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1 Executive summary

1.1 Background

This addendum supplements the report entitled "Air Quality in the Highlands, First Stage Review and Assessment, Consultation Document" which was produced for Highland Council by Protective Services in December, 1998. The first stage review and assessment of air quality in the Highlands was based on the standards, advice and recommendations which were current at the time when the report was compiled.

These included:-

- The Air Quality Regulations 1997
- The United Kingdom National Air Quality Strategy
- The Framework for Review and Assessment of air quality, LAQM. G1(97)
- The Review and Assessment: pollutant specific guidance. LAQM.TG4(98)

The report concluded that Highland Council would need to proceed to a second stage review and assessment in the case of two pollutants, namely, Nitrogen dioxide (NO_2) and PM_{10}. The conclusions were based solely on predicted traffic flows exceeding certain numbers in the year 2005.

As a consequence of the review of the National Air Strategy and developments in air quality modelling and predictions, the aforementioned documents were superseded by:-

- The Air Quality Regulations 2000
- The Air Quality Strategy for England, Scotland, Wales and Northern Ireland
- Revised Guidance Framework for Review and Assessment of Air Quality LAQM.G1(S)(00) March 2000
- Review and Assessment: Pollutant Specific Guidance LAQM.TG4(00) May 2000

1. The Review and Assessment: Pollutant Specific Guidance LAQM.TG4(00) provides more sophisticated screening procedures to enable a local authority to carry out a first stage review and assessment of air quality.

Having regard to these screening procedures for NO2 and PM10, it can be concluded that the risk of traffic sources causing exceedances of the Government's air quality objectives at relevant locations in the Highlands is insignificant for the years 2004/2005.

The Scottish Executive has advised that further consideration should be given to the seven pollutants, with particular reference to :-

- Processes regulated by Part A and Part B processes
- SO_2 emissions -

a) from solid fuel domestic heating sources ; and
b) from boiler plant greater than 5MW

2. The Scottish Environment Protection Agency has been consulted regarding emissions from Part A and Part B processes in the Highland Council Area.

The Scottish Environment Protection Agency advise that all processes in Highland comply with emission standards for the pollutants of interest and that emissions from such processes do not compromise the Air Quality Objectives at present and will not do so in 2005

3. In March 2000, NETCEN produced a report for the Department of the Environment, Transport and the Regions, National Assembly for Wales, the Scottish Executive and Department of the Environment in Northern Ireland entitled "First Phase Air Quality Review and Assessment"

(see http://www.aeat.co.uk/netcen/airqual/laqm/fpr.html). The information contained therein can be used to augment the aforementioned guidance and screening procedures.

Having regard to the screening procedures for SO2, from solid fuel domestic heating, in the light of the above report it can be concluded that the risk of causing exceedances of the Government's air quality objective at relevant locations in the Highlands is insignificant for 2005.

4. In May 2000, Entec UK Ltd reported to the Scottish Executive on "Emissions of Sulphur dioxide from Small Combustion Plants of <20MW"

In the light of the above report it can be concluded that, in the case of SO2 emissions from Small Combustion Plants of <20MW the risk of causing exceedances of the Government's air quality objective at relevant locations in the Highlands is insignificant for 2005.

2 Review of Nitrogen Dioxide from road traffic in the Highlands

2.1 Air Quality Standards and Objectives for NO_2

The Air Quality Regulations 2000 supersede the Air Quality Regulations 1997. The new air quality standards and objectives for NO_2 are shown in Figure 1.

Figure 1 Air Quality Standards and Objectives for NO_2

The Government and the devolved administrations have adopted an annual mean of 40 μg/m3 (21 ppb), and a 1-hour mean of 286 μg/m3 (150 ppb), as the air quality standards for nitrogen dioxide. The objectives are for the annual mean standard to be achieved by the end of 2005, and a 1-hour mean of 200 μg/m3 (105 ppb) not to be exceeded more than 18 times per year, to be achieved by the end of 2005 (approximately equivalent to the 99.8th percentile of hourly means).

1 Conversion Units
To convert concentrations of nitrogen dioxide between $\mu g/m^3$ and ppb, use the following factors:
1.913 x ppb = $\mu g/m^3$
0.523 x $\mu g/m^3$ = ppb
To convert concentrations of NOx from ppb to $\mu g/m^3$, assume that all NOx is expressed as NO_2, and use the factor of 1.905 i.e. 20 ppb NOx = 38.1 $\mu g/m^3$ NOx

2.2 Comparison of the 1998 and the 2000 pollutant specific guidance – NO_2

1998 In the 1998 Review and Assessment: pollutant specific guidance "LAQM.TG4(98)" the guidance for local authorities was that if the annual average daily traffic flows near any relevant location were likely to exceed 20,000 in the year 2005, the local authority should proceed to a second stage review and assessment of NO_2. On that basis, the First Stage Review and Assessment of Air Quality in the Highlands in 1998 concluded that it would require to proceed to a second stage review and assessment for NO_2.

2000 The Review and Assessment: Pollutant Specific Guidance LAQM.TG4(00) May 2000 provided a more detailed screening method for determining whether there is a risk of exceeding the objectives for NO_2 by the end of 2005.

In the case of NO_2 from traffic, LAQM.TG4(00) specifies that the authority should have regard to the following information:-

- information on existing and 2005 forecast annual mean traffic flows for any existing or proposed roads in the authority's area which could generate significant quantities of NOx.
- estimated 2005 annual mean background NOx concentrations from the Internet site (http://www.aeat.co.uk/netcen/airqual/);

2.3 2005 forecast annual mean traffic flows for roads which could generate significant quantities of NOx.

Nitrogen dioxide (NO2) and nitric oxide (NO) are both oxides of nitrogen and are collectively referred to as NOx. In the Highland Council area, it is only roads in and around Inverness which have the potential to generate significant quantities of NOx. Significant road links in Inverness are listed in Figure 2. Roads and Transport Services have advised that the increase in traffic in the year 2005 is likely to result in the annual daily mean traffic flows which are shown in column 4 of Figure 2. The estimated average vehicle speed in kilometres per hour is shown in column 5.

2.4 Estimated 2005 annual mean background NOx concentrations

The estimated 2005 annual mean background NOx concentration are published on Internet site (http://www.aeat.co.uk/netcen/airqual/) and are detailed in 1 x 1 kilometre squares. The Grid reference for the selected road sections in Inverness are shown in column 2 of Figure 2. The respective estimated background NOx levels in 2005 are listed in column 3.

