MARLBOROUGH DISTRICT COUNCIL

Ambient Air Quality Monitoring Annual Report 2003

Prepared for
Marlborough District Council

By
Laboratory Services - Air Quality Group

November 2004
AQ5017

Ambient Air Quality Monitoring
Annual Report 2003

A report for
Marlborough District Council
Seymour Square
Blenheim

Ph 03 578 5249
Contact: Lynda Neame

11 November 2004

Watercare Services Ltd
52 Aintree Avenue
Airport Oaks
PO Box 107 028
Airport Oaks
AUCKLAND

Ph 09 255 1188
Fax 09 255 1530

[ ] [ ]

Dr Judy Warren
Author

Rob Hannaby
Peer Reviewer

DISCLAIMER

This report or document ("the Report") is given by Watercare Services Ltd solely for the benefit of Marlborough District Council as defined in the Contract or Terms and Conditions between Watercare Services Ltd and Marlborough District Council, and is strictly subject to the conditions laid out in that Contract or Terms and Conditions.

Neither Watercare Services Ltd nor any of its employees makes any warranty, express or implied, or assumes any legal liability or responsibility for use of the Report or its contents by any other person or organisation.

TABLE OF CONTENTS

Page

1 INTRODUCTION 6
2 PARAMETERS MONITORED 7
2.1 Visibility 7
2.2 Inhalable Particulate (PM_{10}) 8
2.3 Sulphur Dioxide 8
2.4 Nitrogen Dioxide 8
3 AIR QUALITY GUIDELINES AND STANDARDS 10
3.1 New Zealand Ambient Air Quality National Environmental Standards 10
3.2 New Zealand Environmental Performance Indicators 11
4 MONITORING SITES 12
4.1 Visibility 12
4.2 Inhalable Particulate 12
4.3 Passive SO_2 and NO_2 12
5 METHODS 14
5.1 Quality Assurance 14
5.2 Visibility Monitoring 14
5.3 Inhalable Particulate Monitoring 14
5.4 Passive SO_2 and NO_2 Monitoring 14
6 VISIBILITY STUDY – RESULTS AND DISCUSSION 16
6.1 Visibility Monitoring Summary 16
6.2 Visibility and Presence of Haze 16
6.3 Overall Clarity Rating for Marlborough District 18
6.4 Overall Visibility 20
7 INHALABLE PARTICULATE – RESULTS AND DISCUSSION 21
7.1 Ambient Particulate in Marlborough 21
7.2 Exceedances of Ambient Air Quality Guidelines for PM_{10} 24
8 COMPARISON OF PARTICULATE AND VISIBILITY DATA, 2003 26
9 PASSIVE NO_2 AND SO_2 – RESULTS AND DISCUSSION 27
9.1 Passive NO_2 and SO_2 Results - Marlborough 27
10 SUMMARY 30
10.1 Visibility 30
10.2 Inhalable Particulate 30

10.3 Passive SO_2 and NO_2 30

TABLES

Page

Table 1: Ambient Air Quality Guidelines and Standards 10
Table 2: Environmental Performance Indicators for Air 11
Table 3: MDC Site Description Summary 13
Table 4: Visibility Monitoring Summary 16
Table 5: Occurrence of haze, smoke and dust 17
Table 6: Visual Range – Farthest Distance 19
Table 7: PM_{10} Summary Statistics 2002 22
Table 8: PM_{10} Exceedances and Meteorological Data 25
Table 9: Comparison of PM_{10} to Atmospheric Visibility 26

FIGURES

Page

Figure 1: Agricultural Burning, Waihopai Valley, Marlborough District 7
Figure 2: HiVol PM_{10} Sampler 15
Figure 3: Occurrence of Haze, Inversions and Smoke 18
Figure 4: Visibility of Target Landmark 19
Figure 5: General Visibility Rating 20
Figure 6: Comparison of PM_{10} to EPI 21
Figure 7: PM_{10} concentrations (24 hr avg) at Blenheim 23
Figure 8: PM_{10} concentrations (24 hr avg) at Redwoodtown 23
Figure 9: PM_{10} concentrations (24 hr avg) at Picton 24
Figure 10: Passive NO_2 Results (monthly avg) 27
Figure 11: Passive NO_2, 2003 & 2003 28
Figure 12: Passive SO_2 Results (monthly avg) 28
Figure 13: Passive SO_2 2002 & 2003 29

APPENDICES

Appendix A **PM_{10} Exceedance – Meteorological Data**
Appendix B **Laboratory Reports**

1 INTRODUCTION

The Marlborough District Council (MDC) undertakes ambient air quality monitoring within the Marlborough district.

In 2003, the MDC monitored visibility at three sites in the district from May to December. Monitoring of visibility commenced in July 1999 at four sites in the Marlborough District. At three of these sites, monitoring was discontinued after one year. At the fourth site (Woodbourne), monitoring has continued from 1999 up until present. Results from 1999 to 2001 were previously reported in the Ambient Air Quality Monitoring Annual Report 2001. This report presents results from all sites for 2003.

Inhalable particulate is monitored on a year-round basis at one site in Blenheim (Middle Renwick Road). In addition, the MDC monitored inhalable particulate at Oxford St, Picton from 13 October 2002 to 26 September 2003, and at Redwoodtown, Blenheim, from 22 June 2003 to 26 September 2003 (winter 2003). Particulate concentrations are reported to MDC by Watercare on a monthly basis.

Furthermore, MDC have undertaken passive nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) monitoring at five sites in the district from July 2002 to November 2003. Passive NO_2 and SO_2 results are reported to MDC on a quarterly basis.

This report contains an annual summary of particulate results for 2003 and passive NO_2 and SO_2 results for 2002 and 2003.

2 PARAMETERS MONITORED

2.1 Visibility

Visibility is a measure of the degree to which the atmosphere is transparent. Visibility degradation is caused by haze, which obscures the clarity, colour and form of what is seen through the atmosphere.

The amount of cloud cover, and angle of sun, can also affect visibility. Low cloud and rain can obscure visibility, and therefore weather conditions at the time of observation are recorded. Furthermore, it is desirable to have recordings of visibility made at similar times of the day to minimise variability due to sun angle.

Visibility can be used as an indicator of general air quality. The main factors which affect visibility include particulate matter and nitrogen dioxide (NO_2). Other air pollutants such as other nitrogen oxides (NO_2, NO, N_2O, and other nitrogen oxides collectively referred to as NO_x), sulphur dioxide (SO_2), ozone (O_3) and volatile organic compounds (VOC) can also affect visibility through secondary particle formation. Fine particles ($PM_{2.5}$) are the most significant contributors to reduced visibility.

Sources of contaminants that cause reduced visibility include natural processes (windblown dust, coastal processes, volcanic eruptions), industrial discharges (SO_2 and NO_x), agricultural discharges such as dust from cultivation and smoke from rural burn-offs, and domestic sources, including home heating and outdoor burning, and vehicles. Visibility may also be enhanced or reduced by weather conditions. Warm dry conditions may favour secondary particle formation, whereas rain can wash particles out of the atmosphere.

Figure 1: Agricultural Burning, Waihopai Valley, Marlborough District

2.2 Inhalable Particulate (PM_{10})

Particulate matter refers to numerous substances that exist in the atmosphere. It is a somewhat complex category, encompassing a wide range of chemically and physically diverse substances. Particulate matter includes all solid and aerosol matter that exists in ambient conditions.

Particulate matter has been divided into several categories, based upon the potential health or environmental effect. Total suspended particulate (TSP) consists of all particles which range in size from 20 μm diameter downwards. Particles larger than 20 μm are too large to remain airborne for extended periods, and thus are categorised as deposited particulate.

TSP is sufficiently small to be inhaled, however, the larger particles (10 – 20 μm) are readily filtered out in the nasal cavity. Therefore, it is not considered to be the main cause of concern with respect to health effects. TSP has a nuisance or annoyance effect, degrading the aesthetic quality of the ambient air.

Particles with a diameter of 10 μm or less (PM_{10}) can be inhaled into the respiratory system. The main effect of inhalable particulate is on human health. Major health effects are increased mortality, aggravation of existing respiratory disease, increased hospital admissions, and increased lost days (lost work days, school days, and increase in restricted activity days).

