PART F. CHAPTER 3 - OVERVIEW

1. Chapter 3 is concerned with air quality and with various of the sources of air pollution in the Canterbury region. It is divided into sections which introduce the topic, detail various issues which require resolution, and put in place objectives, policies, and rules dealing with each issue. The detail of the chapter is discussed more fully below.

Section 32 report

2. Before promulgating this section of its plan, the Regional Council undertook a detailed section 32 analysis. The result of that analysis is contained in a document headed "**Section 32 report: Air quality chapter of the Proposed Natural Resources Regional Plan**". It is report number RO2/4, and it is dated the 1st of June 2002.

3. The report is a lengthy document comprising seven parts and running to some 376 pages. It is not necessary to discuss its contents in detail.

4. The report was prepared some years ago and as a result it required some updating. The Commissioners heard evidence from the following:-

   (a) Ms L.E. Kirk - a senior resource management planner with the Council.

   (b) Mr K.J.W. Taylor - an environmental quality manager with the Council.

   (c) Ms T. Aberkane - an environmental scientist with the Council responsible for ambient air quality monitoring.

   (d) Mr P. Zawar-Reza - a lecturer in physical geography at the University of Canterbury, who has undertaken numerical atmospheric modelling focusing on air pollution dispersion over Christchurch.

(e) Dr E. Wilton - an air quality scientist with specialist expertise in relation to the environmental effects of air pollution, the methodology used to determine the effectiveness of proposed methods to reduce PM_{10} concentrations in Christchurch, and the impact of chapter 3 on Timaru.

(f) Dr M. Epton - a specialist with the Christchurch School of Medicine and Health Sciences who has researched air pollution and the associated health effects, especially from particulate matter.

(g) Mr G. Fisher - a senior air quality scientist with NIWA, who has undertaken work on emissions and who has modelled the air shed in Christchurch.

(h) Mr J. Baines - a director of Taylor Baines & Associates, which firm specialises in the application of social assessment to social research and social impact studies.

(i) Dr K. Bicknell - a senior lecturer in economics employed by Lincoln University, who has valued the health and welfare benefits of reduced particulate emission, made recommendations on the values that would be incorporated into an economic analysis of specific policies, and undertaken an economic analysis.

(j) Mr R. Jamieson - the General Manager - Commercial - for Orion New Zealand Limited.

(k) Ms A.J. Scott - an employee of Environment Canterbury.

(l) Mr M.R. Goudin - the Regional Council's clean heat project manager.

5. The evidence was intended to provide the Commissioners with an overview of Chapter 3, to explain how it came into existence, and to provide information that has become available following public notification of Chapters 1 to 3 of the NRRP.

Background

6. It was readily apparent to the Commissioners that concerns have been voiced about air quality in Christchurch for very many years. They were told that the first known Press report of smoke nuisance in Christchurch occurred on the 8th of August 1869. In the 1930s the Sunlight League was established in Christchurch. It sought to inform public opinion about air pollution, and to advance the use of smokeless fuels for heating and power generation. Issues relating to Christchurch's air quality were raised in Parliament in the mid-1950's and the need for investigations into the contributions from different sources was then suggested. In the 1960s the Clean Air Society was established. It pursued similar goals to those advanced by the Sunlight League and it continues in existence to this day.

7. The first substantial legislative efforts to manage air quality were introduced by the Clean Air Act 1972. The Commissioners were told that the legislation followed measurements of smoke and sulphur dioxide undertaken in Christchurch by the DSIR and recommendations made by the Air Pollution Committee and the Board of Health. The Act promoted the control and abatement of pollution. It contained various provisions for controlling both domestic and industrial emissions. At a domestic level, it provided for the establishment of clean air zones by Parliament at the request of local authorities. Within such zones, authorities could control the fuels used in domestic appliances and the appliances themselves.

8. In February 1973 the Christchurch City Council passed a by-law requiring that approved means of heating should be installed in houses under new building permits. In 1975 the City Council resolved to declare the whole of the city as a clean air zone under the Clean Air Act. The Clean Air Zone (Christchurch) Order was promulgated in 1977. Its effect was to limit the installation of heating equipment in new dwellings to those approved by the Clean Air Council. Initially this move did not stop the installation of non-approved appliances in existing houses, but the Commissioners were told that this was subsequently caught by an amendment in 1979.

9. By 1982 all other local authorities in the Christchurch metropolitan area had put forward proposals to have their urban areas declared clean air zones. The result was the Clean Air Zones (Canterbury Region) Order 1984, which covered most of greater Christchurch. Under the order the use of non-approved appliances in new dwellings was prohibited and only approved fuels could be used. The order was further amended in 1988 to include, amongst other things, fuel use specifications.

10. In 1991 the City Council brought its building by-laws into line with the provisions of the Clean Air Zone Order and as a consequence open fires in new houses were effectively banned. Also in 1991 a by-law was made under the Clean Air Act by the City Council to prohibit rubbish and garden fires during May, June, July and August of each year.

11. The various local authority controls became part of the Canterbury Regional Council's Transitional Regional Plan in 1991 - see sections 368 and 369 of the Resource Management Act 1991. Under the Transitional Plan small scale fuel burning appliances that are to be installed and used in the Clean Air Zone need to be approved by the Regional Council. Industrial and trade premises and processes are categorised in three categories - some need to obtain a resource consent and others do not.

12. Since the passage of the 1991 Act, Environment Canterbury has had responsibility for air quality management issues in the region, and in particular it has had responsibility for managing the discharges of contaminants into air under section 15 of the Act.

13. The Regional Policy Statement was notified in October 1993. It became operative in 1998. It details in broad terms air quality issues in Canterbury and contains an objective which seeks to maintain or improve ambient air quality so that it is not a danger to people's health and safety and to reduce nuisance effects of low ambient air quality - see Chapter 13 - Objective 1.

