30 December 2020

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Stephen O'Connor
Chair of the Independent Planning Commission
for the Dendrobium Extension Project
Level 3, 201 Elizabeth Street
SYDNEY NSW 2000

c/o: Stephen Barry via [redacted]

Dear Commissioner,

RE: Dendrobium Extension Project (SSD 8194)

Please find enclosed points of clarification following the Independent Planning Commission (IPC) meeting with the Independent Advisory Panel for Underground Mining (IAPUM) on 17 December 2020.

The clarifications relate to:

1. Height of fracturing.
2. Risk assessment.
3. Mine closure.

If you have any queries please don't hesitate to contact me at [redacted] or [redacted].

Yours sincerely

Gary Brassington
Manager Approvals
Illawarra Metallurgical Coal – South32

ENCLOSURE 1

SOUTH32 RESPONSE – IPC QUESTIONS

1. Height of Fracturing

- The IAPUM stated that if the height of fracturing above the proposed longwall panels was restricted to below the Bald Hill Claystone (which is the geological layer immediately below the Hawkesbury Sandstone) this would reduce surface water losses:

  > *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* [sic] [Bald Hill 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.* (page 18, line 15 of IAPUM transcript).

- The IAPUM notes that panel width controls the height of fracturing:

  > *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* [subsidence-related impacts to surface features] *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.* (page 18, line 15 of IAPUM transcript).

- South32 does not disagree that if the sub-surface fracture network remained below the Bald Hill Claystone, it would reduce surface water loss from the catchment in comparison to what has been predicted in the Environmental Impact Statement (EIS).
  - However, it is noted that the predicted surface water losses for the Project, which are based on the sub-surface fracture network extending to the surface, are negligible at the catchment scale, would be offset in accordance with the terms of the Planning Agreement that have been agreed with the Planning Secretary and the Minister for Water, and would be licensed under the *Water Management Act 2000* following the introduction of the licensing regime for underground mining in the Special Catchment Area (refer to line 6.3.139 of the Department of Planning, Industry and Environment's [DPIE] Assessment Report for the Project).
  - It is noted the IAPUM agrees the approach adopted in the EIS to predict surface water losses is conservative.

    > *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 …*
    >
    > *… 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 5 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.* (page 23, line 40 and page 24, line 5 of the IAPUM transcript).

- Such an approach (ensuring the height of sub-surface fracturing remains below the Bald Hill Claystone) is critical to an operation like the Metropolitan Mine, which mines directly beneath the Woronora Reservoir.

- By comparison, South32's mine design philosophy sets back mining from the reservoirs and perennial streams (i.e. named watercourses) (with significant associated sterilisation of coal reserves).

- In regard to the various prediction methodologies for height of fracturing, the Independent Expert Panel for Mining in the Catchment (IEPMC) (the predecessor of the IAPUM) stated in its Part 1 Report[1] there were uncertainties associated with all methodologies (emphasis added):

  > *The height of complete groundwater drainage is an important consideration in groundwater modelling and the Tammetta equation and the Ditton equations were developed in Australia for this purpose some 5 years ago. Considerable controversy and confusion surround their predictive capacities in the Catchment Special Areas. The Panel has given detailed consideration to the equations and,* ***notwithstanding that uncertainty is associated with all****, recommends erring on the side of caution and deferring to the Tammetta equation until:*
  >
  > *i. field investigations quantify the height of complete drainage at the Dendrobium Mine and Metropolitan Mine, and/or*
  >
  > *ii. alternative geomechanical modelling of rock fracturing and fluid flow is utilised to inform the calibration of groundwater models.*

[1] https://www.chiefscientist.nsw.gov.au/__data/assets/pdf_file/0006/313917/IEPMC-Report_Term-of-Reference-1.pdf

- It should be noted that field investigations at the Dendrobium Mine indicate that connective fracturing to the surface may have occurred at panel widths of 250 m (refer to page 81-82 of the IEPMC Part 1 Report).
- It should also be noted that the seam to surface fracturing assumed in the EIS modelling was adopted on the basis of geomechanical modelling (i.e. Flac2D) following the IEPMC recommendation (ii) above, as well as prior recommendations of Galvin & Mackie.

