STAFF REPORT

TO: Environment & Planning Committee

FROM: Trevor James, Resource Scientist
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REFERENCE: C301

SUBJECT: **RICHMOND AIR QUALITY - TRENDS AND SPATIAL PATTERNS - REPORT REP10-07-08 -** Report prepared for meeting of 1 July 2010

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1. INTRODUCTION

Each winter fine particulate (PM_{10}) air pollution levels in Richmond reach levels well-known to significantly adversely affect the health of residents (particularly the very young and old). National regulations specify air quality standards that must be met to protect people's health. The vast majority of the problem is caused by emissions from domestic solid fuel heating appliances (mostly woodburners).

This report addresses three key questions about air quality in Richmond regarding this problem:

1. Is air quality improving in Richmond?

2. How does air quality vary over the Richmond airshed?

3. What progress is the level of compliance with TRMP rules for discharges from domestic sources?

Once we know information about trends we have to ask "Why is it trending this way?" and "Are Council's policies and methods working?". Once we know information about spatial variation we need to ask "Is our monitoring at an appropriate site within the airshed?" In particular, "Does this information from the site enable us to address the health risk of the people in the airshed?".

This report summarises findings from two studies into air quality in Richmond and the Waimea Plains:

- "Assessing long-term trends in PM_{10} emissions and concentrations in Richmond" Feb 2010

- "Spatial variation of particulate pollution in Christchurch and Nelson/Richmond during winter 2008" April 2010

A full copy of these reports is available on request.

Results from these studies are also discussed with particular relevance to policy and monitoring.

A statistically rigorous trend analysis requires sufficient data (at least four years with continuous data at three minute intervals). This analysis takes into account meteorological variation that has been undertaken for Richmond and includes data from 2000-2009 (however, data for 2001 and 2002 is missing).

Air particulate monitoring using a mobile monitoring unit has been carried out for the first time in Richmond. Results provide some useful insights into where hotspots of air pollution are apparent. Such monitoring included one pass from Richmond through Brightwater and Wakefield.

Both reports were produced by NIWA, with considerable input from EnviroNet Ltd for the trend analysis. Staff from both Nelson and Tasman councils were involved in the design of the study, fieldwork of mobile monitoring to determine spatial patterns of PM_{10} in Richmond and Nelson and peer-review of the reports. (Both studies were funded by Envirolink).

2. LONG-TERM TRENDS IN PM_{10} EMISSIONS AND CONCENTRATIONS IN RICHMOND

2.1 Introduction

From viewing the raw data of the total number of exceedences of the National Standard for 24 hour average PM_{10} (50ug/m^3) for years 2000 and 2003 to 2009 it is possible to infer that the situation is improving (see Figure 1).

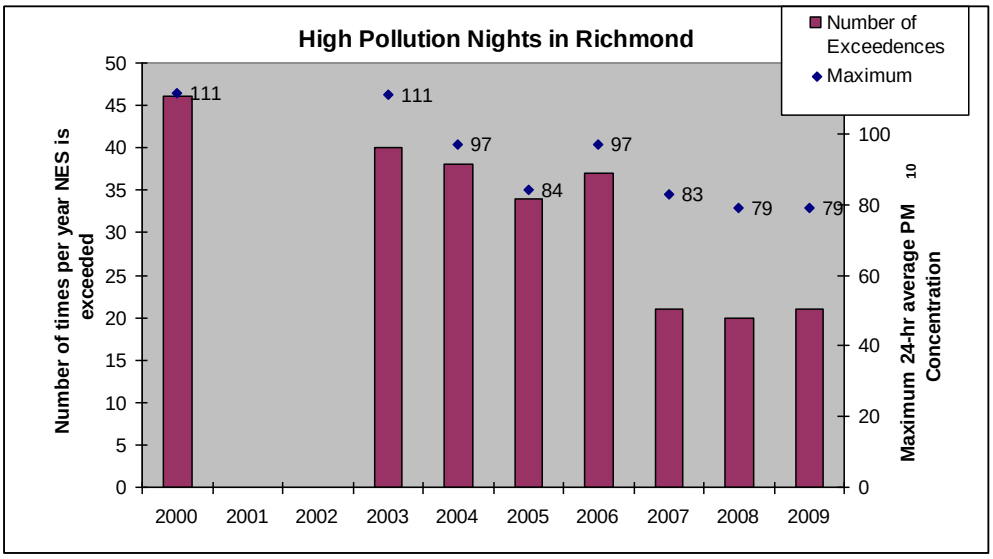


Figure 1: Total number of days per year that the NES was exceeded. Note: no data was collected in 2001 and insufficient data was available for 2002 (Council's air quality monitoring programme started at this time).

