PM_{10} concentrations. Direct road traffic emissions account for a maximum of 13% of the total PM_{10} concentration at Blackgrange, and as little as 5% of the total at the Tullibody bypass.

It is noted that the DMRB modelling predictions of PM_{10} concentrations at Alloa Ring Road are higher than the measured PM_{10} concentration at this location. Measured PM_{10} concentrations predicted to 2010 are $17.1\mu g/m^3$ compared to the modelling prediction of $19.5\mu g/m^3$. The DMRB modelling tool is known to systematically over-predict pollutant concentrations. Based on the comparison between measured and predicted levels it can be assumed that the modelling predictions overestimate PM_{10} concentrations by up to 13%. Based on this over-prediction, it is considered unlikely that the PM_{10} objective will be exceeded close to the Alloa Ring Road.

Based on the over-prediction of PM_{10} concentrations noted at Alloa Ring Road, it is also considered unlikely that the annual mean PM_{10} objective will be exceeded close to the A907 at Blackgrange and on the A908 at Fishcross.

Roads with high flows of buses and / or HGVs

LAQM technical guidance identifies a risk of exceeding the NO_2 objectives near roads where a significant proportion of the traffic are heavy duty vehicles. A significant proportion is defined as greater than 20% of total flow. There are no roads within Clackmannanshire where such a high percentage of heavy duty vehicles would be expected and as such it is considered that there is no risk of exceeding the PM_{10} objectives.

New roads constructed or proposed since the previous round of R&A

The only new road constructed in Clackmannanshire since the last U&SA is a bypass around Tullibody. While the road will reduce the volume of traffic passing through Tullibody town centre, with a resultant improvement in air quality in Tullibody the road should also be assessed to determine whether there may be negative air quality impacts on receptors along the route.

The Tullibody bypass was included in the DMRB assessment, and the predicted PM_{10} annual mean concentration is $17\mu g/m^3$. It is unlikely, therefore, that there will be an exceedence of the 2010 annual mean objective close to this road.

Roads with significantly changed traffic flows, or new relevant exposure

Clackmannanshire Council have advised that there are no known roads with significantly changed traffic flows, or new relevant exposure that could result in exceedences of the PM_{10} objectives.

Industrial sources

New industrial sources / Industrial sources with substantially increased emissions, or new relevant exposure

Based on consultation with the SEPA no new industrial processes which are significant emitters of PM_{10} have commenced operation in Clackmannanshire Council since the last round of Review and Assessment. There are no existing significant industrial sources of NO_2 in Clackmannanshire.

Quarries / landfill sites / opencast coal / handling of dusty cargo at ports etc.

Clackmannanshire Council advised that only one quarry, Tillicoultry Quarry, is currently operating in Clackmannanshire. The technical guidance states that there is a risk of exceeding the PM_{10} objectives at receptors within 200m of the quarrying activity if the background PM_{10} concentration is less than 16µg/m^3. Background PM_{10} concentrations are estimated to be less than 16µg/m^3 at this site. In addition, there is no history of dust complaints as a result of quarrying activity. It is considered unlikely, therefore, that there will be any exceedences of the PM_{10} objectives near this quarry.

Domestic sources

An assessment of potential for exceeding PM_{10} objectives as a result of domestic solid fuel burning has been conducted since the last U&SA. The assessment concluded that the majority of towns and villages were supplied with mains gas, and that this was the preferred fuel for the majority of households. In those areas without mains gas supply, there is no population density with more than 100 households within 0.25km^2, the threshold given in the technical guidance for the potential to exceed NAQS objectives to exist. The conclusion that it is unlikely for exceedences of the PM_{10} NAQS objectives to occur in Clackmannanshire as a result of domestic fuel burning remains valid.

Based on the available data it is concluded that it is unlikely that the NAQS objective for PM_{10} will be exceeded in Clackmannanshire.

10 CONCLUSIONS

This study considered local air quality monitoring data and road traffic count data that were available since the last assessment of air quality in April 2005. The study also considered all new developments in the Clackmannanshire area since April 2005 and reviewed their potential to cause exceedence on NAQS objectives. The pollutants considered in this assessment are carbon monoxide, benzene, 1,3-butadiene, lead, nitrogen dioxide, sulphur dioxide and fine particulate material (PM_{10}).

The assessment has determined that it is unlikely that exceedences of any of the national air quality objectives for any of these pollutants will occur. Accordingly, there is no requirement for Clackmannanshire Council to conduct any Detailed Assessments. It is recommended that the Council continues the current monitoring of air quality levels in its area. The Council should also continue to assess any new developments for potential to cause exceedence of NAQS objectives.