Annual Air Quality Monitoring 2007

Marlborough District Council

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Executive Summary

The main air contaminant of concern in Marlborough is PM_{10} (particles in the air less than 10 microns in diameter). During 2007, PM_{10} monitoring was carried out at two sites in Redwoodtown (Bowling Club and Croquet Club) and at the historical PM_{10} monitoring site in Middle Renwick Road (MMR) in Blenheim. The methods of monitoring were a Met One Beta Attenuation Monitor (BAM) at the Bowling Club site in Redwoodtown. At the Croquet Club and the MRR site monitoring took place every third day at both sites using gravimetric high volume sampling.

Four breaches of the NES for PM_{10} of 50 µg m^{-3} (24-hour average) were measured at the Bowling Club site in Redwoodtown during 2007. The maximum measured PM_{10} concentration was 62 µg m^{-3}. No guideline or National Environmental Standard exceedences were recorded at the Middle Renwick Road air monitoring site.

The highest measured 24-hour average concentration in Redwoodtown was 81 µg m^{-3} and was measured at the Brooklyn Drive monitoring site during 2004. The validity of this concentration was tested during 2007 because of concerns that the monitoring site, located in a residential back yard may have been impacted on by local chimneys.

A comparison of PM_{10} concentrations at the Croquet Club near Brooklyn Street and PM_{10} concentrations measured at the Redwoodtown Bowling Club was conducted for the period 22 June 2007 to 31 December 2007. Concentrations were similar and highly correlated at the two sites. This indicates that it is unlikely that the Brooklyn Street area experiences higher PM_{10} concentrations during the winter months. The MRR site data were used to establish that 2004 was not a worst case year for PM_{10} concentrations. Based on these data, it would seem reasonable that the 2004 PM_{10} concentrations measured at Brooklyn Street were influenced by localised sources and should not be used for air quality management purposes. As a result, it is recommended that MDC revise the starting point of their straight line path and therefore the predicted reduction in PM_{10} concentrations required to meet the National Environmental Standard for Ambient Air Quality.

Annual average PM_{10} concentrations of around 15 µg m^{-3} (Redwoodtown) and 11 µg m^{-3} (MRR) were estimated for 2007. These compare with an annual average guideline of 20 µg m^{-3} (MfE, 2002) and are low relative to other years.

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1 Introduction

The main air contaminant of concern in Marlborough is PM_{10} (particles in the air less than 10 microns in diameter). Historically, concentrations of PM_{10} have exceeded national environmental standards (NES) in Blenheim during the winter months. During 2007, concentrations of PM_{10} were measured at three sites in Blenheim, two sites in Redwoodtown (Bowling Club and Croquet Club) and a site at 106 Middle Renwick Road (MRR).

National Environmental Standards for ambient air quality (Table 1.1) were introduced in September 2004 (MfE, 2004). Based on air quality monitoring in other urban areas of New Zealand it would seem unlikely that concentrations of NES contaminants other than PM_{10} would be in breach. Consequently resources for air quality monitoring have focused on PM_{10}. The NES includes specifications for monitoring PM_{10} in areas such as Blenheim where breaches are likely.

In addition to the NES, MfE provides guidelines for ambient air quality (Table 1.2) and air quality indicator categories to assist in the presentation and management of air quality in New Zealand (Table 1.3). Air quality monitoring data in this report are presented relative to air quality guidelines and these indicator categories. These categories provide a useful perspective on the overall quality of the air and provide a valuable tool for evaluating trends in concentrations over time.

Previous air quality monitoring in the Marlborough District includes historical monitoring of PM_{10} at the MRR monitoring site, intermittent monitoring of PM_{10} at the Redwoodtown site, survey PM_{10} monitoring at Picton and Renwick during 2000 and 2002 respectively, visibility surveys and passive sampling for nitrogen oxides and sulphur oxides.

Table 1.1: National Environmental Standards for ambient air quality (MfE, 2004)

Contaminant	NES values		
	Concentration	Averaging Period	Allowable exceedences per year
Carbon monoxide	10 mg m^{-3}	8-hour	1
Particles (PM_{10})	50 µg m^{-3}	24-hour	1
Nitrogen dioxide	200 µg m^{-3}	1-hour	9
Sulphur dioxide [b]	350 µg m^{-3}	1-hour	9
Sulphur dioxide [b]	570 µg m^{-3}	1-hour	0
Ozone	150 µg m^{-3}	1-hour	0

Table.1.2: Ambient air quality guidelines for New Zealand (MfE, 2002)

Contaminant	2002 guideline values	
	Concentration[a]	Averaging Period
Carbon monoxide	30 mg m^{-3} 10 mg m^{-3}	1-hour 8-hour
Particles (PM_{10})	50 µg m^{-3} 20 µg m^{-3}	24-hour Annual
Nitrogen dioxide	200 µg m^{-3} 100 µg m^{-3}	1-hour 24-hour
Sulphur dioxide [b]	350 µg m^{-3} 120 µg m^{-3}	1-hour 24-hour
Ozone	150 µg m^{-3} 100 µg m^{-3}	1-hour 8-hour
Hydrogen sulphide [c]	7 µg m^{-3}	1-hour
Lead [d]	0.2 µg m^{-3} (lead content of PM_{10})	3-month moving, calculated monthly
Benzene (year 2002) Benzene (year 2010)	10 µgm^{-3} 3.6 µgm^{-3}	Annual Annual
1,3-Butadiene	2.4 µgm^{-3}	Annual
Formaldehyde	100 µgm^{-3}	30-minutes
Acetaldehyde	30 µgm^{-3}	Annual
Benzo(a)pyrene	0.0003 µgm^{-3}	Annual
Mercury (inorganic) [d] Mercury (organic)	0.33 µgm^{-3} 0.13 µgm^{-3}	Annual Annual
Chromium VI [d] Chromium metal and chromium III	0.0011 µgm^{-3} 0.11 µgm^{-3}	Annual Annual
Arsenic (organic) [d] Arsine	0.0055 µgm^{-3} 0.055 µgm^{-3}	Annual Annual

Notes:

[a] All values apply to the gas measured at standard conditions of temperature (0° C) and pressure (1 atmosphere).