Current research is recognising the division of particulate into finer fractions, including $PM_{2.5}$ and PM_1, which may penetrate beyond the bronchial tubes and deep into the aveoli. These fine particulates contain secondarily formed aerosols (gas-to-particle conversion), combustion particles, and recondenced organic and metal vapours. Larger particles usually contain earth crust materials and fugitive dust from roads and industry.

2.3 Sulphur Dioxide

Sulphur dioxide is an acidic gas with a pungent odour, which is mainly produced by the burning of fossil fuels. The gas is quite corrosive and can cause damage to building and other materials. It can also have significant effects on human health.

Sulphur dioxide can also have significant effects on the human respiratory system. Inhalation of high ambient concentrations of sulphur dioxide can cause stimulation of the nerves in the air passages, resulting in a reflex cough, irritation and chest tightness. It can also cause narrowing of the air passages, particularly in people suffering from asthma and chronic lung disease. These people frequently have narrowed airways, and any further restriction will have a disproportionately large effect, compared to people with uncompromised respiratory systems.

2.4 Nitrogen Dioxide

Nitrogen oxides incorporates several species that exist in the atmosphere, which are collectively referred to as NO_x. The two main oxides are nitrogen dioxide (NO_2), which is of concern due to its potential to cause health effects, and the monoxide form nitric oxide (NO), which is less toxic but may oxidise to NO_2 in the atmosphere. NO_2 contributes to susceptibility to respiratory infections.

Nitrogen oxides are formed in most combustion processes by oxidation of the nitrogen present in the atmosphere. Nitric oxide is the predominant primary product but this can then be oxidised to nitrogen dioxide in ambient air. As with carbon monoxide, motor vehicles are the major source of the nitrogen oxides in most parts of the country, although power stations and other large combustion units may be significant localised sources as well.

The main health effects of the oxides of nitrogen are due to NO_2, which is a respiratory irritant. Nitric oxide is believed to be quite harmless at the levels normally encountered in urban air.

Nitrogen oxides are also important air pollutants because of their role in photochemical smog. NO_2 is a reddish brown gas, which if often visible during smog events, and has synergistic effects with other pollutants such as SO_2 and particulate.

3 AIR QUALITY GUIDELINES AND STANDARDS

3.1 New Zealand Ambient Air Quality National Environmental Standards

The Ministry for the Environment (MfE) has promulgated National Environmental Standards (NES) for air quality. These standards were released in July 2004, and for several major contaminants they replaced the Ambient Air Quality Guidelines (AAQG) 2002. Both the NES and the AAQG are set to protect human health. The NES must be complied with by 01 September 2005, but allow a number of exceedances per year.

Visibility is an indicator of air pollution i.e. it can be used to indicate the presence of air pollutants which may have an adverse effect on health. As it is only an indicator criteria, it does not have a guideline value.

Inhalable particulate has recognised direct effects on human health. The NES for inhalable particulate are given in Table 1.

Sulphur dioxide and nitrogen dioxide also have a recognised effect on human health. There are NES or AAQG for 1 hour and 24 hour averaging periods. Passive monitoring, which measures ambient concentrations over a one month averaging period, cannot be directly compared to these values, but nevertheless provides an indication of the potential for a problem to exist. Passive sampling results can be compared to UK guidelines for annual averages. Passive samplers can also provide a comparison between different locations within a region.

Table 1: Ambient Air Quality Guidelines and Standards

Contaminant	Source	Value	Averaging Period	Purpose
Inhalable particulate (PM_{10})	NZ AAQG 2002	20 $\mu g/m^3$	Annual	Chronic health effects
	NZ NES 2004	50 $\mu g/m^3$	24 hour average	Acute health effects
Fine particulate ($PM_{2.5}$)	NZ AAQG 2002	25 $\mu g/m^3$	24 hours	Monitoring guideline
Sulphur dioxide	NZ AAQG 2002	120 $\mu g/m^3$	24 hour average	Health effects
	NZ NES 2004	350 $\mu g/m^3$ (570 $\mu g/m^3$)	1 hour average (max value)	Health effects
	UK AQM 2002	20 $\mu g/m^3$	Annual average	Ecosystem
Nitrogen dioxide	NZ AAQG 2002	100 $\mu g/m^3$	24 hour average	Health effects
	NZ NES 2004	200 $\mu g/m^3$	1 hour average	Health effects
	UK AQM 2002	40 $\mu g/m^3$	Annual average	Health effects

3.2 New Zealand Environmental Performance Indicators

The Resource Management Act (1991) requires the quality of the environment to be maintained or enhanced. In order to provide guidance on when enhancement should be required, the MfE has provided Environmental Performance Indicators (EPI), as set out in Table 2. These indicators can act as both indicators of poor air quality, and goals which policy can work towards achieving.

Table 2: Environmental Performance Indicators for Air

Category	Maximum Measured Value	Comment
Action	Exceeds guideline	Completely unacceptable by national and international standards
Alert	Between 66 % and 100 % of the guideline	Warning level, which can lead to guidelines being exceeded if trends are not curbed
Acceptable	Between 33 % and 66 % of the guideline	A broad category, where maximum values might be of concern in some sensitive locations, but are generally at a level which does not warrant dramatic action
Good	Between 10 % and 33 % of the guideline	Peak measurements in this range are unlikely to affect air quality
Excellent	Less than 10% of the guideline	Of little concern. If maximum values are less than a tenth of the guideline, average values are likely to be much less
Not Assessed		Insufficient monitoring data to assess this category

4 MONITORING SITES

4.1 Visibility

There are four sites that are used by MDC for visibility monitoring. They are:

- Elisha Drive, Blenheim
- MDC Office Roof, Seymour Square, Blenheim
- Scotland Street, Picton
- Woodbourne Airport, Woodbourne

Visibility monitoring commenced at all four sites in 1999, and continued until July 2000. From July 2000 until the present date, visibility monitoring has been continued at the Woodbourne site. From May 2003 until the end of 2003, and continuing through 2004, monitoring has re-commenced at the other three sites.

This report presents results of monitoring at Woodbourne, Elisha Drive, MDC Blenheim and Picton sites in 2003.

4.2 Inhalable Particulate

The permanent PM_{10} monitoring site is located at 106 Middle Renwick Road, Blenheim. This site has been operating since February 2000.

The Redwoodtown site was located at Redwoodtown Bowling Club, 65A Weld St, Blenheim. Monitoring was undertaken between June and September 2003. This site was previously monitored from September 2001 to December 2001, and from May to September 2002.

The Picton site was established on Oxford Street. Monitoring commenced on 13 October 2002, and was terminated on 26 September 2003. This site has not previously been used for air quality monitoring.

A summary description of each site, as provided by MDC, is included in Table 3.

4.3 Passive SO_2 and NO_2

There are five sites used for passive SO_2 and NO_2 monitoring. Both SO_2 and NO_2 is monitored at each site. The sites are:

- Picton
- Bowling Club
- Riverlands
- State Highway 1
- State Highway 6

Monitoring commenced at all sites in June 2002, and was terminated in November 2003.

A detailed description of each site, as provided by MDC, is included in Table 3.