Figure 2 Factors affecting NO_2 concentrations arising from road traffic in the year 2005 in the Highland Council area

Road Section	1 x 1 km square Grid Reference	Estimated Background NOx ($\mu g/m^{3)}$) In 2005	Projected Daily Mean Traffic Flow in 2005	Average Vehicle Speed (kilometres per hour)
Academy Street	266500 844500	10	14,500	15 kph
Castle Street	266500 844500	10	18,000	20 kph
Ness Bridge	266500 844500	10	18,000	8 kph
Bridge Road	267500 844500	10.2	24,750	48 kph
Raigmore interchange to Smithton	269500 844500	7.5	30,120	56 kph
Telford Street	**265500 844500**	**8.4**	**21,980**	**30 kph**
Longman roundabout to Charleston	265500 848500	5.3	28,300	96 kph
Shore Street roundabout to Rose Street roundabout	266500 844500	10	24,550	48 kph
Friars Bridge	266500 844500	10	23,000	48 kph
Harbour Road roundabout to Longman roundabout	266500 844500	10	30,120	55 kph
Raigmore Interchange to Kessock Bridge	267500 846500	9.2	32,900	96 kph
Rose Street roundabout to Harbour Road roundabout	266500 844500	10	28,225	56 kph

Telford Street is highlighted in the above Figure as it can be considered to be a relevant location in that there are dwellings near to the road. None of the other road sections are sufficiently near to relevant locations to be considered for screening. Thus Telford Street is used in the screening process.

2.5 Screening approach in LAQM.TG4(00) based upon the methodology set out in the Design Manual for Roads and Bridges

The Review and Assessment: Pollutant Specific Guidance LAQM.TG4(00) May 2000 describes how the information which has been collated in Figure 2 can be used to determine whether there is a risk of exceeding the annual mean air quality objective in 2005.

In practice, meeting the annual mean objective is expected to be more demanding than achieving the 1-hour objective. It is therefore generally considered that if the annual mean objective is achieved, it is unlikely that the 1-hour objective will be exceeded.

The potential significance of NOx emissions from road traffic is dependent upon the traffic conditions, such as the flow, speed and vehicle mix. The impact of traffic emissions also falls off rapidly with increasing distance from the kerbside, and it is important to take account of where the nearest exposed population will be.

To assist authorities in the identification of roads with the potential to emit significant quantities of NOx, a screening approach has been prepared, based upon the methodology set out in the Design Manual for Roads and Bridges (DMRB). Based upon a knowledge of traffic flow, vehicle speed and the 2005 background NOx concentration, it is possible to determine whether there is a risk of exceeding the annual mean air quality objective in 2005. If the annual mean objective is not at risk of being exceeded, then it is unlikely there will be a breach of the 1-hour objective. Roads with less than 10,000 vehicles per day are unlikely to have a significant impact and can effectively be ignored. A nomogram has been provide in LAQM.TG4(00), for a single carriageway road (Figure 3).

To use the nomogram, it is necessary to identify the point whose co-ordinates are at the daily mean traffic flow and 2005 background NOx concentration. **If the point lies below the line, for the average vehicle speed relevant to the road under investigation, road traffic may be considered to be insignificant, and it should not be necessary to proceed further**

2.6 Screening of Telford Street, Inverness using the nomogram in LAQM.TG4(00) for NO_2 for a single carriage road

As stated in 2.4 above, Telford Street is considered to be a relevant location and is used in the screening process.

In Telford Street the road is single carriageway and the houses are typically set back >2 metres from the edge of the kerb. The required input data for the assessment are:

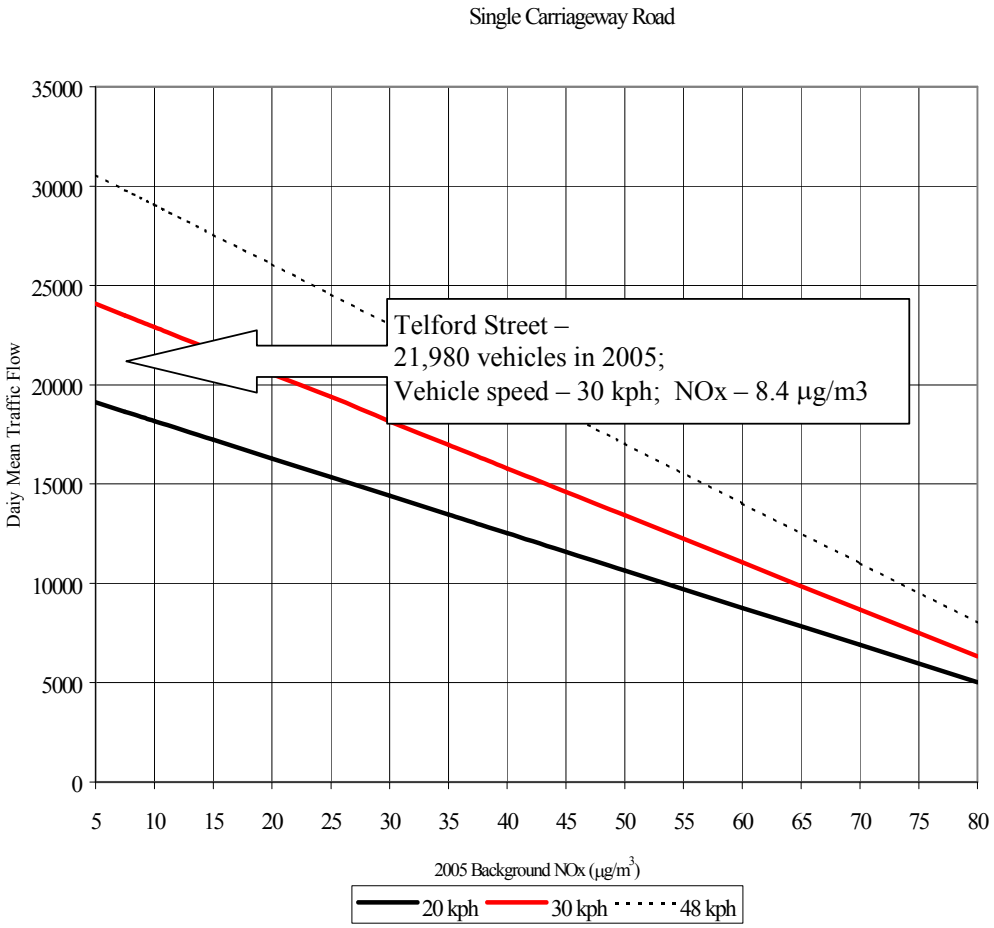
- 2005 annual mean background NOx concentration derived from the Internet site (http://www.aeat.co.uk/netcen/airqual/) for the nearest 1 x 1 km grid square. In this case the 2005 annual mean background NOx concentration is 8.4 μg/m3;