2.2 Methods

For valid trend analysis meteorological conditions at the time of sampling must be taken into account. A warm, wet or windy winter will naturally have better air quality. A recently -developed technique called boosted-regression-tree analysis was used to analyse periods with similar meteorology.

2.3 Results

Figure 2 below plots the percentage of the time that exceedences (or breaches) occur on days with similar temperature and windspeed. This uses 24-hour PM_{10} exceedence data from days with (i.e. <6.8^{o}C 4-hour temperature from 8.00 pm to midnight and <5.0 m/s 24-hour average windspeed).

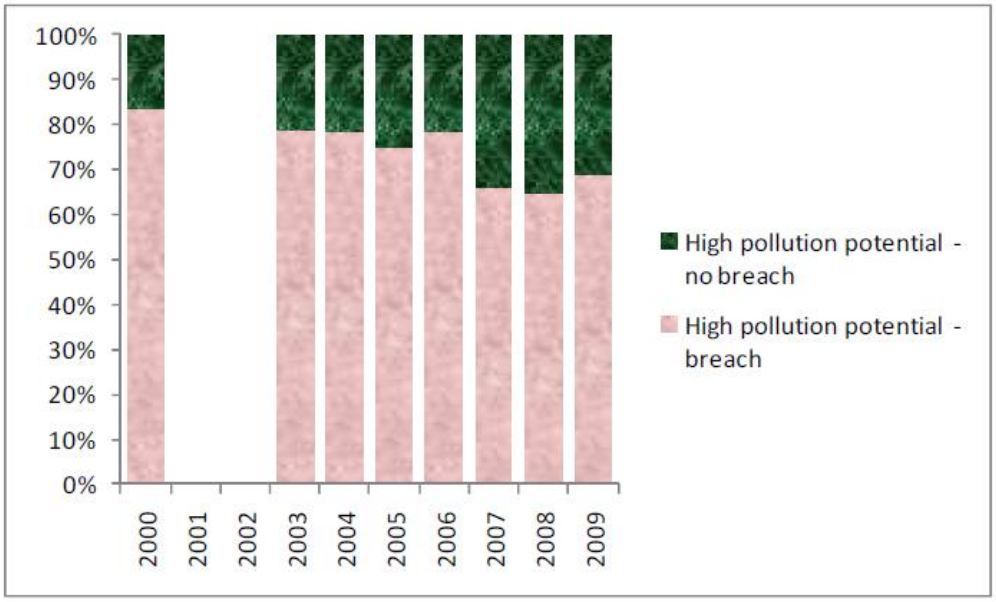


Figure 2: Year-to-year variation of the percentage of high potential pollution days with PM_{10} concentrations greater than 50µg/m^3 (24-hour average).

This evaluation of year to year variations in the prevalence of meteorological conditions conducive to high pollution, and the number of days that these conditions resulted in breaches of 50 µg m^{-3}, provided evidence of a decrease in PM_{10} emissions. The proportion of high pollution days resulting in NES breaches reduced from around 70-80% from 2000 to 2006 to 45-55% during 2007, 2008 and 2009.

The meteorological conditions most conducive to elevated PM_{10} was a 24-hour average wind speed of less than 3.8 ms^{-1} and 4-hour average temperature (8pm to midnight) of less than 6.8 ºC.

Median and 25th and 75th percentiles for PM_{10} also show significant decrease (see Figure 3 below).

