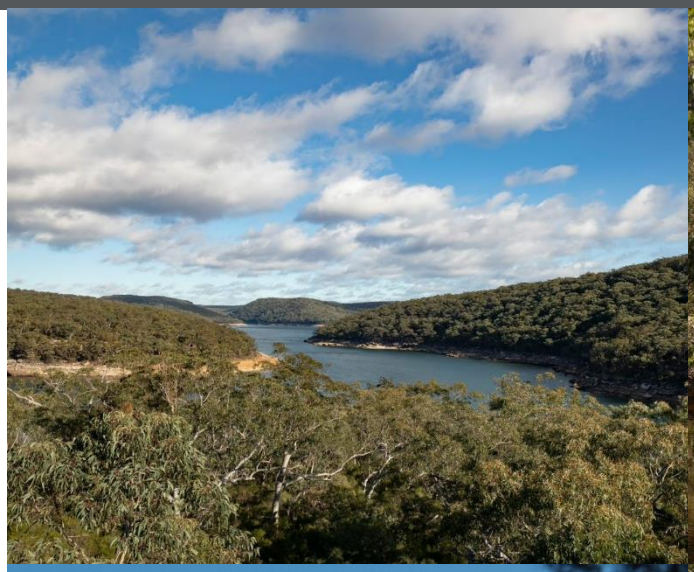
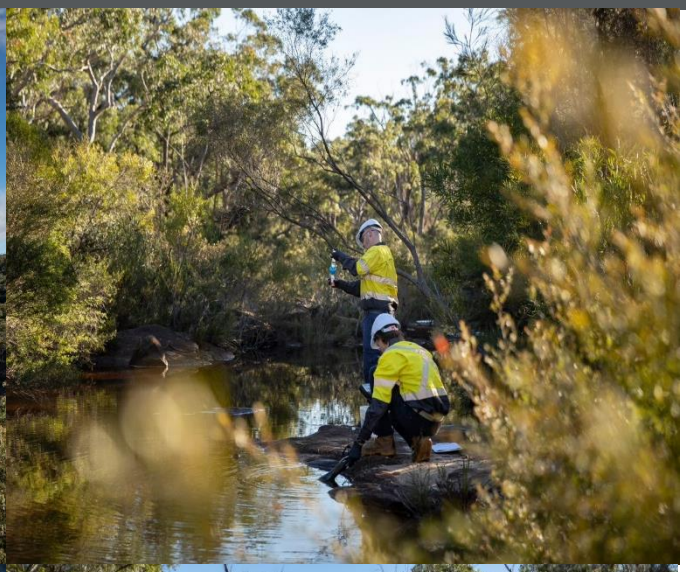
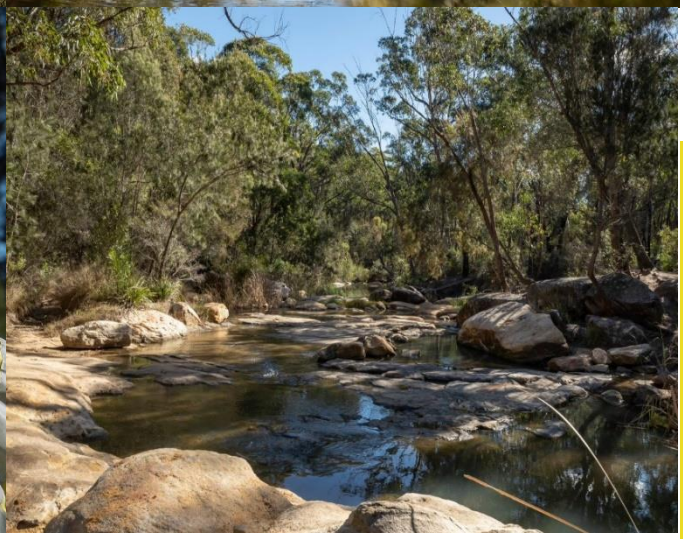
Illawarra Metallurgical Coal

Landscape Report







Appin Mine Longwall 905 Landscape Report

2023

EXECUTIVE SUMMARY

This report has been prepared by the South32 Illawarra Metallurgical Coal Environmental Field Team (IMCEFT) to summarise the observed and measured subsidence effects on water, landscape features and terrestrial ecology, resulting from the extraction of Longwall 905.

Extraction of Longwall 905 commenced on 25 September 2022 and was completed on 28 February 2023.

The IMCEFT conducts detailed monitoring and inspections of landscape features including the Nepean River, tributaries, cliffs and steep slopes, and private properties. This monitoring was conducted in accordance with the Appin Longwalls 709 to 711 and 905 Extraction Plan (EP), dated July 2022.

IMCEFT identified no new surface impacts associated with the extraction of Longwall 905. Results from specialist analysis and assessment will be incorporated in the Longwall 905 End of Panel Summary Report and associated attachments.

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ABBREVIATIONS

CMA – Corrective Management Action

DPE - Department of Planning and Environment

DPI – Department of Primary Industries

DRE - Department of Department of Resources and Geoscience

EoP – End of Panel

EP – Extraction Plan

IMCEFT – Illawarra Metallurgical Coal Environmental Field Team

OEH - Office of Environment and Heritage (now BCD)

BCD- Biodiversity and Conservation Division (formerly OEH)

SCA – Sydney Catchment Authority (now WaterNSW)

SA NSW – Subsidence Advisory NSW

TARP – Trigger Action Response Plan

1 INTRODUCTION

This report outlines monitoring of landscape features relevant to Longwall 905 and forms part of the Appin Area 9 Longwall 905 End of Panel Report (EoP Report). Monitored features include the Nepean River and its tributaries, cliffs and steep slopes, terrestrial flora, as well as private properties (farm dams and private boreholes). Monitoring of landscape features relevant to Longwall 905 has been carried out in accordance with Appin Longwalls 709 to 711 and 905 Extraction Plan (EP), dated July 2022. The Trigger Action Response Plan (TARP) details the actions required for any subsidence impacts (Appendix B).

Extraction of Longwall 905 commenced on 25 September 2022 and was completed on 28 February 2023. Monitoring was conducted for landscape features for Longwall 905 during baseline, active mining (i.e. longwall within 400m of a feature) and post-mining periods. This monitoring involved measurement of surface water quality and levels, groundwater quality and levels, from Illawarra Metallurgical Coal (IMC) boreholes and private bores, and general observation of landscape features within the mining area. The results of the monitoring are outlined in the relevant sections below.

2 SUMMARY OF MONITORING PROGRAM

The Appin Longwall 709 to 711 and 905 monitoring program has been designed to identify impacts and consequences of mining and is presented in Figure 1 and Figure 3. Monitoring is conducted during baseline, active-mining and post-mining periods. Baseline inspections are undertaken up until the longwall is within 400m of a feature. During active mining, inspections typically increase to weekly until the longwall is 400m past the feature. Monthly post-mining inspections continue as outlined in the EP.

