NELSON CITY COUNCIL

Nelson Air Quality Plan

Proposed Plan Change A3

s42A Report – Appendix 4

Air quality & effects of rules on home heating

Report Date
21 April 2016

Hearing Date
3 May 2016

Nelson City Council
te kaunihera ō whakatū

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Interpretation

This report utilises a number of abbreivations for brevity's sake as set out in the glossary below:

Abbreviation	Means…
"the Act"	Resource Management Act 1991
"the AQP"	Operative Nelson Air Quality Plan 2008
"BCP"	Behaviour Change Programme
"the Council"	Nelson City Council
"NCC"	Nelson City Council
"NESAQ"	Resource Management (National Environmental Standards for Air Quality) Regulations 2004
"PCA3"	Proposed Change 3 to the Nelson Air Quality Plan
PM_{10}	Particles in the air less than 10 microns in diameter
$PM_{2.5}$	Particles in the air less than 2.5 microns in diameter
"the Plan"	Operative Nelson Air Quality Plan 2008
"RMA"	Resource Management Act 1991
"RPS"	Nelson Regional Policy Statement 1997
"s32"	Section 32 of the Resource Management Act 1991
"ULEB"	Small scale ultra-low emission burning appliances

1.0 INTRODUCTION

Report Author

1.1 My name is Emily Victoria Wilton. I am an air quality scientist with over 20 years of experience in air quality science and have specific expertise in air quality management.

1.2 I hold a PhD in environmental science (visibility degradation), a Master degree in Applied Science (first class honours) in Air Quality Management and a BSc in Chemistry and Psychology.

1.3 My work experience includes 8 years with Environment Canterbury and 15 years as a self-employed air quality consultant. In the former capacity I was responsible for the air quality monitoring network and staff, conducted air quality investigations and contributed to the development of the Air Plan.

1.4 As a consultant I have been engaged by many Councils throughout New Zealand to assist in the management of air quality and have been an expert witness at a number of air plan hearings. I worked on the National Air Quality Research Team from 2003 until 2012 and was involved in a range of projects including real life testing of emissions from wood burners. I have been involved in numerous health and air pollution projects and was key contributor to the assessment of health impact of air pollution in New Zealand (HAPINZ) work. I have also undertaken numerous projects for the Ministry for the Environment and provided them advice on a range of air quality issues, the most recent relating to the review of the National Environmental Standard for particulate.

1.5 I have been asked by the Council to prepare this addendum to the s42A report on PCA3.

1.6 Along with contextual information and other matters of fact, this report includes my personal views and recommendations to accept or reject points made in submissions on PCA3. These views and recommendations are my own, except where I indicate otherwise.

1.7 Though not a requirement of Council plan change hearings, I have read and agree to abide by the Code of Conduct for Expert Witnesses, and have

prepared this report in accordance with it. The report content is within my area of expertise except where stated otherwise. I have not omitted to consider the material facts known to me that might alter or detract from the opinion expressed in this report.

1.8 In some instances, I have specifically relied on the evidence, expertise and/or views of others. This includes expertise of Dr Neil Gimson (Golder Associates) and the evidence of Mr Popenhagen and Mr McIlrath.

Report Scope and Structure

1.9 This report relates to air quality issues associated with PCA3, including the impact of the existing AQP approach to wood burners on people's ability to heat their homes.

1.10 In relation to these matters, this report specifically covers the following:

a. **Section 2** provides a summary of the key air quality issues relevant for the plan change, and briefly discusses the findings of a study conducted in 2015 addressing the linkages between the Council's approach to wood burners and the prevalence of cold and/or damp homes; and

b. **Section 3** includes a discussion of the submissions of relevance to my report.

2.0 AIR QUALITY AND FUEL POVERTY

Summary of Air Quality considerations

2.1. In this section of my report, I briefly outline the findings of several studies I have been commissioned by the Council to produce over recent years. I also touch on relevant considerations of the AQP, and on other work commissioned by Council that has informed my own assessments.

Operative AQP Context

2.2. Air quality in Nelson has improved following the introduction of the AQP, which was notified in 2003 and became operative in 2008. The Plan included management measures targeting domestic home heating as the main source of winter time breaches of the National Environmental Standard (NES) for PM_{10}. The plan aimed to reduce PM_{10} concentrations in Nelson's Airshed A by 70% and by 39% in Airshed B1[1]. The measures included in the Air Plan were:

a. a ban on outdoor rubbish burning from 2004;

b. emission limits for new installations of solid fuel burners of 1.5 g/kg and an energy efficiency of 65% (when tested to AS/NZS 4013[2]);

c. a ban on the use of open fires from January 2008;

d. a ban on the installation of solid fuel burners in new dwellings or existing dwellings using other heating methods from 23 August 2003 (Plan notification date);

e. for Airsheds A and B1 - staged phase out of older burners from 2010, 2011 and 2013. The latter phase out date of wood burners installed between 2000 and 2003 was withdrawn following 2011 revisions to the NES. This resulted in approximately 200 burners in Airshed A which did not get phased out and for which no legislative replacement date currently exists;

[1] Wilton, 2009, Industrial PM_{10} emissions and reductions scenarios – Nelson Airshed B1. Nelson City Council report.
[2] NZS 4012 and 4013 is a joint New Zealand and Austrialian standard prescribing the testing procedures and methodology for determining emissions and efficiencies from small scale wood burners.

f. for Airshed B2 - staged phase out of older (pre 1991 burners) by 2010 and of burners dating from the period 1991 - 1996 by 2012.

2.3. These measures have resulted in significant reductions in PM_{10} concentrations, particularly in Airsheds A and B1.

Compliance with NES levels by Airshed

2.4. I have assessed the likely compliance of Airshed A with the NESAQ for PM_{10} in "*Assessment of trends in PM_{10} concentrations in Airshed A and evaluation of airshed capacity*[3]*"* and for Airsheds B1, B2 and C in "*Nelson Air Quality Assessment – Meeting the NES for PM_{10} 2014 update*[4]*"*.