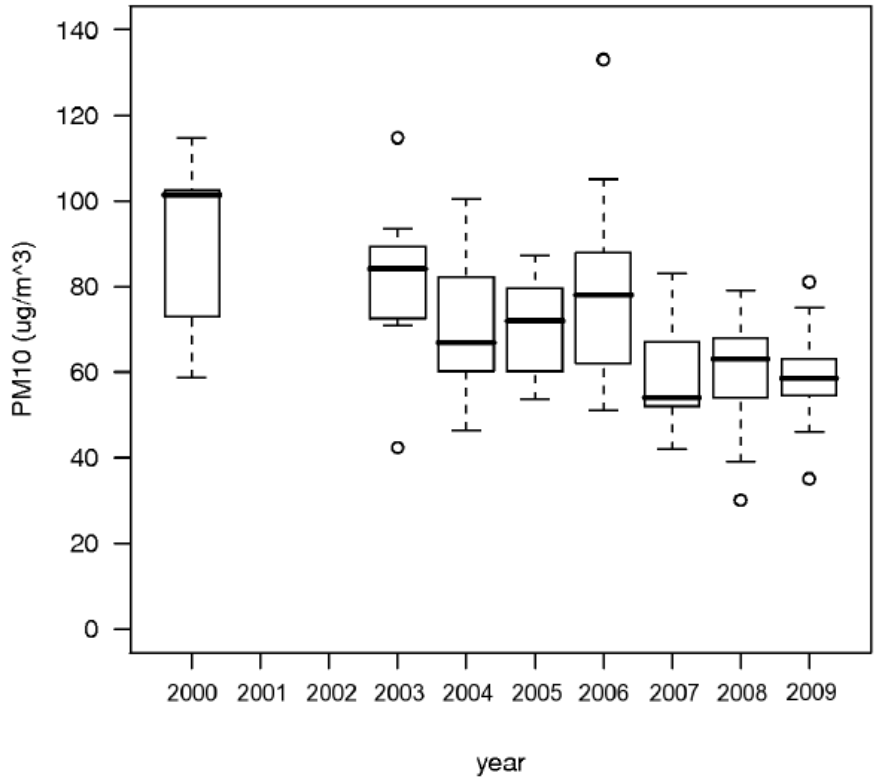


Figure 3: Variations in 24-average PM_{10} concentration for the 107 days when meteorological conditions were most conducive to elevated PM_{10} (24-hour average wind speed of less than 3.8 ms^{-1} and 4-hour average temperature (8pm to midnight) of less than 6.8 ^oC). The box-whisker plot shows the data distribution for each year. The median (middle number) is shown by the bold horizontal line within the rectangular box, the 75th percentile is shown by the top of the box and 25th percentile is shown by the bottom of the box.

2.4 Discussion

The apparent "step-change" in concentration between years 2006 and 2007 may be the result of Council's consultation and promotion of the air quality issue (more than during previous years). Additionally, around this time several relevant rule changes in the Tasman Resource Management Plan were introduced including a range of education initiatives by Council. The effect of rule changes and education initiatives in Nelson City may well also have an influence in the behaviours of Richmond residents as Council has received many queries from Richmond residents who seemed to think Richmond's rules were similar to Nelson's. Because Nelson City's initiatives are regularly reported on in the Nelson Mail and this is the major newspaper covering greater Richmond and Nelson, it is inevitable that there will be influence from Nelson City's initiatives on actions in Richmond.

Over the three years from 2007 results suggest a stalling of the downward trend in PM_{10}, although this is not able to be statistically validated due to the short period of data. The economic recession that has led to reductions in house sales could be part of the reason for this. Council's compliance monitoring programme involves enforcement of the TRMP rules requiring replacement of non-complying wood-burners at the time of house sale and we may see improved downward trends with respect to PM_{10}. See Section 4 for a progress report on this compliance monitoring programme.

The current Air Quality National Environmental Standard currently requires that steady progress towards achieving only one exceedence per year. Figure 4 below is a scatterplot showing Richmond's progress since the standard was brought in 2005. The points on the graph are second-highest concentrations of PM_{10} for each year. The Straight Line Path (SLiP) is relevant where resource consents are required for discharges of PM_{10}. In order for resource consents to be granted, the effect of any discharge must not cause the SLiP to be exceeded. The SLiP is a straight line drawn between the second-highest value in 2005 to 50 in 2013.

