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Attention: Billy Agland,

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Dear Billy,

LONGWALL 709 END OF PANEL REPORT AQUATIC FLORA AND FAUNA REVIEW

Introduction

Illawarra Metallurgical Coal (IMC) extracts coal from the Bulli Seam in Area 7 of the Appin Colliery in the Southern Coalfield of New South Wales using longwall mining techniques. Appin Area 7 consists of approved Longwalls 701 to 711. Longwalls 701 to 708 were extracted between 27 October 2007 and 3 January 2022. Longwall 709 began extraction 22 February 2022 and was completed 8 October 2023.

Stantec (formerly Cardno and The Ecology Lab) was commissioned by IMC to undertake an Aquatic Flora and Fauna Review (AFFR) in relation to the extraction of Longwall 709 to support the End of Panel (EoP) reporting for Longwall 709. Stantec has been undertaking ongoing monitoring of aquatic habitat and biota in the section of the Nepean River adjacent to the Appin Area 7 mining area. 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 ecology assessment (AEA) (Cardno 2021a) and Extraction Plan (EP) (IMC 2022). 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 site visits undertaken by Stantec and a comparison with those predicted in the AEA and EP.
- > Recommendations for any management actions associated with aquatic habitat and biota and future monitoring.

This review considers the effects of extraction of Longwall 709 in Appin Area 7 and focuses on the findings of ongoing monitoring by IMC and data from aquatic ecology monitoring sites on the Nepean River.

Aquatic Ecology Management and Monitoring

The requirements recommended in the AEA and included in the EP for Longwalls 705 to 711 and 905 (IMC 2022) included monitoring of the following indicators at impact and control sites as a measure of aquatic health:

- > Aquatic habitat, including fish habitat and riparian vegetation.
- > Aquatic macroinvertebrates sampled in accordance with the Australian River Assessment System (AUSRIVAS) and derived biotic indices.
- > Fish sampled using bait traps.
- > Limited in-situ water quality sampling; and
- > Species composition of aquatic macrophytes.

The AEA also included a literature review on the physical setting, aquatic habitat, water quality, aquatic macroinvertebrates, fish, threatened species, populations and ecological communities in Appin Area 7.

Table 1-1 summarises the monitoring that has been completed in Appin Area 7 in line with the AEA and EP. Pre-extraction monitoring for Longwall 709 was undertaken from 2003 to 2023.

Table 1-1 Timing of aquatic ecology monitoring events undertaken for Appin Area 7 Longwalls 705 to 711 before and after the commencement of extraction of each longwall. Monitoring included in situ water quality, AUSRIVAS macroinvertebrates, fish sampling and assessment of macrophytes unless otherwise identified. 'Bef' and 'Aft' indicate whether surveys were done before or after, respectively, commencement of extraction of each longwall.

Longwall No.	Start	Finish	Sep 03	Sep 05	Apr 08	Nov 08	Dec 10	Dec 11	Dec 12	Dec 13	Dec 14	Nov 15	Nov 16	Nov 17	Nov 18	Nov 19	Dec 20	Dec 21	Dec 22	Dec 23	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Report Reference			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Notes:			a	b	c			d	e	f	g										
705	Sep 12	Mar 14	Bef	Bef	Bef	Bef	Bef	Bef	Aft	Aft	Aft	Aft	Aft	Aft	Aft	Aft	Aft	Aft	Aft	Aft	
706	Apr 14	Nov 15	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Aft	Aft	Aft	Aft	Aft	Aft	Aft	Aft	Aft	Aft	
707A/B	Jan 16	Jun 18	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Aft	Aft	Aft	Aft	Aft	Aft	Aft	Aft	
708A/B	Apr 19	Jan 22	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Aft	Aft	Aft	Aft	Aft	
709	Feb 22	Oct 23	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Aft	Aft
710A/B	Nov 23		Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef
711	Yet to commence		Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef

Report Reference: (1) The Ecology Lab (2004), (2) The Ecology Lab (2006), (3) The Ecology Lab (2008b), (4) The Ecology Lab (2009), (5) Cardno Ecology Lab (2011), (6) Cardno Ecology Lab (2012), (7) Cardno Ecology Lab (2013), (8) (Cardno Ecology Lab 2014), (9) Cardno Ecology Lab (2015), (10) Cardno (2016), (11) Cardno (2017), (12) Cardno (2018), (13) Cardno (2019), (14) Cardno (2020), (15) Cardno (2021b), (16) Cardno (2022), (17) Stantec (2023), and (18) Stantec (*in prep*).