14. The Regional Council has taken a number of additional steps in the discharge of its responsibilities under the 1991 Act. In 1993, and again in 1997, issues and options documents were released consulting on various air quality options. In 1998 a draft air plan was released and public comment was sought on various issues. The document put forward the objective of reducing PM_{10} concentrations to 50 ug/m3 (24 hour average) by 2011. It proposed various means of attaining that end. These are commented on in greater detail below. In March 1998 the Regional Council resolved to prohibit the domestic use of coal in Christchurch by September 1998 and open fires by September 2001. In April 1998 the proposed coal ban was referred to the Environment Court. The matter then went to the High Court which quashed the proposed coal ban in October 1998. In November 1998 the Regional Council decided to proceed with a hearing to consider the use of section 369(11) to ban the domestic burning of coal and also to hear submissions on the draft air plan. Those submissions were heard in July to December 1999. On the 30th of March 2000 the hearings panel released its recommendations on the coal ban and on the draft air plan. The Council accepted those recommendations on the 4th of May 2000. It did not however adopt the proposed ban on the domestic burning of coal under section 369(11) of the Act, and decided instead that the issue should be considered in the context of other related measures to be developed as part of an overall strategy to address adverse health effects from suspended particulate.

15. From June 2000 until December 2001 a range of Council workshops on various of the issues that might be addressed in an air plan were undertaken.

16. The Council commissioned and considered a large number of reports and investigations which inter alia have sought to measure the condition of the air in Christchurch. The reports have also sought to determine the characteristics of Christchurch's air quality, and to detail how it measures up against national environmental guidelines and standards. Investigations have sought to identify what specific effects might be a consequence of the contamination which exists, to determine why Christchurch's air is degraded, what is causing the existing poor air quality, and how the Christchurch air shed functions.

17. In December 2001 a Council workshop was held. It discussed the various reports received, and resulted in the development of a course of action which ultimately led to chapter 3.

18. That course of action was formally adopted by the Council in December 2001.

19. On the 28th of February 2002 the Council considered the NRRP and the accompanying section 32 report, and adopted the various recommendations amending the proposed emission standard. It also decided to defer adoption of the NRRP and associated section 32 report until after further consultation with the Christchurch City Council. That consultation was undertaken, and as a result, the Regional Council amended the timeframe for prohibiting the use of open fires by bringing forward the proposed date from the 1st of January 2008 to 1st of January 2006. With this amendment, chapter 3 was adopted and approved by the Council. It was then notified as detailed earlier in these recommendations.

20. The outcome is the suite of objectives, policies, and rules that are contained in Chapter 3 of the NRRP.

Research Undertaken/Reports Obtained/Analyses Undertaken

(a) Air Quality

21. Generally air pollution in Canterbury comes from burning - in particular wood, coal, petrol, and diesel - as well as from industrial processes. Monitoring has been carried out at permanent sites in Christchurch (in St. Albans), Kaiapoi, and Timaru. Monitoring units have been moved around in other towns where air quality is not considered to be as bad. Mass measurements have been carried out using an instrument known as a Hi Volume sampler, where a preconditioned and weighed filter is exposed for 24 hours while a known volume of air passes through it. The particles left on the filter are then collected, and after conditioning and weighing, the difference in weight can be used to calculate the concentration of PM_{10} in the air. In more recent years, instruments which allow continuous measurements have become available. One of these - known as TEOM - has been used at most Canterbury monitoring sites. Under this method, the weight is

based on the change in the oscillating frequency of the element, as particles collect on the filter. To ensure moisture is not measured, the sample of air is heated. This heating volatilises some particles, and this results in lower concentrations being measured than would be measured by a Hi Volume sampler. The Commissioners were told that the TEOM method underestimates the concentrations compared to the Hi Volume sampler by about 30%. They understand that chapter 3 has been based upon data obtained using the Hi Volume sampler.

22. Other monitoring methods have been used to analyse other contaminants, in particular polyaromatic hydrocarbons and volatile organic compounds.

23. At the time the plan was notified, there were various national guidelines in place. Relevantly they were as follows:-

Contaminant	Averaging Period	Guideline
PM_{10}	24 hours	50 ug/m3
Carbon monoxide	1 hour 8 hour	30 mg/m3 10 mg/m3
Sulphur dioxide	1 hour 24 hours	350 ug/m3 120 ug/m3
Nitrogen dioxide	1 hour 24 hour	200 ug/m3 100 ug/m3
Ozone	1 hour 8 hour	150 ug/m3 100 ug/m3
Benzene	Annual	3.6 ug/m3
BaP	Annual	0.3 ng/m3

The maximum readings for PM_{10} obtained at selected sites in Canterbury during a one year period were as follows:-

(a) in Waimate, 84% of the guideline;

(b) in Timaru, 152% of the guideline; and

(c) in Christchurch, 420% of the guideline.

Maximum carbon monoxide concentrations were less than the guideline figures - with the exception of the 8-hour maximum concentration in Christchurch which was recorded at 140% of the guideline. The 8-hour carbon monoxide concentration exceeded the guideline in Christchurch a few times each year. Maximum sulphur dioxide concentrations were low compared to the guidelines; maximum NO2 concentrations were also below guidelines. The Commissioners were also told that recent monitoring of benzene and BaP suggests that these contaminants exist in very high concentrations at certain locations. The NRRP does not at present deal directly with these contaminants because the testing post dates its notification. Moreover the testing to date is limited. The Commissioners were assured that the Regional Council will consider a variation should further testing suggest that this is necessary.

24. The Commissioners were told that PM_{10} exceeds, or gets close to, the guideline in most Canterbury towns quite frequently. It was also clear to them that the guidelines were exceeded on many occasions. For example in 2002 the guideline was exceeded in Christchurch on 17 occasions . In 2003 it was exceeded on 23 occasions. In Timaru the guideline was exceeded 19 times in 2002 and 32 times in 2003.

25. The evidence suggests that concentrations fluctuate on a daily basis, and from winter to winter. These fluctuations are caused primarily by variations in weather conditions. Pollution concentrations increase in the evening and peak during the night. They decrease during the early morning and often peak again around 9 a.m. The relationship between the morning and evening peaks of different contaminants varies depending upon the sources of contamination.

