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TRANSCRIPT OF PROCEEDINGS

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INDEPENDENT PLANNING COMMISSION - PANEL MEETING WITH THE INDEPENDENT PANEL FOR UNDERGROUND MINING (IAPUM)

RE: DENDROBIUM

PANEL:	**STEPHEN O'CONNOR (Chair)** **JOHN HANN (Commissioner)**
COUNSEL ASSISTING:	**RICHARD BEASLEY SC**
OFFICE OF THE INDEPENDENT PLANNING COMMISSION:	**STEPHEN BARRY** **JULIAN ARDAS**
IAPUM:	**JIM GALVIN** **RAE MACKAY** **ANN YOUNG** **NEIL MCINTYRE**
DEPARTMENT:	**MIKE YOUNG** **HOWARD REED**
DATE:	**10.36 AM, MONDAY, 14 DECEMBER 2020**

THIS PROCEEDING WAS CONDUCTED BY VIDEO CONFERENCE

MR O'CONNOR: Welcome to this stakeholder meeting proceeding, the Independent Planning Commission's electronic public hearing into the State's significant development application for the Dendrobium Extension Project. I'm Steve O'Connor. I'm the chair of this panel. Joining me is my fellow commissioner, John Hann. We are also being assisted by Steve Barry, Julian Ardas and Richard Beasley.

Before we begin, I would like to acknowledge the traditional custodians of the lands which we variously meet and pay my respects to their elders past, present and emerging, and to the elders from communities who may be participating today.

South32 Limited, the applicant, owns and operates and the Dendrobium Mine, an underground coal mine located around eight kilometres west of Wollongong in the southern coalfields of New South Wales. The mine produces metallurgical coal for steel-making in Australia and overseas. The applicant is seeking planning approval to allow it to extract an additional 78 million tonnes of run-of-mine coal from two new mining areas, known as Areas 5 and Area 6, and to extend the life of the mine until the 31st of December 2048.

The application has come to the Commission for determination because it received more than 50 unique public objections. I note that the Department of Planning, Industry and Environment has provided its assessment report and has recommended approval of the development application. The Minister for Planning and Public Spaces has directed that the Commission hold a public hearing into the application. He has also asked the Commission to determine the application within 12 weeks of the date of the referral from the department of their assessment report.

In line with regulations introduced in response to the ongoing COVID-19 pandemic, this meeting will be conducted online. A full transcript of the meeting will be published in the next few days. Thank you. That completes the introductory statement. I might just ask everyone to introduce themselves. I might start with you, John.

MR HANN: John Hann, Commissioner.

MR O'CONNOR: Thank you. Then I go to Steve Barry, please.

MR BARRY: Steve Barry. Planning Director at the office of the Independent Planning Commission.

MR O'CONNOR: And then to Julian.

MR ARDAS: Julian Ardas, a consultant planner assisting the Commission.

MR O'CONNOR: And Richard Beasley.

MR BEASLEY: Richard Beasley, counsel assisting.

MR O'CONNOR: Thank you. Then, Jim. Are there, Jim? You're on mute.

MR GALVIN: Jim Galvin, chair of the Independent Advisory Panel.

MR O'CONNOR: Thank you. Rae. Is Rae there?

MR Mackay: Yes. Sorry. Rae Mackay. I am a member of the Advisory Panel.

MR O'CONNOR: Thank you, Rae. Neil.

MR McINTYRE: Neil McIntyre, ... the Advisory Panel.

MR O'CONNOR: Thank you. And Ann.

MS YOUNG: Ann Young, member of the Advisory Panel.

MR O'CONNOR: And then from the Department of Planning, Industry and Environment, Mike.

MR YOUNG: Mike Young from the Department of Planning, Industry and Environment. I'm an executive director involved in the assessment of mining projects there.

MR O'CONNOR: And Howard.

MR REED: Howard Reed. I'm contracted to the department and reporting to Mike Young.

MR O'CONNOR: Thank you. I think that covers everyone that's participating in the session today. I thought we might just start by asking Jim if there's any, sort of, introductory comments; overview; you know, initial statements or propositions that the panel would like to put to us.

MR GALVIN: Okay. Thanks Stephen. There is a couple of opening comments. The panel had to work to a very tight timeframe dealing with this advice. It had to end up getting an extension in any case. But the level of its own analysis is being constrained in this case and it's really relying very much on the what the proponent and the department and other stakeholders could provide. So that's the first point.

The second point is that we deliberately avoided providing advice on what we thought were acceptable impacts and what we considered were performance measures. That did not come into our scope of works. We very much viewed that as that's what the IPC is there for and, further, if we were expected to provide that sort

of advice we would want to hear from all stakeholders first so that we could form a view across the board.

So the lack of advice in that regard in our report should not be taken – should not be inferred from that lack of advice that we actually endorse the mine design and the predicted impacts and consequences. That inference shouldn't be drawn by the fact that we haven't made comment in those areas. And an example of that, for example, is the comment, "The panel has not identified any changes to the mine plan which would significantly reduce environmental impacts." That is a correct statement, but it didn't set out to identify those changes.

The process for today I think that would work best is that as we deal with your questions, if I can give either a high-level answer or an overview I will do that, and then I will then defer to the technical specialists as need be, recognising, particularly in this matter, that there is a lot of overlap between the different technical specialists. And so particularly groundwater, surface water, it's likely that both Neil and Rae will want to make a contribution. Thank you.

MR O'CONNOR: That sounds fine, Jim. That makes a lot of sense. In fact, John and I have been through a similar process with expert panels and that's exactly the way we handle the chair; making some overview comments; giving, you know, a more concise answer but then deferring to the various specialists to assist and to elaborate. So, yes, that sounds perfectly fine to me the way you're proposing to – that we might proceed. So unless there are any other comments you want to make, Jim, we might - - -

MR GALVIN: No.

MR O'CONNOR: - - - make a start. And the first question, which won't come as a surprise to anyone that's been following the proceedings of this panel, we're struggling to understand just the feasibility of being able to seal the mine post closure, and we know that the Independent Mining Panel have had a bit to say about that and conclusion number 24, in particular, highlighted those concerns. So we'd just like to hear a bit more about what those complications are, just to have a better understanding of why it's such, perhaps, a difficult thing to achieve.

MR GALVIN: Okay. So to give some context to this, this is not a Dendrobium-specific problem, it's not an Australian mining industry problem; it is a global problem. And some perhaps 20 years ago the international mining industry realised that it had some real issues with legacy issues with mines that had been abandoned and hadn't been sealed, but also operating mines where the manner in which they could be closed hadn't been taken into account in the mine design and that then was presenting them with technical challenges in terms of, could they ever, at the cessation of the operational stage of the mine, leave the mine in a state that was stable, safe, non-polluting and, ideally, self-managing.

And so the international community since then has focused on this area and has produced its own set of international guidelines, which both the – which the Australian Government has largely adopted. And in the last 10 years we're now seeing, at the mine design stage, a focus on the complete life cycle of an operation and basing current decision-making on what implications that has served for closing the mine. And by mine closure I don't mean closing the gate and people don't come to work, I mean, in simple terms, being able to hand back the lease and hand it on to the next generation.

Now, in the case of Dendrobium and the southern coalfields it's – mining there dates back now to some 150 years or more. These mines, a lot of them are interconnected physically. If they're not the barriers between the mines are not necessarily all that wide or watertight, and that's assuming that you can rely on the mine plans. And then we're working in an area, geographically, some incise topography. And we know from experience around the world that makes it also very difficult to seal a mine if you're workings are updip of some of your entries, because as you try to seal the mine you're creating a pressure head on the seals and on the surrounding country.

So when we look at the groundwater modelling in particular, and we look at the contentious issue of Hydrofaction to the surface, the things that come to mind is, well, where would you put seals in that mine to enable the groundwater level to recover, which is what a lot of the modelling is based on. Now, if I was in the Newcastle district at the moment around, say, Lake Macquarie, level surface, all the entries are at, basically, sea level type elevations, it's no – it's not all that difficult to imagine that you can backfill your shafts and backfill your drifts to the water level or recover to near the surface. There's plenty of examples of that. But where we've got situations where perhaps some of those entries are at a lower level, lower elevation than what the hydrofacturing could go to, or whether the surface is, when we then have entries at lower elevations that requires much more careful consideration and, in some cases, as currently the case at Pike River in New Zealand, it may not be practical to seal a mine so that you can keep the water in it, you have to let it out. So that is one issue.