	Site Area	Where	Purpose	Details	X-coord	Y-coord	Parameter	Old Site ID	New Site ID
Visibility	**Blenheim**	Elisha Drive, Blenheim	Survey site to monitor visibility	Elevated site , residential over town.	2590680	5962532	Visibility	**M1**	
	Blenheim	MDC Beehive Building, Seymour Square	Survey site to monitor visibility	On building over town.	2589688	5965710	Visibility	**M2**	
	Woodbourne	Air Traffic Control Tower	Permanent site to monitor visibility	Airport control tower.	2582409	5965467	Visibility	**M3**	
	Picton	39 Scotland Street, Picton	Survey site to monitor visibility	Elevated site , residential over town.	2593658	5989592	Visibility	**M4**	
PM10	**Picton**	25 Oxford Street	Survey site to monitor PM10	Enclosed site.	2593855	5989623	PM10	None	
	Blenheim	SH6 - 106 Middle Renwick Road	Permanent site to monitor PM10	Enclosed site.	2588212	5966047	PM10	**2**	
	Blenheim	Blenheim Bowling Club, 65A Weld Street, Redwoodtown	Survey site to monitor PM10	Enclosed site.	2589778	5964037	PM10	**3**	
SO2 and NO2	**Blenheim**	SH1 - 34 Main Street	Survey site to monitor SO2 and NO2	Roadside.	2590343	5965502	SO2 and NO2	None	
	Blenheim	Blenheim Bowling Club, 65A Weld Street, Redwoodtown	Survey site to monitor SO2 and NO2	Enclosed site.	2589760	5964034	SO2 and NO2	**3**	
	Blenheim	Manchester Street, Riverlands Industrial	Survey site to monitor SO2 and NO2	Roadside.	2594114	5963633	SO2 and NO2	None	
	Blenheim	SH6 - 136 Middle Renwick Road	Survey site to monitor SO2 and NO2	Roadside.	2588029	5966019	SO2 and NO2	None	
	Picton	68 Broadway, Picton	Survey site to monitor SO2 and NO2	Roadside.	2593966	5989950	SO2 and NO2	None	

Table 3: MDC Site Description Summary

5 METHODS

5.1 Quality Assurance

All sampling is undertaken by the Marlborough District Council. Sampling operation includes maintenance of the site and calibration of monitoring equipment, and changeover of passive samplers on a monthly basis. Analysis of filters and provision of quality assured data is undertaken by Watercare.

Watercare Services Ltd holds IANZ accreditation for the operation of its laboratory. The Watercare Services Ltd Air Quality Department holds IANZ accreditation for a variety of its air quality sampling and analytical methods, including HiVol PM_{10} sampling.

5.2 Visibility Monitoring

Visibility monitoring in MDC was undertaken using manual observations of visibility. No instruments were used for recording visibility. Visibility monitoring was undertaken in accordance with the process determined for MDC, and detailed in the ESR report "Visibility observers guide: human judgement of visible air quality" (ESR July 1999). Monitoring required observation of visibility three times per week (Monday, Wednesday and Friday), at each of four sites. Multiple parameters were recorded, including weather conditions, sky colour, presence of haze, smoke, or dust, and farthest distance visible.

Visibility monitoring uses the same methodology as was employed in the project commencing 1999.

The visibility program design is in general accordance with the Ministry for the Environment's (MfE) "Good practice guide for monitoring and management of visibility in New Zealand" (MfE 2001).

5.3 Inhalable Particulate Monitoring

Particulate is collected by drawing air through a filter using a standard high volume (HiVol) air sampler (Figure 3). The inlet on the sampler has a cut-off of 10 microns (PM_{10}), which is the limit for total inhalable particulates. The method for the high volume sampling is Watercare Test Method 0C09, which is based on USEPA cfr40.

Sampling is usually undertaken for a 24 hour period. Sampling occurs once per three days in the winter period when particulate concentrations are potentially higher (1 in 3 day regime), but extends to once per six days throughout the rest of the year. In 2003, a 1 in 3 day regime was undertaken between 01 May and 1 September.

5.4 Passive SO_2 and NO_2 Monitoring

Passive samplers were supplied by Watercare, with analysis subcontracted to ELS. Samplers were prepared and constructed in accordance with methods developed by CSIRO, as reported in Ayers *et al* 1998. Briefly, glass fibre filters are impregnated with sodium hydroxide and sodium iodide. The filters are installed in a plastic casing, with a stainless steel mesh on one end to allow exposure to ambient air. Atmospheric NO_2 reacts with sodium iodide to form nitrite, which is extracted and analysed by UV Visible spectrophotometic method.

Samplers were exposed for periods of approximately one month. Laboratory blanks and spikes were prepared and analysed with each batch. Samplers were housed under an inverted Frisbee.

Figure 2: HiVol PM_{10} Sampler

6 VISIBILITY STUDY – RESULTS AND DISCUSSION

6.1 Visibility Monitoring Summary

Monitoring was undertaken at Woodbourne from 1999 to the present day. Earlier (pre 2003) results from Woodbourne were reported in the 2002 Annual Report.

Monitoring at the other three sites was undertaken from 1999 to 2000 (reported in the 2001 Annual Report). These sites were not monitored in 2001 or 2002, but monitoring recommenced in 2003 and continued to the end of the year (and is continuing in 2004). Only 2003 results have been presented in this report.

The number of observations, and time of day when observations were made, are given in Table 4.

Table 4: Visibility Monitoring Summary

Site	Start Date	End Date (in 2003)	Number of Observations	Observation Times
Woodbourne	01/01/03	31/12/03	248	08:07-09:15 16:23–17:53
Elisha Drive	02/05/03	31/12/03	98	08:07-09:15 16:23–17:53
MDC Blenheim	05/05/03	19/12/03	158	08:00-11:40 15:30-17:00
Picton	19/05/03	31/12/03	91	07:57-10:45

6.2 Visibility and Presence of Haze

Aside from weather conditions, it is the presence of haze in the atmosphere that can most severely affect visibility. Haze may be caused by natural processes or human activity. It may also be exacerbated by atmospheric conditions, in particular by temperature inversions trapping particulate within a limited atmospheric depth.

Table 5 shows the percentage of observations when haze, dust, or smoke was recorded, for each site. Haze, smoke and dust recordings are taken directly from the field observations. These define "haze" as a brown sky colour. "Smoke" refers to either an individual plume e.g. agricultural fire, or a collection of sources e.g. households. "Dust" is non-smoke plume.

Elisha Drive had the highest percentage of haze and smoke. Haze occurred on 22 % of the monitored days, and smoke was observed on 92% of the monitored days. The Elisha Drive site is elevated above the plains on the edge of Blenheim, and the extremely high percentage of smoke reflects both domestic home heating and agricultural burnoffs.

At the other two sites urban (MDC Blenheim and Picton), smoke was observed on around 50% of monitored days. This is also a reasonably high frequency. At Woodbourne, a rural site, smoke was only observed on 17% of monitored days.

The frequency of smoke observation may have been skewed by the fact that at 3 sites, observations started in May when winter domestic heating had commenced. Also, recording smoke is a yes/no choice, with no indication of the scale of the plume. Nevertheless, smoke is a very common occurrence in the district.

The frequency of dust events was very low (refer Table 5).

Table 5: Occurrence of haze, smoke and dust

Site	Number of Observations	Haze as % of Total Observations	Smoke as % of Total Observations	Dust as % of Total Observations
Woodbourne	248	5.6%	17.3%	0.4%
Elisha Drive	98	22.4%	93.9%	1.0%
MDC Blenheim	158	8.9%	49.4%	1.3%
Picton	91	6.6%	50.5%	0.0%

Figure 3 shows the overall breakdown of days when haze was recorded. Haze occurred concurrently with smoke or inversions on 80 - 100% of recorded days. Inversions were concurrent with haze events for over 80% of the time at Elisha Drive and Picton, 31% of the time at Woodbourne, but only 14% of the time at MDC. The difference between sites may be due to the height of the observation point, but may also be affected by the observer's opinion of what constitutes an inversion. The high correlation of inversion and haze at most sites suggests that inversions do contribute significantly to formation of haze.