26. Contamination problems are exacerbated by the inversion layer which commonly exists in parts of Canterbury. Normally temperature decreases with height. In Christchurch however, after sunset, the ground cools the air close to it more than the air above it, creating a temperature inversion. That inversion continues through most of the night and early morning, until the ground starts to warm up during the following day. Generally as the air temperature close to the ground cools and the inversion is created, the wind eases, and the concentration of contaminants in the air tends to build up. Such weather conditions are typical under anti-cyclonic conditions, or when a southerly dies. In such conditions Christchurch and Canterbury enjoy fine weather, with clear skies and light winds. The low wind speeds and temperature inversion at night mean that the air is very stable, and pollution produced at this time either does not rise, or does not get blown away.

27. Within Christchurch, it is also clear that concentrations vary across the city. Concentrations depend on which direction the wind drift is coming from, and whether the wind drift carries polluted or clean air.

(b) <u>Sources of Exceedance</u>

28. The Council used two methods - an emissions inventory which estimates emissions from key sources and quantifies relative contributions - and receptor modelling which determines the key source of contributing concentrations of emissions measured at a receptor site.

29. The Commissioners were advised that emissions inventories are the most common and reliable method used by regulatory authorities worldwide to quantify sources of air pollution and to provide the bases for air quality strategy development.

30. Several emission inventories have been prepared for Christchurch - in 1996, in 1999, and in 2002. Each quantified emissions for a typical winter's day. Unfortunately there were significant methological differences in relation to the information obtained from industrial and commercial activities, with the result that a direct comparison of industry data collected in 1996 and 1999 cannot be made with data obtained in 2002. As a result the Commissioners were told that estimates presented for 1996 and 1999 were revised using "back cast" estimates.

31. The inventories emissions suggest that the domestic home heating sector contributes 84% of all PM_{10} emissions in Christchurch, that motor vehicles contribute 8%, and that the industrial and commercial sector contributes 8%. The sources of PM2.5 emissions were said to be the domestic home heating sector - 86%; motor vehicles - 9%, and the industrial and commercial sector - 5%. Turning to carbon monoxide, the domestic home heating sector contributes some 50% of all emissions, motor vehicles 49%, and the industrial and commercial sector 1%. The contributions from the three sectors to carbon dioxide are rather more even. The domestic sector contributes 35%, motor vehicles 41%, and the industrial and commercial sector 24%. Oxides of nitrogen are contributed as to 80% by motor vehicles, 7% by the home heating sector, and 13% by the industrial and commercial sector. The same sector contributes 80% of all sulphur dioxide emissions, while the domestic heating sector contributed only 5%, and the motor vehicle sector 15%.

32. It was also estimated that in 2005 there were 8,500 open fires, 3,000 multi fuel burners, 34,000 woodburners, 500 pellet burners, 32,000 gas burners, and 1,500 oil burners being used in suburban Christchurch.

33. As noted above, the contaminant of greatest concern in Christchurch and in other towns and urban areas of Canterbury is PM_{10}. The analyses undertaken suggested that woodburners contribute 60% of the total domestic heating PM_{10}, open fires 26%, and multi fuel burners 14%. It was noted that open fires and multi fuel burners contributed significantly more emissions per appliance than the woodburners in use as at 2002.

34. PM_{10} contamination decreased between 1996 and 2002. Further it seems that the greatest total reduction in PM_{10} emissions were from the domestic heating sector. The change is due to the increased domestic use of gas and electricity, and the reduced use of wood and coal.

35. Studies have been carried out in Timaru, Ashburton, Kaiapoi, Rangiora, and Waimate. The results were largely consistent with those found in the Christchurch survey. The relative contributions to winter time PM_{10} from domestic heating were thought to be as follows:-

    (a) Timaru - 91%;

    (b) Ashburton - 88%;

    (c) Kaiapoi - 96%;

    (d) Rangiora - 89%;

    (e) Waimate - 98%.

    Contributions from industry and commerce in the same towns were respectively considered to be 3%, 10%, 1%, 10%, and 0%, and from motor vehicles 6%, 2%, 3%, 1%, and 2%.

36. The conclusions reached from using emissions inventories, and from using the alternative technique - receptor modelling - compelled the conclusion that domestic home heating is the main source of PM10 pollution in Christchurch and in the towns and urban areas across Canterbury.

(c) <u>Box Modelling/Air Shed</u>

37. Once it had the emissions information and knowledge of the relevant meteorology, the Regional Council had to enquire what events were leading to high pollution levels, and how much emissions needed to be reduced to achieve better air quality.

38. To endeavour to answer these questions in part, it requested NIWA to undertake box modelling on its behalf. Box modelling assumes a virtual box sitting over Christchurch. Calculations are made of contaminants going into that box, and contaminants coming out of it. The resulting concentrations of the contaminants of interest can then be determined.

39. In examining the box model, NIWA had to account for any pollution that blows in from one side, any pollution that blows out from the other side, emissions from sources within the box, any that escape through the top of the box, any that deposit to the surface, and of course the dimensions of the box (given that its top is determined by reference to the inversion layer in Christchurch). Given that the inversion height is not fixed, NIWA allowed for the size of the box to vary.

40. The box model enabled the impact of emissions at different times of the day to be calculated, and determined whether or not the relationship between emissions and concentrations is linear. It confirmed that domestic heating emissions have a greater impact on concentrations of PM_{10} than motor vehicles or industry.

41. The Regional Council also had to determine where the air is coming from on nights when there is an air pollution problem in Christchurch, how far it travels, and where it goes. This required analysis of Christchurch's air shed.

42. Christchurch has a topographic boundary to the south - the Port Hills - but there is no obvious boundary in other directions. To determine the most likely airflow patterns during periods when Christchurch experiences high levels of PM_{10} pollution, modelling using computer programmes that simulate meteorology had to be undertaken. The modelling suggested that during cold apparently stagnant winter nights, cold air drains off the Port Hills. This was referred to as katabatic drift or drainage. That air meets with cold air draining from the Southern Alps across the central Canterbury Plains. The model data was then used as an input for what is known as a back-trajectory model which in turn was used to establish where any given parcel of air was at any specified moment and the location it had come from. This information in turn enabled the Council to qualitatively draw lines on maps. It was used to determine the location of the clean air 1 and 2 zones contained in the proposed plan.