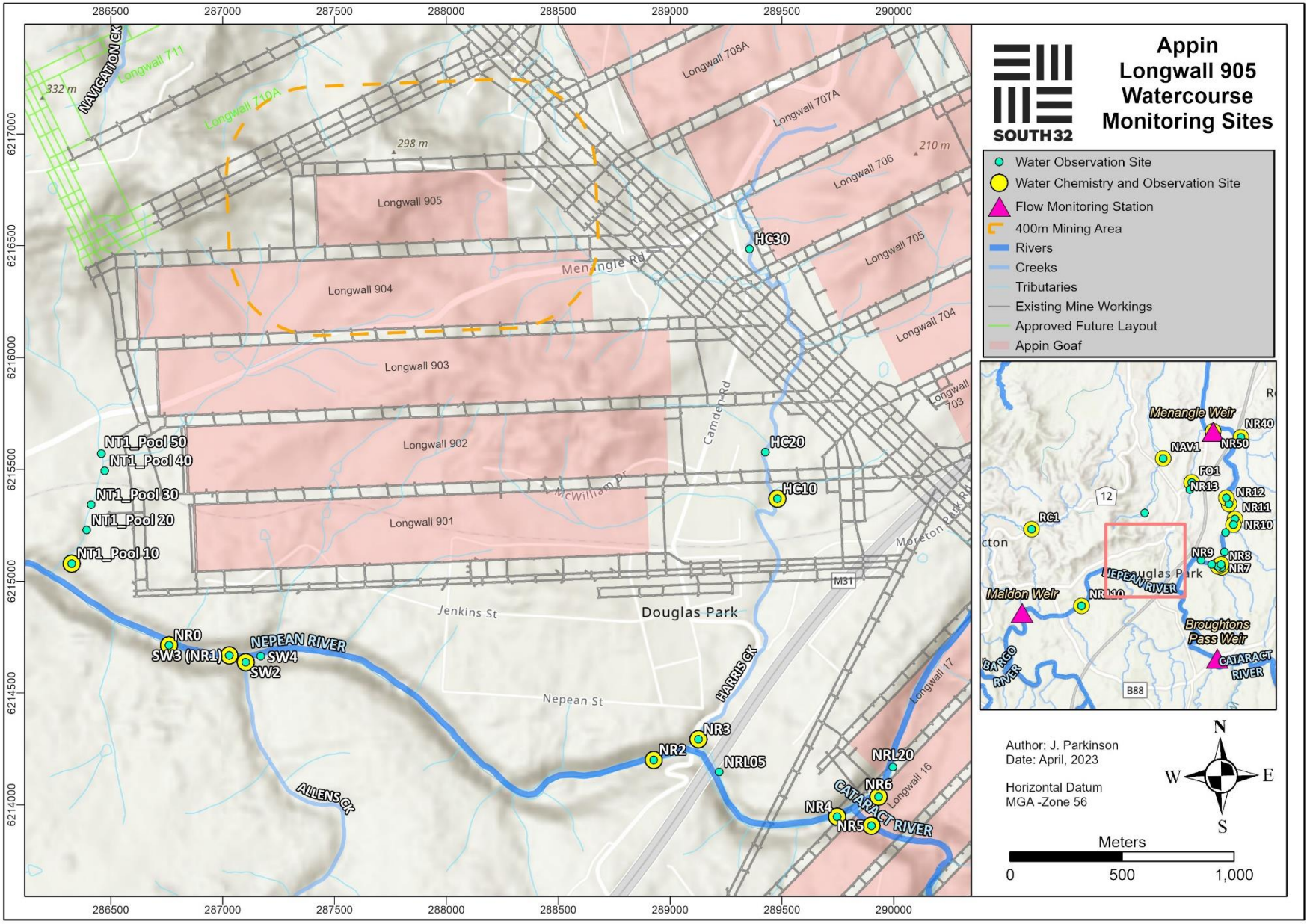

Figure 1: Map showing IMC surface water monitoring sites relevant to Longwall 905.

3 SUMMARY OF IMPACTS

Monitoring and inspections of the Nepean River and its associated tributaries is undertaken in accordance with the approved Appin Longwalls 709 to 711 and 905 EP. Monitoring is conducted by IMCEFT monthly prior to and after mining, and weekly during active subsidence. Water quality and water levels are recorded along with photographic records and observational notes.

During the extraction of Longwall 905, no new surface impacts were observed.

3.1 Water Quality

In-situ water quality parameters are measured at relevant monitoring sites on the Nepean River and its tributaries. In-situ water quality parameters include temperature, electrical conductivity (EC), oxidation-reduction potential (ORP), pH, dissolved oxygen (DO) as well as visual observations. Water samples are also taken for laboratory analysis. Specialist assessment of water quality results will be included in the Surface Water and Groundwater Assessment of the Longwall 905 EoP Report.

3.1.1 Gas Releases

No new gas releases were observed during the extraction of Longwall 905. 11 previously reported gas releases were active on the last inspection on 5 April 2023. Continued monitoring of gas release zones previously reported during the extraction of Longwall 901 to Longwall 904 was undertaken. The status of these releases during the latest inspection are summarised in Table 1. Previously reported gas releases have overall shown a decrease in size and intensity since initially reported. AA9_LW901_018 is the only gas zone to show an increase however the gas zone remains at a Level 1 Trigger. Monthly monitoring of gas zones will continue as per the EP.

Photo 1: Gas release zone AA9_LW901_018. Taken on 5/04/2023.

3.1.2 Water Level and Flow

Water levels in the Nepean River and its tributaries were monitored by IMCEFT using visual observations and water level measurements at installed benchmarks where available. Inspections are undertaken where access was safe and granted. No subsidence induced flooding of riverbanks was observed. Additionally, no areas of dry riverbed were observed. For additional assessment of water level and flow refer to the Surface Water and Groundwater Assessment of the Longwall 905 EoP Report.

3.1.3 Appearance

The appearance of the Nepean River and its tributaries was monitored by IMCEFT where access was safe and granted. Photographs are taken at monitoring sites, gas zones and any other potential impact site. Apart from the previously mentioned gas release zones, no impacts to the appearance of the Nepean River or tributaries were observed during the extraction of Longwall 905. High rainfall events during 2022 lead to IMCEFT observing erosion to riverbanks, loss of vegetation cover and sediment movement along the Nepean River.

3.1.4 Groundwater

IMC boreholes relevant to Longwall 905 are: S1941 and S2537. Specialist assessment of groundwater data (level and quality) will be included in the Surface Water and Groundwater Assessment of the Longwall 905 EoP Report. Additional boreholes may be assessed in the Surface Water and Groundwater Assessment.