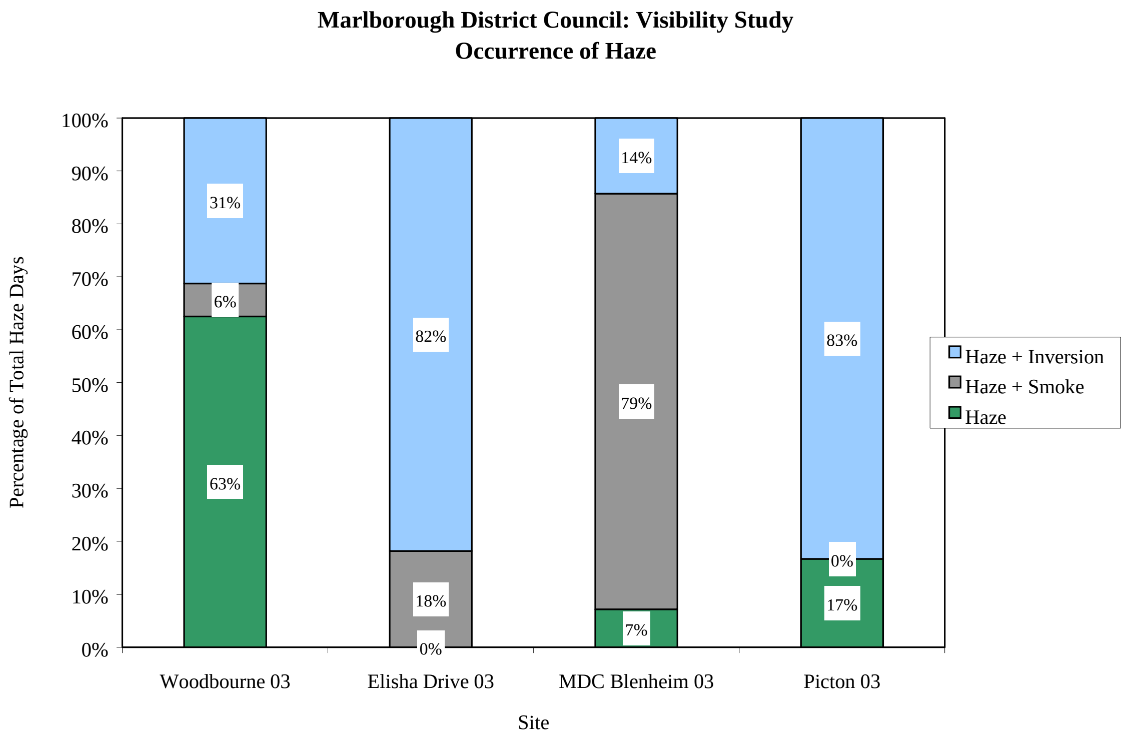

Figure 3: Occurrence of Haze, Inversions and Smoke

6.3 Overall Clarity Rating for Marlborough District

The overall visual clarity is represented by the distance through the atmosphere over which landmarks and features can be readily observed. It is represented by the ease with which the chosen target landmark for each site is observed, and by the farthest distance (farthest landmark) that can be viewed on an observation day. Visibility observations undertaken by MDC have included the clarity of the target outline, whether the target colour can be determined, and an estimate of farthest distance viewed. These combine to give an indication of the overall visual clarity.

The clarity with which the target could be viewed at each site is shown in Figure 4. Figure 4 shows that for the majority of the time, the target could be seen with excellent clarity, or only slight haziness.

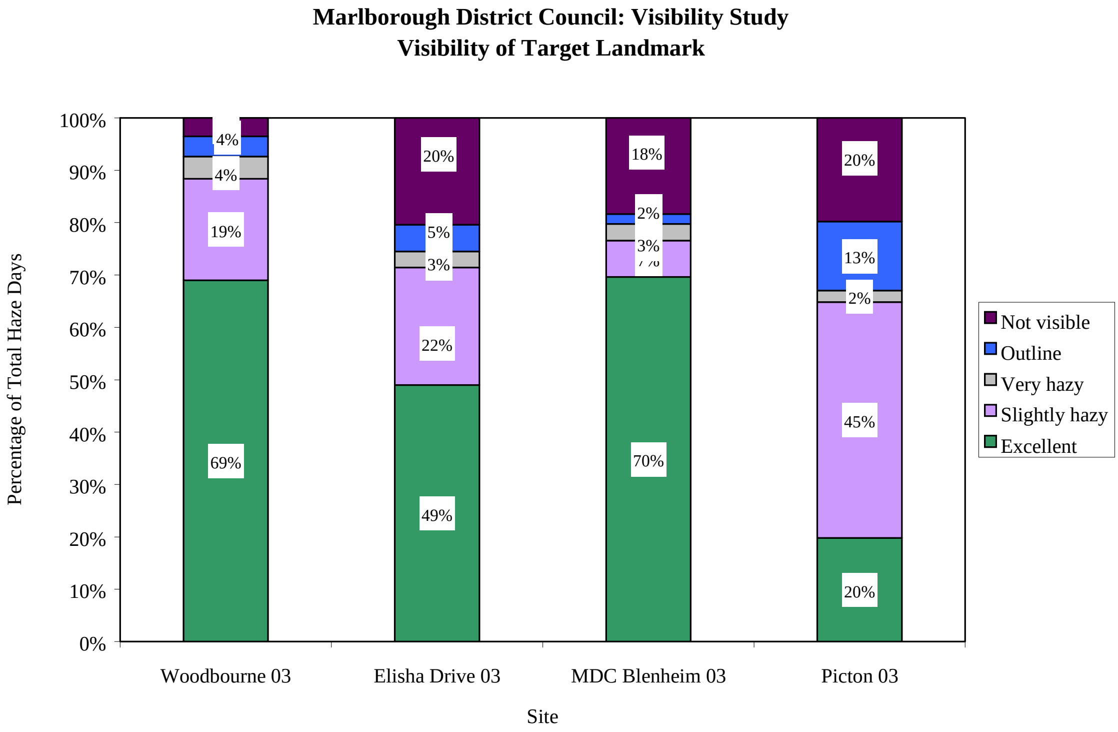

Figure 4: Visibility of Target Landmark

The maximum distance viewed each observation day was also recorded. The maximum distance provides an indication of the transparency of the atmosphere. Results are presented in Table 6.

Table 6: Visual Range – Farthest Distance

Site	0-2 km	2-10 km	11-25 km	26-50 km	51-69 km	70+ km
Woodbourne	1%	2%	9%	52%	13%	22%
Elisha Drive	0%	2%	6%	24%	64%	4%
MDC Blenheim	0%	9%	10%	24%	27%	30%
Picton	3%	24%	71%	1%	0%	0%

At Woodbourne, Elisha Drive and MDC Blenheim, maximum visual distance of 25 – 70 km is common. At Picton, the maximum visual distance is usually less than 25 km. This is because topography at Picton limits the number of available landmarks, rather than the visibility at Picton being poorer than the other sites.

6.4 Overall Visibility

The overall visibility gives an indication of how good visibility is on each day. Visibility observations undertaken by MDC included an assessment of the overall visibility on each observation day. The overall visibility rating is presented in Figure 5.

Figure 5 shows that in 2003, overall visibility was average or above average for 56% to 73% of the time. There is insufficient information from other regions to compare this to national averages. However, at Woodbourne, overall visibility was average or above average for between 65 and 80% of the time between 1999 and 2003. The rural location of Woodbourne may be contributing to this site having better overall visibility.

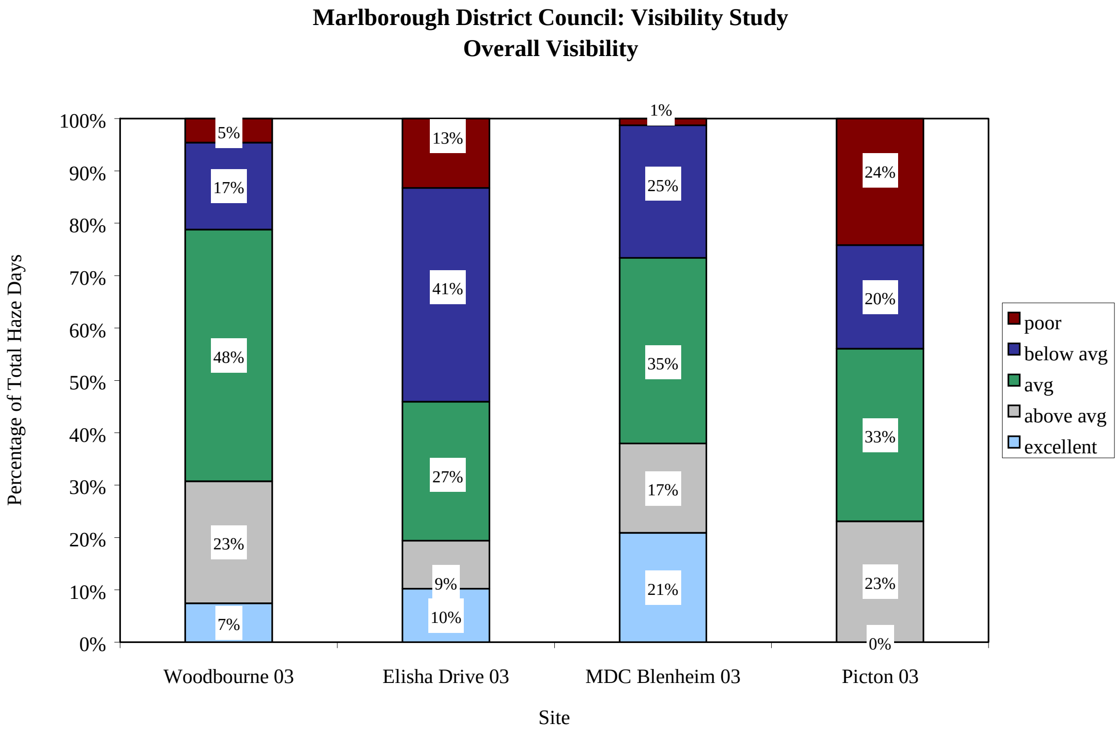

Figure 5: General Visibility Rating

7 INHALABLE PARTICULATE – RESULTS AND DISCUSSION

7.1 Ambient Particulate in Marlborough

Site performance in 2003 was good. Two of three sites achieved over 95% valid data. Individual results are: Middle Renwick Road 98.8%; Redwoodtown 96.6%; and Oxford St, Picton 89.4% valid data.