- the annual average daily traffic flow in Telford Street in 2005 is predicted to be 21,980 vehicles;

- daily average traffic speed and vehicle mix (percentage of HGVs) in Telford Street is assumed to be approximately 30 kph (and <12% HGV) respectively;

- From the nomogram at Figure 3 (reproduced from Figure 6.1 in LAQM.TG4(00)), at an annual mean background NOx concentration in 2005 of 8.4 μg/m3, the plot for average vehicle speeds of 30kph is intersected at a point corresponding to an annual average daily mean traffic flow of 23,400. The predicted annual average daily mean traffic flow for 2005 is 21,980 vehicles, which lies below this point of intersection. Therefore, it is not necessary to proceed to a further stage of Review and Assessment, as the risk of exceeding the objectives is insignificant.

Figure 3 Screening of Telford Street, Inverness for NO2 using the nomogram in LAQM.TG4(00)

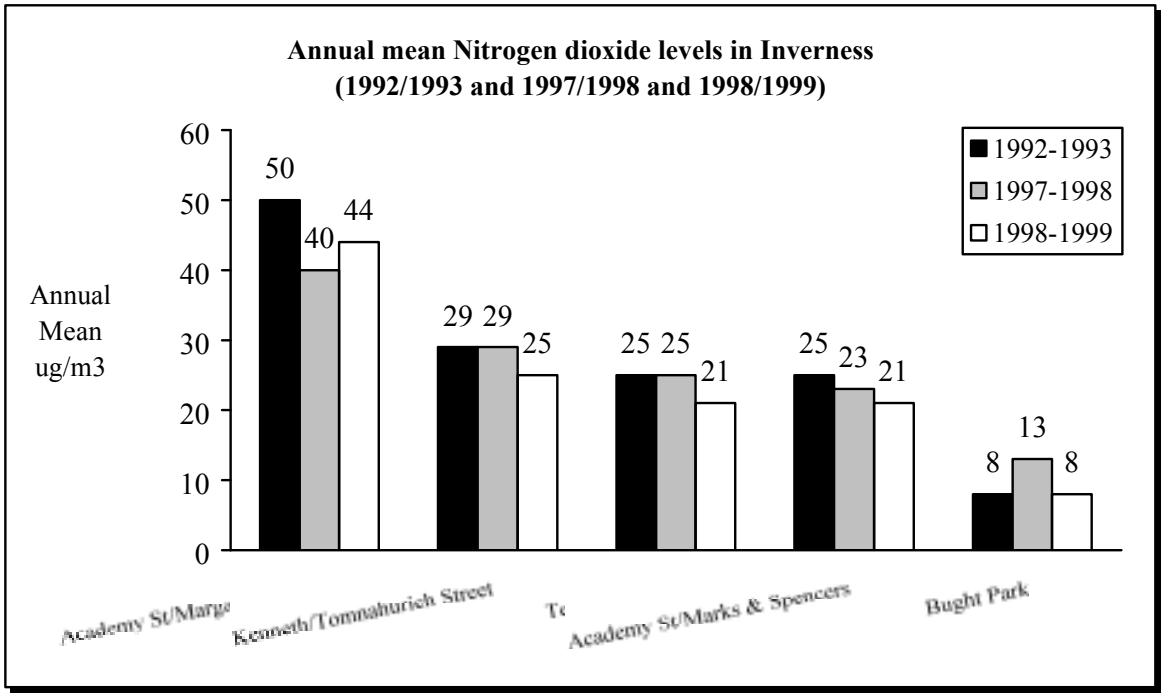


2.7 Nitrogen dioxide levels obtained from passive diffusion tubes in Inverness

In the main report, "Air Quality in the Highlands, First Stage Review and Assessment, Consultation Document" the results of monitoring by passive diffusion tube were reported in paragraph 11.7. Monitoring has continued at sites in Inverness and Dingwall and the additional results for 1998/99 have been added to Figures 4 and 5 below.

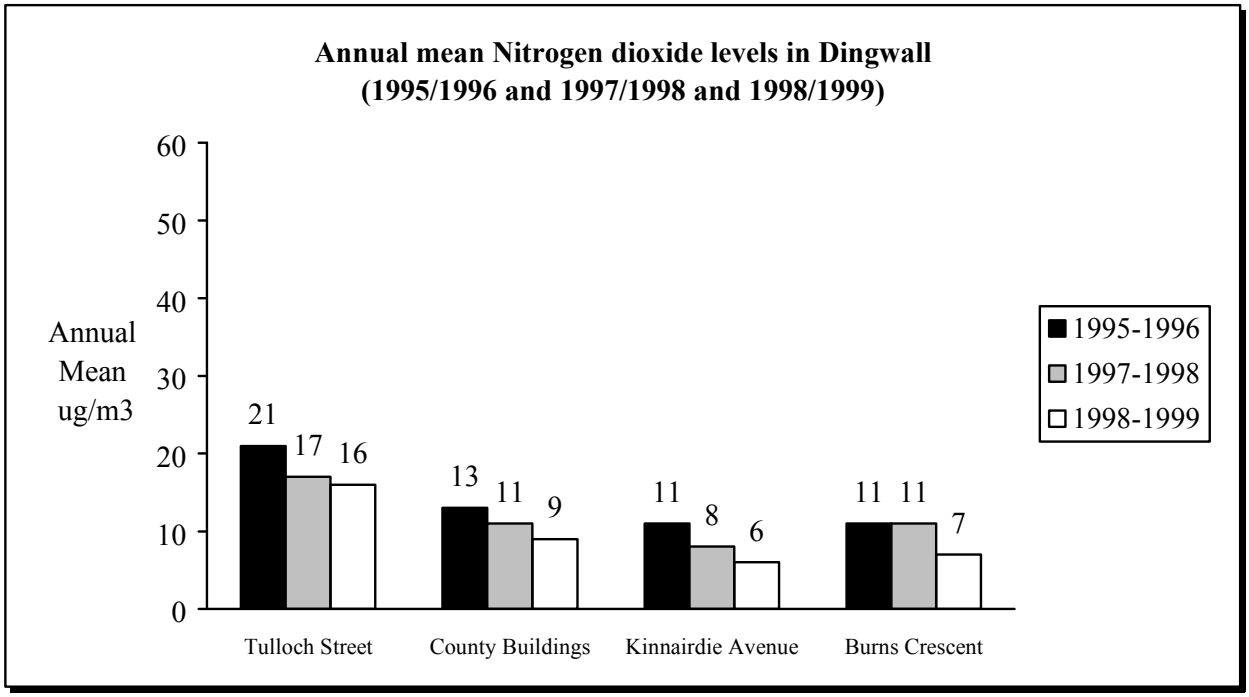
The monitoring results show a downward trend in NO_2 levels with the exception of Academy Street/Margaret Street in Inverness.

