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TRANSCRIPT OF PROCEEDINGS

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INDEPENDENT PLANNING COMMISSION

MANGOOLA COAL CONTINUED OPERATIONS

IPCN PANEL:

PROFESSOR SNOW BARLOW (Chair)
PETER COCHRANE

OFFICE OF THE IPCN:

STEPHEN BARRY (Director of Planning)
BRADLEY JAMES (Principal Case Manager)

NSW HEALTH:

DR RICHARD BROOME (Acting Executive Director of Health Protection)

ENVIRONMENT PROTECTION AUTHORITY (EPA):

ADAM GILLIGAN (Director of Regulatory Operations)

DEPARTMENT OF PLANNING, INDUSTRY AND ENVIRONMENT (DPIE):

MATTHEW RILEY (Director of Climate and Atmospheric Science)
LAUREN EVANS (Acting Director of Minerals and Quarry Assessments)

9.08 AM, THURSDAY, 25 MARCH 2021

PROF S. BARLOW: Well, good morning and welcome to you all. And thank you for making yourselves available for this meeting. Before we begin I would like to acknowledge the traditional owners of the land from which we meet today and pay my deepest respects to their Elders past, present and emerging. Welcome to the meeting today to discuss the Mangoola Coal Continued Operations Project, a state significant development application currently before the Commission for determination. The Mangoola Mine is an existing open-cut coal mine located 20 kilometres west of Muswellbrook in the Upper Hunter Valley.

The project involves the extraction of an additional 52 million tonnes of run-of-mine coal by establishing a new open-cut mining area known as the northern extension area, essentially, north of the existing mine. My name is Professor Snow Barlow and I am the chair of this Independent Planning Commission panel to determine this project. With me today is my fellow commissioner and panellist on this project, Peter Cochrane, and we have from the Commission, Brad James and Steve Barry. In the interests of openness and transparency and to ensure the full capture of information, today's meeting is being recorded and a complete transcript will be available on the Commission's website in the next few days.

This meeting is part of the Commission's consideration of this project and will form one of several sources of information upon which the Commission will base its advice. It's important for the Commissioners to ask questions of attendees and to clarify issues whenever it is considered appropriate. If you're asked a question and are not in a position to answer, please feel free to take the question on notice and provide any additional information in writing from which we can then put on our website. And I request that all members here today introduce themselves before speaking and for fall members to ensure they do not speak over the top of each other to ensure the accuracy of the transcript. And thank you and we'll now begin. Could we begin just by – for myself and Peter Cochrane's information, just if you could identify yourselves on the meeting and the positions you hold. Now, we've seen who – the invite list is but I just want to make sure we know who we're talking to in terms of your positions. Perhaps we could begin with you, Matt.

MR M. RILEY: Okay. Thank you, Professor Barlow. So I'm Matthew Riley. I'm the Director of Climate and Atmospheric Science at the Department of Planning, Industry and Environment within the EES Science, Economics and Insights division. My primary responsibility is to maintain the air quality monitoring networks of New South Wales which includes the Upper Hunter air quality monitoring network and provide atmospheric research, climate change research and air quality forecasting for the State.

PROF BARLOW: Thank you, Matthew. Lauren, you're next on my list anyway.

MS L. EVANS: Thank you. I'm Lauren Evans. I'm Acting Director of Resource Assessments within Planning and Assessment and my regular role is Team Leader, Hunter Coal Projects.

PROF BARLOW: Thank you. And next?

MR S. BARRY: Richard, I think.

PROF BARLOW: Richard.

DR. R. BROOME: Hi, sorry.

PROF BARLOW: Oh, Richard, your name's not coming up on my screen.

DR BROOME: So I'm Richard Broome and I'm actually the Acting Executive Director of Health Protection New South Wales, which is part of New South Wales Health, and is responsible for protecting the public against health hazards and, primarily, around infectious diseases but we also support the government in its policy around environmental matters.

PROF BARLOW: Thank you, Richard. Thanks very much. So thank you all for coming today and the reason that we sent you an agenda for today's meeting and - - -

MR P. COCHRANE: Snow, you forgot Adam.

PROF BARLOW: Oh, Adam. I hadn't – I can't see Adam on the screen. I'm sorry, Adam.

MR A. GILLIGAN: That's all right. Adam Gilligan, Director of Regulatory Operations with the EPA. So I lead a team of environmental regulators based in both Parramatta and Newcastle who are responsible for environment protection licensing of coal mines in the Hunter as well as managing the Upper Hunter air quality advisory committee and working with Matt on the monitoring network.

PROF BARLOW: Oh, thank you, Adam. Look, I'm sorry for missing you but it's just the vicissitudes of Zoom, you weren't on my, sort of, screen. So just to get back to where we're going to start is in determining this project, Commissioner Cochrane and myself have some questions we want to ask about – it basically concerns with the air quality in the Upper Hunter region and the potential impacts of development of more coal mines in that region and what do we know about that and are there any impacts that we can determine. And you've had our – you've had our question for you which I'm just trying to bring up. Peter, would you like to ask the first question? Peter, can you hear me?

MR COCHRANE: I can. Sorry, my cursor disappeared. So our first question was what are the trends in PM10 and PM2.5 levels at Muswellbrook but also Wybong, Jerrys Plains, Singleton and Merriwa since the establishment of the network? And by way of explanation, a number of the submissions referred to sustained high levels of PM2.5 in particular in the Upper Hunter and exceedances and concerns about the long term cumulative effects of that. So we wanted to start off with the long term trends from the monitoring network first.

MR RILEY: Thanks, Commissioner. Professor Barlow, I may, if I might, request – I've got a short presentation to perhaps set the context and answer a few of the questions if the Commission's happy to view that.

PROF BARLOW: That would be terrific. Thank you, Matt.

MR RILEY: Okay. Thank you, Professor. I will just share my screen now. Can you confirm that you can see my presentation?

MR COCHRANE: Yes.

PROF BARLOW: Yes. I've got it. Thank you.

MR RILEY: And now in presentation mode, can you still see it?

PROF BARLOW: Yes. Thank you.

MR RILEY: Okay. Thank you. I'll go through very quickly because I know there is a lot to go through but I do think it's important. This presentation will hopefully answer a few of your questions and provide a little bit of context of observed data from the network. So I'll just kick straight into it and I'll start talking about PM10, so the larger particles of concern to us and often particles that can be associated with crustal matter, so dust in particular. Important to note for PM10, however, that PM10 also does include the finer particles. It is a measure of all the particles from basically about .1 of a micron in aerodynamic diameter up to 10 microns in aerodynamic diameter. So it does include PM2.5 as well.