The air quality measured at each site, relative to AAQG, was determined by calculating the Environmental Performance Indicator (EPI) for three sites. The EPI's are shown graphically in Figure 6.

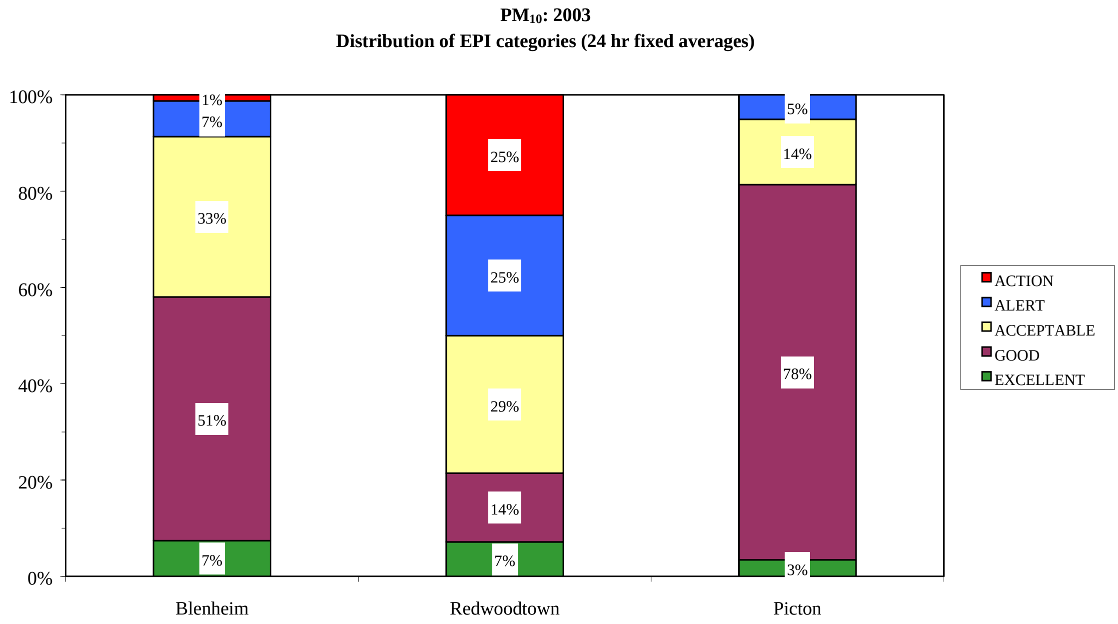

Figure 6: Comparison of PM_{10} to EPI

At the Blenheim site, there was one exceedance in 2003. Air quality was in the "action" category for 1% of the time, the "alert" category for 7% of the time, in the "acceptable" category for 33% of the time, in the "good" category for 51% of the time, and in the "excellent" category for 7% of the time (refer to Table 2 for explanation of categories). The percentage of "acceptable " and "good" air quality was similar to previous years. However, 2003 is the first year an exceedance has been recorded at this site.

At Redwoodtown, air quality appeared to be worse than in Blenheim. Guidelines were exceeded on 7 monitored days, resulting in 25% of days in "action" category, 25% "alert", 29% "acceptable", 14% "good", and 7% "excellent". It should be noted that the "alert" category is likely to be higher than for the Blenheim site because monitoring occurred over the winter only, when exceedances were more likely to occur. However, the timing of monitoring at this site is comparable to 2002. In 2002, this site was monitored from May to September, in 2003 it was monitored from July to September, and in both years exceedances occurred in the May to August period.

At Picton, air quality was similar to Blenheim in 2003. Air quality did not reach the “action” category (no exceedances occurred). Air quality was in the “alert” category for 5% of the time, in the “acceptable” category for 14% of the time, and in the “good” category for 78% of the time, and in the “excellent” category for 3% of the time (refer to Table 2 for explanation of categories).

The regular occurrences of “alert” categories in 2000, 2001, 2002 and 2003, and the occurrence of “action” category (guidelines have been exceeded) at Blenheim and Redwoodtown, indicate the need to improve air quality in Blenheim with respect to PM_{10}.

PM_{10} concentrations are shown in Figure 7 (Blenheim), Figure 8 (Redwoodtown), and Figure 9 (Picton). Summary statistics are presented in Table 7.

Table 7: PM_{10} Summary Statistics 2003

Site	No. of Samples	Maximum (μg/m^3)	Minimum (μg/m^3)	Average (μg/m^3)	No. of Exceedances of NES*
Blenheim	81	75.1	1.5	16.9	1
Redwoodtown	28	59.9	3.9	31.6	7
Picton	59	41.3	0.7	13.3	Nil