With Dendrobium we know it's surrounded by old mines. We know that Area 1, the first couple of longwalls, they undermine the old workings at the Mount Kembla Colliery, and then there is absolutely no doubt that you have connected fracturing to that mine. So when the water level – if you seal Dendrobium and the water level starts to build up, and recovers to that elevation, the question then becomes, where does the water then start to go to? Where can it come out? What's the quality of that water? Are the seals in Mount Kembla capable of withstanding that pressure head? and so on. So that's – they're the issues we're raising.

I'm sorry we certainly don't have any answers to them at the moment. We have reviewed some work, the previous panel, the independent panel for mining in the catchment, of which three of the current four members were members of that panel. We have reviewed some work for Water New South Wales, early work where they endeavouring to understand what's the legacy of those other mines in terms of water

loss from the catchment. They're dealing with similar sorts of issues. The catchment report that we did put out did identify a need to go back and understand much better how those old mines are interconnected and related.

The real issue – and, again, it's the Pike River, New Zealand one is an example – is that if it's not physically possible to seal the mine, that you cannot only sustain those water pressures on the seals but also not impact on stability of the surrounding strata as the water pressure recovers, then you may have no option than to continue to allow that water out of the mine in perpetuity.

One solution, again, is well illustrated by Pike River, and that is, two years ago, when I was closely involved in that project, the seal was to go in at the entrance to the mine. Subsequently, there has been a decision to re-explore the main entry to the mine, which rises up a bit in stone until it hits the coal seam, and the plan there now will almost likely be, now that they're back in the mine, to put their main seal at the top of the entry to the mine, so two and a half kilometres into the mine. They will then construct the seal at a much higher elevation than what they would have. And that takes a lot of the water pressure off the seals. It removes the risk of slope instability. So that's an example sort of consideration. If you did seal Dendrobium would you seal it actually at the entrance to the surface or would you travel up the mine, you know, a certain distance and put a seal there. And whilst that may not cover all options, that may give you a better outcome than sealing at the surface.

So the long and the short of this, which experience well demonstrates, and which Rae is dealing with at the moment as Commissioner of Rehabilitation in Victoria, is, these mine closure issues are deceptively complex. They're nowhere near as simple as thinking you're just going to seal an entry.

MR O'CONNOR: And so does it follow from that, then, Jim, if it does prove to be a very complex environment and really not practical to seal, that there would continue to be water discharges from the mine and continue to be water losses from surface water and groundwater into the mine void as it just continues to flow?

MR GALVIN: That's our thinking at the moment. I will just quickly defer to Rae and Neil to make sure that they're aligned with that. Rae?

MR Mackay: Yes. Thanks, Jim. Yes, I think that's certainly the implication at the moment. Obviously the water levels will come back up in the mine. There will be a degree of re-pressurisation, but it won't be to surface. And therefore you can expect continual drainage from the .....

MR GALVIN: Neil?

MR McINTYRE: Nothing to add to that, Jim.

MR GALVIN: Okay.

MR O'CONNOR: Thank you. And I guess the converse, if the mine is able to be sealed, and there's a practical solution there and it can be effected and therefore there aren't continual water losses from the surface, I understand that there's then an issue around the potential for contaminated water with the mine void as time progresses and re-pressurisation happens, that rising to the surface and forcing water quality impacts.

MR GALVIN: That is a possibility – a plausible possibility that you would need to investigate. The engineering logic physics would say, yes, that's possible. And, indeed, we do know of case studies where that is happening, both overseas and in a similar manner in Newcastle. What we are not saying categorically that I will happen. We are saying that it is a credible outcome.

The concern is simply this: that those areas are responding to rainfall, some more than others but they are responding to rainfall. And I'm not talking, at the moment, Area 5 and 6. I'm talking of the existing legacy at Dendrobium response to rainfall. So the question is, well, if the rain can get in, why can't the water get out? And the second component to that is that the most likely place for water to get in is where you have the least depth of cover, and the least depth of cover occurs under the watercourses, because they're in the bottom of the valleys.

So if you now get a reverse situation and water stills from the mine as the groundwater recovers then the first place you would expect to see it report is into the streams that are flowing into the catchment. The second point then to question is, well, what would be the quality of that water? And one would have to question, well, what's the dissolved mineral content of that water? And we don't know the answer to that, but certainly it's something that has to be very carefully considered. And the third point is, if that's the spill point what are the implications, then, for groundwater recovery at elevations that are still higher than the base of those streams. Now again, I think, as a matter of completeness, I should defer to Rae and then to Neil for any additional comment on that. Is that okay, Steve?

MR O'CONNOR: Yes, that's fine. Thank you.

MR GALVIN: Okay. Rae.

MR Mackay: Yes. Thanks very much, Jim. The situation with our mining is that water is actually going downwards at the deeper horizons. So I'm talking about what's happening in the very shallow in the catchment system, but effectively going down into the coal system and flowing northwards. With groundwater pressure recovery we could anticipate that that mechanism would re-establish itself, and if it does re-establish itself there probably isn't going to be a very large risk of water coming back up into the catchment that's contaminated from the coal. But because we've disturbed, extensively, the vertical permeability through there, Jim is absolutely right, we can't discount it at the present time, or might not feel that it's, you know, hugely likely. But the modelling that has been done to date doesn't give us any opportunity to actually see whether it is possible or not, and therefore the

modelling needs to actually grow to develop what happens post mining under a case of a rehabilitation that allows re-pressurisation. So my view on it is, it is a credible risk. It's something that needs to be looked at and dealt with in due course.

MR O'CONNOR: Can I just ask a question there, and this might be a no question, but just so I get a better understanding. Are we talking about, it could be a remote possibility, but if it does happen that that water that's in the coal seams might have some contaminated material within it and it potentially rises to the surface, is that a sort of a one-off event, or is that just a continual cycle that might happen? Once re-pressurisation is achieved then that event is finished and it might over a very long period, I don't know.

MR Mackay: Difficult to give a definitive answer on that, but my view on it is that if it does occur that it will be a long-term problem - - -

MR O'CONNOR: Okay. Thank you. Thank you.

MR Mackay: - - - which will be well ..... - - -

MR GALVIN: Can I just add a little bit to that. Steve, you mentioned water in the coal seam, or contamination from the coal seam. That's really not the source of a contamination in this case, I think. It's more the fact that you've got fresh fraction that works near the surface and that that's where you're leaching mineralisation. Now, one would think that in time to come that that would eventually – most of that would leach out, but the time start on that we don't know. And you are – there is the element of the upwelling from what's deeper in the mine. Whether that's physically – there is some discussion at the moment as to how physically possible that is. Rae, unless you want to come in there again Neil may also have some comment on that.

MR Mackay: I suspect that whatever rehabilitation mechanism we have - - -

MR McINTYRE: .....

MR Mackay: - - - ..... of that from Neil. Okay.

MR O'CONNOR: Go ahead, Neil.

MR GALVIN: Neil?

MR McINTYRE: Actually, it's naturally about six to 15 per cent. The total water in the rivers will come from the shallow groundwater. So as re-pressurisation occurs ..... will go back to that natural state. So there is a significant portion of water would be coming from the shallow groundwater and then, as Jim says, it's a matter of understanding how fractured that shallow area is and how much contaminants would be picked up from that .....

MR GALVIN: I think the other perspective to put on this is that we – none will be around to know if and when this ever happens, because this is not something that we're going to see develop in the next 50 years; it's going to be longer than that. So it makes more challenging to plan for.

MR O'CONNOR: Yes. No, I'm well aware of the long-term nature of some of these potential impacts. I might move on, then, to the issue around bushfires, and this probably has more relevance for the swamps. So it might be a question Ann might want to get involved in as well. Just the likelihood of bushfires in the catchment, if they occur, what impact do they potentially have on water quality; how – over what periods of time, and I was thinking in particularly with the potential for the swamps to be drying out, that their likelihood of being subject to bushfires and just what their resilience levels are and how they can bounce back from bushfires, or once they've lost some of their hydrology cycle, you know, whether that might not be possible. And then, I guess, that whole question around bushfires is through a lens of climate change where I think there's general acceptance that both the severity and the frequency of bushfires is likely to increase over time.

MR GALVIN: Okay. I will give some ..... - - -

MR BEASLEY: Can I add a rider to that question, Steve.

