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Dear Josh,

LONGWALL 15 END OF PANEL REPORT AQUATIC FLORA AND FAUNA REVIEW

Introduction

South 32 - Illawarra Metallurgical Coal (South32) extracts coal using longwall mining techniques from the Dendrobium Coal Mine, situated approximately 15 km to 20 km west of Wollongong. Consent for the mine, granted in November 2001, allows extraction from three longwall domains, known as Areas DA1, DA2 and DA3. DA3, situated to the west of Lake Cordeaux, is currently being mined. A modification to the mine layout of DA3, approved in December 2008, allowed the mine to be expanded and Area 3 to be sub-divided into three smaller domains, DA3A, DA3B and DA3C. Mining of DA3B Longwall 16 is currently underway. Longwalls in DA3B have been extracted as follows:

- Longwall 9 commenced 9 February 2013; completed on 2 June 2014;
- Longwall 10 commenced 21 January 2014; completed 20 January 2015;
- Longwall 11 commenced 18 February 2015; completed 26 January 2016;
- Longwall 12 commenced 22 February 2016, completed 31 January 2017;
- Longwall 13 commenced 3 March 2017, completed on 19 April 2018;
- Longwall 14 commenced 22 May 2018, completed 26 February 2019;
- Longwall 15 commenced 4 April 2019, completed 22 January 2020; and
- Longwall 16 commenced 25 February 2020 and is currently underway.

Longwalls 17 to 18 will be extracted following Longwall 16 and extraction of DA3A Longwall 19 at a later date.

Cardno NSW/ACT (Cardno) was commissioned by South32 to undertake a review of the status of aquatic flora and fauna in relation to the extraction of Longwall 15 to support the End of Panel reporting for the longwall. Cardno has been undertaking ongoing monitoring of watercourses within the DA3B mining area including the perennial Wongawilli Creek, Donalds Castle Creek and several associated first and second order tributaries (referred to hereafter as drainage lines). The overall objective of the monitoring is to determine whether the extent and nature of observed impacts, primarily subsidence-induced fracturing of bedrock, diversion and loss of aquatic habitat, if any, are consistent with the predictions made in the aquatic flora and fauna review (AFFA) (Cardno Ecology Lab 2012) and Subsidence Management Plan (SMP) (BHPBIC 2012) for DA3B. This review includes:

- An overview of the management of aquatic flora and fauna including monitoring proposed and undertaken;
- Review of observed impacts to aquatic habitat, flora and fauna from South32 impact reports and site visits undertaken by Cardno and a comparison with those predicted in the SMP; and

- Recommendations for any Corrective Management Actions (CMA) and future aquatic flora and fauna monitoring.

This review considers the effects of extraction of Longwall 15 in DA3B and focuses on the findings of ongoing monitoring by South32 and on data from aquatic ecology monitoring in Wongawilli Creek, Donalds Castle Creek and WC21 (a drainage line of Wongawilli Creek). Other information on other drainage lines of Wongawilli Creek (WC15) and Lake Avon (LA4A) where mining impacts were observed during extraction of Longwall 15 has also been provided by South32, though these are not routinely monitored by Cardno as part of the ongoing aquatic ecology monitoring.

Four rock fractures were identified during detailed mapping of WC14 (located approximately 800 m to the northeast of Longwall 15) in January 2020 (South32, 2020). These were attributed to extraction of Longwall 8 and are not discussed further in this review.

Any impacts to swamps and amphibians are considered by other specialist consultants.

Aquatic Ecology Management and Monitoring

The monitoring requirements recommended in the AFFA for DA3B and included in the SMP for DA3B incorporates a Before, After, Control, Impact (BACI) sampling design to monitor mine subsidence impacts on the aquatic environment with collection of at least two years of baseline data followed by monitoring during extraction, and at least two years of post-extraction monitoring. The following indicators were monitored at impact and control sites within and outside the SMP area for DA3B as a measure of aquatic health:

- Aquatic habitat condition - using a modified version of the Riparian, Channel and Environmental Inventory method (RCE) (Chessman *et al*. 1997);
- Macroinvertebrates, including threatened species of dragonfly (Adams emerald dragonfly and Sydney hawk dragonfly), using AUSRIVAS and standardised artificial collectors;
- Limited *in-situ* water quality – using a portable probe; and
- Fish abundance using backpack electrofishing and bait traps.

