Air Quality in the Highlands

First Stage Review and Assessment

Consultation Document

Protective Services - December, 1998

Figure 1 The Highland Council Areas

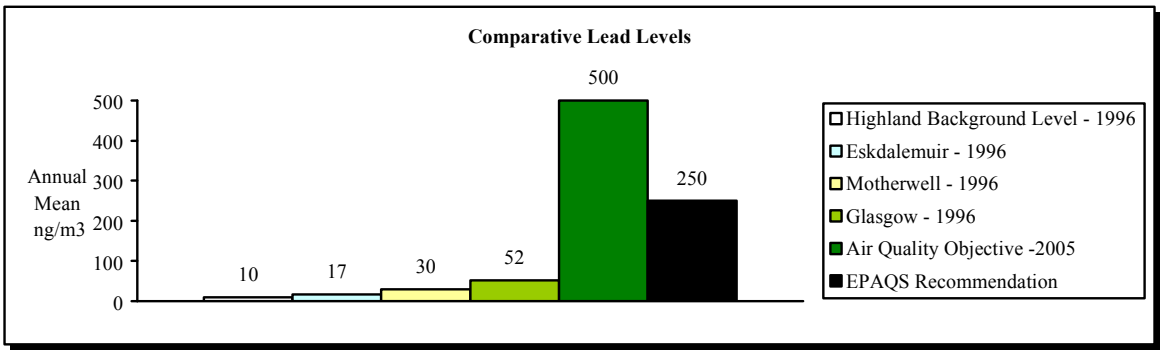
1 Contents

2 Figures and Annexes

TABLE OF FIGURES AND ANNEXES

NOTES ON READING THE CHARTS IN THE ABOVE FIGURES

Unfortunately, in photocopying this report, the shading in some of the charts has not been faithfully reproduced. However, in charts with more than two shades, these can easily be read as follows. The bars when read from left to right follow the same order as the legend when read from top to bottom. Thus in the example below, the third bar from the left (having a value of 30ng/m3) corresponds to Motherwell, i.e. the third entry in the legend, when read from the top.



3 Executive Summary

The UK Government published its strategic policy framework for air quality management in 1995 establishing national strategies and policies on air quality which culminate in the Environment Act, 1995. As a requirement of the Act, the Secretary of State has since prepared a National Air Quality Strategy. The National Air Quality Strategy provides a framework for air quality control through air quality management and air quality standards. New national air quality standards have been proposed by the Expert Panel on Air Quality Standards (EPAQS) for the UK Government. These new air quality standards and their objectives have been enacted through the Air Quality Regulations in December 1997. The Environment Act requires Local Authorities to undertake an air quality review. In areas where air quality objectives are not anticipated to be met by the year 2005 Local Authorities are required to establish Air Quality Management Areas.

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

For the purpose of determining the focus of review and assessment, local authorities should have regard to locations where individuals are likely to be exposed over the averaging time of the prescribed objective. The following interim approach is recommended to define relevant locations which should be the focus of review and assessment:

- for objectives with short averaging times (the sulphur dioxide objective and the hourly objective for nitrogen dioxide) reviews and assessments should be focused on any non-occupational, near ground level outdoor location given that exposures over such short averaging times are potentially likely;

- for objectives with longer averaging times (the objectives for benzene, 1,3 butadiene, carbon monoxide, PM_{10}, lead and the annual objective for nitrogen dioxide) reviews and assessments should be focused on the following near ground level outdoor locations: background locations; roadside locations; and other areas of elevated pollutants concentrations where a person might reasonably be expected to be exposed (e.g. in the vicinity of housing, schools or hospitals etc) over the relevant averaging time of the objective.

The identification of relevant locations with respect to the sources of the pollutants requires further consideration. Two documents which are awaiting publication are likely to be helpful. These are:-

- The Environment Agency document, "Guidance for estimating the Air Quality Impact of Stationary Sources", and;
- The Highways Agency document, "The Design Manual for Roads and Bridges, 1998"

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

4 The National Air Quality Strategy and Local Air Quality Management

The Environment Act 1995 required the Secretary of State to produce a National Air Quality Strategy which provides a framework for air quality control through national strategies and policies for air quality and the establishment of air quality standards. This was published in March 1997. The Strategy proposed new national air quality standards and objectives for 8 major pollutants following recommendations from the Expert Panel on Air Quality Standards (EPAQS).

Air Quality Standards are used as benchmarks for setting air quality objectives. They represent the levels at which there would be an extremely small or no risk to human health. Where EPAQS has not yet made a recommendation the air quality standard has been derived from the World Health Organisation recommendation.

Air Quality Objectives represents the Government's best judgement of the progress which can be made towards getting air quality as close to the benchmark standards as is reasonable and justifiable on the grounds of cost and benefits by the year 2005. They will be used as triggers for action by local authorities. These air quality standards and objectives were given statutory force under the Air Quality Regulations 1997.

In addition Part IV of the Environment Act 1995 requires local authorities to undertake new duties for local air quality management. These new duties commenced at the end of 1997. Local Authorities require to undertake a review and assessment of air quality within their areas. Where air quality objectives will not, or are unlikely to be met by the year 2005, the authority will require to designate an Air Quality Management Area and draw up an Action Plan to remedy the situation. A minimum of two air quality reviews are recommended in order to assess compliance with air quality objectives, one to assess air quality at the outset of the National Air Quality Strategy and a second to be carried out towards the end of the time scale of 2005.

The complexity and detail of a review and assessment should be consistent with the risk of air quality objectives not being achieved by the year 2005. In the first instance the local authority should carry out the initial screening of industrial transport and any other significant sources of pollution within their locality **(first stage review and assessment).** By using simple screening techniques, it will be possible to determine which areas should be the focus of a local authority's attention. In areas well below the air quality objective it may not be necessary to undertake any further investigation, except for a further assessment of air quality nearer the year 2005 to ensure that there has been no significant decline in air quality.

If exceedances do, or are likely to exist, and there is the potential for human exposure over the specified averaging period for a pollutant, the authority should proceed to a **second stage assessment.** In areas where there is the potential risk of elevated levels of a pollutant, a local authority will require to estimate ground level concentrations at the road side and at industrial and background locations within their area. This will enable the local authority to predict the highest potential pollution concentrations. The approach is intended to be precautionary. If there is no risk that an objective will not be achieved, a local authority can be confident that an Air Quality Management Area will not be necessary. However, if by 2005, it is likely that the standard will be approached or exceeded, a local authority should proceed to the **third stage.** Second and third stage review and assessments require to be completed by the end of 1999.

Those authorities which need to progress to the third stage are likely to require to undertake more sophisticated modelling and monitoring techniques. Local authorities will have to predict whether the air quality objective is unlikely to be met by the year 2005. This will be the crucial factor which will trigger the designation of an Air Quality Management Area.

Measures have already been put in place in order to tackle the problem of poor air quality at both national and international level. However there is a significant local dimension to air quality, with emissions varying dramatically in different areas, depending on geography, industry and traffic. Local Air Quality Management aims to ensure that solutions are tailored to local needs. The National Air Quality Strategy requires all local authorities to develop an integrated approach to local air quality management, ensuring that air quality is considered alongside issues such as transport and land use planning.

5 National Air Quality Strategy Objectives

For ease of reference, the national air quality strategy objectives are reproduced in Figure 2 below. It is likely that the Government will amend the objective for Lead in the light of the recent recommendations from the Expert Panel on Air Quality Standards (EPAQS). The Panel, has assessed available health and air quality data and has recommended an Air Quality Strategy Objective for Lead in the United Kingdom of 0.25μg/m^3 measured as an annual average. The current objective for lead of 0.5 μg/m^3 was based on the World Health Organisation's recommendation.

Figure 2 Air Quality Objectives for the year 2005

Substance	Air Quality Objective
Benzene	5ppb or less, when expressed as a running annual mean.
1,3-Butadiene	1ppb or less, when expressed as a running annual mean
Carbon Monoxide (CO)	10ppm or less, when expressed as a running 8 hour mean
Lead	0.5 μg/m^3 or less, when expressed as an annual mean
Nitrogen dioxide (NO_2)	150 ppb or less, when expressed as an hourly mean, and 21 ppb or less, when expressed as an annual mean
PM_{10}	50 μg/m^3 or less, when expressed as the 99th percentile of daily maximum running 24 hours mean
Sulphur dioxide (SO_2)	100 ppb or less, when expressed as the 99.9th percentile of 15 minute means

6 The Highland Council Area

6.1 Topography

The area of the Highland Council covers around one third of the Scottish mainland and includes Skye and other inner Hebridean islands. This diverse area, stretching from coast to coast, encompasses not only the mountains, glens and lochs for which the Highlands are renowned but also extensive lowlands. The west coast is mountainous with numerous deeply indented sea lochs. In the north east lies the "flow" country of Caithness. Further south on the east coast lie three estuarine systems, the Dornoch, the Cromarty and the Moray firths. South of the Great Glen fault, lie the Monadhliath and Cairngorm mountains and to the south west the area extends to the Ardnamurachan peninsula.

There are numerous towns, villages, scattered rural communities and inhabited islands. Around 30% of the population lives in the coastal area around Inverness, the Highland "capital" and one of the fastest growing towns in Europe.

6.2 Neighbouring Local Authorities

The Highland Council shares landward boundaries with Moray, Aberdeenshire, Perthshire and Kinross, and Argyll and Bute Councils. The land use along the boundary areas is predominantly rural, mountainous or moorland. There is no heavy industry in the boundary areas which could impact on the air quality objectives in the Highland Council area. The Western Isles and the Orkney Islands are the nearest island council areas to Highland.

6.3 Meteorology

In a second stage review and assessment there may be a need to obtain detailed meteorological reports. Information on predominant wind directions, wind speed and cloud cover is often needed for inclusion in dispersion models for atmosphere pollutants.

There are eight Meteorological Stations which provide such data in the Highland Area. The nearest station to Inverness is at Kinloss. At that location the predominant wind direction is south westerly. The eight Meteorological Stations in the Highland Council area are at Altnahara, Aviemore, Aultbea, Durnish, Invergordon, Shin, Tulloch Bridge and Wick.

6.4 Industry

In the context of air quality, the processes which are most likely to emit pollutants are those which are prescribed processes under Part I of the Environmental Protection Act 1990. Prescribed processes require to be authorised by the Scottish Environment Protection Agency. Part A processes are those which are subject to integrated pollution control. As such, releases of substances to land, water and air are controlled. Account is taken of the best practical environmental option in determining the medium to which the substances should be released.

In the case of Part B processes, only emissions to atmosphere are considered. Part B processes are controlled so as to ensure that emissions of potentially harmful substances are minimised.

The Part A authorised processes in Highland are listed in Annex 1 and their locations are shown in Annex 2 to this report. The Part B authorised processes in Highland are listed in Annex 3 and their locations are shown in Annex 4.

6.5 Population

By 1996, the population of the Highlands had increased to 210,696. Within this overall picture of population there have been variations between the Areas. Between 1986 and 1996, Nairn has grown by over 7%, whilst Caithness and Sutherland have both experienced population loss.

Figure 3 Population change by Highland Council Area 1986-1996

Highland Council Area	1986	1996	% change
Badenoch and Strathspey	10,600	11,230	5.9
Caithness	27,130	25,950	-4.4
Inverness	60,770	64,970	6.9
Lochaber	19,370	19,570	1.0
Nairn	10,240	11,020	7.6
Ross and Cromarty	47,900	50,830	6.1
Skye and Lochalsh	11,530	11,990	4.0
Sutherland	13,210	13,140	-0.5
Totals	**202,736**	**210,696**	**4.0**

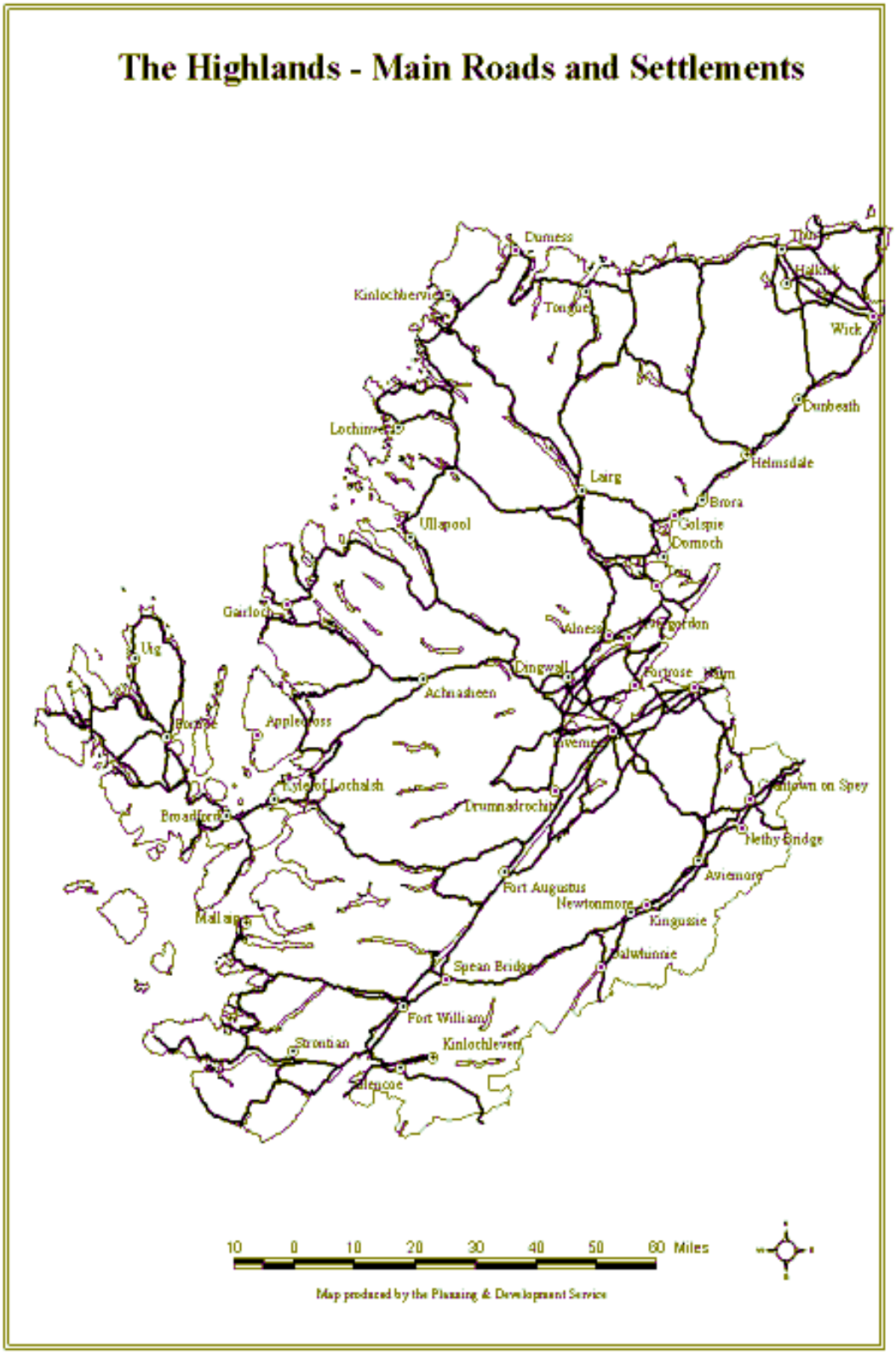
6.6 Road Network

Road is the dominant form of transport in Highland. The Council area has around 7,500 km of road network. Of this, 1,000 km is trunk roads and maintained by or on behalf of The Scottish Office. Traffic flows within Highland vary considerably, both across the network and between the winter and summer months. On the West Coast average daily flows between 1994 and 1996 were less than 1,000 per day, falling to below 150 on the more remote parts of the network. Close to Inverness, however, they rose to over 21,000 vehicles per day at the Kessock Bridge. On some parts of the network summer flows are over three times those in the winter.

Since 1981 there have been a number of significant improvements to the road network. These have substantially reduced travel times, particularly from areas to the north and south of Inverness as a result of the Kessock and Cromarty Firth crossings. Journey times from Inverness to Fortrose, Dingwall and Dornoch, for example fell by over 40% between 1981 and 1991. The central belt has also become more accessible with travel times reducing by 29% to Glasgow and 19% to Edinburgh in the same period. Improvements to the A9, the A830 and other roads in the Inverness area are under active consideration.

The main roads and settlements in Highland are shown in Figure 4.