Figure 4 Annual mean Nitrogen dioxide levels in Inverness



The annual mean NO_2 level in Academy Street near Margaret Street in 1998/1999 was 44 µg/m3, i.e. 4 µg/m3 above the objective of 40 µg/m3 for 2005. This is considered further in paragraph 2.8.

Figure 5 Annual mean Nitrogen dioxide levels in Dingwall



2.8 NO_2 levels in Academy Street near Margaret Street

As shown in Figure 4 above, the annual mean NO_2 level in Academy Street in 1998/1999 was 44 μg/m3, i.e. 4 μg/m3 above the objective of 40 μg/m3 for 2005. Some further consideration should be given to that result. In practice, meeting the annual mean objective is expected to be more demanding than achieving the 1-hour objective. It is therefore generally considered that if the annual mean objective is achieved, it is unlikely that the 1-hour objective will be exceeded.

Nitrogen dioxide (NO2) and nitric oxide (NO) are both oxides of nitrogen and are collectively referred to as NOx. All combustion processes produce some NOx emissions, largely in the form of nitric oxide, which is then converted to nitrogen dioxide, mainly as a result of reaction with ozone in the atmosphere. Only nitrogen dioxide is associated with adverse effects upon human health.

The main sources of NOx emissions in the UK are road transport, which accounted for almost 50% of total UK emissions in 1997, the electricity supply industry which accounted for 20%, and the industrial and commercial sectors which accounted for about 17%. In most urban areas, the contribution of road transport to local emissions will be much greater, and for example, accounts for more than 75% of NOx emissions in London.

Significant reductions in emissions are expected by 2005 from the road transport sector as a result of the implementation of various policy measures.

These reductions are taken account of in the methodologies found in the Review and Assessment: Pollutant Specific Guidance LAQM.TG4(00) May 2000. The screening methods can be used to consider the reductions in NO_2 which Academy Street is likely to be experience.

As can be seen from Figure 6 and Figure 11 the traffic flow in Academy street has almost reached saturation and is not forecast to increase significantly in future years.

Figure 6 Increase in traffic in Academy Street, Inverness

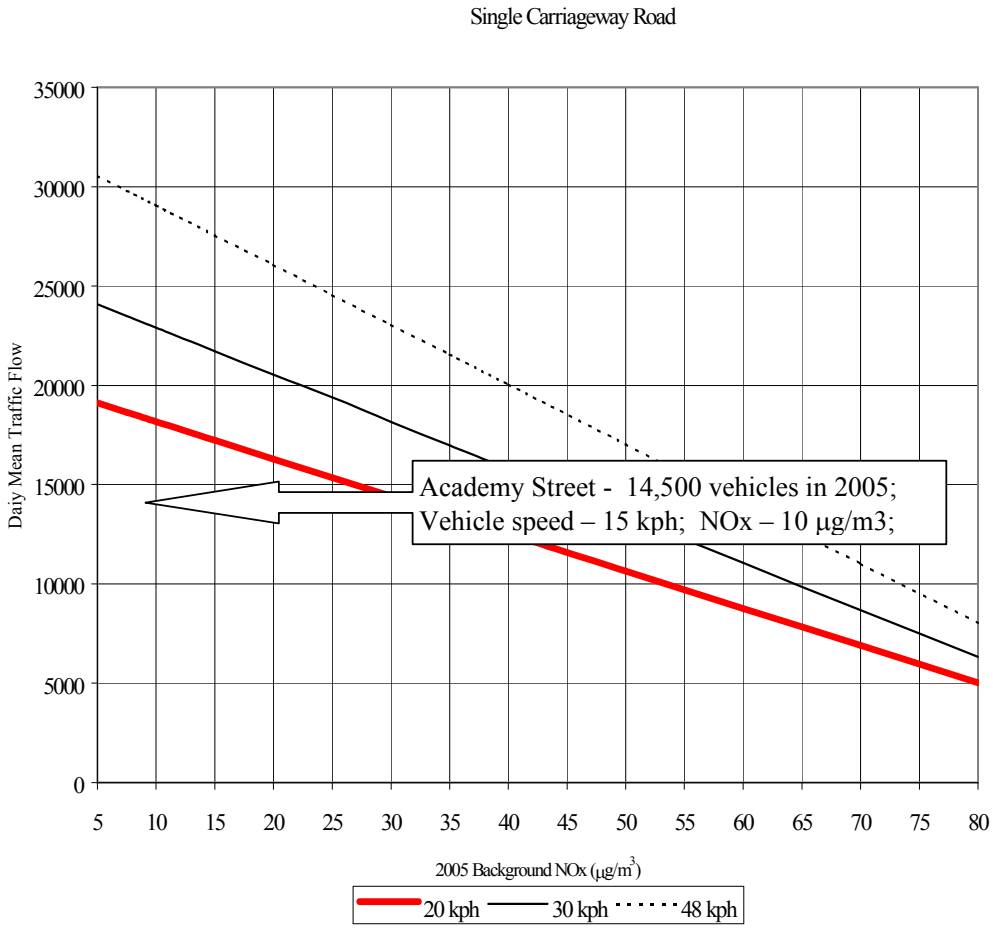
Road Section	1 x 1 km square Grid Reference	Daily Mean Traffic Flow 1997	Daily Mean Traffic Flow 1999	Daily Mean Traffic Flow 2005 (projected)	Estimated Background NOx ($\mu g/m^{3)}$) In 2005
Academy Street	266500 844500	** 13,720	14,350	14,500	10

Key
**** denotes estimation.**

Thus it is reasonable to assume that Academy Street will benefit from the significant reductions in emissions which are expected by 2005 from the road transport sector as a result of the implementation of various policy measures.

