Voices of the Valley
Hazelwood Mine Fire Inquiry Term of Reference 6
Outline of Submissions

1 Introduction

1.1 There is considerable ongoing concern in the Latrobe Valley community about the impact of the Mine Fire on health, including whether it contributed, and continues to contribute, to the death of some residents.

1.2 Terms of Reference 6 and 7 are directed to that issue.

1.3 Term of Reference 6 provides that the Board of Inquiry is to inquire into and report on whether the Hazelwood Coal Mine Fire contributed to an increase in deaths, having regard to any relevant evidence for the period 2009 to 2014. The hearing for Term of Reference 6 took place from 1 September to 3 September 2015.

1.4 Term of Reference 7 provides that the Board of Inquiry is to inquire into and report on short, medium and long term measures to improve the health of the Latrobe Valley communities, having regard to any health impacts identified by the Board as being associated with the Hazelwood Coal Mine Fire. This Term of Reference is to be addressed at a separate hearing later this month. It is not dealt with further in these submissions.

1.5 Voices of the Valley (**VotV**) are thankful that the Board is looking into these very serious matters. As the evidence from the Inquiry made plain, VotV became concerned about the health impacts, including an increase in the incidence of death, during and soon after the Mine Fire. VotV first sought to obtain data from the Registry of Births, Deaths and Marriages (**RBDM**) to investigate their concerns, but no response was received. VotV then spent months compiling data from archived newspapers. The data was rough, but it confirmed their concerns.

1.6 The Department of Health (as it then was) (**DoH**), after receiving the VotV analysis and data from the RBDM, dismissed VotV's concerns. It is now clear that that dismissal was on the basis of a highly questionable, and defensive, interpretation of the data.

1.7 In fact, proper statistical and epidemiological analysis reveals that the alarming trend observed by VotV is real, and was probably caused by air pollution from the Mine Fire.

2 VotV's work and the Government response

2.1 On 9 February 2014 the Hazelwood Mine Fire broke out. Within a few days, members of the Latrobe Valley community observed that it was having an effect on the health of people in the Valley.

Health surveys

2.2 In order to gather information, Mr Ipsen, a member of VotV, built an on-line questionnaire, which he ran from 5 to 17 March 2014. Around the same time, on 2 March 2014 and 23 March 2014 the organisation "Disaster in the Valley" (which later merged to become VotV) hosted two community protest meetings at which they gathered health-related questionnaires from community member attendees. Mr Ipsen compiled and analysed the data from his online questionnaire and each of the protest meeting questionnaires.[1] The results were provided to the DoH on 6 May 2014 and to the previous Hazelwood Mine Fire Inquiry.

Rapid Health Risk Assessment

2.3 Also in March 2014, the DoH commissioned the Monash University Rapid Health Risk Assessment. By that time the Mine Fire had been burning for over a month.

2.4 The DoH and, in particular, the then Chief Health Officer Dr Rosemary Lester placed great reliance on the statement, on page 5 of that report, that:

> *…epidemiological modeling undertaken as part of this review found that for combined $PM_{2.5}$ exposures around 250 µg/m3 in Morwell South and for exposures around the National Environment Protection Measure (NEPM) in the rest of Morwell, no additional deaths would be expected even if the exposure continues for 6 weeks.*[2]

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[1] T267.

[2] Page 5, "RAL2" to Exhibit 14, witness statement of Dr Rosemary Lester.

2.5 The DoH's unwavering reliance on the report failed to take into account the many, significant limitations in the modeling and prediction provided. That failure is surprising, given that most of those limitations were clearly set out in the report itself. It is also very concerning, given the grave consequences that could follow if the prediction was inaccurate (and which did indeed follow, as addressed in section 3 below).

2.6 The limitations as set out in the report included:

(a) the lack of any comparable brown coal Mine Fire on which a health effects study had been conducted;[3]

(b) the unprecedented nature of a fire in a brown coal mine only a few hundred metres away from a township;[4]

(c) the delay in conducting air pollution monitoring after the commencement of the fire;[5]

(d) the lack of any data relating to air toxics, including polycyclic aromatic hydrocarbons, dioxins, furans, formaldehyde or other volatile organic compounds;[6]

(e) the absence of any prior study on the effect of medium-term exposure to coal Mine Fire smoke;[7] and

(f) the failure to take into account the particular vulnerabilities of the local population or the likely effects of the Mine Fire on groups with such vulnerabilities.[8]

2.7 Professsor Abramson accepted that the statement "*no additional deaths would be expected even if the exposure continues for 6 weeks*" is not a conclusion

[3] T354:18-27; Page 4, "RAL2" to Exhibit 14 - statement of Dr Lester.

[4] Page 6, "RAL2" to Exhibit 14 - statement of Dr Lester.