2.5. Airshed A is still non-compliant with the NES for PM_{10}, and a reduction in peak winter 2014 concentrations of around 14% is estimated for ongoing compliance with the NES under worst-case meteorology. Measures to achieve compliance in Airshed A could include the replacement of older pre-2004 burners with NES compliant wood burners and implementation of a behaviour change programme. There is currently no capacity within Airshed A for the installation of new burners. PCA3 includes a mechanism for assessing future capacity and allocating new ULEB should PM_{10} concentrations reduce sufficiently in accordance with existing policy.

2.6. Airshed B1 may be compliant with the NES for PM_{10} and it is possible that no further reductions in concentrations are required in that respect. There is currently no capacity within Airshed B1 for the installation of new burners, however. Similar to the approach for Airshed A, PCA3 includes a mechanism for assessing future capacity in Airshed B1 should PM_{10} concentrations reduce sufficiently in accordance with existing policy.

2.7. Airsheds B2 and C are compliant with the NES for PM_{10}. As a result of less stringent burner phase-outs regulations, these airsheds will experience greater ongoing reductions in PM_{10} concentrations as households replace older non-NESAQ complying burners at the end of their useful life. On this

[3] Wilton, E., & Zawar Reza, P, Assessment of trends in PM_{10} concentrations in Airshed A and evaluation of airshed capacity. Nelson City Council Technical Report.
[4] Wilton, E., 2014, Nelson Air Quality Assessment – Meeting the NES for PM10 2014 update. Nelson City Council Technical Report.

basis, capacity is theoretically available to enable additional emissions in these airsheds.

2.8. An emission inventory carried out in 2014 shows domestic heating is the main source of anthropogenic PM_{10} emissions in all Airsheds in Nelson accounting for 55% (Airshed B1) to 94% of daily winter emissions. Motor vehicle emissions are minimal at around 2-6% of daily winter PM_{10} emissions. The industrial contribution to PM_{10} is low (2-5%) in all airsheds except B1 where it contributes 41% of daily winter PM_{10}.

Effectiveness of air quality management

2.9. The effectiveness of air quality management in Nelson has been assessed using air quality monitoring data for PM_{10} for each airshed. Air quality monitoring for PM_{10} has been carried out continuously in Airshed A since 2000 and in B1 since 2005. Monitoring in Airshed B2 was carried out in 2010 and 2015 and in Airshed C during 2008, 2009 and 2015. Assessments relating to airsheds A and B1 are more robust owing to the longer monitoring period.

2.10. Data for Airsheds A show that the approach adopted by the NCC for reducing PM_{10} concentrations has been more effective in reducing PM_{10} for compliance with the NES than any other approach taken throughout New Zealand. My analysis shows a close relationship between projected impact of regulatory measures (Air Plan) and observed PM_{10} concentrations over time.

2.11. The impact was assessed for Airshed A in a 2014 report (*Assessment of trends in PM_{10} concentrations in Airshed A and evaluation of airshed capacity*[5]. This found concentrations of PM_{10} had decreased by around 66-69% since 2001, when a maximum concentration of 165 µg/m^3 was recorded along with 81 exceedences of 50 µg/m^3. The reduction achieved

[5] Wilton, E., & Zawar Reza, P, Assessment of trends in PM_{10} concentrations in Airshed A and evaluation of airshed capacity. Nelson City Council Technical Report.

is close to the 70% reduction required estimated for the original air plan based on worst case 2001 concentrations[6].

2.12. An evaluation of the worst case meteorological conditions indicates worst case concentrations in Airshed A in 2003 and that a reduction in 2014 PM_{10} concentrations of around 14% (or 5% if considered relative to 2001 concentrations) is still required to meet the NESAQ based on worst case meteorology.

2.13. The strategies have also been effective in reducing PM_{10} concentrations in Airshed B1 and in reducing emissions to ensure compliance in Airsheds B2 and C.

Dispersion between Airsheds

2.14. An updated evaluation of the dispersion of contaminants across Nelson including between airsheds was carried out by Dr Neil Gimson of Golder and Associates in 2015[7]. This report identified the origin (by census area unit) of PM_{10} concentrations measured at the monitoring sites and other areas within each Airshed. Key findings were that the contribution of Airshed C to Airshed A was lower than estimated in a previous report (around 25%)[8] at around 6% as well as a 3% contribution to Airshed A from Airshed B2. Similarly the contribution of Airshed B2 to PM_{10} concentrations in Airshed B1 was estimated at around 15% compared with 50% previously.

2.15. I have integrated results from this study into the 2015 revised projections analysis. This enables an evaluation of the impact of allowing changes in emissions in one Airshed on another Airshed.

[6] Wilton, E, 2002a, Improving air quality in Nelson, An assessment of the effectiveness of management options for reducing PM10 concentrations in Nelson - Stage One. Unpublished Nelson City Council Report.
[7] Gimson, N., 2015, Urban Airshed Modelling Dispersion of PM_{10}. Nelson Air Quality Plan – Air Quality Technical Assessment. Golder and Associates Report 1527668-004 R.
[8] Golder Associates. (2012). Development of an Air Quality Model and Meteorological Data Sets for the Nelson-Richmond Urban Area. Golder Associates Report Number 0978104449

Other modelling results

2.16. I have evaluated the likely changes in PM_{10} concentrations in each airshed for the status quo, the introduction of BCP, phasing out non-NES complying burners, as well as a number of scenarios for enabling new burner installations. The method and results are detailed in "air quality management in Nelson – modelling of additional scenarios – 2015"[9].

2.17. The model allows an assessment of the impact of a BCP achieving a 10% reduction in existing burner emissions in terms of the equivalent number of ULEB burners. This has been used for Airshed B2 and C to identify the number of new ULEB burners that could be installed whilst maintaining the projected status quo improvements in air quality.