3.1.5 Landscape Features

Observations of cliff lines and steep slopes along the Nepean Gorge and associated tributaries were undertaken by IMCEFT on a monthly basis where access permitted. Monitoring included observational and photographic records, and monitoring of piezometers and slope inclinometers. No impacts to cliffs were identified during the extraction of Longwall 905. Observations above the active longwall were conducted where access was available. Further discussion of observations to property features will be included in the Longwall 905 EoP Report

3.1.6 Terrestrial Ecology

Terrestrial ecology in Appin Area 9 is monitored by IMCEFT in conjunction with general observational monitoring. Aspects that are considered whilst monitoring include changes in vegetation condition and vegetation that may have been impacted by rockfalls, soil slippage or gas emissions. No impacts or changes to terrestrial ecology were observed during monitoring for Longwall 905.

3.1.7 Private Property Inspections

Built Feature Management Plans (BFMPs) have been prepared by IMC for landholders above Appin Longwalls. Post-mining inspection of dams, boreholes and natural features set out in the BFMPs are conducted by IMCEFT with the consent of relevant property/infrastructure owner and tenant (if applicable). Post-mining inspections were undertaken at properties Lot 16 DP251063, Lot 900 DP1072947 and Lot 1 DP810978 (Figure 3). Lot 22 DP803255 was also reinspected following a recommendation in the Longwall 904 EoP Report. Monitoring included collection of in-situ water quality parameters and water samples for laboratory analysis. Results of water quality will be included in the Surface Water and Groundwater Assessment of the Longwall 905 EoP Report.

3.1.8 Aboriginal Archaeology

No Registered Aboriginal Archaeological Sites are located within the Study Area. There are no declared Aboriginal Places under the National Parks and Wildlife Act 1974 or identified Aboriginal Sites within the Study Area.

3.1.9 European Heritage

No Heritage Sites are located within the Study Area.

Table 1: Summary of Nepean River gas zones relevant to Appin Area 9, as of 5 April 2023.

Site ID	Easting	Northing	Impact Type	Identification Date	Status as of 5 April 2023	Date Last Active	Last Active Description	Impact Level	Report Date
AA9_LW901_001	286880	6214670	Gas Release	2/03/2016	Active	5/04/2023	1 gas release in an area of 1m^2 area. Release is light and intermittent	1	3/03/2016
AA9_LW901_002	286712	6214745	Gas Release	7/03/2016	Inactive	21/03/2016	1 release, light and intermittent	1	8/03/2016
AA9_LW901_003	286766	6214713	Gas Release	7/03/2016	Inactive	4/04/2016	1 release, light and intermittent	1	8/03/2016
AA9_LW901_004	286820	6214695	Gas Release	7/03/2016	Inactive	2/05/2016	1 release, light and intermittent	1	8/03/2016
AA9_LW901_005	286962	6214666	Gas Release	7/03/2016	Active	5/04/2023	7 releases in an area of 3m by 4m. light to moderate releases, constant to intermittent	1	8/03/2016
AA9_LW901_006	286997	6214667	Gas Release	7/03/2016	Inactive	24/01/2023	5 releases, in an area of 2m by 3m. moderate and intermittent releases	1	8/03/2016
AA9_LW901_007	287506	6214668	Gas Release	15/03/2016	Inactive	9/09/2021	3 releases within an area of 5m by 2m. Light and intermittent releases	1	16/03/2016
AA9_LW901_008	287065	6214662	Gas Release	18/03/2016	Inactive	24/01/2023	2 releases, light and intermittent in a 1m by 1m area.	1	22/03/2016
AA9_LW901_009	287249	6214679	Gas Release	18/03/2016	Active	5/04/2023	2 releases, 1 light, 1 moderate both intermittent in a 4m by 1m area.	1	22/03/2016
AA9_LW901_010	287317	6214697	Gas Release	18/03/2016	Active	5/04/2023	2 groups of releases, 2m by 2m and 3m by 3m. Approximately 10 releases in each, light and constant releases.	1	22/03/2016
AA9_LW901_011	287036	6214664	Gas Release	21/03/2016	Active	5/04/2023	1 release, light and intermittent	1	22/03/2016
AA9_LW901_012	287191	6214670	Gas Release	21/03/2016	Active	5/04/2023	Approximately 10 releases, light and intermittent in a 20m by 30m area.	1	22/03/2016

AA9_LW901_013	287377	6214698	Gas Release	21/03/2016	Active	5/04/2023	2 releases, light and intermittent in a 1m by 1m area.	1	22/03/2016
AA9_LW901_014	287575	6214652	Gas Release	21/03/2016	Inactive	26/02/2022	1 release, constant and heavy in a 1m by 1m area.	1	22/03/2016
AA9_LW901_015	287103	6214639	Gas Release	29/03/2016	Inactive	30/12/2020	5 releases moderate and constant in a 3m by 1m area.	1	29/03/2016
AA9_LW901_016	287651	6214611	Gas Release	4/04/2016	Inactive	05/09/2022	1 release, light and intermittent.	1	4/04/2016
AA9_LW901_017	287156	6214658	Gas Release	8/04/2016	Inactive	23/02/2023	3 releases, all light and intermittent	1	8/04/2016
AA9_LW901_018	287429	6194691	Gas Release	21/04/2016	Active	5/04/2023	3 heavy/moderate releases, approximately 7 light intermittent releases. Area is 10m by 5m.	1	22/04/2016
AA9_LW901_019	288075	6214239	Gas Release	4/04/2017	Inactive	23/02/2023	2 releases, light and intermittent	1	5/04/2017
AA9_LW901_020	288157	6214154	Gas Release	4/04/2017	Inactive	29/01/2023	1 release, light and intermittent	1	5/04/2017
AA9_LW901_021	288455	6214091	Gas Release	26/04/2017	Active	5/04/2023	1 release, light and intermittent	1	9/05/2017 & 24/04/2020
AA9_LW901_022	288620	6214128	Gas Release	26/04/2017	Inactive	22/06/2022	3 releases, light and intermittent in a 2m x 2m	1	9/05/2017
AA9_LW901_023	288292	6214083	Gas Release	17/07/2017	Inactive	17/07/2017	Approximately 10 Light constant releases within 1 m^2.	1	19/07/2017
AA9_LW901_024	288253	6214102	Gas Release	24/05/2017	Inactive	24/05/2017	One intermittent release of light intensity.	1	30/05/2019
AA9_LW901_025	288218	6214128	Gas Release	24/05/2017	Inactive	10/10/2018	5 light releases in a 7m by 2m area.	1	30/05/2019
AA9_LW901_026	288016	6214314	Gas Release	31/01/2018	Inactive	17/01/2022	1 release, light and intermittent	1	01/02/2018
AA9_LW902_001	287733	6214551	Gas Release	16/07/2018	Inactive	5/10/2021	2 releases, light and intermittent.	1	18/07/2018
AA9_LW902_002	287704	6214562	Gas Release	4/09/2018	Inactive	16/07/2020	1 release, light and intermittent	1	4/09/2018