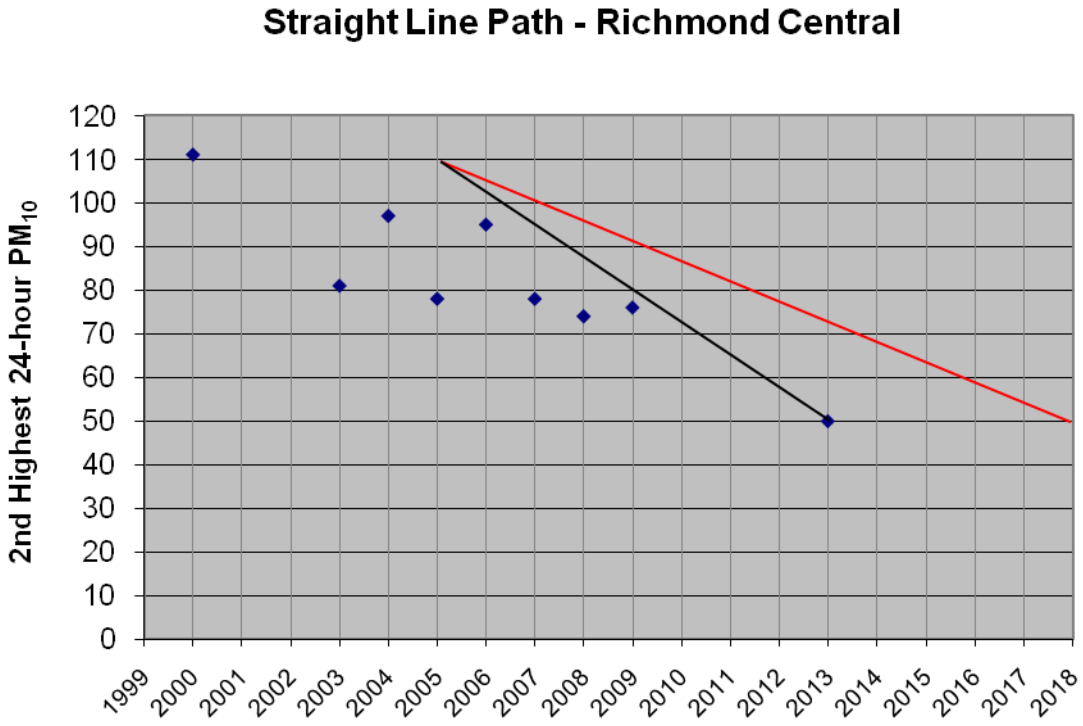


Figure 4 Maximum 24-hour concentrations as plotted with the straight line path (SLiP). The black line is the SLiP set down by the current NES (based on the second-highest concentration). The red line is the SLiP with the proposed new NES compliance date. Note: Under the proposed changes to the NES the SLiP will no longer be part of the regulation but it is still recommended to use this for reporting purposes.

It is difficult to project emissions into the future due to the large natural variability in the data. However, we cannot be confident that Richmond will achieve compliance with the Air Quality National Environmental Standard by 2013 (existing NES compliance date) but we may achieve compliance in 2018 (the proposed NES amended date). "Black-box" modelling by Environet Ltd has shown that we will be close to achieving compliance by 2018. The TRMP rule requiring woodburners be compliant at the time of house sales will have decreasing effectiveness as time progresses. This is because there will be an increasing proportion of houses that come up for re-sale that have already had the woodburner replaced.

Improvement in woodburner operation is likely to be part of the reason for improved air quality. The national standard for air quality allows only one exceedence per year from 2013 (although this date is currently under review as is the number of exceedences).

3. SPATIAL PATTERNS OF PARTICULATE AIR POLLUTION IN RICHMOND

3.1 Introduction

The aims of this study were to:

1. Determine the spatial variation of particulates in Richmond and Nelson
2. Enable a review of the location of monitoring sites within the Richmond airshed.

3.2 Methods

A vehicle-based mobile monitoring system was used to assess spatial variation of particulate pollution in the corridor from Wakefield to Nelson, with a focus on the main urban areas of Richmond and Nelson. The monitoring occurred over six winter nights in July 2008. Particulate matter was collected in 1, 2.5 and 10 micron inlets (to collect PM_1, $PM_{2.5}$, PM_{10}) using a GRIMM (Model 107) low-volume sampler that measures using a light-scattering technique.