[5] T355:5-23; Page 15, "RAL2" to Exhibit 14 - statement of Dr Lester.

[6] T357:2-13; T378:1-5; Page 5, "RAL2" to Exhibit 14 - statement of Dr Lester.

[7] T358:8-21; Page 6, "RAL2" to Exhibit 14 - statement of Dr Lester.

[8] T359:13-31; T375:19-27.

that could now be relied upon to say that there were no deaths related to the Mine Fire.[9]

VotV's investigations

2.8 During and after the Mine Fire, members of VotV heard anecdotal evidence associating local deaths with the Mine Fire. Obviously, that gave rise to significant concern. In a mid-May 2014 VotV meeting members began to discuss the possibility that the Mine Fire had caused an increase in deaths in the Latrobe Valley.[10] The organisation immediately resolved to investigate the issue.

2.9 On 27 May 2014, VotV wrote to the RBDM to request the numbers of deaths in February 2014 to the date of the request, and for February to June in 2009 to 2013. The request encompassed the localities of Morwell (3840), Moe (3825), Traralgon (3844) and Churchill (3842).[11] VotV received no response to this request for information[12] and no explanation for the lack of response has been provided by RBDM to date.

2.10 VotV made further requests for data from the RBDM on 4 and 25 August 2014.[13] The RBDM enquired with the DoH on 17 August 2014 whether the DoH could assist in response to the VotV request. The DoH declined to provide any assistance.[14]

2.11 The question of whether the Mine Fire had caused deaths "plagued" the members of VotV. In the absence of official data, they determined to investigate the question by analysing death notices from the local paper, the *Latrobe Valley Express*.

2.12 Between about May and August 2014, volunteer members of VotV attended the offices of the *Latrobe Valley Express* and accessed archived copies of the

[9] T360:1-8.

[10] T268-269.

[11] Exhibit 2 – Statement of Dawn Sims [8]

[12] Ipsen T270:21-22

[13] Exhibit 2 – Statement of Dawn Sims [9], [11]

[14] Exhibit 2 – Statement of Dawn Sims [10]; VotV also notes the recently produced email correspondence of 19 August 2014 between RBDM and DoH in which Dr Lester advises RBDM, in respect of Dr Gunter (a then member of VotV), "if you refer him to us my response will be that there has been an independent inquiry into the fire, and we have nothing further to add."

newspaper at the State Library of Victoria to compile death notice data for the period 2009 to 2014.[15]

2.13 It was an extensive and time-consuming task.

2.14 By 10 August 2014, the *Latrobe Valley Express* data was finally compiled.[16] While the data was crude and Mr Ipsen's statistical analysis of it was inexpert, VotV were alarmed to see confirmation that there was an increase in deaths in the Latrobe Valley at the time of the Mine Fire.[17]

2.15 In mid-August 2014 VotV unanimously resolved to provide the data to the Board of the Hazelwood Mine Fire Inquiry (as then constituted).

2.16 Unfortunately, by that time the Board was in the final stages of preparing its Inquiry report and could not take the *Latrobe Valley Express* data into consideration.[18] The VotV analysis was passed on to the DoH and to the Coroners Court of Victoria.

2.17 On 4 September 2014, over three months after the initial request, VotV were provided with the first RBDM data set.[19] It appeared to VotV that the RBDM data was roughly consistent with the *Latrobe Valley Express* data.[20]

2.18 On 12 September 2014, the ABC's *7.30 Report* broadcast a story about possible increased deaths in the Latrobe Valley as a result of the Mine Fire.[21] The ABC had engaged Associate Professor Barnett to provide an expert statistical analysis and explanation of what the data showed.[22] Associate Professor Barnett provided a report in which he expressed the opinion that

[15] T270-271

[16] T271

[17] T272:23-26

[18] T273

[19] VotV acknowledge that any data relating to June 2014 could not be provided until some time after the request for data on 27 May 2014; Exhibit 2 – Statement of Dawn Sims [13]; Ipsen T270:23-25

[20] T274

[21] Ipsen T274:22-24

[22] T274-275; T456

there was statistical evidence of an increase in deaths in the Latrobe Valley in 2014, which was likely related to the Mine Fire.[23]

The DoH's public statements

2.19 The DoH had provided a statement to the ABC about the RBDM data the day before, being 11 September 2014. The statement concluded that:[24]

(a) The data shows no increase in deaths in Morwell during the period of the Hazelwood open cut coal Mine Fire compared with the same period in previous years.

(b) The official data from the RBDM shows no significant pattern. The reason for individual deaths can have many explanations, including age, an individuals *[sic]* disease profile and external factors such as heatwave.