Impact of wood burner regulatory approach on home heating

2.18. I have carried out an evaluation of the characteristics of households and dwellings in Nelson relative to heat source as well as an assessment of the proportion of households in Nelson likely to be in fuel poverty[10].

2.19. Electricity is the most common method of heating the main living area with 73% (Airshed A) to 88% (Airshed B2) of households using electric heating methods. Heat pump prevalence in these households ranges from 60% to 80%. As noted by Mr McIlrath, heat pumps provide lower cost heating than other electric options.

2.20. Around 40% of households using wood have a total household income of more than $77,000. However, around 18% of householders using wood burners had total earnings of less than $30,000 per year. Around two thirds of the wood used on wood burners was purchased from wood suppliers. Around 29% of wood used by households earning less than $33,000 per year was obtained free of charge compared with 42% for households earning between $33,000 and $50,000 per year.

[9] Wilton E., 2015 Air quality management in Nelson – modelling of additional scenarios – 2015. Nelson City Council Technical Report.
[10] Wilton, E. (2015). Heating, household and dwelling data for Nelson - 2014.

2.21. Around 16% of households were estimated as likely to be in fuel poverty[11] in Nelson. This compares with 22% in Christchurch and 26% in Timaru[12].

2.22. A key finding of the home heating and dwelling assessment is that dwellings in Nelson are likely to be warmer overall than prior to implementation of the AQP. Information that supports this conclusion is that there has been no change in the number of households that do not heat their homes, that there has been an increase in the insulation in dwellings and there has been a decrease in reliance on high cost heating methods.

[11] Fuel poverty occurs when a household needs to spend more than 10% of its annual income on household energy requirements in order to heat the dwelling to a satisfactory temperature. The assessment undertaken in the comparisons noted here are for temperatures of 18°C for living and 16°C for bedrooms (WHO recommends 18°C for bedrooms and 21°C for living areas).

[12] Wilton, E., 2014, Assessing the impact of prohibiting wood burner use on fuel poverty levels in Timaru. Unpublished report for Canterbury Regional Council.

3.0 SUBMISSIONS

Introduction

3.1. Submitters raise a number of issues relating to air quality science and cold homes. Some submitters express concern for those in cold homes that are unable to install wood burners whilst others are concerned that allowing new burners installations will result in degraded air quality. Specific issues raised with respect to air quality science or cold homes are addressed in this section.

Issues

3.2. This report adopts the issue-based approach from the main s42A report, and covers the following matters raised by submitters:

a. better monitoring, enforcement, education, and/or burning practice should be applied;

b. ULEB should be enabled in more/all airsheds

c. enable burners with reduced/no limits on the number or type;

d. NES burners should be enabled instead of, or in addition to, ULEB;

e. adopt 'Option 3' from the Staff Report[13] considered at the December 2015 Council meeting (when notification decision on PCA3 was made);

f. wood burners are better, more effective and/or more efficient than heat pumps;

g. approach to airshed management should be amended;

h. opposition to the plan change due to the effect of new burners on ambient air quality;

i. opposition to the plan change due to impact on industrial / commercial sectors;

[13] Option three from the staff report set the air quality target at the NESAQ level.

j. operative AQP has led to adverse health outcomes due to increased prevalence of cold damp homes;

k. the plan change has not considered all relevant information; and

l. proposed amendments to the rules and methods in PCA3.

3.3. Each of these matters is discussed in turn below.

Better monitoring, enforcement, education and/or burning practice

3.4. Twelve submissions[14] raised the role of monitoring, enforcement, education and/or burning practice as important methods for managing ambient air quality.

3.5. **Submission 103** has questioned the effectiveness of the BCP and the ability to achieve 10% improvement in ambient air quality. The submission recommends targeting 5% instead and adjusting burner numbers accordingly.

3.6. I understand that the Council has not finalised the suite of methods to ultimately be adopted in its BCP. However, my view is that there are several methods than can be adopted to effectively achieve the 10% improvement target (if not better). The primary example I have considered here is targeted improvements in burner operation from the highest polluters.

3.7. My evaluation of the scope to reduce PM_{10} emissions through improved burner operation[15] uses data from real life testing to examine the potential reductions in emissions achievable through behaviour change. A key assumption is that the collective real life test data for New Zealand (study locations include Christchurch, Nelson, Rotorua and Tokoroa) are applicable to individual towns such as Nelson (i.e., that the householders burner operation has the same or similar emissions distribution).

3.8. Overall, my findings suggest that improved burner operation can reduce emissions by a significant amount. For example, the real life test data

[14] Submissions 1, 16, 22, 29, 53, 61, 75, 85, 87, 89, 103 and 107

[15] Wilton, E., 2014, Behavioural factors influencing emissions from wood burners – a literature review to identify key points for burner operation. Unpublished report prepared for Environment Canterbury.

suggests that a small proportion of households (9%) emit more than four times the average PM_{10} emissions (>20 g/kg) and contribute around one third of the total PM_{10} emissions from solid fuel burners. Targeting the worst 9% (around 500 households) of emitters in Nelson could result in a 22% reduction in total emissions if emissions are reduced to 10 g/kg or 27% if their emissions reduced to 5 g/kg. [16]

3.9. It is my view that implementation of a BCP that involves household specific evaluation and correction of the operation of the fire could result in the reductions specified above. The process would need to involve identifying and addressing any barriers to the householder being able to sustain an improved burner operation (e.g., access to kindling). Further reductions are also possible through targeting a larger number/ proportion of households.

3.10. A 10% reduction in PM_{10} emissions through a behaviour change programme is therefore technically very feasible from a science viewpoint. The other key aspects of the achievability of this are the ability to identify the gross emitters, having the resources to access sufficient homes (about 500 across Nelson based on 9%) and having a well-designed targeted programme that results in sustained improved emissions.