AA9_LW902_003	288805	6214172	Gas Release	29/01/2019	Active	5/04/2023	2 releases, light and intermittent	1	30/01/2019
AA9_LW902_004	289876	6214000	Gas Release	26/04/2019	Inactive	22/12/2022	4 releases, all light and intermittent in a 3m by 3m area	1	1/05/2019
AA9_LW902_005	288692	6214136	Gas Release	26/04/2019	Active	5/04/2023	1 release, light and intermittent	1	1/05/2019
AA9_LW902_006	288955	6214209	Gas Release	24/05/2019	Inactive	2/11/2023	1 release, light and intermittent	1	31/05/2019
AA9_LW902_007	287982	6214357	Gas Release	15/08/2019	Inactive	9/09/2021	3 releases, all light and intermittent	1	19/08/2019
AA9_LW902_008	288500	6214109	Gas Release	11/09/2019	Inactive	11/09/2019	15 constant and intermittent releases within an area of approximately 15m by 5m.	1	12/09/2019
AA9_LW903_001	287602	6214639	Gas Release	23/04/2020	Inactive	23/02/2023	3 light intermittent releases within an area of approximately 4m by 4m.	1	24/04/2020
AA9_LW904_001	289901	6213903	Gas Release	10/08/2021	Inactive	24/01/2023	3 light/intermittent releases within an area of approximately 5m by 3m.	1	15/09/2021

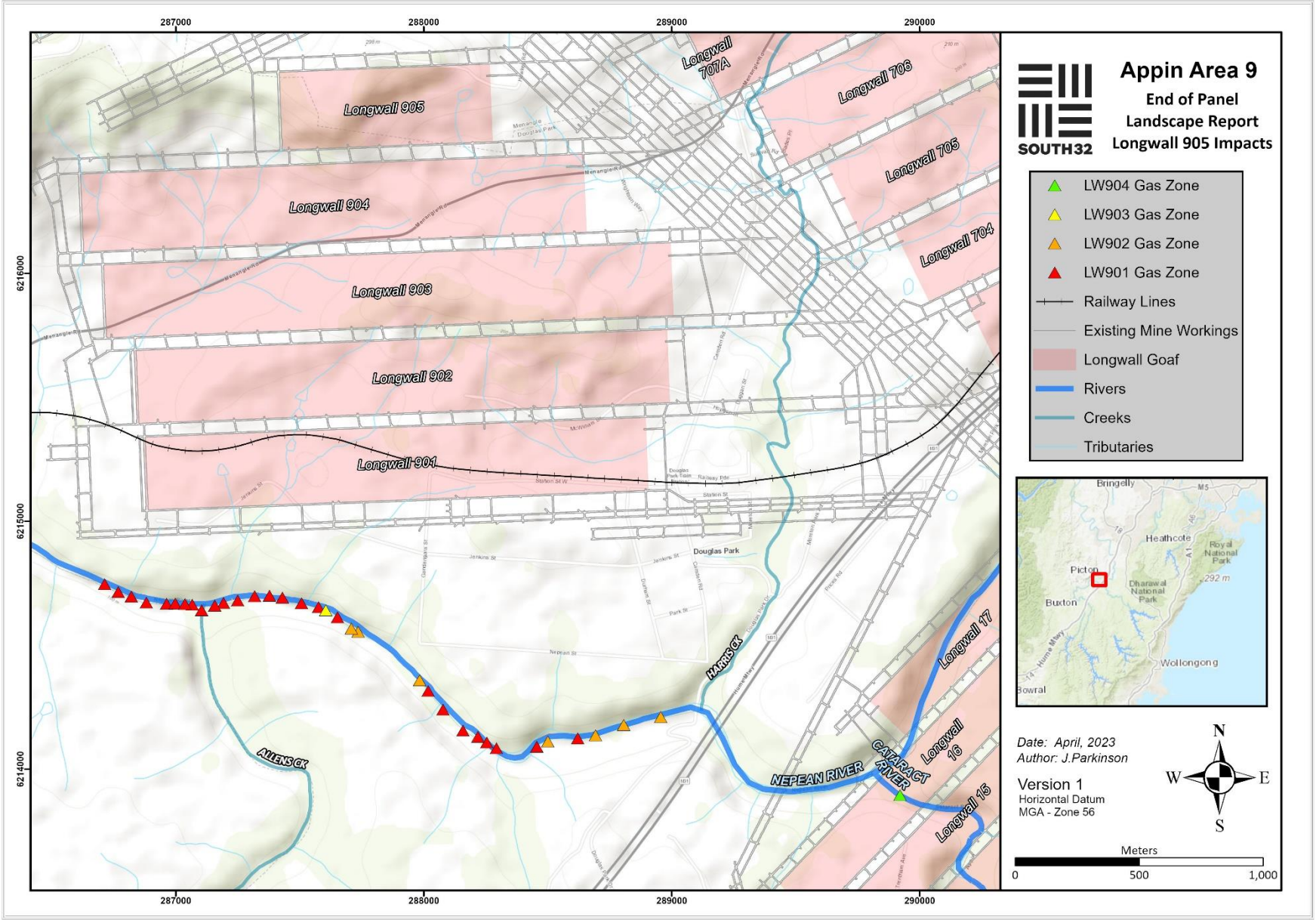

Figure 2: Map showing gas release zones recorded during Appin Area 9 longwalls.