Notes: a) Sites 1 to 6 only, b) macrophyte assessment at Sites 1 to 6 only, c) fish sampling only, d) macroinvertebrate and fish sampling only, Sites 7 and 8 not sampled, e) macroinvertebrate and fish sampling only, Sites 7 and 8 were also not sampled for any indicator, f) macrophyte assessment undertaken in January 2014, no water quality, fish and macroinvertebrate sampling at Sites 3 and 4, g) Sites X5 and X6 sampled in January 2015.

The current assessment for the AFFR for the Longwall 709 EoP considers the findings of existing aquatic ecology surveys of Appin Area 7 monitoring sites undertaken from 2003 to 2023. This includes the most recent aquatic ecology surveys undertaken in December 2022 following the commencement of extraction of Longwall 709 and in December 2023 following the completion of extraction of Longwall 709. Recent findings of surveys of physical mining impacts undertaken by the Illawarra Metallurgical Coal Environmental Field Team (IMCEFT) (IMC 2023) and of changes in surface water quality assessed by HGEO (2023) are also included. IMCEFT undertake weekly monitoring of landscape and natural features in Appin Area 7 when features are within 400 m of the active longwall, and monthly thereafter. This includes monitoring during extraction of Appin Area 7 longwalls to identify any fracturing, pool water level reduction, changes in flow and water quality in the Nepean River.

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

- > Level 1 – Reduction in aquatic habitat resulting from the mining over 1 season.
- > Level 2 – Reduction in aquatic habitat resulting from the mining over 2 seasons.
- > Level 3 – Reduction in aquatic habitat resulting from the mining for >2 consecutive seasons or complete loss of habitat.

Impacts exceed predictions when mining results in more than negligible environmental consequences for a threatened species, threatened population or endangered ecological community. Trigger specific management actions aim to minimise any further impacts to the aquatic environment, and include requirements for further monitoring, reporting, application of mitigation measures and notification of relevant stakeholders, as required.

Predicted and Observed Impacts

Physical and Water Quality Mining Impacts

The results of impact monitoring undertaken in the Nepean River by IMCEFT and other specialist consultants during extraction of Longwall 709 are provided in IMC (2023). The results of impact monitoring undertaken in the Nepean River by IMCEFT and Stantec are compared with the impacts to aquatic habitat and biota predicted to occur in the aquatic assessment (Cardno 2021a), EP (IMC 2022) and other specialist studies in **Table 1-2**. IMCEFT identified no new impacts associated with the extraction of Longwall 709. Three previously reported

Appin Area 7 gas release zones had active gas release during Longwall 709 extraction (**Figure 1-1**). These were Gas Zone 18 located on the Nepean River approximately 5 km upstream of Longwall 709, Gas Zone 4 on Elladale Creek near its confluence with the Nepean River approximately 4 km upstream of Longwall 709 and Gas Zone 10 on Ousedale Creek near its confluence with the Nepean River approximately 1 km upstream of Longwall 709. The areas of gas release ranged from 0.5 m² to 30 m².

No changes to water quality or water levels were identified in the Nepean River or its tributaries within 400 m of Longwall 709 following the commencement of extraction of this longwall that could be attributed to mining (HGEO 2023). Reductions in pool water levels at site NR0 were comparable to changes that occurred at control site NR110 and are thus not considered to be related to mining (HGEO 2023). An increase in EC and reduction in pH was observed at some sites on the Nepean River and/or tributaries during extraction of Longwall 709. Although these constituted triggers in the water quality TARPs, these relate to a general reduction in rainfall and flow, and an increase in evaporative conditions in the Nepean River catchment and therefore are likely not related to mining (HGEO 2023).

Table 1-2 Predicted and observed impacts to aquatic ecology in the Nepean River associated with Longwall 709.

