Tabled @ Hearing
27/10/15

Proposed Canterbury Air Regional Plan

Responses to Questions of the Panel

This document contains the Officers' responses to the questions of the Hearing Panel set out in its document circulated on the 23rd of October. The questions and the author responsible for each answer are set out in the table below.

#	Question	Author
1.	Do any of the submissions raise an objection on the basis that the Section 32 analysis is inadequate?	Lisa Jenkins
2.	Has the Lyttelton Port Recovery Plan been approved by the Minster for Earthquake Recovery?	Michelle Mehlhopt
3.	Has the Council considered the benefit of an index, particularly to the rules, as in the NRRP?	Lisa Jenkins
4.	Did the Council consider setting the target for PM2.5 in Policy 6.4 as an annual average, either instead of or in addition to a 24-hour average target? If so, for what reasons was a 24-hour average chosen as the most appropriate?	Lisa Jenkins
5.	Rule 7.14 - Is there an internal inconsistency in the recommended re-draft of Rule 7.14 between the wording "100% of the discharge will be offset" and the reference in the matters of discretion to "no net increase of PM10 emissions"?	Lisa Jenkins
6.	What is the Council's response to the requested explanatory note in the Winstone Wallboards (pCARP 2193) on Policy 7.14? Is Winstone Wallboards request consistent with the Council's interpretation of the offsetting requirements of the NESAQ?	Lisa Jenkins
7.	Rules 7.15 and 7.16 - Is there an unintended consequence of the inclusion of the reference to "total PM10" in Rules 7.15 and 7.16 (as requested in the Keer Keer submission) that the smaller combustion sources (2MW in a Clean Air Zone or 5MW outside a Clean Air Zone) would need to measure condensable particulate emissions (not just filterable emissions as envisaged in Schedule 6) in order to demonstrate compliance with these rules?	John Iseli
8.	Rules 7.17 and 7.18 - Have recommended policies been drafted for managing large scale and industrial emissions by application of the Best Practicable Option, together with re-drafts of rules 7.17 and 7.18 (as discussed at 3-7 of the S42A report)?	Lisa Jenkins
9.	Why have Timaru and Ashburton been singled out to have crop residue burning buffer areas?	Lisa Jenkins
10.	Definitions - What is the common meaning of "notional boundary" as used in the definition for a sensitive activity?	Lisa Jenkins
11.	Could the Council please provide further information (or direct us to where it is located in the supporting documents) about the non-regulatory measures to mitigate the potential effects of reduced household heating, including with reference to the recommendations of the Canterbury District Health Board report "Potential effects of wood burner restrictions on wood burning households in Christchurch, September 2014).	Nadeine Dommisse
12.	The s42A report states (at 4-1): "Many submissions have questioned the science basis of the pCARP. The science underpinning the NESAQ is not relevant to the imperative that the CRC must enforce observance of the NESAQ. Beyond that, the science that	Lisa Jenkins

	has informed the Air Plan review is robust and current." Some of the submitters contend that the proposed plan should be withdrawn given the present level of concern about the efficacy of the NESAQ standards. They argue that now is the wrong time to promote a revised plan. So viewed, does the middle sentence of the quotation fairly respond to their argument?	
13.	Please consider the attached marked up version of the Objectives and Policies with reference to the explanation provided on the annexed document.	Lisa Jenkins
	Crop Residue Burning Buffer Areas	
14.	Could the Council please clarify the basis for the proposed buffer areas around Timaru and Ashburton. In particular, the S32 report indicates that the buffer areas were based on the Golders technical report predicting that an exceedance of 200µg/m3 could be experienced within 6km of stubble burning in certain wind and meteorological conditions. However, Table 5 (p. 19) of the Golders report seems to indicate that a buffer distance based on not exceeding this criterion would be 3 to 4 km.	Lisa Jenkins
15.	Could the Council also comment on whether compliance with the 200 µg/m3 (1-hour average) PM10 criterion would also avoid amenity effects.	Tim Mallett
16.	With reference to the estimated buffer distances in Table 5 (p. 19), is the large difference between the 3 to 4 km buffer distance suggested to avoid impacts greater than 200 µg/m3 at any time (worst case) compared to 100m for a 10% chance of the criterion being exceeded, related to the small number of days with relatively cool and stable weather conditions discussed on p. 9?	Jeff Bluett
17.	Some more information on the percentiles between the worst case and 10% (presumably 18 days out of 180 days modelled) may assist in explaining the implications of the modelling – for example what are the buffer distances that would be recommended based on say a 1% (2nd highest) or 5% (9th highest) chance of exceeding the 200 µg/m3 criterion.	Jeff Bluett
18.	On how many days over the periods considered (February to March 2010, 2011 and 2012) did the "relatively cool and stable" conditions that resulted in "reflection" events occur?	Jeff Bluett
19.	Could these particularly adverse weather conditions be readily defined or anticipated by weather predictions, for example a combination of wind speed and temperature?	Jeff Bluett
	Management Approach to fine particle concentrations in airshed	
20.	Could the Council please provide some more detailed information about the assertion in the S42A report that managing 24-hour average PM10 concentrations will also manage PM2.5 concentrations? In particular: What would be the likely differences in relative source contributions between industry, domestic heating and motor vehicle emissions if PM2.5 were considered rather than PM10?	Tim Mallett
21.	In a similar vein, what would be the likely differences in relative source contributions between industry, domestic heating and motor vehicle emissions if the annual average period were considered rather than the worst-case wintertime period?	Tim Mallett

22.	How might these differences, if there are any significant differences, influence the management approach to fine particulate concentrations in the Canterbury airsheds?	Lisa Jenkins

(1) Do any of the submissions raise an objection on the basis that the Section 32 analysis is inadequate?

Lisa Jenkins

1. Yes, please see Attachment 1 for a summary of the submissions I was able to identify in the time available. I have drawn identified from the Summary of Decisions Requested ("SODR") where they were flagged at the time of SODR preparation. There may be more discussion of the section 32 analysis in the full submissions, or located within the SODR against specific plan provisions. This further discussion can be provided to the Panel if required.

(2) Has the Lyttelton Port Recovery Plan been approved by the Minster for Earthquake Recovery?