2.20 On 16 and 17 September 2014, two documents were uploaded onto the DoH's website.[25] These two documents took the form of 'fact sheets', published by the DoH, and presented information about deaths in the Latrobe Valley in the first half of 2014, compared with 2009 to 2013. The two documents contained examples of selective reporting,[26] and failed to take into account the complexities affecting the data, such as the evacuation of residents from Morwell.[27]

Doctor Flander's first report

2.21 In response to the *7.30 Report* program and Associate Professor Barnett's report, Dr Rosemary Lester, then Chief Health Officer of the DoH, determined to obtain an expert report.[28]

2.22 On 16 September 2014, Dr Lester emailed the University of Melbourne's Centre for Epidemiology and Biostatistics a 'project brief', which requested a review of

[23] T456

[24] Exhibit 3 – Statement of Linda Cristine, Attachment 1 – Email of Bram Alexander to Sarah Farnsworth

[25] Exhibit 3 – Statement of Linda Cristine [13.2], [13.3], Attachments 2 and 3

[26] T393-397

[27] T278:26-T279:2

[28] T405:5-14

the data relating to deaths in the Latrobe Valley.[29] Dr Louisa Flander of the University of Melbourne was assigned to undertake this work.

2.23 Dr Flander provided her final report to the DoH on 26 September 2014.[30] Between Dr Flander's engagement by the DoH on 16 September 2014 and the finalisation of her report, she provided the DoH with three draft reports.[31] These three drafts show the evolution of Dr Flander's report.

2.24 The DoH, through Dr Lester, provided feedback to Dr Flander by three emails dated 23 and 24 September 2014.[32] Dr Lester had no recollection of any telephone calls with Dr Flander in relation to these draft reports.[33] She agreed in evidence that an explanation for the changes made to successive drafts of Dr Flander's report was the feedback she had provided.[34]

Reports on further RBDM data

2.25 In November 2014, VotV sought further Latrobe Valley data from RBDM. The additional data sought included two additional postcode areas surrounding the Hazelwood Mine, 12 months of each year rather than just January to June, and covered an extended ten year period. VotV also sought comparison data for the state of Victoria.[35]

2.26 RBDM provided further data to VotV in about December 2014. RBDM charged VotV $485.00 for provision of the data.[36] The data was passed on to Associate Professor Barnett, who produced a report in respect of his analysis of the material.[37]

2.27 The DoH also obtained further data from the RBDM on 15 January 2015.[38] It then engaged Dr Flander on about 2 February 2015 to analyse the further data

[29] T403-404

[30] Exhibit 20; Lester T412:15-17

[31] Exhibits 17, 18, 19; Lester T410-412

[32] Exhibit 16

[33] T414:3-6

[34] T416:7-9

[35] T275.

[36] T276; Department of Justice tax invoice to Wendy Farmer, VotV, in the amount of $485.00.

[37] Exhibit 27.

[38] Exhibit 2 – Statement of Dawn Sims [19]

received, and undertake a peer review of Associate Professor Barnett's reports.[39]

2.28 In response to this request by the DoH, Dr Flander produced two reports, dated 28 April 2015 and 4 June 2015.[40] Prior to finalising her critical analysis of Associate Professor Barnett's reports, Dr Flander provided two draft versions of her report to the DoH.[41] The DoH, through its staff, including Dr Danny Csutoros, provided feedback to Dr Flander regarding these draft reports. Significant parts of the feedback were incorporated directly into Dr Flander's final report.[42]

Inadequacy in the Government response

2.29 On 26 May 2015, the Victorian Government re-opened the Inquiry into the Mine Fire.

2.30 Prior to May 2015, the government response to VotV's concerns was deficient, adversarial and lacking in objectivity leading to the likely compromise of an expert supposed to have been independent.

2.31 The DoH was wrong to rely on the statement in the Rapid Health Risk Assessment carried out by Professor Abramson and others that "*no additional deaths would be expected even if the exposure continues for 6 weeks*". Such reliance was against the weight of the many, and significant, limitations on that prediction, which were clearly set out within the body of the Rapid Health Risk Assessment.

2.32 The lack of a response by the RBDM to the VotV request for data dated 27 May 2014 was inadequate. Further, the DoH's reluctance to facilitate the VotV request for information in August 2014 was indicative of the DoH's reticence to properly investigate the concerns raised by VotV.

2.33 The DoH took an adversarial approach to the concerns VotV raised. The two public statements on the DoH website in September 2014 'argued the case' that

[39] Exhibit 3 – Statement of Linda Cristine [16]

[40] Exhibits 21, 22

[41] Exhibits 9, 10

[42] T309-317

there had been no increase in deaths as a result of the Mine Fire.[43] Further, the feedback provided to Dr Flander on or about 27 March 2015 encouraged her to 'challenge more directly' certain conclusions in Associate Professor Barnett's work.[44]

2.34 Communications between the DoH and Dr Flander, including draft reports by Dr Flander and feedback provided by the DoH in response to those draft reports, in February 2014 and March-April 2015, evince a lack of objectivity on the part of the DoH that infected the final reports produced by Dr Flander.