The screening approach in LAQM.TG4(00) based upon the methodology set out in the Design Manual for Roads and Bridges can be applied to Academy Street in the same way as was carried out for Telford Street. The result is shown in Figure 7 below.

Figure 7 Screening of Academy Street, Inverness for NO2 using the nomogram in LAQM.TG4(00)



In Academy Street the road is single carriageway and commercial properties are typically set back >2 metres from the edge of the kerb. The required input data for the assessment are:

- 2005 annual mean background NOx concentration derived from the Internet site (http://www.aeat.co.uk/netcen/airqual/) for the nearest 1 x 1 km grid square. In this case the 2005 annual mean background NOx concentration is 10 µg/m3;
- the annual average daily traffic flow in Academy Street in 2005 is predicted to be 14,500 vehicles;
- daily average traffic speed and vehicle mix (percentage of HGVs) in Telford Street is assumed to be approximately 15 kph (and <12% HGV) respectively;
- From the nomogram at Figure 7 (reproduced from Figure 6.1 in LAQM.TG4(00)), at an annual mean background NOx concentration in 2005 of 10 µg/m3, the plot for average vehicle speeds of 20kph is intersected at a point corresponding to an annual average daily mean traffic flow of 18,000. The predicted annual average daily mean traffic flow for 2005 is 14,500 vehicles, which lies below this point of intersection. Therefore, the risk of exceeding the objectives is insignificant.

3 Review of PM_{10} from road traffic in the Highlands

3.1 Air Quality Standards and Objectives for PM_{10}

The Air Quality Regulations 2000 supersede the Air Quality Regulations 1997. The new air quality standards and objectives for PM_{10} are shown in Figure 8.

Figure 8 Air Quality Standards and Objectives for PM_{10}

The Government and the devolved administrations have adopted two air quality objectives for fine particles (PM_{10}), which are equivalent to the EU Stage 1 Limit Values. The objectives are 40 $\mu g/m^3$ as the annual mean, and 50 $\mu g/m^3$ as the fixed 24-hour mean to be exceeded no more than 35 days per year, to be achieved by the end of 2004. The objectives are based on measurements carried out using the European gravimetric transfer reference sampler or equivalent.

3.2 Comparison of the 1998 and the 2000 pollutant specific guidance – PM_{10}

1998 In the 1998 Review and Assessment: pollutant specific guidance "LAQM.TG4(98)" the guidance for local authorities was that if the annual average daily traffic flows near any relevant location were likely to exceed 25,000 in the year 2005, the local authority should proceed to a second stage review and assessment of PM_{10}. On that basis, the First Stage Review and Assessment of Air Quality in the Highlands in 1998 concluded that it would require to proceed to a second stage review and assessment for PM_{10}.

2000
The Review and Assessment: Pollutant Specific Guidance LAQM.TG4(00) May 2000 provided a more detailed screening method for determining whether there is a risk of exceeding the objectives for PM_{10} by the end of 2004.

In the case of PM_{10} from traffic, LAQM.TG4(00) specifies that the authority should have regard to the following information:-

- estimated annual mean background PM_{10} concentrations (gravimetric) for 2004 from the Internet site (http://www.aeat.co.uk/netcen/airqual/);
- traffic data for existing or proposed roads (excluding those with daily average traffic flows of less than 5,000 veh/day)

3.3 2004 forecast annual mean traffic flows for roads which could generate significant quantities of PM_{10}.

In the Highland Council area, it is only roads in and around Inverness which have the potential to generate significant quantities of PM_{10} by virtue of the vehicle numbers involved. Significant road links in Inverness are listed in Figure 9. Roads and Transport Services have advised that the increase in traffic in the year 2004 is likely to result in the annual daily mean traffic flows which are shown in column 4 of Figure 9. The estimated average vehicle speed in miles per hour is shown in column 5.

3.4 Estimated 2004 annual mean background NOx concentrations

The estimated annual mean background PM_{10} in 2004 (µg/m3 gravimetric) concentrations are published on Internet site (http://www.aeat.co.uk/netcen/airqual/) and are detailed in 1 x 1 kilometre squares. The Grid reference for the selected road sections in Inverness are shown in column 2 of Figure 9. The respective estimated annual mean background PM_{10} concentrations for 2005 are listed in column 3.

Figure 9 Factors affecting PM_{10} concentrations arising from road traffic in the year 2004 in the Highland Council area

Road Section	1 x 1 km square Grid Reference	Estimated Background PM_{10} (µg/m$^{3)}$	Projected Daily Mean Traffic Flow	Average Vehicle Speed (miles per hour)
Academy Street	266500 844500	15.8	14,450	10 mph
Castle Street	266500 844500	15.8	17,800	13 mph
Ness Bridge	266500 844500	15.8	17.900	5 mph
Bridge Road	267500 844500	15.8	24,500	30 mph
Raigmore interchange to Smithton	269500 844500	15.6	30,000	35 mph
Telford Street	265500 844500	15.7	21,800	18 mph
Longman roundabout to Charleston	265500 848500	15.4	27,355	60 mph
Shore Street roundabout to Rose Street roundabout	266500 844500	15.7	24,250	30 mph
Friars Bridge	266500 844500	15.7	22.900	30 mph
Harbour Road roundabout to Longman roundabout	266500 844500	15.8	28,120	35 mph
Raigmore Interchange to Kessock Bridge	267500 846500	15.6	31,810	60 mph
Rose Street roundabout to Harbour Road roundabout	266500 844500	15.8	28,050	35 mph

Telford Street is highlighted in the above Figure as it can be considered to be a relevant location in that there are dwellings near to the road. None of the other road sections are sufficiently near to relevant locations to be considered for screening. Thus Telford Street is used in the screening process.

3.5 Screening approach in LAQM.TG4(00) based upon the methodology set out in the Design Manual for Roads and Bridges

The Review and Assessment: Pollutant Specific Guidance LAQM.TG4(00) May 2000 describes how the information which has been collated in Figure 9 can be used to determine whether there is a risk of exceeding the annual mean air quality objective in 2004.

