Our Ref: NE30130_R020_Rev0: DP
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14 November 2023

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Attention: Josh Carlon

Dear Josh,

LONGWALL 21 END OF PANEL REPORT AQUATIC FLORA AND FAUNA REVIEW

Introduction

South32 - Illawarra Metallurgical Coal (IMC) 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 Dendrobium Area 1, Dendrobium Area 2, and Dendrobium Area 3 (DA1, DA2 and DA3). DA3, situated between Lake Cordeaux and Lake Avon, is currently being mined. A modification to the mine layout of DA3, approved in December 2008, allowed the mine to be expanded, with DA3 divided into three smaller domains, DA3A, DA3B and DA3C.Longwall 21, the first longwall to be mined in Area 3C, commenced extraction 25 April 2023 and was completed 6 August 2023.

Stantec (formerly Cardno) was commissioned by IMC to undertake a review of the status of aquatic flora and fauna in relation to the extraction of Longwall 21 to support the End of Panel reporting. Stantec has been undertaking ongoing monitoring of watercourses within the DA3B and DA3A mining areas including the perennial Wongawilli Creek, Sandy Creek, Donalds Castle Creek and several associated first and second order ephemeral / intermittent tributaries. The overall objective of the monitoring is to determine whether the extent and nature of observed impacts, primarily subsidence-induced fracturing of bedrock, flow diversion and loss of aquatic habitat, if any, are consistent with the predictions made in the Aquatic Flora and Fauna Assessment (AFFA) for Longwalls 20 and 21 (Cardno 2019), Subsidence Management Plan (SMP) (IMC 2019) and Area 3C Watercourse Impact, Monitoring and Contingency Plan (WIMMCP) (IMC 2020). 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 IMC impact reports and a comparison with those predicted in the SMP.
- Recommendations for any Corrective Management Actions (CMA) and future aquatic flora and fauna monitoring.

This review focuses on any physical and water quality impacts to watercourses overlaying and within 400 m (i.e., have potential to be impacted based on previous observations of mining impacts in the Dendrobium mine area) of Longwall 21 and any associated potential impacts to aquatic habitat and biota that may have occurred during extraction of Longwall 21. This review also considers tributaries within 400 m of Longwall 21. These are Wongawilli Creek and Wongawilli Creek tributaries WC20, WC24 and WC24A and Lake Avon tributary LC5. The aquatic ecology impact assessment is based on the findings of ongoing field surveys in these watercourses by the Illawarra Metallurgical Coal Environmental Field Team (IMCEFT) and on Stantec's experience of undertaking monitoring and assessment of aquatic habitat and biota in the Dendrobium Mine Area. This review does not consider Donalds Castle Creek and its tributaries. Although these watercourses were considered in the AEA for Longwalls 20 and 21 (Cardno 2019), they are located outside the Study Area for Longwall 21, which is located over 600 m to the east.

The potential impacts to aquatic ecology attributed to extraction of Longwall 21 are also placed in context of the cumulative impacts to aquatic ecology experienced in the Dendrobium mining area. A full assessment of

impacts due to extraction of all longwalls in DA3A, DA3B and DA3C will be provided in the latest biennial monitoring report (Stantec *in prep*) following completion of aquatic ecology surveys in 2023. Any impacts to swamps and amphibians are considered by other specialist consultants.

Aquatic Ecology Management and Monitoring

The monitoring requirements recommended in the AFFA and SMP for Longwall 21 incorporates a Before, After, Control, Impact (BACI) sampling design. The program monitors 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 DA3C 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.
- Fish abundance using backpack electrofishing and bait traps.

It was recommended that monitoring in Area 3A and Area 3C be undertaken once every year (Cardno 2020a). Monitoring in DA3B is undertaken biennially.

Table 1-1 summarises the monitoring that has been completed in DA3 including monitoring in Area 3C from 2021 in line with the AFFA and SMP for Longwalls 20 and 21. Baseline DA3 surveys were undertaken 2010 and 2011 (Cardno Ecology Lab 2011), followed by the during-extraction monitoring in 2013 (Cardno Ecology Lab 2014), 2014 (Cardno Ecology Lab 2015), 2015 (Cardno 2016), 2017 (Cardno 2018), 2019 (Cardno 2020a), 2021 (Cardno 2022) and 2023 (Stantec *in prep*). Surveys in 2021 also provided further baseline data for Longwall 21. 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 DA3C.