It was recommended that monitoring in DA3B be undertaken once every two years (Cardno Ecology Lab, 2012).

Table 1-1 summarises the monitoring that has been completed in DA3B in line with the AFFA and SMP. Baseline surveys were undertaken in DA3B in 2010 and 2011 (Cardno Ecology Lab 2011), followed by the during-extraction monitoring in 2013 (Cardno Ecology Lab 2014), 2015 (Cardno 2016), 2017 (Cardno 2018) and 2019 (Cardno 2020). Additional monitoring was undertaken in DA3B in 2011 to support the AFFA, including more extensive fish surveys in WC21 and during the 2014 investigations in DA3A (Cardno Ecology Lab 2015). The AFFA also included a literature review on the physical setting, aquatic habitat, water quality, aquatic macroinvertebrates, fish, threatened species, populations and ecological communities in DA3B. Aquatic habitat in WC21 was also inspected visually by Cardno during 2014 following the observation of physical mining impacts within the tributary.

South32 undertake weekly monitoring of landscape and natural features in DA3B when within 400 m of the active longwall, and monthly thereafter. This includes monitoring during extraction of DA3B longwalls to identify any fracturing, pool water level reduction, changes in flow and water quality in Wongawilli Creek and its drainage lines and Lake Avon drainage lines.

The SMP includes the following triggers as part of the Trigger Action Response Plans (TARPs) relating to aquatic ecology:

- Level 1 – Reduction in aquatic habitat for 1 year;
- Level 2 – Reduction in aquatic habitat for 2 years following the active subsidence period (i.e. when a Longwall within 400 m of a feature, such as a creek, is completed); and
- Level 3 – Reduction in aquatic habitat for >2 years or complete loss of habitat following the active subsidence period.

These trigger specific management actions aim to minimise any further impacts to the aquatic environment, and include requirements for further monitoring, reporting, application of (CMAs), such as grouting and repair of fractures, and notification of relevant stakeholders, as required.

Table 1-1 Monitoring undertaken for DA3B longwalls in line with the DA3B SMP Requirements and Recommendation in Cardno Ecology Lab (2012)

Report	Survey Date	Sampling Component
Baseline Monitoring		
Dendrobium Areas 3A and 3B. Aquatic Ecology Monitoring 2008 to 2013 (Cardno Ecology Lab 2014)	Mar / May / Sep Nov 2010 Apr / Jun / Sep / Oct 2011	Habitat assessment, fish, macroinvertebrates, water quality
During Extraction Monitoring		
Dendrobium Areas 3A and B. Aquatic Ecology Monitoring 2008 to 2013 (Cardno Ecology Lab 2014)	Apr / Jun / Sep / Nov 2013	Habitat assessment, fish, macroinvertebrates, water quality
Dendrobium Area 3A Aquatic Ecology Monitoring 2008 to 2014 (Cardno Ecology Lab 2015)	Throughout 2014	Observations of mining impacts and effects on aquatic habitat in WC21 in 2014 that were attributed to extraction of Longwalls 9 and 10, undertaken as part of DA3A monitoring fieldwork
Dendrobium Area 3B Aquatic Ecology 2010 to 2015 (Cardno 2016)	May / Jun / Oct / Nov 2015	Habitat assessment, fish, macroinvertebrates, water quality
Dendrobium Area 3B Aquatic Ecology 2010 to 2017 Cardno (2018)	Apr / May / Oct / Nov 2017	Habitat assessment, fish, macroinvertebrates, water quality
Dendrobium Area 3B Aquatic Ecology 2010 to 2017 Cardno (2018)	May / Jun / Oct / Nov 2019	Habitat assessment, fish, macroinvertebrates, water quality