Michelle Mehlhopt

2. As at the date of preparing this response the Lyttelton Port Recovery Plan has not yet been approved by the Minister for Canterbury Earthquake Recovery. The Council will update the Panel further as to any progress on this matter throughout the hearing.

(3) Has the Council considered the benefit of an index, particularly to the rules, as in the NRRP?

Lisa Jenkins

3. Yes. An index was considered but omitted, mainly due to time constraints prior to the notification of the pCARP. An index would be useful to assist Plan users, and it would be consistent with the approach taken in the Land and Water Regional Plan.

(4) Did the Council consider setting the target for $PM_{2.5}$ in Policy 6.4 as an annual average, either instead of or in addition to a 24-hour average target? If so, for what reasons was a 24-hour average chosen as the most appropriate?

Lisa Jenkins

4. Yes. The 24 hour average was considered the most appropriate because it is consistent with the NESAQ requirements for PM_{10}. It also recognises that Canterbury experiences significant wintertime peaks of PM (mainly due to wood burning) and these peaks are considered to be damaging to health[1]. The World Health Organisation recommends targets to be set for both annual averages and 24hour averages. Because of the wintertime peaks, addressing 24hour averages will result in annual averages being met, so using both indicators in the Canterbury context is not necessary. Reducing peaks ensures annual averages are also driven down.

5. Annual average guidelines for $PM_{2.5}$ developed by the World Health Organisation do not necessarily take wintertime peaks into account. It is unclear if application of annual average guidelines will deliver appropriate health outcomes in Canterbury where wintertime peaks are significant. If an annual average target for $PM_{2.5}$ is to be

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[1] *Health effects of particulate matter: Policy implications for countries in eastern Europe, Caucasus and central Asia*. World Health Organisation. 2013. And: *Health impacts of particulate: a literature review*. E Wilton. 2014.

adopted, it would need to be set at such a level as to protect people from short term or peak exposure effects.

(5) Rule 7.14 - Is there an internal inconsistency in the recommended re-draft of Rule 7.14 between the wording "100% of the discharge will be offset" and the reference in the matters of discretion to "no net increase of PM_{10} emissions"?

Lisa Jenkins

6. Yes. "No net increase" suggests existing discharges do not have to be offset. Regulation 17 requires 100% of the discharge to be offset where an existing discharge is increased.

7. Recommendation R-14 in the Section 42A report provides alternative wording that does not replicate this inconsistency.

(6) What is the Council's response to the requested explanatory note in the Winstone Wallboards (pCARP 2193) on Policy 7.14? Is Winstone Wallboards request consistent with the Council's interpretation of the offsetting requirements of the NESAQ?

Lisa Jenkins

8. Winstone Wallboards suggested note states:

Note: in the case of existing activities renewing their consents, this rule only applies if the proposed activity increases off site levels of PM10 by 2.5µg/m³ or more above the previously consented level

I do not consider that the note is entirely consistent with Regulation 17 of the NESAQ. The note indicates an existing activity would need to increase discharges by more than more than 2.5 micrograms per cubic metre within the polluted airshed to trigger Clause 3(a) of Regulation 17 (or Rule 7.14). My reading of Regulation 17 is that Clause 3(a) (and Rule 7.14) would be the only path to consent if an existing activity (that currently contributes more than 2.5 micrograms per cubic metre to the airshed outside of the property, or will as a result of consent changes to the existing consent) seeks to increase their discharge at all.

9. The rule wording could be altered to make this more clear. Alternative wording can be provided in reply.

(7) Rules 7.15 and 7.16 - Is there an unintended consequence of the inclusion of the reference to "total PM10" in Rules 7.15 and 7.16 (as requested in the Keer Keer submission) that the smaller combustion sources (2MW in a Clean Air Zone or 5MW outside a Clean Air Zone) would need to measure condensable particulate emissions (not just filterable emissions as envisaged in Schedule 6) in order to demonstrate compliance with these rules?

John Iseli

10. Yes, the term "total PM_{10}" does suggest the sum of filterable + condensable PM_{10}. This is inconsistent with the intent expressed in Schedule 6, which is to allow for

smaller combustion sources to be able to demonstrate compliance using filterable emissions testing.

(8) Rules 7.17 and 7.18 - Have recommended policies been drafted for managing large scale and industrial emissions by application of the Best Practicable Option, together with re-drafts of rules 7.17 and 7.18 (as discussed at 3-7 of the S42A report)?

Lisa Jenkins

11. No, recommended policies or rules have not been drafted. The Section 42A report did not provide draft provisions as it was thought that it would be helpful to see and/or hear the evidence of submitters before doing so.

12. On reviewing the evidence I have been able to give the issues more thought and consider that Rule 7.17 may be able to be deleted and the catchall discretionary rule relied on (in conjunction with the large scale fuel burning device permitted activity rules) to address large scale discharges outside of Clean Air Zones. I consider at this stage that Rule 7.18 could be redrafted as a non-complying activity. However, with the right policy guidance, discretionary activity status within Clean Air Zones could also be appropriate. The policy guidance needs to be very clear in order to ensure that outcomes are delivered. Overall I consider that Policies 6.2 and 6.3 provide appropriate guidance. Policy 6.21 is likely too stringent, and could be redrafted to deliver on the objectives in a more effects focused manner.

(10) Definitions - What is the common meaning of "notional boundary" as used in the definition for a sensitive activity?

Lisa Jenkins

13. The common meaning of "notional" is "not definite". As used in the pCARP, it is intended to ensure that setbacks apply to where an activity takes place rather than the legal boundary of a sensitive activity.

(11) Could the Council please provide further information (or direct us to where it is located in the supporting documents) about the non-regulatory measures to mitigate the potential effects of reduced household heating, including with reference to the recommendations of the Canterbury District Health Board report "Potential effects of wood burner restrictions on wood burning households in Christchurch, September 2014).

Nadeine Dommisse

14. Please see Attachment 2.

(12) The s42A report states (at 4-1):

"Many submissions have questioned the science basis of the pCARP. The science underpinning the NESAQ is not relevant to the imperative that the CRC must enforce observance of the NESAQ. Beyond that, the science that has informed the Air Plan review is robust and current." Some of the submitters contend that the proposed plan should be withdrawn given the present level of concern about the efficacy of the NESAQ standards. They argue that now is the wrong time to promote a revised plan. So viewed, does the middle sentence of the quotation fairly respond to their argument?