(d) Environmental Effects

43. Having determined that air quality in areas such as Christchurch is degraded, and that guidelines for PM_{10} in particular are often exceeded, the Council set out to determine the various environmental and health effects of that pollution.

44. It commissioned research into the impacts of poor air quality in Christchurch on what are known as "**restricted activity days**". Restricted activity days are days spent in bed, days missed from work, and days when normal activities are partially restricted due to illness. The Council was seeking to ascertain how many restricted activity days are attributable to air pollution in Christchurch. The methodology used was based upon work undertaken in the United States. There was considerable extrapolation involved and the materials on which the analysis was based have not been validated in New Zealand. Nevertheless it was estimated that in Christchurch in 2001, the number of restricted activity days due to air pollution was between 300,000 to 600,000 per year. While it was acknowledged there is every possibility of error in this analysis, the resulting figures suggested that the adverse effects of air pollution - resulting in restricted activity days - have a considerable impact on a large proportion of the City's population.

45. The evidence also suggested that there are other adverse effects - in particular amenity impacts - arising from air pollution. These include visibility and nuisance effects, smoke and odour nuisance, the soiling of laundry, deposition on buildings, and the like. The Commissioners were reminded that Christchurch has a problem with brown haze - particularly during the winter months - and that that haze is often seen as being an air pollution problem.

46. Evidence was presented to the Commissioners suggesting that there are rather more significant health effects arising from air pollution in Christchurch. That evidence suggested that the short term effects of particulate pollution on healthy people are relatively minor and are predominantly nuisance effects e.g. irritation of eyes, nose and throat, increased risk of colds and influenza, and asthma attacks. However it also suggested that there is a group of people who are more

vulnerable to particulate pollution - including children, people with asthma, people with smoking related diseases, and people with pre-existing heart disease. It is the effect of pollution on these vulnerable groups which is of most concern. It was explained to the Commissioners that a significant amount of data has been collected in Christchurch. A mortality study was undertaken over the years 1988-1993. The study examined deaths in over 65-year-olds. It concluded that there is a 1% rise in total deaths and a 4% increase in respiratory mortality for each 10 ug/m3 rise in PM_{10}. Estimates given to the Commissioners suggest that there are about 55 extra or premature deaths a year in Christchurch attributable to air pollution. Why those deaths occur is a matter of considerable debate. Nevertheless the Commissioners were told that the local data ties in with that contained in the international literature. The evidence suggested that with increases in air pollution there is an increase in the rate of death from both cardiac and respiratory disease in the elderly, and an increased rate in the number of hospital admissions for cardiac disease in adults and for respiratory disease in all age groups. It also seems that there is direct evidence of increased symptomatology and medication use amongst those in the community with established lung diseases.

47. The Commissioners were presented with a compelling case by Dr Epton on the potential health effects from PM_{10} in the Christchurch situation. However the conclusions expressed by Dr Epton were not shared by all medical practitioners who gave evidence at the hearing. There is a difficulty in separating the effects that arise due to extreme cold from those that arise from ambient PM_{10} concentrations, given that in Christchurch these events are generally concurrent. Dr Epton supported his conclusions by reference to similar studies in warm climates such as Hong Kong where the relationship between hospital admissions and pollution events is not dependent upon cold conditions. The Commissioners were presented a counter view. They were told that hospital admissions in Portugal are linked to cold in the absence of pollution events. While fascinating to consider, the Commissioner did not need to form a view on which interpretation of the data was correct. As will be discussed later, the promulgation of the National Environmental Standard resulted in the Commissioners not having to determine the appropriate air quality objective in relation to PM_{10}.

(e) Valuing the Effects

48. An attempt was made to value these various effects. This required an examination of the appropriate values and Christchurch residents' willingness to pay for improvements in air quality. The Commissioners were told that surveys suggest that there is wide agreement that there are a number of benefits associated with lower levels of suspended particulate matter - including reduced risks of mortality, and reduced risks of various health related problems. It also suggests that there are various welfare and amenity benefits. The Commissioners were advised that attaching a value to lives lost or at risk is an emotive issue, but that there are several possible ways to approach the issue. Essentially those researching the question are required to determine how much each individual in a community is willing to pay to reduce the risk of death or health related problems albeit by a small amount. The values are then summed over the number of individuals in the chosen community. In New Zealand estimates of the value of a statistical life have mostly been undertaken in the context of employment related risks and/or road safety. Cited values of a statistical life, adjusted for New Zealand currency and wage conditions, range from $684,000 to nearly $16,000,000. The average is around $5.4 million. In 1989/1990 a willingness to pay survey was conducted to determine the value that people in New Zealand place on reducing the risk of a fatal automobile crash. Based on the results of that survey, the Government accepted the value of a statistical life at $2M (1991 values). Adjusted for inflation using the ordinary time wage rate, this figure equated to approximately $2.49M in 2000. This is apparently the figure used by the Land Transport and Safety Authority and by Transit New Zealand when evaluating roading projects, and by the Ministry for the Environment when evaluating environmental policy. This figure was recommended to the regional council as a starting point. It does however have to be adjusted because the people most at risk of early death from pollution differ in important ways from those at risk from road fatalities. Those most at risk from air pollution include those aged 65 or over. The recommended option was to look at statistical life years. This essentially involved obtaining a value for a statistical life year, and then applying that value to the remaining life expectancy of somebody at risk from a pollution related death. The recommended value was

that deaths from pollution should be valued at between 50 and 70% of the full value of a statistical life. This equates to a value of approximately $1.5M. On the evidence available, it also seems likely that there will be a reduction in hospital admissions if air pollution can be reduced. There will also be a financial benefit from reduced hospital admissions, and wages and salaries saved as a consequence.

49. It was clear to the Commissioners, from the evidence presented, that many of the economic issues are still controversial, on both a theoretical and on a practical level. Nevertheless the Commissioners accept that in broad terms there are significant economic benefits to be achieved from reducing air pollution.