3.11. A recent Environment Canterbury project funded by the Ministry for the Environment aims to provide guidance on effective behaviour change programmes for reducing emissions from wood burners. More details on this programme are provided in the report of Mr Popenhagen.

3.12. A target of 10% should therefore be achievable provided the programme is adequately resourced by NCC. This 10% reduction would enable the installation of up to 1600 ULEB in Airsheds B2 and C without compromising the continued improvement in PM_{10} emissions associated with the natural attrition replacement of older burners with lower emission NES compliant burners over time.

[16] Note assumed average emission rate for NES burners is 4.5g/kg as discussed further at paragraph 3.31 below.

ULEB should be enabled in more (or all) airsheds

3.13. Thirteen submissions[17] sought that the airshed restrictions for ULEB should be relaxed or removed.

3.14. I found that allowing the installation of unlimited ULEB in Airsheds A and B1 would result in an increase in PM_{10} emissions in these areas and compromise attainment of the NES for PM_{10}.

3.15. **Submission 36** has sought that burners be authorised for the more elevated parts of Tahunanui in Airshed B1 as the ability for emissions to dissipate from the hills is greater than the lower lying areas.

3.16. The issue with regards to allowing additional emissions on the elevated parts of Tahunanui (and other hill areas) is that on days when meteorological conditions are conducive to elevated concentrations the wind flows down the hill (katabatic flow) and stagnates in the low lying flat areas. Thus while emissions may dissipate from the hills they contribute to elevated PM_{10} concentrations on the low lying areas. Under these conditions, allowing additional ULEBs in elevated areas will increase the likelihood of NES breaches in lower lying areas.

3.17. **Submission 58** is similar to Submission 36. It contends that the environmental conditions around Orsman Crescent are such that it should be treated differently from the remainder of Airshed A.

3.18. Orsman Crescent is located in the elevated valley area of Airshed A. It is likely that the area itself experiences better air quality than the St Vincent Street area. However, based on the topography and meteorology, emissions from the area will contribute to poor air quality in the valley catchment below on days when meteorological conditions are conducive to elevated PM_{10} concentrations.

3.19. I have consulted Dr Gimson regarding the likelihood of the discharge occurring above the inversion layer as suggested by the submitter and his view was that it was unlikely to be the case. Dr Gimson also confirmed my view that the drainage flow from the hill to the valley would carry the pollutants into the valley area. If the Panel wishes to involve Dr Gimson in the consideration of this issue, he can be made available as required.

[17] Submissions 2, 6, 16, 18, 23, 29, 34, 36, 53, 58, 60, 76 and 108

3.20. For the reasons above, my view is that Orsman Crescent should not be treated differently to the remainder of Airshed A.

Enable burners with reduced or no limits on number or type

3.21. Eight submissions[18] sought to relax or remove the limitations on the number and type of burners enabled by the plan change.

3.22. A limit has been imposed on the number of burners to restrict the degradation in air quality that might occur as a result of enabling them to be installed. Each new burner allowed into an airshed adds emissions potentially causing a worsening in air quality.

3.23. The policy approach specified in the Air Plan is that air quality will continue to improve until "Acceptable" air quality is achieved[19]. Allowing new installations of burners is not consistent with continued improvements unless emissions are reduced through other mechanisms.

3.24. The mechanism proposed for doing this in Airsheds B2 and C is the BCP. The number of burners allowed in these airsheds equates to the reduction in emissions estimated through the BCP. If burner numbers were allowed to exceed this level air quality would likely worsen in these airsheds.

3.25. If the AQP's continual improvement aims are to be achieved, my recommendation is that ULEB installations in new dwellings or existing dwellings using other heating methods be limited to the numbers specified in PCA3. I note that the future certification pathway and the non-complying activity resource consent pathways will afford the opportunity for additional ULEB to be allocated where it can be demonstrated that doing so will not compromise continual improvement aims.

[18] Submissions 4, 48, 69, 73, 75, 76, 89 and 91
[19] See policy A5-1.3

NES burners should be enabled instead of, or in addition to, ULEB

3.26. Twenty-three submissions[20] sought that NES burners should be enabled by the plan change, either instead of or in addition to ULEB.

3.27. I investigated the option of enabling NES burner installations into all airsheds as part of the work I was commissioned by Council to complete in 2015[21]. That report concluded that only a very small number of NES compliant burners could be installed relative to ULEB in airsheds that had capacity for any burner installations. The ratio of NES burners to ULEB used is 2 NES compliant burners to 9 ULEB (i.e., 2:9).

3.28. The NES compliant burners are required to meet an emission limit of 1.5 grams of particulate per kilogram of fuel burnt when tested to the NZS 4012/4013, a laboratory based test regime which was not designed to measure real life emissions. Test results from NES compliant burners cannot be directly compared with those of ULEB burners under real life testing because of the differing test regimes.

3.29. The test procedure for ULEB attempts to simulate real life emissions by including start up emissions, using different fuels and including a higher moisture content for wood. However, it should be noted that no in home testing has been carried out.

3.30. The plan change adopts a real life testing emission rate of 0.5g/kg for ULEB; however, an average real life emission of 1.0 g/kg has been assumed in the modelling as most ULEB on the market currently are still subject to 'human error'.

3.31. Real life test data for NES compliant burners across New Zealand shows average emissions of around 4.5 g/kg for these burners[22], or three times greater than the emission limit for burners authorised under the NES laboratory conditions. I have accordingly adopted the more realistic figure of 4.5g/kg for the purposes of the modelling exercise and consideration of future appliance allocation.

[20] Submissions 5, 7, 8, 22, 29, 35, 38, 42, 43, 53, 57, 61, 77, 80, 81, 84, 89, 93, 94, 99, 104, 106 and 107
[21] Wilton E., 2015 Air quality management in Nelson – modelling of additional scenarios – 2015. Nelson City Council Technical Report.
[22] Wilton, E. (2014). Nelson Air Emission Inventory - 2014. Nelson City Council Technical Report.