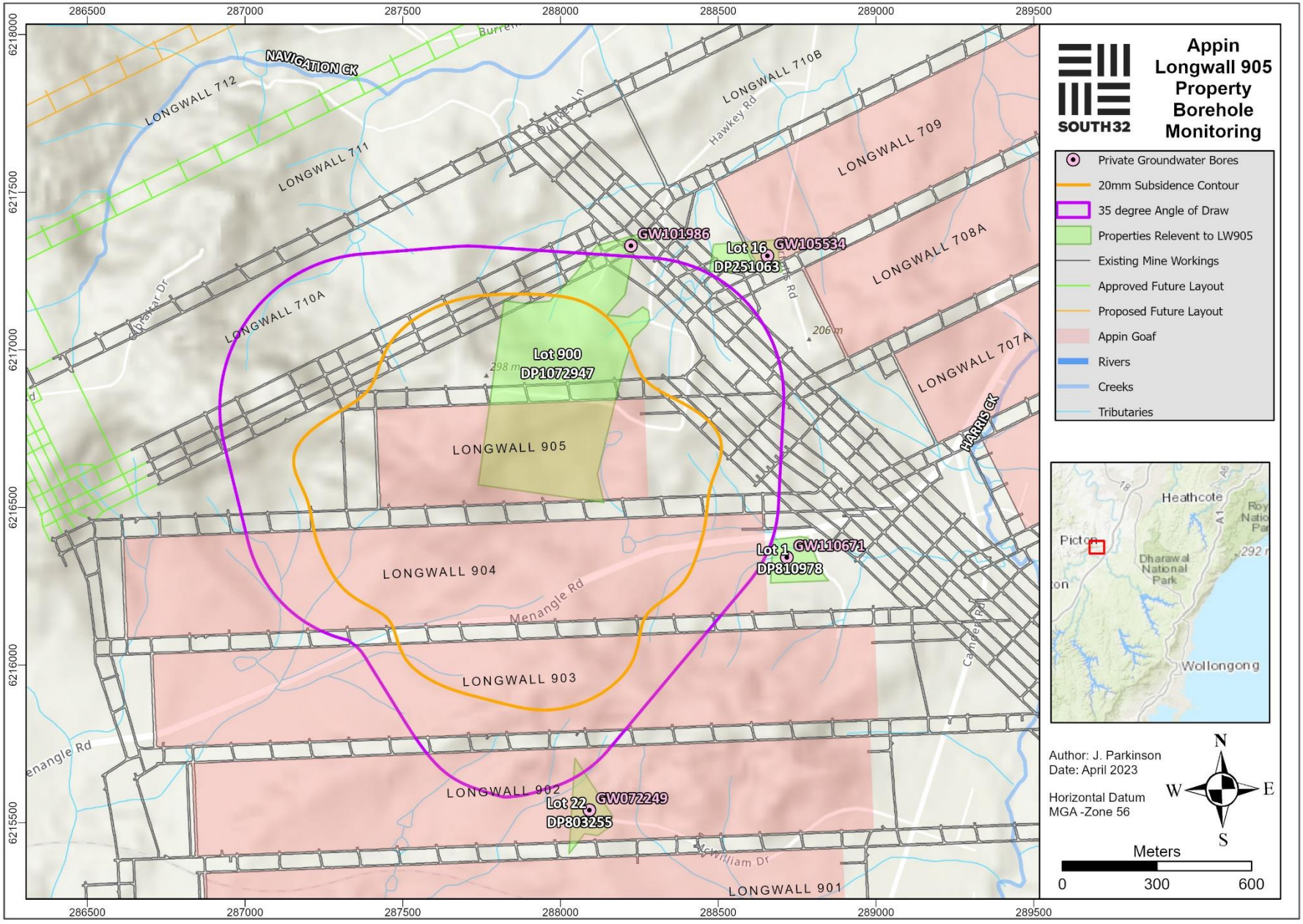

Figure 3: Map showing private properties with boreholes inspected following Longwall 905.

4 FUTURE MONITORING

Future monitoring for Appin Longwalls 709 to 711 and 905 are outlined in Appendix A. These recommendations are based on monitoring commitments in the Appin Longwalls 709 to 711 and 905 EP and the proximity of longwalls to established monitoring sites.

5 APPENDIX A

Appendix A : Appin Longwalls 709 to 711 and 905 Key Monitoring

MONITORING SITE	MONITORING TYPE	MONITORING FREQUENCY	PARAMETERS	FUTURE MONITORING (LONGWALL 709)
SURFACE WATER				
Foot Onslow Creek FO1 (Lab, Field, Level, Obs) FO2 (Obs) **Harris Creek** HC10 (Lab, Field, Obs) HC20 (Level, Obs) HC30 (Obs) **Navigation Creek** NAV1 (Lab, Field, Level, Obs) NAV2 (Obs) **Nepean River** NR110 (Lab, Field, Level, Obs) NR0 (Lab, Field, Level, Obs) SW2 (Lab, Field, Obs) SW3 (Lab, Field, Obs) SW4 (Field, Obs) NR2 (Lab, Field, Level, Obs) NR3 (Lab, Field, Obs) NR4 (Lab, Field, Level, Obs) NR5 (Lab, Field, Obs) NR6 (Lab, Field, Obs) NR7 (Lab, Field, Obs) NR8 (Lab, Field, Level, Obs) NR9 (Lab, Field, Level, Obs) NR10 (Lab, Field, Obs) NR11 (Lab, Field, Obs) NR12 (Lab, Field, Level, Obs) NR13 (Lab, Field, Level, Obs) NR40 (Lab, Field, Obs) NR50 (Lab, Field, Obs) NT1_POOL10 (Lab, Field, Level, Obs)	• Laboratory analysis (Lab) • Field parameters (Field) • Water levels (Level) (where a suitable structure exists) • Observations (Obs)	• Monthly baseline monitoring prior to mining • Weekly observations and field analysis during active subsidence • Monthly laboratory analysis during active subsidence • Monthly monitoring for two years post mining • If required as a result of assessment of mining impacts	**Field Parameters:** • Temperature • Dissolved Oxygen (DO) • Specific Conductivity • pH • ORP **Laboratory analysis:** • pH and EC • Filtered, Na, K, Ca, Mg, Cl, Ni, Zn, Fe, Mn, Al, SO_4 • Total Fe, Mn, Al • Total Alkalinity • TKN, TP, NH_3.N, NO_x.N (TON), FRP, TSS, DOC **Lab Sample for Gas Releases[#]:** • CH_4 • C_2H_6 • Trace Phenols • Sulphide **Observations:** • Iron or salinity staining (e.g. orange or white staining in water or on banks/seeps) • Evidence of springs in the Nepean River • Visual signs of impacts (i.e. cracking, fracturing, vegetation changes, increased erosion, changes in water colour etc) • Stream flow and pool water level • Impacts determined from comparing photo points taken prior to, during and post mining	No longer required as 2 year post mining period has lapsed: NT1_POOL10 NT1_POOL20 NT1_POOL30 NT1_POOL40 NT1_POOL50

MONITORING SITE	MONITORING TYPE	MONITORING FREQUENCY	PARAMETERS	FUTURE MONITORING (LONGWALL 709)
NT1_POOL20 (Field, Level, Obs) NT1_POOL30 (Field, Level, Obs) NT1_POOL40 (Field, Level, Obs) NT1_POOL50 (Field, Level, Obs) **Racecourse Creek, Remembrance Drive** RC1 (Lab, Field, Level, Obs) – Reference Site #If and where strata gas emission plumes above 3000 L/min are detected (Lab, Field, Obs)				
Flow monitoring • Maldon Weir • Broughtons Pass Weir • Menangle Weir	• Gauged flow station	• Daily flow	• Monitoring undertaken by WaterNSW. Observational data to be compared with flow records at weir sites.	No Changes