(f) Consultation

50. The Regional Council undertook various air quality public opinion surveys to assess the public's views about Christchurch's and Timaru's winter air pollution problem, and possible solutions to that problem. The surveys suggest that the vast majority of people consider that there is an air pollution problem. Further, the majority of persons support steps being taken to clean up air pollution in both Christchurch and Timaru.

51. In 1997 further surveys were undertaken to assess the Christchurch public's reaction to possible air quality control measures. Three air quality control options were presented to respondents - banning coal for domestic use from 1998, banning open fires from 2000, and making it compulsory to replace woodburners after 15 years of use if they do not comply with applicable standards at that time. A total of 1,510 persons were surveyed, and the Commissioners were told that the margin of error was 2.5%. The survey results suggested that:-

(a) 64% were in favour of banning coal, 17% opposed, with the remaining 19% neither in favour nor opposed;

(b) 59% were in favour of banning open fires, 23% opposed, and 18% indifferent;

(c) 65% supported replacing woodburners after 15 years if they did not comply with the then current standards, 16% were opposed, and 19% were indifferent;

(d) 6% were opposed to all three suggested options.

52. Further surveying was undertaken in May 2001 to assess the public's reaction to possible air quality control measures in Christchurch. On this occasion:-

(a) 64% recognised pollution as a health problem, and 35% said that they, friends, or family were affected by air pollution;

(b) 87% believed that something should be done about air pollution;

(c) 4% were opposed to any form of pollution control;

(d) 45% supported banning new woodburner installations (40% opposed);

(e) 52% supported banning open fires from 2005 (34% opposed);

(f) 37% supported no replacement of woodburners or open fires with new woodburners from 2005 (47% opposed), and

(g) 37% supported no replacement of woodburners after 15 years from 2010, and 47% opposed.

53. After the NRRP was notified, a further survey was undertaken. A total of 1,484 households were surveyed. The results were as follows:-

(a) 37% said that they, friends, or family, were affected by the effects of air pollution;

(b) 52% supported banning new woodburner installations (39% opposed);

(c) 80% supported replacing existing woodburners with new low emission burners;

(d) 70% supported banning open fires (21% opposed), and

(e) 69% supported older burners being phased out within 15 years of installation (21% opposed).

54. In June 2004 another survey was undertaken involving 625 individuals. It concluded that:-

(a) 89% considered that Christchurch had a serious pollution problem;

(b) 45% considered that air pollution was not acceptable;

(c) 32% considered that they, their family, or friends, had been affected; 73% noted health effects, 15% quality of life effects, 11% environmental effects, 10% smell effects, 7% visual effects, 4% effects on buildings, and 6% other effects.

(g) Social Impact Assessment

55. The Regional Council commissioned a social impact assessment. It was intended to complement the existing cost benefit analysis, and the public opinion surveys.

56. The social assessment work reviewed existing materials, and reported on consultation with key stakeholder groups in order to confirm the nature and distribution of social impacts likely to result from implementing the rules relating to domestic heating in the proposed plan.

57. It was disclosed that there is little disagreement over the need to address wintertime air pollution problems, and the researchers recorded little doubt about the need for the Regional Council to act decisively and clearly. However those approached expressed the view that there were data deficiencies. There was also concern expressed about the "invisible problem" that would be created from inadequately heated homes. It was recognised that air quality and public health are related, and that simply banning the use of solid fuel is not the answer. While this might clean up the air, it was equally likely to lead to unhealthily cold homes for a significant number of Christchurch residents. This was the concern expressed by a group of medical practitioners at the hearing.

58. Various recommendations were made to the Regional Council - in particular to ensure that there are financial incentives and assistance programmes in place, to proactively manage the risks for more vulnerable households, to improve baseline data, to co-ordinate inter-agency efforts, to educate, to raise public awareness, and to take stronger enforcement measures.

(h) Clean Heat Project

59. One of Environment Canterbury's responses was to launch the clean heat project. It was launched in February 2003. At present it is focused on Christchurch only. It aims to encourage households in Christchurch to:-

(a) replace polluting domestic heating appliances, and

(b) to provide financial assistance for those who may be adversely affected.

60. Considerable moneys have been allocated to the project. It is being funded by a special rate for Christchurch. The funding has varied from year to year. The average yearly rate has been approximately $14.88 per $100,000 of capital rateable value.

61. As at the 6th of August 2004 some 6,600 registrations had been lodged with the Council, some 3,535 assessment had been undertaken, and some 2,299 households had qualified for assistance. A total of 1,545 conversions had been undertaken.

(i) Possible Measures to Reduce PM10 concentration

62. The Council has endeavoured to assess the impacts of different measures which might be taken to reduce PM_{10} concentrations in Christchurch.

63. By reference to various guidelines, at an early stage (1996) it set an air quality target for PM_{10} of 50 ugm/3 (24 hour average). This was based on one allowable exceedance (averaged over three years to account for variations in meteorology from year to year). Based on monitoring undertaken from 1990 to 1996, a 74% reduction in the discharge of PM_{10} to air was required to meet this guideline. Analyses undertaken following the 1999 emissions inventory suggested that to achieve the desired target, it was necessary to limit either the number of burners or the allowable emissions from each burner, or to adopt an option combining a combination of both measures. A number of other options were examined, including the banning of open fires and older style burners by various dates. It was considered that a combination of policies could result in compliance with the target figure being achieved around 2014.