Lisa Jenkins

15. Yes, in my view it does. The review of Chapter 3 of the NRRP (the operative Air Plan) was undertaken partly in response to the revision of the NESAQ that occurred in 2011. The Council is required to enforce observance of the existing Standards. To date the Minister for the Environment has only indicated that the standards will "be consulted on in the coming year"[2], and Ministry for the Environment staff have advised that the review has not yet begun (they are currently at the scoping stage)[3].

16. The science basis for the pCARP identifies the state and trends within the polluted airsheds. Within all polluted airsheds there are no trends to indicate NESAQ targets will be achieved without further intervention. On the basis that PM_{10} is known to cause adverse health effects[4], reduction in PM_{10} will provide for the health and wellbeing of people in Canterbury.

(13) Please consider the attached marked up version of the Objectives and Policies with reference to the explanation provided.

Lisa Jenkins

17. I have provided responses to the Panel's notes from Attachment One where appropriate below.

Objectives

[Panel note: Does the word "recognise" add anything to Objective 5.6, as originally drafted, given that recognition of new technology is implicit in providing for it?]

Lisa Jenkins

18. In my view it does not, the redrafted Objective makes sense without the word "recognise".

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[2]: Next steps in National's Bluegreen agenda - Speech to Environmental Defence Society's 'Wild Things' Conference. Hon. Dr Nick Smith. 13 August 2015

[3] Pers. Comm. Carmel Rowlands and Rapunzel De Leon

[4] Pg. 35. Review of evidence on health aspects of air pollution – REVIHAAP Project. World Health Organisation 2013

[Panel note: Would the inclusion of a specific reference to "discharges to air" in Objective 5.7, as suggested by us, maintain the intent of the proposed Objective?]

Lisa Jenkins

19. Yes.

[Panel note: Does the inclusion of reference to location of discharging activities in Objective 5.8 (as recommended in the s42A report) effectively result in a duplication with Objective 5.9?]

Lisa Jenkins

20. Yes, there is some duplication.

[Panel note: Would Objective 5.9 be better expressed as "significant adverse effects are avoided" rather than in terms of "achieving appropriate air quality outcomes"?]

Lisa Jenkins

21. In my view this would result in an objective that reads more as a policy (i.e. a management response rather than an "end state"). Improvement could be made by stating what "appropriate outcomes" are, i.e. sensitive and discharging activities are not limited by each other[5].

Policies

Central Policies Applying to All Activities

[Panel note: The Panel is unclear what Policy 6.7, as drafted, would achieve, in particular:

- **The Council does not seem to have the ability to require an activity to relocate, it would only have the ability to refuse consent; and**
- **It seems unlikely that the Council would grant consent for an activity that was having a significant adverse effect on other land use activities.]**

Lisa Jenkins

22. I agree, the Council could not compel a discharging activity to relocate, but could refuse consent if effects cannot be suitably reduced.

23. Policy 6.7 ensures that it would be unlikely that consent would be granted unless the discharging activity mitigated their effects to a point that the effects could be considered appropriate within the receiving environment. It prompts applicants to consider their appropriateness in their environment so they can ensure their proposal is appropriate, and provides decision makers with a tool to require significant reduction of effects or to decline consent. Without strong policy guidance it is more difficult to defend a position that an existing activity or its existing effects are no longer appropriate.

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[5] Scope for this suggested change is provided by submission point 2727 - Ravensdown

[Panel note: Would reference to people's social and economic wellbeing in Policy 6.11 be more appropriate than reference to the regional and national economy?]

Lisa Jenkins

24. Yes.

[Panel note: Would the improvements contemplated by Policy 6.12 be better implemented through review/adaption conditions applicable for the lifetime of the consent?]

Lisa Jenkins

25. Yes, the policy is intended to prompt consideration of such conditions and where necessary, ensure such conditions are defensible.

Industrial and large scale discharges to air

[Panel note: In effect, does Policy 6.20 duplicate Policy 6.10?]

Lisa Jenkins

26. There is some duplication, but 6.20 provides more specific guidance than 6.10, in that it requires minimisation (specifically, by large scale dischargers) of degradation of ambient air quality.

Space heating region wide

[Panel note: It is not clear to the panel how the uptake of improved technology, and the other components of Policy 6.28, are interlinked.]

Lisa Jenkins

27. On looking at the policy critically, I can see it is unclear. Policy 6.28 is intended to give support to innovative heating solutions and improved passive heating options such as insulation or subdivision design that maximises solar gain. To an extent it goes beyond the scope of the Air Plan, but is intended to support avoidance of discharges to air that might otherwise occur. The policy may be better expressed as:

Encourage the uptake of both passive and innovative heating options that minimise emissions.

Space heating in Clean Air Zones

[Panel notes:

1. **Is there a way to amalgamate/restructure Policies 6.38 to 6.42A given that only Policy 6.41 is unique to the Christchurch and Timaru Air Zones and that all other policies are duplicated?**
2. **The Panel would like a further explanation of this suite of policies at the hearing. In particular we are unclear about the intent of the reference to replacing ultra-low emitting burners with another deice of the same type.]**

Lisa Jenkins

28. Yes, the policies can be restructured to remove duplication. I can provide restructured wording in reply.

29. I am able to provide further explanation of the suite of policies at the hearing.

(14) Crop Residue Burning Buffer Areas

Could the Council please clarify the basis for the proposed buffer areas around Timaru and Ashburton. In particular, the S32 report indicates that the buffer areas were based on the Golders technical report predicting that an exceedance of 200µg/m3 could be experienced within 6km of stubble burning in certain wind and meteorological conditions. However, Table 5 (p. 19) of the Golders report seems to indicate that a buffer distance based on not exceeding this criterion would be 3 to 4 km.

Jeff Bluett

30. The 3 to 4 km buffer distance was indicated by the modelled worst-case impacts of stubble burning events, and is given in Table 5 on page 19 of the report. The value of 6 km quoted in the summary section is intended to allow for uncertainties in the model predictions, reasonable variation in the configuration parameters, and the possibility of several burns occurring simultaneously. It is stated in the report to be a conservative estimate of a buffer distance, at the higher end of a range between 3 km and 6 km, and Figure 9 (exceedences of 200 $\mu g/m^3$ under the simultaneous-burn scenario) shows plumes extending up to 6 km to the southwest of the northwest PM_{10} source.