Predicted and Observed Impacts

Physical and Water Quality Mining Impacts

Details of the physical and associated water level, flow and quality triggers identified by Illawarra Metallurgical Coal Environmental Field Team (IMCEFT) (South32 2020) during extraction of Longwall 15 are provided in **Table 1-2**. Eight rock fractures were identified during extraction of Longwall 15. Four (three in LA4A and one in WC15) were in areas where fracturing had not been identified previously and four (three in WC15 and one in WC21) were in areas where fracturing had been identified previously during extraction of Longwalls 13 and / or 14. All except one (DA3B_LW15_003) of the fractures in LA4A (a second order drainage line of Lake Avon approximately 300 m north of Longwall 15) would likely result in flow diversions, though no flow was present at the time of identification. Although fracture DA3B_LW15_015 was reported as an impact associated with Longwall 15, it is likely this impact occurred during extraction of Longwall 14 (fracturing had been identified in LA4 previously during extraction of Longwalls 13 and 14) and only become visible due to rainfall events which dislodged vegetation and rock fragments (South32 2020). The fracture identified during extraction of Longwall 15 at WC15 Rockbar 18 overlies Longwall 15 and was also attributed to extraction of this longwall. It was not located in the direct flow path and so is not expected to result in flow diversions. The two fractures identified in WC15 in January 2020 were additional fractures to Rockbar 21 and 25 where fracturing had been identified previously during extraction of Longwalls 13 and 14, respectively. Flow diversions were present here. An additional fracture was also observed in WC15 Pool 2 in April 2020, though no flow diversion was present. Fracturing was first observed at WC15 Pool 2 during extraction of Longwall 13 (South32 2020). Low water levels were observed in WC15 Pool 34 (below the installed water level logger) during the extraction of Longwall 15, though similar water levels were observed during the baseline period. During the latest inspection in WC15 on 28 April 2020, water was present in 15 of the 34 (44%) pools mapped in this watercourse. The one fracture identified in WC21 was in an area already affected by fracturing and flow diversions following extraction of previous longwalls. No fracturing was observed Donalds Castle Creek or Wongawilli Creek during extraction of Longwall 15. Changes in dissolved oxygen (DO) and electrical conductivity (EC) were observed on Wongawilli Creek and a change in EC observed in Donalds Castle Creek during extraction of Longwall 15. On two occasions at Wongawilli Creek (FR6) DO was recorded below the 50.5 % saturation trigger, these were 19.1% on 26 November 2019 and 49.4% on 29 January 2020. EC was also recorded above the 154.1µS/cm trigger level on two occasions, these were 162 µS/cm on 15 July 2019 and 221 µS/cm on 26 November 2019. It is noted DO and EC values outside the triggers were recorded in the baseline period (South32 2020).

Table 1-2 Physical and water quality impacts observed by IMCEFT during extraction of DA3B Longwall 15

Watercourse	Site / Reference	Impact Type	Identification Date	Comment
Donalds Castle Creek	Donalds Castle Creek (FR6)	Water Quality	25/03/2019	Electrical conductivity trigger
LA4A	*DA3B_LW15_003*	Rock Fracturing	17/06/2019	Rock fracturing and associated rock fragmentation at *LA4A_Step 3A*.
LA4A	*DA3B_LW15_014*	Rockfall, Rock Fracturing and Fragmentation	11/10/2019	Rockfall, rock fracturing and fragmentation to *LA4A_Step 3B* and *LA4A_Channel 3A.*
LA4A	DA3B_LW15_015	Rock Fracturing	11/10/2019	Fracturing at Rockbar 2. Flow diversion would occur.
WC15	DA3B_LW15_027	Rock Fracturing	21/01/2020	Fracturing at Rockbar 18. Not located in direct flow path
WC21	*DA3B_LW13_010 (Update)*	Rockfall / fracturing	21/08/2019	Rockfall and fracturing to a step at *WC21_Pool 53*.
WC15	DA3B_LW13_035 (Update)	Rock Fracturing	21/01/2020	Additional rock fracturing to Rockbar 21. Originally identified during extraction of Longwalls 13 and 14. Flow diversion present.
WC15	DA3B_LW14_016 (Update)	Rock Fracturing	21/01/2020	Additional rock fracturing to Rockbar 25. Originally identified during extraction of Longwall 14. Flow diversion present.
Wongawilli Creek	Wongawilli Creek (FR6)	Water Quality	29/01/2020	Dissolved oxygen trigger
Wongawilli Creek	Wongawilli Creek (FR6)	Water Quality	29/01/2020	Electrical conductivity trigger
WC15	DA3B_LW13_046 (Update)	Rock Fracturing	1/04/2020	Additional rock fracturing and displacement to Pool 2. Originally identified during extraction of Longwall 13.