3.3 Results and Discussion

Results showed that in both Nelson and Richmond the spatial distribution of particulate matter (PM_1, $PM_{2.5}$, PM_{10} and Black Carbon) is consistent with residential combustion being the major contributor to air pollution in winter nights. Large gradients were observed between residential and non-residential areas with lower concentrations observed in commercial areas that are not active at night time. Hotspots of high particulate were found in four particular areas of Richmond:

- Near the Hunter Laminates discharge on the Richmond deviation. Mostly spread along Wakatu Drive.

- On the south-west side of a low ridge that runs from the Holy Trinity Church back to the hills in a SE direction. This includes the SE part of Hunt Street, Barnicoat Place, Heaphy Street, part of Waverley Street, Bell Street and NW end of Cautley Street

- At the lower end of the small valley that Churchill Street runs down and surrounding area to the NW. This includes Polglase Terrace, Mason Place, Griffen Street, Lower Churchill Street, Churchill Street ends of Marlborough Crescent, Hill Street from Churchill Street to Sutton Street, Sutton Street, Tuffnell Street, SE end of William Street, Warren Kelly Street.

- An area centred about 500 metres north east of Richmond Mall. This includes D'Arcy Street, Herbert Street, Fauchelle Avenue, Elizabeth Street, and Florence Street.

The plot on the map below shows how PM_{10} concentrations vary over Richmond township. The concentrations are averages over $120m^2$ grids over six nights when sampling was undertaken within the period of 21-27 July, 2008.