31. Whilst there are uncertainties in the work, as discussed in the report, we consider that modelling assessment indicates a reasonable upper limit of the buffer distance for worst-case impacts is 6 km.

(15) Could the Council also comment on whether compliance with the 200 µg/m3 (1-hour average) PM10 criterion would also avoid amenity effects.

Jeff Bluett

32. The assessment of amenity effects was specifically excluded from the Golder work. The relationships between the emission rates of PM_{10}, odour emissions, visibility of the plume and deposition rates have not been established. Therefore, it is not possible at this stage to state that compliance with the 200 $\mu g/m^3$ (1-hour average) PM_{10} criterion will also avoid amenity effects.

Tim Mallett

33. No, the 200 µg/m3 would not necessarily protect against amenity effects, and may not even protect against health effects. The value was based on the maximum hourly concentration that is observed in Ashburton on days when the NESAQ 24-hour 50 µg/m3 limit is met. In other words, the 200 µg/m3 1-hour limit offers a similar level of protection against health effects that the NESAQ offers in Ashburton. For detail regarding how the 1-hour average indicator was developed, please see Attachment 3.

Technical report: Air Quality impacts of Crop Residue Burning in Canterbury.

(16) With reference to the estimated buffer distances in Table 5 (p. 19), is the large difference between the 3 to 4 km buffer distance suggested to avoid impacts greater than 200 µg/m3 at any time (worst case) compared to 100m for a 10% chance of the criterion being exceeded, related to the small number of days with relatively cool and stable weather conditions discussed on p. 9?

Jeff Bluett

34. To clarify, the chance of the 1-hour average PM_{10} criterion of 200 µg/m^3 being exceeded decreases with distance from the source. Table 5 on page 19 shows a 10 % chance of an exceedence over a range 100 m beyond the paddock boundary. The worst-case PM_{10} occurs, by definition, on one occasion, so there is a 0.6 % chance – one day in the modelled 178 days - of an exceedence over a range of 3 to 4 km beyond the boundary.

35. The large change in the buffer distance from 3 to 4 km for worst case effects to 100 m for more moderate effects is indicative of the small number of occasions on which concentrations can be elevated at significant distances from the paddock boundary. The meteorological conditions conducive to impacts occurring more than one km away are infrequent, as discussed later.

36. The "cool and stable conditions" mentioned in the report refer specifically to the elongated plumes of PM_{10} which exceed the Idaho Admiration Procedures Act (IDAPA) management criterion (hourly PM_{10} concentration of 64 µg/m^3), over a range of up to 10 km. The more stable conditions occur towards the end of the day, when the temperature is dropping. This is when the stubble burning was presumed to take place. Under these conditions less mixing occurs in the atmosphere and the PM_{10} plumes are therefore less diluted.

37. The cooler, more stable conditions thus are more relevant to lower concentrations than the ECan-suggested limit of 200 µg/m^3. They are not relevant to the worst-case concentrations which occur in the model at the 3 to 4 km range as localized impacts, rather than elongated plumes. The meteorological conditions relevant to worst-case impacts and their frequencies are also discussed later.

(17) Some more information on the percentiles between the worst case and 10% (presumably 18 days out of 180 days modelled) may assist in explaining the implications of the modelling – for example what are the buffer distances that would be recommended based on say a 1% (2nd highest) or 5% (9th highest) chance of exceeding the 200 µg/m3 criterion.

Jeff Bluett

38. The area impacted by PM_{10} concentrations above 200 µg/m^3 more frequently than one occasion in three summers is confined to locations closer to the paddock, and the buffer distance drops sharply with increasing probability. Examples of buffer distances associated with events of differing frequencies are shown in Table 1 below.

Table 1. Variation of impact distance with probability of event.

Probability	Number of occurrences in three summers	Range of PM_{10} impacts (from paddock boundary)	Notes
0.5%	1	3 to 4 km	Worst-case, see Table 5 of report.
1%	2	400 m	
5%	9	250 m	
10%	18	100 m	"Moderate impacts" in Table 5 of report.

(18) On how many days over the periods considered (February to March 2010, 2011 and 2012) did the "relatively cool and stable" conditions that resulted in "reflection" events occur?

Jeff Bluett

39. The number of days on which the meteorological conditions actually gave rise to elevated PM_{10} concentrations can be estimated from a visual inspection of the spatial patterns of PM_{10} in Figure 5 of the report. This is more reliable than an examination of the meteorological conditions themselves, due to the complexity of the three-dimensional time-evolving meteorological situation. If it is assumed that isolated occasions of elevated PM_{10} occur under different wind directions from each other, then one plume of PM_{10} in the spatial pattern emanating from a source area can be counted as one day's event.

40. Using this method of inspection, there are twelve days on which the relatively cool and stable conditions lead to plumes of elevated PM_{10} above 32 $\mu g/m^3$. On two of these occasions, the hourly PM_{10} reached 64 $\mu g/m^3$.

41. Conditions conducive to the shorter-range, worst-case impacts occurred on one day in the modelling period.

(19) Could these particularly adverse weather conditions be readily defined or anticipated by weather predictions, for example a combination of wind speed and temperature?

Jeff Bluett

42. The meteorological conditions which lead to high concentrations of PM_{10} are difficult to define in terms of surface-based measurements such as wind speed and temperature. The likelihood of elevated PM_{10} depends on vertical structure of the time-evolving atmosphere, including changes in wind speed and temperature with height, and turbulence and vertical mixing. Indications from the modelling are that worst-case PM_{10} concentrations occur downwind of the source region when mixing height is low, and when the atmosphere is neutrally stable (as opposed to convectively unstable). Mixing and stability also depend on surface heating by the sun, which is moderated by cloud cover.

43. By way of example, the model results have been examined at a location in the localized peak of PM_{10} southwest of the northwest source area, where the hourly

PM_{10} exceeded 200 $\mu g/m^3$. This occurs once in the model. However, the range of meteorological conditions under which the top three PM_{10} concentrations occur – wind speed between 4.8 and 5.5 m/s, temperature between 16.5 and 23.0 degrees Celsius – includes seven days when the PM_{10} is significantly lower (the wind direction varies but there are no plumes in other directions from the source). In other words, attempting to define the conditions for elevated PM_{10} in terms of one or two surface-based meteorological parameters leads in this case to a large number of 'false positives', where the conditions appear right for a pollution event, but the event does not occur. Incidentally, this feature has been found by ECan when attempting to explain urban PM_{10} events in Christchurch.

