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Attention: Josh Carlon

Dear Josh,

APPIN AREA 7 LONGWALL 708 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 710. The sequence of longwall extraction has been as follows:

- > Longwall 701: 27 October 2007 to 9 May 2008;
- > Longwall 702: 18 September 2008 to 20 May 2009;
- > Longwall 703: 22 October 2009 to 3 March 2011;
- > Longwall 704: 7 May 2011 to 29 July 2012;
- > Longwall 705: 7 September 2012 to 27 March 2014;
- > Longwall 706: 23 April 2014 to 28 November 2015; and
- > Longwall 707: 7 January 2016 to 19 June 2018; and
- > Longwall 708: 2 April 2019 to 3 January 2022.

Cardno NSW/ACT now Stantec (Cardno) was commissioned by IMC to undertake an Aquatic Flora and Fauna Review (AFFR) in relation to the extraction of Longwall 708 (sections 708A and 708B) to support the End of Panel (EoP) reporting for the longwall. Cardno 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 (The Ecology Lab 2004) and Subsidence Management Plan (SMP) for Longwalls 705 to 710 (Cardno Forbes Rigby 2008). 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 Cardno and a comparison with those predicted in the SMP; and
- > Recommendations for any management actions associated with aquatic habitat and biota and future monitoring.

This review considers the effects of extraction of Longwall 708 in Appin Area 7 and focuses on the findings of ongoing monitoring by IMC and on data from aquatic ecology monitoring sites on the Nepean River.

Aquatic Ecology Management and Monitoring

The monitoring requirements recommended in the aquatic assessment and included in the SMP for Longwalls 705 to 710 included monitoring of 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.

Table 1-1 summarises the monitoring that has been completed in Appin Area 7 in line with the aquatic assessment and SMP. Pre-extraction monitoring for Longwall 708 was undertaken 2003 to 2018. Monitoring in November 2019, December 2020 and December 2021 provided post extraction data for this longwall. The aquatic assessment 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 Timing of aquatic ecology monitoring events undertaken for Appin Area 7 Longwalls 705 to 710 before and after the commencement of extraction of each longwall. Monitoring included in situ water quality, AUSRIVAS macroinvertebrates, and 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

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
Report Reference			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
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
706	Apr 14	Nov 15	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	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
708A/B	Apr 19	Jan 22	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Bef	Aft	Aft	Aft
709 & 710	Commenced Feb 22		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 (2021) and 16 (Cardno *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 708 EoP considers the findings of previous surveys of Appin Area 7 monitoring sites and the recent findings of surveys for physical mining impacts undertaken by the Illawarra Metallurgical Coal Environmental Field Team (IMCEFT) (IMC 2022) and of changes in surface water quality assessed by HGEO (2022). 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 SMP includes the following triggers as part of the Trigger Action Response Plans (TARPs) relating to aquatic ecology:

- > Level 1 – 1 season reduction in aquatic habitat resulting from mining when compared with baseline condition;

- > Level 2 – 2 consecutive season reduction in aquatic habitat resulting from mining when compared with baseline condition; and
- > Level 3 – greater than 2 consecutive season reduction in aquatic habitat resulting from mining or a complete loss of habitat.

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

The results of impact monitoring undertaken in the Nepean River by IMCEFT and other specialist consultants during extraction of Longwall 708 are provided in IMC (2022). The results of impact monitoring undertaken in the Nepean River by IMCEFT and Cardno are compared with the impacts to aquatic habitat and biota predicted to occur in the in the aquatic assessment (The Ecology Lab 2004) and SMP in **Table 1-2**. IMCEFT identified no new impacts or triggers associated with the extraction of Longwall 708. One update to an existing gas release on the Nepean River was identified. This related to gas release AA7_LW703_Gas Zone 10 on Ousedale Creek first identified during extraction of Longwall 703 on 21 May 2010 (**Figure 1-2**). The site is approximately 2,050 m from Longwall 708B at its closest point and is not attributed to extraction of Longwall 708. Three other gas release zones on the Nepean River (Zones 4, 5 and 15) were observed to be active at some point during extraction of Longwall 708. However, these were over 4 km upstream of the eastern end of Longwall 708 (closest to the Nepean River) and were not attributed to this longwall. No gas releases, fracturing, changes in water levels and flow or changes in water quality have been attributed to mining of Longwall 708 (HGEO 2022).