So PM10, while it can be dominated by dust, it also does include smoke and other combustion particles as well. So I'll just start here and I'll just put up the annual average PM10 concentrations from Singleton and Muswellbrook over the past decade. And what you can see is you can see that there is some differences towards the end of the decade and some higher levels, but I think we're all quite aware of the impacts of the drought and Black Summer. I'll come back to that when I present a few other graphs. But what you can see is you can basically see a trend here that when you look at climate data you think there's a – you can see or probably tease out that there's likely a contribution from climate.

What we'll go to there is just in contrast because it's important to look at the trends, not just in the Upper Hunter, but contrast it with another location. So I'm going to put Wagga Wagga, which is another regional location not impacted by coal mining but, indeed, impacted by agricultural activities and continental dust as well. And what you can see here is there's not necessarily a significant difference between Wagga, Singleton and Muswellbrook. What you can see is you can see the same sorts of signatures from climate in these locations. The Commission did ask about Merriwa and Wybong, so I'll just add those to the graph as well so just that you can see that similar patterns we see across multiple locations.

This is often indicative – because PM10 can be a pollutant that travels a long distance, it's indicative of a regional pollutant. So pollutants that are regional in nature often follow this – these trends where you see similar trends over large distances. Just getting back to the impacts of climate, what I'm going to do is just show you a graph where I've taken the annual average temperature from the Bureau of Meteorology's Scone automatic weather station and overlay that on the Singleton Muswellbrook and I've left Wagga in there. So you can see that, you know, there is clearly a climate signal that's associated with this data. And this is not unexpected because we know that when we have high temperatures, they're generally associated with dry conditions as well and hotter, drier conditions do lead to more dust at continental scales as well as regional scales and local scales.

And, of course, hot, dry weather also impacts on fire activity which we saw to devastating effect in Black Summer. Now, what I'll do is I'll quickly move onto PM2.5. These are the particles that are of probably the greatest health concern. They generally have the greatest impact. Now, recall PM2.5 is a subset of PM10 so it's not unusual that we can see the impacts of Black Summer in both the PM10 and the PM2.5 trends. Here we've got Muswellbrook and Singleton and what you can see here is there is similar trends here but there is one difference and, that is, Muswellbrook does have higher PM2.5 concentrations than Singleton. That's primarily due to wood smoke – wood smoke emissions in Muswellbrook.

The geography of Muswellbrook, it's in a little bit more of a basin compared to Singleton which is a bit more open and a high use of domestic solar fuel wood heaters in winter. I'll come back to that in just a moment. But what I wanted to do is just show you those differences between Muswellbrook and Singleton and also the impacts of the Black Summer fires. And again as we did with PM10 just to contrast another site, I've put the Liverpool PM2.5 data in as well. And this is a site in Sydney and what you can see here is we had lower PM2.5 levels at Liverpool in 2011. That could just be due to some regional differences in the climate during that period because we still are several 100 kilometres away from each other.

But, in general, you can see that he PM2.5 levels at Liverpool are comparable to the PM2.5 levels at Muswellbrook and this is because of Liverpool having a much greater concentration of population. Indeed, we still get wood-fired heater usage in Liverpool as well but we also see an increase contribution to PM2.5 from motor vehicles as well. But it's giving you a little bit of context about how Muswellbrook will compare to an area of Sydney. All right. And given it is an area of Sydney that does have some of our highest PM2.5 levels, but I'm just giving you this information so you can understand that there are some similarities between regions, both that are closely located but also regions that have some significant separation.

I just wanted to put rainfall on here. It could be a little bit difficult to interpret this. So this is annual – the annual rainfall in Scone over this 10 year period. It's the dash line. And you can see a bit of a correlation where the years we have – we have lower PM2.5 and dry years we have higher PM2.5. I'm just going to invert the axis so just basically invert the precipitation axis and that shows it a little bit more clearly. I put

this in just to illustrate the impact that climate has on regional air pollution and PM2.5 and PM10 can be considered as regional air pollutants. Just to finish off the context, these are 48 – sorry, these are 24 month rainfall deciles across New South Wales over this past decade and what you can see is you can see that specific variation in climate.

We have some average years, some wetter years and, indeed, the period 2017/18/19, the driest years and some of the driest years we've had with quite extensive drought. So these climate drivers do have an impact on regional pollution. We have undertaken some specific research into the origins of PM2.5 pollution in Singleton and Muswellbrook. This is from the Upper Hunter Fine Particle Characterisation Study. I just draw your attention to the bottom graph which is Muswellbrook and you can see in this that, in particular in winter, we're seeing roughly about over 60 per cent of the pollutants – pollution is associated with wood smoke, wood-fired heaters.

And, annually, that accounts for around about 30 per cent of the overall PM2.5 at Muswellbrook. Importantly, when you look at those variations between Muswellbrook and Singleton, it really is that difference in wood smoke that accounts for the vast bulk of the difference between the PM2.5 that we record in Muswellbrook and that we record in Singleton. So that's a brief overview. I hope that's helped with some context setting and, of course, I will provide that presentation to the Commission if you would like it.

PROF BARLOW: Thank you, Matthew. Do you mind just going back to that last slide which is the summary slide just so we can understand it a little better?

MR RILEY: Yes. Have you got that slide again, Professor Barlow?

PROF BARLOW: Yes. Thank you. Thank you, Matthew. That's great. Wood smoke's easy. What does secondary sulphate represent?

MR RILEY: Secondary sulphate represents particles that are formed in the atmosphere from gases. It's an important thing to recognise that unlike some of the other pollutants, particle pollution comes from two sources. It comes from direct emissions of particles. So think about it as something such as dust kicked up through mining activities or, indeed, dust picked up by dust storms from continental Australia or, indeed, smoke from bushfires. They're direct emissions of particles. But PM2.5 is also formed in the atmosphere from chemical interactions between gaseous precursors. And one of the main sources of that secondary particle formation is associated with sulphur dioxide. So sulphur dioxide in the atmosphere contributes to the formation of sulphate particles.

Within New South Wales we do have sources of sulphur dioxide in the region, the power stations – Bayswater, Liddell – but also the coastal and central west power stations as well. So, you know, Vales Point, Mount Piper, during this time – Wallerawang were still – were still operating and, of course, Eraring as well. An

important thing to note with secondary sulphate is it doesn't form immediately. It's not an instantaneous reaction. It's generally driven by the mixture of gases that are in the environment and solar radiation. And so secondary sulphate can form over a number of days or a number of hours to days and can be transported significant distances as well. And it's important to note that this secondary sulphate that we see here in the Upper Hunter is not significantly different to the levels of secondary sulphate that we see in areas such as Sydney.

PROF BARLOW: Okay. Thank you. And the sort of – the other thing which is sort of interesting is that the vehicle industry, is that diesel particulates or what's that, you know, industry – vehicle/industry? Is that diesel or what particulates?