MONITORING SITE	MONITORING TYPE	MONITORING FREQUENCY	PARAMETERS	FUTURE MONITORING (LONGWALL 709)
Foot Onslow Creek FO1 (qualitative obs) FOS1 (gauge with logger) **Navigation Creek** NAV1 (qualitative obs) NAVS1 (gauge with logger)	• Visual observation of inflow and outflow • Gauged flow site	• Monthly/weekly inspection (obs sites) • Daily flow (logger sites)	• Inspection for potential fracturing for observable loss of surface water flow	
GROUNDWATER				
Private Bores GW108990 GW100289 GW072874 GW100673 GW101986 GW105531 GW105534 GW106675 GW111781 GW112381 GW105376 GW105574 GW106574 GW107791 GW108907 GW108990 GW072196 GW110671 *(in consultation with bore owner and if accessible and access is granted)*	• Lab sample • Field parameters • Water levels • Observations	• Where access is available and granted, water level and water quality monitoring at least once before and once after the bore is mined under	**Field Parameters:** • Electrical Conductivity • pH **Laboratory analysis:** • pH and EC • Filtered, Na, K, Ca, Mg, Cl, Ni, Zn, Fe, Mn, Al, SO_4 • Total Fe, Mn, Al • Total Alkalinity • TKN, TP, NH3-N, NOx-N (TON), FRP, TSS, TDS, DOC **Lab Sample for Gas Releases:** • CH_4 • C_2H_6 • Trace Phenols • Sulphide **Observations:** • Iron or salinity staining (e.g. orange or white staining in water or in the bores	No Changes
IMC Boreholes S1913 S1936		• Water levels to be logged at least twice daily in the pre-		No Changes

MONITORING SITE	MONITORING TYPE	MONITORING FREQUENCY	PARAMETERS	FUTURE MONITORING (LONGWALL 709)
S1941 S1954 S2157 S2315 S2536 S2536A S2537 S2538 S2632		mining baseline, impact and post-mining period • At least one appropriately purged sample pre-mining and post mining, where access permits, tested for the analytes in the previous column		
Groundwater inflows to the mine	• Mine water budget • Observations	• Flow meters	Water flow from the goaf to the mine (analysed as a moving average i.e. 20 day average)	No Changes
AQUATIC ECOLOGY				
Impact Sites Sites 5, 6, X3 and X4 **Control Sites** Sites 1, 2, 7, 8, X5, X6, X7 and X8	• Water quality - field parameters • Survey and sampling • Observations	• Twice in spring for two years prior to the commencement of mining • Once every two years during mining • Once every two years after mining	• Habitat surveys • Aquatic macrophyte observations • Macroinvertebrate monitoring • AUSRIVAS sampling • Fish sampling • Observations of threatened species • Assessments of: – Water quality – Flow – River morphology	No Changes
TERRESTRIAL ECOLOGY				
• Inspection of the area will be conducted as outlined in the Landscape TARP	• As indicated in the Landscape TARP	• Prior to mining provide pre-mining baseline survey of vegetation communities and threatened flora populations for comparison with post-mining • Monthly prior to mining • Weekly during active subsidence • In response to any identified impacts on flora/fauna or threatened species, communities or populations	• Observations of threatened species and endangered ecological communities • Changes in vegetation condition • Stressed or dead vegetation not readily explained by natural processes (causes may include rock / cliff falls or mass movement, gas emissions, changes in flooding/ ponding)	No Changes

MONITORING SITE	MONITORING TYPE	MONITORING FREQUENCY	PARAMETERS	FUTURE MONITORING (LONGWALL 709)
ABORIGINAL ARCHAEOLOGY				
No sites requiring monitoring				
EUROPEAN HERITAGE				
No non-Aboriginal heritage sites were identified in the Longwalls 709 to 711 and 905 Study Area during the assessments undertaken for the BSO EA				
LANDSCAPE FEATURES				
Nepean River cliff lines - Sensitive terrain near built features (Razorback Range) Razorback Range Cliffs Monitoring locations on private properties to be determined as appropriate/required in consultation with landowner/s	• Observational and photographic monitoring • Piezometers • Slope inclinometers	***Harris Creek and Nepean River cliff lines*** - Baseline recording once prior to mining. - Monthly routine inspections with weekly inspections during critical periods ***Low Terrain Sensitivity*** (visual inspection) - 6 months prior to mining - 6 months after active subsidence ***Medium Terrain Sensitivity*** - 6 to 12 months prior to mining - 3 monthly during active subsidence	• Visual inspections • Photographic records • Ground survey (mid to high terrain sensitivity) • Piezometers (high terrain sensitivity) • Slope inclinometers (high terrain sensitivity)	No Changes

MONITORING SITE		MONITORING TYPE	MONITORING FREQUENCY	PARAMETERS	FUTURE MONITORING (LONGWALL 709)
			- 6 months after active subsidence ***High Terrain Sensitivity*** - 12 months before commencement of subsidence for visual and on ground survey - Monthly for visual during active subsidence - 3 monthly for ground survey during active subsidence - Installation of piezometers and inclinometers as required and in consultation with landowners as part of PSMP process		

6 APPENDIX B

Appendix B: Appin Mine Areas 7 and 9 TARPS, Key Monitoring, Triggers and Response

Monitoring	Trigger	Action
Surface Water Quality#		
Nepean River Control Sites: NR110 (Upstream perturbations) SW2 (Upstream perturbations from Allens Creek) NR5 (Upstream perturbations from Cataract River) NR8 (Upstream perturbations from Elladale Creek) NR10 (Upstream perturbations from Ouesdale Creek) NR40 (Upstream perturbation from Menangle Creek) Impact Sites: NR0 NR4 (assess influence from Harris Creek) NR12 NR13 NR50 **Creeks and Tributaries** Control Site: RC1 Impact Sites: NAV1 FO1 HC10 NR3	***Level 1**** Impact monitoring sites when comparing the baseline period to the mining period for that site: • Mining results in pH reduction greater than 1 standard deviation but less than 2 standard deviations from pre-mining mean resulting from the mining for two consecutive months • Mining results in DO reduction greater than 1 standard deviation but less than 2 standard deviations from pre-mining mean resulting from the mining for two consecutive months • Identification of strata gas plume of flow rate <3000 L/min • Trend analysis shows deviation from baseline post mining.	• Continue monitoring program • Submit an Impact Report to BCS, DPE – Water, WaterNSW and other relevant stakeholders • Report in the End of Panel Report • Summarise actions and monitoring in Annual Review
	Level 2* Impact monitoring sites when comparing the baseline period to the mining period for that site: • Mining results in pH reduction greater than 2 standard deviations from pre-mining mean resulting from the mining for two consecutive months • Mining results in DO reduction greater than 2 standard deviations from pre-mining mean resulting from the mining for two consecutive months • Mining results in EC increases greater than 2 standard deviations from pre-mining mean resulting from the mining for two consecutive months • Identification of strata gas plume of flow rate >3000 L/min • Trend analysis shows significant deviation from baseline post-mining.	• *Actions as stated for Level 1* • Review monitoring program • Notify relevant technical specialists and seek advice on any CMA required • Implement agreed CMAs as approved *Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. water quality changes with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts* Strata Gas Emission Plume: • Estimate gas emission flow rates. Re-estimate should significant change be observed • Take sample of plume (if possible) for: - chemical composition - dissolved methane from exactly above gas plume and at established downriver monitoring site - dissolved sulfide and total phenols from exactly above gas plume and at nearest downriver monitoring site
	Level 3* Impact monitoring sites when comparing the baseline period to the mining period for that site: • Level 2-type reduction in water quality resulting from the mining observed for six consecutive months	• *Actions stated for Level 2* • Notify BCS, DPE - Water, WaterNSW and relevant resource managers and technical specialists and seek advice on any CMA required • Invite stakeholders for site visit • Develop site CMA (subject to stakeholder feedback) • Completion of works following approvals, including monitoring and reporting on success