Figure 4 The Highlands - Main Roads and Settlements



6.7 Annual average daily traffic flows for existing roads 1996 and 2005

Traffic flows are measured by Highland Councils' Roads and Transport Services. The Department of the Environment Transport and the Regions has predicted annual % growth rates. These are published in the National Road Traffic Forecasts (Great Britain) 1997. By combining this data, forecasts of traffic growth can be made for the year 2005. The forecasts are based on traffic survey data which was collected between 1994 and 1996

Inverness has the highest traffic flows in Highland. The numbers given for each of the years represent a low forecast, a central estimate, and a high forecast. The central estimate is considered to be the most likely outcome.

Figure 5 Forecasts for annual average daily traffic flows in Inverness, 1998 and 2005

Road Section	1,998			2,005		
	Low forecast	Central forecast	High forecast	Low forecast	Central Forecast	High forecast
Academy Street	14,470	15,107	15,741	15,675	17,021	18,642
Castle Street	17,241	18,000	18,755	18,677	20,280	22,212
Ness Bridge	18,678	19,500	20,318	20,234	21,971	24,063
Bridge Road	19,294	20,143	20,988	20,901	22,695	24,856
Raigmore interchange to Smithton	19,673	20,539	21,401	21,312	23,141	25,346
Telford Street	21,038	21,964	22,885	22,791	24,747	27,104
Longman roundabout to Charleston	21,654	22,607	23,555	23,458	25,471	27,897
Shore Street roundabout to Rose Street roundabout	21,685	22,639	23,589	23,491	25,508	27,937
Friars Bridge	21,757	22,714	23,667	23,569	25,592	28,030
Harbour Road roundabout to Longman roundabout	22,701	23,700	24,694	24,592	26,703	29,246
Raigmore Interchange to Kessock Bridge	22,988	24,000	25,006	24,903	27,041	29,616
Rose Street roundabout to Harbour Road roundabout	24,117	25,179	26,234	26,126	28,369	31,070

6.8 Transport and Tourism

For an area the size of Highland, the use of cars and camper vans by visitors to travel about is perhaps bound to predominate, but public transport clearly has its own advantages for users, local residents, and the general environment. Data for 1993-95 indicates that 68% of holiday trips in the Highlands and Islands made by UK visitors is by private car (own or hired) and 61% of trips made by overseas visitors who arrive by sea or channel tunnel is by car or camper van. No similar information is available for those overseas visitors who arrive by air.

6.9 The Highlands of Scotland Tourism Strategy

The Highland Council, Highlands of Scotland Tourist Board, and Highlands and Islands Enterprise (on behalf also of the Local Enterprise Companies and public and private sector agencies) produced a joint Tourism Strategy in 1997 setting out visions and objectives for this vital economic sector. Actions have been identified for a wide range of issues including marketing, accommodation, services, the environment and transport. Some specific targets have been set for the year 2000. These include targets to increase all tourism expenditure by 26% to £469 million and to increase expenditure outwith the peak July to September period by 28%. Improvements to the A9, A830 and other roads in the Inverness area are under active consideration.

6.10 Freight

The majority of freight in Highland is transported by road. No figures on freight tonnage are available for The Highland Council area but HGVs account for around 10% of all traffic on the A9 and A96. Road freight in Scotland has increased by 19% between 1985 and 1994 and accounts for over 70% of the total. The Highland figure is likely to be significantly higher.

6.11 Rail

Rail travel is an insignificant form of commuter travel in Highland with less than 1% of workers travelling to their place of employment by train. Rail services are, however, an important means of transport for tourists both into and within Highland. Eight per cent of UK tourists to the Highlands and Islands area used the train to travel there between 1993 and 1995. A survey of rail passengers carried out in the summer of 1993 found that 45% of visitors would not have been in the Highlands without the train.

7 Benzene

7.1 Air Quality Standards and Objectives for Benzene

The Government has adopted a running average of 5 ppb as an air quality standard for benzene, with an objective for the standard to be achieved by the end of 2005. The focus of an authority's review and assessment for benzene should be non-occupational near ground level outdoor locations with elevated benzene concentrations in areas where a person might reasonably be expected to be exposed over a year (e.g. in the vicinity of housing, schools, or hospitals etc.).

7.2 Sources and significance of Benzene in the atmosphere

Benzene is an aromatic VOC (Volatile Organic Compound) which is a minor constituent of petrol (about 2% by volume). The main sources of benzene in the atmosphere in Europe are the distribution and combustion of petrol. Of these, combustion by petrol vehicles is the single biggest source (70% of total emissions) whilst the refining, distribution and evaporation of petrol from vehicles accounts for approximately a further 10% of total emissions. Benzene is emitted in vehicle exhaust not only as unburned fuel but also as a product of the decomposition of other aromatic compounds. Benzene is known to be a human carcinogen.

In the UK the main atmospheric source of benzene is the combustion and distribution of petrol, of which it is a minor constituent, currently comprising about 2% by volume in the UK, on average. Diesel is a relatively small source. Motor vehicle exhaust gases contain some of this unburned benzene, but they also contain benzene formed from the combustion of other aromatic components of petrol. Motor vehicles are the most important single source on a national basis, accounting in 1996 for 64% of the total UK annual emission of 41 ktonnes, with most of this total arising from petrol vehicles. Six tonnes, 15% of the total, were emitted from industrial processes.

7.3 Benzene levels: The UK Perspective

Existing national policies are expected to deliver the prescribed air quality objective for benzene by the end of 2005. Roadside levels of benzene, next to even the most busy or congested roads are expected to be well below the objective by the year 2005. Only those authorities with major industrial processes which either handle, store or emit benzene, which have the potential, in conjunction with other sources, to result in elevated levels of benzene in relevant locations, are expected to need to undertake a second or third stage review and assessment. It is expected, for benzene, that most local authorities will not need to progress past the first stage.

7.4 Information to be collated for the first stage review of Benzene

In compiling information for the first stage review and assessment, the local authority is required to collate the following:-

1. details of Part A and Part B authorised processes present within its area (see Annexes 1 to 4);
2. planned developments of the above mentioned types in the locality;
3. details of any significant sources of benzene in neighbouring areas which could impact significantly within the authority's areas;
4. details of any surveys or investigations undertaken to obtain information to compile the report.

7.5 Information to be considered for the assessment of Benzene in the Highlands

For all existing and proposed activities identified by local authority in 7.4 above, the authority should then identify those existing or proposed processes or activities which have the potential, singly or together, to emit significant quantities of benzene and

- are expected to be in existence and/or operational by the end of 2005 and
- for which there is potential for exposure of individuals in relevant locations.

For the purposes of a First Stage review and assessment for benzene these can be assumed to consist of:

a) one or more Part A or Part B processes of the type indicated by the Governments guidance to be a potential significant source of benzene

b) ***planned developments of the above mentioned types in the locality***.

7.6 Estimated background levels in the Highlands: Benzene

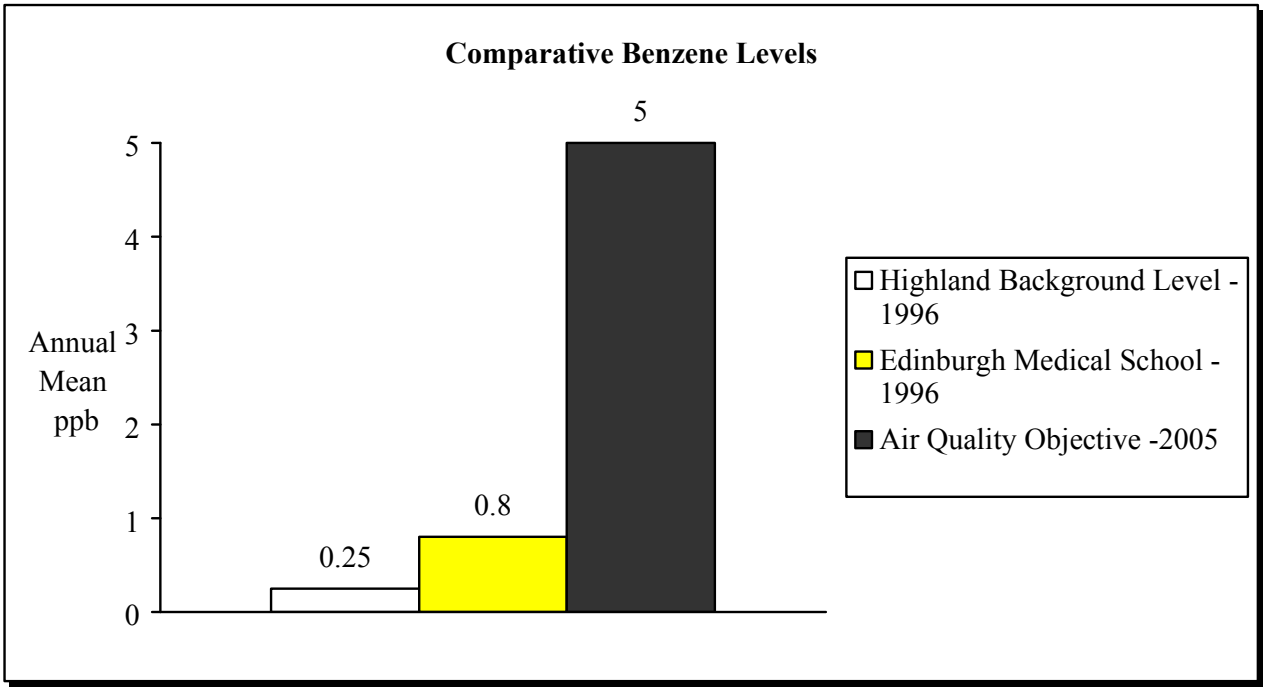
By reference to the national maps (Stedman, 1998), the estimated background concentration of benzene throughout the Highlands in 1996 was less than 0.25ppb.

7.7 Benzene Monitoring in the UK

Benzene is monitored in the UK on behalf of the Department of Environment, Transport and the Regions at 13 sites. The only site in Scotland which is part of the Automatic Hydrocarbon Monitoring Network is in Edinburgh.

In 1996, at the Edinburgh Medical School, the running annual mean for benzene was 0.8 ppb. This compares favourably with the Governments objective for benzene, which is that a level of less than 5ppb should be achieved by 2005.

Figure 6 Comparative Benzene Levels -1996



7.8 Part A and Part B processes: Benzene

In its guidance, the Government has identified certain categories of processes which have the potential to release significant quantities of benzene into the atmosphere. It should be noted that not all processes included in the category necessarily release that substance. The processes which are listed below have been identified solely on the basis of their classification. No account has been taken of abatement technologies which may be in place to prevent or minimise emission.

Figure 7 Part A Authorised Processes: Benzene

Process Operator	Address	Highland Council Area	NGR
Carbonisation			
SGL Technic Limited	Muir of Ord Industrial Estate	Ross And Cromarty	NH 5310 4890
Petroleum process			
Talisman Energy (UK) Ltd	Nigg Oil Terminal	Ross And Cromarty	NH 7868 6876

Part B Authorised Processes: Benzene

There are no Part B processes within the Highlands which fall within the Governments classification of processes which are likely to give rise to significant quantities of benzene.

7.9 Planned developments and neighbouring areas: Benzene

There are no planned developments in the Highland Council area, or sources of benzene in neighbouring areas which could impact significantly on the air quality in local authority Area. It is not anticipated that the position will have changed by the year 2005.

7.10 Conclusions: Benzene

As can be seen from Figure 6, the background level of benzene in the Highlands in 1996 was 95% lower than the Government's objective for the year 2005. It is not anticipated that any local point source would raise ambient levels above the Government's objective of 5ppb. However, there are two authorised Part A processes in Highland which fall within the Government's classification of processes which have the potential to release significant quantities of benzene. It is unlikely that the aforementioned processes will cause problems with local air quality. However, as a priority, further information on likely environmental levels of benzene arising from these processes will be sought from the Scottish Environment Protection Agency.

The Government is currently investigating ambient levels of benzene in the vicinity of petrol filling stations. Future updates of LAQM.TG4(98), "Review and Assessment: pollutant specific guidance" will take account of the research findings and consider whether petrol stations should be categorised as having the potential to release significant quantities of benzene.

Every local authority is required to carry out a second review and assessment of air quality before 2005. By then, the "Guidance for Estimating the Air Quality Impact of Stationary Sources" from the Environment Agency will be available. It is recommended that the impact of the aforementioned processes should be reassessed at that time.

8 1,3-Butadiene

8.1 Air Quality Standards and Objectives for 1,3-butadiene

The Government has adopted a running annual average of 1 ppb as an air quality standard for 1,3-butadiene with an objective for the standard to be achieved by the end of 2005. The focus of an authority's review and assessment for 1,3-butadiene should be non-occupational, near ground level outdoor locations with elevated 1,3-butadiene concentrations in areas where a person might reasonably be expected to be exposed over a year (e.g. in the vicinity of housing, schools, or hospitals etc.)

8.2 Sources and significance of 1,3-butadiene in the atmosphere

1,3-butadiene, like benzene, is a volatile organic compound. 1,3-butadiene in the atmosphere is mainly derived from the combustion of petrol and other materials. Although neither petrol nor diesel fuel contains 1,3-butadiene it is formed in the combustion process from olefins in the fuel. 1,3-butadiene is also an important industrial chemical, and is handled in bulk at a small number of industrial locations in the UK. Other than in the vicinity of such locations, the dominant source of 1,3-butadiene in the UK atmosphere is the motor vehicle. The UK national atmospheric inventory for 1,3-butadiene showed that, in 1995, 67% of national annual emissions arose from petrol vehicles and 13% arose from industrial processes. 1,3-butadiene, like benzene is also a known, potent, human carcinogen.

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8.3 1,3-butadiene levels: The UK Perspective

Existing national policies are expected to deliver the prescribed air quality objective for 1,3-butadiene by the end of 2005. Roadside levels of 1,3-butadiene, next to even the most busy or congested roads are expected to be well below the air quality objective. Only those authorities with major industrial processes, which either handle, store or emit 1,3-butadiene and which have the potential, in conjunction with other sources, to result in elevated levels in relevant locations, are expected to need to undertake a second or third stage review and assessment.

8.4 Information to be collated for the first stage review of 1,3-butadiene

In compiling information for the first stage review and assessment, the local authority is required to collate the following:-

1. details of Part A and Part B authorised processes present within its area (see Annexes 1 to 4);
2. planned developments of Part A and Part B authorised processes
3. details of any significant sources of 1,3-butadiene in neighbouring areas which could impact significantly present within the authority's area
4. details of any surveys or investigations to obtain information to compile this report.

8.5 Information to be considered for the assessment of 1,3-butadiene in the Highlands

For all existing and proposed activities identified by the local authority in 8.4 above, the authority should then identify those existing or proposed processes or activities which have the potential, singly or together, to emit significant quantities of 1,3-butadiene, and

- are expected to be in existence and/or operation by the end of 2005 and
- for which there is potential for exposure of individuals in relevant locations.

For the purposes of a First Stage review and assessment for 1,3-butadiene these can be assumed to consist of:

(a) one or more Part A or Part B processes of the type indicated by the Government's guidance to be a potential significant source of 1,3-butadiene
(b) ***planned developments of the above mentioned types in the locality.***

8.6 Estimated background levels in the Highlands: 1-3, butadiene

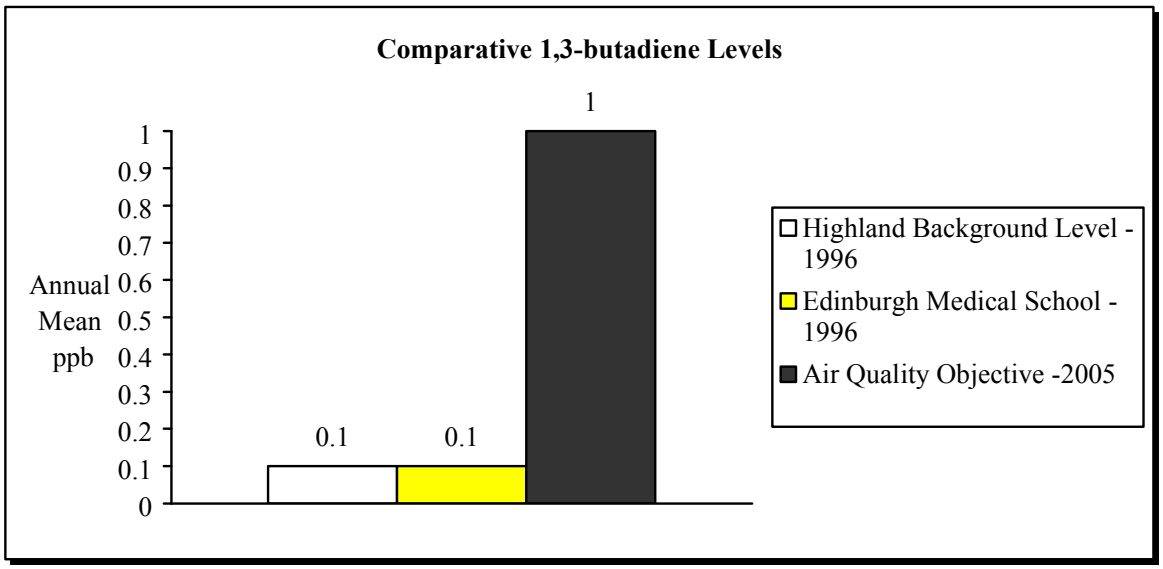
By reference to the national maps (Stedman, 1998), the estimated background concentration of 1-3, butadiene throughout the Highlands in 1996 was less than 0.1ppb.