The proposed 24-hour objective for PM_{10} is more stringent than the annual mean objective. However, the 24-hour mean objective (expressed as 50 μg/m^3, gravimetric, to be exceeded no more than 35 times per year) is potentially a difficult standard against which to carry out an assessment, due to the day-to-day variations in PM_{10} concentration and composition.

It is therefore recommended that the initial stages of review and assessment are carried out by calculating the annual mean PM_{10} concentration and then estimating the 90th percentile concentration. The 90th percentile of daily means in a calendar year is approximately equivalent to 35 exceedance days.

An empirical relationship between the annual mean concentration and the 90th percentile of daily means has been derived from an analysis of monitoring data at UK automatic sites between 1992 and 1997. This gives the equation:-

PM_{10} (90th percentile of daily means) = PM_{10} (annual mean)*1.79

The proposed 24-hour objective is therefore highly unlikely to be exceeded if the annual mean concentration is below 28 μg/m^3, gravimetric. In the case of Telford Street, the estimated annual mean concentration in 2004 is 15.7 μg/m^3, gravimetric.

The potential significance of PM_{10} emissions from road traffic is dependent upon a number of factors including the background concentration (for 2004), and traffic conditions such as the traffic flow, speed and HGV mix. The impact of traffic emissions falls off rapidly with increasing distance from the kerbside, and it is also important to take account of where the nearest exposed population will be.

To simplify the assessment of road traffic emissions, a nomogram in LAQM.TG4(00) for a single carriageway road has been derived using the methodology set out in the *Design Manual for Roads and Bridges (DMRB*).. Based upon a knowledge of the traffic flow and vehicle speed, it is possible to determine whether there is risk of exceeding the proposed objectives. Roads with daily average traffic flows of less than 5,000 vehicles per day are unlikely to have a significant impact.

To use the nomogram, it is necessary to identify the point whose co-ordinates are at the daily mean traffic flow and 2004 background PM_{10} concentration. **If the point lies below the line, for the average vehicle speed relevant to the road under investigation, road traffic may be considered to be insignificant, and it should not be necessary to proceed further.**

3.6 Screening of Telford Street, Inverness using the nomogram in LAQM.TG4(00) for PM_{10} for a single carriage road

As stated in 3.4 above, Telford Street is considered to be a relevant location and is used in the screening process. In the case of Telford Street. the 2004 the estimated annual mean PM_{10} concentration (μg/m^3, gravimetric) is 15.7 μg/m3. LAQM.TG4(00) advises that it is highly unlikely for the proposed 24-hour objective to be exceeded if the annual mean concentration is below 28 μg/m^3, gravimetric.

In Telford Street the road is single carriageway and the houses are typically set back >2 metres from the edge of the kerb. The required input data for the assessment are:-

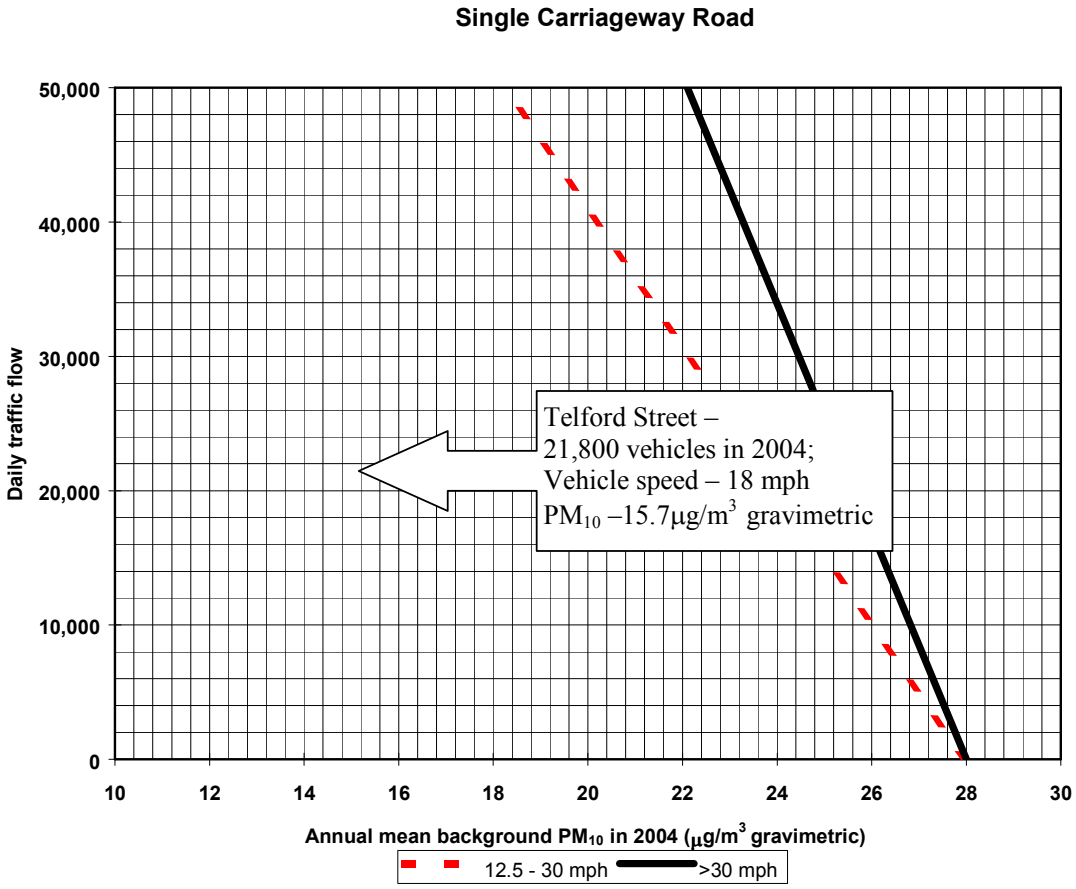
- the estimated annual mean PM_{10} concentration (μg/m^3, gravimetric) in 2004 derived from the Internet site (http://www.aeat.co.uk/netcen/airqual/) for the nearest 1 x 1 km grid square. In this case the 2004 the estimated annual mean PM_{10} concentration (μg/m^3, gravimetric) is 15.7 μg/m3;

- the annual average daily traffic flow in Telford Street in 2004 is predicted to be 21,800 vehicles;

- daily average traffic speed and vehicle mix (percentage of HGVs) in Telford Street is assumed to be approximately 18 mph (and <12% HGV) respectively;

- From the nomogram in Figure 10 (figure 8.2 LAQM.TG4(00)) at an annual mean background PM_{10} in 2004 of 15.7μg/m^3 gravimetric, an annual average daily mean traffic flow in excess of 50,000 vehicles would be required to cause exceedance of the objective. The predicted annual average daily mean traffic flow for 2004 is only 21,800 vehicles, and that is significantly below the 50,000 vehicles. Therefore, it is not necessary to proceed to a further stage of Review and Assessment, as the risk of exceeding the objectives is insignificant.