[b] The sulphur dioxide guideline values do not apply to sulphur acid mist.

[c] The hydrogen sulphide value is based on odour nuisance and may be unsuitable for use in geothermal areas.

[d] The guideline values for metals are for inhalation exposure only; they do not include exposure from other routes such as ingestion. These other routes should be considered in assessments where appropriate.

Table 1.3: Environmental Performance Indicator categories for air quality (MfE, 2002)

Category	Value relative to guideline	Comment
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
Good	Between 10% and 33% of the guideline	Peak measurements in this range are unlikely to affect air quality
Acceptable	Between 33% and 66% of the guideline	A broad category, where maximum values might be of concern in some sensitive locations but generally they are at a level which does not warrant urgent action
Alert	Between 66% and 100% of the guideline	This is a warning level, which can lead to exceedences if trends are not curbed
Action	More than 100% of the guideline	Exceedences of the guideline are a cause for concern and warrant action, particularly if they occur on a regular basis

The sources of PM_{10} emissions in Blenheim are already known through the results of an emission inventory that was completed in 2005. The results from the emissions inventory indicate that domestic home heating is the main source of PM_{10} emissions, contributing around 85% of the daily wintertime PM_{10} (Wilton, 2005b). Other sources of PM_{10} in the urban areas of Blenheim include outdoor burning (6%), motor vehicles (7%) and industry (2%).

2 Methodology

During 2007, two methods of monitoring PM_{10} were used. The main monitoring site at the Redwoodtown Bowling Club used a Met One beta attenuation monitor (BAM) which is an NES compliant monitor. The BAM provides continuous hourly average PM_{10} concentrations. The other two sites used gravimetric high-volume sampling, a method compliant with the MfE (2002) reference method specifications. This method was also used at the Redwoodtown site for the period January to May 2007. The high-volume sampling was carried out based on a one day in three sampling regime with samples collected over a 24-hour period from midnight to midnight. Results are compared with the NES and with air quality indicator categories for PM_{10}.

Hourly average meteorological data, including temperature, wind speed and wind direction, were obtained from a NIWA site on the outskirts of Blenheim. Meteorological data were compared with PM_{10} on days when pollution was elevated.

2.1 Air quality monitoring sites

There are two permanent air quality monitoring sites located in Blenheim located at the Redwoodtown Bowling Club and at a site in Middle Rewick Road (MRR). Figure 2.1 shows the MRR site, which provides a historical record of PM_{10} in Blenheim and is located to the north-west of Blenheim, and the Redwoodtown sites (Bowling Club, Brooklyn Drive and Croquet Club), which are located to the south and south east within the main urban area. The Brooklyn Street site was a temporary location used during 2004.

The Croquet Club site was established in 2007 for the purposes of evaluating the relationship between Brooklyn Street area PM_{10} and PM_{10} concentrations measured at the Bowling Club. This was considered important because PM_{10} concentrations of the magnitude measured during 2004 at Brooklyn Street had not been measured at the Bowling Club and because the reductions required in PM_{10} concentrations in Blenheim had been dependent on the Brooklyn Street results. A further reason for concern was the location of the Brooklyn Street monitoring site, which was sited in a residential backyard. This situation is not ideal because of the proximity of neighbouring dwellings and the potential for PM_{10} discharges from their chimneys. The owner of the site had agreed not to use their wood burner for the duration of the sampling. Figure 2.2 shows the position of the 2004 monitoring site with neighbouring chimneys around 20 and 40 metres from the site.

Figure 2.1: Location of air quality and meteorological monitoring sites in Blenheim for 2007.

Figure 2.2: Location of the 2004 Brooklyn Street monitoring site

2.1.1 Middle Renwick Road (MRR) monitoring site

The MRR air quality monitoring site was established in the back yard area of a Council site at 106 Middle Renwick Road. Figure 2.2 shows the surrounding area, and Figure 2.3 shows the high-volume sampler located at the MRR monitoring site. Site details are shown in Table 2.1.

Figure 2.2: Aerial photo of the MRR air quality monitoring site (note: pink dot depicts monitoring site)

Figure 2.3: PM_{10} monitor at the MRR air monitoring site

Table 2.1: Site summary details for the MRR air quality monitoring site

Site name	**Blenheim – 106 Middle Renwick Road**
Site contact details	Marlborough District Council
Description of site	Empty sealed back yard area
Site category	Residential neighbourhood
Purpose of site and sources	To measure ambient air concentrations of PM_{10} at the historical air quality monitoring site in Blenheim. Main source during the winter months is solid fuel burning for domestic heating.
Proposed duration of monitoring	Ongoing
Contaminants monitored	PM_{10}
Site co-ordinates	E 2589778 N 5964037
Date of site installation	January 2000
Meteorological characteristics of area	Low wind speeds occur regularly during the winter months. Temperature inversions are likely.
Sample frequency	One day in three from May 2005 One day in six

	prior to this during the summer and one day in three during the winter.
Inlet height	1.5 metres
Averaging period	24-hour

2.1.2 Redwoodtown Monitoring Site - Blenheim

The 2007 monitoring site in Redwoodtown was carried out at the now permanent air quality monitoring site established at the Blenheim Bowling Club on Weld Street. Figures 2.4 and 2.5 show the surrounding area and the location of the monitoring site within the Bowling Club grounds. Summary site details are given in Table 2.2.