8.7 1-3, butadiene monitoring in the UK

1-3, butadiene is monitored in the UK on behalf of the Department of Environment, Transport and the Regions at 13 sites. The only site in Scotland which is part of the Automatic Hydrocarbon Monitoring Network is in Edinburgh.

In 1996, at the Edinburgh Medical School, the running annual mean for 1-3, butadiene was 0.1 ppb. This can be compared to the Government's objective for 2005 of 1ppb or less when expressed as a running annual mean.

Figure 8 Comparative 1,3-butadiene levels - 1996



8.8 Part A and Part B processes: 1-3, butadiene

In its guidance, the Government has identified certain categories of processes which have the potential to release significant quantities of 1-3, butadiene into the atmosphere. It should be noted that not all processes included in the category necessarily release that substance. The processes which are listed below have been identified solely on the basis of their classification. No account has been taken of abatement technologies which may be in place to prevent or minimise emission.

Figure 9 Part A Authorised Processes: 1-3, butadiene

Process Operator	Address	Highland Council Area	NGR
Carbonisation			
SGL Technic Limited	Muir of Ord Industrial Estate	Ross And Cromarty	NH 5310 4890
Petroleum process			
Talisman Energy (UK) Ltd	Nigg Oil Terminal	Ross And Cromarty	NH 7868 6876

Part B Authorised Processes: 1-3, butadiene

There are no Part B processes within the Highlands which fall within the Government's classification of processes which are likely to give rise to significant quantities of benzene.

8.9 Planned developments and neighbouring areas: 1-3, butadiene

There are no planned developments in Highland, or sources of 1-3, butadiene in neighbouring areas which could impact significantly on the air quality in the Highland Council Area. It is not anticipated that the position will have changed by the year 2005.

8.10 Conclusions: 1,3-butadiene

As can be seen from Figure 8, the background level of 1,3-butadiene in the Highlands in 1996 was 90% lower than the Government's objective for the year 2005. It is not anticipated that any local point source would raise ambient levels above the Government's objective of 1ppb. However, there are two authorised Part A processes in Highland which fall within the Government's classification of processes which have the potential to release significant quantities of 1,3-butadiene. It is unlikely that the aforementioned processes will cause problems with local air quality. However, as a priority, further information on likely environmental levels of 1,3-butadiene arising from these processes will be sought from the Scottish Environment Protection Agency.

Every local authority is required to carry out a second review and assessment of air quality before 2005. By then, the "Guidance for Estimating the Air Quality Impact of Stationary Sources" from the Environment Agency will be available. It is recommended that the impact of the aforementioned processes should be reassessed at that time.

9 Carbon monoxide (CO)

9.1 Air Quality Standards and Objectives for Carbon monoxide

The Government has adopted an 8-hour running average of 10 ppm as an air quality standard for carbon monoxide (CO), with an objective for the standard to be achieved as the maximum 8-hour running average by the end of 2005. The focus of an authority's review and assessment for Carbon monoxide should be the following non-occupational, near ground level outdoor locations: background locations; roadside locations; and other areas of elevated Carbon monoxide concentrations where a person might reasonably be expected to be exposed over an 8-hour period (e.g. in the vicinity of housing, schools, or hospitals etc.).

9.2 Sources and significance of Carbon monoxide in the atmosphere

Carbon monoxide is a toxic gas which is emitted into the atmosphere as a result of combustion processes, and is also formed by the oxidation of hydrocarbons and other organic compounds. The main source of Carbon monoxide in the UK is road transport which accounted for 71% of the total emission of 4.6 Mtonnes in 1996. Carbon monoxide at levels found in ambient air may reduce the oxygen-carrying capacity of the blood. It survives in the atmosphere for a period of approximately 1 month but is eventually oxidised to carbon dioxide (CO2).

Carbon monoxide is produced from incomplete combustion. Its effects on human health are of most concern where it inhibits oxygen uptake by the lungs.

The main source of Carbon monoxide in the United Kingdom is road transport which accounted for 71% of the total emission of 4.6 Mtonnes in 1996. Road transport sources will constitute a larger proportion of the total in most cities and maximum 8-hour concentrations are therefore expected near busy, especially congested roads.

9.3 Carbon monoxide levels: The UK Perspective

Existing national policies are expected to deliver the national air quality objective by the end of year 2005 with the possible exception, in some years, of the near vicinity of heavily trafficked roads or in the vicinity of certain stationary sources. Only those authorities with such sources which have the potential to result in elevated levels of Carbon monoxide in relevant locations are expected to proceed to a second or third stage review and assessment. It is expected, for this pollutant, that most local authorities will not need to progress past the first stage.

9.4 Information to be collated for the first stage review of Carbon monoxide

In compiling information for the first stage review and assessment, the local authority is required to collate the following:-

1. details of Part A and Part B authorised processes present within its area (see Annexes 1 to 4);
2. information on current and 2005 forecast annual average daily traffic flows for any existing or proposed roads in the authority's area with existing or predicted traffic flows which, at the end of 2005, could generate significant quantities of Carbon monoxide
3. information on current urban background concentrations due to dispersed road transport sources derived from locally sited automatic monitoring or from national maps (see http://www.environment.detr.gov.uk/airq/aqinfor.htm or http://open.gov.uk or see Stedman 1988)
4. planned developments of the above mentioned types in the locality, including those which will increase traffic flow;
5. details of any significant sources of Carbon monoxide in neighbouring areas which could impact significantly within the authority's area
6. details of any survey or investigations undertaken to obtain information to compile the report.

9.5 Information to be considered for the assessment of Carbon monoxide in the Highlands

For all existing and proposed activities identified by the local authority in 9.4 above, the authority should then identify those existing or proposed processes or activities which have the potential, singly or together, to emit significant quantities of CO and

- are expected to be in existence and/or operation by the end of 2005 and
- for which there is a potential for exposure of individuals in relevant locations.

For the purposes of a First Stage review and assessment of Carbon monoxide these can be assumed to consist of:

(a) road links with current or projected average daily traffic flow greater than 50,000
(b) one or more Part A processes of the type indicated by the Government's guidance to be a potential significant source of Carbon monoxide
(c) planned developments of the above mentioned types in the locality, including those which will increase traffic flow.

9.6 Estimated background levels in the Highlands: Carbon monoxide

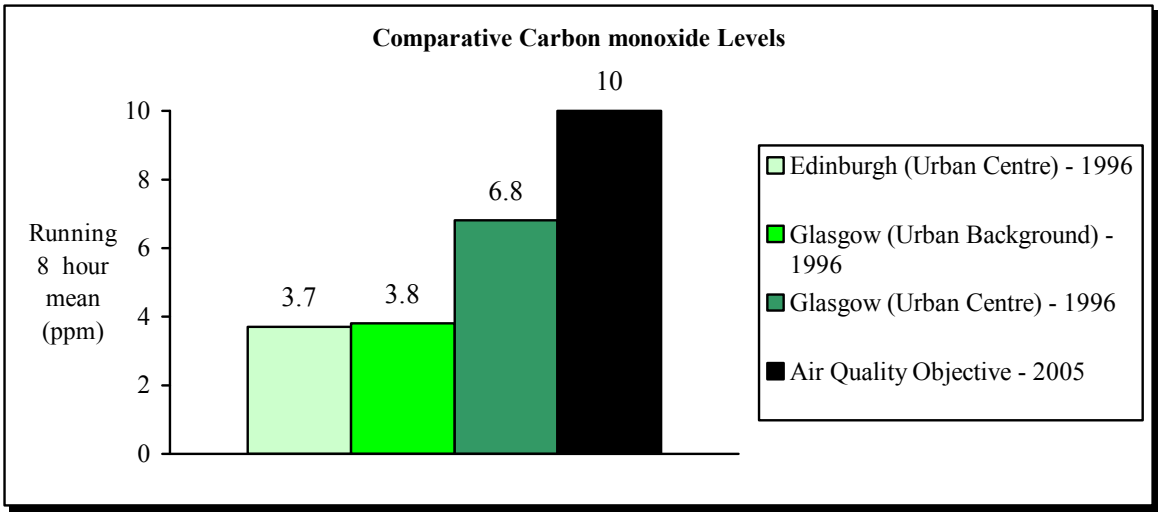
By reference to the national maps (Stedman, 1998), the estimated background level of carbon monoxide throughout the Highlands in 1996 was less than 0.2 ppm.

9.7 Carbon Monoxide Monitoring in the UK

In 1996 in the UK, carbon monoxide was monitored on behalf of the Department of Environment, Transport and the Regions at 39 sites. There were three monitoring sites in Scotland. An "urban centre" site at Edinburgh and in Glasgow, an "urban centre" site and an "urban background" site. In Glasgow, an additional "kerbside" site commenced data collection in March 1997.

In 1996 the running 8 hour mean at Edinburgh was 3.7ppm. In Glasgow, the level at the "urban centre" site was 6.8ppm, whereas at the "urban background", the level was 3.8ppm. These levels can be compared with the Government's objective for Carbon monoxide which is that the level of CO, when expressed as a running 8 hour mean, should be less than 10ppm by 2005.

Figure 10 Comparative Carbon monoxide levels



9.8 Part A and Part B processes: Carbon monoxide

In its guidance, the Government has identified certain categories of processes which have the potential to release significant quantities of Carbon monoxide into the atmosphere. It should be noted that not all processes included in the Category necessarily release that substance. The processes which are listed below have been identified solely on the basis of their classification. No account has been taken of abatement technologies which may be in place to prevent or minimise emission.

Figure 11 Part A Authorised Processes : Carbon monoxide

Process Operator	Address	Highland Council Area	NGR
Processing non-ferrous metals			
UKAEA	Dounreay, Thurso	Caithness	NC 9925 6785
Primary manufacture of aluminium by electrolysis			
Alcan Smelting & Power UK	Alcan Disposal Site, Kinlochleven	Lochaber	NN 1815 6187
Alcan Smelting & Power UK	Lochaber Smelter	Lochaber	NN 1250 7535

Part B Authorised Processes : Carbon monoxide

The Government has not identified any Part B processes as likely to release significant quantities of Carbon monoxide.

9.9 Planned developments and neighbouring areas: Carbon monoxide

There are no planned developments in Highland, or sources of Carbon monoxide in neighbouring areas which could impact significantly on the air quality in the Highland Council Area. It is not anticipated that the position will have changed by the year 2005.

9.10 Conclusions: Carbon monoxide

As can be seen from Figure 10, the background level of Carbon monoxide in the Highlands in 1996 was 98% below the Government's objective for the year 2005. It is not anticipated that any local point source would raise ambient levels above the Government's objective of 10ppm. However, there are three authorised Part A processes in Highland which fall within the Government's classification of processes which have the potential to release significant quantities of Carbon monoxide. It is unlikely that the aforementioned processes will cause problems with local air quality. However, as a priority, further information on likely environmental levels of Carbon monoxide arising from these processes will be sought from the Scottish Environment Protection Agency.

Every local authority is required to carry out a second review and assessment of air quality before 2005. By then, the "Guidance for Estimating the Air Quality Impact of Stationary Sources" from the Environment Agency will be available. It is recommended that the impact of the aforementioned processes should be reassessed at that time.

As can be seen from Figure 5 Forecasts for annual average daily traffic flows in Inverness, 1998 and 2005, the highest projected annual average daily traffic flow in the year 2005 will be on the road link between Rose Street roundabout and Harbour Road roundabout in Inverness. The highest forecast is 31,070 vehicles per day as an annual daily average. This is substantially less than the 50,000 vehicles per day which the Government have identified as the trigger for local authorities to progress to a second stage review and assessment.

10 Lead

10.1 Air Quality Standards and Objectives for Lead

The Government has adopted an annual average of 0.5 μg/m^3 (500 ng/m^3) as an air quality standard for lead with an objective for the standard to be achieved by the end of 2005. The current objective for lead of 0.5 μg/m^3 is based on the World Health Organisation's recommendation. It is likely that the Government will amend the objective for Lead in the light of the recent recommendations from the Expert Panel on Air Quality Standards (EPAQS). The Panel, has assessed available health and air quality data and has recommended an Air Quality Strategy Objective for Lead in the United Kingdom of 0.25μg/m^3 (250 ng/m^3) measured as an annual average.

The focus of an authority's review and assessment for lead should be non-occupational, near ground level outdoor locations with elevated lead concentrations in areas where a person might reasonably be expected to be exposed over a year (e.g. in the vicinity of housing, schools or hospitals etc.).

10.2 Sources and significance of Lead in the atmosphere

Lead is the most widely used non-ferrous metal and has a large number of industrial applications, both in its element form and in alloys and compounds. The single largest use globally is in the manufacture of batteries, but other uses as a pigment in paints and glazes, in alloys, in radiation shielding, tank lining and piping. As the compound tetraethyl lead, it has been used as a petrol additive to enhance the octane rating. With the recognition of the adverse effects of lead on human health and the growing use of catalytic converters, which are poisoned by lead, this use is declining rapidly. Most of the current emissions of lead in the UK arise from petrol-engined motor vehicles.

During the 1970s and early 1980s the lead content of petrol was gradually reduced, so that total emissions from vehicles remained broadly constant. Lead concentrations in air have decreased significantly, however, in the past decade. The reason for this decrease is twofold. The major reduction in the maximum permissible lead content of leaded petrol for 0.4g/1 to 0.15g/1 in January 1986 almost halved urban air lead levels in the space of a few months. This reduction was reinforced and sustained by the introduction of unleaded petrol in 1987 and the continued increasing market share of this fuel ever since, to the point where, since 1993, all new petrol engined cars are catalyst equipped and therefore must run on unleaded petrol.

10.3 Lead levels: The UK Perspective

Existing UK policies are expected to deliver the national air quality objective for lead at all rural, urban background sites and roadside locations by the year 2005. Only authorities with significant industrial sources, which have the potential to result in elevated levels of lead in relevant locations, are expected to need to undertake a second or third stage review and assessment.

10.4 Information to be collated for the first stage review of Lead

In compiling information for the first stage review and assessment, the local authority is required to collate the following:-

1. details of Part A and Part B authorised processes present within its area (see Annexes 1 to 4);
2. information on current urban background concentrations due to dispersed road transport sources to be taken from maps (see http://www.environment.detr.gov.uk/ airq/aqinfor.htm or http://open.gov.uk or Stedman, 1998) or suitable, locally sited monitoring site data;
3. planned developments of the above mentioned types in the locality;
4. details of large Part A authorised processes in neighbouring areas which could impact within the authority's area;
5. details of any surveys or investigations undertaken to obtain information to compile the report.

10.5 Information to be considered for the assessment of Lead in the Highlands

For all existing and proposed activities identified by the local authority in 10.4 above, the authority should then identify those existing or proposed processes or activities which have the potential, singly or together, to emit significant quantities of lead and

- are expected to be in existence and/or operation by the end of 2005 and
- for which there is a potential for exposure of individuals in relevant locations.

For the purposes of a First Stage review and assessment for lead these can be assumed to consist of:

(a) one or more Part A processes of the type indicated by the Government's guidance to be a potential significant source of lead
(b) Part B processes of the type indicated by the Government's guidance, or a number of such processes in close proximity, which collectively have the potential to emit significant quantities of lead
(c) industrial or other sites with non-prescribed processes with the potential to emit significant quantities of lead;
(d) planned developments of the above mentioned types in the locality.