Attribute	Predicted Physical Impacts	Associated Predicted Impacts on Aquatic Ecology	Observed Impacts
Nepean River			
Ponding, flooding and scouring of stream banks	<p>The maximum predicted subsidence, upsidence and closure experienced by the Nepean River, resulting from the extraction of Longwalls 709 to 711 and 905, is less than 20 mm (MSEC 2021).</p> <p>The river is not predicted to experience any significant changes in the levels of ponding, flooding or scouring of the riverbanks, or any significant changes in the water levels or stream alignment due to longwall extraction.</p>	<p>There are unlikely to be any measurable impacts on the availability or connectivity of aquatic habitats in the downstream reach of the Nepean River due to its flooded nature and very low gradient</p>	<p>No changes in ponding flooding and scouring of stream banks observed (IMC 2023). No impacts to aquatic ecology identified during observations by Stantec of aquatic macroinvertebrates, fish and aquatic macrophytes in December 2022 or December 2023 (Stantec 2023; Stantec <i>in prep</i>).</p>
Fracturing of bedrock and diversion of surface flows	<p>The Nepean River is located a minimum distance of 1.5 km from the longwalls. The Nepean River would experience vertical subsidence, upsidence and closure of less than 20 mm. It is considered unlikely, therefore, that the Nepean River would experience adverse physical impacts due to the mining-induced movements from Longwalls 709 to 711 and 905.</p> <p>Any minor fracturing is not predicted to lead to significant water loss or reductions in flow due to the flooded nature of the river and regulatory influence of Menangle Weir.</p>	<p>It is considered unlikely that there would be any net loss of water from the catchment. No significant changes in the quantity or quality of permanent aquatic habitat.</p>	<p>No fracturing (IMC 2023) or changes to surface flow (HGEO 2023) observed. Some reductions in pool water levels that occurred at impact sites also occurred at control sites, and thus were not considered to be related to mining (HGEO 2023). Regardless, no impacts to aquatic ecology identified during observations of aquatic macroinvertebrates, fish and aquatic macrophytes in December 2022 or December 2023 (Stantec 2023; Stantec <i>in prep</i>).</p>
Gas releases	<p>Minor gas releases, associated iron precipitate and reductions in concentrations of dissolved oxygen may occur due to extraction.</p>	<p>Negligible environmental consequences were predicted associated with minor gas releases.</p>	<p>No new gas release zones were identified during extraction of Longwall 709.</p> <p>One previously identified gas release was observed to be active in the Nepean River during extraction of Longwall 709, however, this was not attributed to extraction of Longwall 709.</p> <p>No changes to indicators of aquatic ecology at monitoring sites have been observed (Stantec 2023; Stantec <i>in prep</i>).</p>
Water Quality	<p>Minor changes in water quality could occur due to gas releases, including associated iron precipitate and reductions in concentrations of dissolved oxygen (DO).</p> <p>Longwall extraction is not anticipated to have any significant impacts on surface water quality or availability as a result of mining the proposed longwalls (SLR 2021a; b).</p>	<p>No more than minor associated impacts to aquatic biota are expected.</p>	<p>No mining-induced changes to water quality have been observed following commencement of extraction of Longwall 709 (IMC 2023, HGEO 2023).</p> <p>No changes to indicators of aquatic ecology were observed at aquatic ecology monitoring sites (Stantec 2023; Stantec <i>in prep</i>).</p>