EC was also found to exceed the trigger of 185.8 µS/cm at Donalds Castle Creek (FR6) during 25 March 2019 to 28 October 2019, with a maximum of 344 µS/cm on 16 August 2019.

Impacts on Aquatic Habitat and Biota

The impacts to aquatic habitat and biota observed by South32 and Cardno associated with the physical and water quality impacts described above are summarised in **Table 1-3**. They are compared with the impacts to aquatic habitat and biota predicted to occur in the in the AFFA (Cardno Ecology Lab 2012). These predictions were based on the maximum predicted subsidence parameters for the sections of Wongawilli Creek, Donalds Castle Creek and the tributaries that flow through the DA3B SMP Area, their predicted impacts on the physical and water chemistry characteristics of the waterways (MSEC 2011), and the assessment of potential impacts on surface water quality (Ecoengineers 2011).

The physical mining impacts observed in LA4A and WC15 would be expected to be associated with some reduction in the amount aquatic habitat. At the scale of individual drainage lines, such impacts would relatively severe. By April 2020, approximately 2 km of WC15 (71% of its 1.6 km length) had experienced water loss and reduction in availability of aquatic habitat. It is possible that rainfall variability explains the reduction in water levels in WC15 Pool 34, given no impacts have been observed upstream, or in, WC15_Pool 34. Though unobserved fractures and flow diversions may be present. The finding that similar patterns are evident in baseline data (i.e. before any mining) does indicate that this pool (and WC15) is naturally ephemeral and therefore provides relatively limited aquatic habitat compared with larger watercourses such as Wongawilli Creek. Although no additional physical mining impacts were observed in WC21 during extraction of Longwall 15, it is possible that Longwall 15 has contributed to existing fractures and flow diversions in WC21, which partly overlies this longwall. By April 2020, the length of habitat loss in WC21 was 1.1 km, or 75% of its 2.7 km length. The length of watercourse affected by reductions in availability of aquatic habitat is likely to fluctuate with rainfall.

Table 1-3 Predicted and observed impacts to aquatic ecology associated with Longwall 15