* Exceedance of 50 μg/m^3, 2004 NES

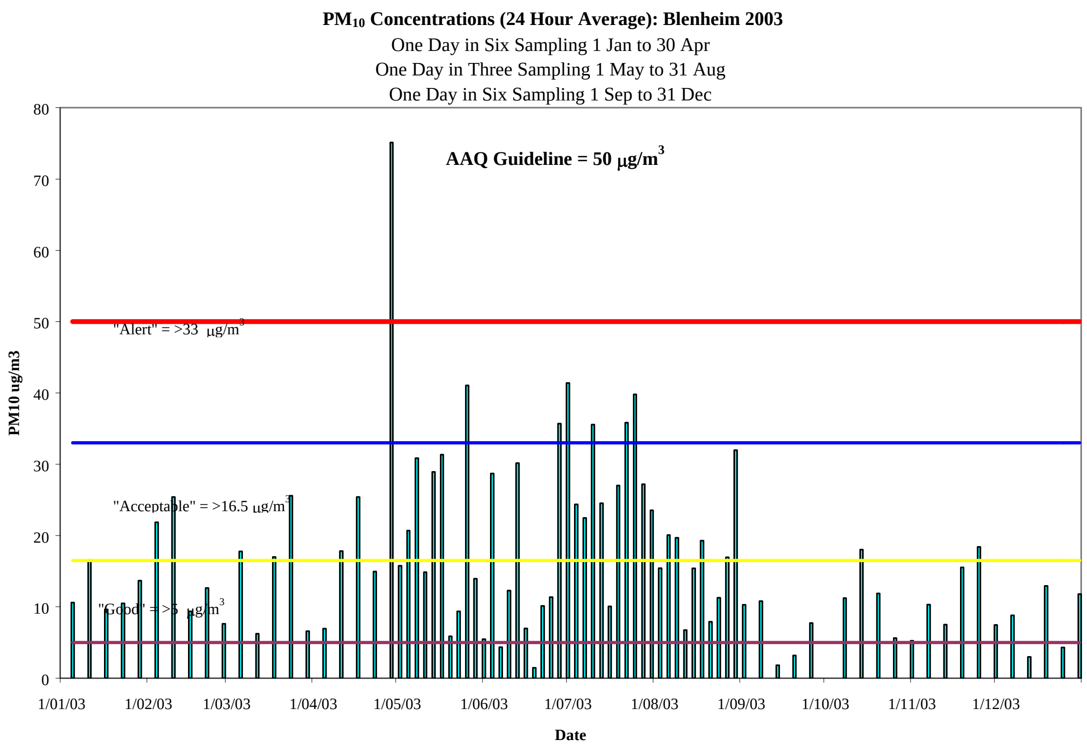

Figure 7: PM_{10} concentrations (24 hr avg) at Blenheim

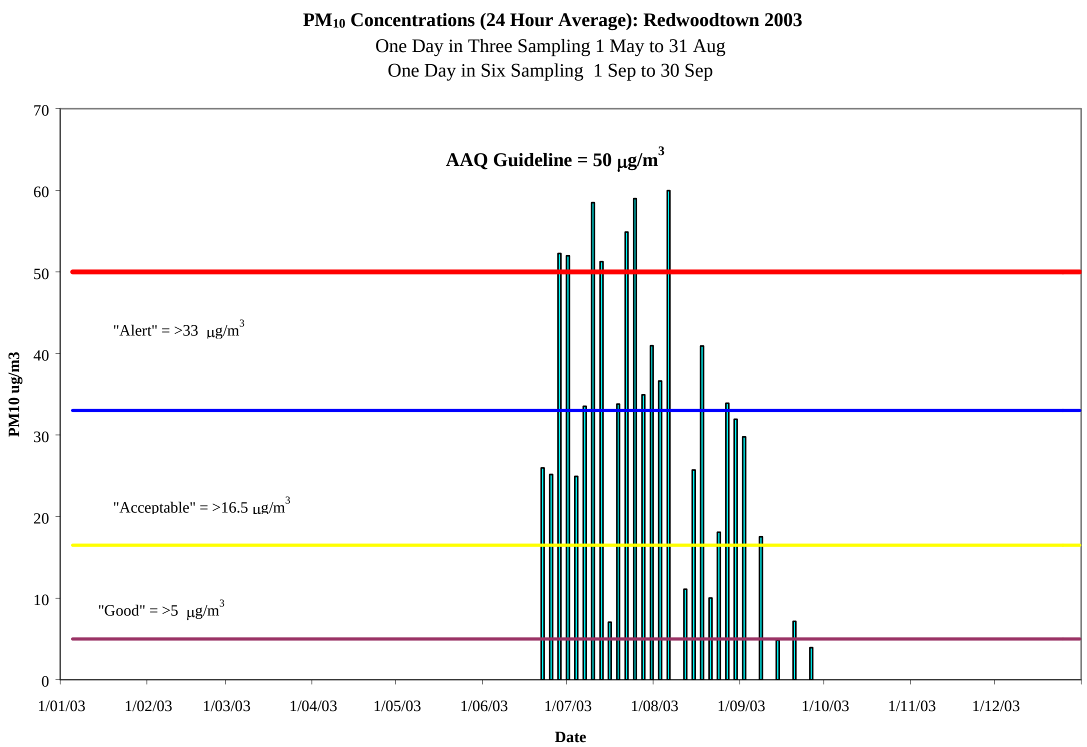

Figure 8: PM_{10} concentrations (24 hr avg) at Redwoodtown

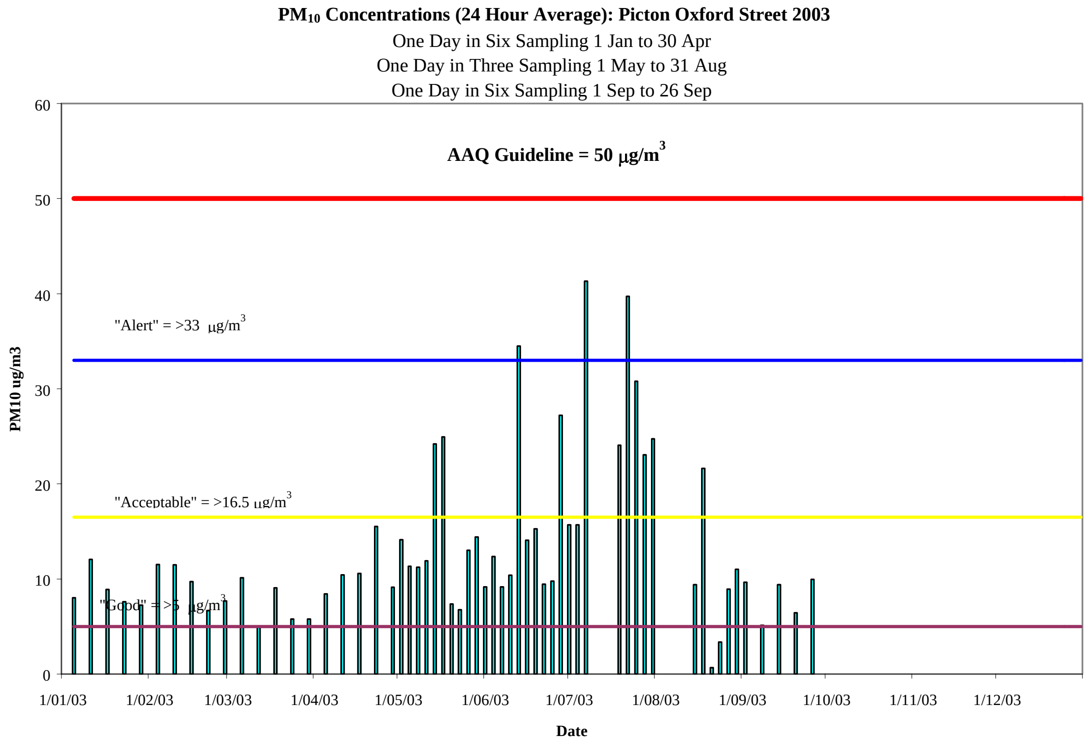

Figure 9: PM_{10} concentrations (24 hr avg) at Picton

7.2 Exceedances of Ambient Air Quality Guidelines for PM_{10}

The MfE NES of 50 µg/m^3 was exceeded at Blenheim on one of the monitored days, and at Redwoodtown on seven monitored days in 2003. The exceedance at Blenheim occurred in May, before the winter domestic heating season. This high value is an anomaly at this time of the year.

In addition to exceedances, the EPI category of "alert", i.e. ambient PM_{10} concentrations greater than 33 µg/m^3, was reached on six days at Blenheim and seven days at Redwoodtown. The effect of meteorology on ambient PM_{10} was evaluated.

Meteorological data from the Landcare Research Station is purchased from NIWA by MDC. The data obtained is wind speed, wind direction, rainfall and temperature.

The exceedance dates, ambient PM_{10} concentrations, and meteorological data is summarised in Table 8 below. Hourly wind speed and temperature results, and wind directions are shown graphically in Appendix A.

Table 8: PM_{10} Exceedances and Meteorological Data

Date	Blenheim PM_{10} ($\mu g/m^3$)	Redwoodtown PM_{10} ($\mu g/m^3$)	Rainfall (mm)	Average Temp (°C)	Average Wind Speed (m/s)
29/04/03	75.1	Not monitored	0.0	9.8	1.1
26/05/03	41.0	Not monitored	0.0	8.4	1.1
28/06/03	35.7	52.3	0.0	6.9	1.4
1/07/03	41.4	52.0	9.0	7.2	3.0
7/07/03	22.4	33.5	0.0	5.8	1.4
10/07/03	35.6	58.5	2.4	6.8	1.6
13/07/03	24.5	51.3	0.0	2.3	1.2
19/07/03	27.0	33.8	0.0	4.2	1.4
22/07/03	35.8	54.9	0.0	4.5	1.4
25/07/03	39.8	59.0	0.0	4.7	1.3
28/07/03	27.2	34.9	0.0	9.1	1.1
31/07/03	23.5	41.0			
3/08/03	15.4	36.6	0.0	8.8	2.8
6/08/03	20.1	59.9	0.0	7.7	3.1
18/08/03	19.3	40.9	0.0	7.20	3.0
27/08/03	16.9	33.9	0.0	11.6	2.7

Ambient PM_{10} concentrations were exceeded on days that typically had cool nights (0.4 – 6 °C) (refer Appendix A), and low wind speeds (average less than 5 m/s). This is expected where domestic heating is the major source of particulate – cool nights encourage heating use, and low wind speeds reduce dispersion.

The effect of meteorology on overall particulate concentrations was further evidenced by high values often being reported at both sites. For example, when an exceedance of the NES occurred at Redwoodtown, this often coincided with concentrations at Blenheim above 33 $\mu g/m^3$ (“alert” EPI category).