MR O'CONNOR: Yes. By all means.

MR BEASLEY: Because I think what you're raising there is conclusion 39 from the panel about "The risk of permanent loss of swamps due to the combination of mining impacts and severe bushfire need to be further considered in the context of the impacts of the 2019/2020 bushfires", which essentially was the question you were asking. And I'd be really interested to hear an expansion of that and also whether, in raising the impacts of the 2019/2020 bushfires, the impacts of what's predicted for climate change are also something that needs to be taken into account, which I think was part of your question in any event.

MR GALVIN: I'd like to give that some context first, Steve, for Ann.

MR O'CONNOR: Sure.

MR GALVIN: Now, Dr Ann Young did her PhD on this topic a long, long time ago and knows the swamps in the southern coalfield intimately. More recently she has come onto another panel that I chair dealing with the impact of mining on swamps in the western coalfield. And the mechanism for the drying of those swamps would appear to be different to what we're talking about in the southern coalfield; almost certainly it is. However, from the swamps perspective it still ends up being dry.

Most recently – and I haven't had the opportunity to visit yet, but Ann has – Ann has had the chance to tour the Newnes plateau and see the impact of the fires and which swamps have come back and which swamps haven't. I have seen that from

managing mines up in that area decades ago, and I know that when they're wet they do come back pretty quickly, but she – Ann now has the advantage of seeing a couple of seeing a couple of swamps that are very dry. I also know, from just her own interests, that Ann keeps a pretty close watch on what's happening in the southern coalfield, and has other experience in that area.

In fairness to Ann, most of her contributions have been over a period of time as a member of the public, and her own time and expense. Ann has only come onto these panels quite recently, so she hasn't had the benefit of any discussions that some of us have had in the past on climate change, and certainly nothing that we've turned our mind to while Ann has been a member of the panels. And, in fact, neither Rae nor Neil other. So climate change may be pushing the limit a bit, but certainly Ann's knowledge of bushfires, etcetera, is as – she's the leader in that area. So perhaps Ann would like to comment.

MS YOUNG: Thanks, Jim. And I probably should preface this by saying that I'm aware you, the IPC, have been addressed by Professor David Keith on this broad issue and David and I have been running parallel courses in swamps for about 40 years I think.

I think I'll start with a quote from a paper which was written in 2006 for the then Sydney Catchment Authority about the erosion at three major sites in the southern coalfield, commonly known as Flat Rock Creek, which is in Woronora catchment; Native Dog and Drill Hole swamps, which are in Avon catchment. And the conclusion which was done was that fires alone do not appear to trigger erosion in upland swamps. The watering of swamps through mine subsidence may play a role in increasing the sensitivity of upland swamps to external forces such as fire. Now, remember that's 2006. In 2006 we had no data at all on the water response within swamps to the mining.

So that was a flag which was flown. I think that flag now has a fair amount of wind behind it because we have now, courtesy of the mines and the monitoring that they have done, a very strong understanding that direct under-mining particularly drops the water table rapidly, and to a large extent permanently except for some small spikes after high rainfalls in these swamps.

We also know that the soil moisture of the sediments in the swamps declines over time; a little more slowly than the water table response but still within months to years rather than decades, and that's important for two reasons. Both of those things are important for two reasons; one is when a fire goes over a swamp, if the water table is high the fire whips across quite quickly, it doesn't burn down into the sediments, the organic rich sediments. Also, those organic rich sediments are quite sticky, and they bind together the sand, which is the predominant sediment of those swamps.

So that's why an intact swamp, like I presume you've most seen some photos of the ones in the ..... Plateau, the controlled swamps like a broader barrier swamp which

they call them, those are regenerating rapidly, and they are getting a ground cut, they are getting a vegetation cover, and so when there were the big fires in February those swamps were naturally protected by that vegetation cover, and particularly by the intact root mat which is quite strong in a lot of these swamps. In the Southern Coalfield if you wish to put a spade through the – down to dig a hole in it – you would work hard for the first 15, 20 centimetres and then it's clean sands, or dirty sands actually so those are natural protections.

Once the swamp is dry the water table is usually below the bedrock surface, the sands become a lot less cohesive, and the vegetation does not recover at anything like the same rate as it does in an intact swamp so for all of those reasons there is considerable evidence, I think, that the dehydration of the swamps makes them much more susceptible to erosion after fires, and that is probably particularly so in the Southern Coalfield where there's not a deep layer of peat over most of the swamps, and so it's pretty easy for the fire – for the erosion to get down into the sandy sediments below.

MR BEASLEY: And do I understand that Southern – the swamps we're talking about here – are slightly more vulnerable to the impacts of bushfires anyway but the impact of mining adds to that?

MS YOUNG: I don't know that I would really want to put a difference like that, Richard. I think we haven't investigated that well enough but they are certainly, in some cases, slightly drier swamps so partly – essentially a climatic difference. The other thing that happens, of course, is that the vegetation changes or we think it changes; we are beginning to get some information from Dendrobium that indicates that to a more woody vegetation, and the woodier the vegetation the hotter the fire, and the greater chance of breaching of that root mat.

MR HANN: And can I just ask there, when you say the vegetation changes, are you saying the vegetation changes because the hydrology changes or because a fire goes through the vegetation changes, and it then – it sort of snowballs and makes it more prone for future fires?

MS YOUNG: It changes. It changes effectively because of the hydrological changes. I now - - -

MR BEASLEY: Sorry, does that mean it ceases to be one particular kind of swamp and becomes a different kind of swamp effectively because of the change to the vegetation?

MS YOUNG: It may well stay within the Coastal Upland Swamp community; probably less easy for it to stay within the – in the Temperate Highland Peat Swamps in the ..... Plateau but there are four main sub-communities within the Coastal Upland Swamps Ecological community, and it is quite likely that it may transition to a drier one, perhaps the Banksia thicket or ..... rather than a Cyperoid Heath.

MR O'CONNOR: And then be more susceptible to bushfire?

MS YOUNG: Yes, partly because you may increase the woody component, and the woody component becomes more susceptible to fire.

MR BEASLEY: And Ann, sorry, the damage – the potential damage from fire to the root mat, is that something that significantly delays recovery or is that like a permanent problem?

MS YOUNG: It depends whether it rains or not, Richard.

MR BEASLEY: All right.

MS YOUNG: If you get a heavy rain and it erodes then it becomes a permanent problem. It's – I probably should make the comment that these swamps in the past, in geological time, have eroded in part and then re-established themselves; there is plenty of evidence for that.

MR BEASLEY: Over, I take it, a significant time period?

MS YOUNG: No, it can happen quite quickly but then they re-grow over 10, 15,000 years.

MR BEASLEY: All right.

MS YOUNG: But the difference with the ones like the Drill Hole Swamps, Flat Rocks Creek is that they have eroded to bedrock, and therefore they now are a channel and they will not naturally regenerate over a reasonable period of time. I will make one comment on climate change, about which I am not an expert, but I just note the fact that these sorts of issues of dehydration generally are probably exacerbated by the dehydration, at least in the swamps, and potentially possibly in the surrounding ridges and so forth as well.

MR O'CONNOR: Okay. Thank you, very much, Ann, for that response. I might move onto the conclusion number 26 where there was reference to being no substantive sensitivity analysis, and I think also some discussion around the risk assessment.

MR GALVIN: I will deal with that one. I think the way to approach that is previous inquiries, back to the 2009 Southern Coalfields Inquiry and the subsequent Metropolitan Bulli Seam Operations PACs, and noting since those ones in 2009 and 2010 we actually haven't had another Southern Coalfield matter like this come before the panel or the IPC so there is a 10 year gap there but they – those inquiries had an emphasis on basing these assessments on a risk management approach, and by that what we're saying is well, risk is the combination of the consequences of something happening, and what is the likelihood of it happening; if it happens what

controls could we put in place to change the likelihood and or consequences of it happening, and if it still happens how can we treat it.

And the typical risk management approach, and as embedded in Standards and Guidelines, is that having gone through the process of identifying consequence of likelihood, and what the residual risk is, to then consider is that residual risk acceptable, tolerable or do I need to mitigate it further or eliminate it, and so this is a – it leads to this continuous improvement type approach of going back again, and revisiting controls and treatments. And controls and treatments could be, well, don't do it at all or do it differently or let it happen, and fix the problem after it occurs, or you just learn to live with the outcome.