10.6 Estimated background levels in the Highlands: Lead

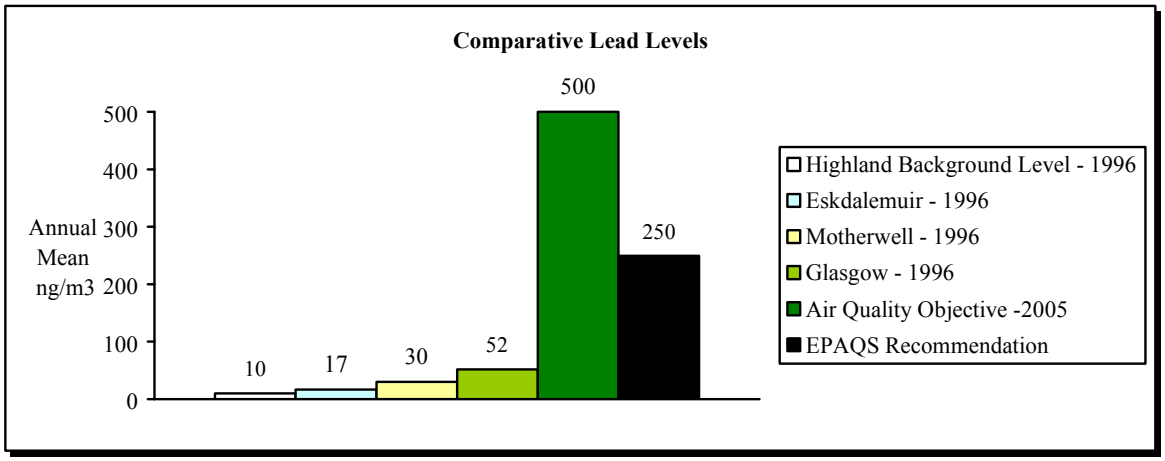
By reference to the national maps (Stedman, 1998), the estimated background concentration of lead throughout the Highlands in 1996 was less than 0.01 $\mu g/m^3$ (10 ng/m^3).

10.7 Lead monitoring in the UK

In 1996 in the UK, lead was monitored on behalf of the Department of Environment, Transport and the Regions at various sites. There are two monitoring sites in Scotland which are part of a multi-element monitoring network. These are at Glasgow and Motherwell. At a third site at Eskdalemuir, lead is monitored as part of the Lead in Petrol network. This network was established to monitor the effect of the reduction of the lead content of petrol and the introduction of unleaded petrol.

In Glasgow, between 1980 and 1996 the annual mean concentration of lead in the atmosphere fell from 460 ng/m^3 to 52 ng/m^3. In Motherwell over the same period, the annual mean concentration of lead in the atmosphere fell from 260 ng/m^3 to 30 ng/m^3. At Eskdalemuir, an annual concentration of 17 ng/m^3 was recorded in 1996. These levels can be compared with the Government's objective for lead which is that the annual average concentration should not exceed 0.5 $\mu g/m^3$ (500 ng/m^3) by 2005.

Figure 12 Comparative Lead levels – 1996



10.8 Part A and Part B processes: Lead

In its guidance, the Government has identified certain categories of processes which have the potential to release significant quantities of Lead into the atmosphere. It should be noted that not all processes included in the category necessarily release that substance. The processes which are listed below have been identified solely on the basis of their classification. No account has been taken of abatement technologies which may be in place to prevent or minimise emission

Figure 13 Part A Authorised Processes : Lead

Process Operator	Address	Highland Council Area	NGR
Petroleum process			
Talisman Energy (UK) Ltd	Nigg Oil Terminal	Ross And Cromarty	NH 7868 6876
Processing non-ferrous metals			
UKAEA	Dounreay Thurso	Caithness	NC 9925 6785
Primary manufacture of aluminium by electrolysis			
Alcan Smelting & Power UK	Alcan Disposal Site, Kinlochleven	Lochaber	NN 1815 6187
Alcan Smelting & Power UK	Lochaber Smelter	Lochaber	NN 1250 7535

Figure 14 Part B Authorised Processes : Lead

Process Operator	Address	Highland Council Area	NGR
Lead Glass Processes			
Caithness Glass Plc	Industrial Estate, Wick	Caithness	ND 36005210

10.9 Planned developments and neighbouring areas: Lead

There are no planned developments in Highland, or sources of lead in neighbouring areas which could impact significantly on the air quality in the Highland Council Area. It is not anticipated that the position will have changed by the year 2005.

10.10 Conclusions: Lead

As can be seen from Figure 12, the background level of Lead in the Highlands in 1996 was 98% below the Government's objective for the year 2005 and 96% below the Expert Panel on Air Quality Standards recommendation. It is not anticipated that any local point source would raise ambient levels above the Government's objective of 0.5 $\mu g/m^3$ or the Expert Panel on Air Quality Standards recommendation of 0.25$\mu g/m^3$. However, there are four authorised Part A processes and one Part B process in Highland which fall within the Government's classification of processes which have the potential to release significant quantities of Lead. It is unlikely that the aforementioned processes will cause problems with local air quality. However, as a priority, further information on likely environmental levels of lead arising from these processes will be sought from the Scottish Environment Protection Agency.

Every local authority is required to carry out a second review and assessment of air quality before 2005. By then, the "Guidance for Estimating the Air Quality Impact of Stationary Sources" from the Environment Agency will be available. It is recommended that the impact of the aforementioned processes should be reassessed at that time.

11 Nitrogen dioxide (NO_2)

11.1 Air Quality Standards and Objectives for Nitrogen dioxide

The Government has adopted a 1-hour average of 150 ppb as an air quality standard for nitrogen dioxide (NO_2), with an objective for the standard to be achieved as the hourly maximum by the end of 2005. The Government has also adopted an annual average of 21 ppb as an air quality standard with an objective to achieve this by the end of 2005. The focus of an authority's review and assessment for the annual average objective should be non-occupational, near ground level outdoor locations with elevated NO_2 concentrations in areas where a person might reasonably be expected to be exposed over a year (e.g. in the vicinity of housing, schools or hospitals etc.).

11.2 Sources and significance of Nitrogen dioxide in the atmosphere

Nitrogen oxides are formed during high temperature combustion processes from the oxidation of nitrogen in the air or fuel. The principal source of nitrogen oxides - nitric oxide (NO) and nitrogen dioxide (NO2), collectively known as NOx - is road traffic, which is responsible for approximately half the emissions in Europe. NO and NO2 concentrations are therefore greatest in urban areas where traffic is heaviest. Other important sources are power stations, heating plants and industrial processes.

Nitrogen dioxide (NO_2) and nitric oxide (NO) are both oxides of nitrogen and together they are referred to as NOx. All combustion processes produce some NOx, but only NO_2 is associated with adverse effects on human health. The main sources of NOx in the United Kingdom are road transport, which, in 1996 accounted for about 47% of the emissions of 2.1 million tonnes per year as NO_2, power generation 22% and domestic sources 4%. In urban areas, the proportion of local emissions due to road transport sources is larger.

Nitrogen dioxide has a variety of environmental and health impacts. It is a respiratory irritant, may exacerbate asthma and possibly increase susceptibility to infections. In the presence of sunlight, it reacts with hydrocarbons to produce photochemical pollutants such as ozone. In addition, nitrogen oxides have a lifetime of approximately 1 day with respect to conversion to nitric acid. This nitric acid is in turn removed from the atmosphere by direct deposition to the ground, or transfer to aqueous droplets (e.g. cloud or rainwater), thereby contributing to acid deposition.

11.3 Nitrogen dioxide levels: The UK Perspective

The results of the analysis set out in the National Air Quality Strategy suggest that for NO_2, a reduction in NOx emissions over and above that achieved by national measures will be required to ensure that air quality objectives are achieved everywhere by the end of 2005. Local elevated levels of NO_2 in relevant locations, are expected to identify a need to progress to the second or third stage review and assessment for this pollutant.

11.4 Information to be collated for the first stage review of Nitrogen dioxide

In compiling information for the first stage review and assessment, the local authority is required to collate the following:-

1. details of Part A and Part B authorised processes present within its area (see Annexes 1 to 4);
2. information on current and 2005 forecast annual average daily traffic flows for any existing or proposed roads in the authority's area with existing or predicted traffic flows, which at the end of 2005, could generate significant quantities of NO_2;
3. information on current urban background concentrations due to dispersed road transport sources to be taken from local diffusion tube measurements or automatic measurements at background sites or from national maps (see http://www.environment.detr.gov.uk/airq/ aqinfo.htm or see Stedman, 1998)
4. planned developments of the above mentioned types in the locality, including those which will increase traffic flow;

5. details of any significant source of NO_x in neighbouring areas which can impact significantly within the authority's area;
6. details of any surveys or investigations undertaken to obtain information to compile the report.

11.5 Information to be considered for the assessment of Nitrogen dioxide in the Highlands

For all existing and proposed activities by the local authority in 11.4 above, the authority should then identify those existing or proposed processes or activities which have the potential, singly or together, to emit significant quantities of NOx and

- are expected to be in existence and/or operation by the end of 2005 and
- for which there is potential for exposure of individuals in relevant locations.

For the purposes of a First Stage review and assessment these can be assumed to consist of:

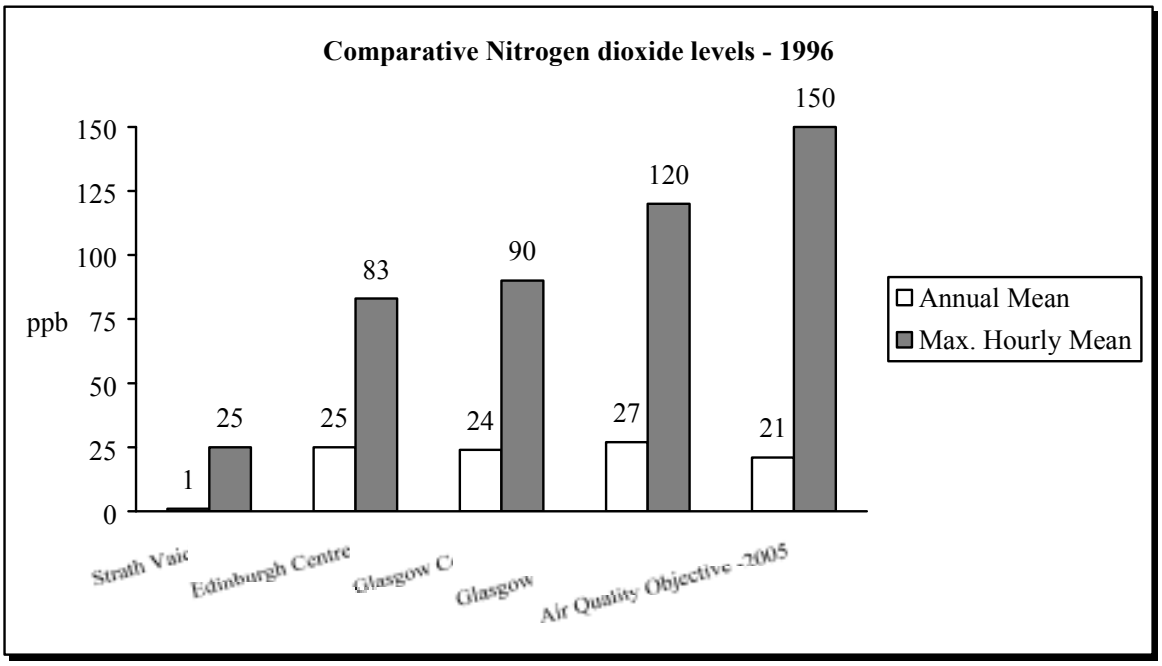
(a) one or more existing or planned roads with a projected annual average daily traffic flow of greater than 20,000 in 2005;
(b) an annual mean urban background NO2 concentration in 1996 of greater than 30 ppb
(c) one or more Part A or Part B processes of the type indicated by the Government's guidance to be a potential significant source of NO2
(d) ***an indication of existing sources acting in combination to exceed a current annual mean concentration of 30 ppb (for example as measured by diffusion tubes or automatic measurement methods).***

11.6 Nitrogen dioxide monitoring in the UK

In the UK, Nitrogen dioxide is monitored on behalf of the Department of Environment, Transport and the Regions at 53 sites. In 1996, there were four automatic monitoring sites in Scotland. Two of these were in Glasgow, one in Edinburgh and the fourth was in Strath Vaich in the Highland Council Area.

The annual mean and maximum hourly values of Nitrogen dioxide at the above sites are show in Figure 15 below These levels can be compared with the Government's objective for Nitrogen dioxide, as shown in the right hand column of Figure 15, which is that the level of NO_2 , when expressed as an annual mean should be less than 21ppb and the maximum hourly mean should be less than 150ppb by 2005.

Figure 15 Comparative Nitrogen dioxide levels - 1996

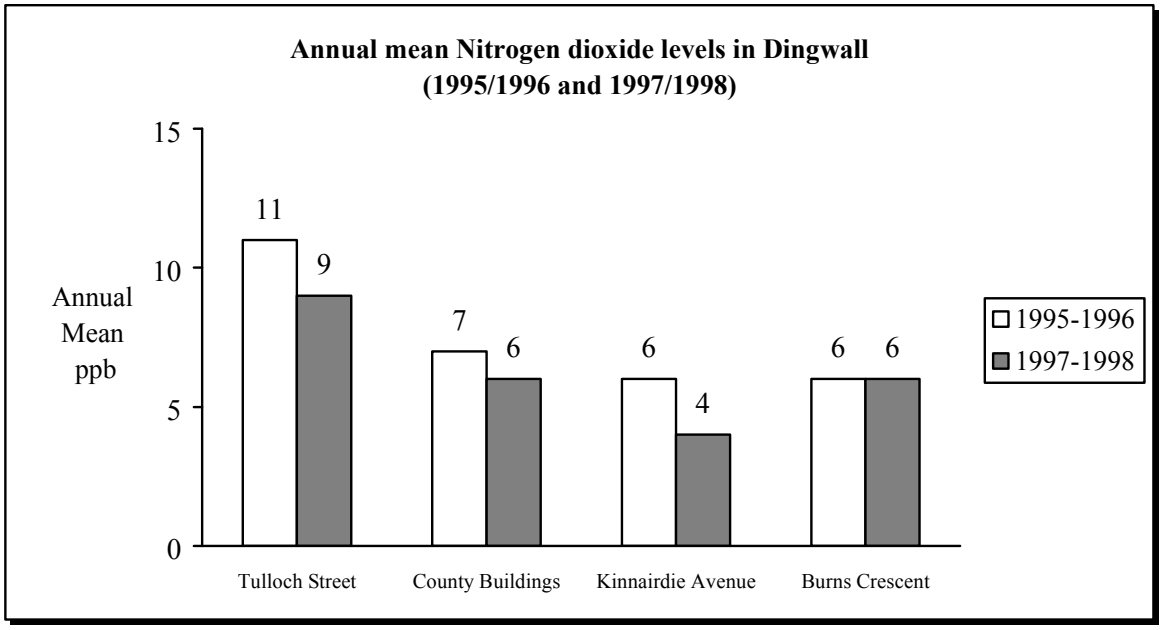


11.7 NO_2 Monitoring by passive diffusion tubes in the Highlands

Nitrogen dioxide levels were monitored by the passive diffusion tube method in nine Highland towns during 1997/1998. The results of the monitoring for that period and for previous years are shown in Annex 5 Results of Nitrogen dioxide monitoring in the Highlands.

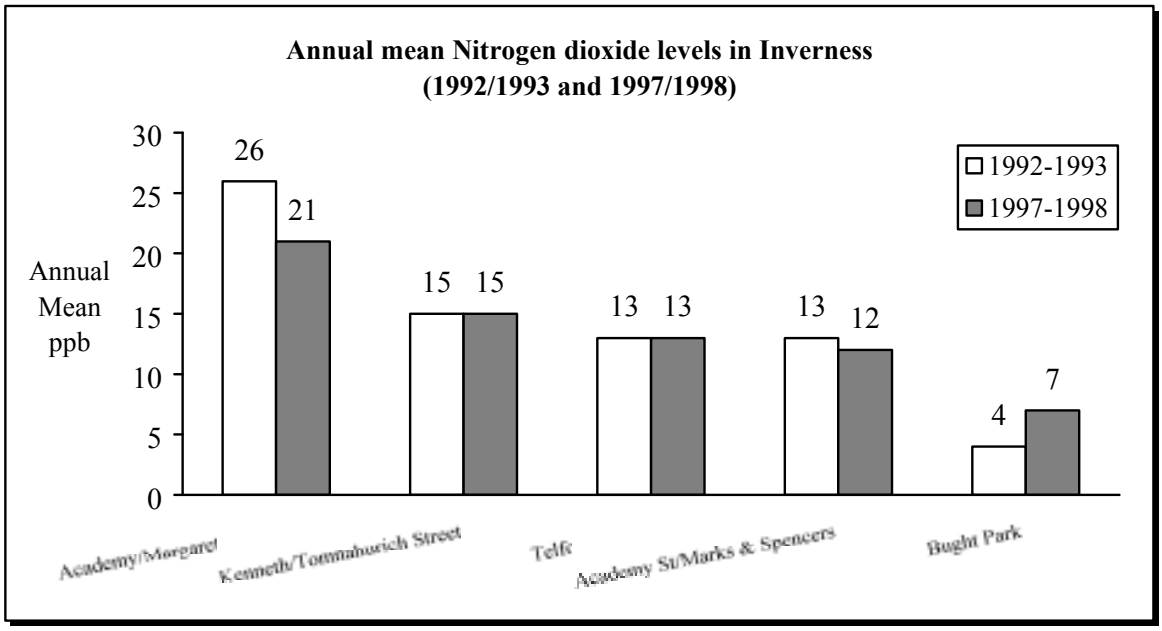
In previous years monitoring has been undertaken in Dingwall and Inverness. The four sites in Dingwall are part of the ongoing UK NO_2 Survey. The results of monitoring at the four sites in Dingwall in 1995/1996 and 1997/1998 are shown in Figure 16 below.