MR RILEY: Yes. Like, it's a combination of different sources. And one of the things with this project is this project undertook source apportionment using a technique called positive matrix factorisation. And what that does is it looks at the different mixes of chemicals that we analyse during the sampling and analytical process and it looks at their occurrence together. And one of the things that came out of this study is that there was a fingerprint of both vehicle emissions and industrial emissions that occurred at the same time. Think about it – and we were unable to tease apart the specific vehicle component or the specific industry component – think about it in this context.

If we were looking at, say, a dry cleaner on a street and it emitted sources of particulate pollution and right next to that dry cleaner we had a chicken shop and our monitoring point was in a direct line between the dry cleaner and the chicken shop, so whenever the wind was blowing along that axis, we would always get a mix of pollutants from both of those sources. Even though they each have their own individual contribution, we couldn't pick out the – and we couldn't pull apart the quantum of those individual contributions. So that is – so that is why we – that is why we went to – that's why we put them together as vehicle and industry. But it is a mix of diesel use on site in the coal mines but also from traffic emissions in the region. For instance, think about the road transport traffic through the Hunter Valley up and down the highway, and other industrial sources. Just unable to tease them apart, so it's a mix of them.

PROF BARLOW: Thank you. Thank you, Matt. That's very helpful. And, well, finally from me – but perhaps Peter may have some questions – the industry-aged sea salt, why do you differentiate between industry-aged and sea salt?

MR RILEY: So again this is one that is particularly challenging. Oceanic processes and coastal processes form particles. You can see that when you drive along the coast and you see that little bit of a haze that you see along the coast. That's salt in the air that's formed from natural processes. If you think about the topography of the Hunter Valley, what you get is you get basically a funnelling of coastal processes up the valley. Indeed, if you're at somewhere such as Scone on a very hot summer day, you might – Singleton, sorry, is probably a better example. Singleton on a very hot

summer day, you'll really be hanging out for the sea breeze to come and give you a bit of respite.

Now, what we can do is in this analysis you see the sea salt that has been transported with that front. But at the same time, it's mixed in with a whole bunch of industry emissions as well. And, again, if you think about that example of the metaphor I gave with the dry cleaner and the chicken shop, it's the same thing. There's a mix of industrial emissions. There's a mix of sea salt emissions and we're just unable to tease out the actual components from each of them. And that's slightly different to what you see in the second bottom category there which is sea salt. Sometimes you get a very strong sea salt signature where there is no contribution from industry and this is because it's been quite a vigorous transport of sea salt up the valley and there hasn't been time for the gaseous emissions from industry to form particles and mix that in with the sea salt. So this is why we said it's industry-aged. It takes time for those particles to develop, whereas sometimes you get just fresh sea salt and you can clearly see that.

PROF BARLOW: Thank you, Matthew, and one – just a question of interest. Is the fact that you have perhaps greater amounts of – they're rather similar but – of sea salt in the Upper Hunter than Singleton, is that just the funnel effect of the valley, is it?

MR RILEY: Yes. It's basically the funnel effect of the valley and it's a few different – it's a few different things but what you can see is, you know, for example, here in Singleton, if I look at sea salt – can you see my mouse?

PROF BARLOW: Yes.

MR RILEY: So if I look at sea salt here, fresh sea salt in spring, and I compare that to fresh sea salt in spring at Muswellbrook, because there's a difference between Muswellbrook and Singleton – remember this is Muswellbrook at the bottom – what you get is you get less fresh sea salt at Muswellbrook, sorry, down here but you get more aged industry sea salt. You get – and you're going to – don't read just on the contributions here because they're percentages. They – my apologies, I should have put one in that has actual micrograms. But you can see how some of this fresh sea salt is transformed into the aged industry sea salt. That's because there's a bit more time for those reactions to occur, so it's a little bit harder to tease those apart.

PROF BARLOW: Thank you, Matthew. Peter, do you have any questions for Matthew?

MR COCHRANE: I do. I have two. Thanks very much, Matt. That's been really helpful. Firstly, on this slide, the difference between wood smoke and biomass smoke.

MR RILEY: Yes.

MR COCHRANE: I'm assuming wood smoke is fire – you can attribute to, sort of, household fires and biomass is bushfires, presumably; is that correct?

MR RILEY: Yes, that's what we've tried to do – that's what we've tried to do with this one and you can see that in – that in summer, there's no wood smoke but you still see a signature from biomass smoke. Also in spring, at a time when we typically have a lot of hazard reduction burnings, there's more biomass smoke and less wood smoke. Part of this is due to there's aging processes that occur in the smoke and the plume of the smoke as it goes through. And in this study we were able to, in particular, track two of those tracers, levoglucosan and mannosan and ratios between levoglucosan and mannosan were – enabled us to be able to pull apart what is, sort of, smoke that has come from wood smoke within the community and smoke that has come from biomass burning being transported from further away and we could see that in those signatures of those two – those two tracers.

MR COCHRANE: And biomass smoke is a far bigger component of the Muswellbrook – greater than it is at Singleton presumably because it's closer to the Blue Mountains or closer to forested areas that would have been burnt from time to time.

MR RILEY: Yes, that could be the case. We would have to do a little bit more work on that. It's not something we pulled out specifically in this. But also this is one year's worth of data. It may have been the case that there were a bit more hazard reduction burns occurring in that time in autumn and spring and they are specifically located such that they impacted Muswellbrook more than Singleton. But it's fair to say that there are contributions of large scales from hazard reduction burnings that you can trace at multiple stations.

MR COCHRANE: Okay. And have you done this analysis that's in this slide for any other year? Obviously, we'd be particularly interested in any trend data there might be in those components - - -

MR RILEY: No. We haven't replicated this study. This is – to do these types of studies is actually quite intense scientifically and quite costly. We did, a couple of years after this, do a similar study using similar – a similar approach but expanded it in the Lower Hunter. And we work with ANSTO, the Australian Nuclear Science Technology Organisation, to support some of their monitoring at multiple locations and they continue to provide similar analysis to this but on a condensed scale. So there is data specifically from Muswellbrook from the ANSTO monitoring in Muswellbrook that I can try and provide to you to give you a greater understanding.

PROF BARLOW: That would be very helpful. Thank you, Matthew.

MR COCHRANE: Did that form part of – there was a CSIRO study that I think ANSTO contributed to of air quality in the Upper Hunter but it's quite a few years old now.

MR RILEY: Yes, that is this study. That's the results from this study. So this was a study that was commissioned by and designed by the New South Wales Government. So at the time, OEH working with New South Wales Health and we commissioned CSIRO and ANSTO to conduct the study.

MR COCHRANE: Okay. Going back a few slides – and, Snow, you've probably got questions on some of the other slides – but the annual average for PM2.5, I notice sits above the recommended level of 8 micrograms per cubic metre every single year for Muswellbrook.

MR RILEY: That is correct.

MR COCHRANE: Although, as you point out, the major contributor – the single major contributor to that is wood smoke.