44. This means that standard surface-based measurements from a weather station in, say, Ashburton, would not indicate with a high level of certainty the likelihood of adverse conditions relevant to crop residue burning. Moreover, the level of certainty would be reduced further when attempting to forecast adverse meteorological conditions in advance.

Management Approach to fine particle concentrations in airsheds

Could the Council please provide some more detailed information about the assertion in the S42A report that managing 24-hour average PM10 concentrations will also manage PM2.5 concentrations? In particular:

(20) What would be the likely differences in relative source contributions between industry, domestic heating and motor vehicle emissions if PM2.5 were considered rather than PM10?

Tim Mallett

45. If daily **$PM_{2.5}$** concentrations were considered, rather than PM_{10}, the relative contribution from home heating would be **slightly higher** (around 5%). This is because PM_{10} from home heating is slightly richer in $PM_{2.5}$ than PM_{10} from the other two sources.

46. For detail and workings please see Attachment 4.

(21) In a similar vein, what would be the likely differences in relative source contributions between industry, domestic heating and motor vehicle emissions if the annual average period were considered rather than the worst-case wintertime period?

Tim Mallett

47. If **annual** PM_{10} concentrations were considered, rather than a 24-hour average in winter, the relative contribution from home heating would be **slightly lower** (around 10% lower for Timaru). This is because the annual average includes long periods when there is very little home heating (outside winter). The reason the relative contribution does not fall further than that is because there is less dispersion in winter, so the various proportions of emissions in winter have a greater influence on the annual concentration than those at other times of year.

48. For detail and workings please see Attachment 4.

(22) How might these differences, if there are any significant differences, influence the management approach to fine particulate concentrations in the Canterbury airsheds?

Lisa Jenkins

49. The approaches adopted to reduce PM_{10} emissions will also reduce $PM_{2.5}$ emissions. The difference will be in the reductions required and the stringency of the measures adopted. Achieving WHO standards for $PM_{2.5}$ (24hr average) over a similar time frame as is anticipated for achieving NESAQ compliance, would likely require more stringent measures, particularly with regard to the dominant wintertime source (home heating).

50. Regardless of the indicator (PM_{10}, $PM_{2.5}$, 24 hour or annual average) PM reductions, and in particular wintertime reductions, are necessary in the airsheds in order to achieve the pCARP Objectives of providing for health and wellbeing and NESAQ targets.

Attachment 1

Full Name	Summary of Decision Requested	Submission ID
Eliot Sinclair & Partners Limited	Amend the policies and rules and undertake a re-evaluation of the section 32 assessment to take into account the relevant matters identified in the submission regarding rules 7.29 and 7.30 in submission points pCARP-1213, pCARP-1214, pCARP-1211, pCARP-1212, pCARP-1215.	pCARP-1216
GL Bowron and Co Ltd	Withdraw the section 32 report and replace with a section 32 report that has been developed using the following principles for assessing the effectiveness of the proposals: 1. Rules to be tailored to the issues arising in each spatial category; 2. Within a spatial category - three different types of Clean Air Zone, plus non-Clean Air Zone with no sensitivity issues, and non-Clean Air Zone with sensitivity issues - Rules to target the greatest gains in emission reductions for greatest cost-effectiveness, including on the issue of odour; 3. Different approaches to be taken to managing ambient air quality and localised effects on air quality; 4. Responsibility for legacy issues, for example, legacy reverse sensitivity, is a public good (or liability); and 5. Adequate transition periods to be provided to industry in cases where the cost effectiveness of upgrading technology to meet new air plan requirements is identified as an issue, on the basis of adequate information.	pCARP-1274
Straterra Inc	Withdraw the section 32 report and replace with a section 32 report that has been developed using the following principles for assessing the effectiveness of the proposals: 1. Rules to be tailored to the issues arising in each spatial category; 2. Within a spatial category - three different types of Clean Air Zone, plus non-Clean Air Zone with no sensitivity issues, and non-Clean Air Zone with sensitivity issues. Rules to target the greatest gains in emissions reductions for greatest cost-effectiveness, including on the issue of odour; 3. Different approaches to be taken to managing ambient air quality and localised effects on air quality; 4. Responsibility for legacy issues, for example, legacy reverse sensitivity, is a public good (or liability); and 5. Adequate transition periods to be provided to industry in cases where the cost effectiveness of upgrading technology to meet new air plan requirements is identified	pCARP-1959

Full Name	Summary of Decision Requested	Submission ID
	as an issue, on the basis of adequate information.	
Mr and Sir Peter William and David Russell Moller and Hay	Amend the section 32 to address the lack of specificity concerning sources and chemical composition of pollutants which leads to inappropriate blanket regulations.	pCARP-2184
Mr and Sir Peter William and David Russell Moller and Hay	(s32 report) Re-investigate the economic and social costs of the proposals in Christchurch and other Canterbury towns and the cost/benefit of proceeding with them.	pCARP-2189
Mr and Sir Peter William and David Russell Moller and Hay	Ensure better analysis is undertaken regarding the financial, social and cultural effects of such major changes to the home life of citizens in Canterbury.	pCARP-2215
Molly Melhuish	Ensure that the effectiveness evaluation of Policy 6.1 compares the effectiveness of removing smoky fires instead of wood burners in reducing PM2.5 pollution.	pCARP-2438
Lowe Corporation Limited and Colyer Mair Assets Limited	Provide evidence to illustrate the contribution that industrial sources make to polluted airsheds and contaminants and justify in terms of section 32 [analysis] that the increased controls on industry are necessary and appropriate.	pCARP-2585
Garth Gould	Amend Option 3 page 4-65 of the Section 32 Report for the Proposed Plan by: Deleting paragraph 4 and inserting the following new paragraph: Prohibit the use of older style non-complying wood burners from 2025. Deleting paragraph 5 and inserting the following: Prohibit the use of wood burners 15 years and older from 2025. Deleting paragraph 6 and including a new rule to prohibit the use of inadequately dried wood.	pCARP-2663

Attachment 2

The Canterbury District Health Board report "Potential effects of wood burner restrictions on wood burning households in Christchurch" September 2014, recommended a cross-sectoral response to identify specific mitigation measures to address the effects that can arise from household temperatures below the recommended minimum temperatures for health.