Attribute	Predicted Physical Impacts	Associated Predicted Impacts on Aquatic Ecology	Observed Impacts
Tributaries			
Ponding, flooding and scouring of stream banks	<p>No reversals of stream grade in third order watercourses (Foot Onslow Creek, Harris Creek, Navigation Creek and Navigation Creek Tributary 1) or in first and second order watercourses are predicted. Large-scale adverse changes in the levels of ponding or scouring of the banks due to the mining induced tilt are, thus, unlikely.</p> <p>It is possible localised ponding could develop where the natural grades are small. The potential impacts within tributaries are expected to be minor and localised. Impacts resulting from changes in surface water flows due to mining-induced tilt are expected to be small in comparison with those which occur during natural flooding conditions.</p>	<p>Localised and minor changes in habitat availability and connectivity may occur but these effects will be difficult to detect due the high variability in natural flows within these ephemeral watercourses. Consequently, impacts to aquatic habitat and biota due to tilt, if any, are expected to be minor and localised in drainage lines located directly above and within 400 m of the proposed longwalls.</p>	<p>No changes in ponding flooding and scouring of stream banks observed (IMC 2023). No associated impacts to aquatic habitat or biota therefore expected.</p>
Fracturing of bedrock and diversion of surface flows	<p>Fracturing of the uppermost bedrock could occur along watercourses that are located directly above or adjacent to the proposed longwalls (including Navigation Creek, Foot Onslow Creek and a small section of Harris Creek). Surface water flow diversions could occur in these watercourses.</p> <p>In times of heavy rainfall, the majority 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.</p>	<p>Fracturing may result in the draining of pools in these watercourses, particularly during low flows, resulting in a reduction in the availability of aquatic habitat and the connectivity of remaining habitat. This may result in the reduction in population size of aquatic biota at the scale of individual watercourses.</p> <p>However, given the natural ephemeral / intermittent nature of these watercourses and the abundance of such habitat in the Nepean River Catchment, impacts on aquatic habitat and biota are expected to be negligible at this catchment scale.</p>	<p>No fracturing observed in tributaries of the Nepean River (IMC 2023). No associated impacts to aquatic habitat or biota therefore expected.</p>
Gas releases	<p>Minor gas releases, associated iron precipitate and reductions in concentrations of dissolved oxygen may occur due to extraction.</p>	<p>Negligible environmental consequences were predicted associated with minor gas releases.</p>	<p>No new gas release zone identified during extraction of Longwall 709.</p> <p>Two previously identified gas release were observed to be active in tributaries of the Nepean River during extraction of Longwall 709, however, these were not attributed to extraction of Longwall 709.</p> <p>No changes to indicators of aquatic ecology in downstream sections of the Nepean River have been observed (Stantec 2023; Stantec <i>in prep</i>). Any effect on aquatic habitat or biota due to isolated gas releases in tributaries would be expected to be localised, minor in magnitude and negligible at the scale of the Nepean River catchment.</p>
Water Quality	<p>Longwall extraction is not anticipated to have any significant impacts on surface water quality or availability due to mining the proposed longwalls (SLR 2021a; b).</p>	<p>No significant impacts to aquatic habitat or biota expected in the absence of impacts to water quality.</p>	<p>No mining-induced changes to water quality have been observed following commencement of extraction of Longwall 709 (IMC 2023, HGEO 2023). No associated impacts to aquatic habitat or biota therefore expected.</p>