- The IAPUM also noted the uncertainty associated with the equations used to estimate the height of fracturing:

  > *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.* (page 19, line 15 of the IAPUM transcript).

- In consideration of the above, estimating surface water losses for panel widths less than 305 m will be inherently uncertain. Given the IEPMC considers that panel widths of 250 m at the Dendrobium Mine have resulted in connective fracturing to the surface, panel widths significantly narrower than 250 m (such as the 163 m wide panels at the Metropolitan Mine) would be required to provide reasonable certainty that sub-surface fracturing would remain below the Bald Hill Claystone.
- As per the MineCraft Report, the Project would be uneconomic at panel widths equivalent to the Metropolitan Mine.
- It is noted that the IAPUM stated that South32 has not commented on the MineCraft Report:

  > *Now, the value of that study* [the MineCraft Report] *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. …* (page 27, line 30 of the IAPUM transcript).

- This is not correct. As quoted in Section 6.2.33 of the DPIE Assessment Report, South32 provided comment to DPIE on the final draft of the MineCraft Report and stated that the "*Report adequately demonstrates the relative negative impacts on Project economics from reductions in longwall width, and supports that the Project is not economically feasible with narrow panels*". Page 9-6 of the Project EIS similarly states "*Narrower panels would result in significant adverse impacts to the economic viability of the Project and continued operations of the approved Dendrobium Mine*".
- In summary:
  - The methodologies to predict height of fracturing have inherent uncertainty, and so panel widths similar to the Metropolitan Mine (163 m) would be required to provide reasonable certainty that the height of fracturing remains below the Bald Hill Claystone.
  - By comparison, the negative economic impacts to the Project of narrower longwall panels are well understood, with the MineCraft Report demonstrating the Project would be uneconomic at these panel widths. The direct economic consequences of the "no Project" scenario include the loss of employment of the 400 workers at the Dendrobium Mine and loss of $1,070 million (in net present value terms) to the NSW economy, and the indirect economic consequences outlined in the BAEconomics Report.
  - In consultation with the NSW Government, South32 has sought to address residual predicted surface water losses (which are negligible at the catchment scale) due to the Project via the following:
    - Estimating predicted surface water losses using a conservative modelling methodology – following the recommendations of the IEPMC.
    - Providing water offsets – as recommended by the IEPMC, acknowledged by the IAPUM as being a pragmatic approach to addressing water losses, costed independently by Government (including for the upfront payment for post-mining losses) and agreed to by the Planning Secretary and the Minister for Water. The Government can use the funding provided by the offsets to invest in water security and supply projects that will have intergenerational benefits.

2. *Risk Assessment*

- The IAPUM considered that it was not evident that risk assessment addressing likelihood and consequence of impacts occurring had been conducted for the Project:

  > *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.*
  >
  > …
  >
  > *Now, a lot of that work may have been done; it's just not evident in the EIS that it has been done.* (page 12, line 45 and page 13, line 35 of the IAPUM transcript).

- It should be noted that the EIS includes a *Stream Risk Assessment* report (refer to Appendix B of the Surface Water Assessment prepared for the EIS), that follows the methodology recommended by the Planning Assessment Commission for both the Metropolitan Mine and Bulli Seam Operations. The table in Plate 1 below is an extract from the *Stream Risk Assessment* that outlines the key steps in the risk assessment methodology and where they were addressed in the *Stream Risk Assessment*.
- The *Stream Risk Assessment* considers various attributes of the Project area to inform the consequence of impacts occurring, for example the importance of a watercourse to drinking water supplies, perennial versus ephemeral streams, the presence of key fish habitat.
- The IAPUM made the following comments with respect to perennial streams and key fish habitat within pools:

  > *So that is – that loss of flow, that component of loss of flow cannot be recovered at all by sealing* [i.e. remediation of subsidence-related impacts]. *And it's that base flow that much of the ecology is sensitive to because that is the flow 25 that persists in the river for much of the year, or all of the year, in perennial streams.* (page 25, line 25 of the IAPUM transcript)
  >
  > …
  >
  > *Our view would be that with the pools particularly, with what we know or what we don't know, we wouldn't be 5 signing off at the moment on impacts on pools without knowing whether they are, for example, key fish habitats.* (page 27, line 5 of the IAPUM transcript).