64. Various options were considered for domestic heating management in Christchurch. These included the following:-

(a) do nothing;

(b) initiatives focused at domestic heating sources of PM_{10}, namely:-

(i) education and promotion of:

- the burning of dry wood
- the burning of smokeless fuels
- the correct operation/maintenance of a burner
- the installation of low emission burners
- the appropriate choice of appliance size
- energy efficiency measures
- the use of cleaner methods of home heating on high pollution nights
- conversion to non-solid fuel heating devices

(ii) emission standards for new solid fuel burners

(iii) control the sale fuel or appliances

(iv) compulsory no-burn days

(v) fuel/appliance bans by:

- prohibiting the use of open fires
- prohibiting or phasing out the use of solid fuel burners in new homes or homes without burners
- preventing the installation of solid fuel burners in new homes or homes without burners
- prohibiting use of solid fuel burners in houses meeting specified energy efficiency
- limiting the number of solid fuel burners in Christchurch
- prohibiting solid fuel burners following a change of house ownership
- prohibiting the use of coal
- prohibiting the use of solid fuel

(vi) economic instruments, such as:

- financial contributions under section 108 of the RMA
- financial incentive programmes
- tradeable emission permits
- fuel taxes, emission charges, equipment use charges

(vii) improving energy efficiency through improvement in the Building Code

(c) initiatives focused on industrial emissions of PM_{10}

(d) initiatives focused on outdoor burning emissions of PM_{10}

(e) initiatives focused on motor vehicle emissions of PM_{10}

65. In addition, three air quality targets were considered - a target with zero exceedances from the guideline, a target allowing for one exceedance, and a target allowing for two exceedances.

66. The Regional Council sought to analyse how effective the alternative methods would be. It considered their efficiency and appropriateness.

67. The Regional Council sought to obtain an economic analysis of the cost effectiveness of the various options it had identified to deal with air pollution. It undertook this exercise so that a benefit/cost analysis of each of the policy options could be considered.

68. Some seven policies were evaluated, which were combined to form four separate scenarios, namely:-

(a) the banning of open fires by 2005,

(b) the banning of open fires by 2005 and the phasing out of non-complying burners from 2005,

(c) the banning of open fires by 2005 and the phasing out of non-complying burners from 2010, and

(d) the banning of open fires by 2005, the phasing out of non-complying burners from 2010, and no burners being installed in new houses from 2005.

Each was evaluated in terms of its difference from the status quo.

69. All scenarios were evaluated using two criteria - a net present value (benefit/cost) analysis, and a cost effectiveness analysis. The banning of open fires was found to be the most cost effective policy. However this of itself did not meet the overall policy objective (in terms of the reduction in emissions to the desired level). The only way to achieve the desired reduction in emissions was to combine an open fire ban with other policies. However it was noted that additional gains from other more stringent requirements are small - and that they are costly. Indeed the analysis suggested that the net present value of each of the other policies is negative. They not only reduce the cost effectiveness of the policy scenario, but also reduce the net benefits to be derived from the policy change.

70. The net present value expected to result from the implementation of an open fire ban ranges from $217M to $395M. It is expected to cost between $2.3M and $2.5M to achieve a one percentage decline in discounted cumulative emissions. The variants which could be contained in the draft air plan noted above were evaluated. They generated the lowest net benefits and were the least cost effective of the scenarios. There was considerable variability in the net present values of the expected total benefits - from minus $63M to $231M, and it was noted that it is expected to cost between $9M and $9.8M to achieve each percentage reduction in discounted cumulative emissions.

71. After consideration it was proposed that in Christchurch, the various rules and methods proposed for small scale solid fuel heating should provide for the following:-

    (a) an emission standard of 1g/kg, and 65% thermal efficiency;

    (b) prohibiting burners from being installed in new houses or existing houses using other heating methods;

    (c) prohibiting the use of open fires;

    (d) phasing out non-complying enclosed burners 15 years after the date of installation.

Outside Christchurch, it was considered that rules and methods could be less strict than those proposed in Christchurch. It was proposed that new installations of solid fuel burners should meet an emission standard of 1g/kg and 36% thermal efficiency as from the 1st of January 2004, and that all current installations up until that time would be permitted. Any new open fire installation would require resource consent from January 2004. This was done in recognition of the fact that domestic solid fuel burning devices are considered to be the main contributors of PM10 contamination.

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72. The NRRP - chapter 3 - devolved against this background and as a result of the numerous analyses undertaken.

73. Chapter 3 is intended to apply to the whole of the Canterbury region (but excluding the coastal marine area). It seeks to address two principal air quality issues in Canterbury:-

(a) localised air quality issues arising from odour, dust, suspended particulate emissions (PM_{10}), agri chemical spray, and the discharge of contaminants from industrial or trade processes or premises;

(b) ambient air quality issues in Canterbury. Ambient air is the air outside buildings and structures. The chapter is prefaced on the assumption that discharges of PM_{10} (suspended particulate), CO (carbon monoxide), NOx (nitrogen oxide), O3 (ozone), SO2 (sulphur dioxide), hazardous air pollutants, and other contaminants from a variety of sources including industrial trade processes, domestic heating, motor vehicles, and outdoor burning, are of concern in Christchurch and in the Canterbury region as a whole. Significant ambient air resource management issues for the Canterbury region are considered to include the nuisance and health effects on people, and on their social, cultural, and amenity values.

74. The NRRP does not directly deal with global air quality issues. The view has been taken that this is primarily the responsibility of central government.

75. The contaminant of most concern from the public health perspective is PM_{10}.

76. The NRRP also focuses on Christchurch, because the regional council has undertaking more monitoring and investigations in the Christchurch area than it has in other urban areas in Canterbury. The rules proposed for the rest of Canterbury are generally less strict than those proposed for Christchurch. The Commissioners were told that it is proposed to further address air quality problems in other centres including Timaru, Ashburton and Rangiora at a later date. Investigations and monitoring in these centres is apparently progressing. If further measures are needed for other areas then variations to the NRRP will be required.

77. There are three objectives recorded - one (AQL 1) - which deals with localised air quality issues and two which deal with ambient air quality issues (AQL 2 and 3). There are twenty-one policies and associated methods identified. Policies related to objective AQL 1 dealing with localised air quality are policies AQL 1 to AQL 8. Policies related to AQL 2 and 3 which contain the objectives for ambient air quality in Canterbury and Christchurch respectively are policies AQL 9 to AQL 12 and policies AQL 13-21.

78. The PM10 target for Christchurch is 50 ug/m3 (24 hour average) with no more than one annual exceedance averaged over three years by 2012 - AQL 3. This is for Christchurch only. This is considered to be a “first stage” target.