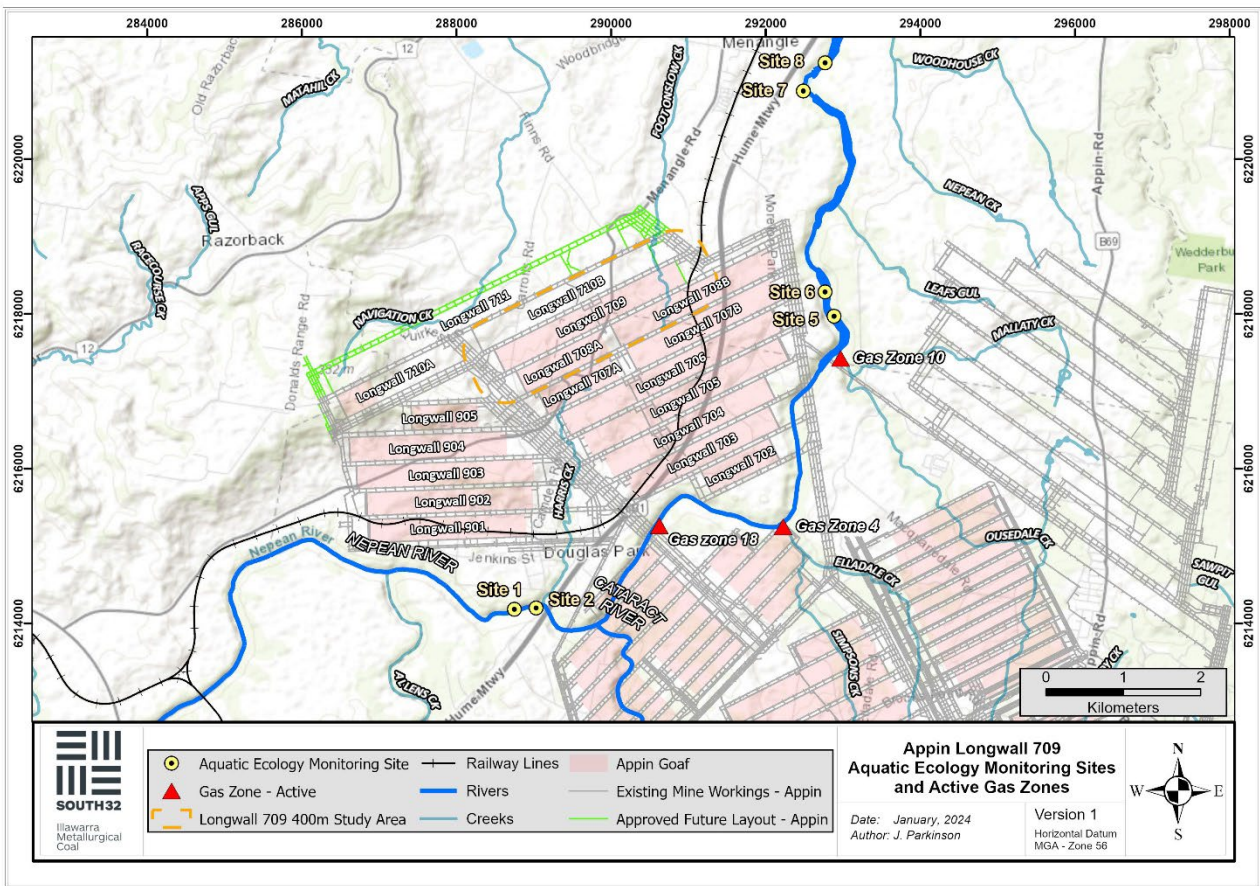


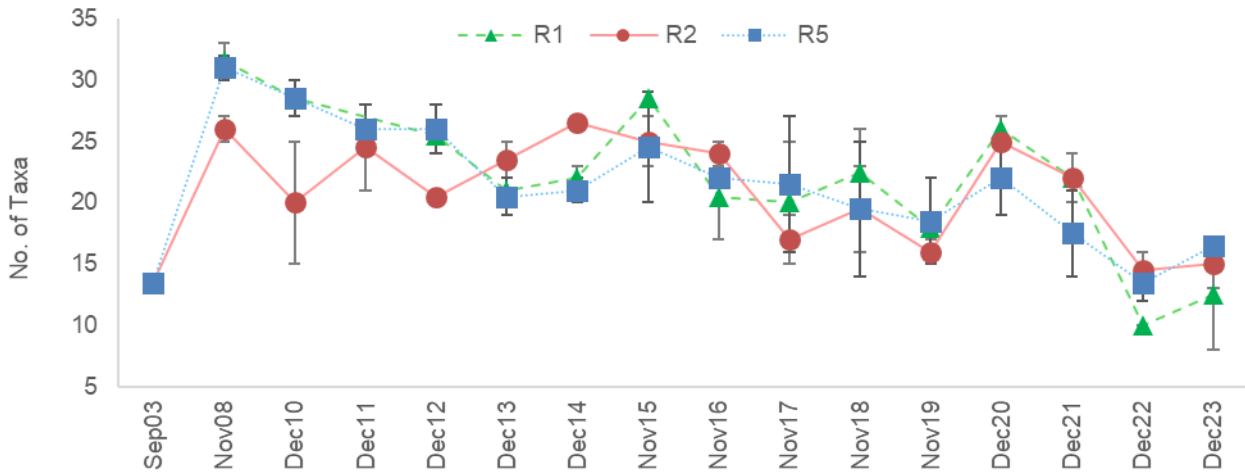
Figure 1-1 Aquatic ecology monitoring site locations and active gas release zones on the Nepean River, Elladale Creek and Ousedale Creek during the extraction of Longwall 709 in December 2023.