Table 1-1 Monitoring undertaken for DA3A longwalls in line with the Longwall 21 SMP Requirements and Recommendation in Cardno (2020a)

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	Habitat assessment, fish, macroinvertebrates, water quality
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 2019. Cardno (2020a)	May / Jun / Oct / Nov 2019	Habitat assessment, fish, macroinvertebrates, water quality
Dendrobium Area 3A, 3B and 3C Aquatic Ecology Monitoring 2010 to 2021. Cardno (2022)	Apr / May / Sep / Oct 2021	Habitat assessment, fish, macroinvertebrates, water quality
Dendrobium Area 3A, 3B and 3C Aquatic Ecology Monitoring 2010 to 2023. Stantec (*in prep*)	Apr / May / Sep / Oct 2023	Habitat assessment, fish, macroinvertebrates, water quality

IMC undertake weekly monitoring of landscape and natural features in DA3 when within 400 m of the active longwall, and monthly thereafter. This includes monitoring during extraction of active longwalls to identify any

fracturing, pool water level reduction, changes in flow and water quality in Wongawilli Creek, Donalds Castle Creek, and their tributaries.

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 is within 400 m of a feature, such as a creek).
- Level 3 – Reduction in aquatic habitat for >2 years or complete loss of habitat following the active subsidence period.

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

Predicted and Observed Impacts

Physical and Water Quality Mining Impacts

Details of the mining related impacts identified in watercourses by IMCEFT (IMC 2023) during extraction of Longwall 21 are provided in **Table 1-2** and **Figure 1-1**. Five impacts were identified in watercourses during extraction of Longwall 21. These were three rock fractures in WC20 during July 2023 and iron straining in WC24 in August 2023. The rock fractures were between 2.3 m and 3.5 m long and although flow was not present at the time of inspection. Flow diversions during periods of flow is likely in the case of two fractures (DA3C_LW21_014 and DA3C_LW21_015), though would be unlikely in the case of the third (DA3C_LW21_017) due to it been located outside of the direct flow path. The iron staining in WC24 was observed along 45 m of dry WC24 streambed originating at WC24 Pool 35 downstream to WC24 Rockbar 15. Iron staining was not visible in these areas during the baseline mapping.

Table 1-2 Mining related impacts observed in watercourses by IMCEFT during extraction of DA3A Longwall 21

Site ID	Impact Type	Watercourse	Identification Date	Description	Trigger Level
DA3C_LW21_014	Rock Fracture	WC20	11/07/2023	Rock fracturing to rockbar	2
DA3C_LW21_015	Rock Fracture	WC20	11/07/2023	Rock fracturing to channel	2
DA3C_LW21_017	Rock Fracture	WC20	26/07/2023	Rock fracturing and uplift to rockbar	1
DA3C_LW21_020	Iron Staining	WC24	01/08/2023	Iron staining in channel	1
DA3C_LW21_021	Iron Staining	WC20*	01/08/2023	Iron staining on basal step	1
DA3C_LW21_035	Iron Staining	Wongawilli Creek	09/10/2023	Iron staining present flowing on valley slope within proximity to Wongawilli Creek.	1
DA3C_LW21_036	Iron Staining	Wongawilli Creek	09/10/2023	Iron staining present flowing on valley slope within proximity to Wongawilli Creek.	1

**Iron staining located outside WC20 watercourse channel in basal step of Swamp 144.*

Localised iron staining (2 m by 1 m) was also observed outside the watercourse channel on the downstream basal step of Swamp 144 at the headwaters of tributary WC20 (DA3C_LW21_021).