8 COMPARISON OF PARTICULATE AND VISIBILITY DATA, 2003

In 2003, there were a total of 16 days when the NES standard was breached, or when the MfE "alert" category was reached (Table 8). Visibility was monitored at Elisha Drive and MDC offices on some of these days. The visibility conditions on high particulate days, where available, are summarised in Table 9.

Table 9: Comparison of PM_{10} to Atmospheric Visibility

Date	Blenheim PM_{10} ($\mu g/m^3$)	Redwoodtown PM_{10} ($\mu g/m^3$)	Haze	Inversion	General Visibility Rating
26/05/03	41.0	Not monitored	Yes	Yes	Poor to avg
7/07/03	22.4	33.5	No	No	Below avg to avg
25/07/03	39.8	59.0	Yes	Yes	average
28/07/03	27.2	34.9	Yes	Yes	Poor to below avg
6/08/03	20.1	59.9	No	No	average
18/08/03	19.3	40.9	Yes	Yes	Above avg
27/08/03	16.9	33.9	No	No	Below avg to avg

NR No Recording of visibility on this day

In general, high particulate coincided with haze and / or inversion conditions. The weather conditions during high particulate events are indicative of calm, clear weather, with poor potential to disperse contaminants. These conditions can be expected to occur on several occasions every winter, and a corresponding high particulate concentration can likewise be expected every winter.

9 PASSIVE NO_2 AND SO_2 – RESULTS AND DISCUSSION

9.1 Passive NO_2 and SO_2 Results - Marlborough

Sampling for SO_2 and NO_2 commenced in July 2002, and continued until November 2003. Samplers are prepared in batches, and blank and spiked samples are analysed concurrently as part of analytical quality assurance (QA).

Results of passive NO_2 monitoring are shown in Figure 10 (2003) and Figure 11 (2002 and 2003). The passive NO_2 results were unusually low for the June/July/August batch, which suggests that batch of samplers may have been faulty. However, QA and QC for this batch of samplers was good, so there is no obvious explanation for the low results.

Results of passive SO_2 monitoring are shown in Figure 12 (2003) and Figure 13 (2002 and 2003).

Excluding the anamolous NO_2 batch, results show a distinct seasonal trend, with concentrations being higher in winter. The results also show a trend between sites, with higher concentrations in the vicinity of the SH1 and SH6 sites. The difference between sites was more pronounced for SO_2 than for NO_2. This is attributed to the contribution from diesel-powered vehicles on these major roads.

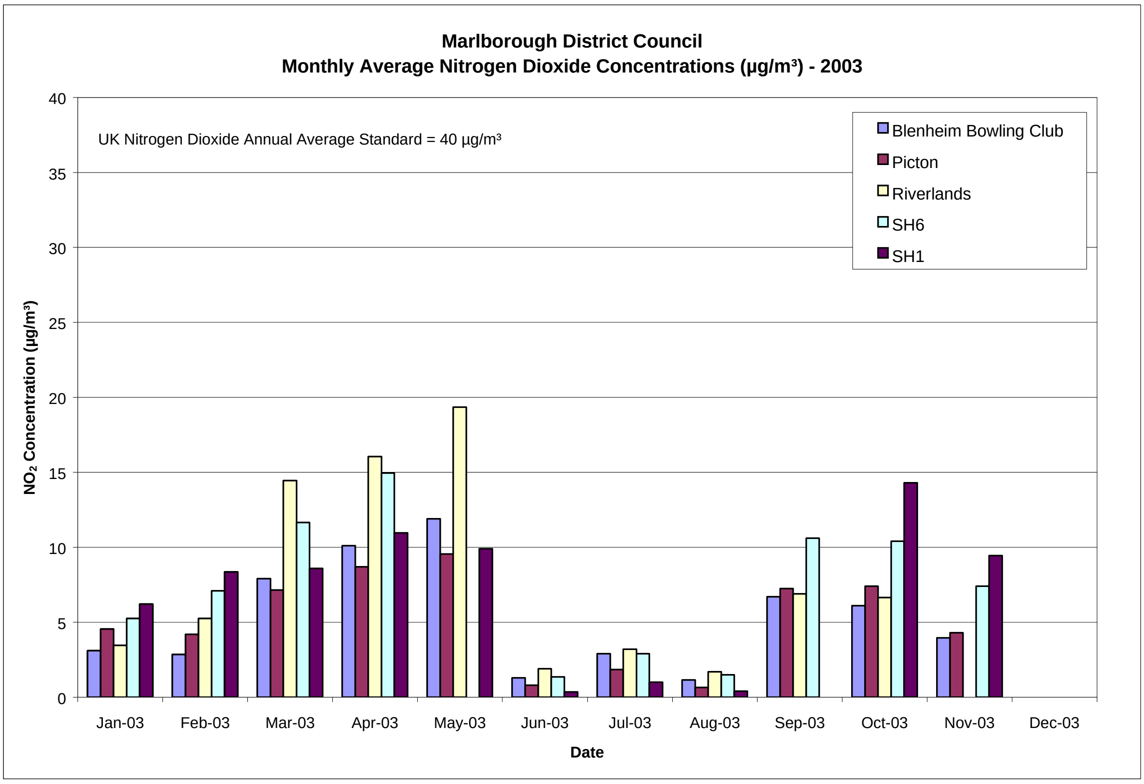

Figure 10: Passive NO_2 Results (monthly avg)

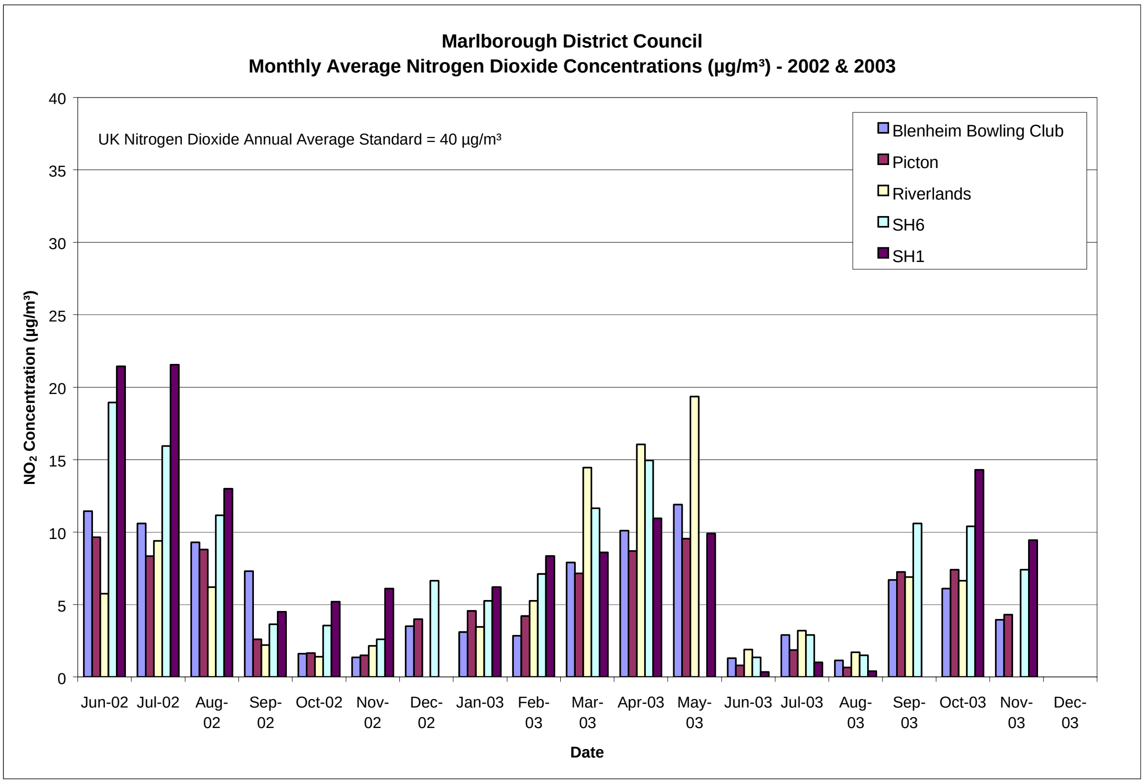

Figure 11: Passive NO_2, 2002 & 2003

The results from MDC are all less than the UK annual guidelines of 40 µg/m^3 for NO_2 and 20 µg/m^3 for SO_2 (Table 1).