Figure 2.4: Aerial photo of the Redwoodtown air quality monitoring site (note: pink dot depicts monitoring site)

Figure 2.5: PM_{10} monitor at the Redwoodtown air quality monitoring site

Table 2.2: Site summary details for the Redwoodtown air quality monitoring site

Site name	**Redwoodtown**
Site contact details	Marlborough District Council
Description of site	The site is located at the Blenheim Bowling Club, which is to the south-east of central Blenheim. The surrounding area includes a bowling green, gravel petanque area and paved areas.
Site category	Residential neighbourhood
Purpose of site and sources	To measure worst-case ambient air concentrations of PM_{10} in Blenheim. The main source during the winter months is solid fuel burning for domestic heating. The site is downwind of a large residential area for meteorological conditions conducive to poor air quality.
Proposed duration of monitoring	Ongoing
Contaminants monitored	PM_{10}
Site co-ordinates	X = 2589778, y = 5964037
Date of site installation	January 2002 – intermittent monitoring until 2005
Meteorological characteristics of area	Low wind speeds occur regularly during the winter months. Temperature inversions are likely.

Sample frequency	One day in three
Inlet height	1.5 metres
Averaging period	24-hour

2.1.3 Croquet Club Monitoring Site - Blenheim

The Croquet Club monitoring site was established in June 2007 with the purpose of providing an indication of the relationship between PM_{10} concentrations measured near the vicinity of the Brooklyn Street site and PM_{10} measured at the Bowling Club. The PM_{10} sampler at this site is shown in Figure 2.6. Site details are shown in Table 2.3.

Table 2.3: Site summary details for the Croquet Club air quality monitoring site

Site name	**Croquet Club**
Site contact details	
Description of site	The site is located at the Blenheim Croquet Club, which is to the south-east of central Blenheim.
Site category	Residential neighbourhood
Purpose of site and sources	To evaluate the relationship between PM_{10} concentrations measured in the vicinity of the 2004 Brooklyn Street site and those measured at the Bowling Club.
Proposed duration of monitoring	Temporary – 2007 only
Contaminants monitored	PM_{10}
Site co-ordinates	2590564, 5963568
Date of site installation	June 2007
Meteorological characteristics of area	Low wind speeds occur regularly during the winter months. Temperature inversions are likely.
Sample frequency	One day in three
Inlet height	1.5 metres
Averaging period	24-hour

Figure 2.6: Location of the Croquet Club air monitoring site

2.2 Quality assurance

The operation of high volume PM_{10} samplers and the changing of filters were carried out by MDC staff. Flow calibrations were carried out every 3-4 months, normally during the morning. Filters were couriered to Watercare Services Ltd, who undertook filter weighing in accordance with the New Zealand and Australia standard for high volume sampling. Watercare services hold IANZ accreditation, for HiVol PM_{10} sampling.

Transportation of filters occurs at the end of each month, with filters stored and transported in snaplock bags at ambient temperature. Quality assurance methods include the analysis of one field blank per site per month. Field blanks outside of the "acceptable" range (± 8 mg per filter) are noted in a report from Watercare Services.

Operation of the BAM is also carried out by MDC staff. Hourly data is recorded by the instrument and logged by an iQuest iRIS 320 datalogger. Results are telemetered hourly to MDC and stored in the hydrotel database.

3 Air quality monitoring in Blenheim

3.1 PM_{10} concentrations at Redwoodtown

During 2007, PM_{10} concentrations in Redwoodtown were measured using the NES compliant BAM (all year) and a gravimetric high volume sampler (January to May). Concentrations reported for 2007 are the results of the 24-hour average BAM PM_{10}.

Four exceedences of the air quality guideline and the NES for PM_{10} (50 µg m^{-3}, 24-hour average) were recorded during 2007. All exceedances occurred in June with the maximum measured PM_{10} concentration of 62 µg m^{-3} (24-hour average). Figure 3.1 shows the 24 hour average PM_{10} concentrations measured at Redwoodtown during 2007

A comparison of the BAM and gravimetric high volume sampler (reference method) for 2006 showed that PM_{10} concentrations were underestimated by around 7% when measured with the BAM. This relationship was not re-evaluated for 2007 because the period of overlap between the two monitoring methods did not include the winter months, when PM_{10} concentrations are highest.

If 2007 BAM data were adjusted for gravimetric equivalence[1] the number of NES exceedences would have been six and the maximum PM_{10} concentrations would have been 66 µg m^{-3}.

The NES allow one exceedence of 50 µg m^{-3} (24-hour average) per year and requires any subsequent breach to be publicly notified within a month of it occurring. During 2007 MDC notified three breaches based on the measured BAM concentrations.

[1] Based on the 2006 relationship between BAM and high volume sampler – i.e., 7% upwards adjustment.

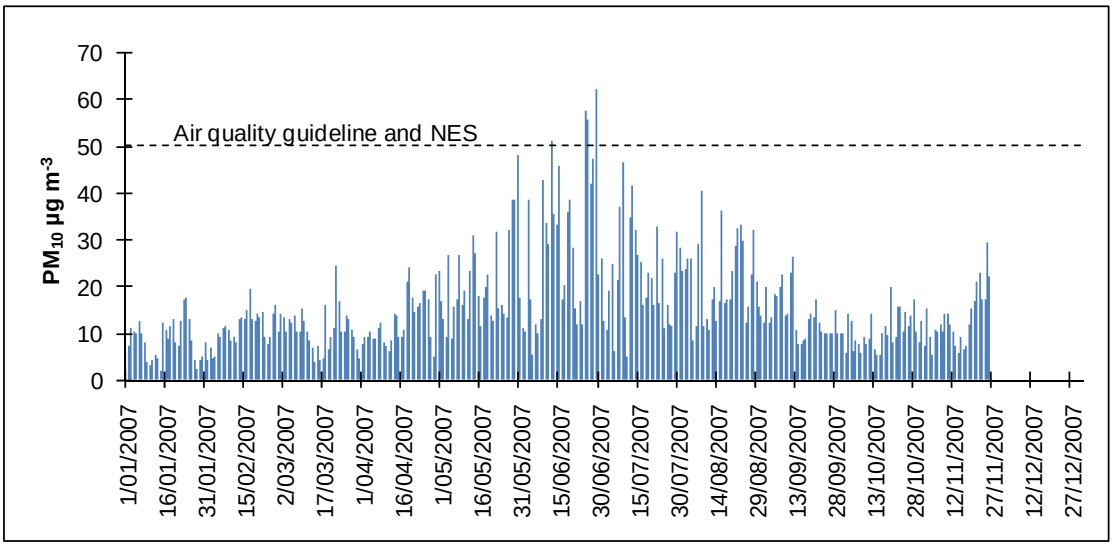

Figure 3.1: 24-hour average PM_{10} concentrations measured at Redwoodtown during 2007

Figure 3.2 compares daily and PM_{10} concentrations measured during 2005 to 2007 to the MfE air quality indicator categories (shown in Table 1.3). The majority of the PM_{10} concentrations measured were less than 66% of the air quality guideline, within the "acceptable" and "good" air quality categories. The proportion of PM_{10} concentrations in the alert or action categories for 2007 appears lower than for 2005 and 2006 (7% compared with 13% and 20%). Seasonal variations in the distribution of PM_{10} concentrations for 2007 are shown in Figure 3.3.