During the monitoring period of Longwall 21, two additional slope springs and associated iron staining were identified upslope of WC_Pool_50 on Wongawilli Creek (DA3C_LW21_035 and DA3C_LW21_036) in October 2023. Both slope springs were active during the inspection with both the seepage and iron staining extending to Wongawilli Creek. These slopes springs are located approximately 95 and 85m north of the slope spring associated with DA3B_LW17_017 respectively.

Iron staining was reported in Wongawilli Creek prior to Longwall 21 extraction in August 2021 (DA3B_LW17_031), during extraction of Longwall 17, and was also observed in tributaries WC17 and WC21 following extraction of Longwall 7, 9 and 13. The influx of iron was evident in most stream features extending from WC_Pool 50 down to WC_Pool 20. The distance between these features is approximately 2.9km. During inspections in September 2023, no iron was evident on Wongawilli Creek upstream of spring at

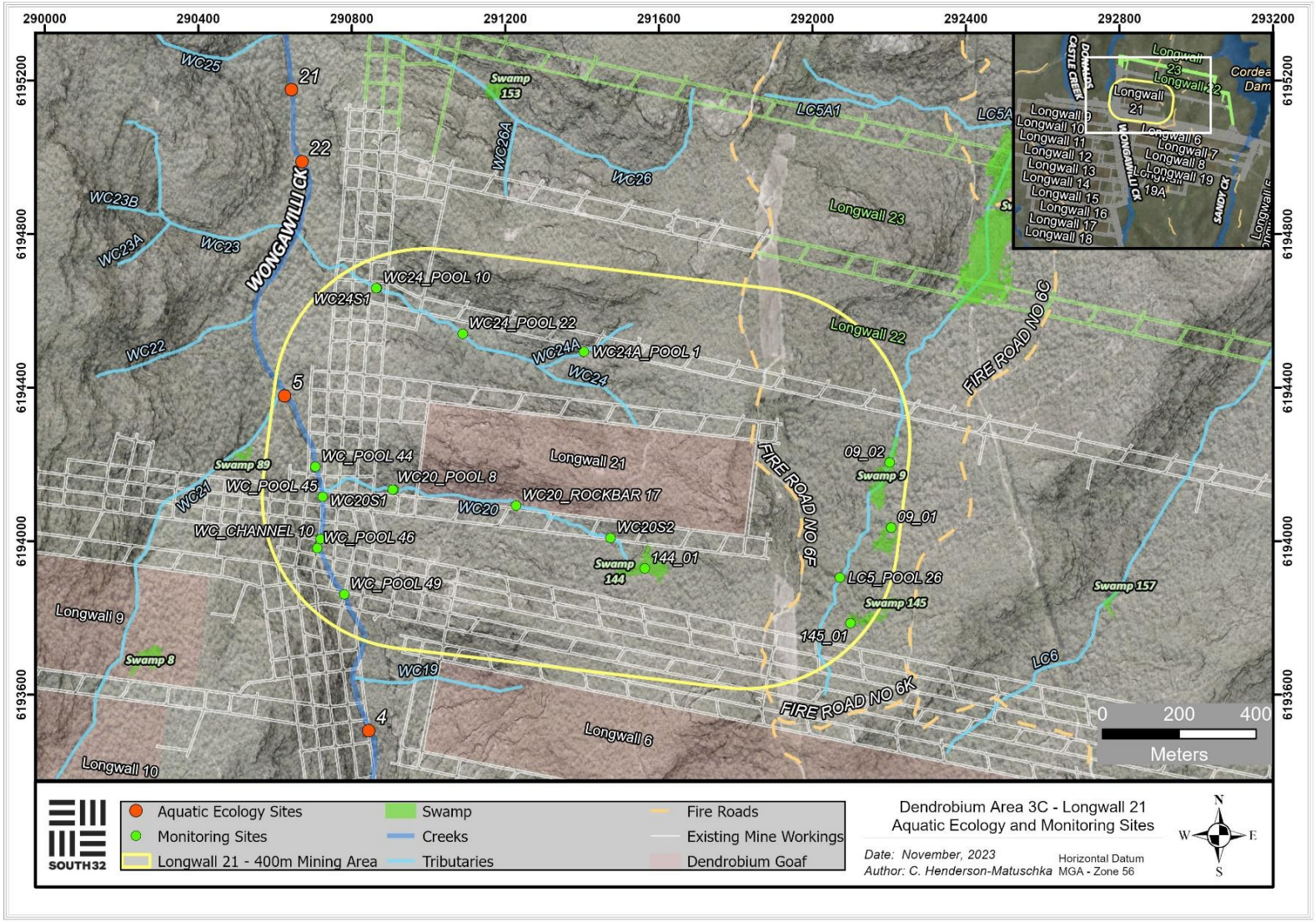

Figure 1-1. DA3C Longwalls 21 to 23, existing mine workings, nearby watercourses and associated monitoring sites including aquatic ecology monitoring sites 4 to 5 and 21 to 22.

WC_Pool 53. Downstream of WC_Pool 20, isolated sections of iron staining were restricted to shallow sections of pools and rockbars with the deeper pools remaining unaffected. No observable iron was evident at Wongawilli Creek (FR6) and WC_Pool 2. Iron staining was first observed in Wongawilli Creek during the baseline period prior to mining in 2007.

Prior to extraction of Longwall 21 in January 2023, a gas release was identified in Wongawilli Creek Pool 50 (DA3A_LW19_029). During the recent inspection 11 September 2023 an intermittent gas release was still occurring.

No changes to water quality identified in watercourses within 400 m of Longwall 21 following the commencement of extraction of this longwall (HGEO 2023).

Impacts on Aquatic Habitat and Biota

The assessment of impacts to aquatic habitat and biota due to the physical and water quality impacts observed by IMC and described above are summarised in **Table 1-3**. The findings are compared with the impacts to aquatic habitat and biota predicted to occur in the AFFA for Longwall 21 (Cardno 2019). These predictions were based on the maximum predicted subsidence parameters for the sections of Wongawilli Creek and tributaries that flow through the Longwall 20 and 21 SMP Area, their predicted impacts on the physical and water chemistry characteristics of the waterways (MSEC 2019), and the assessment of potential impacts on surface water and groundwater (HGEO 2019).

Table 1-3 Predicted and observed impacts to aquatic ecology associated with Longwall 21.