2.35 Two notable examples are:

(a) Dr Lester wrote to Dr Flander in an email dated 23 September 2014 that 'one of the things which gives us comfort that this is nothing more than random variation is [that the greatest increase in deaths was in Moe]'.[45]

(b) Dr Flander changed the phrase, referring to the link between increased deaths and the Mine Fire, 'plausible hypothesis' in an earlier draft report, to a 'supposition worthy of investigation', which appeared in the final report. This change in wording was derived directly from DoH feedback on her draft report.[46]

2.36 VotV were frustrated and alarmed by DoH's reluctance to engage with the very serious concerns raised by VotV.

2.37 VotV also consider the position taken by the DoH to be difficult to understand, given the grave significance of the issue they were addressing.

3 Statistical and epidemiological analysis

3.1 The statistical and epidemiological data establishes that:

(a) it is probable that there was an increase in mortality in the periods February to March 2014 and February to June 2014 compared to the same periods across 2009 to 2013; and

[43] Exhibit 29 – Report of Professor Ian Gordon dated 11 August 2015 [30]

[44] Exhibit 8; T326-328

[45] T418

[46] T314-316

(b) it is probable that the increase in mortality in those periods was caused by particulate air pollution from the Mine Fire.

3.2 We submit that the Inquiry's findings ought reflect that evidence.

Overview of expert witnesses

3.3 Four expert witnesses gave evidence in relation to the statistical data concerning mortality rates in the Latrobe Valley in the period surrounding the Mine Fire: Professor Armstrong, Professor Gordon, Associate Professor Barnett and Dr Flander.

3.4 The circumstances surrounding the involvement of each expert is, briefly:

(a) Professor Armstrong was retained by the Board and produced a report in August 2015.[47]

(b) Professor Gordon was retained by VotV specifically to provide a report for this Inquiry by letter dated 5 August 2015. His report dated 11 August 2015 was filed by VotV.[48]

(c) Associate Professor Barnett was initially approached by the ABC in early September 2014, and was later in direct contact with the Voices of the Valley. Associate Professor Barnett produced two reports, dated September 2014 and December 2014. He undertook the analysis on a pro bono basis.

(d) Dr Flander was engaged by the DoH in September 2014. Dr Flander filed three reports, the first is undated, the second is dated 28 April 2015 and the third is dated 4 June 2015.

Each of the above expert witnesses participated in the conclave held on Monday 31 August 2015, and contributed to the resulting Joint Report.[49]

The Mine Fire contributed to an increase in deaths

[47] Exhibit 28 – Expert report of Prof. Bruce Armstrong.

[48] Exhibit 29 – Report of Prof. Ian Gordon dated 11 August 2015.

[49] Exhibit 30, Joint expert report of Armstrong, Barnett, Flander and Gordon dated 31 August 2015

3.5 In oral evidence, each of these experts was asked if the Mine Fire contributed to an increase in deaths in the Latrobe Valley.

3.6 Professor Armstrong addressed the question in two parts:

(a) Was there evidence of an increase in deaths during the period of the Mine Fire and following, in the Latrobe Valley?

(b) What was the cause of that increase?

We agree that that is a convenient way to approach the task.

Was there an increase in deaths during the period of the Mine Fire and following?

3.7 The first part of the question required a purely statistical analysis.

3.8 In the language of the expert witnesses as set out in the joint report, the evidence is that:

(a) there is moderate statistical evidence for a higher mortality from all causes and from cardiovascular disease in the Latrobe Valley in the period February to June 2014, compared to the same period during 2009 to 2013;[50]

(b) there is some statistical evidence that the increase in mortality in the February to March 2014 period (the period of the Mine Fire) was *greater than* the increase in mortality across February to June 2014.[51] (That is, when the period of the Mine Fire is compared to the longer period of February to June 2014, there is some evidence that there was a greater increase.)

3.9 Looking to the data itself:[52]

(a) In the period February to June 2014 compared to February to June across 2009 to 2013, **there was a 17% increase in mortality**. The p-value associated with this increase is 0.014, meaning that the probability

[50] Exhibit 30, Joint expert report of Armstrong, Barnett, Flander and Gordon dated 31 August 2015 at [1.1]

[51] Exhibit 30, Joint expert report of Armstrong, Barnett, Flander and Gordon dated 31 August 2015 at [1.2]

[52] Exhibit 29, Table 2, page 5.

that the increase was the result of chance alone is 71:1, or put another way it is **98.6% likely that the increase was not due to chance.**

(b) In the period February to March 2014 compared to February to March across 2009 to 2013, **there was a 20% increase in mortality**. The p-value associated with this increase is 0.088, meaning that the probability that the increase was the result of chance alone is 11:1, or put another way it is **91.2% likely that the increase was not due to chance**.