Table 1-2 Predicted and observed impacts to aquatic ecology in the Nepean River associated with Longwall 708

Attribute	Predicted Physical Impacts	Associated Predicted Impacts on Aquatic Ecology	Observed Impacts
Ponding, flooding and scouring of stream banks	<p>The river is not predicted to experience any significant changes in the levels of ponding, flooding or scouring of the river banks, or any significant changes in the water levels or stream alignment due to longwall extraction.</p> <p>The maximum predicted cumulative subsidence and upsidence on the Nepean River, resulting from the extraction of Longwalls 701 to 710, is 60 mm and 380 mm respectively (MSEC 2008). This could affect the level of the river bed and banks, with some sections of the river becoming slightly shallower.</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	No changes in ponding flooding and scouring of stream banks observed (IMC 2022). No impacts to aquatic ecology identified during observations by Cardno of aquatic macroinvertebrates, fish and aquatic macrophytes in December 2021 (Cardno <i>in prep</i>).
Fracturing of bedrock and diversion of surface flows	Mining may also cause minor fracturing of the river bed, but this 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.	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.	No fracturing observed (IMC 2022). No impacts to aquatic ecology identified during observations of aquatic macroinvertebrates, fish and aquatic macrophytes (Cardno <i>in prep</i>).
Gas releases	Minor gas releases, associated iron precipitate and reductions in concentrations of dissolved oxygen may occur due to extraction.	Negligible environmental consequences	<p>No new gas release zone identified during extraction of Longwall 708.</p> <p>Four existing gas releases were observed to be active during Longwall 708, however are not attributed to the longwall.</p> <p>No changes to indicators of aquatic ecology at monitoring sites have been observed (Cardno <i>in prep</i>).</p>
Water Quality	<p>Localised iron staining may occur.</p> <p>Minor changes to water quality may occur.</p>	No more than minor associated impacts to aquatic biota are expected.	<p>No mining-induced changes to water quality have been observed by IMCEFT or Cardno during extraction of Longwall 708</p> <p>Regardless, no associated changes to indicators of aquatic ecology were observed at aquatic ecology monitoring sites (Cardno <i>in prep</i>).</p>