Mitigation measures include providing support and incentives to households for changing home heating appliances, financial support for vulnerable households to upgrade home heating appliances, and providing information and advice on energy efficiency, insulation and operating wood burners to reduce smoke.

Environment Canterbury has developed a non-regulatory programme to support the implementation of pCARP policies and rules requiring households in polluted airsheds to upgrade home heating appliances, and operate wood burners to meet a no visible smoke rule.

Targeted financial assistance

The programme includes providing targeted financial assistance for the upgrade of older style appliances and open fires for each airshed with the amount of funding available to each household is outlined in Table 1 below.

Table 1: Financial assistance available per household

Clean Air Zone(s)	Financial Assistance	Criteria for financial assistance	Advice and Education
Christchurch Kaiapoi Rangiora Ashburton	$1,000 for replacement wood burner $2000 for replacement with a heat pump	Community Services Card or health referral from Plunket or Canterbury District Health Board	Home Heating Assessments through Community Energy Action, available to all households at no cost. The assessments consider insulation, curtains, draft stopping and heating sources. Community Energy Action can also provide advice on other sources of funding available, for example funding from the Red Cross for households awaiting earthquake repairs and grants available from central government for insulation.
Timaru	$1,000 for replacement wood burner $2000 for replacement with a heat pump	Community Services Card or health referral from Plunket or Canterbury District Health Board	Home Heating assessments by Energy Smart – available to all households at no cost.
Geraldine Waimate	No set subsidy guidelines		Home heating assessments available to all households through Energy Smart

In addition Environment Canterbury also provides discretionary funding to assist vulnerable households with home heating, including providing fuel for heating. This funding is based on a needs assessment undertaken by Community Energy Action (in greater Christchurch airsheds) that includes a free home energy check and assessment of any available funding assistance that may be available for the household. Based on this needs assessment Environment Canterbury may fund up to 100% of the heating. The majority of households who access this funding have received around 50% of funding required. This approach enables more assistance to be provided to those who are least able to make heating changes.

Banks including ASB, ANZ, BNZ, Kiwibank and Westpac offer financial solutions for home heating and insulation such as adding additional costs for upgrading appliances or fitting insulation onto mortgages

Healthy Homes Officer

Funding is provided by Environment Canterbury to recruit a Healthy Homes Officer to provide information to households on subsidies available, burning smoke-free, insulation, and energy efficiency. This role is to be appointed in early 2016 and will be funded by Environment Canterbury for a three year period. A key responsibility for this role is to lead the development of a cross-organisational implementation plan addressing issues identified in the Health Impact Assessment. Community Energy Action will employ and support this role, with the Canterbury and South Canterbury District Health Boards contributing information on healthy homes.

Targeted rate for Clean Air Zones

An air quality rate is proposed for Clean Air Zones (on top of a uniform annual change that applies region-wide). The rate recognises the benefits that will accrue to these specific areas (both rural and urban) from better management of emissions from outdoor burning, home heating, industry and odour. The targeted rate provides for home energy and heating assessments, discretionary hardship funding for households that have to replace heating, and financial assistance to low income households for replacing open fires and wood burners.

The Long Term Plan rating zones are intended to match the Air Plan Clean Air Zones. The Long Term Plan rating zones will be adjusted according to any changes made to the Clean Air Zones through the Air Plan hearing process. Table 2 provides the budget available for financial subsidies available for future years, funded from the targeted rate from each Clean Air Zone.

Table 2: Budget to provide financial assistance in Clean Air Zones

	Christchurch	Ashburton	Kaiapoi	Rangiora	Timaru	Geraldine	Waimate
2016	$200,000	$40,000	$40,000	$40,000	$200,000	$20,000	$20,000
2017	$204,680	$40,936	$40,936	$40,936	$204,680	$20,468	$20,468
2018	$209,674	$41,935	$41,935	$41,935	$209,674	$20,967	$20,967

2019	$215,063	$43,013	$43,013	$43,013	$215,063	$21,506	$21,506
2020	$220,891	$44,178	$44,178	$44,178	$220,891	$22,089	$22,089
2021	$227,186	$45,437	$45,437	$45,437	$227,186	$45,437	$22,719

Attachment 3

28 January 2015

23 October 2015

MEMORANDUM

FROM : **TIM MALLETT**

TO : **CARMEL ROWLANDS**

SUBJECT: ***Recommendation for a 1-hour health guideline value for PM_{10} for use when evaluating effects of stubble burning***

Summary.

*Environment Canterbury has commissioned Golder Associates to undertake a dispersion modelling evaluation of the health effects of PM_{10} emissions from stubble burning in Canterbury. To support that work, the air quality investigations team were asked by the planning section to provide advice on an appropriate 1-hour health guideline for PM_{10} or $PM_{2.5}$ that could be used to evaluate the significance of modelled PM concentrations. We have not been able to find any published 1-hour health guidelines for PM_{10}. However we suggest a 1-hour PM_{10} concentration of **200 ug/m^3** would be appropriate to compare modelled concentrations. This is towards the upper end of the hourly concentrations experienced at the Ashburton monitoring site on days that meet the NESAQ 24-hour threshold concentration.*

Findings of the relevant health reports.

We have reviewed the available international scientific literature, and found no applicable guideline value for PM_{10} or $PM_{2.5}$ expressed as a 1-hour average. The shortest averaging time available to assess the short-term health effects of PM_{10} or $PM_{2.5}$ is 24-hour. The main findings of the two most relevant reports are presented below. We also contacted three senior researchers working in the field of health effects of particulate matter, Ian Longley (Air Quality Scientist at NIWA), Simon Hales (Research Associate Professor at the University of Otago) and Jo Cavanagh (Environmental Scientist at Landcare Research). All three replied that there were not aware of any currently available guideline value for PM_{10} or $PM_{2.5}$ for a 1-hour averaging time.