79. Various rules relate to each policy. The rules relate to discharges to air from small and large scale fuel burning devices, from outdoor burning, from industrial and trade premises and processes, from intensive farming, from waste management processes, and from the discharge of agri-chemicals. The information to be provided with resource consent applications is detailed, and an explanation and the principal reasons for the various methods adopted in the plan are provided. Environmental results anticipated are set out and there are provisions dealing with air quality monitoring and review.

80. There are various appendices, schedules, and maps. These cover various matters, e.g. guides to minimise smoke emissions from outdoor burning, and from the incineration of agri-chemicals and animal remedy containers, and criteria for assessing offensive or objectionable dispersal or deposition of smoke particles, dust, and odour. The maps divide Christchurch into two zones - clean air zone 1 which is considered to have poor air quality and which it is intended will be subject to more stringent rules, and clean air zone 2 which is intended to act as a buffer for the ambient air surrounding Christchurch. The rest of the region is not specifically "zoned" on the maps - but it comprises the Canterbury region outside clean air zones 1 and 2.

Real Life Emissions

81. As noted, the NRRP includes various measures that seek to reduce domestic woodburner particulate emissions.

82. The various measures contained in the proposed plan were based on forecast winter time particulate emission loads in Christchurch. Emissions were calculated for each solid fuel burning appliance by multiplying the quantity of fuel thought to be used by what was considered to be a representative emission factor appropriate for that appliance. The particulate emission factors used were based on a combination of international and local emission testing data. The international data were derived from studies that measured the fuel performance of woodburners - i.e. emissions discharged from installed woodburners under normal operating conditions. For low emission woodburners (i.e. those with authorisation confirming particulate test emissions below 1.5g/kg) field data were not available and an estimated emission factor of 3g/kg was used. This value was used by the Regional Council to determine the contribution low emission woodburners make to emission loads, and to estimate the number of appliances that can be sustained in the air shed.

83. The emission factor however was considered unreliable. It was taken from data obtained during the authorisation process. The standard authorisation test is only designed to compare emission performance between burners, and it does not necessarily represent emissions generated in practice. Further it does not include normal operating procedures such as lighting and stoking up a fire, nor poor behavioural practices such as banking up a fire and closing the dampers over night. Standardised fuel is used to eliminate the influence of fuel type, moisture, sap content, and density.

84. As a result a study was jointly funded by the Regional Council, the Nelson City Council, and the Ministry for the Environment. The study commenced in 2003, and it was completed in 2004. The results were written up and reported in June 2005.

85. The study aimed amongst other things to establish whether the 3g/kg emission estimate was representative of real life emissions from low emission woodburners. It was conducted in three stages. First real life operation was simulated in a laboratory to determine emissions under normal operating practices using merchant supplied firewood. Secondly measured emissions from appliances installed in the field using the same firing method and fuel types were measured. In the third stage, tests were conducted on the same field appliances, but operated by the householder, using their own firewood supply.

86. It became apparent that the results obtained were not necessarily representative of low emission woodburners as a class of appliance. As a result, emission factors could not be developed. However it also became clear that in the "real life" situation, some low emission woodburners may well be producing emissions that are substantially higher than the emission factor previously assumed. It was accepted that further testing was required before firm conclusions could be drawn, but on the limited basis of the study, it was noted that the previously assumed emission factor of 3g/kg was likely to be an under estimate. The calculated median resulting from the study was 13g/kg. If this is correct it suggests that the emission factor used in the preparation of the NRRP could be far too low.

87. The study was not robust enough to use as a definitive guide to emission factors. Nevertheless it was considered useful for indicating the potential range of uncertainties associated with the factor used for forecasting emissions from low emission burners. It was also noted that the use of a potentially unrepresentative emission factor in the NRRP's development, could have resulted in under estimates in air quality assessments of the reductions required to meet air quality objectives.

National Air Quality Standards

88. In October 2003, again subsequent to notification of the NRRP, the Ministry for the Environment publicly notified a range of proposed national environmental air quality standards. It was envisaged that these would cover:-

(a) dioxins and other toxics, through a range of bans on activities that discharge unacceptable quantities of dioxins and other toxics into the air;

(b) ambient (outdoor) air standards for firm particles, carbon monoxide, nitrogen dioxide, sulphites, and ozone;

(c) an emission standard for the design of domestic woodburning appliances, and

(d) a requirement for landfills with a total capacity over 1,000,000 tonnes to collect and destroy landfill gas.

89. The national standards were to be introduced pursuant to the provisions of section 43 of the Act.

90. Following submissions and consultation, in early July 2004 Cabinet considered and adopted the policy intent of fourteen proposed national environmental standards for air quality. The proposal was to provide a guaranteed level of protection to people in New Zealand from certain contaminants in the air.

91. The regulations were drafted and they were adopted by Order in Council on the 6th of September 2004. They are known as the Resource Management (National Environmental Standards Relating to Certain Air Pollutants, Dioxins and other Toxics) Regulations 2004 (S.R. 2004/309). They have since been amended on two occasions - once in 2004 and again in 2005.

92. Various parts of the regulations have come into force at different times.

93. As from the 8th of October 2004, and subject to various exceptions the lighting of fires and the burning of waste at landfills became prohibited. So did the burning of tyres, the burning of bitumen on roads, the burning of coated wire, the burning of oil in the open air, and the operation of a high temperature hazardous waste incinerator (although in each case there are exceptions). As from the 1st October 2006 the operation of incinerators at schools or health care institutions was prohibited unless a resource consent has been granted for the discharge produced.