3.10 The statisticians describe subparagraph (a) above as being "moderate" evidence, but when viewed in terms of probabilities it immediately becomes apparent that the increase in deaths was very unlikely to be the result of random variation or chance. The same applies to subparagraph (b) above.

3.11 In relation to the higher p-value for the February to March period compared to the February to June period, Professor Gordon explained that the difference is a "*simple consequence of the larger sample size for February to June*."[53] As Professor Gordon explained, the p-value will be a function of both the size of the rate ratio and of sample size.[54] Professor Gordon warned about reliance on the conventional 0.05 threshold for p-values.[55] Professor Armstrong similarly expressed the view that he did not adhere to the convention about the significance of the 0.05 threshold.[56]

3.12 We observe that any comparison between 2014 and 2009 (alone or together with the years 2010 to 2013), will include traumatic deaths from the Black Saturday bushfire. If those deaths are excluded from the data, the relative number of deaths in 2014 compared to the prior years will increase.

3.13 We also note the evidence of Dawn Sims that the data provided, particularly for 2014, may be incomplete. Data released by the RBDM to date (as analysed by the experts) did not include 'pending' data. As explained by Ms Sims, data is classified as 'pending' when the cause of death has not yet been resolved. Importantly, more recent data will be more likely to be incomplete, because the

[53] T602:23-26

[54] T602:26-29

[55] T594:13-23 (Professor Armstrong)

[56] T493:4 (noting that 0.5 should be 0.05)

data is updated to 'completed' as the deaths are investigated over time.[57] This may have the effect of understating the extent of the increase in mortality in 2014, potentially both in terms of the rate ratio and the p-values.

3.14 In summary, the evidence shows that it is *probable* there was an increase in mortality across both relevant periods and that increase was not due to chance.

What was the cause of that increase?

3.15 This requires an analysis of the circumstances as they existed in the relevant period in 2014, compared to 2009 to 2013. The expert witnesses identified four potential causes: fine particle air pollution from the Mine Fire or bushfires, carbon monoxide air pollution and heat.

3.16 The experts reviewed and considered the data and other material relating to these possible causes, and opined in the joint report that it was very likely that air pollution during the Mine Fire caused an increased in mortality.[58]

3.17 Individual answers given by the expert witnesses are instructive.

3.18 Professor Armstrong considered that:

> *[O]f the various explanations that one can put forward, the most likely is that an increase, if one occurred, was due to the increase in the particulate pollution of the air during that period of time, mostly likely due to the Mine Fire but possibly added to by bushfires that occurred at the same time, and I based that principally on two things. Firstly, the evidence that there is a relationship between particulate pollution and risk of death in the Latrobe Valley as observed by Dr Flander and her colleagues, and secondly, there is a large body of evidence to indicate that short-term increase in particulate pollution are associated with short-term increases in death as well as long-term exposure being associated with longer term increase in death.*[59]

3.19 Professor Gordon stated:

> *I agree with Professor Armstrong, taking into totality the statistical evidence, the other factors that were looked at that might partly explain results such as temperature which in my view do partly explain it but not nearly enough to remove the apparent effect of the coal mine fire. Things which are inconsistent need explaining and the possible issue*

[57] T284-285, T288, T290, T294-295

[58] Exhibit 30, Joint expert report of Armstrong, Barnett, Flander and Gordon dated 31 August 2015 at [2.3]

[59] T518:20-T519:3

> *about Morwell comes into that which I will comment on in a second but there are all sorts of other standard things like biological plausibility, analogy with other situations, past data about the affected air pollution and so on, Professor Armstrong has spoken about these and they apply to this case in favour of the causal connection.*[60]

3.20 Associate Professor Barnett referred to material prepared by the US Environmental Protection Agency with the Clean Air Scientific Advisory Committee, the American Heart Association and the World Health Organisation and then stated as follows:

> *So really when we have these very big, very well respected groups all saying there is a causative association between exposure to these pollutants and deaths, it really feels from my point of view there would have to be something very surprising going on in Morwell not to see that increase. Then when we look at the evidence we see an increase in deaths of a relative risk of between about 10 and 15 per cent depending on what you adjust for which is around the size we would expect. We see an increase in emergency hospital admissions and again, it would be extremely surprising to see an increase in emergency hospital admissions and not an increase in deaths.*[61]

The Associate Professor then addressed the reduction in the number of deaths in Morwell (but not Latrobe Valley) in the February to March 2014 period (relative to the same period across 2009 to 2013).