Impacts on Aquatic Habitat and Biota

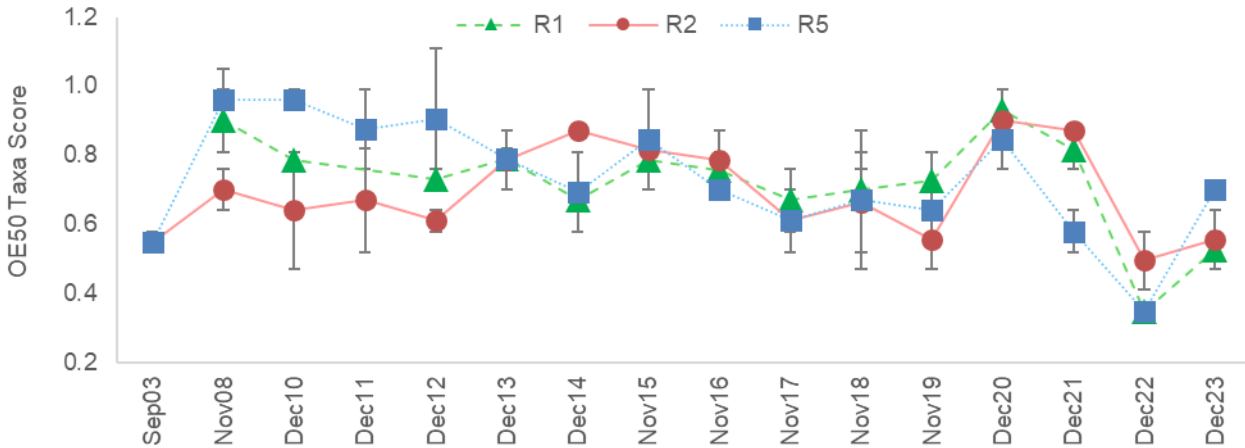
There were no observed impacts to indicators of aquatic ecology that could be attributed to extraction of Longwall 709 in data collected following commencement of extraction of this longwall in December 2022 (Stantec 2023) and December 2023 (Stantec *in prep*). None of the AUSRIVAS aquatic macroinvertebrate indices, including Total no. of Taxa (**Figure 1-2a**), OE50 Taxa Scores (a biotic index of habitat and water quality) (**Figure 1-2b**) or SIGNAL2 Score (a biotic index of water pollution) (**Figure 1-2c**), indicated changes occurred at Sites 5 and 6 (impact sites for Longwall 709) (Reach 2) in December 2022 or December 2023 that could be attributed to extraction of Longwall 709 (Stantec 2023; Stantec *in prep*). Changes that occurred in these indices at Reach 2 in December of 2022 and 2023 were comparable to those at control Sites 1 and 2 (Reach 5), and 7 and 8 (Reach 1). Although there was an apparent increase in SIGNAL2 Score at Reach 2 evident in 2023 relative to Reach 1 and Reach 5, such an increase in SIGNAL2 Score (and associated improvement in water quality) would not be expected to be associated with mining. There was also no evidence of mining related impacts in fish or macrophyte data collected in December 2023 (Stantec, *in prep*). Further detailed analysis of all data collected in December 2023 will be undertaken and reported in early 2024 (Stantec *in prep*).

The aquatic habitat in sections of Nepean River visited during the aquatic ecology monitoring program was generally in good condition and there was no evidence of any change in the availability of aquatic habitat that could be attributed to mining. Poor water quality, particularly water at the bottom of the water column, and alteration to the natural flow regime of the river due to several flow controlling structures within, upstream and downstream of the study area, may explain the often depauperate macroinvertebrate assemblages sampled. There was no evidence that any impaired aquatic habitat or water quality is due to any mining related disturbance in the Nepean River.