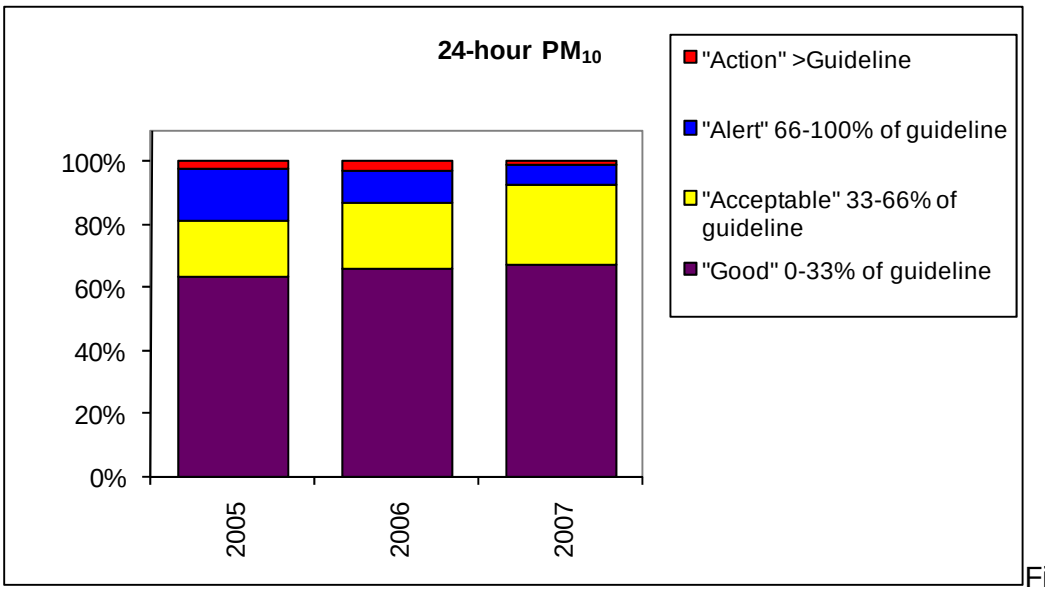

Figure 3.2: Comparison of PM_{10} concentrations measured at Redwoodtown during 2005 to 2007 to MfE air quality indicator categories

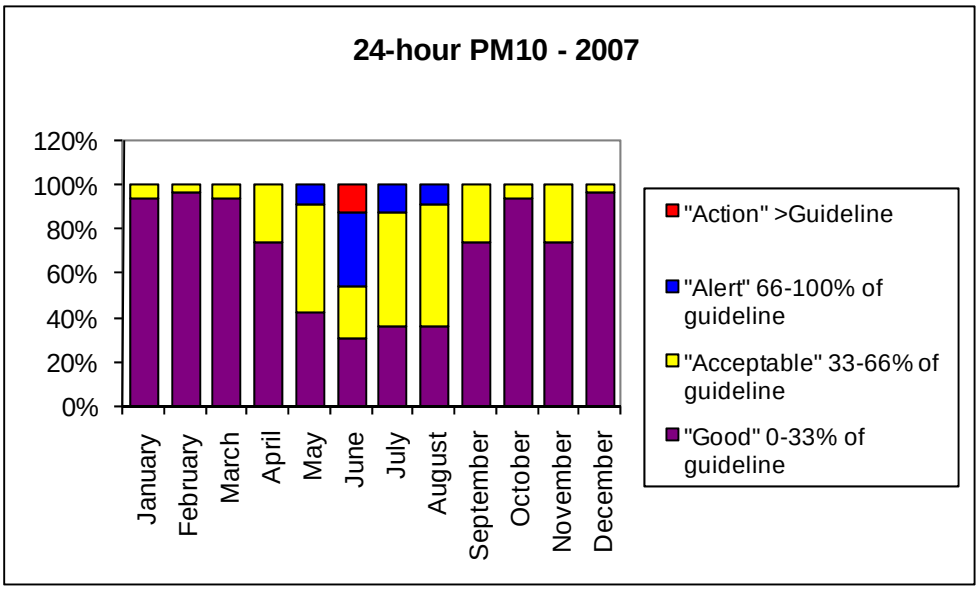

Figure 3.3: Comparison of daily PM_{10} concentrations each month during 2007 to MfE air quality indicator categories

The annual average PM_{10} concentration for 2007 was 15 µg m^{-3}. During 2005 and 2006 annual average PM_{10} concentrations of 18 and 17 µg m^{-3} were estimated. The Ministry for the Environment specifies an annual average guideline for PM_{10} of 20 µg m^{-3}. The NES does not include an annual average concentration for PM_{10}.

Table 3.1 shows summary statistics for PM_{10} monitoring results from the Redwoodtown site since monitoring commenced in 2002. Note, however, that the monitoring period has varied from year to year, with 2005 being the first year when monitoring was conducted from January to December and that the 2004 monitoring was for a different site in Brooklyn Street.