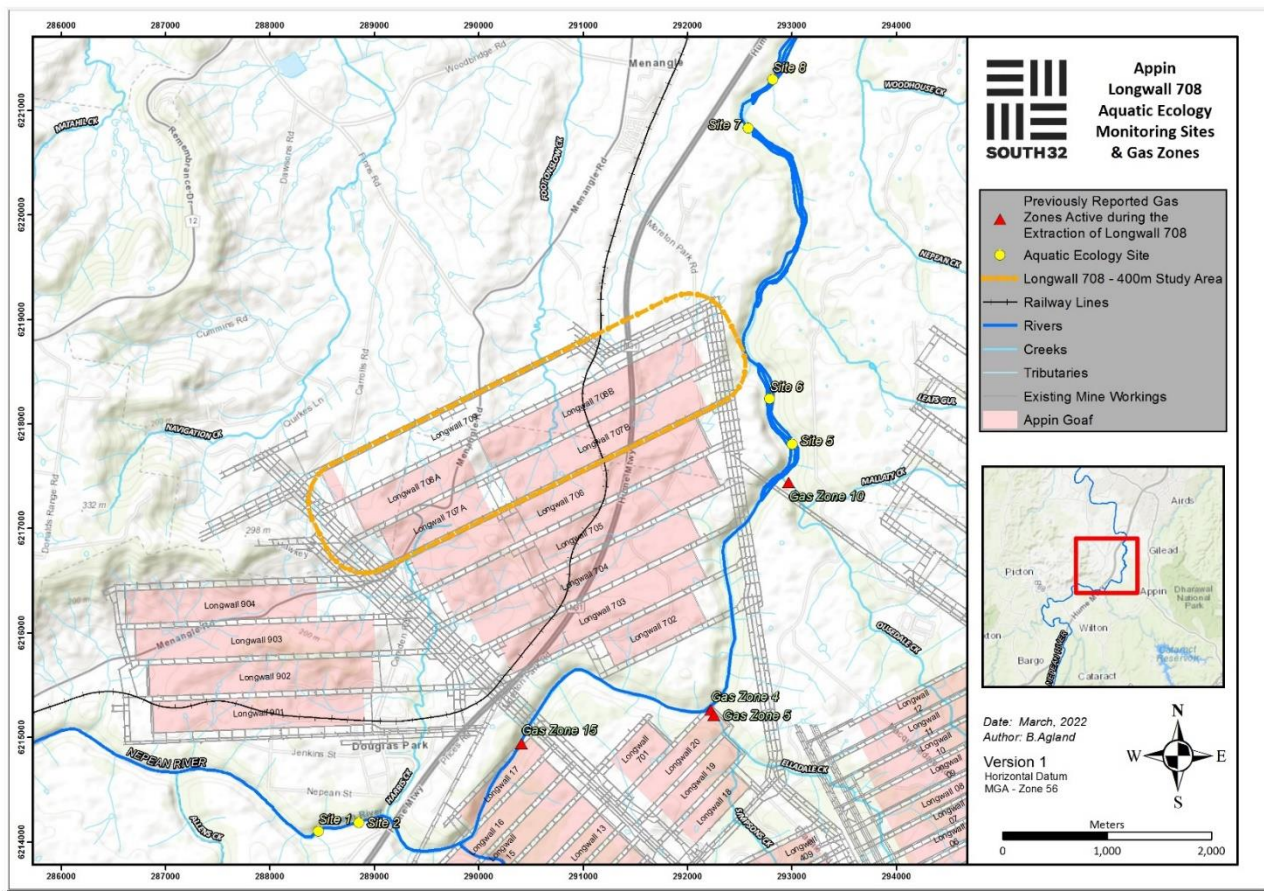


Figure 1-2 Existing gas release zones on the Nepean River and Ousedale Creek April 2022

There were no observed impacts to indicators of aquatic ecology (number of taxa and biotic indices derived from macroinvertebrate sampling) that could be attributed to extraction of Longwall 708 in data collected following commencement of extraction of this longwall, including during the most recent surveys in December 2021 (Cardno *in prep*). These results were not surprising 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 attributed to natural spatial and temporal variation, rather than mining. 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.

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 708 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. Most recently, high flows that occurred in the river between November of 2016 and 2017 appear to have had a substantial effect on the extent of aquatic macrophytes irrespective of mining. Despite this, the species composition of macrophytes has been relatively consistent and the number and type of species identified in December 2021 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.

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 708 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, TARPs have not been triggered.

Table 1-3 TARP levels applicable to aquatic features relevant to Longwall 708 as of March 2022.

TARP	Trigger
Level 1 – 1 season reduction in aquatic habitat resulting from mining when compared with baseline condition.	Not triggered
Level 2 – 2 consecutive season reduction in aquatic habitat resulting from mining when compared with baseline condition.	Not triggered
Level 3 – greater than 2 consecutive season reduction in aquatic habitat resulting from mining or a complete loss of habitat.	Not triggered

Conclusion and Recommendations

No changes to aquatic ecology indicators that could be associated with extraction of Longwall 708 have been detected in aquatic ecology data collected in December 2021. This was not surprising given no more than minor gas releases and change in water quality have been observed in the Nepean River associated with mining. The gas releases and identified in the Nepean River active during extraction of Longwall 708 do not appear to have had any measurable effect on 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 2022. 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 708.

Yours sincerely,



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