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	Adverse changes in the potential for ponding, flooding or scouring of the banks along the creek due to the mining-induced tilt are unlikely.	Measurable effects on the availability and connectivity of most aquatic habitats are unlikely. There is potential for minor, localised changes in the availability of aquatic habitat in some pools. Associated impacts to aquatic biota, if they occur, are therefore expected to be minor and localised.	None identified by IMCEFT during extraction of Longwall 21.
Fracturing of bedrock and diversion of surface flows	The overall likelihood of significant fracturing resulting in surface water flow diversions at the rockbars along Wongawilli Creek is 7 % (based on the rate of rockbar fractures experienced in DA3B due to extraction of Longwalls 9 to 12). Minor fracturing could occur along the creek at distances up to approximately 400 m from the proposed longwalls.	Seventeen rockbars are located in Wongawilli Creek within 600 m of Longwalls 20 and 21. Based on the predicted fracture rate, it would be expected that on average one of these would experience fracturing associated with flow diversions. The potential drainage of smaller pools would represent a relatively minor impact in the context of the length of pool habitat within the Study Area (365 m). The loss of the largest pool (100 m in length) does, however, represent a relatively large impact to aquatic habitat. However, based on the low rate of fracture that would result in flow diversions and the size range of associate pools, the probability of fracturing resulting in large reduction in pool habitat is expected to be low. Minor and isolated fracturing, if it occurs, would not cause any significant diversion of surface flows although it could cause localised reductions in the availability of aquatic habitat.	No reductions in pool water levels and flow or changes in water quality observed by IMC during extraction of Longwall 21, and thus no suggestion of impacts occurring to aquatic habitat and biota.
Water Quality and Availability	Baseflow to Wongawilli Creek may decline by 0.20 ML/day (approximately 1.6 % of mean annual flow) due to groundwater depressurisation following longwall extraction (HGeo 2019). The cumulative effects of DA3B and Longwalls 20 and 21 would be to further reduce flows by about 1.3 ML/d. This could result in zero flow conditions up to 44% of the time (i.e., 146 out of 365 days) compared with natural conditions (10 % of the time), although 12	An overall reduction in base flow and increase in the number of zero flow days would impact aquatic habitat and biota in Wongawilli Creek. Although the reduction in baseflow would be small, the predicted increase in zero flow days would reduce longitudinal connectivity in the watercourse and possibly also the amount of aquatic habitat available to biota if pool levels also decrease during these periods. If pools do not drain completely then these would	Iron staining and the single gas release during extraction of Longwall 21 not associated with any water quality triggers. No evidence of impacts to aquatic biota during observations in April, June and September 2023.