a) Number of Taxa



b) OE50 Taxa Score



c) SIGNAL2 Score

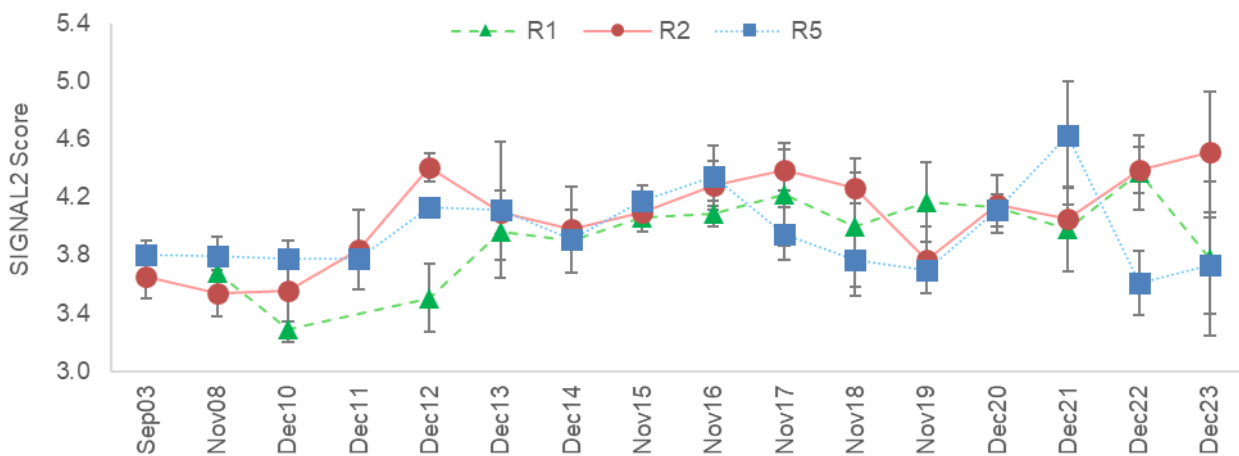


Figure 1-2 a) Number of taxa, b) SIGNAL2 Scores and c) OE50 Taxa Scores from AUSRIVAS sampling at Sites in Nepean River 2003 to 2023.

There was no evidence of any changes to fish and aquatic macrophytes attributable to mining. The fish assemblage sampled in the Nepean River following the commencement of extraction of Longwall 709 was comparable with that sampled prior to extraction and no fish kills or any other observations that may suggest an impact due to mining have been observed. Over the course of the monitoring program large changes in the distribution of aquatic macrophytes have occurred. High flows that occurred in the river between November of 2016 and 2017 appeared to have had a substantial effect on the extent of aquatic macrophytes irrespective of mining. (Cardno 2018). The more recent high flow event that occurred in 2022 appeared to have had a more limited effect on the composition and extent of aquatic macrophytes at the sites surveyed in December 2022 (Stantec 2023). The species composition of macrophytes has been relatively consistent and the number and type of species identified in December 2022 and December 2023 were very similar to those identified previously, albeit turbid water due to recent rainfall in December 2021 likely obscured some submerged plants. Given the absence of any observed macrophyte desiccation and die-back, there was no evidence to suggest that changes in macrophyte diversity and distributions are outside what would be expected due to natural variation.

The absence of impacts associated with extraction of Longwall 709 (and previous longwalls) could be expected given only minor gas releases have previously been observed in the Nepean River associated with mining. Statistically significant differences in these indicators among surveys and monitoring locations on the Nepean River, where present, were previously attributed to natural spatial and temporal variation, rather than mining (Stantec 2023).

No significant impacts to aquatic habitat and biota in tributaries of the Nepean River associated with extraction of Longwall 709 were observed. No physical impacts such as fracturing and flow diversions were observed by IMC (2023) nor were there any changes to water quality following commencement of extraction of Longwall 709 that could be attributed to mining (HGEO 2023). There is no evidence that previously identified gas releases in Elladale Creek and Ousedale Creek that were active during extraction of Longwall 709 have significantly affected water quality in these tributaries, and, thus, significant impacts to aquatic habitat and biota are therefore not expected.

Aquatic Ecology TARP

Table 1-3 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 709 may be appropriate, if any. No reduction in aquatic habitat was observed on the Nepean River during the aquatic ecology monitoring program that could be attributed to mining. Thus, the TARP has not been triggered.

Table 1-3 TARP levels applicable to aquatic features relevant to Longwall 709, as of January 2024.

TARP	Trigger
Level 1 – Reduction in aquatic habitat resulting from the mining over 1 season.	Not triggered
Level 2 – Reduction in aquatic habitat resulting from the mining over 2 seasons.	Not triggered
Level 3 – Reduction in aquatic habitat resulting from the mining for >2 consecutive seasons or complete loss of habitat.	Not triggered
Exceeding Predictions: Mining results in more than negligible environmental consequences for a threatened species, threatened population or endangered ecological communities.	Not triggered

Conclusion and Recommendations

No changes to aquatic ecology indicators that could be associated with extraction of Longwall 709 have been detected in aquatic ecology data collected in the Nepean River in December 2022 and December 2023. This was expected given only minor gas releases have been observed in the Nepean River associated with mining. The gas releases in the Nepean River active during extraction of Longwall 709 do not appear to have had any measurable effect on water quality, aquatic macroinvertebrates, fish and macrophytes in the Nepean River. Further monitoring will be undertaken at all Appin Area 7 potential impact and control sites in Spring 2024. This will include a further assessment of any changes to aquatic habitat and biota that may have occurred at Appin Area 7 monitoring sites following the completion of Longwall 709 and subsequent longwalls.



Yours sincerely,

A handwritten signature in black ink, appearing to read 'DP', with a horizontal line underneath.

Daniel Pygas
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for Stantec
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