Figure 16 Annual mean Nitrogen dioxide levels in Dingwall



In Inverness, a survey was undertaken in 1992/1993. The annual mean levels for that period are compared to the results which were obtained in 1997/1998 in Figure 17 below.

Figure 17 Annual mean Nitrogen dioxide levels in Inverness



11.8 Nitrogen dioxide trends in the Highlands

We can see from Figure 16 and Figure 17 above that the general trend is for Nitrogen dioxide concentrations to fall over time. This is consistent with Government predictions. From 1 January 1993, new petrol driven cars were fitted with catalytic converters. Cars with catalytic converters emit less oxides of nitrogen. Nitrogen dioxide levels will tend to fall as more pre-1993 cars are replaced with models with catalytic converters. However, in some areas these benefits will be offset by increased annual traffic flows. A slight rise in Nitrogen dioxide level is evident at Bught Park, Inverness. This is likely to be linked with the increase in car journeys to the Aquadome leisure facility which opened in 1997. The highest concentration of 26ppb was recorded at the junction of Academy Street and Margaret Street, Inverness in 1992-1993. The level at that location fell to 21ppb in 1997-1998.

It can be inferred from Figure 16 and Figure 17 and the results in Annex 5 that between 1992 and 1997, existing sources of NO_2 acting in combination, did not exceed an annual mean concentration of 30 ppb. The 30ppb level referred to in paragraph 11.5(d) above is one of the Government's indicators which if exceeded, would prompt the local authority to undertake a second stage review and assessment.

11.9 Estimated background levels in the Highlands: Nitrogen dioxide

In Annex 5 most of the monitoring locations are at "kerbside" locations. These were chosen to measure the higher levels of NO_2 to which people could be exposed. As we move away from roads, the levels of NO_2 fall until there is a residual "background" level.

Background levels have been estimated for the whole of the UK and these are published in the national maps. By reference to the national maps (Stedman, 1998), the estimated background concentration of NO_2 in the Highlands in 1996 was estimated not to exceed 5ppb. This is significantly less than the urban background level of 30ppb referred to in 11.5(c) above. The 30ppb level for urban background levels is one of the Government's indicators which if exceeded, would prompt the local authority to undertake a second stage review and assessment.

11.10 Annual mean daily traffic flows in excess of 20,000 vehicles

The most significant source of Nitrogen dioxide is road traffic. As can be seen from Figure 5 Forecasts for annual average daily traffic flows in Inverness, 1998 and 2005", there are a number of road links which currently exceed an annual average daily traffic flow of 20,000 or are likely to do so by the year 2005. This means that the Highland Council is required to proceed to a second stage review and assessment.

A second stage review would involve the estimation of Nitrogen dioxide levels attributable to road traffic by the methodology in the updated version of The Design Manual for Roads and Bridges which, the publication of which is imminent. The methodology takes account of traffic composition, flow rates, average traffic speeds and the distance of the receptor point from the road. Detailed information on these variables will be required for a realistic assessment to be made.

It is interesting to note that although traffic flows in Telford Street are approximately 40% higher than in Academy Street, the levels of Nitrogen dioxide as measured by passive diffusion tubes are much lower in Telford Street than at the Academy Street/ Margaret Street junction. NO_2 levels in Telford Street with estimated traffic flows in 1998 of around 20,000 have remained at 13ppb whereas in Academy Street with estimated traffic flows in 1998 of around 15,000, levels of 21ppb have been recorded. It is suggested that street layouts have an effect on Nitrogen dioxide levels. Telford Street has fewer continuous lines of multi-storeyed buildings next to the roadside than does Academy Street. Thus traffic fumes are likely to disperse more readily in Telford Street than in Academy Street.

11.11 Part A and Part B processes: Nitrogen dioxide

In its guidance, the Government has identified certain categories of processes which have the potential to release significant quantities of Nitrogen dioxide into the atmosphere. It should be noted that not all processes included in the Category necessarily release that substance. The processes which are listed below have been identified solely on the basis of their classification. No account has been taken of abatement technologies which may be in place to prevent or minimise emission.

Figure 18 Part A Authorised Processes: Nitrogen dioxide

Process Operator	Address	Highland Council Area	NGR
Carbonisation			
SGL Technic Limited	Muir of Ord Industrial Estate	Ross And Cromarty	NH 5310 4890
Petroleum process			
Talisman Energy (UK) Ltd	Nigg Oil Terminal	Ross And Cromarty	NH 7868 6876
Processing non-ferrous metals			
UKAEA	UKAEA Dounreay Thurso	Caithness	NC 9925 6785
Primary manufacture of aluminium by electrolysis			
Alcan Smelting & Power UK	Alcan Disposal Site Kinlochleven	Lochaber	NN 1815 6187
Alcan Smelting & Power UK	Lochaber Smelter	Lochaber	NN 1250 7535
Paper and pulp manufacturing			
Arjo Wiggins Carbonless Papers Ltd.	Annat Point Fort William Mill	Lochaber	NN 0845 7675

11.12 Part B Authorised Processes: Nitrogen dioxide

There are no Part B processes in the Highlands which the Government has classified as having the potential to release significant quantities of Nitrogen dioxide.

11.13 Planned developments and neighbouring areas: Nitrogen dioxide

There are no planned developments in Highland, or sources of Nitrogen dioxide in neighbouring areas which could impact significantly on the air quality in the Highland Council Area. It is not anticipated that the position will have changed by the year 2005.

11.14 Conclusions: Nitrogen dioxide

The predicted traffic flows in Figure 5 Forecasts for annual average daily traffic flows in Inverness, 1998 and 2005", indicate that there are several road links which are likely to have traffic flows in excess of 20,000 before the year 2005. Thus, on that basis, the Highland Council will require to carry out a second stage review and assessment before the end of 1999. This will entail a more detailed prediction of the annual mean and 1 hour maximum concentrations at relevant locations. The methodology is likely to include that described in The Design Manual for Roads and Bridges.

Six authorised Part A processes in Highland fall within the Government's classification of processes which have the potential to release significant quantities of Nitrogen dioxide. It is unlikely that the aforementioned processes will cause problems with local air quality. However, as a priority, further information on likely environmental levels of Nitrogen dioxide arising from these processes will be sought from the Scottish Environment Protection Agency. It is recommended that the impact of the aforementioned processes should be reassessed when the second stage review and assessment is undertaken.

12 PM_{10}

12.1 Air Quality Standards and Objectives for PM_{10}

The Government has adopted a running 24-hour average of 50 $\mu g/m^3$ as an air quality standard for PM_{10} with the objective for the standard to be achieved as the annual 99th percentile of daily maximum running 24-hour averages (that is no more than four days exceeding the standard in a year), by the end of 2005.

In the Air Quality Regulations 1997, PM_{10} is defined as the mass fraction of particles which if inhaled would penetrate beyond the larynx, as defined in ISO standard 7708. When undertaking review and assessment of particles, for practical purposes, the working definition of PM_{10} should be taken as that defined in the United States Code of Federal Regulations [40CFR50], this being the best available approximation to the ISO thoracic fraction that can be sampled with currently-available PM_{10} monitoring equipment.

The focus of an authority's review and assessment for PM_{10} should be non-occupational, near ground level outdoor locations with elevated PM_{10} concentrations in areas where a person might reasonably be expected to be exposed over a 24 hour period (e.g. in the vicinity of housing, schools or hospitals etc.).

12.2 Sources and Significance of PM_{10} in the atmosphere

The principal source of airborne PM_{10} matter in European cities is road traffic emissions, particularly from diesel vehicles. As well as creating dirt, odour and visibility problems, PM_{10} particles are associated with health effects including increased risk of heart and lung disease. In addition, they may carry surface-absorbed carcinogenic compounds into the lungs.

National UK emissions of primary PM_{10} have been estimated as totalling 213,000 tonnes in 1996. Of this total, around 24% was derived from road transport sources, 38% from industrial sources, 16% from power stations and 17% from domestic and other low-power combustion. It should be noted that, in general, the emissions estimates for PM_{10} are less accurate than those for the other pollutants with prescribed objectives, especially for sources other than road transport.

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

The quantification of sources of PM_{10} in the UK is still the subject of research.

12.3 PM_{10} levels: The UK Perspective

The majority of national monitoring network sites are in cities where road transport and domestic combustion are the main sources in the immediate vicinity. PM_{10} data from the national monitoring networks show that the PM_{10} standard is currently exceeded at all sites and it is likely that this will be the most difficult of the air quality objectives to achieve for most authorities. Results from the "First Phase" studies undertaken by a small number of local authorities show the potential for significant impacts from certain forms of industrial activity, for example quarries.

12.4 Information to be collated for the first stage review of PM_{10}

The Government has established the Airborne Particles Expert Group (APEG) to advise on sources of PM_{10} in the UK and current and future ambient concentrations. Their conclusions are expected by the end of 1998. Further advice to local authorities on review and assessment of particles will be formulated in the light of the APEG conclusions. However, an interim approach to first stage review and assessment is provided here.

In compiling information for the first stage review and assessment, the local authority is required to collate the following:-

1. details of Part A and Part B authorised processes present within its area (see Annexes 1 to 4);
2. information on current and 2005 forecast annual average traffic for any existing or proposed roads in the authority's area with existing or predicted traffic flows which, at the end of 2005, could generate significant quantities of PM_{10};
3. information on approximate emissions densities from road transport and other low-level dispersed sources (e.g. domestic coal burning) of PM_{10};
   information on current annual average urban background concentrations from suitable local measurements or from national maps (see http://www.environment.detr.gov.uk/airq/aqinfor or Stedman, 1998).
4. information on current average secondary particulate background concentrations from locally sited sulphate measurements or from the national maps
5. (see http://www.environment.detr.gov.uk/airq/aqinfor)
6. planned developments of the above mentioned types in the locality, including those which will increase traffic flow;
7. details of any significant sources of PM_{10} in neighbouring areas which could impact significantly within the authority's area;
8. details of any surveys or investigations undertaken to obtain information to compile the report.

12.5 Information to be considered for the assessment of PM_{10} in the Highlands

For all existing and proposed activities identified by local authority in 12.4 above, the authority should then identify those existing or proposed processes or activities which have the potential, singly or together, to emit significant quantities of PM_{10} and

- are expected to be in existence and/or operation by the end of 2005 and;
- for which there is potential for exposure of individuals in relevant locations.

For the purposes of a First Stage review and assessment for PM_{10} these can be assumed to consist of:

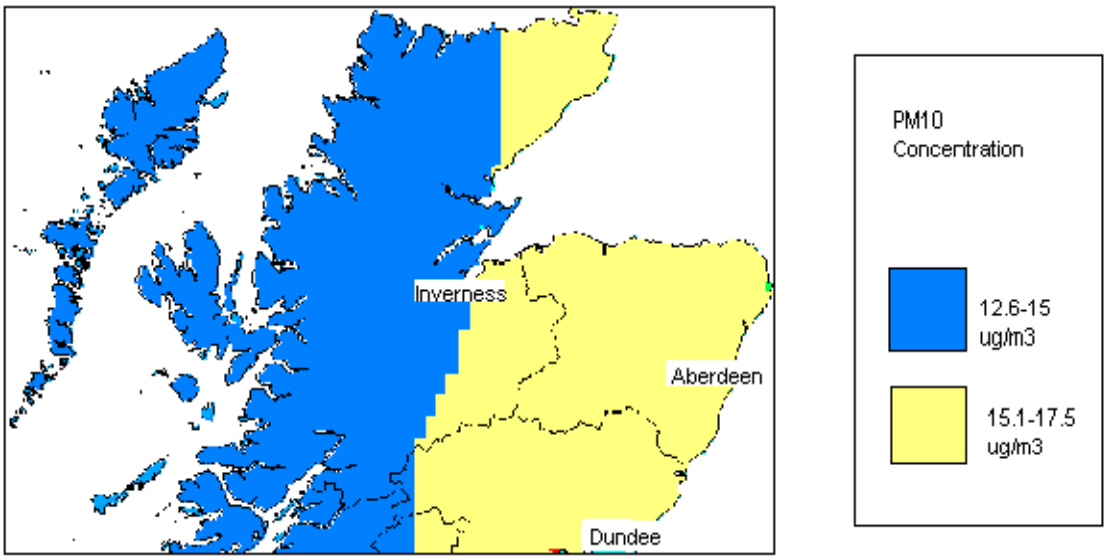
(a) urban areas for which the annual average regional background due to secondary particles is currently greater than $8\mu gm^{-3}$ (see http: //www.environment.detr.gov.uk/airq/aqinfor);
(b) emissions from low-level dispersed sources (including road traffic) greater than 10 tonnes in any single 1 km x 1km grid square or an average of 5 tonnes in several adjacent squares;
(c) one or more existing or planned roads with a projected annual average daily traffic flow of greater than 25,000
(d) one or more Part A or Part B processes of the type indicated by the Government's guidance to be a potential significant source of PM_{10}
(e) any industrial process that emits significant quantities of dust in the form of PM10 from uncontrolled or fugitive sources within the plant.

12.6 Estimated background levels in the Highlands: PM_{10}

PM_{10} particles

By reference to the national maps (Stedman, 1998), the estimated PM_{10} background levels in Highlands in 1996 were between 12.6 and 15 µg/m³, rising to between 15.1 and 17.5 µg/m³ in areas east of Inverness including the eastern parts of Caithness and Sutherland, Easter Ross and Nairn and the east part of Badenoch and Strathspey. Part of the national map is shown below in Figure 19

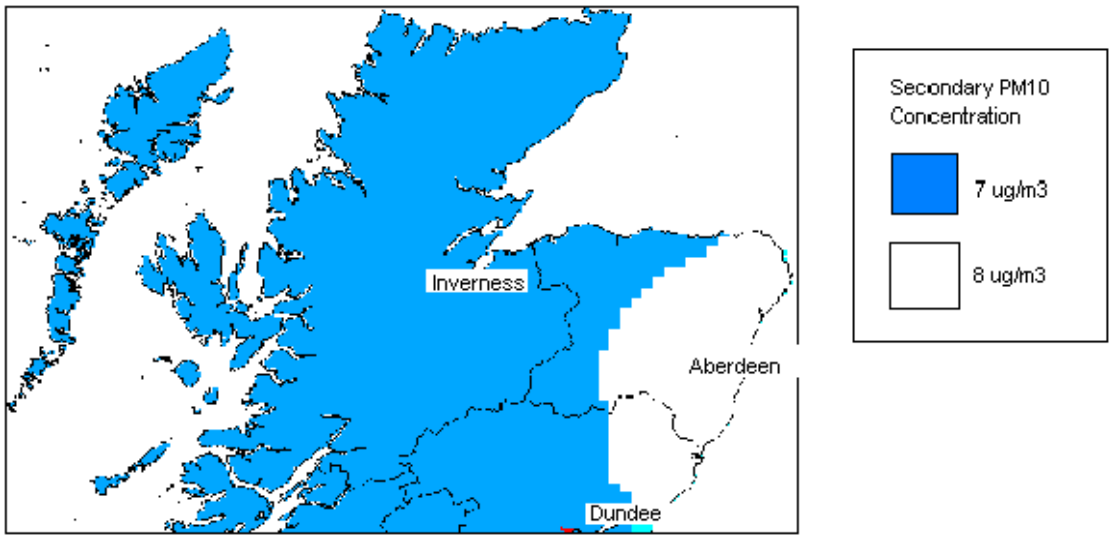
Figure 19 Estimated PM_{10} concentrations from the National Maps



Secondary PM_{10} particles

By reference to the national maps (Stedman, 1998), the estimated background concentration of secondary PM_{10} particles throughout the Highlands in 1996 was less than 7 µg/m³. An extract of the national map is shown in Figure 20 below. This is below the level of 8 µg/m³ for secondary particles which the Government has indicated would be of significance in urban areas and would require the local authority to proceed to a second stage review.