Attribute	Predicted Physical Impacts	Predicted Impacts on Aquatic Ecology	Observed Impacts to Aquatic Ecology
	% to 15 % of the time (an increase from 37 to between 44 and 54 days per year) is considered more likely based on available pre- and post-mining data (HGeo 2019). The effect on overall catchment yield of the Cordeaux River catchment is expected to be negligible. Impacts to water quality due to mining are expected to be minor in stream reaches within subsidence affected areas (HGeo 2019). Effects are likely to include slight and temporary changes in water salinity, pH and iron content with local discolouration of streambeds and rock faces by iron hydroxide.	provide refuge for aquatic biota until flow returns. It is expected that such impacts to aquatic habitat and biota would be restricted to sections of Wongawilli Creek adjacent to mining, as there would be negligible impact to the overall yield of the Cordeaux River catchment. Impacts to aquatic habitat and biota due to changes in water quality appear unlikely as only minor changes in water quality are expected.	
Tributaries of Wongawilli Creek			
Ponding, flooding and scouring of stream banks due to tilt	Although predicted changes in grade (3%) are larger as a proportion of the natural grade (10% to 20%), compared with that for creeks, it is unlikely that there would be large-scale adverse changes in the levels of ponding or scouring of the banks along these drainage lines due to subsidence induced tilt. It is possible that localised increased ponding could develop in some isolated locations, where the natural grades are small and where the drainage lines exit the mining area	Localised changes in habitat availability and connectivity may occur along the drainage lines due to tilt but these effects will be difficult to detect due the large variability in grade and natural flows within these ephemeral systems. The impacts resulting from the changes in surface water flows are expected to be small in comparison with those which occur during natural flooding conditions. Consequently, impacts to aquatic habitat and biota due to tilt, if any, are expected to be minor and localised.	No impacts observed due to tilt.
Fracturing of bedrock and diversion of surface flows	Fracturing is expected to occur along the sections of the drainage lines that are located directly above Longwall 21 (WC20). Fracturing can also occur outside the extents the proposed longwalls, with minor and isolated fracturing occurring at distances up to approximately 400 m. Surface water flow diversions are also likely to occur along the sections of drainage lines that are located directly above the proposed longwalls. In times of heavy rainfall, most of the runoff would flow over the fractured bedrock and soil beds and would not be diverted into the dilated strata below. In times of low flow, however, surface water flows can be diverted into the dilated strata below the beds.	Fracturing induced flow diversions in the highly ephemeral drainage lines directly above longwalls would result in a reduction in the amount of aquatic habitat. However, smaller drainage lines such as these are limited in habitat value for aquatic biota. Flow diversions would reduce the volume and duration of flow in these ephemeral drainage lines. Approximately 200 m of first order stream WC20 occurs directly above Longwall 21 and approximately 1.5 km occurs within the Study Area. These lengths represent a very small proportion of that present in the wider Cordeaux River Catchment.	Some minor rock fracturing was observed in tributary WC20. Although flow diversions may occur, the natural ephemeral nature of WC20 indicates that any reduction in availability and connectivity of aquatic habitat and associated impacts to aquatic biota in WC20 would be minor.
Water quality	Impacts to water quality due to mining are expected to be minor in stream reaches within subsidence affected areas (HGEO 2020). Effects are likely to include temporary changes in water salinity, pH and iron content with local discolouration of streambeds and rock faces by iron hydroxide.	Minor impacts to water quality are unlikely to represent substantial risks to aquatic habitat and biota in drainage lines.	Iron staining in WC24 and basal step of WC20 were not associated with any water quality triggers. No impacts to water quality in drainage lines observed. Thus, no associated impacts to aquatic habitat and biota are expected.