Now, in the subsidence, putting that then to the subsidence framework, what we would do is – and I will give you, say, a simple example of mining under a residential area because this is something that is very, very well established in Australia, and we are leaders in it – so if I was doing mine planning I would come up with a conceptual mine plan, then I would subject it to my subsidence assessment, and I would look at what are the effects, and by that I mean what are the ground movements, what are the ground decimations, and that's fine; you know that.

Then you say, okay, well, what's the impact of those, and so now I'm getting a little bit more interested in well, the ground will crack and those cracks could be so many millimetres wide, and they are likely to be spaced at a certain interval, the building – the surface will tilt – so we would look at the impact, and then we would say, well, does it really matter, does it matter if the ground cracks. The answer can be yes or no so it is determined by well, what is the consequence.

Now, if I'm sitting in my purposefully designed HardiPlank house I used to live in, in Lake Macquarie that was designed to subside a couple of metres, consequences are not so severe. If I am sitting in the house I'm in at the moment, which is a rigid double brick home, the consequences are very severe so translating that to the environment we're dealing with at Dendrobium, to apply that logic would be to develop a mine plan, assess the effects, subsidence effects, turn them into impacts and then say okay, what other consequences, and go back and do an intrative mine design until we get to the situation where the risk is considered tolerable or acceptable.

Now, a lot of that work may have been done; it's just not evident in the EIS that it has been done.

MR BEASLEY: And can I just ask, so I understand what you're saying, that the idea of risk assessment is reasonably familiar to lawyers; I just want to make sure I'm understanding what you're saying, in a risk assessment there might be a moderate risk of something happening but if it does happen the consequences might be almost negligible, and it might be really expensive to cater for that risk so that might be something where you don't do anything?

There might be another instance where there's a really low risk of something happening but if it does happen the consequences are catastrophic so even if it's expensive to deal with that risk you might have to do it because even low risk sometimes come in, and if the consequences are catastrophic you've got to do something about it, and if I'm understanding you that's what you're talking about here in terms of, for example, the longwall width and how much cracking, and the intensity of cracking, what that might be and the risk that then poses to the environment?

MR GALVIN: Yes. So you're dead right. To take it one little step further, in risk management one of the pitfalls is that you do your consequence, and you don't like the answer, and then people then convince themselves to – the likelihood is so low it will never happen therefore we can accept it.

Now, there is a standard for doing risk assessments in the mining industry written by a person who is from outside the mining industry, a leader in risk management, which says that:

> *Not only should you rank risk in terms of a combined likelihood and consequence but you should separately always rank risk in terms of purely consequence.*

And as I have a mine manager to me no fatality is acceptable, not interested in the likelihood; it's not acceptable, okay.

So there are situations where you just say, well, the consequence is just not acceptable. There are others where I say you eliminate it, mitigate it or tolerate it. Now, in this case an important point that needs to be made, and it needs to be made to answer some of your future questions so I think I will make it now because you've led into it, in this case, when we look at subsidence, we are dealing with two components.

We are dealing with what – if you had asked me to do something for you 20 years ago – and I have been in the subsidence game now for 45 years – I would have given – done all the analysis based on what we call conventional subsidence analysis; simply level surface; if I went to South Africa again what I would expect there, and what I would expect in Britain.

It's only in the late – the mid to late nineties that we realised that in types of country in size topography like the Southern Coalfield, and high horizontal stress environments etcetera, there is another component to subsidence which we call unconventional, and that is valley sides moving closer together, and its points on the surface, some kilometres away, changing their location.

Now, you won't pick it; we've never picked it until we had GPS because we were putting our survey instruments on the same block of land that was moving, and there's no – there's such small differential movements that it doesn't matter. But

when it comes to valley closure that's a different story because we're now – the valley sides are wanting to move closer together, that's compressing the base of the valleys, and those valley bases are naturally under compression anyway; that's why these valleys form in the first place, and continue to get deeper but mining certainly accelerates it and the cracking goes a lot deeper than the natural process.

So when you look at longwall panel width you need – and the valley closure behaviour in the Southern Coalfield is such that you have to go to very small panel widths to be able to prevent that from happening, and when I say small I mean less than 150 metres, and that's apparent and the panel saw this for themselves the other day when we flew over narrow panels and we could see the impacts of valley closure.

However, what also needs to be borne in mind, and is important is that whilst panel width may not be a good control for managing those impacts or practical control, it is a very practical control for managing the connection between the surface and the underground so in other words the membrane that separates the height of fracturing from the surface.

And it depends again on your local geometry and conditions but panel width is a fundamental control for managing height of fracturing and connection from the surface to the underground, and those panel widths are not as constrained as in the case of preventing all skin effects – I call them – at the surface. You can have much wider panels and still have the potential to have a barrier or a membrane between your surface and your – and your mine.

So coming back then to the risk assessment, one of the issues that we tried to explore, and a combination of available information already and timelines, we didn't – the analysis is not complete – is well, what role does panel width still have to play in Dendrobium in having accepted that the surface is fractured, and we get a sub-surface flow, what is the role of panel width in preventing that flow from entering the mine, and having it report back to the surface.

And the important point about that is not just that Water New South Wales get to stack their water, albeit orange coloured water for a while, but that eliminates this long-term issue of mine closure, and can the water, as the water level recovers in the mine, can we then have that water reporting back into the catchment. We haven't eliminated it but we've certainly reduced it significantly because we've left a membrane in place to restrict the water outflow.

MR BEASLEY: Jim, can I just ask a follow-up to you before someone else talks so I understand it, but in terms of the observations the panel has made, and its conclusions, is what you're saying – is it this that yes, there seems to be this driven by the economics, I think, of the mine but we will assume that there will be this – with 305 made up longwalls there will be this cracking to the surface but it will be the same if we considerably reduce the width of the longwall whereas your – I won't call it a criticism – but the observation of the panel means there isn't this sensitivity

analysis to determine whether the intensity of the – even if you assume there's cracking all the way to the surface – there isn't a sensitivity analysis about whether the intensity – the impacts – from lesser cracking at lower longwalls hasn't been done?

MR GALVIN: That's correct. Perhaps Steve, when I've looked at your question 8, "Is it reasonable and practical for the applicant to have prepared such an assessment" I think we could answer both of those in the one answer if it's okay with - - -

MR O'CONNOR: That's perfectly fine. Thanks, Jim.

MR GALVIN: All right. Well, the way to do that is if you have access to the department's assessment report – if we could go to figure 12 in that report – it's on page 104; if you don't have it I can share the screen with you on it?

MR HANN: I've got it in front of me, Jim. John Hann here.

MR GALVIN: Okay. I think that's very helpful, and it's helpful in answering the last question, and future ones.

MR BEASLEY: Did you say page 104?

MR GALVIN: It's – yes, it's page 104 is the page number on it.

MR BEASLEY: Well, yes, okay.

MR GALVIN: Are we right to go?

MR O'CONNOR: Yes, go ahead.

MR HANN: Yes, thanks, Jim.

MR GALVIN: If you look at that figure, just standing back from it for one moment, this is – this proposal is – I'm just going to turn you off for a moment; it's garbage collection day here, and you've just got to wait one – okay. So this proposal is distinguished by the fact that the applicant is saying, "Look, we will assume that we will get connected fracturing all the way to the surface, and we will take the surface water and we will compensate for it." And there's a lot of pragmatism about that; that certainly has lots of benefits from a point of view of performance measures and so forth.

But the reality is that in practice the behaviour may not be like that, and I'm not sure, as this process develops, how we're going to reconcile that extreme position with what we actually then are relying on measuring in the field. And if we go to that figure 12, it's a good example, because if I look at the left-hand diagram ..... in simple terms anything that's purple and red is basically saying, "We have fracturing all the way through to the surface." And again, in simple terms, when you look at

the mining at Dendrobium to date, you would simply say, "Well, everything is fractured through to the surface."

And in the latest peer review of some additional work – a peer review by Professor Hebblewhite that the panel has only looked at this in the last few weeks because we're dealing with two other Dendrobium matters at the moment as well – we have become aware of that review – it is pretty conceded by everyone, us included, that Dendrobium in the past has fractured through to the surface.