Attribute	Predicted Physical Impacts	Predicted Impacts on Aquatic Ecology	Observed Impacts to Aquatic Ecology
Wongawilli Creek			
Ponding, flooding and scouring of stream banks due to tilt	No significant change predicted.	No measurable effects due to tilt.	None identified by IMCEFT during extraction of Longwall 15 or by Cardno at aquatic ecology monitoring sites on Wongawilli Creek in 2019 (Cardno 2020).
Fracturing of bedrock and diversion of surface flows	No significant fracturing resulting in surface water flow diversions. Minor, isolated fractures of the streambed may occur within 400 metres from the proposed Longwalls. Minor fracturing of the creek bed and subsequent diversion of flows would not have significant geochemical effects. Formation of ferruginous springs is unlikely, but could occur at the margins or upslope of swamps (Ecoengineers 2011).	No significant changes in the quantity or quality of permanent aquatic habitat due to fracturing of bedrock and diversion of surface flows.	No reductions in pool water levels and flow observed by South32 or Cardno during extraction of Longwall 15. The relatively minor changes in water quality that have been observed at Wongawilli Creek (FR6) are not expected to have significant impacts on aquatic biota. No evidence of impacts occurring to aquatic macroinvertebrates and fish in data collected in 2019 (Cardno 2020).
Donalds Castle Creek and drainage lines (WC21, WC15, LA4A)			
Ponding, flooding and scouring of stream banks due to tilt	Reversals in grade may occur along Tributary WC21, adjacent to the tailgates of Longwalls 10 and 11. These could result in small increases in the levels of ponding, flooding and scouring of stream banks in highly localised areas along the tributaries. The impacts resulting from such changes are expected to be small relative to those that occur naturally during floods.	Localised changes in habitat availability and connectivity may occur along the tributaries due to tilt, but will be difficult to detect because of the large variability in natural flows within these ephemeral systems.	No impacts observed due to tilt.
Fracturing of bedrock and diversion of surface flows	Fracturing of the bedrock is likely to occur. In ephemeral creeks with alluvial deposits, fractures are likely to be in-filled by deposits during flow events. In areas with exposed bedrock, some diversion of surface flows into underlying strata and drainage of pools may occur, particularly during low flows. It is unlikely, that this would result in a significant impact on the overall quantity or quality of water flowing from the catchment.	There is unlikely to be any significant long-term changes in the quantity, quality or connectivity of aquatic habitats. Any losses of habitat and connectivity that do occur would be minor, localised and transient.	None observed in Wongawilli Creek or Donalds Castle Creek during extraction of Longwall 15. Fracturing of bedrock and potential diversion of flows in Lake Avon drainage line LA4A and Wongawilli Creek drainage lines WC15 and WC21 is likely to have resulted in some further minor reduction in quantity and connectivity of aquatic habitat in these drainage lines. Given the abundance of comparable first and second order stream habitat in the upper Avon and Cordeaux Catchments, associated impacts to aquatic biota would also be expected to be minor. The relatively minor changes in water quality that have been observed in Donalds Castle Creek (FR6) are not expected to have significant impacts on aquatic biota.

Based on the abundance of first and second order stream habitat in the local area, in isolation these impacts could be considered relatively minor in the context of the Metropolitan Catchment Special Area. The cumulative impact to drainage lines due to extraction of longwalls in DA3B and the wider Metropolitan Catchment should however, be considered. Mapping by IMCEFT indicates that approximately 97 km, or 14 %, of the total 556 km length of watercourse habitat within the upper Avon and Cordeaux Catchments has experienced mine subsidence movements which could have resulted in loss of flow and reduction in pool water level (Cardno 2018). It is noted that a large proportion of this is expected to be ephemeral first and second order watercourses that provide more limited habitat for aquatic biota compared with larger and more permanent watercourses such as Wongawilli Creek. Nevertheless, these watercourses would still provide connectivity for some species at times of naturally high rainfall.

In Wongawilli Creek, the reductions in water levels and flow observed previously during extraction of Longwall 13 and during the first 5 to 6 months of extraction of Longwall 14 were not observed during extraction of Longwall 15. The previously observed reductions were associated with mining induced groundwater depressurisation at a time of several months of low rainfall, resulting in full or partial (if some water remained in some pools), loss of aquatic habitat, and likely also some biota, along approximately 1.4 km of the watercourse, representing about 10 % of its 12 km total length. During 2019 and the first three months of 2020, such reductions were not apparent, indicating such changes in Wongawilli Creek were temporary and likely to occur only during sustained low rainfall. This was supported by the findings of the 2019 aquatic ecology investigations, that did not indicate any impacts to aquatic macroinvertebrates in Wongawilli Creek in 2019, suggesting impacts to aquatic biota were also temporary (Cardno 2020). Conclusions around the presence of temporary impacts should, however, be considered with caution as it is possible that any future and slightly more adverse, longer or more frequent periods of low pool water levels and flow may have greater and more noticeable impacts on aquatic biota in the creek. It could be expected that extraction of Longwall 15 would contribute to mining induced groundwater depressurisation and contribute to any future reductions in flow and pool water levels at Wongawilli Creek during periods of low rainfall. Changes in the abundance of aquatic macroinvertebrates associated with mining impacts in Donalds Castle Creek and WC21 were observed in 2019 and during previous aquatic ecology investigations (Cardno 2020), and it is expected that extraction of Longwall 15 may contribute to any future impacts observed in these watercourses. It is noted that due to Donalds Castle Creek being located approximately 2 km from Longwall 15, impacts to this creek due to extraction of this longwall may be minimal.