Only relatively minor impacts were observed in watercourses following commencement of extraction of Longwall 21. These were three rock fractures in WC20, iron staining in WC24 and WC20 and an increase in existing iron straining in isolated sections of Wongawilli Creek downstream of WC Pool 50. No changes in water quality in watercourses within 400 m of Longwall 21 were identified following commencement of extraction (HGEO 2023). Although flow diversions may occur due to two of the three fractures in WC20 that located in the main channel, any reduction in availability and connectivity of aquatic habitat and associated impacts to aquatic biota in the naturally ephemeral / intermittent WC20 would also be minor. The third fracture in WC20 was located outside of the main flow path and would not be expected to result in flow diversions, and, thus, would not be expected to impact aquatic habitat and biota. Localised iron staining in

WC20 would not be associated with significant impacts to aquatic habitat and biota given these ephemeral / intermittent tributaries provide aquatic habitat of limited value and represent a very small component of the total aquatic habitat in the Dendrobium Mine area.

In the absence of changes in water quality in Wongawilli Creek associated with the ongoing gas release in WC_Pool 50, and any change in aquatic habitat noted during the recent aquatic ecology surveys in Wongawilli Creek in April, June and September 2023, any associated impacts to aquatic ecology are expected to be negligible.

Associated impacts include a modification to aquatic habitat associated with iron flocculation and infilling of habitat interstices and changes in some indicators of water quality. A previous assessment of related impacts to aquatic ecology due to iron staining and flocculation in SC10C (Cardno 2020b) indicated a reduction in the abundance of some aquatic macroinvertebrate taxa (including the pollution sensitive leptophlebiid mayfly), but not other taxa, suggesting impacts to aquatic ecology associated with iron staining and flocculation are limited. Monitoring and assessment of iron straining in the Dendrobium Mine Area and associated impacts to aquatic ecology will continue as part of the ongoing DA3 monitoring program, with further aquatic ecology surveys of the 2023 monitoring period to be completed in November 2023.

Preliminary examination of AUSRIVAS data at sites on Wongawilli Creek from 2019 to 2023 (monitoring of Longwall 21 impact Site 20 and 21 began in 2021), does not indicate impacts to aquatic habitat and biota have occurred at sites adjacent to Longwall 21 (Sites 21 and 22) or those that have experienced iron staining (Sites 5 and 4), relative to sites farther upstream on Wongawilli Creek and that have not experienced iron staining (Sites 3, 2, X4, 1, X5, X6, X7 and X8). Sites X7 and X8 are also the overall control sites for Wongawilli Creek located upstream of DA3A, DA3B and DA3C longwalls. Trends in number of taxa (**Figure 1-2a**), SIGNAL2 Score (a biotic index of water pollution) (**Figure 1-2b**) and OE50 Taxa Score (a biotic index of habitat and water quality) (**Figure 1-2c**) appear largely consistent among sites through this period. Although fewer taxa were caught at Site 22 in June 2023 than during previous surveys, similar apparent reductions in number of taxa were also observed at Sites X4, 1, X5, X6 and X8. Thus, changes at Site 22 appear related to natural variation unrelated to mining. More taxa were also observed at Sites 21 and 22 during the latest survey in September 2023. There was no evidence to suggest changes in SIGNAL2 Scores or OE50 Taxa Scores at Sites 21, 22, 5 and 4 through this period were related to iron staining in Wongawilli Creek. Further and more detailed statistical analysis and reporting of AUSRIVAS data will be undertaken following completion of the final 2023 survey in November 2023. This will also be supplemented by analysis of more extensive and quantitative macroinvertebrate data collected from 2011 to 2023.