When you look at Area 5, however, you will notice the colour scheme is quite different. Now, we can't – I have had a go at reproducing some of this, and I can give you some rough numbers, but we can't produce a diagram – a figure like that – because it's based on layers of actual mining height and layers of actual depth of cover, and so forth. But when you look at Area 5, with one very small exception, you don't see purple and red, and you don't see a lot of orange; you do see a fair bit of yellow and green which is saying that there is still a 50 to 150 metre barrier undisturbed.

Now, I'm not saying unfractured. The equation that is being used to generate these diagrams – it's a meta equation – is not telling you the height of fracture, and that's a misnomer; it is telling you the height of free drainage, and what that means is that the water rapidly drains up to that height. Above that height the panel adopts a term that one of its previous panel members put forward, Col Mackie, that above that height the drainage path is torturous. It's hard work trying to get through but up to that point it's pretty easy for the water to flow out.

So what that is showing is the height of free drainage; we still have 50 to 150 metres of stratum above the height of free drainage so you would have to look at Area 5, and say, well, gee, that is already quite different to what the past experience of Dendrobium has been.

Now, I want to take a little bit further because in the previous inquiry into mining in the catchment, for which Dr Col Mackie did provide a lot of advice to the panel, and Col and I have been on a number of these inquiries in the past, and he was on the two previous – he was on all three inquiries I have previously mentioned, Southern Coalfield and the two Bulli Seam operations so between us we have quite a lot of experience.

And Col intuitively, some few years ago, suggested that in the Hawkesbury Sandstone, which is the upper most stratum in this area, it's highly permeable near the surface but as you get deeper the permeability reduced, and he had the concept that well, maybe we can designate a particular elevation where if we could hide a fracturing below that elevation we would have not an impermeable barrier to surface water but certainly, a major obstacle to surface water freely flowing into the mine.

And he and I ran a few numbers on that, and I'm not going to tell you at the moment what they are, but then we now have Professor Mackay on the panel, and this is his

first – Professor Mackay is on a panel I was chaired in Victoria for many years, and he was recruited from the UK by the Victorian government to come out and look at ground water issues in surface mining.

He has not been to the Southern Coalfields as far as I know – we have had him locked up in Victoria – but it was quite reassuring to me that quite independently he has come to a view – a similar view to Col Mackie – a similar concept – that there may be a particular elevation that if we keep height of fracturing below it we can maintain that barrier, and I am going to get Ray to talk a little bit more about that in a moment but the big picture being that if I now move to the right-hand side of that diagram, we now see to what height the height of fracturing actually extends to – to what strata it extends to.

And without pinching Ray's thunder too much, Ray has the view that well, if we kept height of fracturing below the ball tilt claystone then this issue of water into the mine, and in time to come water out of the mine could – that the risk could be reduced significantly because of this barrier. And when I look at the right-hand side that zone is the zone marked yellow, and you can see that there are areas – sections of Area 5 that already satisfy that criteria, and there are other areas where we are higher up in the Hawkesbury Sandstone but we're still nowhere near the surface, and that is all based on a 305 metre panel width.

So the issue that this panel has been toying with, and hasn't the resources or the time to take further, is what would those figures look like if we then said well, what's 250 metre panel width look like, or what does 200 look like, and that's what we mean in our report of sensitivity analysis.

And closing this off now for me, and I go back to the very opening comment about mining under, say, a residential area with your conceptual mine plan, you've tested against your subsidence, you go back and you fine-tune it, that's the information that we're not seeing having been done here but that, I quickly add, is not to say it wasn't done, and it just hasn't been needed in the EIS.

I will draw breath there. Before I hand to Ray, perhaps, Steve, the panel members may have some questions on that component otherwise we hand over to Ray.

MR O'CONNOR: I think that was very useful from my perspective. I don't have any immediate questions; anyone else have questions, John?

MR HANN: Jim, thank you, no. Look, the couple of key areas that I wanted to explore you've answered very thoroughly in that last section you've covered so thank you.

MR YOUNG: Jim, Steve, it's Mike Young here. Could I just make or put a couple of questions to, I guess, Ray, but also to Jim, just to clarify things because we have had these discussions before as the panel was preparing its advice, and that - - -

MR O'CONNOR: Certainly. Go ahead, Mike.

MR YOUNG: Thank you. That is that my understanding of the company's approach in this instance is that there has been conjecture around anticipating the height of fracture. Obviously, that's a complex issue and there's various different equations that can be used and, possibly – and I guess it comes back to that question 8, I think, that the panel – the IPC may be putting to you, Jim, is about the feasibility of doing such an exercise and what level of uncertainty you would have in doing that. And then, secondly, I guess attached to that is that if you did that, to what extent could you either then measure it or regulate it as a means of, you know, I guess, preventing or reducing or mitigating surface water losses and other impacts.

MR GALVIN: So I appreciate the difficulty in measuring. To measure is only one equation ..... is another equation. They're both used, in some cases, the same data points that come up with different interpretations and then in the previous panel inquiry, the catchment panel inquiry, where I looked at this in a lot of detail, I have to say I am doubtful whether either equation is necessarily mechanistically sound. So you're right, Mike, it is not a measurable performance. It's not easy to measure that as a performance indicator and that's why I said earlier about the company's approach is pragmatic. Now, having said that, Tametta does give you, as far as we can see, a worse case outcome. But, more importantly, even if it's mechanistically unsound, it seems to give you a good correlation with Dendrobium experience to date. So that says to me you could put some weight on it.

Now, the risk of opening another can of worms which again, and this now also advised – involves Professor McIntyre's input as well as Rae's, is what actually is the water take from the surface. Because you could take an extreme view and say but for the mine being there we would be pumping no water out of it. Well – so, therefore, all water out of the mine comes from the catchment and that's what your performance measure or your compensation is simply based on, that this is how much water comes from the mine, full stop, then time to ..... or whatever, and that's it. Simple as that. Not quite that simple because a component of that water's coming out of the coal seam and that coal seam is getting into the coal seam who knows where but a long way out of the catchment, I dare say. It's coming in from some aquifers higher up as well and that's the same, where are they being charged.

However, and again, this is an area that Mark – that Neil and Rae have done a fair bit of work on, and I won't go into any further detail that would be referring to them. It's more than just – the water that's coming in from the surface is more than just the water that you've got a crack in the bottom of the river or the water course and, therefore, that water goes into the mine. The fracturing of the near surface is also having other impacts on the surface in the way that the amount of water it takes to recharge how much is lost to evapotranspiration or ..... and so forth. So coming back to this diagram, it's not a black and white answer but neither is the company's pragmatic approach because I think, at the end of the day, I can see a lot of potential for debate going forward as to, well, how much of that water is surface water.

MR YOUNG: Yes.

MR GALVIN: So I think we've still got a problem in having a performance measure that is measurable. Now, maybe – I think it's probably an appropriate time for Rae and Neil to come in and, if necessary, correct me or give a little bit more detail. And, again, I think we go in the order of Rae and then Neil. Rae?

MR MACKAY: Yes. Thanks again, Jim. I think there are a couple of things that are probably worth exploring just to sort of tease out the ideas that Jim has put out there. One is that there is a vertical permeability to the formations above the height of permanent drainage and that vertical permeability allows water to flow in. Effectively, if you took all the storage terms out, if you just allowed water to come into the surface and go down, the flow rate downwards would be pretty much equal to the vertical permeability. So with the estimates that are currently made for the Hawkesbury sandstone which are, I think, probably at the lower end of where I would expect them to be based on the properties, we're going to get at least 10 millimetres of water per year percolating downwards and it could be a bit higher than that in the longer – if my rather naïve, at the moment, interpretation that the Hawkesbury sandstone suggests that the vertical permeability is probably a little bit higher than has been estimated, both by the modelling and by some interpretation of the permeability values that are available to the assessment team.

So there will be a flow downwards and, clearly, as you allow the height of fracturing to go up, you get into higher and higher permeability and, therefore, you get into a situation where that amount of flow going downwards into the mine is going to become greater. So it won't ever be zero and it will become greater. The trouble is that that actually takes time for the amount of water that's going into the mine to be equal to the amount of water that's actually being infiltrated down into the deeper sections from the near surface. There's a lot of storage in the Hawkesbury sandstone that has to be depleted first and the modelling shows pretty clearly that over the life of mining a very high percentage of the water that is reporting to the mine is almost certainly storage water and I would be pretty comfortable with that.