Table 3.1: Summary of PM_{10} concentrations measured at Redwoodtown from 2002-2007

	2002	2003	2004	2005	2006	2007
"Good" 0-33% of guideline	18%	22%	46%	63%	66%	69%
"Acceptable" 33-66% of guideline	62%	30%	22%	17%	21%	24%
"Alert" 66-100% of guideline	10%	26%	20%	17%	10%	6%
“Action” >Guideline	10%	22%	12%	3%	3%	1%
Percentage of valid data	14%	7%	22%	32%	68%	99%
Annual average (µg m-3)	-	-	22	18	17	15
Measured exceedences	5	6	10	3	6	4
Guideline exceedences (extrapolated for missing data based seasonal variations)	16	34	31	9	10	4
99.7 %ile concentration (µg m-3)	58	60	79	57	55	57
Annual maximum (µg m-3)	58	60	81	58	59	62
Number of records	50	27	82	115	247	360

3.2 PM_{10} concentrations at the MRR site

Daily average PM_{10} concentrations measured at the MRR site during 2007 are shown in Figure 3.4. No NES breaches were recorded at the MRR site. Prior to 2007, the only breaches measured at MRR occurred in 2000 (56 µg m^{-3}) and 2003 (75 µg m^{-3}). The maximum measured PM_{10} concentrations at MRR during 2007 was 28 µg m^{-3}. This is the lowest annual maximum concentration measured at the site since monitoring began in 2000. The previous lowest maximum concentration was 41 µg m^{-3} and occurred during 2002.

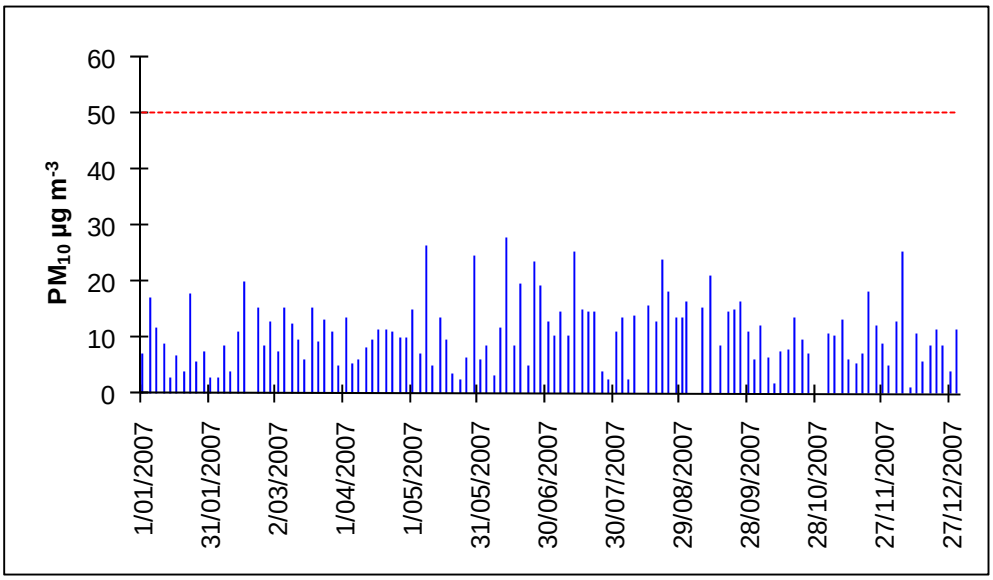

Figure 3.4: Daily winter PM_{10} concentrations measured at the MRR site during 2007.

Changes in PM_{10} concentrations relative to air quality indicator categories at MRR from 2001 to 2007 are shown in Figure 3.5. Results suggest that PM_{10} concentrations measured during 2007 were lower than previous years on average.

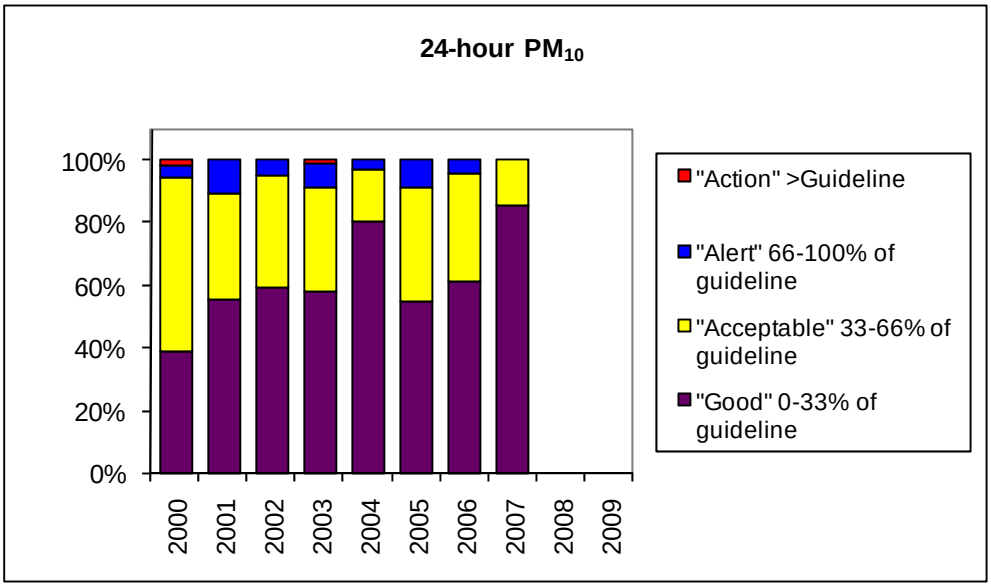

Figure 3.5: Comparison of PM_{10} concentrations measured at the MRR site from 2000 to 2007 to MfE air quality indicator categories

The estimated annual average PM_{10} concentration for MRR for 2007 is 11 µg m^{-3}.

Summary statistics for PM_{10} monitoring results are shown in Table 3.2.