A recent review of the 2006 WHO ambient air guidelines (WHO 2013) highlights that "*there is significant evidence from toxicological and clinical studies using combustion derived particles that peak exposures of short duration (ranging from less than an hour up to a few hours) lead to immediate physiological changes, which is supported by epidemiological observations.*"

The WHO report acknowledges the existence of health effects for short exposure to $PM_{2.5}$, and the fact that there is no "no observed adverse effect level" for $PM_{2.5}$, so any exposure is potentially harmful to some degree. However the authors do not provide a guideline value for shorter averaging time than 24 hours.

A recent report from the USEPA (2011) considered two key questions that are related to the issue of PM guideline value for sub-daily exposure:

1. To what extent does the currently available scientific evidence provide support for considering a standard with an averaging time less than 24 hours to address health effects associated with sub-daily fine particle exposures?
2. To what extent does the currently available scientific evidence provide support for considering separate standards with distinct averaging times to address effects associated with seasonal fine particle exposures?

The short answer provided in the document was that, *based on the currently available scientific evidence and other information:*

> *"with regard to averaging times for the $PM_{2.5}$ standards, it is appropriate to retain annual and 24-hour averaging times to provide protection against health effects associated with long-term (seasons to years) and short-term (hours to days) exposure periods. The available evidence does not provide a sufficient basis for consideration of other averaging times, including an averaging time less than 24 hours to address health effects associated with sub daily exposures or an averaging time to address effects associated with seasonal exposures, given the relatively small amount of relevant information available."*

Use of Workplace Exposure Standards

The Department of Labour (now the Ministry of Business, Innovation and Employment) has published workplace exposure standards for many substances, including inhalable and respirable dust, for both long-term and short term exposure. The long-term, time-weighted average guidelines for these two substances are 10 mg/m^3 and 3 mg/m^3 respectively, which is significantly higher than the World Health Organisation guideline of 0.05 mg/m^3 (50 ug/m^3), as a 24 hour average. However the workplace exposure standards are designed for occupational health purposes, not public health.

The workplace exposure standards also include specific Short Term Exposure Limits (STELs) for many substances, addressing short-term exposures of 15 minutes. There are no STEL values provided for particulate matter, so the generic value of three times the time-weighted average, so 30 mg/m^3 and 9 mg/m^3 for inhalable and respirable particulate respectively

Use of the 24-hour guideline

One method to derive a 1-hour PM_{10} criterion is to calculate the maximum 1-hour concentration that would not result in an exceedance of the 24-hour guideline, after allowing for background concentrations. Assuming, for example, a constant background concentration of 5 ug/m^3, and no other discharges, then the one-hour concentration could reach 1080 ug/m^3, without causing the 24-hour concentration to exceed 50 ug/m^3. However we would caution against the use of this calculation result as a guideline value, as it could be very misleading. The WHO 24-hour guideline was derived from epidemiological studies undertaken mainly in large European and North American cities. While the hourly average concentration can vary significantly within a 24-hour period, there is some PM_{10} present at all hours of the day. I am not aware of any studies of health effects where the entire 24-hour dose of PM_{10} was delivered in a one one-hour period. Therefore one cannot say with any confidence that exposing a person to 1080 $\mu g/m^3$ for one hour would have no more health effects that a typical urban exposure of 50 $\mu g/m^3$ spread over 24-hours, despite the arithmetic suggesting they are equivalent.

For this reason we don't recommend the use of 1080 $\mu g/m^3$ as a guideline one-hour concentration.

Idaho approach

The State of Idaho Department of Environmental Quality has conducted a study of particulate concentrations resulting from stubble burning, as part of its requirements to produce a "State Implementation Plan" for managing air quality (State of Idaho Department of Environmental Quality, 2009). The report uses the four levels of PM concentration as defined in the department's document "IDAPA 58.01.01.556 – Criteria for defining levels within stages (of an air pollution emergency)". The four levels used in the document are:

Caution:	80 ug/m^3 ($PM_{2.5}$ 1-hour average)
	50 ug/m^3 ($PM_{2.5}$ 24-hour average)
	385 ug/m^3 (PM_{10} 1-hour average)
	150 ug/m^3 (PM_{10} 24-hour average)
Alert:	350 ug/m^3 (PM_{10}, 24-hour average)
Warning:	420 ug/m^3 (PM_{10}, 24-hour average)
Emergency:	500 ug/m^3. (PM_{10}, 24-hour average)

When the lowest of these levels, the "caution" level, is reached, or likely to be reached, no additional stubble fires may be lit.

When the "alert" level is reached or likely to be reached, certain industrial emissions must cease, including waste incineration and soot-blowing outside certain hours.

When the "warning" level is reached, coal and residual oil burners must switch to natural gas or distillate oils (diesel).

When the "emergency" level is reached, or likely to be reached, certain industries (mining, quarrying, and construction) are required to cease activities.

In the Idaho stubble burning report, a value of 80% of the "caution" value, or 64 ug/m^3 (PM2.5, 1-hour) was used to evaluate the dispersion modelling results. At this time we have been unable to find the basis or rationale for either the "caution" value of 80 ug/m^3, or the use of 80% of that value in the stubble burning report. It may be related to the level at which additional stubble fires could result in a combined concentration that exceeded one of the other criteria, or it may be related to the meteorological conditions that would give rise to a 1-hour concentration of 80 ug/m^3. In the absence of an explanation of the rationale for the "caution" value, it is difficult to justify the use of either value, 64 ug/m^3 or 80 ug/m^3, as a threshold for use when presenting the stubble burning dispersion modelling results[6].

Use of ambient monitoring data from Ashburton.

Another possibility for deriving a one-hour guideline concentration is to consider the ambient PM_{10} monitoring data for Ashburton over the last five years, as Ashburton is the closest town to the study area, and in particular the maximum one-hour average on days when the 24-hour average was below the NESAQ criteria of 50 ug/m^3. Table 1 shows these maximum one-hour concentrations on "NESAQ-compliant days" in Ashburton over the past five years.

[6] After this report was drafted Duncan Backshall provided a reference, Coefield and Cain 2001, which suggested that the value was obtained by asking a panel of experts for their view of the preferred 1-hour guideline and calculating the median of the responses.