3.32. Enabling the installation of NES compliant burners in new dwellings and existing dwellings using other methods in Airsheds B2 and C would reduce the number of installations to 220 households in Airshed B2 and 130 in Airshed C.

3.33. From a scientific viewpoint allowing a mix of ULEB and NES compliant burners is feasible. However, unless the mix were predetermined it would be most likely that householders would install an NES compliant burner, thus significantly limiting the number allowed. Moreover, without predetermination of the appliance mix, monitoring and administration of the allocation could be considerably more complicated than as proposed by PCA3.

3.34. **Submission 93** has suggested that there are areas in Nelson where there is no history of NES breaches and that Nelson is the only district in New Zealand to ban wood burners.

3.35. The NES for PM_{10} was introduced in New Zealand in 2004 and has been effective since 2005. Since its introduction, monitoring of PM_{10} has been carried out in Airsheds B2 in 2010 and 2015 and in Airshed C in 2008, 2009 and 2015. No breaches have been recorded at these sites during these years. However, previous monitoring and assessments indicated both airsheds had the potential for breaches and as a result measures were included in the Air Plan to reduce PM_{10} in both areas, albeit to a lesser extent than Airsheds A and B1.

3.36. As a result of these measures a significant reduction in PM_{10} emissions in these areas between 2005 and 2015 has occurred[23]. If this reduction had not occurred, my view is that it is possible that NES breaches would have been recorded in these Airsheds.

3.37. There are areas within Airsheds in Nelson where no monitoring has been carried out and where there is the potential for cleaner air. As indicated previously, many areas which enjoy good air quality contribute emissions to other areas where air quality is degraded.

3.38. The AQP for Nelson does prohibit installations of burners in new dwellings and existing dwellings using other heating methods in all Airsheds. This is

[23] Wilton, E. (2014). Nelson Air Emission Inventory - 2014. Nelson City Council Technical Report.

a more stringent approach with regards to new dwellings and existing dwellings without solid fuel than adopted by other Councils.

3.39. There are exceptions, including Environment Canterbury who previously adopted a similar regulation for Christchurch. While that Council has recently revised its approach to allow new installation of ULEB, they have adopted significantly more stringent measures with regards to households with burners to compensate. Their proposed rules specify that from 2019 an NES compliant burner must be replaced with a ULEB (or clean heat) after a 15 year useful life on any property less than 2 hectares within the Christchurch air zone.

3.40. Other Councils use varying degrees of prohibitions, phase outs and consenting regimes as noted in the s32 Report (at Annexure 1).

3.41. Whilst Nelson adopted a more prohibitive approach than many Councils, it also had a significantly worse air quality issue in Airshed A than most Councils. In 2001, the NES value of 50 $\mu g/m^3$ was breached on 81 days (almost daily throughout winter) and maximum concentrations were around 165 $\mu g/m^3$ (24-hour average). The extent of air quality management required to improve air quality to meet the NES depends on the scale of the problem.

3.42. In my experience, the management regime adopted by Nelson has been more effective in improving air quality than any other regime adopted throughout the country. In Airshed A, a reduction in daily winter PM_{10} concentrations of 66-69% is estimated to have occurred since 2001. Other areas with similar extent of problem include Christchurch, Alexandra and Arrowtown.

3.43. Scientific evaluations of the effectiveness of regulatory measures in Christchurch are lacking. I carried out a simplistic analysis of data in 2013 which suggested daily winter PM_{10} concentrations in Christchurch had reduced by around 55%. However, at that stage ECan's final (2016) phase out of non-complying burners was yet to occur.

3.44. In the Otago towns of Alexandra and Arrowtown, measures to reduce PM_{10} concentrations have included restrictions on the installation of new burners to those meeting an emission limit of 0.7 g/kg (NZS 4012/4013) and phase out of non NESAQ complying burners. Trend analysis conducted by

Otago Regional Council staff indicate a reduction in PM_{10} concentrations in the Arrowtown airshed of around 25% but minimal reduction in Alexandra[24].

3.45. Overall, my observations are that Councils that have been ineffective in reducing PM_{10} concentrations to meet the NES are now having to consider more stringent measures.

3.46. It is my view that the more stringent measures adopted in AQP were appropriate for Nelson and have been effective in reducing PM_{10} concentrations.

3.47. **Submission 94** considers that the proposed plan change will increase fuel poverty as the people who need burners the most will be unable to afford ULEB. The submission seeks that NES burners be enabled in homes that predate modern insulation requirements.

3.48. Households that obtain wood free of charge would feel the most financial benefit from having a wood burner. Low and medium income households will feel the benefits (via their household budgets) to a greater extent than higher income households. The evidence of Mr McIlrath shows that households that do not have access to free firewood would benefit equally from a heat pump in terms of operating costs.

3.49. Fuel poverty occurs when the cost of energy exceeds 10% of the annual household income. Situations resulting in increases in energy costs may therefore contribute to increased fuel poverty. In the case of the proposed plan change there would be no increase in fuel poverty as the plan change enables burners but provides no further restrictions on heating methods.

Adopt 'Option 3' from the Staff Report to the 12/15 Council meeting

3.50. Two submissions[25] sought that a discarded option considered as part of the PCA3 consideration of alternative – 'Option 3' – be favoured to the notified provisions. The key difference between Option 3 and the notified provisions is that the former uses the NES levels as a benchmark for the

[24] Deborah Mills, 2015, Otago Regional Council - personal communication.
[25] Submissions 35 and 97

purposes of allocating new appliances, whereas the plan change aligns with the operative AQP policy direction of continual ambient air quality improvement.