Once you allow that storage to decay then it, effectively, goes to being at a rate of inflow which is roughly equal to the vertical permeability and that's a pretty unconstrained number at the moment. It's – we don't know where it is. It could be an order of magnitude higher than the current estimate or it could be the same or it could be lower. And until we get an understanding of that we won't know what effects we've got on the surface. What we've got at the moment is that with this concept that we assume cracking right the way to the top, effectively, what we've got is an upper bound which is formed by the – effectively, the availability of recharge at the top and that availability of recharge is assumed to be around about 130 millimetres a year. And so that's a sort of limiting value and that seems to be not unreasonable based on all the evidence that has been presented. So it is, you know, a difficult analysis.

And at the moment all I can say is that, yes, if you can keep the levels down and you put them into the claystone, we know the claystone has a lot lower permeability, therefore, we do have a better seal above and we will reduce the amount of drainage that's coming from the near surface and we can see the benefits of that presumably coming through. But at the moment, I don't have evidence to confirm absolutely that that would be the case because, obviously, there are a lot of stressors and strains that are going on in the formations that may have a bigger impact than I understand at the present time. And I defer to Jim on that. In terms of the near surface, it's probably much better if Neil actually was to explain that to you because the near surface is affected by the unconventional cracking and that near surface is operating in a quite a different way to the way we're seeing deep drainage going on. So to you, Neil.

MR HANN: Excuse me, Rae. Just for clarification, you used the phrase, "Keep the levels down." Could you just explain that for our benefit?

MR MACKAY: So if – effectively, the height of this zone of low cracking, the thicker that can be, the better off we are. If we can make that zone include really low permeability horizons, we're even better off again. And so anything – if you can come down below to that fracturing below the claystones then we should be much, much better off. If it goes above the claystones then we're relying on the Hawkesbury sandstone estimates of vertical permeability and the higher we go up, in terms of the fracturing, then the connection into higher vertical permeability zones increases. So we get a higher drainage rate.

MR HANN: No, thank you, Rae. And that goes back, I think, to what Jim Galvin was saying about sensitivity on the longwall panel widths - - -

MR MACKAY: Yes.

MR HANN: - - - and the thickness or the height of cracking or fracturing. No, thank you.

MR REED: Steve, may I just ask a simple matter of clarification?

MR O'CONNOR: Certainly. Go ahead, Howard.

MR REED: Perhaps if we could go back to that figure that Jim was talking, figure 12, in the assessment report.

MR O'CONNOR: Yes.

MR REED: I've just been having a look at it and following the conversation carefully and I think that both Jim and Rae are talking about restricting the height of cracking to below the Bald Hill claystone as an aquitard. Is that correct?

MR GALVIN: It's a concept. It's an option how that - - -

MR REED: Yes.

MR GALVIN: - - - this is what we mean by sensitivity analysis. One of the – an option that should be assessed in a risk assessment framework to see whether that actually provides a – that ends up giving you a level of risk that's quite tolerable to all stakeholders.

MR REED: Jim, I just wanted to point out, for clarity, that the way that diagram is drawn it's the height of connected fracturing strata layer intersected. So if you don't want to intersect the Bald Hill claystone then that leaves the yellow area out as well as the blue. It's only the green in the upper Upper Balgo sandstone that would not intersect.

MR GALVIN: That's fine, Howard.

MR REED: Yes.

MR GALVIN: The point being that that's all based on a 305 metre panel width.

MR REED: I understand that.

MR GALVIN: All the years of, you know, engineering analysis and risk management you would at least go back and say, well, what's 250 look like, what's 200 look like.

MR REED: I just wanted to clarify that for the sake of the Commission. That's all.

MR GALVIN: Okay.

MR O'CONNOR: Thanks, Howard. We might go to Neil, if we can.

MR MCINTYRE: Yes. So a few things to pick up on. First, I will take on – pick up on the matter of accounting for resurface water losses that Jim raised. So with using the assumption that a very large proportion of the surface water above the longwalls reports to the mine and that this will be compensated for, raises the importance directly of proper accounting methods. Proper and agreeable accounting methods such that the water losses are estimated. In principle, surface water losses can be estimated either by an accurate surface water monitoring system, however, in practice that's very difficult because it's impossible to accurately monitor the surface water over the whole catchment and the mine's proposals are for doing that, partially, are satisfactory, in our opinion.

And then, the more practical way of accounting is to measure what actually comes into the mine. And as Jim and Rae mentioned, the water reporting to the mine is a combination of what's being lost from the surface and what's being lost from storage in the ground water. Now, after closure, if the ground water is allowed to be pressurised, then that storage will be replenished from the surface. So in that case it

can be said that all the mine water take is eventually replenished from the surface. So in that case it becomes quite a straightforward account matter. However, much of that replenishment in the case of re-pressurisation would be after closure of the mine. So it can take many decades, perhaps even more that 100 years, for that full loss of surface water to be realised. And that's where there's a line. So on the ground water model to be able to predict what that loss will be post closure, so there is quite a reliance on the ground water model and the need to make some assumptions about losses in the post closure period.

With regards to – I will go back to the original question which was around risk assessment and Jim quite comprehensively responded with respect to the panel width and its effect on drainage. The risk estimates are - commentary on risk assessments in our document largely related to risks around surface features and the set backs of long walls from these surface features. So in answer to the question what would be the consequences if there was full substantive risk assessment, well, our view is that the consequences would be that you may end up with a suboptimal one, potentially, that's suboptimal from a risk perspective. From environmental perspectives that possibly one that's also suboptimal from an economic perspective. So in the Department's assessment they've decided that they are happy with the balance that the mine has proposed between the environmental considerations and the economic considerations. But that was questioned in our report because of the lack of substantive risk assessment.

The third point to pick up is just on raised discussion about the drainage mechanisms. So much of the surface water ends up in these drainage lines and so the assessment of how much of that water drains down into the mine is very ..... to the assumptions that are made about the connections between the surface water system and the ground water system. That's one of the limitations of the ground water modelling. These types of regional ground water models simply are not designed to accurately represent the interactions between the surface and the ground water. And that's where much of the uncertainty comes from about the volume, the rates of losses of surface water. I think that's enough from me on that.

MR YOUNG: Neil, would it be fair – Neil, it's Mike Young here. I'm just wondering it would be fair to say that the – whether the assumptions were reasonably conservative given the assumptions around height of fracturing and so forth and I'm not sure you would use the word worst case but, perhaps, conservative as a way to deal with that uncertainty?

MR MCINTYRE: I think that's – I think everyone agrees that in most respects the modelling was conservative. The panel did have some reservations about how the ground water model had been calibrated and it was difficult to properly assess exactly how conservative it was because of these limitations in the calibration. So that's something that Rae could pick up on.

MR MACKAY: Yes. Hi, Mike. I think - - -

MR YOUNG: .....

MR MACKAY: - - - it's reasonably conservative. The – as I said, effectively, if you assume that you're going to take the full take of recharge, effectively, then that's the implication is that that's, you know, that you can't go above that. My assessment of the recharge calculations are that they're probably pretty good but I can only do it on the basis of the information that's been provided there. But I would be surprised if we had a greater recharge potential than has been described in the assessment report.

MR O'CONNOR: Thank you, Rae, for those comments. John, do you want to ask a couple of questions now? You have to come off mute, John.

MR HANN: Thanks to the panel. Yes, you've covered most of the areas. Quick comment on the effectiveness of a remediation, particularly around the water courses and the rock bars, from your experience.

MR GALVIN: Okay. So when we're talking valley closure, and we know from some very good work done over many years at Waratah Rivulet that you flew over the other day and the saw the rock bars had been remediated, we know that the fracturing induced by valley closure is not just confined to the riverbed, but it goes in under the mountain as well and there's some diagrams where it has been measured at 150 metres either side of the water course at Waratah Rivulet rings a bell. Something of that order. But the point being it goes in under the mountains. It also cuts across bends in rivers so the valley closure itself doesn't always follow the water course. If it can cut through a corner of headland it will. It's deep. And so when we come to remediating a rock bar that's controlling, causing the water to build up in the pool, the focus on the remediation is primarily is to put a pool ..... back in so that the pool will retain water in between rainfall events.

We are not remediating the whole surrounding environment. So we're getting leakage still bypassing. Okay. And we're only remediating selective features of the river or the water course and the water course system. So, for example, where we have boulder fills, we still have our fractionate work underneath the boulder fill. The water was out of sight before and it's still out of sight but it's certainly now flowing through a fresh fracture network that it wasn't in the past. So the remediation is really – it's a spot treatment. It's quite site specific and really focusing on, in the case of pools, just restoring their water retaining capacity in between rainfall events. Neil, would you like to comment further on that? Neil? Would you like .....