Year	Maximum	2nd highest	3rd highest
2013	181	164	154
2012	280	248	178
2011	155	149	148
2010	134	113	112
2009	203	193	182

Table 1. Three highest 1-hour PM_{10} concentrations in Ashburton on days when the 24-hour average PM10 concentration was between 45 and 50 ug/m^3.

On days that comply with the NESAQ, it is unusual for the hourly concentration to exceed 200 ug/m^3. It could therefore be argued that, if the 1-hour PM_{10} concentration from stubble burning does not exceed 200 ug/m^3, and the concentrations only last for an hour within any day, then any adverse effect from the stubble burning is no greater than that allowed under the NESAQ. Hence it could be argued that the use of 200 ug/m^3 as a one-hour guideline is consistent with the intent of the NESAQ in terms of protecting human health.

Note that this conclusion is valid only where there are no other significant sources of PM_{10} impacting on the same area. If the plume from stubble burning was to impact on a town that already had elevated PM_{10} concentrations, then the combined effect of the existing concentration plus the stubble burning could exceed the NESAQ even if the stubble burning produce well below 200 µg/m^3. In some airsheds on some days there would be no "room" for additional PM_{10} from any source, including stubble burning.

Conclusion.

For the purposes of evaluating the concentrations from dispersion modelling of stubble burning emissions, a 1-hour PM_{10} concentration of 200 ug/m^3 would be appropriate, and not inconsistent with the intent of the NESAQ. The Idaho value of 64 µg/m^3 would be a useful guide to areas where further attention may be needed, but does not represent an exceedance of the intent of the NESAQ. It must be stressed that this value of 200 µg/m^3 does not represent a health guideline, or a level of no adverse health effects. It is likely that adverse health effects do occur at this concentration, as they do with a 24-hour concentration of 50 µg/m^3. However it is reasonable to expect that any adverse effect at this concentration would be no greater than that which could occur during exposure to a 24-hour average concentration of 50 µg/m^3.

References

Coefield,J. and Cain, C. Montana Department of Environmental Quality empirical study (July 2000) presented at Fire, Smoke and Health Workshop, Seattle, WA, June 5 - 6, 2001

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Ministry for the Environment (MfE) and Ministry of Health (MoH), 2002. Ambient air quality guidelines 2002 update. Air quality report No 32.

State of Idaho Department of Environmental Quality (SIDEQ), 2009. *Open Burning of Crop Residue State Implementation Plan (SIP) Revision.*

US Environmental Protection Agency (USEPA), 2011. P*olicy Assessment for the Review of the Particulate Matter*, U.S. Environmental Protection Agency Office of Air Quality Planning and Standards Health and Environmental Impacts Division.

Attachment 4

Detail and working in relation to question 20 – "What would be the likely differences in relative source contributions between industry, domestic heating and motor vehicle emissions if PM2.5 were considered rather than PM10?"

The question refers to "source contributions", rather than emissions. The difference is important. For example, in Christchurch in 2013 we estimate that 57% of the anthropogenic PM_{10} **emissions** on a winter's day were from home heating. The contribution of home heating emissions to the daily PM_{10} concentrations is likely to be higher than 57%, as home heating emissions tend to occur mainly during the evening when there is often little dispersion, whereas motor vehicle and industrial emissions tend to occur mainly during the day, when there is more dispersion.

We haven't yet published $PM_{2.5}$ emission estimates for a winter's day in 2013. However, both $PM_{2.5}$ and PM_{10} emissions were estimated for the 2009 inventory and this information can be used, together with the 2013 PM_{10} emission estimates, to estimate $PM_{2.5}$ emissions for 2013. This yields the estimates given in Table 1. Table 2 contains the results of similar calculations for Timaru.

Christchurch	PM_{10} Emissions (kg/day)	PM10 emissions (%)	$PM_{2.5}$ as a % of PM_{10}	$PM_{2.5}$ emissions (kg/day)	$PM_{2.5}$ emissions (%)
Home heating	1475	57%	0.96	1416	63%
Motor vehicles	507	20%	0.85	431	19%
Industry	594	23%	0.65	386	17%
Total	2576	100%		2233	100%

Table 1. PM emission estimates for Christchurch, 2013

Timaru	PM_{10} Emissions (kg/day)	PM10 emissions (%)	$PM_{2.5}$ as a % of PM_{10}	$PM_{2.5}$ emissions (kg/day)	$PM_{2.5}$ emissions (%)
Home heating		88%			91%
Motor vehicles		7%			5%
Industry		5%			4%
Total		100%			100%

Table 2. PM emission estimates for Timaru, 2012

World Health Organisation (WHO), 2006. Air Quality Guidelines - Global Update. 2005. Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide, published by the World Health Organization Regional Office for Europe.

WHO, 2013. *Review of evidence on health aspects of air pollution – REVIHAAP*, WHO regional office for Europe.

Detail and working in relation to question 21 – "In a similar vein, what would be the likely differences in relative source contributions between industry, domestic heating and motor vehicle emissions if the annual average period were considered rather than the worst-case wintertime period?"

We don't have annual emission estimates for home heating, motor vehicles or industry, but we do have the results of a source apportionment study that ran in Timaru for 12 months in 2006/7, which are summarised in Table 3 below. This study estimates source contributions to $PM_{2.5}$ at the Timaru monitoring station on a daily basis, allowing winter average and annual average contributions to be calculated. Home heating emissions have reduced slightly since 2006/7, so we would expect a slightly smaller % contribution from home heating in 2013. Note the source categories are slightly different, as source apportionment uses the chemical components of the $PM_{2.5}$ to estimate source contributions. While it can distinguish woodburning from non-wood sources, it does not distinguish between $PM_{2.5}$ from domestic woodburning, industrial woodburning, or outdoor woodburning.

The % contribution from woodburning to the annual average concentration is lower than the % contribution to the winter average, which is to be expected, given there is less woodburning in the non-winter months. However the reduction is quite small, as winter contributes the bulk of the annual average $PM_{2.5}$ concentration (due to the poorer dispersion conditions in winter), so the winter sources dominate the annual source contributions.

Source:	% contribution (Winter)	% contribution (annual)
Wood burning	89%	77%
Motor vehicles	5%	8%
Marine aerosol	1%	6%
Secondary particulate	5%	10%
Total	100%	100%

Table 3. % source contribution estimates for $PM_{2.5}$ in Timaru, 2006/7