94. Further, the standard has various ambient air quality standards.

95. As from the 1st of September 2005 ambient air quality standards were introduced. These are contained in a schedule to the regulations. Relevant standards are as follows:-

Contaminant	Threshold Concentration	Permissible Excess
Carbon Monoxide	10 milligrams per cubic metres expressed as a running 8 hour mean	One 8 hour period in a 12 month period
Nitrogen dioxide	200 micrograms per cubic metres expressed as a 1 hour mean	9 hours in a 12 month period
Ozone	150 micrograms per cubic metre expressed as a 1 hour mean	Not to be exceeded at any time
PM_{10}	50 micrograms per cubic metre expressed as a 24 hour mean	One 24 hour period in a 12 month period
Sulphur dioxide	350 micrograms per cubic metre expressed as a 1 hour mean 570 micrograms per cubic metre expressed as a 1 hour mean	9 hours in a 12 month period not to be exceeded at any time

96. The ambient air quality standards for each contaminant apply at any place that:-

(a) is in an air shed

(b) is in the open air; and

(c) where people are likely to be exposed to the contaminant.

An air shed is defined as the region of a regional council, but it includes any part of a region specified by the Minister by notice in the Gazette to be a separate air shed. The regulations also provide that if the discharge of a contaminant is permitted by a resource consent, the ambient air quality standard for the contaminant does not apply to the area that the resource consent applies to.

97. Regional councils are required to monitor air quality. They must give public notice if a standard is breached.

98. Regulations 17A to C apply to applications for resource consents to discharge PM_{10} into the air shed before the 1st of September 2013 if:-

(a) the concentration of PM_{10} in the air shed already breaches the ambient air quality standard, and

(b) the discharge to be permitted by the resource consent is likely to increase significantly the concentration of PM_{10} in the air shed.

99. Regulation 17A applies to an application if there is no regional plan that applies to the air shed, or if there is a regional plan that applies to the air shed, but the plan does not comply with regulation 17B(2). Regulation 17B applies to an application if there is a regional plan that applies to the air shed and the plan complies with regulation 17B(2). Regulation 17C applies to an application if the application cannot be granted under either regulation 17A or regulation 17B and either the concentration of PM_{10} in the air shed, at the time the application is decided, is on or below what is known as the straight line path or the curved line path, or the application has been made in circumstances to which section 124 applies and the concentration of PM_{10} in the air shed, at the time the application is decided, is above the straight line path or the curved line path. (The words curved line path and the words straight line path are defined.)

100. Pursuant to regulation 17A, a consent authority must decline an application for resource consent to which regulation 17(2) applies if the discharge being permitted by the resource consent is likely to cause, at any time, the concentration of PM_{10} in the air shed to be above the straight line path. However the regulation does not prevent an application declined under regulation 17A being decided under regulation 17C if that regulation applies to the application.

101. Under regulation 17B, an application to which the regulation applies must be granted or declined in accordance with the regional plan applying to the air shed, if there is a regional plan which complies with regulation 17B(2). A plan complies if it contains:-

(a) a curved line path which shows how the ambient air quality standard for PM_{10} will be achieved in an air shed on or before the 1st of September 2013, and

(b) rules that ensure that an application for resource consent is declined if the grant of the resource consent is likely to cause, at any time, the concentrations of PM_{10} in the air shed to be above the curved line path.

102. Under regulation 17C, a consent authority must decline an application for resource consent to which regulation 17(4) applies, unless the applicant reduces the amount of PM_{10} being discharged from another source into the same air shed. If, at the time the application is decided, the concentration of PM_{10} in the air shed is on or below the straight line path, or the curved line path, the reduction of discharges must be equal to or greater than the increase in concentration of PM_{10} in the air shed above the straight line path or the curved line path caused by the discharge permitted by the resource consent. If at the time the application is decided, the concentration of PM_{10} in the air shed is above the straight line path or the curved line path, the reduction in discharges must be equal to or greater than the amount of the discharge permitted by the resource consent. The reduction in discharges of PM_{10} must take effect within one year after the grant of the resource consent, and be effective for the duration of the resource consent.

103. Pursuant to regulation 18, an application for resource consent to discharge PM_{10} to an air shed where the concentration of PM_{10} in the air shed does not breach its ambient air quality standard, if made before the 1st of December 2013, must be declined, if the discharge to be permitted by the resource consent is likely, at any time, to cause the air shed to exceed the ambient air quality standard for PM_{10}.

104. Regulation 19 deals with resource consents for PM_{10} discharges after the 31st of August 2013. It provides that after that date, no resource consent to discharge PM_{10} into an air shed may be granted if the concentration of PM_{10} into the air shed breaches its ambient air quality standards; or the granting of the resource consent is likely, at any time, to cause the concentration of PM_{10} in the air shed to breach its ambient air quality standard.

105. There are provisions relating to resource consents for the discharge of carbon monoxide, nitrogen oxide, and ozone, and for the discharge of sulphur dioxide.

106. The discharge of particles to air from a woodburner installed after the 1st of September 2005 in a building on a property with an allotment size of less than two hectares is prohibited. This provision however does not apply if various design standards and thermal efficiency standards are met. The design standard for a woodburner is a discharge of less than 1.5 gram of particles for each kilogram of dry wood burnt. It provides a method of measurement. The thermal efficiency standard for a woodburner is the ratio of useable heat energy output to energy input, and it must not be less than 65%.

107. There are differences in approach between the NRRP and the national environmental standard. The NES effectively sets minimum ambient air quality objectives which have to be achieved by 2013. It is stricter than the NRRP. In practical terms, it moves the PM_{10} ambient air quality debate in Christchurch from "**what is the appropriate objective**" to "**how do we achieve the objective**".

108. The relationship between the National Environmental Standards contained in the regulation, and the NRRP, is governed by section 43B of the Act. It provides that a rule that is more stringent than a National Environmental Standard prevails over the standard, if the standard expressly says that a rule or consent may be more stringent than it. Conversely, a rule may not be more lenient than a National Environmental Standard. A rule is more lenient than a standard, if it permits or authorises an activity that the standard prohibits or restricts.

109. Reference should also be made to section 70B, which was introduced into the Act as from March 2004 by the Resource Management (Energy and Climate Change) Amendment Act 2004. It relates to discharges into the air of greenhouse gases. It provides that if a National Environmental Standard is made to control the effects on climate change of the discharge into air of greenhouse gases, a Regional Council may make rules that are necessary to implement the standard, provided the rules are no more or less restrictive than the standard.

The Commissioners now turn to consider Chapter 3 by reference to all of this material.