MR MCINTYRE: Sorry, Jim ..... sorry, Jim. Could you just repeat the last piece?

MR GALVIN: I said would you like to comment on what I've said about the extent to which you can remediate water courses.

MR MCINTYRE: Well, as the proponents recognised, the remediation works themselves can be practically challenging and have their own environmental impacts. And, therefore, many, if not most circumstances, it would be difficult to make a case

to do the remediation works, I think. In terms of where you do remediating works, the effectiveness of it is localised so it's basically sealing the rock pool so that you maintain the water in the rock pool for as long as possible. But it doesn't maintain the flow through the rock pool because it's not remediating further upstream. And so we would regard it as a partial remediation with some benefits that's certainly near restoring the ecosystem functionality of the stream.

MR GALVIN: Neil, you had some contribution to our report and we should also bring Ann in on this as well because she's far more field experienced than us. But, Neil, you had some comment to start with on the impact of mining on the time that a stream continues to flow and I think it was – can you just revisit that for us? You were talking in - - -

MR MCINTYRE: Yes.

MR GALVIN: Go on.

MR MCINTYRE: Yes. Well, one of the mechanisms that a stream loses water is reduction in the base wall. So when the ground water level drops, the supply of ground water to the stream reduces and that's one of the primary impacts. As there is depressurisation, the base walls drop and that's more of an impact in streams which have a larger base wall component such as Wongawilli Creek. So that is – that loss of flow, that component of loss of flow cannot be recovered at all by sealing. And it's that base flow that much of the ecology is sensitive to because that is the flow that persists in the river for much of the year, or all of the year, in perennial streams.

MR GALVIN: Ann?

MS YOUNG: I think it's probably just simplest to say that there is no proven technology for remediating swamps. That was certainly the conclusion of the ISC in 2014 and I've not seen anything where a new strategy, other than things like ..... coir logs to try to manage some surface erosion, has occurred. I just want to point too that point 9 of the Commission's comments states that given the proposed offsets that are only designed to address water take that leads for a mediation to address the predicted impacts, including on swamps. As I understand it, the proponents have decided to not attempt any swamp rehabilitation but have, instead, proposed a full offset, particularly in a new property wherever that may be, that they have purchased for the purpose of obtaining ..... credits. So I think that, perhaps – I don't know whether the swamp research and rehabilitation plan the company has been engaged in since 2013 has had any practical trials of swamp rehabilitation but I just note that they are considering a full offset of any impacts to the swamps.

MR HANN: Thank you, Ann. And it is understood that there are offsets proposed that cover the swamps particularly.

MS YOUNG: Thank you.

MR O'CONNOR: Any further questions, John?

MR HANN: Look, it's a broad one, Jim, for you and the panel but there are some, I think, 45 conclusions in your report and the Department's assessment report I think states that it has taken account of your report. Are there any particular comments you might have in regard to any specific conclusions of your report and how they've been addressed in the assessment report of the Department.

MR GALVIN: I will make a few comments and it's inevitable when you have such a range of complex issues, our report is quite long, the Department's assessment's quite long and we haven't had the chance to sit down and look with the Department and its assessment report. So it's only natural that there will be a bit of, I guess, editorials and clarifications that come out of it. And that's – most of our comments are in that vein. The discussion much – a lot of the discussion already has taken place on the role of panel width and, clearly, we see that panel width is important and we would not concur, at least with how it's written in the Department's report, that – and I can't tell you which – where it is at the moment – that we believe panel width has no part to play. It does.

The opening comment, I think, is important that because we haven't addressed some things doesn't mean that it can be inferred that we don't consider that they are issues. That they are but it's really a matter of just alerting the Department and the IPC to some of the issues that need to be considered. And, again, I will just use mine design as an example that it's really, in our view, what horrible impacts and consequences the IPC comes up with that then determines the mine plan. It's not for us to be dabbling with it at the moment. The concept of management plans, the Department's report falls back on that as a solution to many of the issues we've raised and we would agree they're solutions, however, there's an intervening step which perhaps by the way we structured our report hasn't come through clear enough.

What we have done is with our recommendations broken them up into three headings. The first one being these are the things we think are important for the IPC to consider when it's assessing the project. That's fine. Then we've qualified the next heading as project approval conditions by saying should the project be approved. And that's where we're placing a lot of reliance on management plans. We mentioned TARPS. We put a fair bit of emphasis on the mine closure plan. That shouldn't be interpreted as saying that those management plans solve the problem and, therefore, the IPC doesn't need to be concerned about assessing it. The 735 had a brief comment on that. Let me have a quick look, 735. It's just an example of where I think we need to be a little bit careful. 735 says:

> *The Department considers that there's not enough information currently available on pool values, for example, presence of key fish habitats to advocate larger setbacks to increase the measure of protection offered to a particular stream feature.*

And it carries on. Now, we just have a little bit of a concern that because there's a lack of information, does that mean we don't deal with that issue any further or does it mean that it requires more serious consideration. Our view would be that with the pools particularly, with what we know or what we don't know, we wouldn't be signing off at the moment on impacts on pools without knowing whether they are, for example, key fish habitats. It could be then, in normal circumstances without COVID, etcetera, we may have had the opportunity to have a very close look at those pools and talk to people face to face and it may be that there are no issues. But at the moment, the concern is that without a risk assessment that goes into looking at a particular pool and assessing the consequences should it be drained, okay, that it's not – well, I would say, it's not necessarily logical. It's certainly not consistent with how you would normally go about risk of management to put a constant setback distance, standoff distance around all features without actually having regard to the nature of the feature and the consequences should it be impacted.

So to ungarble that for you, there are features that are exposed to 300 millimetres predicted closure that have got a 100 metre radius standoff around them. Likewise, there's features that have got 800 predicted millimetres of valley closure. Now, you would expect the consequences to be quite different in both those cases. So a fixed standoff distance is not really consistent with the way you would normally manage subsidence impacts. The issue which we certainly accept is that there are other factors to take into account and one of which is economics. We're quite open on that. Frankly, the economic appraisal of longwall panel width that was undertaken, that the Department initiated, has quite limited use or value because it's a comparative study. And the mining engineer wouldn't need to go to that much length to already know what the effect of reducing panel width would be on the economic appraisal.

Now, the value of that study is that the consultant at least has tried to put hard numbers to each of those panel widths that they've evaluated, but I note that the proponent is not prepared to comment one way or the other how reasonable those numbers are. So we really don't know where the economic cut off is for this. And when we talk about reducing longwall panel widths, you know, the panel is quite aware that there must be a panel width at which the whole operation just does not become economic. That can't be determined at the moment by the comparative economic study that the Department seems to place a fair bit of reliance on, in terms of economics or determining the situation. So - - -

MR BEASLEY: Sorry, Jim. In the first part of your answer, you were referring to a part of the Department's assessment report that you said the panel didn't necessarily accept .....

MR GALVIN: Yes. It's 6.2 – the one that we think is - - -

MR BEASLEY: Is it this bit:

That the Department considers the evidence put forward demonstrates there would be little environmental benefit by reducing longwall wall widths by 25 metres, 50 metres or 75 metres.

MR GALVIN: That's relevant. That's part of it. The one I was looking for, and now have in front of me is 6.2.58.

MR BEASLEY: Right.

MR GALVIN:

The Department concludes that reducing longwall void width is not an effective means of reducing, much less eliminating, the environmental impacts of the project.

MR BEASLEY: Yes.

MR GALVIN:

This position is confirmed by the mining panel's conclusions.

I suggest the word surface is probably missing in the beginning. It's not an effective way of reducing, much less eliminating, surface impacts because it's certainly – certainly, panel width is effective in reducing subsurface impacts. But even there, we have reservations because, ultimately, if water reports back to the surface then there is a role for panel width to have – to be able to influence those consequences. Now, I think, again – I think Rae and Neil have some views on this as well. I think we should hear from them quickly, if they have anything to say. Rae, do you have anything to add?

MR MACKAY: No, Jim. I think you've made the case and I don't think there's too much more to be said at this point.

MR GALVIN: Okay. Neil?