MR RILEY: Yes. I think it's important to note when we talked about annual averages of PM2.5 to understand – as you could see from the particle characterisation study – that PM2.5 is a mix of sources – in most locations, is a mix of sources from multiple sources and industry. It's one of the reasons why I did put up Liverpool here and, you know, both of these sites – Liverpool and Muswellbrook – they do have some similar fingerprints because PM2.5 is a regional pollutant, so things such as secondary sulphate and sea salt and other things. But you would see in Liverpool a higher contribution from motor vehicles. In Muswellbrook, you see a higher contribution from wood smoke. If I just go back to this slide, that's one of the important things about this slide. It is not necessarily just one contributor. It is the sum of the contributions from many sources.

MR COCHRANE: Yes.

PROF BARLOW: Peter, have you got another question? I was just going to have a follow up question, but we understand that you established the monitoring network in probably 2010, but became operational in 2011. Do you have – of course, at that stage there were, you know, considerable amount of coal being mined in the Muswellbrook area and, of course, Singleton. Do you have any – is there any – you know, it might've been just grab sample data of air quality in the Upper Hunter before 2011?

MR RILEY: So the work that ANSTO has done at Muswellbrook commences before 2011, so there is information available from their sampling there. They sample not every day, only two days per week but, nevertheless, they do have data for many, many years. So, again, perhaps in getting that data from ANSTO, that will answer some of those questions.

PROF BARLOW: Thank you, Matt. From your knowledge of that data, you know, has the air quality deteriorated in Muswellbrook, say, if you've had a look at, say, 2000 data?

MR RILEY: From my knowledge, the greatest driver of changes in PM2.5 and PM10 air pollution is – over this period from, say, 2000 onwards – is generally driven by large scale interannual variability in climate. When it's hot and when it's dry, when we have El Ninos, when we have droughts, we see increased pollution across the board. Similarly, when we have La Nina years, higher rainfall, we see reduced pollution across the board. That's the main driver of the variation in pollution between stations and regions that we generally see. But I can't talk specifically about that data from Muswellbrook from earlier than 2011. It is best to probably speak to Professor David Cullen at ANSTO directly on that.

PROF BARLOW: Thank you. Thank you, Matt. Peter, do you have any more questions on that data?

MR COCHRANE: Well, this will probably lead into Richard, but I'm – here's a proposition. The average annual PM2.5 concentrations probably contribute to chronic health conditions whereas the shorter term exceedances, I'd imagine, contribute to acute, sort of, respiratory concerns. And I'm interested in the difference between, sort of, the underlying chronic impacts of those higher levels above the recommended levels. But a number of the submissions to us also talked about daily and nightly exceedances that caused distress and – anecdotal, at least, because we didn't get any evidence – anecdotal comments about emergency admissions because of respiratory distress when there were higher gas levels. So, Richard, I'm not sure what – whether you've got a presentation or whether that can kick off some comments from you.

PROF BARLOW: Peter, Adam has his hand up.

MR COCHRANE: Oh, sorry.

PROF BARLOW: Adam, would you like to make a comment?

MR GILLIGAN: Thanks, Professor Barlow. Just with respect to Matt's comments there about climate driving the significant variation – and I certainly don't dispute that – but I think it is important to acknowledge that what we see occur is that – what I wouldn't want you to think is that that doesn't mean that industry contributions increase at those times. When we have hot, dry conditions, that will be the driver for increased dust in the valley and some of that will be dust lift-off from agricultural land or regional dust storms and those sorts of events. But we will certainly see increased dust lift-off from mined areas, some of that simply from exposed areas and some from active mine operations. So, yes, climate is the driver for that because it's obviously harder to control dust when it's hot, dry and windy. But we shouldn't suggest that that is simply something beyond the control of those sort of anthropogenic sources.

PROF BARLOW: Thank you. Thank you, Adam. Can I just ask a follow up on that and then we'll go back to Richard, I think. Is – have you ever, sort of, tried – I know it's probably a challenging task but tried to, you know, attribute what the

contribution of all those, you know, we've just – you know, Matthew's beginning slide which we've seen a lot of as well, you know, those really quite considerable areas of exposed air – whether it be, you know, landfill or coal or whatever it might be – anyway, disturbed, you know, landscape in the Hunter Valley. Have you ever tried to attribute what might be due to, you know, the environmental influences and what might be due to the disturbance influence?

MR GILLIGAN: We have and I could just present a couple of slides to perhaps go to that if that's okay with you.

PROF BARLOW: That would be good. Thank you.

MR GILLIGAN: Okay. If I can just remember where to present my screen on Zoom because I'm mostly using Teams these days. There it is.

PROF BARLOW: Let's see. We haven't got it yet. Oh, thank you.

MR GILLIGAN: Hopefully have it there now.

PROF BARLOW: Yes.

MR GILLIGAN: So we've got 14 monitoring sites across the Upper Hunter and you can see those there in terms of where they're distributed. What we tend to see in the Hunter is a north-west, south-east relationship. So we get norwesters down the valley. We get, you know, wind blowing back up the valley in certain circumstances and what we tend to see in bad conditions is strong norwesterly winds blowing down the valley and on a day like this that's exhibited here, air quality's pretty good because you can see greens and blues. But what we often see is that air comes into the valley relatively clean at the top end at sites like Merriwa in the top left and can become more polluted as it moves down the valley.

That's the case if we've got local contributions to air quality. Whereas if we've got perhaps a more substantial state-wide dust event or perhaps a bushfire impact, the air is already polluted when it arrives in the valley and it remains polluted as it moves further down. So what we've tried to do is look at the days where there's a significant difference between the air quality that arrives at Merriwa and the air quality that's experienced at the population centre of Singleton and what we can actually – can I just check that makes sense as a concept?

PROF BARLOW: Yes, that's fine. Yes.

MR GILLIGAN: So what we - - -

MR COCHRANE: Adam, can you say this in presentation view because we see two slides with next one and your current one and we'd have better definition.

PROF BARLOW: Just a bit more – yes.

MR GILLIGAN: All right. I'll try and do that. Let me see. Is that better?

MR COCHRANE: Yes.

PROF BARLOW: Yes, that's - - -

MR COCHRANE: Thank you.

PROF BARLOW: Thank you, Adam.

MR GILLIGAN: So what we can see on this slide is the number of days with a significant change in air quality between Merriwa and Singleton. And on the left – I appreciate these figures are pretty small – if we're showing from 2012/13 through to '18/19 and what you can actually see there is that, you know, there's generally a reduction in the number of days in which we might say mining has significantly contributed to poor air quality at Singleton. Now, that's not to say that there's not local impacts particularly at some of the monitoring sites that are closer to mining but in terms of the population scale impact at somewhere like Singleton, what this data suggests as one way of cutting it, is that we had more issues with local contributions to poor air quality in the earlier part of the decade than we've seen in the later part. And this data, in theory, should be operating independently of the climate piece because it's a snapshot of those two locations regardless of, you know, what's happening more broadly.