Figure 20 Estimated secondary PM_{10} concentrations from the National Maps

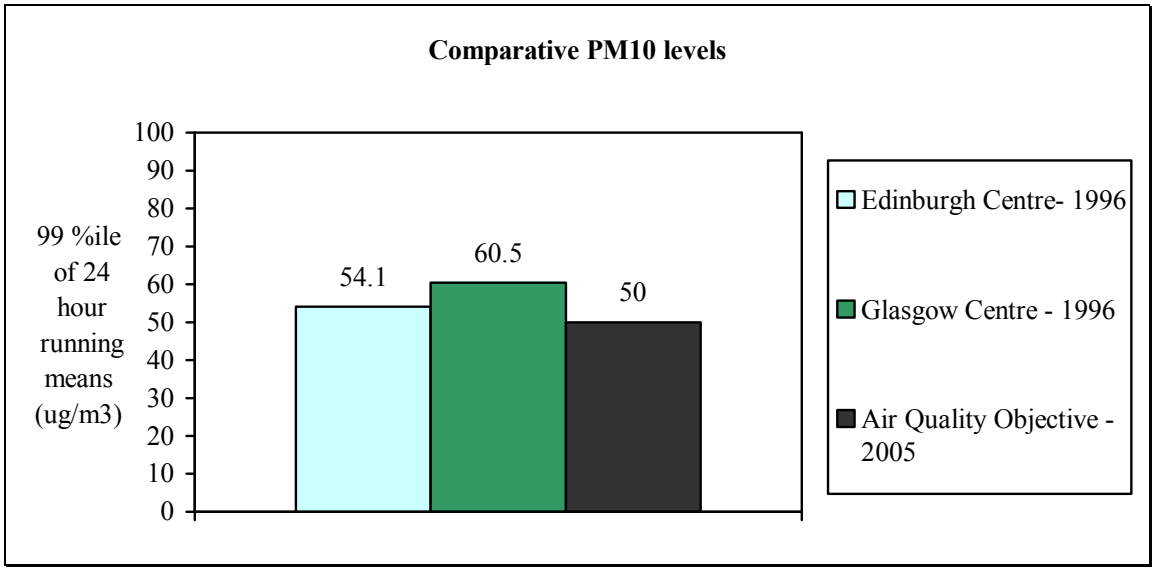


12.7 PM_{10} Monitoring in the UK

In 1996 in the UK, PM_{10} was monitored on behalf of the Department of Environment, Transport and the Regions at 33 sites. There were two monitoring sites in Scotland at Edinburgh and Glasgow. A third kerbside site commenced in March, 1997 in Glasgow.

In 1996, the 99%ile of 24 hour running means at Edinburgh was 54.1 $\mu g/m^3$ and at Glasgow, 60.5 $\mu g/m^3$. These levels can be compared with the Government's objective for PM_{10} which is that the level of PM_{10}, when expressed as the 99%ile of 24 hour running means should be less than 50 μgm^3 by 2005.

Figure 21 Comparative PM_{10} levels



12.8 Estimated emissions of PM_{10} from low level dispersed sources in the Highlands taken from the UK Emissions Inventory

Information on approximate emissions densities from low-level dispersed sources of PM_{10} is available from the Department of Environment, Transport and the Regions world wide web site at http://www.aeat.co.uk/netcen/airqual/. The UK Emissions Inventory at the web site shows that emissions from low-level dispersed sources in the Highlands range from less than 0.001 tonnes/km^2 to more than 0.5 tonnes/km^2.

In rural areas, emissions from domestic sources are less than 0.001 tonnes/km^2. In settlements, the emissions of PM_{10} range from 0.03 to 0.499 tonnes/km^2. Only in the centres of towns with higher populations do the levels exceed 0.499 tonnes/km^2. These estimated emission densities are well below the trigger value which would require the Highland Council to proceed to a second stage review. No single 1km x 1km grid square in the highland Council area has a PM_{10} emission level in excess of 10 tonnes. Neither do any adjacent squares on average exceed 5 tonnes.

12.9 Annual mean daily traffic flows in excess of 25,000 vehicles

The predicted traffic flows in Figure 5 Forecasts for annual average daily traffic flows in Inverness, 1998 and 2005", indicate that there are several road links which are likely to have traffic flows in excess of 25,000 before the year 2005. Thus, on that basis, the Highland Council will require to carry out a second stage review and assessment of PM_{10}.

12.10 Part A and Part B processes: PM_{10}

In its guidance, the Government has identified certain categories of processes which have the potential to release significant quantities of PM_{10} into the atmosphere. It should be noted that not all processes included in the Category necessarily release that substance. The processes which are listed below have been identified solely on the basis of their classification. No account has been taken of abatement technologies which may be in place to prevent or minimise emission.

Figure 22 Part A Authorised Processes: PM_{10}

Process Operator	Address	Highland Council Area	NGR
Carbonisation			
SGL Technic Limited	Muir of Ord Industrial Estate	Ross And Cromarty	NH 5310 4890
Petroleum process			
Talisman Energy (UK) Ltd	Nigg Oil Terminal	Ross And Cromarty	NH 7868 6876
Processing non-ferrous metals			
UKAEA	UKAEA Dounreay Thurso	Caithness	NC 9925 6785
Primary manufacture of aluminium by electrolysis			
Alcan Smelting & Power UK	Alcan Disposal Site Kinlochleven	Lochaber	NN 1815 6187
Alcan Smelting & Power UK	Lochaber Smelter	Lochaber	NN 1250 7535
Paper and pulp manufacturing			
Arjo Wiggins Carbonless Papers Ltd.	Annat Point Fort William Mill	Lochaber	NN 0845 7675

Figure 23 Part B Authorised Processes: PM_{10}

Process Operator	Address	Highland Council Area	NGR
Prescribed Coal Processes			
British Fuels Ltd	BFL, The Harbour Office, Longman Quay	Inverness	NH 66204680
Bruce Lindsey Coal Ltd.	Unit 21, Cromarty Firth Industrial Park, Invergordon	Ross and Cromarty	NH 53204930
John Macdonald and Son (Coal Merchant)	Station Yard, Old Allangrange, Tore	Ross and Cromarty	NH 60705220
Quarries			
John Gunn and Sons Ltd	Skitten Quarry, Wick	Caithness	ND 32105730
A and G Calder	Stonehone Quarry, Watten	Caithness	ND 24305790
A and D Sutherland	Spittal Quarry, Watten	Caithness	ND 16905430
Highland Lime Company	Dornie Quarry, Torlundy, Fort William	Lochaber	NN 17957775
Tilcon (Scotland) Ltd.	Banavie Quarry, Fort William	Lochaber	NN 11407740
Yeoman (Morvern) Ltd.	Glensanda Quarry, Fort William	Lochaber	NM 82254675
Leiths Scotland Ltd.	Torrin Quarry, Torrin, Isle Of Skye	Skye and Lochalsh	NG 58902010
Thistle Aggregates-Ullapool Quarry	Morefield Quarry, Morefield, Ullapool	Ross and Cromarty	NH 13509530
Invershin Quarry	Balblair, By Lairg	Sutherland	NH 58409460
John Fyfe Ltd.	Ardchronie Quarry, Ardgay	Sutherland	NH 61708860
Quarry with Roadstone Coating plant			
John Gunn and Sons Ltd.	Bower Quarry, Bower	Caithness	ND 20205870
Caledonian Quarry Products Ltd.	Daviot Quarry, Inverness	Inverness	NH 72103910
Tarmac Quarry Products Ltd.	Daviot Quarry, Inverness	Inverness	NH 72103910
Leiths Scotland Ltd.	Achilty Quarry, Achilty	Ross and Cromarty	NH 44855635
John Fyfe Ltd., Clach Na Broig Quarry	Poolewe Road, Gairloch	Ross and Cromarty	NG 81507750
Highland Council	Sconser Quarry, Sconser, Isle Of Skye	Skye and Lochalsh	NG 55003200
Pat Munro (Alness) Ltd.	Caplich Quarry, Alness	Ross and Cromarty	NH 66116989

12.11 Planned developments and neighbouring areas: PM_{10}

There are no planned developments in Highland, or sources of PM_{10} in neighbouring areas which could impact significantly on the air quality in the Highland Council Area. It is not anticipated that the position will have changed by the year 2005.

12.12 Conclusions:PM_{10}

Five authorised Part A and nineteen Part B processes in Highland fall within the Government's classification of processes which have the potential to release significant quantities of PM_{10}. It is unlikely that the aforementioned processes will cause problems with local air quality. However, as a priority, further information on likely environmental levels of PM_{10} arising from these processes will be sought from the Scottish Environment Protection Agency.

Every local authority is required to carry out a second review and assessment of air quality before 2005. By then, the "Guidance for Estimating the Air Quality Impact of Stationary Sources" from the Environment Agency will be available. It is recommended that the impact of the aforementioned processes should be reassessed when the second stage review and assessment is being undertaken.

The predicted traffic flows in Figure 5 Forecasts for annual average daily traffic flows in Inverness, 1998 and 2005", indicate that there are several road links which are likely to have traffic flows in excess of 25,000 before the year 2005. **Thus, on that basis, the Highland Council will require to carry out a second stage review and assessment for PM_{10}.**

13 Sulphur dioxide (SO_2)

13.1 Air Quality Standards and Objectives for Sulphur dioxide

The Government has adopted a 15-minute average of 100 ppb as an air quality standard for sulphur dioxide (SO_2), with an objective for the standard to be achieved as the 99.9^{th} percentile (that is on all but 35 periods of 15 minutes per year), by the end of 2005. The focus of an authority's review and assessment should be on any non-occupational, near ground level outdoor location given that exposures over 15 minutes are potentially likely in these locations.

13.2 Sources and significance of Sulphur dioxide in the atmosphere

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

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

The total UK emission in 1996 was 2.0 million tonnes. The main sources were: power generation (65%), other industry (24%), commercial and domestic heating (6%) and road transport (2%).

13.3 Sulphur dioxide levels: The UK Perspective

Sulphur dioxide is emitted in the combustion of coal and oil. The total UK emission in 1996 was 2.0 million tonnes. The main sources were: power generation (65%), other industry (24%), commercial and domestic heating (6%) and road transport (2%).

Exceedances of the air quality standard currently occur in the vicinity of industrial processes for which the stack heights were designed to meet previous air quality standards and in areas where significant quantities of coal are used for space heating. Sulphur dioxide concentrations are elevated at the kerbside but not sufficiently to exceed the air quality standard in the absence of other sources.

13.4 Information to be collated for the first stage review of Sulphur dioxide

In compiling information for the first stage review and assessment, the Local authority is required to collate the following:-

1. details of Part A and Part B authorised processes present within its area (see Annexes 1 to 4);
2. information on approximate emissions densities from domestic combustion and other low-level dispersed sources of SO_2
3. information on current urban background concentrations from locally sited measurements or from national maps (see http://www.environment.detr.gov.uk/airq/aqinfor or Stedman, 1998).
4. information on existence of combustion systems with thermal power rating greater than 5 MW using fuels containing significant quantities of sulphur (i.e. solid fuels or fuel oil)
5. planned developments of the above mentioned types in the locality, including those which will increase traffic flow;
6. details of significant sources of SO_2 in neighbouring areas which could impact significantly within the authority's area;
7. details of any surveys or investigations undertaken to obtain information to compile the report.

13.5 Information to be considered for the assessment of Sulphur dioxide in the Highlands

For all existing and proposed activities identified by the local authority in 13.4 above, the authority should then identify those existing or proposed processes or activities which have the potential, singly or together, to emit significant quantities of SO_2.

- and are expected to be in existence and/or operation by the end of 2005 and;
- for which there is potential for exposure of individuals in relevant locations.

For purposes of a First Stage review these can be assumed to consist of:

(a) one or more Part A or Part B processes of the type indicated by the Government's guidance to be a potential significant source of SO_2
(b) A solid fuel or fuel oil combustion system with thermal power greater than 5MW;
(c) A 1 km x 1 km grid square in the authority's area for which low-level (i.e. domestic combustion and other short stack) annual emissions are greater than 25kg per hour or 40 tonnes per year. Where domestic emissions are the main sources of concern, this can be assumed to approximate to 300 houses burning coal in a 1km x 1km grid square.

13.6 Domestic SO_2 emissions in the Highlands taken from the UK Emissions Inventory

Information on approximate emissions densities from domestic combustion and other low-level dispersed sources of SO_2 is available from the Department of Environment, Transport and the Regions world wide web site at http://www.aeat.co.uk/netcen/airqual/. The UK Emissions Inventory at the web site shows that emissions from domestic sources in the Highlands range from less than 0.1 tonnes/km^2 to not more than 2 tonnes/km^2.

In rural areas, emissions from domestic sources are less than 0.1 tonnes/km^2. In the more populated towns, the emissions of SO_2 range from 0.1 to 2 tonnes/km^2. These estimated emissions are significantly less than the trigger value of 40 tonnes/ km^2/year which would require the Highland Council to proceed to a second stage review.

13.7 Estimated background levels in the Highlands: Sulphur dioxide

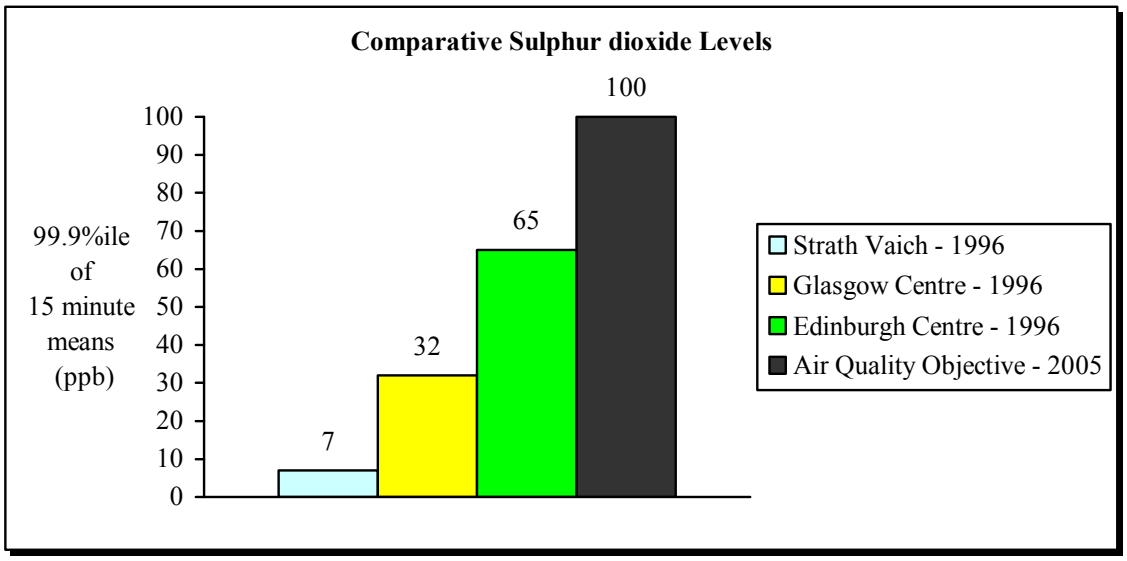
By reference to the national maps (Stedman, 1998), the estimated background concentrations of Sulphur dioxide throughout the Highlands in 1996 did not exceed 2ppb.

13.8 Sulphur Dioxide Monitoring in the UK

In the UK sulphur dioxide is monitored on behalf of the Department of Environment, Transport and the Regions at 42 sites. In Scotland there are monitoring locations at Edinburgh and Glasgow and in 1996, the Strath Vaich site in Highland was part of the Sulphur dioxide automatic monitoring network. The measurement method was UV Fluorescence. Strath Vaich lies to the north of the A835 between Dingwall and Ullapool and is classed as a "remote" site.

In 1996, the recorded Sulphur dioxide level at Strath Vaich was 7ppb, (as the 99.9th percentile of 15 minute means). The Governments objective for the same parameter is that the level should not exceed 100ppb by the year 2005.