3.21 Dr Flander spoke of the link between exposure to particulate matter and mortality being clear.[62] Dr Flander referred in her answer to uncertainties in the data, however, at the conclusion of her evidence Dr Flander confirmed her position as it is set out in the Joint Report – namely, that it was very likely that particulate air pollution during the Mine Fire caused in increase in mortality.[63]

3.22 The above discussion concerns all-cause mortality data. The expert witnesses also reviewed mortality data by specific cause and reviewed data for hospital admissions. Importantly, deaths from cardiovascular disease increased in the relevant periods in 2014 compared to 2009 to 2013:[64]

(a) in the February to June 2014 period, an increase of **11% in mortality** compared to the same months in 2009 to 2013 (from 0.9 in 2009-2013

[60] T521:3-15

[61] T525:21-T526:2

[62] T527:13-17

[63] T53614-T537:10

[64] Exhibit 28, page 8, table 2.

to 1 in 2014). The p-value is 0.04, indicating that it is **96% likely that the increase was not due to chance**; and

(b) in the February to March 2014 period, an increase of **25% in mortality** compared to the same months in 2009 to 2013 (from 0.8 in 2009-2013 to 1 in 2014). The p-value is 0.08, indicating that it is **92% likely that the increase was not due to chance**; and

3.23 According to recent literature studies undertaken by Professor Armstrong – Professor Armstrong undertook the research in his capacity as a member of the expert advisory panel to the Chief Health Officer in New South Wales with respect to air pollution – in an acute air pollution situation the dominant effect on health has been seen to be cardiovascular effects.[65] Professor Abramson and others also noted in their Rapid Health Risk Assessment that studies show an increase in cardiovascular (IHD and stroke) and respiratory (COPD and ALRI) deaths associated with air pollution, with cardiovascular increases being greater than respiratory.[66]

3.24 The above data shows significantly increased mortality due to cardiovascular causes (11% and 25%), with low likelihood that it is a result of chance alone (4% or 8%). Again, this was described by the expert witnesses as 'moderate evidence'.

3.25 This data strengthens the conclusions that can be drawn from the all-cause data. It clearly shows that the increase in mortality was experienced in relation to a cause associated with mortality in acute air pollution situations.

3.26 Moreover, the emergency admissions data reviewed by Professor Armstrong shows an increase in emergency hospital admissions in 2014 compared to 2013. Overall admissions increased by 16%. The p-value was 0.001, indicating that the likelihood that this increase was due to chance was 1 in 1000 (or 0.1%)

3.27 Admissions relating to cardiovascular conditions increased by 16%. The p-value was 0.26, meaning that there was a 26% chance that the increase was due to chance alone. Admissions relating to respiratory conditions increased by

[65] T569:14-27

[66] Page 5, "RAL2" to Exhibit 14 - statement of Dr Lester

31%. The p-value was 0.07 meaning that the probability that this increase was due to chance was 1 in 14 (or 7%).

3.28 The joint report stated that:

> *3.1 Emergency hospital admissions for all conditions in the Latrobe Valley during the period of the mine fire in 2014 were more frequent than they were for the same period in 2013. Hospital admission rates for respiratory and cardiovascular diseases, considered individually, were also greater in 2014 than in 2013, though the statistical evidence for these increases was weaker.*
>
> *3.2 There was strong evidence that emergency hospital admissions were greater in 2014 than 2009-13 in people 25-39 years of age. The causes of this increase should be investigated.*
>
> *4.1 Emergency hospital admissions were greater in infants and children (0-4 years of age), albeit with statistically weak evidence in 2014 than in 2009-13, and greater in older people (65-74 years of age and, less so, 75+ years of age). These are recognised vulnerable groups for health impacts of air pollution.*

These conclusions were agreed by all four experts, with Professor Gordon noting that he had not had an opportunity to independently assess the date.

3.29 This morbidity data provides strong support for the conclusions that (a) there was an increase in mortality in the relevant period and (b) that increase was the result of air pollution from the Mine Fire.

Other causes?

3.30 In relation to the other possible causes, carbon monoxide air pollution and hot days were not considered to be likely or even possible causes of the increase in the number of deaths.

3.31 In relation to the 2014 bushfires, the Mine Fire was far more significant, in terms of potential health effects, than the 2014 Latrobe Valley bushfires. The Mine Fire burned for 45 days, from 9 February 2014 until it was declared safe on 25 March 2014. By contrast, the duration of the relevant bushfires were as follows:

(a) The Hernes Oak-McDonald's Track bushfire ignited on 7 February 2014 and was contained by 9 February 2014;[67]

[67] Hazelwood Mine Fire Inquiry Report 2014, p63

(b) The Driffield Fire(s) were ignited on 9 February 2014 and contained within the same day;[68] and

(c) The Hernes Oak bushfire ignited on 9 February 2014 and was under control by 13 February 2014.[69] [70]

It also stands to reason that smoke and pollutants emitted by the Mine Fire were more severe than the bushfires, given the density of the coal faces, which were the fuel that powered the fire, compared with grass/scrub/bushfires. This is consistent with the observations of Mr Ipsen given in his evidence when he described the difference in smoke between a bushfire and the Mine Fire:

> *They are quite different, the burning coal is quite acrid, leaves a taste in your mouth. The bush fire smoke which everybody knows almost has a smell of eucalypt about it, but the mine fire smells like briquettes.*[71]

The weight of the evidence – applicable legal principles

3.32 Doubts or gaps in scientific knowledge in evidence adduced are not determinative. All that a party in a court proceeding is required to show to make good a causal link is that, *on all of the evidence*, the more probable inference is that the identified cause did contribute.[72] 'More probable' means no more than "*upon a balance of probabilities, such an inference might reasonably be considered to have some greater degree of likelihood; it does not require certainty*".[73] The general standard of proof for causation does not require certainty or precision, and is 'relatively low'.[74]

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[68] *Ibid*, p66

[69] *Ibid*, p64

[70] Statement of Craig Lapsley to the 2014 Inquiry, dated 20 May 2014 [133]

[71] T278:2-8

[72] *Dahl v Grice* [1981] VR 513, 522 (Gobbo J) and 514 (Young CJ) and 515 (Kaye J); *Spence v Gomez* [2013] VSCA 48 [26] (Maxwell P), [78] (Nettle AJ), [59] (Chernov AJ); *Amaca Pty Ltd v King* [2011] VSCA 447 [83] (Nettle, Ashley and Redlich JJA).

[73] *Tabet v Gett* [2010] HCA 12; (2010) 240 CLR 537, 578 [111] (Kiefel J, Hayne and Bell agreeing at 564 [65], Crennan J agreeing at 575 [100]).

[74] *Tabet v Gett* [2010] HCA 12; (2010) 240 CLR 537, 587 [145] (Kiefel J, Hayne and Bell agreeing at 564 [65], Crennan J agreeing at 575 [100]).

3.33 These principles, while not binding on the Board, are instructive as to how the Board may approach its task in resolving this complicated question of causation.

3.34 Moreover, in the context of epidemiology specifically, French CJ in *Amaca Pty Ltd v Booth*[75] observed that an association between two events may be sufficiently strong that it itself supports an inference of causal connection, and further that an association which is shown to increase the risk of a second event may be said to be causally linked to the second event if the association is shown to have a causal explanation.[76]

3.35 Applying that analysis here, the p-values demonstrate very close association between the increase in mortality in the February to June 2014 period and the Mine Fire. Moreover, where the p-values are higher in the earlier periods following the Mine Fire (namely, February to March, such that the association is not as strong), the known link between particulate air pollution and mortality provides the causal explanation which satisfies the necessary causal link.

3.36 A critical point to note from the views of the expert witnesses, in particular the answers of Professors Armstrong, Professor Gordon and Associate Professor Barnett, is that they do not claim to have a complete answer in respect of *all* of the data.

3.37 These witnesses acknowledged that evidence in support of the contribution of the Mine Fire to an increase in mortality is not absolute. Indeed, some statistical data – the decrease in the number of deaths in Morwell in the period February to March and the decrease in mortality relating to respiratory illness – point against the conclusion. That is, some of the data was inconsistent.

3.38 As is clear from the answers given, on balance, when all of the evidence is considered together, the weight of the evidence strongly favours the conclusion that the Mine Fire contributed to the increase in mortality.

3.39 Professor Gordon made the following observation:

> *[W]e are in a situation where causation cannot be attributed on the basis of the gold standard paradigm in science of a randomized controlled*

[75] (2011) 246 CLR 36

[76] At 53-4

> *[sic] – we're nowhere near that, nonetheless there are plenty of very important situations in research and in life where we have to think about this question of causation without the paradigm and epidemiologists and statisticians have thought about that issue a lot and have addressed their minds to the criteria one might apply to draw a conclusion of various strengths, I suppose, about causation.*[77]

Inconsistences in the data

3.40 Moreover, the inconsistencies referred to above are either explicable or not determinative.

3.41 Looking first to the reduction in mortality in Morwell in the period February to March, this was described by Dr Lester in her evidence as follows:

> *I had a personal view that the deaths actually decreased in Morwell, where the exposure was the greatest.* [78]
>
> *[I]t is a basic principle of scientific causation that the greater the exposure to the hazard, the greater the effect should be seen and to have the effect not seen in Morwell, which was much more exposed, and seen in other parts of the Latrobe Valley, which were much less exposed, did not seem to make logical sense.*[79]

3.42 The simple logic Dr Lester refers to hinges on two critical assumptions, neither of which is based in fact:

(a) first, that no one left Morwell, despite the fact that the town was shrouded in acrid smoke, the DoH recommended that vulnerable residents (of South Morwell particularly) consider relocation and limited relocation grants were paid to members of the Morwell community; and

(b) second, that people in Morwell were necessarily subjected to the greatest exposure. This ignores that residents of other areas of the Latrobe Valley – Moe, Traralgon, Churchill – likely work in Morwell.