PROF BARLOW: But conversely, Adam, does it also mean – because I think I recollect that, you know, we know that '17, '18, '19 were drought years but I think '14 was pretty dry, too. So in those years you would have expected, you know, a fair bit of general low air quality and, therefore, not much of a difference because of the contribution of smoke and dust coming in. Is that a fair assumption?

MR GILLIGAN: Look, I think so. Certainly, '18/19 we were heading into drought. It wasn't the worst of the drought – and jump in here, Matt, if I misrepresent your data in any way – but, you know, I think like 2018/19 you would expect in theory that, you know, air quality is worsening. We're getting further into a drought, therefore, you must – there must be a greater contribution from mining under those circumstances. What this suggests is that perhaps in terms of best practice mining operations, that that's being – that effort is being put in to managing those sources during those dry conditions.

PROF BARLOW: Thank you. Peter, do you have - - -

MR COCHRANE: Now, would it be – it would be, I think, fair to say – although, I guess this is a question – that when conditions do get drier, that would trigger dust suppression measures at mine sites. They would be more likely to apply dust suppression measures at mine sites when it's dry and windy.

MR GILLIGAN: Yes, that's absolutely true and we put extra scrutiny on mines when it's hot, dry and windy and we run extra compliance programs to check what they're doing under those circumstances. What we do – I guess, there was a question earlier about exposed areas and while we can't necessarily say specifically what the contribution of those is, what we do see when we go out in hot, dry conditions is that in many cases mines are employing best practice in terms of actual mining operations; so increased use of water carts, modification of digging and damping activities in terms of whether it occurs at all or where it occurs on the site.

So not doing things, you know, higher up on an elevated area during high winds. But what we do see is significant dust lift-off from stockpiles in exposed areas under those circumstances which are much more difficult to control despite the best intentions. And I think that's what our more recent dust buster compliance programs have shown is that there's generally a good practice occurring but we fundamentally have significant areas of land exposed to mining. And some of that's undergoing rehabilitation, obviously, but a lot of it is just fundamentally exposed earth that causes problems. And I might just quickly share another slide from that presentation.

MS EVANS: Could I just make a quick comment about that as well?

PROF BARLOW: Thank you, Lauren.

MS EVANS: Just that our recommended conditions, obviously, would require additional management measures during adverse conditions and those extraordinary regional events and there would also be some conditions in there with respect to progressive rehabilitation that should assist with that.

PROF BARLOW: Thank you, Lauren. Adam, back to you.

MR GILLIGAN: Yes. Sorry, I'm just trying to share that again now. So there's some of our drone footage that shows really good practice. You might be – are you getting two screens again?

PROF BARLOW: Yes. If we could go to presenter. Thanks, Adam.

MR GILLIGAN: There's an example of the sort of good practice that we can see when we run our drone compliance program, so great water carts being used. When we look at a site like this – the impression when you look at that still, there's an excavator in the middle of that shot. There's a fair bit of dust lift-off. It looks like this is poor practice. When you actually play it and you see the dust lift-off, operations have actually stopped on this site, so they're doing the right thing in terms of their operations. But, fundamentally, whilever you have that significant area of earth exposed on a hot, dry, windy day, you're going to see lift-off. And, similarly, here if you look at this shot taken by one of our officers, you can see some plant and equipment in the distance, houses in the foreground. It looks like poor practice if those pieces of plant and equipment are operating. The reality is none of that

equipment is operating. It's just, you know, dust lift off caused by the amount of exposed area under those conditions.

MR BARLOW: Thank you. Thank you, Adam. Just a, sort of, supplementary question which we might have got too late, but I may as well ask it now. In terms of the relative effectiveness of dust suppression measures is the sort of chemical method equally as effective as the water method, so to speak?

MR GILLIGAN: ..... is a range of different things but in any many cases water is just as effective as some of the chemical suppressants that are used particularly because you've got challenges in terms of ongoing mechanical impact on those surfaces, particularly haul roads, and regular use to water in some mines have found is just as effective as use of chemical suppressants.

MR BARLOW: Yes. Yes. We – in this particular application we're dealing with they're seeking to, you know, save water by using chemical suppressions: not all the time but in some cases. Yes. So we were just keen to know whether they were, probably, equally effective, but as you say where you have, you know, mechanical interruption they're probably not as effective as just plain wetness.

MR GILLIGAN: Yes. And, I mean, we remain outcome focussed there, so we set an objective in terms of the sort of control efficiency we expect to see from the mines on haul roads and we don't specify how they're to comply with that. We just expect them to achieve that outcome from a range of best practice tools that are out there.

MR BARLOW: Well, thanks, Adam. Peter, do you have any questions for Adam to – well, we can go back to Richard. I'm sorry, Richard. We've held you.

MR COCHRANE: That's all right. No, that was very helpful, Adam. Thank you.

MR BARLOW: Back to you, Richard, which I believe that, you know, we're sort of already dealing with that question of, you know, are the trends in, sort of, human health data in the Upper Hunter and is any part of that, you think, might be due to deterioration in air quality due to mining?

MR BROOME: Professor Barlow, look, I might – I don't have a presentation. I apologise. The – I thought I might just start off, though, by saying what we know about, I suppose, the health effects of air pollution generally and so, and particularly PM2.5. So PM2.5 there's a huge amount of evidence of the health effects at PM2.5 and there's, I guess, general consensus across the world that exposure to PM2.5, both long term and short term, is associated with the shortening of life, so premature death, and cardiovascular disease and it's quite likely that it also causes respiratory disease, again, both in the short and long term. And importantly, I think, to date there's not – whilst there's – you know, I suppose, the suggestion that PM2.5 from different sources might have different health effects to date there's no really strong evidence to say how much.

So it's generally accepted that what we should do is treat all PM2.5 the same, so – and manage it accordingly and assume that it has the same health effects essentially. And just further to what Peter said earlier yesterday I guess there's – when we look at PM2.5 and the studies that have investigated it they've generally divided into two sorts of exposure. There's long term exposure which is exposure that goes on for several years, probably, and then there's short term exposure which is, you know, the effects of day to day changes in PM2.5, and so the bulk of the health effects of PM2.5 are from long term exposure, but there are the short term effects which are predominantly likely to be in people who have pre-existing illness.

So, for example, if you have asthma a brief, or a 24 hour period of high level exposure, could trigger that effect, or if you have pre-existing heart disease, for example, it could give you angina or cause you to go to hospital in the short term so, but that would predominantly be in people who have existing health effects. And as time goes on there's more and more associations being found between PM2.5 and other health effects but it takes time for us – for those to be sure that those effects are truly due to PM2.5 and not other confounding factors, but as time – you know, as more and more research gets done more associations are observed.