Figure 24 Comparative Sulphur dioxide levels



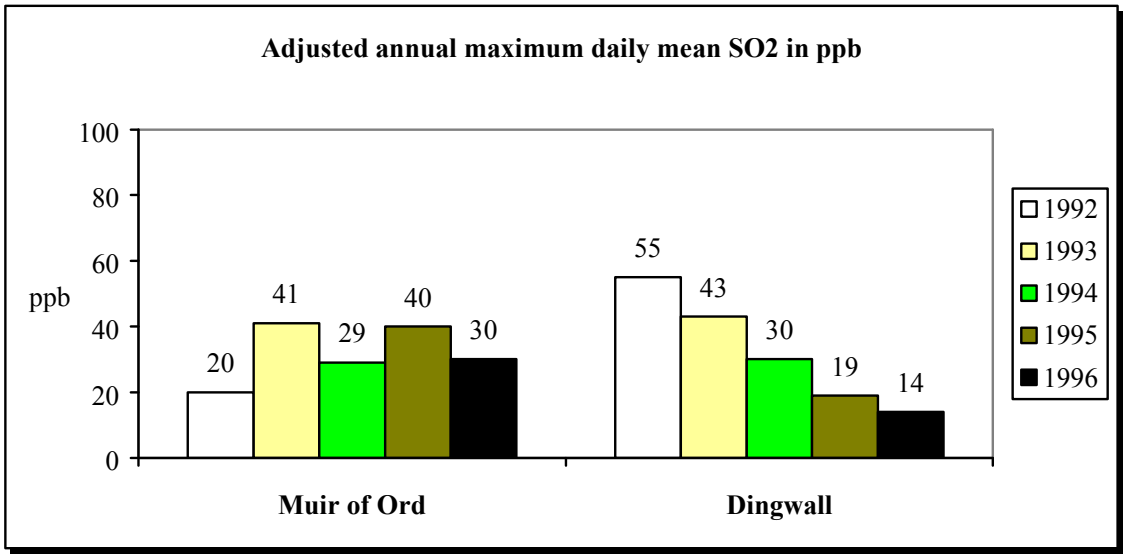
13.9 Sulphur Dioxide Monitoring in the Highlands

Prior to local government reorganisation, Ross and Cromarty District Council had undertaken smoke and Sulphur dioxide measurements at Ross House, High Street, Dingwall and the Church of Scotland hall, Seaforth Road, Muir of Ord. Sulphur dioxide was measured by the semi-automatic Warren Springs Laboratory bubbler method.

The results which can be obtained by the bubbler method are a measurement of the daily mean SO_2 concentration. As such, these levels cannot be compared directly to the 99.9th percentile of 15 minute means. However, the Government's guidance is that if the annual maximum daily mean is less than 48ppb, the air quality objective is not likely to be exceeded. As there is a general tendency for the bubblers to under read at high concentrations, the guidance is that the measured levels should be multiplied by 1.25.

The adjusted values for the annual maximum daily means are shown in Figure 25 below.

Figure 25 Adjusted annual maximum daily mean SO_2 in ppb



As can be seen from Figure 25 above, the SO_2 levels in Dingwall have fallen more than in Muir of Ord between 1992 and 1996. This can be attributed to the introduction of a mains gas supply in Dingwall in 1992 and the consequent replacement of domestic solid fuel heating systems.

Apart from the level of 55ppb in Dingwall in 1992 , the annual maximum daily means have been less than the guideline of 48ppb and hence the air quality objective is not likely to be exceeded.

13.10 Part A and Part B processes: Sulphur dioxide

In its guidance, the Government has identified certain categories of processes which have the potential to release significant quantities of Sulphur dioxide into the atmosphere. It should be noted that not all processes included in the Category necessarily release that substance. The processes which are listed below have been identified solely on the basis of their classification. No account has been taken of abatement technologies which may be in place to prevent or minimise emission.

Figure 26 Part A Authorised Processes : Sulphur dioxide

Process Operator	Address	Highland Council Area	NGR
Carbonisation			
SGL Technic Limited	Muir of Ord Industrial Estate	Ross And Cromarty	NH 5310 4890
Petroleum process			
Talisman Energy (UK) Ltd	Nigg Oil Terminal	Ross And Cromarty	NH 7868 6876
Processing non-ferrous metals			
UKAEA	UKAEA Dounreay Thurso	Caithness	NC 9925 6785
Primary manufacture of aluminium by electrolysis			
Alcan Smelting & Power UK	Alcan Disposal Site Kinlochleven	Lochaber	NN 1815 6187
Alcan Smelting & Power UK	Lochaber Smelter	Lochaber	NN 1250 7535
Paper and pulp manufacturing			
Arjo Wiggins Carbonless Papers Ltd.	Annat Point Fort William Mill	Lochaber	NN 0845 7675

Figure 27 Part B Authorised Processes : Sulphur dioxide

Process Operator	Address	Highland Council Area	NGR
Lead Glass Processes			
Caithness Glass Plc	Industrial Estate, Wick	Caithness	ND 36005210
Roadstone coating			
John Gunn and Sons Ltd.	Bower Quarry, Bower	Caithness	ND 20205870
Caledonian Quarry Products Ltd.	Daviot Quarry, Inverness	Inverness	NH 72103910
Tarmac Quarry Products Ltd.	Daviot Quarry, Inverness	Inverness	NH 72103910
Leiths Scotland Ltd.	Achilty Quarry, Achilty	Ross and Cromarty	NH 44855635
John Fyfe Ltd., Clach Na Broig Quarry	Poolewe Road, Gairloch	Ross and Cromarty	NG 81507750
Highland Council	Sconser Quarry, Sconser, Isle Of Skye	Skye and Lochalsh	NG 55003200
Pat Munro (Alness) Ltd.	Caplich Quarry, Alness	Ross and Cromarty	NH 66116989

13.11 Fuel oil combustion systems with thermal power greater than 5MW

In identifying premises with solid fuel and oil combustion systems with thermal power greater than 5 MW various classes of premises were contacted. Highland Council does not operate any combustion plant within the category. However a number of distilleries, maltings and hospitals do operate boilers which either singly, or in combination have a thermal output in excess of the 5MW. None of these burn solid fuel. The fuels burned are various grades of fuel oil. In some cases, where the premises have more than one boiler, the boilers may be run simultaneously. In other cases, the use of the boilers is staggered. The large boiler at Invergordon grain distillery normally burns gas but can burn fuel oil if the gas supply is interrupted.

As the levels of SO_2 in the Highlands are low, as can be seen from the monitoring results and estimations from the UK Emissions Inventory above, it is not expected that emissions from these fuel combustion systems are likely to cause exceedances of the air quality standard at relevant locations. The methodology for estimating the impact of these sources has not been published but its publication is imminent. When the Environment Agency document "Guidance for estimating the Air Quality Impact of Stationary Sources" is available, a further assessment can be made of these and any other boilers which are identified as being greater than 5MW.

The fuel combustion systems which have been identified to date are shown in Figure 28 below.

Figure 28 Fuel Oil Combustion Systems with thermal power greater than 5 MW

Premises	Address	Highland Council Area	Thermal Power (MW)	NGR
Tormore Distillery	Tormore, Advie	Badenoch and Strathspey	10	NJ 155 350
Balmenach Distillery	Cromdale, Granton on Spey	Badenoch and Strathspey	2 @ 3.8	NJ 078 271
Moray Firth Maltings PLC	Longman Road, Inverness	Inverness	10.5	NH 670 466
Tomatin Distillery	Tomatin	Inverness	3 @ circum 6	NH 792 294
Craig Dunain Hospital (Highland Communities NHS Trust)	Inverness	Inverness	2 @ 3.5	NH 636 438
Royal Northern Infirmary (Highland Communities NHS Trust)	Inverness	Inverness	2 @ 3.5	NH 663 445
Raigmore Hospital (Highland Communities NHS Trust)	Inverness	Inverness	4.2 and 6.3	NH 687 448
Ben Nevis Distillery	Lochy Bridge, Fort William	Lochaber	7.1	NN 126 756
Royal Brackla Distillery	Cawdor	Nairn	7.3	NH 861 515
Invergordon Grain Distillery	Golfview Terrace, Invergordon	Ross and Cromarty	>20 Standby	NH 715 692
Dalmore Distillery	Alness	Ross and Cromarty	7	NH 666 685
Glenmorangie Distillery	Tain	Ross and Cromarty	2 @ 3.5	NH 768 838
Dalmore Distillery	Alness	Ross and Cromarty		NH 666 687
Talisker Distillery	Carbost, Isle of Skye	Skye and Lochalsh	5.7	NG 378 318
Clynelish Distillery	Brora	Sutherland	2 @ 4.6	NC 897 054
Hunters Woollen Mills	Brora	Sutherland	2 @ 3.7	NC 904 044

13.12 Planned developments and neighbouring areas: Sulphur dioxide

There are no planned developments in Highland, or sources of Sulphur dioxide in neighbouring areas which could impact significantly on the air quality in the Highland Council Area. It is not anticipated that the position will have changed by the year 2005.

13.13 Conclusions: Sulphur dioxide

Emissions from domestic and other low-lying sources are concentrated within the main centres of population. These towns are widely separated such that the footprints from these sources do not overlap. The estimated background level of 2ppb is very low.

However, there are six authorised Part A and eight Part B processes in Highland fall within the Government's classification of processes which have the potential to release significant quantities of Sulphur dioxide. In addition, there are sixteen fuel oil combustion systems with thermal power greater than 5 MW.

It is unlikely that the aforementioned processes will cause problems with local air quality. However, as a priority, further information on likely environmental levels of Sulphur dioxide arising from these processes will be sought from the Scottish Environment Protection Agency.

Every local authority is required to carry out a second review and assessment of air quality before 2005. By then, the "Guidance for Estimating the Air Quality Impact of Stationary Sources" from the Environment Agency will be available. It is recommended that the impact of the aforementioned processes should be reassessed when the second stage review and assessment is undertaken.

14 Summary of Conclusions for each Pollutant

14.1 Conclusions: Nitrogen dioxide.

Six authorised Part A processes in Highland fall within the Government's classification of processes which have the potential to release significant quantities of Nitrogen dioxide. It is unlikely that the aforementioned processes will cause problems with local air quality. However, as a priority, further information on likely environmental levels of Nitrogen dioxide arising from these processes will be sought from the Scottish Environment Protection Agency.

The predicted traffic flows in Figure 5 Forecasts for annual average daily traffic flows in Inverness, 1998 and 2005, indicate that there are several road links which are likely to have traffic flows in excess of 20,000 before the year 2005. **Thus, on that basis, the Highland Council will require to carry out a second stage review and assessment before the end of 1999.**

14.2 Conclusions:PM_{10}

Five authorised Part A and nineteen Part B processes in Highland fall within the Government's classification of processes which have the potential to release significant quantities of $PM_{10.}$ It is unlikely that the aforementioned processes will cause problems with local air quality. However, as a priority, further information on likely environmental levels of PM_{10} arising from these processes will be sought from the Scottish Environment Protection Agency.

The predicted traffic flows in Figure 5 Forecasts for annual average daily traffic flows in Inverness, 1998 and 2005, indicate that there are several road links which are likely to have traffic flows in excess of 25,000 before the year 2005. **Thus, on that basis, the Highland Council will require to carry out a second stage review and assessment for PM_{10}.**

14.3 Conclusions: Benzene, 1-3,butadiene, Carbon monoxide, Lead and Sulphur dioxide.

It is not anticipated that any local point source would raise ambient levels of these six pollutants above the Government's objective for the year 2005.. However, there are authorised Part A and Part B processes in Highland which fall within the Government's classification of processes which have the potential to release significant quantities of the particular pollutants. It is unlikely that the aforementioned processes will cause problems with local air quality. However, as a priority, further information on likely environmental levels of the particular pollutants arising from these processes will be sought from the Scottish Environment Protection Agency.

Taking account of all the available information it is reasonable to conclude that the Air Quality Objectives for these pollutants are currently being met and will not be exceeded by 2005.

Every local authority is required to carry out a second review and assessment of air quality before 2005. By then, the "Guidance for Estimating the Air Quality Impact of Stationary Sources" from the Environment Agency will be available. It is recommended that the impact of the aforementioned processes should be reassessed at that time. It is likely that this can be achieved in parallel with the **second stage review and assessment** which will be undertaken in respect of Nitrogen dioxide and $PM_{10.}$

15 References and Acknowledgements

15.1 References

Air Pollution in the United Kingdom, 1996. Available from the Department of the Environment, Transport and the Regions.

Framework for Review and Assessment of air quality, LAQM. G1(97). Published by The Stationery Office.

UK Emissions of Air Pollutants. Salway A.G., Eggleston, H.S., Goodwin, J.W.L. and Murrels, T.P. (1997). The National Environmental Technology Centre, AEA Technology, Culham, Oxfordshire.

Stedman J.R. (1998). Revised high resolution maps of background air pollutant concentrations in the UK, 1996. Available from the National Environmental Technology Centre, AEA Technology, Culham, Oxfordshire.

The Environment Agency, 1998 (in press). Guidance for estimating the Air Quality Impact of Stationary Sources.

The Highways Agency. The Design Manual for Roads and Bridges, 1998 (in press)

Review and Assessment: pollutant specific guidance. LAQM.TG4(98) Published by the Stationery Office

Highland Trends, 1997 Published by the Highland Council Planning Service

The United Kingdom National Air Quality Strategy. Published by the Stationery Office.

The Environment Act, 1995 Published by the Stationery Office

The Air Quality Regulations 1997. Published by the Stationery Office

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North Pollution Control Liaison Group

National Environmental Technology Centre

The Scottish Office

The Highways Agency

The Department of Transport, Environment and the Regions

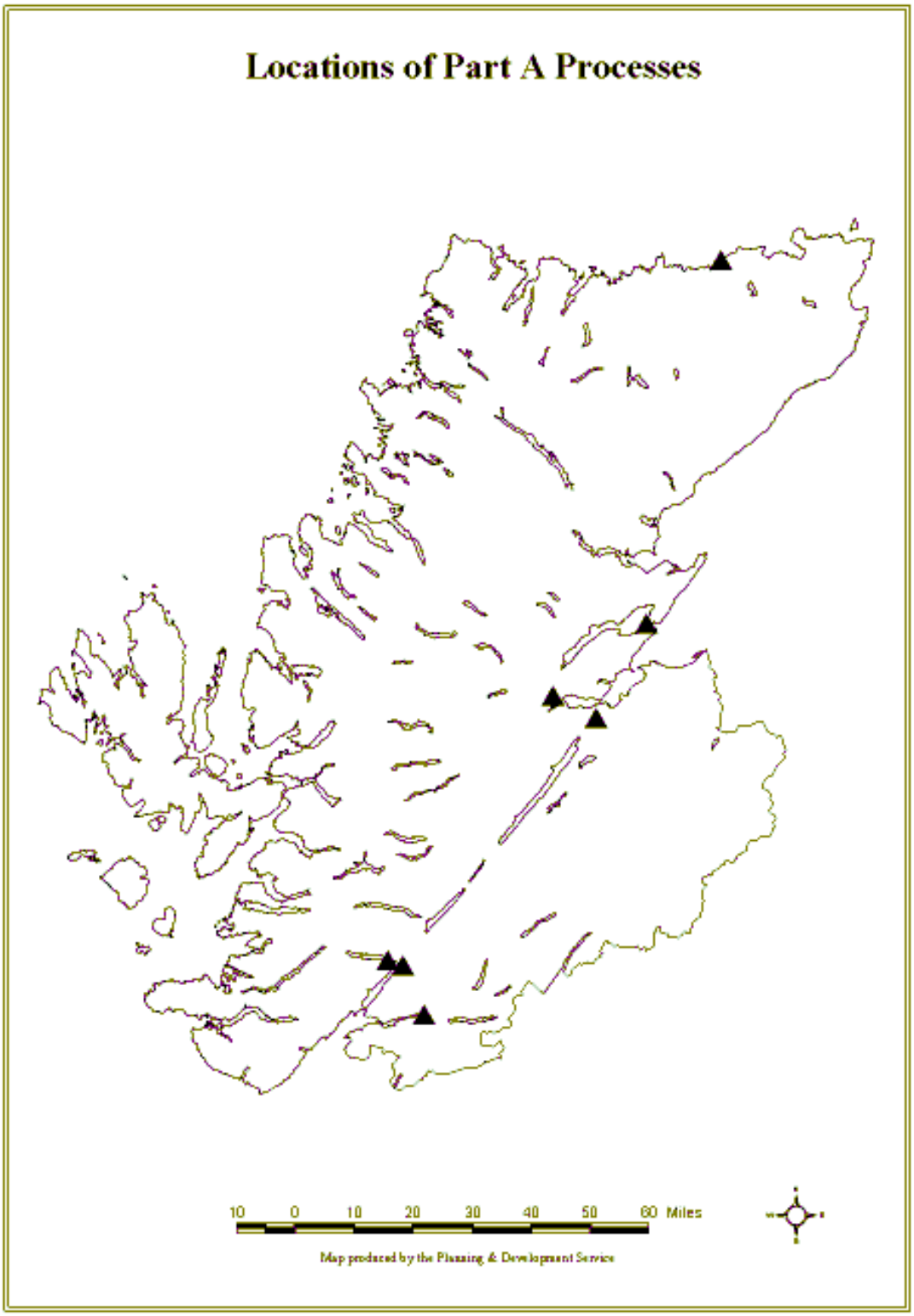
The Scottish Environment Protection Agency