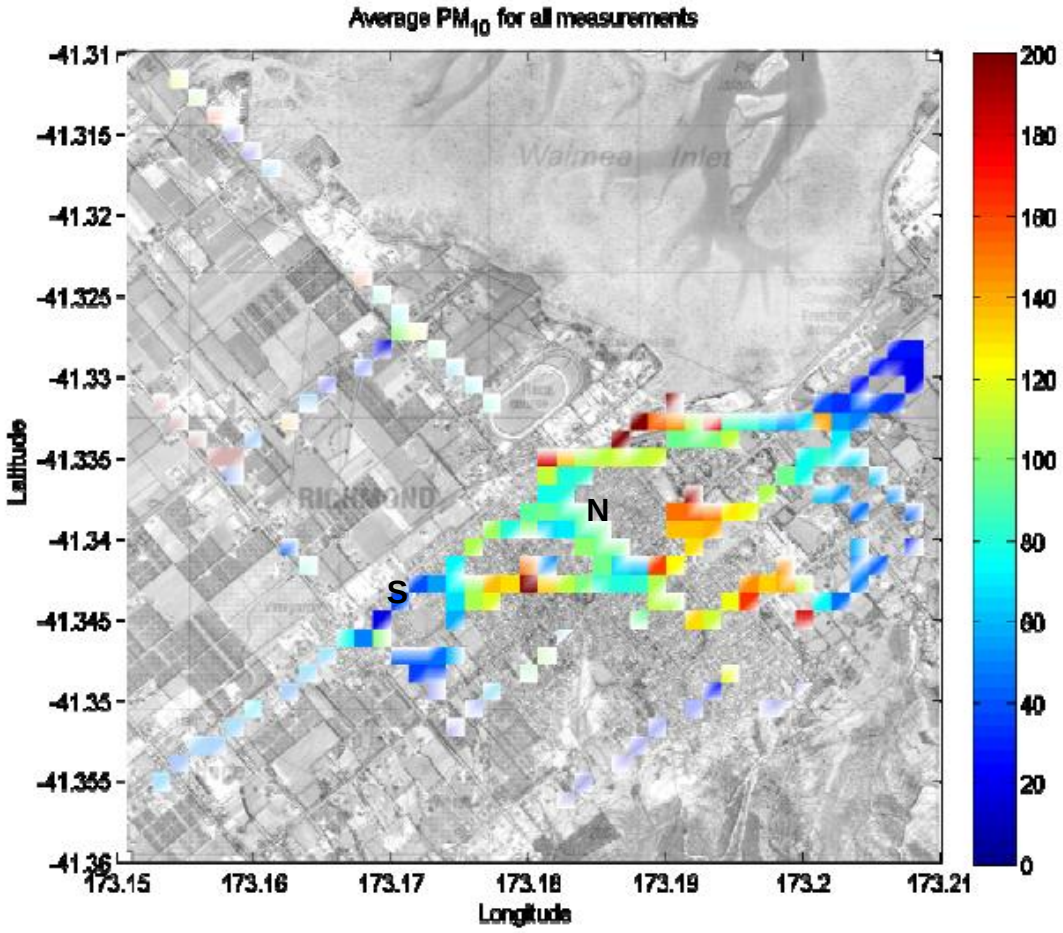


Figure 5: PM_{10} concentrations over Richmond township. The concentrations are averages over 120m^2 grids over six nights when sampling was undertaken within the period of (21-27 July, 2008). The colour scale is PM_{10} concentration in µg m^{-3}. The annotations "N" and "S" mark the locations of the temporary monitoring sites in Richmond North and South respectively.

PM_{10} concentration found during this mobile monitoring study is consistent with measurements of PM_{10} made by Council at sites 600m and 560m NE and SW of the Richmond Central monitoring site carried out in 2007 and 2008 respectively. This sampling was carried out using the Council's Partisol sampler. PM_{10} at the northern of these two sites (marked "N" on the above figure) was an average of 45% higher than the Richmond Central site on days when there were exceedences of the NES. In contrast the PM_{10} concentrations at the Richmond south site (marked "S" on the above figure) averaged 5.6% lower than the Richmond central site on the days when there were exceedences. The only significant exception to this pattern was on 24 June 2008 when the wind was relatively light and blowing from the north-north-east.

The plot on Figure 6 below shows how PM_{10} concentrations vary from Richmond to Brightwater and Wakefield. The concentrations are averages over 200m^2 grids on 27 July, 2008. Isolated "hot-spots" of high concentrations of PM_{10} where found in Brightwater. Note the different colour scale compared to the previous plot.

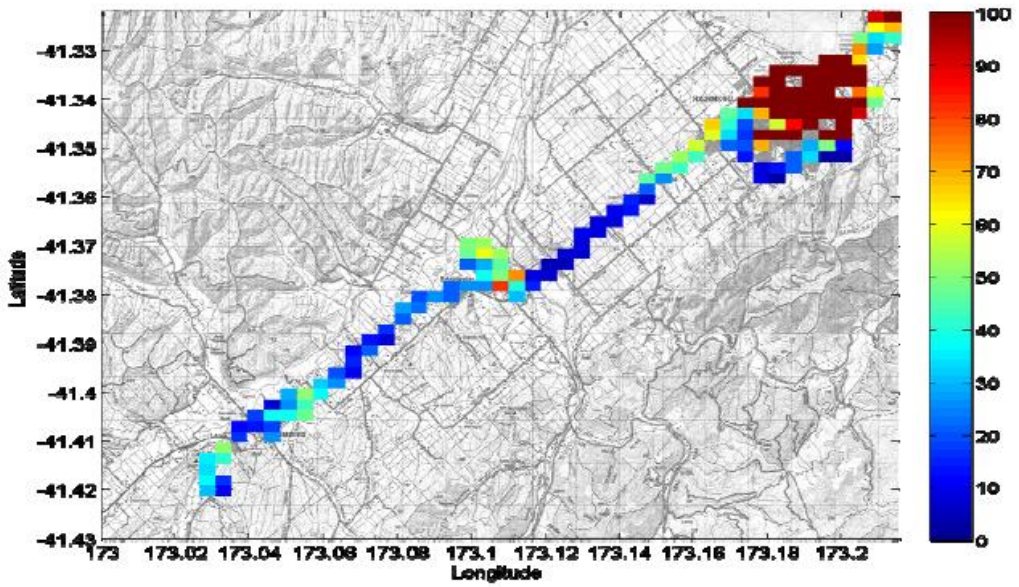


Figure 6 PM_{10} concentrations from Richmond to Brightwater and Wakefield on 27 July, 2008 (averaged over 200m^2 grids). Note the different colour scale compared to the previous plot.

This spatial variation in particulate concentration may be further refined when the 3D air dispersion modelling is complete (first draft of the report due in August 2010).