Table 3.2: Summary of PM_{10} concentrations measured at the MRR monitoring site from 2000 to 2007

	2000	2001	2002	2003	2004	2005	2006	2007
"Good" 0-33% of guideline	39%	55%	59%	58%	80%	55%	61%	85%
"Acceptable" 33-66% of guideline	56%	34%	36%	33%	17%	37%	35%	15%
"Alert" 66-100% of guideline	4%	11%	5%	7%	3%	9%	4%	0%
"Action" >Guideline	2%	0%	0%	1%	0%	0%	0%	0%
Percentage of valid data	15%	20%	22%	22%	16%	25%	33%	32%
Annual average (µg m-3)	19	18	15	16	13	17	14	11
Measured exceedences	1	-	-	1	-	-	0	0
99.7 %ile concentration (µg m-3)	53	46	40	67	46	47	42	27
Annual maximum (µg m-3)	56	48	41	75	49	49	45	28
Number of records	54	74	81	81	60	93	121	116

3.3 PM_{10} concentrations at the Croquet Club

Concentrations of PM_{10} measured at the Croquet Club during 2007 are shown in Figure 3.6. Two winter guideline exceedences were recorded with the high volume sampler on 25 and 28 June with both concentrations measuring 51 µg m^{-3}. Corresponding PM_{10} concentrations at the Bowling Club were 58 µg m^{-3} and 47 µg m^{-3} and were measured using the BAM. A third guideline exceedence (108 µg m^{-3}) was recorded on 27 November under warm, windy conditions. Concentrations of PM_{10} at the Bowling Club site were not elevated on this day. It is therefore likely that high concentrations observed at the Croquet Club on 27 November 2007 occurred because of a localised PM_{10} source.

The relationship between the PM_{10} concentrations measured at the two sites is shown in Figure 3.7. Results indicate a small amount of scatter in the data (r^2 = 0.8) and a one to one relationship based on the line of best fit (Reduced Major Axis Regression). It would seem likely based on these results that the Brooklyn Street area does not experience higher ambient air PM_{10} concentrations than the Bowling Club during the winter months.

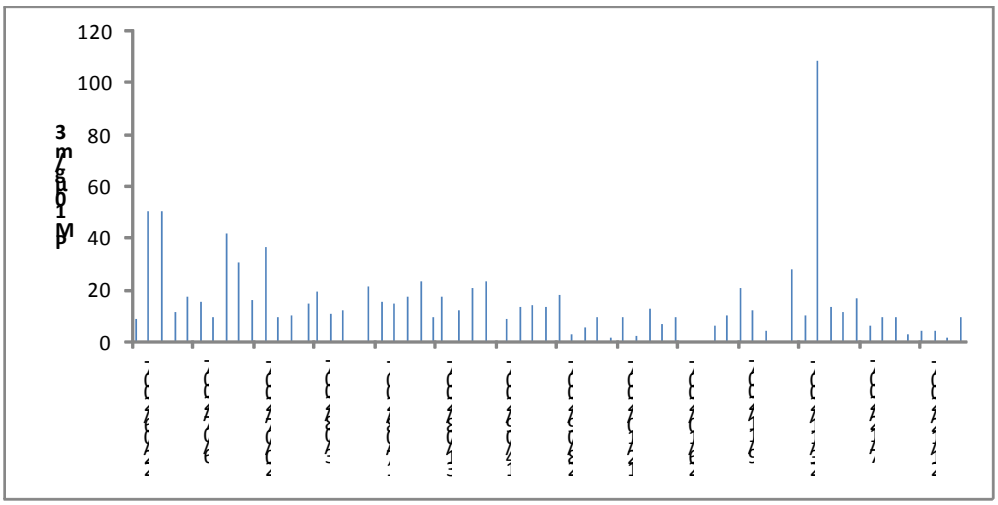

Figure 3.6: Concentrations of PM_{10} measured at the Croquet Club during 2007

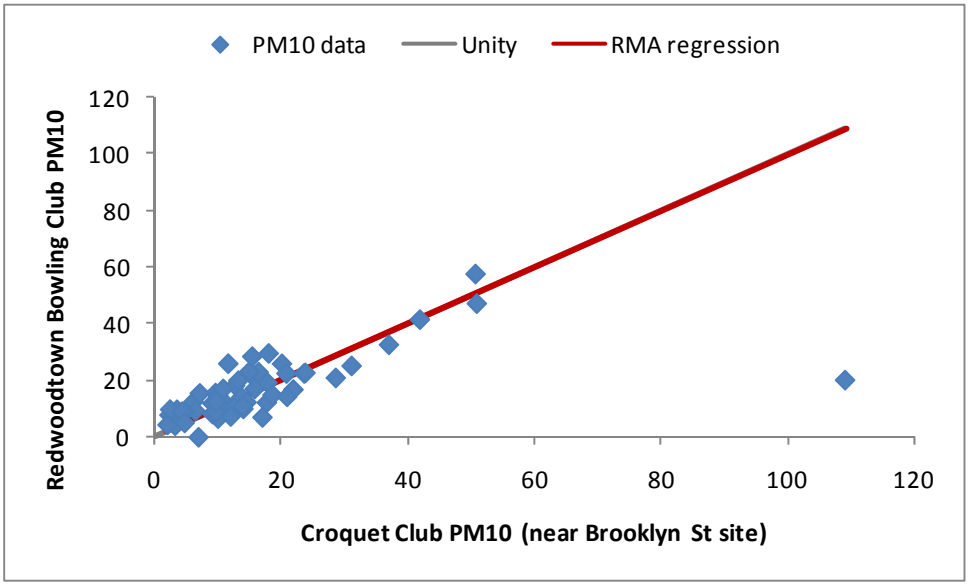

Figure 3.7: Comparison of PM_{10} concentrations at Redwoodtown and Croquet Club for 2007

3.4 PM_{10} and meteorology in Blenheim

Variations in meteorological conditions and hourly average PM_{10} concentrations on days when the 24-hour average PM_{10} measured at Redwoodtown using the BAM concentration exceeded 47 µg m^{-3} are shown in Figure 3.8. The value of 47 µg m^{-3} was chosen to represent high pollution events because a 2007 report suggests that BAM concentrations in Redwoodtown underestimate PM_{10} relative to a gravimetric method by around 7% (Wilton, 2007). Thus this value is likely to be the BAM equivalent of a 50 µg m^{-3} standard if the standard is based on the gravimetric reference method.