Figure 10 Screening of Telford Street, Inverness for PM_{10} using the nomogram in LAQM.TG4(00)



4 Review of emissions from Part A and Part B processes in the Highlands

The Review and Assessment: Pollutant Specific Guidance LAQM.TG4(00) May 2000 identified particular categories of processes which have the potential to release significant quantities of the specific pollutants of interest[1] into the atmosphere. Not all of the processes in Highland which fall within the particular category necessarily release the pollutants of interest or, if they do, the process does not necessarily release the pollutants in significant quantities.

All Part A and Part B processes are authorised and regulated by the Scottish Environment Protection Agency. Emissions are controlled so as not to compromise air quality. The terms of such authorisations are reviewed periodically.

The Scottish Environment Protection Agency has been consulted regarding emissions from Part A and Part B processes in the Highland Council Area.

The Scottish Environment Protection Agency advise that all processes in Highland comply with emission standards for the pollutants of interest and that emissions from such processes do not compromise the Air Quality Objectives at present and will not do so in 2005.

[1] These are benzene; 1,3-butadiene; carbon monoxide; lead; nitrogen dioxide; ozone; fine particles (PM10); and sulphur dioxide.

5 Review of emissions of SO_2 in the Highlands

5.1 Air Quality Objectives for SO_2

There are three air quality standards for SO_2, with 15-minutes, 1-hour and 24-hour averaging periods.

i. The 15-minute mean standard of 266μg/m^3 has an objective of no more than 35 exceedances in a year, to be achieved by 2005.

ii. The 1-hour mean objective of 350μg/m^3, to be exceeded no more than 24 times in a year, is to be achieved by 2004.

iii. The 24-hour mean objective of 125μg/m^3, to be exceeded no more than 3 times in a year, is to be achieved by 2004.

National data on sulphur dioxide concentrations demonstrate that the 15-minute objective is considerably more stringent than either the 1-hour or the 24-hour objectives. This data indicates the 15-minute objective to be widely exceeded in the UK, at both urban and rural sites. These exceedances are associated with emissions from both large and small combustion plants, and domestic coal burning.

5.2 SO_2 from solid fuel domestic heating sources

The Scottish Executive has advised that further consideration should be given to SO_2 emissions from solid fuel domestic heating sources.

5.3 Review and Assessment: Pollutant Specific Guidance LAQM.TG4(00) May 2000

The guidance is cautionary regarding SO_2 from domestic solid fuel burning. It recognises that solid fuel burning for domestic heating has largely been replaced by alternative fuels throughout most of the UK. However, it suggests that there are a few areas remaining where solid fuel burning is still predominant, and which may have the potential to cause exceedances of the objectives. **The risk of exceedance within an area can be considered significant where the density of coal burning (or Solid Smokeless Fuel burning) houses exceeds 300 properties per 1 km2.**

5.4 The "First Phase Air Quality Review and Assessment" report

In March 2000, NETCEN produced a report for the Department of the Environment, Transport and the Regions, National Assembly for Wales, the Scottish Executive and Department of the Environment in Northern Ireland entitled "First Phase Air Quality Review and Assessment". (see http://www.aeat.co.uk/netcen/airqual/laqm/fpr.html). The information contained therein can be used to augment the screening procedures in the current pollutant specific guidance. The approach is consistent with the results of SO_2 monitoring carried out in Muir of Ord by Ross and Cromarty District Council.

The "First Phase Air Quality Review and Assessment" document reports that Market Research Northern Ireland Ltd were employed to carry out a survey of current and expected future use of solid fuels in Belfast and the Dearne Valley, South Yorkshire, using standard market research techniques. Solid fuels are burned extensively for domestic heating in these areas.

5.5 Household fuel use in Belfast and the Dearne Valley

Although the proportion of homes in Belfast and the Dearne Valley areas burning solid fuel were similar, the overall fuel use was very different. Whereas gas is the principal fuel in England, oil is the main fuel in Northern Ireland. This is shown in Figure 11.

Figure 11 Domestic solid fuel use in Belfast and the Dearne Valley

Area	Fuel	Main Fuel % household usage	% of households burning solid fuel
Belfast	Oil	65	
	LPG	2	
	Electricity	16	
	Solid Fuel	**17**	**23**
Dearne Valley, South Yorkshire	Oil	0	
	Gas	72	
	Electricity	4	
	Solid Fuel	**24**	**25**

In the Highlands, in villages where there is no mains gas supply, it is suggested that the percentage of households which burn solid fuel is unlikely to exceed the percentages which pertain in Belfast and Dearne Valley. **Thus it is assumed that in any Highland village or town, the percentage of households which burn solid fuel is unlikely to exceed 25%.** Not all of those households which burn solid fuel will use it as the main fuel for water and space heating. However, the 25% figure is used to give a worst case scenario.

5.6 Household densities in Highland villages and towns.

The number of households in the most densely populated 1km^2 square in various localities in the Highland Council area were calculated by using the ArcView GIS system which is licensed to Highland Council. For the purpose of this screening exercise, it is assumed that no more that 25% of these households will use solid fuel either partially, or as the main fuel for water and space heating. Thus, on that premise, the total number of households in any 1 km^2 square would need to exceed 1200 in order for there to be more than 300 dwellings which burn solid fuel (1200 x 0.25 = 300).

Figure 12 presents the information in a tabular form which shows the number of households in the most densely built up area of each location, the number of households which are assumed to use solid fuel (25%) and the percentage of houses in the 1 km^2 square which would need to burn solid fuel to exceed a density of 300 solid fuel burning households/1 km ^{2}.