While long-term monitoring and reporting of air quality at the Richmond Central site is representative of the average PM_{10} concentrations that occurs over much of the airshed, it does not represent some parts of Richmond that have higher PM_{10} concentrations ("hotspots") and therefore greater adverse public health effects. Three major implications of this are:

1. People living in these "hotspot" areas should be made aware of the proportionate increase in risk to their health, particularly if they suffer from respiratory ailments.

2. Council should consider targeting these areas and contributing sub-airshed catchments as a priority for education/promotion or other methods that will reduce this particulate air pollution. These initiatives in two hotspot areas will also reduce PM_{10} at the Richmond Central site.

3. The Resource Management (National Environmental Standards Relating to Certain Air Pollutants, Dioxins, and Other Toxics) Regulations 2004 require that Councils conduct monitoring in that part of the airshed where the standard is breached by the greatest margin or the standard is breached most frequently, whichever is more likely. Council's mobile Partisol monitor could be used for this application at one of these sites each year.

Moving the Richmond Central site is not considered an option because it is important for continuity of record and trend analysis. It is often difficult to find a site that meets the requirements of the standard and Good Practice Guide for location and situation.

The Richmond Central site is a very good site as far as these requirements are concerned.

4. COUNCIL RESPONSE TO IMPROVE AIR QUALITY

This year compliance monitoring of the Richmond Airshed began with the modifications to Council's "Current Licences" Database to provide a method of capturing and displaying data for each property which became subject to the property sales rule, or had Council verification of the presence of a woodburner. It also captures information regarding those properties where other queries are made in relation to discharges from the subject woodburners.

Since the inception of the database in January 2010, 924 properties and relevant details have been entered. This increases each month as additional property sales occur, and as additional properties are witnessed discharging contaminants into the air during Airshed patrols.

Staff assess monthly sales data to ensure that an actual transfer of ownership has taken place, and then a letter of advice is sent to all property owners where the presence of a woodburner is known or likely. Patrols assess properties which have been sent this letter and if a discharge is witnessed, a Formal Warning notice is issued. This advises that any subsequent discharge will be met with enforcement action. A peer review process sees that accuracy is maintained.

During this time 92 property owners have replaced their non-compliant woodburners with Clean-Air approved woodburners. The installation of all woodburners is assessed through the Building Consent application process. Data regarding those properties which have installed clean-air home heating subsequent to our letters has not been acquired at this stage as no building consent is required for the majority of these heat sources. The focus has been on investigating those properties which clearly breach the TRMP rules, creating property owner awareness so that action is taken to ensure that no discharges occur from non-compliant burners. The methodology used follows the flow chart in Figure 7.

Over the coming weeks an educative approach will begin for those properties that have not sold and maintain their existing use rights to discharge. Unfortunately education is our only method of gaining cleaner discharges from these woodburner operators as the current set of TRMP rules do not allow for enforcement action to be carried out unless a particular discharge is objectionable beyond the property boundary. The level of "objectionableness" is determined using the FIDOL parameters, ie Frequency, Intensity, Duration, Offensiveness, and Location. This is unlikely to be breached by a discharge from a woodburner, and therefore makes improving the quality of those properties' discharges intrinsically difficult until such point as that property sells and is captured by the transfer of property rules. It is likely that the main cause of decreased air quality in Richmond is from those properties which continue to burn using older woodburners not compliant with the National Environmental Standard. With the current rules, Council is unable to enforce improvements in current wood burning techniques which may be consequential to a failure in meeting the strict air quality standards set by the Ministry for the Environment.

However, thorough monitoring through morning and evening patrols and the use of the stated procedures will continue, in an effort to provide Richmond's residents with cleaner air as we do everything possible to attain compliance with the National Environmental Standard.