All the Companies who responded to requests for information

Annex 1 Part A Authorised Processes in the Highlands

Process Operator	Address	Highland Council Area	NGR
Carbonisation			
SGL Technic Limited	Muir of Ord Industrial Estate	Ross And Cromarty	NH 5310 4890
Petroleum process			
Talisman Energy (UK) Ltd	Nigg Oil Terminal	Ross And Cromarty	NH 7868 6876
Processing non-ferrous metals			
UKAEA	UKAEA Dounreay Thurso	Caithness	NC 9925 6785
Primary manufacture of aluminium by electrolysis			
Alcan Smelting & Power UK	Alcan Disposal Site Kinlochleven	Lochaber	NN 1815 6187
Alcan Smelting & Power UK	Lochaber Smelter	Lochaber	NN 1250 7535
Paper and pulp manufacturing			
Arjo Wiggins Carbonless Papers Ltd.	Annat Point Fort William Mill	Lochaber	NN 0845 7675
Timber process			
Wm. Gray & Co.	Dores Road Inverness	Inverness	NH 6509 4289

Annex 2 Location of Part A Authorised Processes in the Highlands



Annex 3 Part B Authorised Processes in the Highlands

Process Operator	Address	Highland Council Area	NGR
Waste Oil Burners			
Norfrost Ltd	Murrayfield, Castletown	Caithness	ND 194 677
Norfrost Ltd	Murrayfield, Castletown	Caithness	ND 194 677
W Mowatt	Mowatt"s Garage, George Street, Wick	Caithness	ND 3610 5150
John Elder and Sons Motor Engineers	Market Hill, Dunbeath	Caithness	ND 16203020
Hugh Simpson Ltd	South Quay, Harbour, Wick	Caithness	ND 36905050
Robert B Flett	Central Garage, Watten	Caithness	ND 24105450
Calterdon Ltd	26 Harbour Road, Inverness	Inverness	NH 67104610
Highland Omnibuses Ltd.	1 Seafield Road, Inverness	Inverness	NH 67104640
Ewen MacRae (West End Garage) Ltd.	Dunvegan Road, Isle Of Skye	Skye and Lochalsh	NG 47654385
Bannermans	Shore Street, Tain	Ross and Cromarty	NH 77808270
Spa Coaches	Spa Garage, Strathpeffer	Ross and Cromarty	NH 48205800
Joseph Johnston and Sons	The Salmon House, Lower Badcaul	Sutherland	NC 17053755
Boilers and Furnaces between 20 and 50 MW			
Arjo Wiggins Carbonless Papers Ltd.	Fort William Mill, Annat Point	Lochaber	NN 08457675
Invergordon Distillery	Golfview Terrace, Invergordon	Ross and Cromarty	NH 71506950

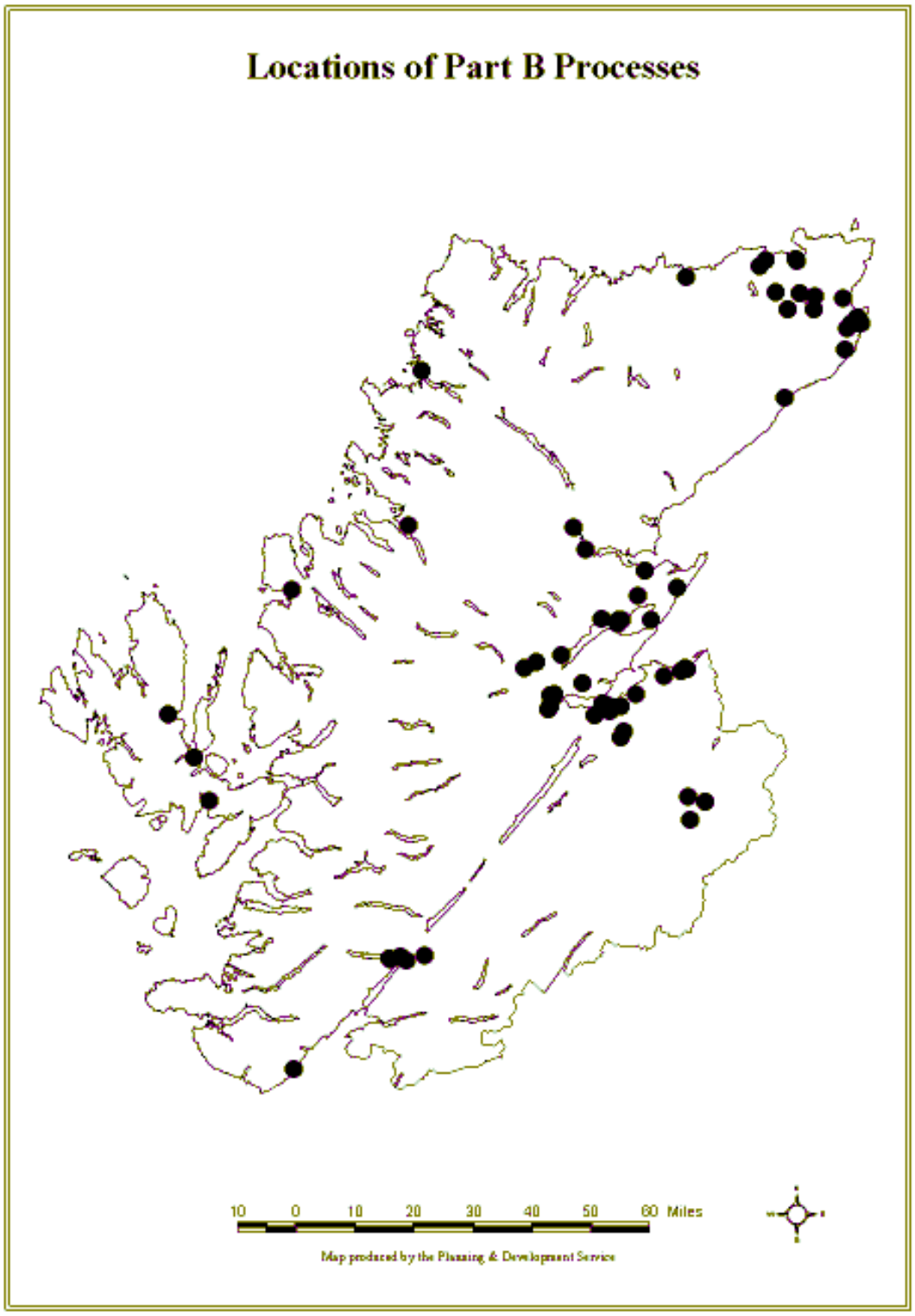
Process Operator	Address	Highland Council Area	NGR
Blending, Packing, Loading And Use Of Cement			
Caledonian Quarry Products Ltd	Knockgranish, Aviemore	Badenoch and Strathspey	NH 902 148
Wm Mackay (Precast) Ltd	Cairns Quarry, Stirkoke, Wick	Caithness	ND 33304920
D M Geddes and Son Ltd	Sinclair Lane, Halkirk	Caithness	ND 13705900
Bardon Concrete	Borrowston Quarry, Wick	Caithness	ND 32604330
Bardon Concrete	Kirkton Gravel Pit, Melvich	Caithness	NC 89106330
John Fife Ltd. (Ready Mix Depot)	Lochybridge, Fort William	Lochaber	NN 12857625
Aggregate Industries (UK) Ltd.	Balblair, Beauly	Inverness	NH 51454505
Blue Circle Industries	Longman Industrial Estate,	Inverness	NH 67204590
John Fyfe Ltd.	Mid Lairgs, Daviot	Inverness	NH 71303730
Inverness Precast Concrete	9 Longman Road, Inverness	Inverness	NH 67004630
Morrison Quarries (Ready Mix Depot)	Henderson Road, Inverness	Inverness	NH 66904630
RMC (UK) Ltd.	Blackcastle Quarry, Nairn	Nairn	NH 832 542
Morrison's Cement Batching Plant	Balnagown Quarry, Kildary, Invergordon	Ross and Cromarty	NH 76007600
Lead Glass Processes			
Caithness Glass Plc	Industrial Estate, Wick	Caithness	ND 36005210
Prescribed Coal Processes			
British Fuels Ltd	BFL, The Harbour Office, Longman Quay	Inverness	NH 66204680
Bruce Lindsey Coal Ltd.	Unit 21, Cromarty Firth Industrial Park, Invergordon	Ross and Cromarty	NH 53204930
John Macdonald and Son (Coal Merchant)	Station Yard, Old Allangrange, Tore	Ross and Cromarty	NH 60705220

Process Operator	Address	Highland Council Area	NGR
Quarries			
John Gunn and Sons Ltd	Skitten Quarry, Wick	Caithness	ND 32105730
A and G Calder	Stonehone Quarry, Watten	Caithness	ND 24305790
A and D Sutherland	Spittal Quarry, Watten	Caithness	ND 16905430
Highland Lime Company	Dornie Quarry, Torlundy, Fort William	Lochaber	NN 17957775
Tilcon (Scotland) Ltd.	Banavie Quarry, Fort William	Lochaber	NN 11407740
Yeoman (Morvern) Ltd.	Glensanda Quarry, Fort William	Lochaber	NM 82254675
Leiths Scotland Ltd.	Torrin Quarry, Torrin, Isle Of Skye	Skye and Lochalsh	NG 58902010
Thistle Aggregates-Ullapool Quarry	Morefield Quarry, Morefield, Ullapool	Ross and Cromarty	NH 13509530
Invershin Quarry	Balblair, By Lairg	Sutherland	NH 58409460
John Fyfe Ltd.	Ardchronie Quarry, Ardgay	Sutherland	NH 61708860
Mobile Crushing and Screening Plant			
John Gunn and Sons Ltd.	Skitten Quarry, Wick	Caithness	-
Tulloch Construction Group	Corrie Lodge, Millburn Road, Inverness	Inverness	-
Kenny Stewart Strathpeffer Mobile	Blairninich, Strathpeffer	Ross and Cromarty	-
Quarry and roadstone coating			
John Gunn and Sons Ltd.	Bower Quarry, Bower	Caithness	ND 20205870
Caledonian Quarry Products Ltd.	Daviot Quarry, Inverness	Inverness	NH 72103910
Tarmac Quarry Products Ltd.	Daviot Quarry, Inverness	Inverness	NH 72103910
Leiths Scotland Ltd.	Achilty Quarry, Achilty	Ross and Cromarty	NH 44855635
John Fyfe Ltd., Clach Na Broig Quarry	Poolewe Road, Gairloch	Ross and Cromarty	NG 81507750
Highland Council	Sconser Quarry, Sconser, Isle Of Skye	Skye and Lochalsh	NG 55003200
Quarry, Roadstone Coating, Bulk Cement			
Pat Munro (Alness) Ltd.	Caplich Quarry, Alness	Ross and Cromarty	NH 66116989

Process Operator	Address	Highland Council Area	NGR
Crematoria			
Highland Council	The Crematorium, Kilvean, Inverness	Inverness	NH 64004340
Manufacture Of Timber And Wood Products			
BSW Sawmills	Corronich Sawmill, Boat Of Garten	Badenoch and Strathspey	NH 944 199
J Gordons and Sons	Station Road, Carrbridge	Badenoch and Strathspey	NH 897 213
BSW Timber Plc	Kilmallie Sawmill, Corpach, Fort William	Lochaber	NN 08357690
Hugh Macrae and Co. Builders Ltd.	12-14 Seafield Road, Inverness	Inverness	NH 676 461
Tulloch Timber (Nairn) Ltd.	Grigorhill Sawmill, Granny Barbour Rd	Nairn	NH 89305620
Munro, J G D Sawmill	Old Evanton Road, Dingwall	Ross and Cromarty	NH 55105990
Chemical Treatment Of Timber			
John Gordon and Sons	Balblair Road, Nairn	Nairn	NH 87805570
Manufacture Of Particleboard			
CSC Forest Products (Sterling) Ltd.	Morayhill, Inverness	Inverness	NH 75304920
Fish meal processes			
McGruther and Marshall Fish Meal	Service Base, Shore Road, Invergordon	Ross and Cromarty	NH 70506840
Trouw Aquaculture UK	Inverbreakie Industrial Estate, Invergordon	Ross and Cromarty	NH 70606960
Coating Process			
ATC Cosmetics	1-3 Unit, Industrial Estate, Castle Ave, Invergordon	Invergordon	NH 70606940
Coating Of Metal Or Plastic			
Highland Fabricators	Nigg, By Tain	Ross and Cromarty	NH 79406960
Vegetable Matter Drying Process			
Graham Imrie	Unit 3, Balmuchy, Cadboll, By Fearn	Ross and Cromarty	NC 86807800
Invergordon Distillery Dark Grains	Golfview Terrace, Invergordon	Ross and Cromarty	NH 71506950

Process Operator	Address	Highland Council Area	NGR
Respraying Of Road Vehicles			
Ormlie Motors	Unit 7e, Ormlie Industrial Estate, Thurso	Caithness	ND 10806780
James Ferries and Company Ltd.	Ferry Road, Inverness	Inverness	NH 67404610
Macrae Dick Ltd.	64 Harbour Road (Hi-Tech), Inverness	Inverness	NH 67704620
Norman Cordiner Ltd.	Harbour Road, Inverness	Inverness	NH 67204610
Hawco Bodyshop	12a Harbour Road, Inverness	Inverness	NH 66804620
Gasification Process			
British Gas Plc Scotland	British Gas Transco, Janetstown, Thurso	Caithness	ND 09206620
British Gas Plc Scotland	British Gas Transco, Milton, Wick	Caithness	ND 34305050
Unloading Of Petrol Into Storage At Service Stations			
G MacKay	MacKays Garage, Castletown	Caithness	ND19306800
Wm Dunnet and Co Ltd	Frances Street, Wick	Caithness	ND 36255060
BP Oil	Longman Service Station	Inverness	NG67104630
Tesco Stores Ltd	West Sleaford, Inverness	Inverness	NH 69504570
MacRae and Dick	Cromwell Tower Filling Station Chapel Street	Inverness	NH66504650
J P McHardy Ltd	Blackpark Filling Station	Inverness	NH52004620
Aird Motors Ltd	High Street, Beauly	Inverness	NH52004590
Sheel UK Ltd	Old Perth Road , Inverness	Inverness	NH68284465
Culloden Ltd	Barn Church Road, Culloden	Inverness	NH71304600
Mr Grant	Forres Road, Nairn	Nairn	NH89005650
Mr David	Great North Road, Muir of Ord	Ross and Cromarty	NH52004900

Annex 4 Location of Part B Authorised Processes in the Highlands



Annex 5 Results of Nitrogen dioxide monitoring in the Highlands

Town	Location	Grid Ref.	Site Class	Annual Mean Concentrations (ppb)		
				1992-1993	1995-1996	1997-1998
Alness	High Street, pedestrian crossing	NH 658 695	Kerbside	-	-	11
Dingwall	Tulloch Street	NH 550 588	Kerbside	-	11	9
Dingwall	County Buildings	NH 547 588	Intermediate	-	7	6
Dingwall	Kinnairdie Avenue	NH 550 596	Background	-	6	4
Dingwall	Burns Crescent	NH 544 593	Background	-	6	6
Fort William	Nevis Bank, mini roundabout	NN 113 743	Kerbside	-	-	10
Fort William	North Service Road	NN 124 755	Kerbside	-	-	10
Invergordon	B817, harbour area	NH 708 683	Kerbside	-	-	9
Inverness	High St/Castle St	NH 707 685	Kerbside	-	-	9
Inverness	Academy St/ Margaret St	NH 666 456	Kerbside	26	-	21
Inverness	Kenneth St/ Tomnahurich St	NH 664 451	Kerbside	15	-	15
Inverness	Union St, bus stops	NH 666 455	Kerbside	-	-	16
Inverness	Union St, parking sign	NH 666 455	Kerbside	-	-	15
Inverness	Academy St, Marks & Spencers	NH 667 455	Kerbside	13	-	12
Inverness	Telford Street	NH 659 456	Kerbside	13	-	13
Inverness	Longman Rd, Inverness College Roundabout	NH 669 461	Kerbside	-	-	13
Inverness	Perth Rd/Culcabock Rd	NH 683 447	Kerbside	-	-	10
Inverness	Queensgate Post Office	NH 666 455	Kerbside	-	-	17
Inverness	Bught Park	NH 658 438	Background	4	-	7
Nairn	High Street	NH 884 566	Kerbside	-	-	13
Nairn	A96/Harbour Road Junction	NH 885 567	Kerbside	-	-	13
Tain	High Street	NH 780 821	Kerbside	-	-	13
Thurso	Olrig St/Trail St	ND 363 509	Kerbside	-	-	10