		• Review the TARP and Management Plan in consultation with key stakeholders *Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. water quality changes with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts*
	Exceeding Performance Measures Mining results in more than negligible gas releases, iron staining or water cloudiness on Nepean River. Mining results in greater subsidence impact or environmental consequences than predicted in the EA and PPR	• *Actions stated for Level 3* • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation • Provide environmental offset if CMAs are unsuccessful
Surface Water Flow and Level		
Nepean River Maldon Weir Broughtons Pass Weir Menangle Weir **Creeks and Tributaries** NAV1 FO1 HC10 NR3	***Level 1**** • Mining results in observational changes to pool level (dry and/or flooded) in comparison to baseline observations and flows, for less than two consecutive months.	• Continue monitoring program • Submit an Impact Report to BCS, DPE – Water, WaterNSW and other relevant stakeholders • Report in the End of Panel Report • Summarise actions and monitoring in Annual Review
	Level 2* • Mining results in observational changes to pool level (dry and/or flooded) in comparison to baseline observations and flows, for more than two consecutive months.	*Actions as stated for Level 1* • Review monitoring program • Notify relevant technical specialists and seek advice on any CMA required • Implement agreed CMAs as approved
	Level 3* • Mining results in observational changes to pool level (dry and/or flooded) in comparison to baseline observations and flows, for six consecutive months.	*Actions stated for Level 2* • Notify BCS, DPE - Water, WaterNSW and relevant resource managers and technical specialists and seek advice on any CMA required • Invite stakeholders for site visit • Develop site CMA (subject to stakeholder feedback) • Completion of works following approvals, including monitoring and reporting on success • Review the TARP and Management Plan in consultation with key stakeholders
	Exceeding Performance Measures Mining results in more than negligible diversion of flows or changes in the natural drainage behaviour of pools in the Nepean River	*Actions stated for Level 3* • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation • Provide environmental offset if CMAs are unsuccessful
Creeks and Tributaries **Foot Onslow Creek** FO1 FOS1 **Navigation Creek** NAV1	***Level 1**** • Fracturing with no observable loss of surface water flow	• Continue monitoring program • Submit an Impact Report to BCS, DPE – Water, WaterNSW and other relevant stakeholders • Report in the End of Panel Report • Summarise actions and monitoring in Annual Review
	Level 2*	*Actions as stated for Level 1*

NAVS1	• Fracturing resulting in loss of surface flow in some creeks or tributary	• Review monitoring program • Notify relevant technical specialists and seek advice on any CMA required Implement agreed CMAs as approved
	Level 3* • Fracturing resulting in total loss of surface flow in all sections of a creek or tributary	*Actions stated for Level 2* • Notify BCS, DPE - Water, WaterNSW and relevant resource managers and technical specialists and seek advice on any CMA required • Invite stakeholders for site visit • Develop site CMA (subject to stakeholder feedback) • Completion of works following approvals, including monitoring and reporting on success • Review the TARP and Management Plan in consultation with key stakeholders
	Exceeding Performance Measures • Mining results in greater subsidence impact or environmental consequences than predicted in the EA and PPR	*Actions stated for Level 3* • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation • Provide environmental offset if CMAs are unsuccessful
Groundwater		
Groundwater inflows to the mine **Private Bores** GW072196 GW072874 GW100289 GW100673 GW101986 GW104661 GW105376 GW105388 GW105531 GW105534 GW105574 GW106574 (grouted) GW106675 GW108907 GW112381 GW112441 (grouted) **IMC Boreholes** S1913 S1941 S1954	***Level 1**** • Increase in water flow from the goaf between 2.7 to 3 ML/day (over 20-day average) • >10 m reduction in water level/pressure in the HBSS from the average level in the period of 12 months prior to the start of a longwall, over a minimum of two months	• Continue monitoring program • Submit an Impact Report to BCS, DPE - Water, WaterNSW and other relevant stakeholders • Report in the End of Panel Report • Summarise actions and monitoring in Annual Review
	Level 2* • Increase in water flow from the goaf between 3 to 3.4ML (over 20-day average) • >15 m reduction in water level/pressure in the HBSS from the average level in the period of 12 months prior to the start of a longwall, over a minimum of two months	• *Actions as stated for Level 1* • Review monitoring frequency • Notify relevant technical specialists and seek advice on any CMA required • Implement agreed CMAs as approved *Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts*
	Level 3* • Abnormal increase in water flow from the goaf >3.4ML (20-day average) • >20 m reduction in water level/pressure in the HBSS from the average level in the period of 12 months prior to the start of a longwall, over a minimum of two months • Mining results in groundwater bores unsafe, unserviceable or damaged	• Actions as stated for Level 2 • Notify BCS, DPE - Water, WaterNSW and relevant resource managers and technical specialists and seek advice on any CMA required • Invite stakeholders for site visit • Develop site CMA (subject to stakeholder feedback). This may include: - Make area safe - Any actions agreed to in the Property Subsidence Management Plan - Provisions of alternate water supply where this has been impacted by mining

S2157 S2315 S2536 S2536A S2537 S2538 S2632		• Completion of works following approvals, including monitoring and reporting on success • Review the Groundwater Model, TARP and Management Plan in consultation with key stakeholders *Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts*

Landscape Features		
Cliffs and Steep Slopes • Nepean River cliff lines • Razorback Range cliffs • Sensitive terrain near built features (Razorback Range) Monitoring locations on private properties to be determined as appropriate/required in consultation with landowner	***Level 1**** • Rock fall from a cliff where the cliff is left mostly intact (<10% length of any single cliff) • Surface movement or rock displacement where any exposed soil surface is stable • Crack at the surface which does not result in ongoing erosion or ground movement • Erosion which stabilises within the period of monitoring without CMA • Crack or fracture up to 100 mm width • Crack or fracture up to 10 m length	• Continue monitoring program • Submit an Impact Report to BCD, DPE and MEG • Report in the End of Panel Report • Summarise actions and monitoring in AR
	Level 2* • Rock fall from cliff where the characteristics of the cliff change (>10% length of any single cliff) • Ground disturbance that is unlikely to stabilise within the period of monitoring without CMA • Mass movement of a slope causing areas of exposed soil • Crack or fracture between 100 – 300 mm width • Crack or fracture between 10 – 50 m length	• *Actions as stated for Level 1* • Report trigger to key stakeholders • Review monitoring frequency • Notify relevant technical specialists and seek advice on any CMA required • Provide safety signage and barricades where appropriate in areas as required for public safety (refer PSMP) • Implement agreed CMAs as approved *Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts*
	Level 3* • Cliff collapse (100% length of any single cliff) • Ground disturbance that does not stabilise within the period of monitoring • Mass movement of a slope causing areas of exposed soil that does not stabilise within the period of monitoring • Crack or fracture over 300 mm width • Crack or fracture over 50 m length	• *Actions as stated for Level 2* • Notify BCD, DPE, Resources Regulator, relevant resource managers and technical specialists and seek advice on any CMA required. • Invite stakeholders for site visit • Develop site CMA (subject to stakeholder feedback). This may include: – Erosion prevention works – Establishment of vegetation • Completion of works following approvals, including monitoring and reporting on success