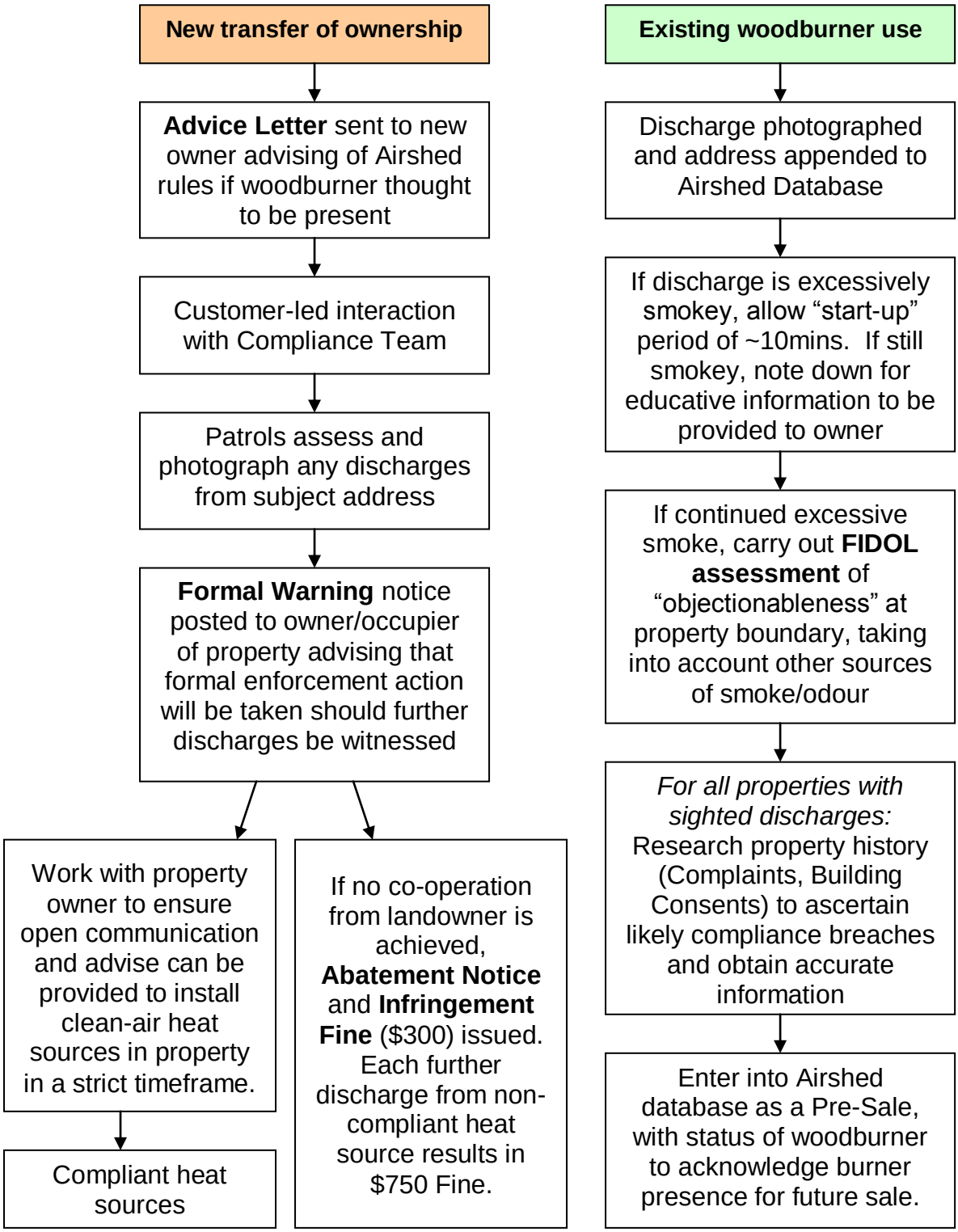


Figure 7 The compliance monitoring process with respect to the TRMP air quality rules

5. CONCLUSION

Trend analysis suggests a decrease in PM_{10} concentrations in Richmond Central of 20-30% from 2000 to 2009.

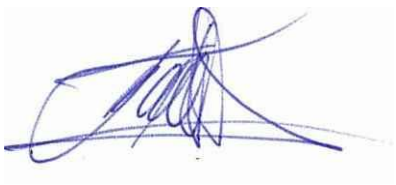
PM_{10} concentrations vary greatly around Richmond and the Waimea Plains. The Richmond central monitoring site represents average concentrations within the urban area. Four particular areas were identified as hot spots.

Compliance monitoring of domestic air emissions is active and progressing well.

6. RECOMMENDATIONS:

1. The Committee receives this report.

2. That Council notes that education initiatives will focus on to hotspot areas and contributing catchments in Richmond and in Brightwater.



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