Threatened Macquarie Perch

It is very unlikely that the threatened Macquarie perch previously identified downstream in Wongawilli Creek has been put at risk by extraction of Longwall 21. 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, and where iron straining has been observed. This was despite extensive sampling here as part of this and previous surveys in Wongawilli Creek for the DA3A, DA3B and DA3C 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. Macquarie perch would be very unlikely to occur in tributaries overlaying Longwall 21 due to the absence of suitable habitat otherwise provided by large permanent pools.

Cumulative Impacts

The cumulative impact to tributaries due to extraction of longwalls in the Dendrobium Mine Area and the wider Metropolitan Catchment should, however, be considered. Mapping by IMCEFT indicates that approximately 40 km of the total 700 km length of watercourse habitat located directly above longwall mining. This could result in loss of flow and reduction in pool water level. It is noted that a large proportion of this is expected to be ephemeral and intermittent 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 habitat and connectivity for some species at times of high rainfall. Given these tributaries are ephemeral, and thus, provide disconnected habitat irrespective of mining, any further reduction in connectivity associated with flow diversions would not be expected to result in significant impacts to aquatic habitat and biota. It is also expected that that connectivity would occur during high rainfall events. It is also likely that extraction of Longwall 21 has and will continue to contribute to groundwater depressurisation in the Dendrobium Mine. This is expected to be associated with some reduction in the amount of aquatic habitat during drought conditions.