So, I suppose, that's the sort of background and so from New South Wales Health point of view we generally rather than focussing too much, I suppose, on observation of differences in health effects between places which is fraught with difficulty because of – you know, there's many what we call confounding factors we generally just focus on what we know about the health effects of air pollution and the fact that we know very well from the evidence that exists that exposure is associated with health effects and that reducing exposure is likely to result in some sort of benefit to the community that's – where the exposure is reduced.

So having – so having said all that I would say if you look at the health – and you can look at health data on Health Stats New South Wales, which is a website that's produced by New South Wales Health to put forward as much as the health information that we have, and very broadly the trends in health conditions in the Upper Hunter and Hunter New England local health district more generally are broadly consistent with trends that we see in New South Wales overall. So when I say trends, you know, there's, for example, a general downward trend in evasive cardiovascular mortality in New South Wales, and there's a general downward trend in the rate of cardiovascular mortality, for example, in Muswellbrook as well.

Having said that there are differences in the rates. So Muswellbrook does seem to have slightly higher rates of cardiovascular disease, for example, and diabetes and some other chronic conditions, but you wouldn't – you wouldn't want to attribute that purely to air pollution. There's a whole range of factors that explain the prevalence of those conditions in a particular community so, you know, for example, socio-economic status. So whilst you can observe differences between places you wouldn't want to attribute those differences to any particular risk factor, I suppose. So that's – I guess, that's, kind of – yes, that's the information that I would like to provide but I would be very happy to answer questions.

MR BARLOW: Thank you. Peter, do you have any questions for Richard?

MR COCHRANE: Well, that has been extremely helpful. Thanks, Richard, and appreciate your comment about confounding effects and the difficulty of attribution of cause and effect. I guess, as I said before the thing we are trying to weigh up is, you know, a number of submissions make those claims that sustained high levels of PM2.5, for example, at Muswellbrook are leading to a higher incidence of admissions to hospitals and of respiratory impacts, but you're saying essentially that's a very difficult line to draw directly.

MR BROOME: Directly. Absolutely. So – but indirectly we do know that exposure to air pollution is associated with things like respiratory hospitalisation and cardiovascular hospitalisation and death as well. But generally at an individual level, or in a small community, those effects are likely to be relatively small and consequently they're very difficult to measure, so the evidence that we have about the health effects of air pollution comes from extremely large studies conducted in, you know, in multiple cities with populations of millions of people usually, and the reason for that is because the effects are quite small and there are these confounding effects. You need to have very, very large studies to have sufficient ..... to be able to detect differences.

So because of that that's why we tend not to try and focus on, you know, local studies or local information about differences. We would rather – we take the information that we know and try and apply it to the policy question at hand.

MR COCHRANE: And one of the – another comment that has been made about the workforce in Upper Hunter is it's actually quite mobile; a lot of them drive in and out as well, so it would be very difficult to attribute cause and effect as well with a mobile workforce – well, a largely mobile workforce.

MR BROOME: Well, in that workforce, I suppose, yes. If you're not clear on what their exposure – and that's another – a general problem in air pollution research is attributing exposure. It can be quite challenging to measure exposure in any kind of precise way and often, you know, we use very broad scale averages

MR COCHRANE: Yes. Okay. No, that was very, very, very helpful. Thank you.

MR BARLOW: Just – Richard, just to continue from that. In relation to – you mentioned a little bit about the local data in Muswellbrook but – and you mentioned also that it is the Hunter Valley New England region, so – and while, you know, we are very aware that, you know, we are dealing with small populations here, so there's probably not going to be any significance in them, but do you see any trends between what, perhaps, is happening in Muswellbrook and then to places that might be a little bit more pristine, say, you know, you could go to Tamworth or, I don't know whether that's in the region but I'm sure Armadale is, so a place like Armadale which is probably well away from those major areas of disturbance? Are there any differences there, Richard?

MR BROOME: ..... I don't have – I haven't looked at that specific question so I don't have that information at my fingertips but, I mean, as I say the trends in Muswellbrook, so the – whether there's a declining trend or an increasing trend or a flat trend is broadly similar to the trend for the whole of New South Wales - - -

MR BARLOW: Yes.

MR BROOME: - - - so – but I can't say – I would assume that the trends will be similar in, you know, in most of New South Wales and, I mean, that is – I mean, that is the pattern. You know, there is a general overall decline in the rate of cardiovascular disease over time as we get better at treating it and live healthier lifestyles.

MR BARLOW: Yes. Okay. Thanks for that. We've probably, really, asked this question but, perhaps, we should ask it explicitly. You know, Peter has sort of said – sort of stated that, you know, Muswellbrook has the worst air quality in Australia. Now, we're aware that, you know, that may be a bit of a stretch but either Richard or Matt or Adam, even, what – you know, is there any sort of truth to those anecdotal statements or, you know, even if we sort of narrow it a little bit more outside urban areas, large population areas to regional areas, is there any truth to that statement or are there other areas around New South Wales, for instance, Matt, where the air quality is just as bad?

MR RILEY: Thanks, Professor Barlow. Yes, I don't think there is truth to the statements. Certainly I would dispute Muswellbrook has the worst air quality in Australia. What we can say is that the air quality that we observe in Muswellbrook, particularly for PM2.5, is above the net annual average and consistently above that. However, there are other stations – there are other locations in New South Wales where we can see similar numbers. I provided some information from Liverpool. Indeed, Professor Barlow, you just mentioned Armadale. We've recently expanded our air quality monitoring and have more monitoring across the state including a full station in Armadale, and we do see things in Muswellbrook that are consistent with things that we see in other – in other towns of similar size on the tablelands or in regional New South Wales where you have cooler winters.

You see a higher use of wood fired heaters and in particular in regions where there can be the influence of topography. If you think about Armadale, for example, it sits in a valley where wood smoke can pool overnight particularly in winter. So there are locations that have similar air pollution to Muswellbrook. Indeed, you can probably characterise many of them as being locations where there has – there is a higher use, higher percentage use, of wood fired heaters. That is a common thing across those stations.

MR BARLOW: Okay. Yes. Thank you for that. Peter, do you have any other, sort of, questions on that particular question that we've put to you?

MR COCHRANE: No. I think you've answered most of those. I don't actually recall – but Launceston had the worst air pollution in Australia for a long time due to wood smoke and there's actually a national program to discourage people from using wood fired heating. That isn't the case in New South Wales at all. The air quality, I'm guessing, is not bad enough to trigger such a program.

MR RILEY: So we – we have had a long and ongoing program working with the EPA to raise awareness of wood smoke issues to assist councils to better manage the impacts of wood smoke because councils are one of the primary – have some of the primary responsibilities and ability to manage the issue within their local government areas.

MR COCHRANE: Yes.

MR RILEY: We actually have just released the New South Wales Draft Clean Air Strategy for consultation. It does highlight wood smoke and it does highlight our continuing and ongoing programs in wood smoke particularly around increasing community awareness and also providing support to councils, but also we – and Adam may wish to ensure that I state this correctly, we also supported a tightening of standards for wood heating as well, so we're pursuing multiple avenues to try and drive down emissions from solid fuel heaters: wood smoke emissions.