Figure 12 Estimated households which burn solid fuel in various locations with no mains gas

A	B	C	D
Location	**Households per 1 km^2 square**	**Estimated households which use solid fuel (25% of B assumed)**	**% of B required to exceed 300 solid fuel burning households/ km ^{2}**
Aviemore	978	245	31
Beauly	575	144	53
Fort William	826	207	37
Golspie	520	130	58
Granton on Spey	909	228	34
Kingussie	603	151	50
Maryburgh	466	117	65
Muir of Ord	665	167	46

As can be seen from Figure 12, of those selected, the location with the greatest density of dwellings was found in Aviemore with 978 households per 1 km^2 square. If 25 % of these dwellings burned solid fuel, the density of solid fuel burning dwellings would be 245 households per 1 km^2 square and **hence the risk of exceeding the air quality objectives for SO_2 would not be significant.**

In the case of Muir of Ord, 46% of households would require to burn solid fuel for there to be considered a risk of exceeding the air quality objectives for SO_2.

Having regard to the screening procedures which have been adopted for SO_2 arising from solid fuel domestic heating, it can be concluded that the risk of causing exceedances of the air quality objective at relevant locations in the Highlands is insignificant for 2005.

The Scottish Executive also advised that further consideration should be given to SO_2 emissions from boiler plant greater than 5MW – 20 MW.

5.7 SO_2 from Small Combustion Plants of <20MW

Combustion plant of less than 20MW are not subject to control by the Scottish Environment Protection Agency.

In May 2000, Entec UK Ltd reported to the Scottish Executive on "Emissions of Sulphur dioxide from Small Combustion Plants of <20MW. Entec carried out screening modelling on the "worst case" sites in each local authority. In Highland, 29 boilers were considered. The air quality objective used for comparison in the survey was the 15 minute mean objective (not to be exceeded more than 35 times each year – equivalent to the 99.9^{th} percentile). The value for the objective, to be achieved by the end of 2005, is **266 μg/m^3**. In Highland the prediction for the "worst case" boiler in Highland was **166 μg/m^3.**

In the light of the Entec report it can be concluded that, in the case of SO_2 emissions from Small Combustion Plants of <20MW, the risk of causing exceedances of the Government's air quality objective at relevant locations in the Highlands is insignificant for 2005.

6 Conclusions

6.1 Revised assessment for NO_2

The purpose of this addendum is to reconsider the impact which road traffic in Inverness will have on the Government's objectives for NO_2 in the year 2005.

It takes account of:-

- revised air quality standards for NO_2
- revised estimates for traffic flow in 2005
- revised pollutant specific guidance
- additional data from passive diffusion tube sampling in Inverness.

Having regard to the above, it can be concluded that the risk of traffic sources causing exceedances of the Government's air quality objectives for NO_2 in 2005 at relevant locations in the Highlands is insignificant.

6.2 Revised assessment for PM_{10}

The purpose of this addendum is to reconsider the impact which road traffic in Inverness will have on the Government's objectives for PM_{10} in the year 2004.

It takes account of:-

- revised air quality standards for PM_{10}
- revised estimates for traffic flow in 2004
- revised pollutant specific guidance

Having regard to the above, it can be concluded that the risk of traffic sources causing exceedances of the Government's air quality objectives for PM_{10} in 2004 at relevant locations in the Highlands is insignificant.

6.3 Revised assessment of emissions from Part A and Part B processes

The Scottish Environment Protection Agency advise that all processes in Highland comply with emission standards for the pollutants of interest and that emissions from such processes do not compromise the Air Quality Objectives at present and will not do so in 2005

6.4 Revised assessment for SO_2

In March 2000, NETCEN produced a report for the Department of the Environment, Transport and the Regions, National Assembly for Wales, the Scottish Executive and Department of the Environment in Northern Ireland entitled "First Phase Air Quality Review and Assessment"

(see http://www.aeat.co.uk/netcen/airqual/laqm/fpr.html). The information contained therein can be used to augment the aforementioned guidance and screening procedures in Review and Assessment: Pollutant Specific Guidance LAQM.TG4(00) May 2000.

Having regard to the screening procedures for SO_2, from solid fuel domestic heating, in the light of the above report it can be concluded that the risk of causing exceedances of the Government's air quality objective at relevant locations in the Highlands is insignificant for 2005

In May 2000, Entec UK Ltd reported to the Scottish Executive on "Emissions of Sulphur dioxide from Small Combustion Plants of <20MW"

In the light of the above report it can be concluded that, in the case of SO2 emissions from Small Combustion Plants of <20MW the risk of causing exceedances of the Government's air quality objective at relevant locations in the Highlands is insignificant for 2005.

7 BIBLIOGRAPHY

In preparing this report, a number of publications are utilised as sources of guidance and information.

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Figure 13 Factors affecting NO_2 levels in the year 2005 and PM_{10} levels in the year 2004 from road traffic sources

Highland Council		Factors affecting NO_2 levels in the year 2005			Factors affecting PM_{10} levels in the year 2004		
Road Section	1 x 1 km square Grid Reference	Estimated Background NOx ($\mu g/m^3$)	Projected Daily Mean Traffic Flow	Average Vehicle Speed (kilometres per hour)	Estimated Background PM_{10} ($\mu g/m^3$)	Projected Daily Mean Traffic Flow	Average Vehicle Speed (miles per hour)
Academy Street	266500 844500	10	14,500	15 kph	15.8	14,450	10 mph
Castle Street	266500 844500	10	18,000	20 kph	15.8	17,800	13 mph
Ness Bridge	266500 844500	10	18,000	8 kph	15.8	17.900	5 mph
Bridge Road	267500 844500	10.2	24,750	48 kph	15.8	24,500	30 mph
Raigmore interchange to Smithton	269500 844500	7.5	30,120	56 kph	15.6	30,000	35 mph
Telford Street	265500 844500	8.4	21,980	30 kph	15.7	21,800	18 mph
Longman roundabout to Charleston	265500 848500	5.3	28,300	96 kph	15.4	27,355	60 mph
Shore Street roundabout to Rose Street roundabout	266500 844500	10	24,550	48 kph	15.7	24,250	30 mph
Friars Bridge	266500 844500	10	23,000	48 kph	15.7	22.900	30 mph
Harbour Road roundabout to Longman roundabout	266500 844500	10	30,120	55 kph	15.8	28,120	35 mph
Raigmore Interchange to Kessock Bridge	267500 846500	9.2	32,900	96 kph	15.6	31,810	60 mph
Rose Street roundabout to Harbour Road roundabout	266500 844500	10	28,225	56 kph	15.8	28,050	35 mph

Key ** denotes estimation.