The six pollution episodes were 12, 25, 26, 28 and 29 June and 9 July. The corresponding PM_{10} concentrations (24-hour average) were 51, 58, 56, 47, 62, and 47 µg m^{-3}.

The highest peak in PM_{10} concentrations generally occurred during the early evening, with a second peak in concentrations occurring in the early morning. This is fairly typical of diurnal profiles for elevated PM_{10} concentrations in urban areas of New Zealand. Higher concentrations occur at these times under low wind speeds.

On most days, winds were typically from the westerly direction. On two days the winds were more variable Temperatures ranged from less than zero degrees Celsius during the nighttime and morning, increasing to up to around 15 degrees Celsius during the afternoon.

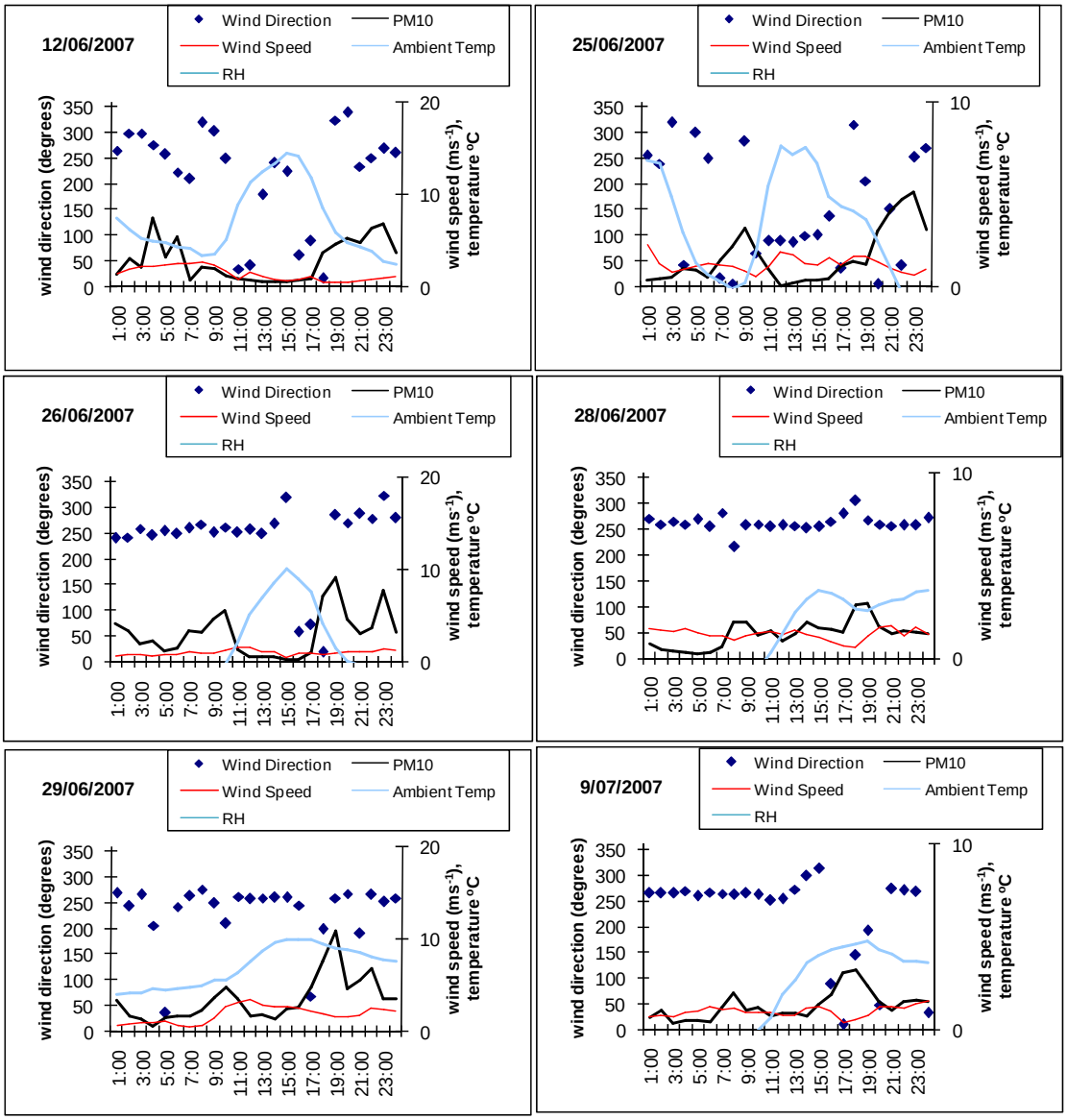

Figure 3.8: Hourly average PM_{10}, wind speed, wind direction and temperature on days when PM_{10} concentrations exceeded the NES at the Redwoodtown site

3.5 Meteorology in Blenheim from May to August

Hourly wind direction and wind speed, measured at the NIWA meteorological monitoring site on the outskirts of Blenheim, are shown in Figure 3.9 for the months May to August 2007.

As with previous years, the predominant wind direction is westerly. The wind speed was greater than 2 m s^{-1} for much of the winter, although periods of low wind speeds were apparent at times. The greatest prevalence of low wind speeds for winter 2007 occurs in June and coincides with the period when the highest PM_{10} concentrations were recorded.