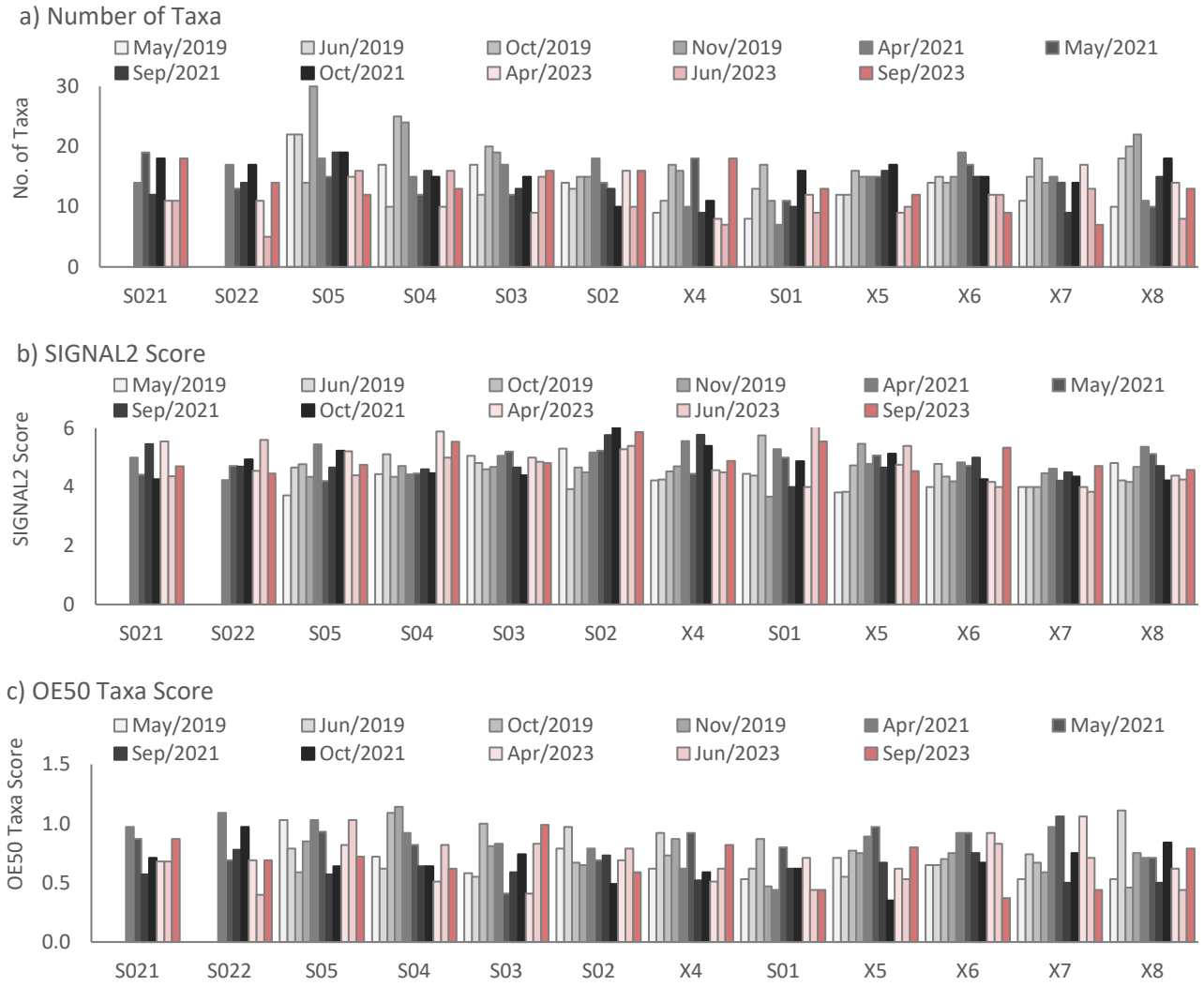

Figure 1-2. a) number of taxa, b) SIGNAL2 Scores and c) OE50 Taxa Scores from AUSRIVAS sampling at Sites in Wongawill Creek during 2019 to 2023. Sites are ordered from left (downstream) to right (upstream).

It is difficult to quantify the additional impact to aquatic habitat and biota in the Wongawilli Creek Catchment and the wider Dendrobium Mine due to extraction of individual longwalls. Physical mining impacts that have occurred can be associated with individual longwalls or a cumulative effect of several longwalls. In such cases, it is difficult to determine if aquatic ecology 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 aquatic ecology TARP levels to determine if any have been triggered and what management actions associated with extraction of Longwall 21 and previous longwalls may be appropriate, if any. These TARPS are applicable to watercourses where aquatic ecology monitoring sites are located within 400 m of Longwall 21 (Wongawilli Creek Sites 5, 21 and 22). No aquatic ecology triggers occurred at these sites during extraction of Longwall 21.

Table 1-4 TARP triggers and current status in Wongawilli Creek relevant to Longwall 21

TARP	Wongawilli Creek
Level 1 – Reduction in aquatic habitat for 1 year	Not triggered
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
Level 3 – Reduction in aquatic habitat for >2 years or complete loss of habitat following the active subsidence period	Not triggered

Conclusion and Recommendations

Only minor physical impacts in tributaries and no water quality impacts to watercourses in the Dendrobium Mine Area have been attributed to extraction of Longwall 21. The iron staining and gas release also represent relatively minimal impacts to aquatic habitat and biota in Wongawilli Creek and its tributaries, nor were any impacts observed to aquatic biota in the preliminary analysis of AUSRIVAS data from surveys in April, June and October of 2023. At this stage, no specific actions associated with Longwall 21 are recommended. Further analysis of the complete aquatic ecology monitoring dataset and assessment of potential impacts associated with extraction of Longwall 21 and of all longwalls in DA3A, DA3B and DA3C, including assessment of any effect of iron staining in Wongawill Creek, will be undertaken following the final survey of the 2023 monitoring period in November 2023.

It would be expected that extraction of Longwall 21 would have contributed to mining induced groundwater depressurisation in the Dendrobium Mine. Physical mining impacts, reduction in availability of aquatic habitat and assumed loss of some associated aquatic biota in tributaries overlying and within 400 m of Longwall 21 may also have occurred but have not yet been observed. Such impacts could result in a greater potential for and severity of any future similar reductions in pool water levels and flow in tributaries and Wongawilli Creek. It is noted that previous reductions in flow observed in Wongawilli Creek have been within predictions. No aquatic ecology TARPs have been triggered with respect to Wongawilli Creek.

It is recommended that further during- and post-mining aquatic ecology monitoring is completed in DA3C in Wongawilli Creek and tributaries in line with the AFFA and SMP for Longwalls 20 and 21. IMC should continue to monitor watercourses (as required by the SMP) that have been affected by Area 3 longwalls. The findings of these will be used to assess whether TARPs will subsequently be triggered.

Yours sincerely,

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