3.51. Treating an air quality standard or guideline as a level that can be polluted up to is inconsistent with good practice in my view. Guideline documents prepared by the Ministry for the Environment[26] advocate against such an approach and planning documents both in Nelson and nationally typically include objectives such as maintaining or enhancing air quality[27]. In the case of PM_{10} it becomes a health issue as PM_{10} is a no-threshold contaminant, which means any degradation in concentrations will likely result in increased health impacts.

3.52. For Airsheds B2 and C allowing pollution up to the NESAQ for PM_{10} would put these airsheds at higher risk of non-compliance because of the lesser certainty around the likely worst case concentrations and meteorological conditions for these airsheds. In my view, such an approach would likewise be inconsistent with the overall aim of continual improvement towards 'Acceptable' levels as defined in the AQP.

3.53. I also consider that a further issue would arise for these airsheds under a pollute-up-to-the-NESAQ scenario if the NESAQ for PM_{10} were revised to an annual average $PM_{2.5}$ as mooted by the Parliamentary Commissioner for the Environment[28].

3.54. I have carried out an analysis of the potential impacts of annual average $PM_{2.5}$ concentrations for all airsheds[29]. This notes that the current WHO value of 10 µg/m^3 for annual average $PM_{2.5}$ is likely to be revised downwards and that Environment Canada has adopted an annual average target of 8 µg/m^3.

3.55. However, it is uncertain whether the Ministry for Environment will revise the NESAQ for particulate to an annual average $PM_{2.5}$ and if it did, what

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[26] For example, MfE (2002), Ambient air quality guidelines, states that *"the main goal for sustainable air quality is to maintain air quality where it is good and to improve air quality where it has been degraded and is affecting people's health."*

[27] For example, the Waikato Regional Air Plan includes the objectives to protect air quality where high, to improve air quality where it is degraded and to maintain it elsewhere. Degraded air quality includes air quality in the 66%-100% of the NES (i.e., alert category).

[28] Parliamentary Commissioner for the Environment, 2015, The state of air quality in New Zealand. Commentary by the Parliamentary Commissioner for the Environment on the 2014 Air Domain Report.

[29] Wilton, E., & Zawar Reza, P., 2015, Air quality management in Nelson – the potential impact of an annual average PM2.5 NES. Envirolink Report NLCC88

level would be adopted. If an annual average $PM_{2.5}$ standard of 8 µg/m^3 were introduced, Airshed B2 would be unlikely to comply and Airshed C may be compliant based on existing concentrations. If air quality were allowed to degrade in these airsheds compliance with an annual average $PM_{2.5}$ standard of 8 µg/m^3 would be unlikely in the absence of additional regulations.

Wood burners are better, more effective or more efficient than heat pumps

3.56. Seven submissions[30] cite the shortcomings of heat pumps as a reason to liberalise the proposed plan change provisions. Of relevance to my report, several of these submitters provide the view that homes in Nelson are inherently colder and unhealthier with increased reliance on heat pumps and other heat sources that do not rely on solid fuel.

3.57. My evaluation of household characteristics for Nelson does not support the suggestion that households in Nelson have become colder overall as a result of management measures targeting domestic home heating.

3.58. The changes in heating and insulation of Nelson dwellings are detailed in the 2015 report on *Potential impacts of management measures - heating, household and fuel poverty data for Nelson - 2014*." This report concludes that it is unlikely that there has been an increase in cold homes in Nelson since 2006 as a result of the phasing out of high emission wood burners.

3.59. In this respect, the results suggest that the proportion of households that do not heat their homes has not increased over this period and there are fewer households relying on high cost heating methods such as electricity (non-heat pump) and unflued gas. In addition, there has been an increase in the proportion of dwellings with ceiling and underfloor insulation, meaning houses should require less energy to achieve the same temperature (or the same energy may be used but the household may be warmer).

3.60. Mr Popenhagen and Mr McIlrath discuss this matter further in their respective briefs.

[30] Submissions 5, 8, 11, 14, 16, 17 and 29

Change the approach to airshed monitoring or boundaries

3.61. Three submissions[31] sought amendments to the Council's approach to airshed management.

3.62. An airshed is defined by the Ministry for the Environment as "an area designated by a regional council for the purposes of managing air quality and gazetted by the Minister." The gazetting of airsheds is a requirement under the NESAQ and there are specifications for monitoring, reporting and consent decisions relating to them.

3.63. Nelson's Airsheds were derived based on geographical and meteorological catchments, with Airshed B being split into B1 and B2 owing to the large industrial presence in the B1 area. The airsheds have provided the basis for air quality management in Nelson with different regulations applying to different areas.

3.64. The alternative to separating Nelson into airsheds would have been to gazette one airshed for the whole city. While this would have provided administrative advantages, regulations would have been based on the worst case air quality. The consequence of this would have been over regulating in many areas.

3.65. **Submission 9** has sought that Council moves its monitoring location for Airshed B1 to distinguish between elevated and lower lying areas.

3.66. In my view, the existing location of the air quality monitoring site in the low lying area is appropriate. The NESAQ requires that air monitoring equipment be located in the area within an airshed where worst case concentrations or greatest frequency of exceedances will occur. Elevated areas are not typically worst case areas as wind flows move air away from the hills towards low lying areas.

3.67. **Submission 76** considers that the current airsheds are not geographically representative.

3.68. I understand that Council's legal advice indicates that revision of airshed boundaries is beyond the scope of PCA3. In the event that the Panel does not share that interpretation, however I note the following points.

[31] Submissions 9, 76 and 94

3.69. The airsheds were set locally taking into account geography, topography and meteorological conditions. Within any airshed air quality will vary and there is no requirement that the monitoring site represent air quality across the airshed.

3.70. Rather, the NESAQ requires that Councils measure the worst air quality within an airshed. Air quality management applies to the whole airshed however, as emissions from one area (with potentially good air quality) may contribute to concentrations in another area (e.g., the monitoring site).