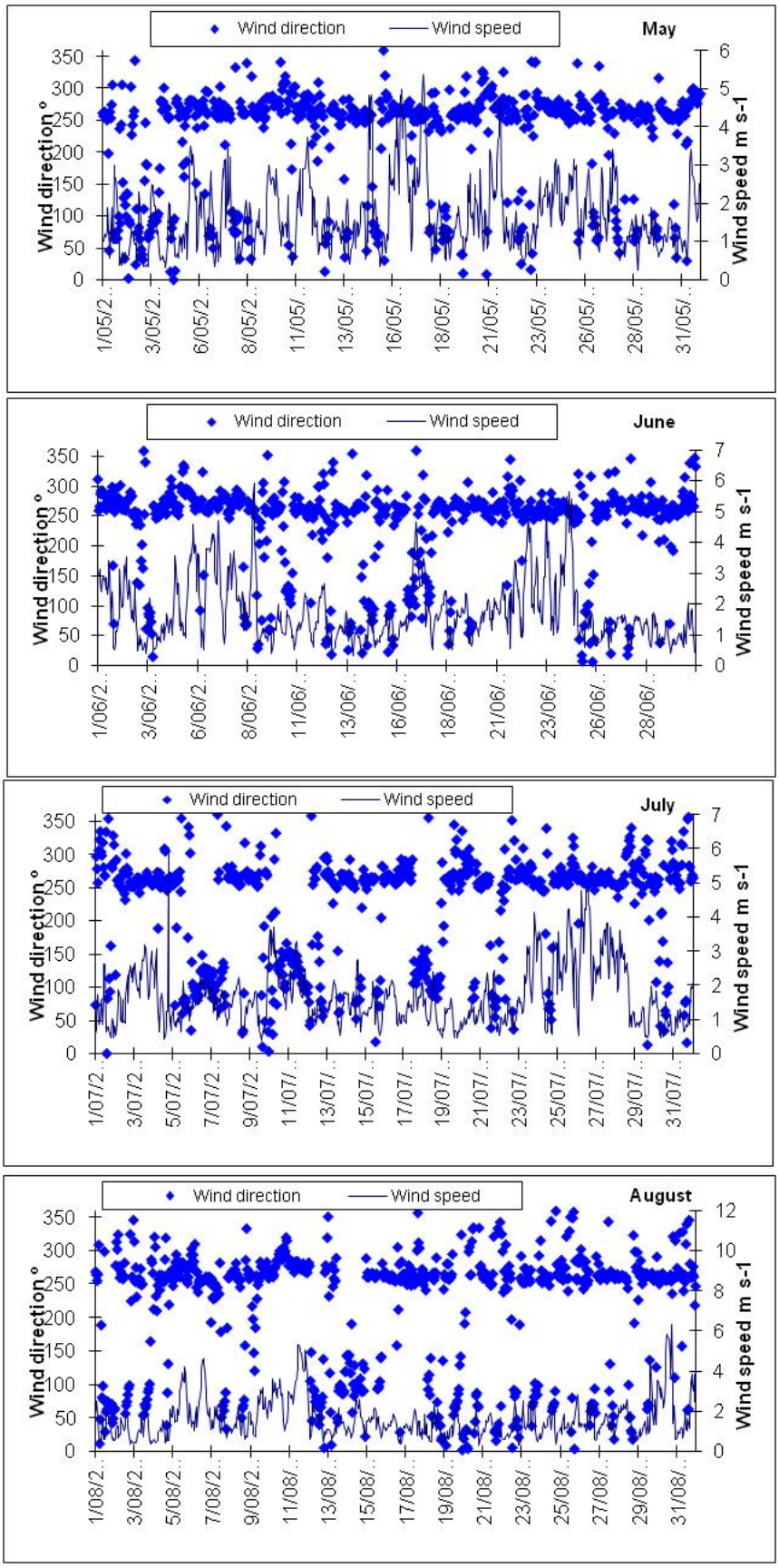

Figure 3.9: Hourly average wind speed and wind direction in Blenheim for May to August 2007

4 Correlation between the BAM and High-volume PM_{10} concentrations

From 23 June 2006 to 31 May 2007, PM_{10} concentrations were measured using both the high-volume sampler (one day in three) and BAM (continuous) at the monitoring site in Redwoodtown. The relationship between the BAM and high-volume sampler was analysed for the collocation period for 2006 and results reported in the 2006 annual air quality monitoring report. The following relationship was observed.

BAM = 0.93 High Vol ($r^2 = 0.9$)

The relationship was not re-examined to include the 2007 data because the period when data overlapped was prior to winter. The relationship during the winter period is of greatest interest because of the occurrence of high pollution episodes during these months.

5 Summary

During 2007 PM_{10} concentrations were measured at three sites in Marlborough. These were, the historical MRR site, the NES compliant Bowling Club site in Redwoodtown and a short term monitoring site at the Croquet Club in Redwoodtown. The purpose of the latter site was to evaluate whether high PM_{10} concentrations were likely in the vicinity of the site to assist in the interpretation of high PM_{10} concentrations recorded at the nearby Brooklyn Street during 2004.

Four exceedences of the NES for PM_{10} were recorded at the Bowling Club site during 2007. The maximum measured PM_{10} concentration at this site was 62 µg m^{-3}. A comparison of the BAM and gravimetric high volume sampler (reference method) for 2006 showed PM_{10} concentrations were underestimated by around 7% when measured with the BAM. If 2007 BAM data were adjusted for gravimetric equivalence[2] the number of NES exceedences would have been six and the maximum PM_{10} concentrations would have been 66 µg m^{-3}.

The annual average PM_{10} concentration measured at the Bowling Club site during 2007 was 15 µg m^{-3}. This compares with previous maximum for the Bowling Club site of 18 µg m^{-3}. Concentrations of PM_{10} at MRR were also lower than previous years with no guideline exceedences recorded and a low annual average PM_{10} concentration of 11 µg m^{-3}.

Concentrations of PM_{10} at the Croquet Club were correlated with the Bowling Club and were a similar order of magnitude. Results suggest the sites are measuring similar winter PM_{10} concentrations. It would seem likely given this correlation, and that 2004 was not a worst case year at MRR, that the 2004 Brooklyn Street site was influenced by localised sources of PM_{10}. As a result, it is recommended that MDC revise the starting point of their straight line path and therefore the predicted reduction in PM_{10} concentrations required to meet the NES.

[2] Based on the 2006 relationship between BAM and high volume sampler – i.e., 7% upwards adjustment.

References

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