MR MCINTYRE: Just summarising a few words said from my perspective, Jim, that the Department's conclusion that the mine has reached the right balance between the environmental and economic considerations does not reflect our report and our recommendations for more rigorous risk assessment based approaches. Secondly, one of our recommendations related to consideration of whether further review of the water loss compensation was needed. I think, to some extent, the Department has done that in the report. But I think we need to emphasise the importance of appropriate compensation losses, especially for the post closure period and raise the question of whether some kind of independent peer review is needed of that arrangement.

MR GALVIN: Okay. Before – thanks, Neil. Before I put a concluding comment to that, Ann, do you – would you like to add anything?

MS YOUNG: Just simply that sometimes the fact that changing panel width doesn't eliminate surface cracking doesn't necessarily mean that all cracking is the same. That wider panels may induce larger cracks with more severe surface consequences and that may be something that needs to be considered.

MR GALVIN: That's an important point which we tried to make and I would like – deserves re-emphasising as well that the way some of the information in the consultant's reports is presented to a layman could appear, well, panel width doesn't matter, it has no impact. To the specialist they realise, well, yes, you do get cracking across all ranges of longwall panel widths but the more you have curved the surface, the more you flex the surface, then it's only – there's no option that the surface has got to stretch more, it's got to compress more and, therefore, the intensity of the cracking, the frequency of it must increase. And we know that very well from our work we do when we undermine built structures as to how the surface behaves.

So to answer your question, there's nothing in the Department's report that I would say for the moment we are hostile to, red flags. I think, probably, that one – that 6.2.58 probably is just a little bit of wordsmithing would give us more comfort with the way that's expressed. And the other issues I'm raising, primarily, I guess, if we read it, we're just conscious of how others may read the report and how that may then be taken as the panel's views on it when that's not always the case. It's simply, really, I guess, at the end of the day what you would normally try and do and that is just to have a – send a report out for a peer review for a sign off on everyone. It's just really what you're saying and because of time constraints, clearly we were just – that opportunity hasn't been there. So that's all I will say there.

MR O'CONNOR: Thank you.

MR HANN: Thanks, Jim.

MR O'CONNOR: Thanks, Jim.

MR YOUNG: Steve, it would just be – just Mike Young here. Just, Jim, I thought it might be helpful for the benefit of the Commission to comment on the role because we're talking about setbacks from streams and the, I guess, the sort of one size fits all approach that the company's taking to some extent. Would you, given your role historically, etcetera, in terms of extraction plans, you know, would you comment on the role of extraction plans and the information being gathered as the mine develops in preventing, you know ..... setbacks and those sorts of things to minimise impacts over time.

MR GALVIN: Yes. I will. You probably raised an issue that you would rather – you might regret. So in the main, anything that can be measured and that we can – as we're mining we're measuring it and we can respond to it either at the time or the

next panel that we mine we would say, okay, we won't go so close or so forth, or we can go closer. Extraction plans play a valuable role in that area. And I've worked as a mine manager without any of these plans. I've worked experiencing subsidence management plans and then I've been involved closely with the transition to extraction plans. They have my full support.

The one challenge in this area, though, which has nothing to do with the Department or its assessment or the panel, it's something, though, that the IPC needs to understand, it's a very strange animal and I do think it's time that we did deal with it as an industry, is that when we talk about valley closure of 200 millimetres and three – you must appreciate that is not measured. We have a prediction methodology that predicts that number. But that predicted value does not correlate at all well with measured and so what has evolved is that people have looked at an actual impact and compared it to the measured closure and said it doesn't correlate very well. But then, strangely, they've compared it to what was predicted and said, oh, we get a better correlation if we use predicted.

So I translate that for you. I'm at the moment in the mid North Coast with a lot of rainfall. Okay. There's a lot of flooding. What we're saying is, well, the weather bureau predicted this amount of millimetres of rain but we actually got so many millimetres else. But at the end of the day, the flooding correlated better with the weather forecaster's predictions rather than what actually happened so we will work to predict it. And that's what we're dealing with here. So when it comes to the extraction plan and we say, well, we will monitor what happens at Donalds Castle Creek. We will monitor build up of valley closure and if we look like we're going to exceed 200 millimetres then we will do something. We can't do that because we are not designing against a measured value. We're designing against the weather forecaster's predictions.

So that's where the valley closure, in this particular project, that's just where it is – that an extraction plan is not capable of dealing with that. It's really after you see that, hell, we did get a fracture and we did get this pool drained that you then start to say, okay, well, this is one of the, whatever people want to call it, the five per cent or the 10 per cent time that predicted didn't correlate with the outcome.

MR YOUNG: Jim, but presumably for subsequent longwalls and the example is metropolitan where they have been doing – looking at those valley closure type issues and pulling up the longwall shorter than what was approved, as a result of that monitoring information.

MR GALVIN: Yes. But that was easy to do because we know that there has not been any cracking more than 400 metres away from a creek. And Dendrobium's EIS and their response to our questions, advice is that they haven't experienced cracking more than 300 metres away, or 310. Now, that's something that's a hard fact. That's measurable, right. Now, with metropolitan, originally the pack recommended that eastern ..... not be undermined in that area. For economic reasons, as I understand it, the company was given approval to undermine some of that creek and in that process

it was found that this criteria of 200 millimetres of closure wasn't necessarily applying and that they had exceeded A performance measure because they were getting cracking in more than 10 per cent of cases. Now, the point being this, that when we were involved then, well, what's going to happen in the future, we had already exceeded the performance measure, and probably charge you a lot of money, Mike, but it was a no brainer to immediately look at that and say, well, look, if we keep 400 metres away, we don't know how much more movement it could tolerate, we don't know what the cumulative is, but we do know that if we keep 400 metres away that we're not going to add to it.

The company ran an argument that, well, they thought they could get closer but they would do a lot of monitoring and they would be very careful to watch what's happening, and that's what they did. And they got to a point where they pulled it off, I think, they stopped at 320 metres. They didn't get much further than what we expected. Ann, you may recall this better than I do, the numbers. But, anyway, they didn't get much further than what the 400 metre was. And it was simply that they were measuring movement and it was starting to accelerate and in ..... technical engineering, whenever you see something start to accelerate, you – that's the time to pull up. The things are – get away from you quickly. So it wasn't really a lot of rocket science there. It was simply - - -

MR O'CONNOR: Jim, I might have to pull you up there. We're running out of time very rapidly. I just want to check with John if he's got any further questions, then Richard, then both Steve and Julian.

MR HANN: I just have one question – one final question. And it just relates to whether the mining panel would have any comment about potential cumulative impacts on infrastructure, such as .....

MR GALVIN: So you got three questions left. If I can wrap all of them up in 30 seconds in one go.

MR HANN: That's fine.

MR GALVIN: The mining panel hasn't looked at other infrastructure risks, however, that's an area that I have a lot of experience in. We're dealing with a complex environment because movements are coming from different directions, we've still got mining in other areas in time to come. It's very difficult to predict at the moment. But this dealing with infrastructure is an area that very much lends itself to extraction plans and monitoring for movements and being able to change the mining operation which may include stop mining in time to prevent too serious a risk to infrastructure. So that one monitoring and a good extraction plan can deal with that. Potential for longer term subsidence, three ..... are not much. After you – subsidence develops incrementally but if you say, well, after five years from mining you wouldn't expect negligible, certainly, from a consequence point of view, not an issue. And reliability of surface water flow predictions, I think Neil has dealt with that for you already. So - - -

MR HANN: Thanks very much, Jim.

MR GALVIN: Yes.

MR O'CONNOR: Yes. That's fine. I think we've dealt with that. Richard, do you have anything further?

MR BEASLEY: I don't but I just wondered whether the Commissioners wanted to explore anything further about conclusion 31, about cumulative contaminant loads. Was that covered to - - -

MR O'CONNOR: Yes. No, I think I got answers my questions there.

MR BEASLEY: Nothing further.

MR O'CONNOR: Okay. Thank you. Steve and/or Julian, any questions?

MR BARRY: Nothing from me. Thanks, Steve.

MR ARDAS: Nothing from me either.

MR O'CONNOR: Look, I might draw the session to a close there and thank everyone for their time this morning and for their input and it, certainly, provided us with a lot of very useful information and answers to questions that we had. And just appreciate the contribution that everyone has made this morning. Having said that, I will call this session to a close and the transcript will cease at this point.

RECORDING CONCLUDED **[12.27 pm]**