3.71. In my view, there is potential merit in considering refinements to Nelson's current airsheds. However, I consider this would be more appropriately managed under a more holistic change in approach to the AQP overall.

3.72. **Submission 94** states that Airshed B1 has 62% higher annual pollution levels than Airshed A. The submission has also sought division of Airshed C into two parts, with the area north of Wakapuaka Cemetery endowed with an unlimited allocation of NES burners.

3.73. My analysis of PM_{10} data indicates that annual average concentrations are around 20% higher in Airshed B1 (around 20 $\mu g/m^3$) than Airshed A (around 17 $\mu g/m^3$). The estimated annual average $PM_{2.5}$ concentrations are around 12 $\mu g/m^3$ for both airsheds currently, although Airshed A is estimated to decrease to around 10 $\mu g/m^3$ if the NESAQ for 24-average PM_{10} is achieved. In terms of $PM_{2.5}$, Airshed B1 is likely to have an even greater challenge in meeting an annual average NESAQ should one be introduced that is below the current estimated annual average $PM_{2.5}$ concentration.

3.74. Given Council's legal advice that division of Airshed C into two parts is beyond the scope of PCA3, scientific evaluation of the splitting of Airshed C has not been carried out.

Opposition to PCA3 due to impact on ambient air quality

3.75. Ten submissions[32] oppose the plan change due to concerns that the provisions will degrade ambient air quality levels.

3.76. The intent of PCA3 is that air quality will not degrade as a result of allowing ULEB into new dwellings and existing dwellings using other heating options. The number of burners that could be installed has been estimated using projections modelling based on capacity created through a 10% reduction in emissions through a BCP. As I have noted above, my view is that achievement of a 10% reduction in existing emissions through targeting of gross emitters should be easily achievable if appropriately implemented and adequately resourced.

3.77. The approach adopted is that the improvements in PM_{10} concentrations in these airsheds predicted (through projections modelling) under the status quo will continue and will result in improving PM_{10} concentrations. These reductions occur as a result of the replacement of older burners with NES compliant burners through natural attrition replacements and are predicted to continue until such time as all existing burners have been replaced.

Opposition to PCA3 due to impact on industrial/commercial sector

3.78. Five submissions[33] have raised concerns about the impact of enabling additional woodburners on the ability for industrial and commercial entities to emit pollutants.

3.79. The NESAQ includes rules relating to the granting of resource consents for discharges to air in "polluted airsheds". A "polluted airshed" is one that is, or has been in breach, of the NESAQ for PM_{10} within the preceding five year period. The requirement is for mandatory offsets for large dischargers of PM_{10} for new industry in polluted airsheds. A large discharger is one that *would be likely, at any time, to increase the concentration of PM_{10} by more than 2.5 µg/m^3 in any part of a polluted airshed other than the site on which the consent would be exercised*.

[32] Submissions 15, 19, 31, 32, 37, 56, 78, 92, 96 and 101
[33] Submissions 26, 65, 66, 92 and 98

3.80. In terms of enabling ULEB in airsheds B2 and C there would only be an issue for industry, in terms of national legislation, if these airsheds exceeded the NESAQ. The selection of a policy option that results in continual improvement in PM_{10} concentrations in these airsheds, and providing limits on the numbers of burners that could be installed reduces the risk of the airshed being classified as "polluted" under the NESAQ.

3.81. Enabling a limited number of ULEB in Airsheds B2 and C whilst reducing emissions through a BCP should not have any negative impacts on existing or new industry.

3.82. Projections modelling underpinning the assessment of ULEB numbers assumed industrial emissions would continue at 2014 levels because a survey of existing industry carried out by NCC indicated modest if any growth was anticipated.

3.83. In response to the submitters concerns, I have carried out an evaluation of the potential impacts of allowing a 10% increase in industrial emissions into airsheds B1, B2 and C.

3.84. In Airsheds B2 and C where PCA3 is enabling the installation of ULEB the impact of a 10% increase in industrial PM_{10} emissions on ambient air quality is negligible.

3.85. The impact in Airshed B1 is more material, at around 3% of 2014 concentrations (around 1.5 $\mu g/m^3$). However, enabling of ULEB burners in this airshed is not proposed in the short term under the proposed permitted allocation in PCA3. Such an allocation would only be realised through one-off resource consent applications or through the future allocation process set out in the plan change appendix. In either case, an assessment would be required indicating PM_{10} concentrations have reduced to "acceptable" air quality.

3.86. If Council sought to allocate some potential future capacity to industry in Airshed B1 an amendment to Appendix AQ2B could be made to account for this.

Operative AQP has led to adverse health outcomes due to increased prevalence of cold damp homes

3.87. Two[34] submissions contend that the current prohibitive approach to wood burners in the AQP has led to adverse health outcomes from increased prevalence of cold or damp homes. The submissions cite increased hospital admissions since 2006 as an indicator of this effect.

3.88. I have examined data in the analysis underpinning the "Potential impacts of management measures - heating, household and fuel poverty data for Nelson – 2014" assessment for indicators of increased coldness in dwellings in Nelson between 2006 and 2014.

3.89. In my view this data are not indicative of an increase in the proportion of cold homes in Nelson arising since the AQP was made operative. Rather, it is my conclusion that overall homes are likely to be warmer since 2006. Information that supports this conclusion includes:

a. the proportion of households that do not heat their homes has not increased since 2006;

b. there are fewer households relying on high cost heating methods such as electricity (non-heat pump) and unflued gas;and

c. there has been an increase in the proportion of dwellings with ceiling and underfloor insulation, meaning houses should require less energy to achieve the same temperature (or the same energy may be used but the household may be warmer).

3.90. The first bullet point is indicative of no change in either direction. The latter two points are indicative of improvements in warmth or reduced energy costs, whichever benefit the householder would choose.