3.43 The expert witnesses acknowledged the inconsistency between the February-March Morwell data and the overall data in their joint report.[80] The joint report noted that evacuation of some residents might explain the lack of observed

[77] T520-521

[78] T414:10-12

[79] T414:15-20

[80] Exhibit 30, Joint expert report of Armstrong, Barnett, Flander and Gordon dated 31 August 2015 at [2.4]

data. In oral evidence, Associate Professor Barnett explained that a 20% evacuation would neutralize the decreasing trend in the Morwell mortality data entirely[81] (that is, if 20% of people in Morwell evacuated that would take away the effect of the reduction in mortality entirely). Also, Professor Armstrong explained that given the uncertainties in the Morwell numbers for those two months the reduction could be the result of random variation, and thus could be discounted.[82]

3.44 Further, some Morwell residents may have been identified incorrectly as having been from one of the other relevant postcodes, because they had evacuated during the period of the Mine Fire. Ms Sims gave evidence that information as to place of residence is usually provided by family members of the deceased, and RBDM have no way of verifying that information.[83]

3.45 Critically, the decrease in mortality in Morwell in those two months did not alter the views of the four experts that the likely cause of an increase in mortality overall was the Mine Fire.

3.46 Second, the specific cause data showed a reduction in mortality from respiratory causes for the periods February to March and February to June. Professor Armstrong in cross-examination said that the data was contrary to an expected increase due to the Mine Fire, however, he explained that the p-values (0.25 and 0.31) meant that the evidence was not very strong.

3.47 Despite these inconsistencies, on balance, the weight of the evidence strongly supports the conclusions that (a) there was an increase in mortality in the relevant period and (b) that increase was the result of air pollution from the Mine Fire.

Conclusion

3.48 For the above reasons, in accordance with the legal principles set out above and based on the evidence before it, the Board ought find that:

(a) it was *probable* that there was an increase in mortality for all causes and for cardiovascular illness in the relevant periods (February to March

[81] T526:5-10

[82] T519:30 – T520:12

[83] T283

2014 and February to June 2014) compared to the same periods in 2009 to 2013; and

(b) it was *probable* that that increase was caused by the Mine Fire.

3.49 Further, given that findings in the nature of those referred to above necessarily involve acceptance by the Board of the very serious health effect the Mine Fire has had on the Latrobe Valley community, it is submitted that the Board ought make recommendations as follows:

(a) That the State Government ensure that it engages with the Latrobe Valley community to determine shortcomings in the available local health services, particularly those relating to health conditions that may have been exacerbated by the Mine Fire.

(b) That the State Government and/or GDF Suez provide funding to address any shortcomings in the available local health services, particularly those relating to health conditions that may have been exacerbated by the Mine Fire.

(c) That expert training be provided to local health service providers to enable them to better identify and treat any health conditions that may be related to the Mine Fire.

(d) That free health checks be made available to members of the Latrobe Valley community in order to identify and address any health conditions arising out of the Mine Fire.

(e) That improvement to local health services be implemented immediately and independently from the long-term health study.

(f) That the long-term health study be expanded to examine the extent of the Mine Fire air pollution within the entire Latrobe Valley (beyond Morwell) and the health impact upon residents of all affected areas.

3.50 VotV notes that the recommendations sought may be further addressed during the upcoming hearings relating to term of reference 7. The utmost gravity of the health impacts that have been addressed by this inquiry should inform the approach taken to the next term of reference.

4 Credit attack on Associate Professor Barnett

4.1 One further matter requires mention. In respect of Associate Professor Barnett, the suggestion was made during the hearing that he was not sufficiently independent, because of his role in providing media and strategic advice to VotV.[84]

4.2 VotV submit that the Board should regard Associate Professor Barnett as having provided independent, expert opinion of a very high quality. In support of this submission, VotV point out that:

(a) Associate Professor Barnett gave evidence of the high value that he places on academic independence and integrity, and that he applied these values to the work done at the request of the ABC and VotV;[85]

(b) The cross-examination of Associate Professor Barnett by Mr Neal, and correspondence at Exhibit 31 revealed no examples of him changing his report at the request of VotV, or the ABC, nor engaging in the practice of providing draft reports and receiving feedback on these drafts;[86] and

(c) The methodology employed, and conclusions reached by Associate Professor Barnett, were largely consistent with those reached by Professor Gordon, the other specialist statistician on the expert panel.[87]

Dated: 9 September 2015

Melanie Szydzik

Megan Fitzgerald

Ray Ternes

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[84] T556-557

[85] T606

[86] T538-567

[87] Exhibit 29 – Report of Professor Gordon, especially [21]-[27]