MR COCHRANE: Does the clean air strategy also deal with other sources of pollutants, or is it primarily focused on wood smoke?

MR RILEY: No, it deals with all sources of pollutants, so everything from electric vehicles and their continued – growing uptake of electric vehicles, the work that New South Wales has put into the New South Wales electricity strategy, the support for our net zero admissions by 2050 target, and intermediate target – only to achieve 35 per cent emissions reduction by 2030 as well, our net zero plan, cleaner transport. It deals with pretty much the whole scope of the major emission sources in New South Wales.

MR COCHRANE: And anything relevant to coal mining?

MR RILEY: Yes. It does speak about regulation and our programs to improve and enhance the regulated community.

MR COCHRANE: Okay. Thank you.

MR BARLOW: Thank you. Adam, I believe you would like to make a comment.

MR GILLIGAN: Thank you. Look, I certainly support Matt's comments about Muswellbrook not necessarily having the worst air quality in New South Wales, but I did just want to quickly show that from our perspective community complaints are certainly increasing in that area, so you will see there on that slide that black line is complaints about air from mining against other sources, and so that's increasing for

us in the Hunter. Also the complaints – so they're, again, just showing an increase in complaints about mine dust in the Hunter increasing and an increasing focus there in the last couple of years for Muswellbrook.

It would suggest – reflects mining encroaching closer to the town whereas it has been more established in Singleton over a longer period of time, and not only are the numbers of complaints increasing but the number of people, so this is showing the number of actual individual informants is also increasing, so it's not just a handful of people getting more frustrated and putting in more complaints. It's a greater number of people complaining to us about their concerns, and there's some evidence there to suggest that – the complaints align with when we know air quality is worse. It's not just people, you know, complaining willy nilly. There's a clear link that when we have more bad weather days we have more complaints as well, and there is – there's also a seasonal piece to that.

We see complaints increase in dry weather. So it's obviously important to look at the actual data and what it's telling us about whether air quality in Muswellbrook is worse than anywhere else and that's obviously of some relevance to the community, but it's also just worth noting that the community is saying it's worsening here regardless of its relativity to other parts of the state or country.

MR BARLOW: Thank you, Adam.

MR COCHRANE: Snow, just a quick question on that. When people complain about mine dust, is that – do you have any sense of how accurate people are distinguishing between mine dust and any other source?

MR GILLIGAN: We've gone through some processes of trying to encourage people to provide us with better information to – when they complain, so there are times when someone in a place like Muswellbrook looks out and sees a bad weather day and says, "Well, this must be mine dust", and, you know, I've, in fact, taken those calls from Newcastle and been able to say, "Well, look, there's actually a regional dust storm occurring. It's bad in Newcastle today as well." What we encourage people to do is to identify poor practice in their complaints and we're certainly seeing some people getting much better at providing us with good actionable data to say, "It was blowing a gale and I saw continued activity at a particular mine for this period of time", and that stuff that we can get our investigators to follow up and take action.

MR COCHRANE: Thank you.

MR BARLOW: Thank you for that. Well, I think we've probably answered that question, how Muswellbrook compares to other areas and we have, you know, in having sense, you know, it's probably not worse but there is from your data, Adam, perhaps, you know, some trend in complaints from that area and perhaps what's behind – do you – have you had any analysis of those complaints? You know, are

they – as you've just said you've been trying to encourage people to be more specific, but did – have you got any data out of that?

MR GILLIGAN: I guess the data shows that people are complaining at the times when we would say the air quality is genuinely worse. They complain more when we're in dryer conditions. The switch from Singleton to Muswellbrook as a focus and the shift in terms of increased number of people complaining, I guess, anecdotally suggests to us that the increased mining activity around Muswellbrook is leading to greater community concern there and I think if you reflect on those videos I showed earlier where you can see houses in the foreground and exposed area relatively close to those homes there's a combination.

Sometimes people will be saying, "I saw some specific bad practice here and I want that actioned", and we will follow up on that, but there is just – I guess it occurs to us when we go out and do our bust the dust programs that there are some fundamental limitations being reached in terms of the capacity of those communities to sustain mining so close to their communities where regardless of mines employing best practice you will continue to see significant dust lift off in bad conditions and that will have impacts on those communities.

MR BARLOW: Perhaps another question on that is, you know, there is always this best practice, but is the superior practice, you know, other things that could elevate dust suppression to above best practice?

MR GILLIGAN: Look, we've gone through a series of pollution reduction programs in mining to identify what best practice is and it certainly identifies some things that could go above and beyond, but there are some practical limitations to applying those in all circumstances or all of the time, and we're certainly shifting our focus to see what extra we can do in that exposed area space that might provide some better outcomes there, but as I say there are some fundamental limitations just due to the scale of and frequency of mining activity in this part of the world.

MR BARLOW: Just another question on that, perhaps, is is one of the things you're thinking about is if rehabilitation, therefore revegetation, begins earlier in the mining process, would that be one of the things that could, you know, could lead a better practice because you presumably would have less exposed areas?

MR GILLIGAN: I guess that's probably more in the territory for the resources regulator to comment on in terms of rehabilitation in its truest sense. We're – I guess, we're keen to stay in our lane and not interfere with their activities around rehab, but what we are keen to see is greater stabilisation - - -

MR BARLOW: Yes.

MR GILLIGAN: - - - so that might be some temporary activities, whether it's, you know, chemical stabilisation or aerial seeding and those sorts of things. It might not necessarily play into a longer term strategy in terms of, you know, return of

biodiversity and, you know, final landform. All we want to do is stop dust lift off and so that might be a relatively short solution. We are turning our minds to ways to achieve that and whether we can employ economic instruments and training schemes and the like to, you know, consider whether there's caps on the amount of area that could be exposed at any point in time and allow mines who are further advanced with their rehab perhaps, you know, trade that greater capacity with mines who are behind, but we're in the early days of considering those sorts of concepts as a way forward.

MR BARLOW: Thank you for that. Peter, do you have any more questions?

MR COCHRANE: Just one last one, I think, for Richard. Just the long term exposure impacts of dust and poor air quality. I'm assuming we're really talking decades, probably, for those things to become evident. Is that correct?

MR BROOME: I think it's a little bit of a grey area. So some of the studies so, for example, one of the big studies that we use for our sort of risk assessment purposes was a study by Pope, I think, in 2003, off the top of my head, which was a big cohort study in the US and there they had – their measures were essentially of 20 years' worth of exposure, but having said that there is – there's increasing evidence, I think, that quite a decent chunk of the long term effects do occur in the first few years after a change in exposure, so say, for example, the US EPA has recommended if you're doing risk assessments that you might want to assume 30 per cent of the full benefit of long term exposure is achieved in the first year.