3.91. In my view, the above results do not support any direct correlation between the reduction in wood burners under the AQP and increased hospital admissions for respiratory conditions arising from greater prevalence of cold homes.

[34] Submissions 35 and 99

PCA3 has not considered all relevant information

3.92. Three submissions[35] have suggested that not all relevant information has been considered in the preparation of the plan change.

3.93. **Submission 53** considers that the plan change should have considered $PM_{2.5}$ emission effects as well as WHO studies and recommendations about ambient air quality. The submission also suggests the plan change has failed to differentiate between anthropogenic and natural sources of PM_{10}.

3.94. WHO indicate that $PM_{2.5}$ and an annual average should be the priority indicator for managing health impacts of particulate pollution. The science supporting this conclusion is strong. However, MfE are yet to provide an indication of the likely NESAQ implications with regards to $PM_{2.5}$. In absence of such a shift, PM_{10} remains the predominant standard for air quality management purposes.

3.95. Notwithstanding this, my evaluation of the likely $PM_{2.5}$ concentrations (24-hour average and annual average) for each airshed has been carried out as part of the science underpinning PCA3[36]. Because ULEB are only allowed in Airsheds B2 and C to the equivalent particulate that is offset by the BCP, there should be no impact on $PM_{2.5}$ concentrations.

3.96. In relation to the submission's point about the sources of PM_{10}, I note that the NESAQ sets a standard for PM_{10} irrespective of source (natural versus anthropogenic). Consequently, scientific studies including the evaluation of management measures need to account for the natural sources contribution to PM_{10}. This is done in the projections modelling by integrating data from receptor modelling studies carried out by staff at GNS for Nelson. These studies identify the proportion of PM_{10} that originates from natural sources such as dusts and marine aerosol on high pollution days during the winter.

3.97. Accordingly, it is my view that PCA3 has given appropriate consideration to anthropogenic versus natural sources of PM_{10} as per the requirements of the NESAQ and that proposed approach is unlikely to hinder Councils ability to adapt to a future $PM_{2.5}$ NESAQ should one be introduced.

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[35] Submissions 53, 89 and 92

[36] Wilton E., & Zawar Reza, P., 2015, Air quality management in Nelson – the potential impact of an annual average $PM_{2.5}$ NES. Nelson City Council Technical Report.

3.98. **Submission 89** considers that ambient PM_{10} levels have not been fully taken into account by the plan change, and that capacity for new appliances must be based on actual emissions relative to the number of woodburners.

3.99. I have evaluated the ambient PM_{10} data for each airshed and this has been used in a number of ways in the assessment. It was a critical factor in identifying Airsheds B2 and C as compliant with the NESAQ and therefore suitable for enabling burners. The ambient PM_{10} data is also integrated into the projections modelling (which underpins the management options assessments), as is the wood burner emissions data. In my view, the level of information considered by the plan change and supporting information is appropriate.

3.100. **Submission 92** cites insufficient availability of ambient monitoring data in Airsheds B2 and C to determine the trends in air quality in these airsheds at present. The submission considers it is therefore not possible to accurately determine the number of ULEBs that can be accommodated without creating a risk that air quality in the airsheds may deteriorate as a result. A delay in allocation of appliances is sought in these airsheds until additional monitoring data is available.

3.101. While additional monitoring data would be of benefit and is a requirement for assessing trends with respect to future additional capacity, the number of ULEB that can be accommodated has been estimated, not based on existing capacity within the airshed, but on the emission reduction associated with a BCP. That is if PM_{10} from domestic heating is reduced by x kilograms through a BCP this equates to y ULEB. Thus the policy option should not create additional risk, provided the BCP is adequately resourced and implemented.

Proposed Rules and Methods

3.102. Nine submissions[37] have sought specific amendments to the proposed rules and methods in the plan change. Of particular relevance to my report are Submission 87 and Submission 92.

[37] Submissions 63-67, 87, 88, 92 and 95

3.103. **Submission 87** seeks that the proposed criteria for determining whether additional ULEBs can be accommodated needs to ensure that there will be no degradation in air quality and a continuation of projected downward trends in PM_{10} can be achieved. The submission considers that the approach as notified for Airshed A and B1 establishes a new baseline that can be polluted up to, rather than ensuring continual improvement.

3.104. It was the intention that PCA3 be aligned with the Air Plan policy intent of continual improvement in air quality. This targets an "Acceptable" level of air quality for these airsheds. I agree with the submission that refinement to the future certification process is required to ensure continual improvement is factored into future allocations. An amendment has been proposed to the approach for assessing capacity in Airsheds A and B1 in AQP Appendix AQ2B to affect the submission.

3.105. The proposed amendment is that step four of the process for evaluating capacity in Airsheds A and B1 is revised from a target concentrations of 50 $\mu g/m^3$ to a target concentration of 33 $\mu g/m^3$. Because there is no established mechanism to achieve ongoing improvements in these airsheds, adopting a staged approached to achievement of 33 $\mu g/m^3$ (Table 1 AQP Appendix AQ2B) as per Airshed B2 is not recommended.

3.106. A slight variation to the wording in assessing capacity in Airshed C is recommended. This approach already includes a staged reduction as per Airshed B2. However it is recommended that reference to Airshed A and B1 be removed from the final sentence in section 5. This should now read: "*Once this information is established the methodology can follow the approach described for Airshed B2".*

3.107. As discussed in the previous section, **Submission 92** and **63** have sought a delay in allocation of appliances until additional monitoring data is available.

3.108. As indicated in the previous section there is minimal reliance on the existing monitoring data in terms of allocation of ULEB appliances.

4.0 CONCLUSION

4.1. I have undertaken a range of scientific studies examining the potential impacts of the PCA3 on air quality in Nelson. It is my view that the findings of these studies still hold.

4.2. Some revisions to Appendix AQ2B have been proposed in light of submissions made.