- These matters are addressed in the *Stream Risk Assessment*. The Project sets back from perennial watercourses with high potential for key fish habitat, and the pools overlying the longwall mining areas have been assessed to be of lower potential for key fish habitat (and notwithstanding, the larger pools have been classified as key stream features, which would not be mined under as 50 to 100 m setbacks have been adopted in the mine plan).
- In summary, it is considered the Project has clearly considered the likelihood and consequence of impacts, as well as suitable controls.
  - The Project has considered the consequence of impacts to reservoirs, dam walls, perennial streams (i.e. named watercourses) and significant swamp clusters (i.e. Area 4), and has setback from these areas to effectively reduce the likelihood of impacts to negligible levels. These controls (i.e. setbacks) would be enforced via Development Consent conditions.
  - The Project has considered the consequence of impacts to key stream features, and reduced the likelihood of impacts through the adopted 50 to 100 m setbacks. The proposed controls, should consequences to key stream features occur, is the remediation of physical impacts. In addition, for relevant studies the consequence of impacts actually occurring to key stream features has conservatively been included in the assessment notwithstanding the setbacks (e.g. surface water losses and offsets for threatened aquatic fauna have conservatively been calculated on the assumption that impacts to key stream features occur). These controls (i.e. remediation and offsets) would be enforced via Development Consent conditions.

Table 1 Risk Assessment Approach

Metropolitan PAC Report Section 6.2	Stream Risk Assessment
Step 1: *Identify the mine characteristics and types of subsidence impacts likely to be experienced in the Project Area. Mine characteristics include depth, geology, mining method, mining height, mine layout and percentage extraction.* …	A summary of mine parameters and potential subsidence impacts is provided in Section 3.
Step 2: *Identify significant natural features that might be at risk from the subsidence impacts that could be expected from the proposal. In the case of the Southern Coalfield, a checklist of features that require consideration could be developed based on the SCI Report. It should include at least rivers and significant streams, upland swamps, endangered ecological communities, threatened species habitat, major cliff lines and Aboriginal Heritage. A full description of these features is required, including any characteristics that may be relevant in assessing potential subsidence-related impacts and consequences for the feature or parts of the feature.* …	Identification and characterisation of streams within the longwall mining area and immediate surrounds is provided in Section 4.
Step 3: *Assess any features identified in Step 2 that warrant special significance status27 in any proposed risk management plan.* …	Assessment of 'significant' features is provided in Section 5.
Step 4: *Using the criteria set out in the SCI Report for deriving RMZ boundaries, draw a Risk Management Zone around those features from Step 2 and Step 3 and assess the risk to the feature (or relevant part of the feature)28, and* …	Identification of risk and assessment of impacts is provided in Section 6.
Step 5: *Proposed risk management plans will be required:* …	A description of risk management measures and acceptability of impacts is provided in Section 7.

Plate 1: Table 1 of *Stream Risk Assessment* (refer to Appendix B of the Surface Water Assessment prepared for the EIS)

3. *Mine Closure*

- The IAPUM commented that mine closure is a "global problem".

  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. (page 4, line 40 of the IAPUM transcript).

- The IAPUM also commented that sealing a mine is difficult if the workings are up-dip of some of your entries.

  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. (page 5, line 15 of the IAPUM transcript).

- It should be noted that the mine workings at Dendrobium are downdip of the mine entries.
- The IAPUM commented that it may be better to seal the Dendrobium Mine within the mine workings rather than just at the surface entrance:

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. (page 6, line 20 of the IAPUM transcript).