		• Review the TARP and Management Plan in consultation with key stakeholders *Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. cracking at the surface with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts*
	Exceeding Prediction • For cliffs of 'special significance' and other cliffs flanking the Nepean River - mining results in more than negligible environmental consequences (i.e. more than occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing, that in total impact more than 0.5% of the total face area of such cliffs within any longwall mining domain • Other cliffs – mining results in more than minor environmental consequences (that is occasional rockfalls, displacement or dislodgment of boulders or slabs or fracturing, that in total impact more than 3% of the total face area of such cliffs within any longwall mining domain	• *Actions as stated for Level 3* • Make area safe • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation • Provide environmental offset if CMAs are unsuccessful
Aquatic Ecology		
Impact Sites: 5, 6, X3 and X4 **Control Sites:** 1, 2, 7, 8, X5, X6, X7 and X8	***Level 1**** • Reduction in aquatic habitat resulting from the mining over 1 season	• Continue monitoring program • Submit an Impact Report to BCD, DPE, DPI Fisheries and other relevant resource managers • Report in the End of Panel Report • Summarise actions and monitoring in AR
	Level 2* • Reduction in aquatic habitat resulting from the mining over 2 seasons	• *Actions as stated for Level 1* • Report trigger to key stakeholders • Review monitoring program • Notify relevant technical specialists and seek advice on any CMA required • Implement agreed CMAs as approved *Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to aquatic habitat with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts*
	Level 3* • Reduction in aquatic habitat resulting from the mining for >2 consecutive seasons or complete loss of habitat	• *Actions as stated for Level 2* • Notify BCD, DPE, DPI Fisheries, relevant resource managers and technical specialists and seek advice on any CMA required. • Invite stakeholders for site visit • Develop site CMA (subject to stakeholder feedback). This may include: – Grouting of fractures which result in flow diversion – Completion of works following approvals

		• Completion of works following approvals, including monitoring and reporting on success • Review the TARP and Management Plan in consultation with key stakeholders *Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to aquatic habitat with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts*
	Exceeding Prediction • Mining results in more than negligible environmental consequences for a threatened species, threatened population or endangered ecological communities	• *Actions as stated for Level 3* • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation • Provide environmental offset if CMAs are unsuccessful
Terrestrial Ecology		
Visual inspections as part of landscape and water monitoring programs in active mining areas	***Level 1**** • Impacts detectable via observational monitoring (e.g. canopy thinning, thinning of shrub layer, minor loss of ground cover) to a single vegetation strata • Subsidence impacts (such as surface cracking, rock falls) resulting in small areas of disturbance that will mitigate without CMA	• Continue monitoring program • Submit an Impact Report to BCD, DPE and other relevant resource managers • Report in the End of Panel Report • Summarise actions and monitoring in AR
	Level 2* • Impacts detectable via observational monitoring (e.g. canopy thinning with dead branches present, thinning of the shrub layer with dead branches, loss of ground cover in multiple areas) to multiple vegetation strata • Subsidence impacts (such as surface cracking, rock falls) resulting in small areas of disturbance that will not mitigate without CMA	• *Actions as stated for Level 1* • Report trigger to key stakeholders • Review monitoring program • Notify relevant technical specialists and seek advice on any CMA required • Implement agreed CMAs as approved *Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to terrestrial habitat with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts*
	Level 3* • Impacts (e.g. canopy thinning with dead branches present, thinning of the shrub layer with dead branches, loss of ground cover in multiple areas) to multiple vegetation strata caused by subsidence effects • Subsidence impacts (such as surface cracking, rock falls) resulting in large areas of disturbance that will not mitigate without CMA • Negligible environmental consequences to threatened species, populations or EEC Reduction in aquatic habitat resulting from the mining for >2 consecutive seasons or complete loss of habitat	• *Actions as stated for Level 2* • Notify BCD, DPE, relevant resource managers and technical specialists and seek advice on any CMA required. • Invite stakeholders for site visit • Develop site CMA (subject to stakeholder feedback). This may include: – Erosion prevention works – Establishment of vegetation • Completion of works following approvals, including monitoring and reporting on success • Review the TARP and Management Plan in consultation with key stakeholders

		Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to terrestrial habitat with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts
	Exceeding Prediction • Mining results in more than negligible environmental consequences for a threatened species, threatened population or endangered ecological communities	• *Actions as stated for Level 3* • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation • Provide environmental offset if CMAs are unsuccessful

***** These may be revised in consultation with DPE and other key stakeholders following analysis of natural variability within the pre-mining baseline data.

The upstream monitoring site NR110 and a series of sites within tributaries of the Nepean River are utilised to indicate non-mining-related perturbations at the proposed Longwalls 709 to 711 and 905 impact monitoring sites within the Nepean River. This provides a means of distinguishing upstream or mid-river effects unrelated to the mining of the proposed longwalls. The following premise applies:

- A TARP at River site NR0 should only be considered to have been triggered whenever an equivalent change (from the long term mean) is not exhibited for the same parameter at the upstream site NR110.
- A TARP at River site NR4 should only be considered to have been triggered whenever an equivalent change (from the long term mean) is not exhibited for the same parameter at the upstream sites NR110 or SW2 (monitors for upstream perturbation from Allens Creek).
- A TARP at River site NR12 and NR13 should only be considered to have been triggered when an equivalent change (from the long term mean) is not exhibited for the same water quality analyte at the upriver sites; NR110, SW2, NR5, NR8 or NR10 (monitors upstream perturbation from Allens Creek, Cataract River, Elladale Creek and Ousedale Creek).
- A TARP at River site NR50 should only be considered to have been triggered when an equivalent change (from the long term mean) is not exhibited for the same water quality analyte at the upriver sites; NR110, SW2, NR5, NR8, NR10 or NR40 (monitors upstream perturbation from Allens Creek, Cataract River, Elladale Creek, Ousedale Creek and Menangle Creek).

Department of Planning and Environment (DPE)

Department of Primary Industries – Fisheries (DPI Fisheries)

Biodiversity and Conservation Division (BCD)

Department of Mining, Exploration and Geosciences (MEG)

Resources Regulator

WaterNSW