The changes in water quality identified in Wongawilli Creek and Donalds Castle Creek at Fire Road 6 during extraction of Longwall 15, and further upstream in the pools affected by low water levels, appear temporary and small in magnitude. The exception was DO of 19.1% saturation recorded on 26 November 2019 at Wongawilli Site FR6. Although indicating anoxic conditions, subsequent measures up to including March 2020 were above the trigger value and in the range of approximately 50% to 90% saturation and are unlikely to represent a risk to aquatic habitats and biota at this location.

It is unlikely that the threatened Macquarie perch previously identified downstream in Wongawilli Creek has been put at risk by extraction in DA3B. Macquarie perch has been recorded in Dendrobium Area 3 in the mid to lower reaches of Wongawilli Creek, including pools just upstream and downstream of the Fire Road 6 crossing (Cardno 2018 and references therein). However, this species was not identified further upstream in Wongawilli Creek where the reduction in flow and water levels have been observed. This was despite extensive sampling here as part of this and previous surveys in Wongawilli Creek for the DA3B monitoring program. It is possible that this species is unable to pass the natural barrier in the form of a cascade / waterfall present a few hundred metres upstream of the Fire Road 6 crossing, at least not in any appreciable numbers.

It is difficult to quantify the additional impact to aquatic habitat and biota in WC15, LA4A and any other watercourses due to extraction of Longwall 15. The physical mining impacts observed during extraction of this longwall occurred following several other mining related impacts that occurred here during extraction of previous DA3B Longwalls 9, 10, 11, 12, 13 and 14. It is probable that the additional fracturing observed in these drainage lines, and any that was not observed in these or other watercourses, has exacerbated the existing impacts to water levels and flow. It is also difficult to link any physical mining related impact with associated impacts on aquatic habitat and biota with extraction of individual longwalls. Physical mining impacts that have occurred may be associated with individual longwalls or a cumulative effect of several longwalls. In such cases, it is unclear if impacts are due to a delayed response following extraction of earlier longwalls, a cumulative effect of extracting multiple longwalls, or a combination of mining impacts with prevailing environmental conditions e.g. prolonged reduced rainfall periods.

Aquatic Ecology TARP

Table 1-4 compares observed impacts to aquatic ecology with the TARP levels to determine if these have been triggered and what management actions associated with extraction of Longwall 15 and previous longwalls may be appropriate, if any. These TARPS are applicable only to watercourses where aquatic ecology monitoring sites are located (Wongawilli Creek, Donalds Castle Creek and WC21). For Site X1 on Donalds Castle Creek, the active subsidence period ended on 24 October 2013 when Longwall 9 was more than 400 m away from this site. For Sites X2 and X3 on WC21, the active subsidence period ended when Longwall 10 was completed on 20 January 2015 and when Longwall 13 was completed on 19 April 2018. TARP levels applicable to aquatic features relevant to Longwall 15. It is noted that the TARP triggers here relate to mining of the domain as a whole, rather than individual longwalls. Thus, the reduction in aquatic habitat observed at these sites constitute a Level 3 Trigger. Albeit no additional physical impacts were