- This is entirely consistent with South32's current closure concept for the Dendrobium Mine, which is to seal the mine entrances as per the currently approved Closure Plan for the Dendrobium Mine. Preliminary engineering studies have been undertaken in consultation with Dams Safety NSW to investigate the preferred approach to hydraulically seal the mine, which includes water retention bulkheads located underground in the main headings as well as seals at surface openings (also required for safety purposes).
- Detailed engineering studies would be completed in consultation with Government and other stakeholders as part of the formal Closure Plan for the approved Dendrobium Mine.
- Under the current Dendrobium Mine consent, the Closure Plan is not required to be prepared until two years prior to the cessation of mining operations in 2030.
- The Project does not change the closure concept for the approved Dendrobium Mine, however, the recommended conditions of approval would bring forward the timing of the Closure Plan (i.e. to "*within three years of commencing development under this consent",* which would be prior to Q1 2024 if the Project was approved in Q1 2021).
- The recommended conditions of approval for the Project (i.e. condition B60) specifically require consideration of sealing the mine as part of the closure strategy for the Dendrobium Mine:

  (c) contain a detailed mine closure strategy for Dendrobium Mine, which includes:

  (i) detailed consideration of all issues associated with sealing or not sealing mine entrances, with particular reference to groundwater re-pressurisation, developing hydraulic pressure heads within main headings and long-term emergence of mine waters within the Metropolitan Special Area and/or the Illawarra Escarpment;

- In regard to post-mining surface water losses, these have been calculated using the EIS groundwater model with the same conservative assumptions for predicted losses during mining (e.g. seam to surface fracturing, surface losses do not re-emerge downstream [which would occur in reality]).
  - For the post-mining losses, the EIS groundwater model assumes dewatering of mine workings ceases once mining is complete. The model conservatively does not consider underground hydraulic seals in the main headings (as per the current Closure Plan for the Dendrobium Mine). The model accounts for some outflow of groundwater via the Illawarra Escarpment (i.e. based on the hydraulic conductivity properties of the outcropping coal seam and other geology of the Escarpment) – as would have occurred pre-mining.
  - The model predicts that groundwater levels would slowly recover post-mining and predicts ongoing surface water losses post-mining, with surface water losses decreasing as groundwater levels recover.
  - This (slow recovery of groundwater) would occur even if it is agreed with Government and other stakeholders not to seal the mine (e.g. beneficial use of water stored in the underground workings by 3rd parties following the cessation of mining may be a preferred scenario), as re-pressurisation of the Hawkesbury Sandstone above Area 3 longwalls is already being recorded by groundwater monitoring bores following the completion of mining despite the ongoing dewatering of the mine workings.
  - Post-mining surface water losses were predicted using the EIS groundwater model out to the year 2150. At 2150 the modelled losses are 355 ML/annum, which represents a negligible loss at the catchment scale.
  - The predicted post-mining surface water losses were provided to Government, and the 2150 rate of loss was then extended for another 170 years (i.e. to the year 2319) to calculate the value of the upfront payment component of the surface water offsets for the Project based on the IPART retail price (1 in 10 years 'drought' price and 9 in 10 years 'non-drought' price).
  - Post-mining, recovery of groundwater levels may result in upward fluxes from the deeper groundwater system with the potential for this groundwater to contribute to baseflow and associated interaction with surface water, although the rate of any upward flux is expected to be negligible compared to rainfall recharge and lateral groundwater fluxes. Therefore, the effect of any upward flux to surface water quality is expected to be negligible. This is supported by the previous observations of the lack of noticeable effects to water quality following the more than 100 years of mining that has occurred in the catchment to date.

- In summary, approval of the Project would increase certainty regarding closure, as although the Project would not change the current closure concepts, approval of the Project would bring forward the timing of the preparation of the detailed closure strategy (in line with the NSW Resource Regulator requirements) for the Dendrobium Mine. The surface water offsets for the Project include upfront payment for post-mining surface water losses, which have been predicted using the conservative modelling assumptions and independently valued by the NSW Government on the basis that these post-mining surface water losses effectively continue into perpetuity.