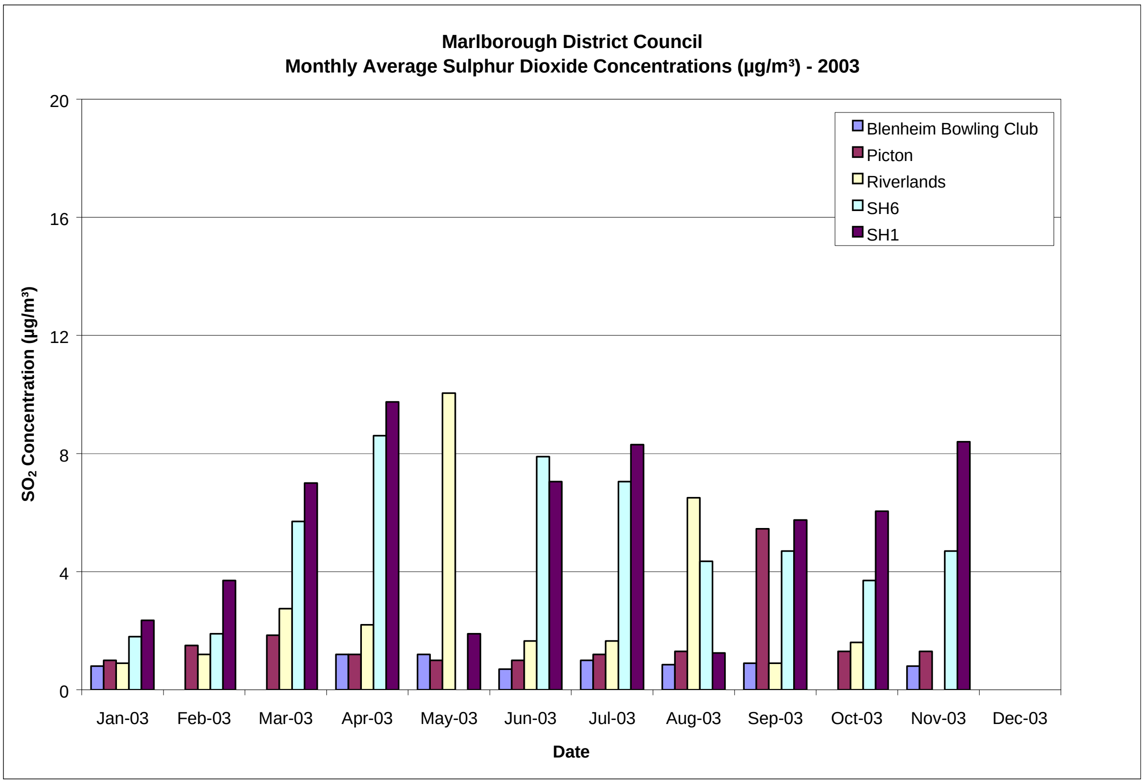

Figure 12: Passive SO_2 Results (monthly avg)

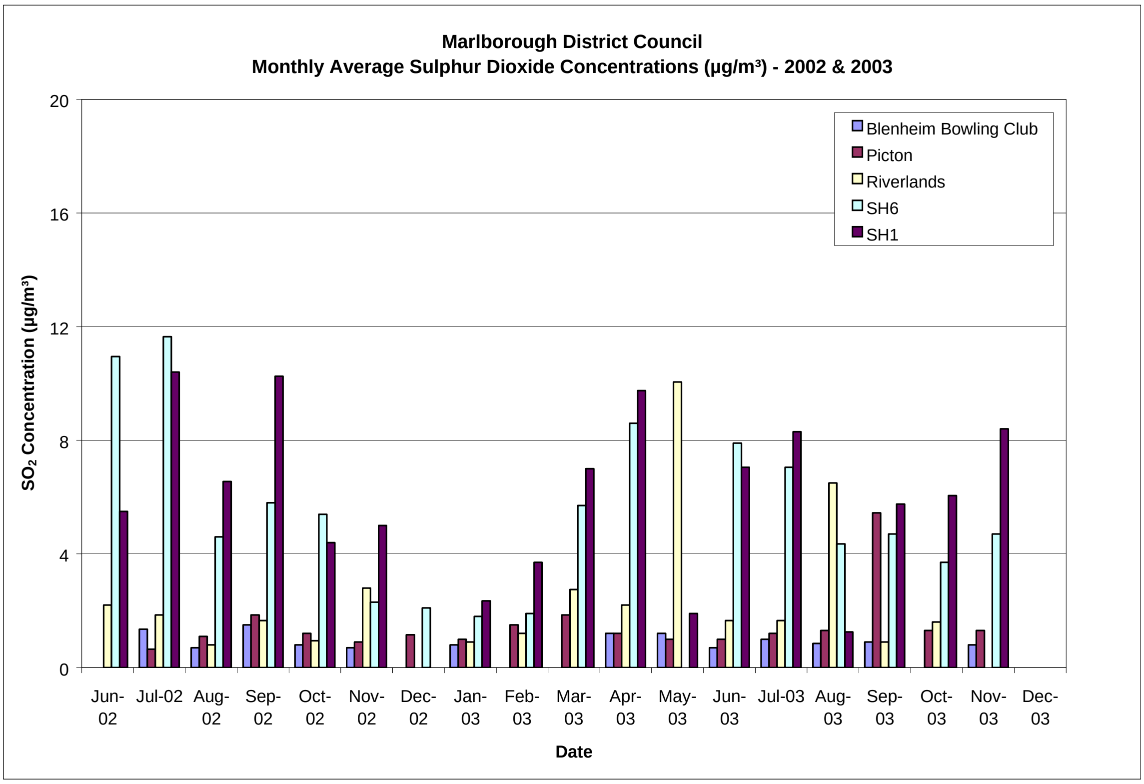

Figure 13: Passive SO_2 2002 & 2003

10 SUMMARY

10.1 Visibility

Visibility was monitored at four sites in the area, including recommencing monitoring at three sites that were monitored in 1999 – 2000 (Elisha Drive, MDC Blenheim and Picton). The method of monitoring used was that developed by ESR in 1999, which is consistent with the MfE GPG "Good practice guide for monitoring and management of visibility in New Zealand" (MfE 2001).

10.2 Inhalable Particulate

Inhalable particulate (PM_{10}) was monitored using a HiVol sampler. The method is the MfE's reference method. Watercare Services Ltd holds IANZ accreditation for HiVol PM_{10} sampling and analysis.

PM_{10} is monitored at a permanent site at 106 Middle Renwick Road, Blenheim. In addition to the permanent site, MDC monitors at investigative sites and suspected "hot spots" every winter. In 2003, PM_{10} was also monitored at the Redwoodtown Bowling Club and at Oxford Street, Picton.

In 2003, there was one exceedance of the National Environmental Standard (NES) of 50 $\mu g/m^3$ at the Blenheim site (the first time an exceedance has been recorded at this site), and seven exceedances at the Redwoodtown site. There were no excceedances at Picton.

The increase in exceedances indicates ambient air quality has not improved in Blenheim. Exceedances typically occur in winter, on cool nights with low wind speed. These meteorological conditions occur every winter, suggesting that with the current rates of particulate discharge, exceedances will continue to occur every winter.

10.3 Passive SO_2 and NO_2

Passive SO_2 and NO_2 monitoring can be used to determine pollution "hot spots", to investigate seasonal effects, and to monitor trends over time. As results are a monthly average, they cannot be directly compared to NZ NES, which are 1 hour and 24 hour averages.

Results to passive monitoring were highest around SH1 and SH 6, showing the contribution of vehicles to SO_2 and NO_2 concentrations. Concentrations were generally higher in the winter, indicative of poorer dispersion conditions in winter. The results did not exceed the UK guidelines for either pollutant.

The Marlborough District Council intends to return to the same sites every 3 to 5 years, to repeat the monitoring exercise, to determine if there are any significant trends over time. This is a simple and cost-effective method of monitoring pollutants that do not currently exceed guidelines.

APPENDIX A

PM_{10} Exceedance – Meteorological Data

Appendix A contains 31 pages including cover

APPENDIX B

Laboratory Reports

Appendix A contains 8 pages including cover