The next 50 per cent in the next five years after that and then the remaining, I think, 20 per cent in the following – up to a period of about 20 years after, so it's a grey area but you wouldn't want – you wouldn't want to assume that it takes many, many years. You would expect to get quite a decent chunk of the benefit in the first few years.

MR COCHRANE: Yes.

MR BARLOW: Are there any differences in the age cohorts there, Richard, do you know? You know, is it – now, what is – we really need, I think, when you're talking about cardio, asthma – well, asthma is probably all ages, but cardiovascular you're probably thinking, you know, more mature populations. What about the useful populations?

MR BROOME: So, yes. So most of the cohort studies that have looked at mortality from cardiovascular disease and respiratory disease have tended to be in people aged 30 years and over. So you wouldn't want to generalise necessarily beyond those things and so, but the effects, the relative risks, seems to be, you know, fairly static across ages if that makes sense. So the risk in a 30 year old of having heart disease is very low, but the relative risk of them having heart disease is the same relative to air pollution, if that makes sense, compared to ..... Having said that there are studies in

young – in children, for example, from Southern California that show associations with lung development.

There is increasing evidence that air pollution is associated with pregnancy outcomes like birth weight and premature birth. So there are – you know, as time goes on we're finding out more and more information about how air pollution can affect younger people and people – in a whole range of ways I think.

MR BARLOW: Thank you. Peter, do you have - - -

MR COCHRANE: ..... take some years for those effects to show up in the health stats, though, I think, is what you're saying.

MR BROOME: Yes. Yes. And at an individual level, and a small community the effects are generally very small. You know, if you're talking a difference of one microgram of PM2.5 between two communities that kind of – the size of that effect would be very hard to detect in a small community. You know, it would likely just end up – it would be within that, sort of, the general variation that you might expect.

MR COCHRANE: So coming back to our specific project that we've got to consider it has been put to us that this is one more. The cumulative impacts should be regarded as unacceptable, but I think what you're saying is it's – well, across the presentations we've had just now very difficult to pick the individual additional impacts, both on air quality and in health, from any particular project. I think you're talking about broad regional effects, the complexity attributing any sort of particular health outcome to any particular air quality data at this stage in this place, I think, is kind of where I would summarise - - -

MR BROOME: Yes. I think that's right. So you wouldn't want to say that any individual person's hospitalisation was attributable to the air pollution, but you would expect in an area with more air pollution that it would make a greater contribution to the population's overall rate of hospitalisation.

MR COCHRANE: Yes.

MR BARLOW: On that theme, Matt, do you and Richard, perhaps as well, you know, we have accedence which PM2.5 and which are present in urban areas as well as rural areas as Matt has showed us – Liverpool. I'm sure there are other areas in urban areas as well. So you have an accedence and is that a World Health Organisation, sort of, guidance that you shouldn't go over 8.5 or – and, you know, are there some escalating series of, you know, of danger signals as you go above, you know, 10 or even 15? So what do we know about that?

MR BROOME: Shall I – I might start, but so generally we have – we have the long term average which is the, I think, the most important standard for protecting people's health because we know that it's long term exposure, cumulative exposure, over a long period of time that leads to the bulk of health effects, but we also, to

protect people from these real acute effects, we have a short term standard. So they do slightly different things, I suppose, but – and if you look at – if you read World Health Organisation documentation which, I suppose, supports the way countries have implemented these things, I mean, they have a different context, but they often talk about the short term standard as being, you know, something that you need to implement actually to be able to achieve the long term standard as well. So in some places measures that stop the air pollution peaks will help you to achieve the long term reduction and your annual average exposure, or a reduction in your long term exposure. So that's probably not quite the same situation as we're facing in New South Wales but, I mean, clearly it's important to prevent brief high levels of exposure because we know those do result in acute health effects.

MR BARLOW: Yes. And I guess you would say, Matt – sorry, I'm not putting words in your mouth, this is a question. Matthew, is that – you know, we have a highly variable climate in Australia so that we have that background of, you know, even though this area isn't because of the wind patterns, a fairly arid country that will kick up dust in those inevitable dry times. Is that what you're saying there, that that – would you go as far to say as the background levels are, you know, episodically perhaps higher in Australia just because of our geography and our climate?

MR RILEY: Yes. I support that, Professor Barlow. We do tend to have some higher – a continental scale level because of dust from the arid interior, but I do also want to bring to the attention of the Commission that with some of the other jurisdictions internationally they don't focus on an annual average measure to assess their attainment of their standards. They take into account some inter-annual variation by looking at multiple years. For example, in the US and I believe in the EU they look at a rolling three year average to assess their attainment. Again, that's representative of the inter-annual variability. For example, in Europe they have dust impacts from Sahara and dust storms. However, we do have large natural sources of particle pollution in Australia.

It's – we're mindful of that. Overall we do aim to reduce PM2.5 because any reductions in exposure to PM2.5 over large populations is likely to lead to improved health outcomes. So what happens with that background level is it means that there's a little bit less for you to work on from the anthropogenic signal but, indeed, our policies, programs, indeed, our warnings and alert systems are designed to help us minimise people's exposure either by driving down overall annual average exposure or during those emergency events such as Black Summer providing people advice so that they can take action to remove themselves from exposure to the pollution.

MR BARLOW: Thank you for that. Yes. Well, again, just one last chance, Peter. Do you have any further questions?

MR COCHRANE: No. Just appreciate the material you've provided and as you may be saying about status, Snow, but it would be very helpful to get copies of all the slides that between you you've presented to us.

MR BARLOW: And, perhaps, just a further question, Matthew, you know, the, whatever it's called these days, the AEC, the Atomic Energy Commission – Lucas Heights, anyway, is that data available on a website somewhere?

MR RILEY: Yes. ANSTO - - -

MR BARLOW: ANSTO. All right.

MR RILEY: - - - data available. That's all right, Professor Barlow. They make that data available on the website. They publish annual and monthly summaries of data from, say, Muswellbrook as well, but the principle of that program, Professor David Cohen, I'm sure he would be quite happy to speak to you about his monitoring results.

MR BARLOW: Was that David Cullen or Callahan?

MR RILEY: Cohen.

MR BARLOW: Cohen. Thank you.

MR RILEY: Yes. C-o-h-e-n.

MR BARLOW: Thank you.

MR RILEY: Professor David Cohen.

MR BARLOW: Thank you very much. Thank you very much for that. Well, may I thank you all for, you know, being so well prepared and giving us, really, such a thorough briefing to the questions you were asked. I don't think we could have asked for more in terms of your openness and I think we've had an excellent discussion which has provided us with much more information than we had when we began. So we thank you all for that and we will probably call an end to this. Thank you. So, thank you, for your time today and thank you for your preparation.

MEETING CONCLUDED **[10.29 am]**