Table 1-4 TARP triggers and current status

TARP	Wongawilli Creek	Donalds Castle Creek	WC21
Level 1 – Reduction in aquatic habitat for 1 year	Not triggered	Triggered September 2014	Triggered December 2014
Level 2 – Reduction in aquatic habitat for 2 years following the active subsidence period (i.e. when a longwall within 400 m of a feature, such as a creek, is completed)	Not triggered	Triggered 24 October 2015	Triggered 20 January 2017
Level 3 – Reduction in aquatic habitat for >2 years or complete loss of habitat following the active subsidence period	Not triggered	Triggered During 2017 Aquatic Ecology Surveys (Cardno 2018)	Triggered During 2017 Aquatic Ecology Surveys (Cardno 2018)

observed during extraction of Longwall 15, it is possible that extraction of this longwall may contribute to the magnitude or duration of existing impacts in WC21. It would be possible but unlikely that extraction of Longwall 15 may have affected Donalds Castle. Actions for a Level 3 Trigger include notification of stakeholders and the development and implementation of CMAs. Such actions have commenced as part of a remediation program for the impacts to WC21 (DPE 2015). The reductions in pool water levels and aquatic habitat in Wongawilli Creek during 2018 occurred for less than 1 year and did not constitute a trigger.

Conclusion and Recommendations

Fracturing associated with flow diversions was observed in drainage lines WC15, WC21 and LA4A during extraction of Longwall 15. Of the eight fracture zones identified, four (one in WC15 and three in LA4A) were in areas previously unaffected by mining and were attributed to Longwall 15. The other four were additional fractures in areas previously affected by Longwalls 13 and 14. In isolation, these impacts represent relatively minimal impacts to aquatic habitat and biota in these watercourses. Due to the limited aquatic habitat provided by WC15, WC21 and LA4A, and the abundance of these stream types in the Metropolitan Special Area, the fracturing and flow diversions observed also represent minor impacts to aquatic ecology at the scale of the Cordeaux River and Avon River catchments. Low rainfall during the monitoring period is likely to have contributed to observations of low pool water levels and flow in these watercourses, which are relatively ephemeral compared with larger watercourses such as Wongawilli Creek. The apparent temporary changes in water quality observed downstream in Wongawilli Creek and Donalds Castle Creek also represent relatively minimal impacts to aquatic ecology. At this stage, no specific actions associated with Longwall 15 or these drainage lines are recommended. No mining impacts were observed in Wongawilli Creek during extraction of Longwall 15 and no impacts to aquatic biota in the creek were observed during aquatic ecology investigations in 2019 (Cardno 2020).

Nevertheless, extraction of Longwall 15 would have contributed to existing physical mining impacts, reduction in availability of aquatic habitat and assumed loss of some associated aquatic biota in these drainage lines and potentially other drainage lines in DA3B. This includes reductions in pool water levels and flow in WC21, WC15, LA4A and other nearby drainage lines observed following the extraction of DA3B Longwalls 9 to 14, representing a local loss of aquatic habitat and biota. That in WC21 has been associated with changes in aquatic macroinvertebrates in 2019 and earlier. However, it is difficult to quantify what proportion of the observed impacts are associated with extraction of Longwall 15 alone. Although reductions in pool water levels and flow in Wongawilli Creek were not observed during extraction of Longwall 15, it would be expected that extraction of Longwall 15 would have contributed to mining induced groundwater depressurisation in DA3B. This could result in a greater potential for and severity of any future similar reductions in pool water levels and flow in Wongawilli Creek. No TARPs have been triggered with respect to Wongawilli Creek. Level 3 triggers were in place for WC21 and Donalds Castle Creek prior to extraction of Longwall 15 and remain in place.

It is recommended that further during and post mining aquatic ecology monitoring is completed in DA3B and in Wongawilli Creek in line with the AFFR and SMP. South32 should continue to monitor watercourses that have been affected by extraction of Longwall 15 and previous longwalls and the findings of these will be used to assess whether TARPs will subsequently be triggered. Further assessment should also be undertaken to determine what component of reductions in flow and water levels in Wongawilli Creek is attributed to patterns in rainfall and physical mining impacts.

Yours sincerely,

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