

APPIN MINE LONGWALL 902 LANDSCAPE REPORT

June 2019



EXECUTIVE SUMMARY

This report has been prepared by the South32 Illawarra Coal Environmental Field Team (ICEFT) to summarise the observed and measured subsidence effects on water, landscape features and terrestrial ecology, resulting from the extraction of Longwall 902.

Extraction of Longwall 902 commenced on the 12 May 2018 and was completed on 3 April 2019.

The ICEFT 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 Area 9 Extraction Plan, dated 2 September 2014.

ICEFT identified six new impacts associated with the extraction of Longwall 902. These impacts were gas releases on the Nepean River.

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ABBREVIATIONS

CMA – Corrective Management Action

DPE - Department of Planning and Environment

DPI – Department of Primary Industries

DRE - Department of Trade and Investment, Division of Resources and Energy

EoP – End of Panel

EP – Extraction Plan

ICEFT – Illawarra Coal Environmental Field Team

OEH - Office of Environment and Heritage

SCA – Sydney Catchment Authority (now WaterNSW)

SMP – Subsidence Management Plan

TARP – Trigger Action Response Plan

1 INTRODUCTION

This report outlines monitoring of landscape features relevant to Longwall 902 and forms part of the Appin Area 9 Longwall 902 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 902 has been carried out in accordance with the Appin Area 9 Extraction Plan, dated 2 September 2014. The Trigger Action Response Plan (TARP) details the actions required for any subsidence impacts (Attachment A).

Extraction of Longwall 902 commenced on 12 May 2018 and was completed 3 April 2019.

Monitoring was conducted for landscape features for Longwall 902 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 Coal and private boreholes) and general observation of the 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 Area 9 monitoring program has been designed to identify impacts and consequences of mining and is presented in Figure 1 and Appendix A 1. 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 Extraction Plan.

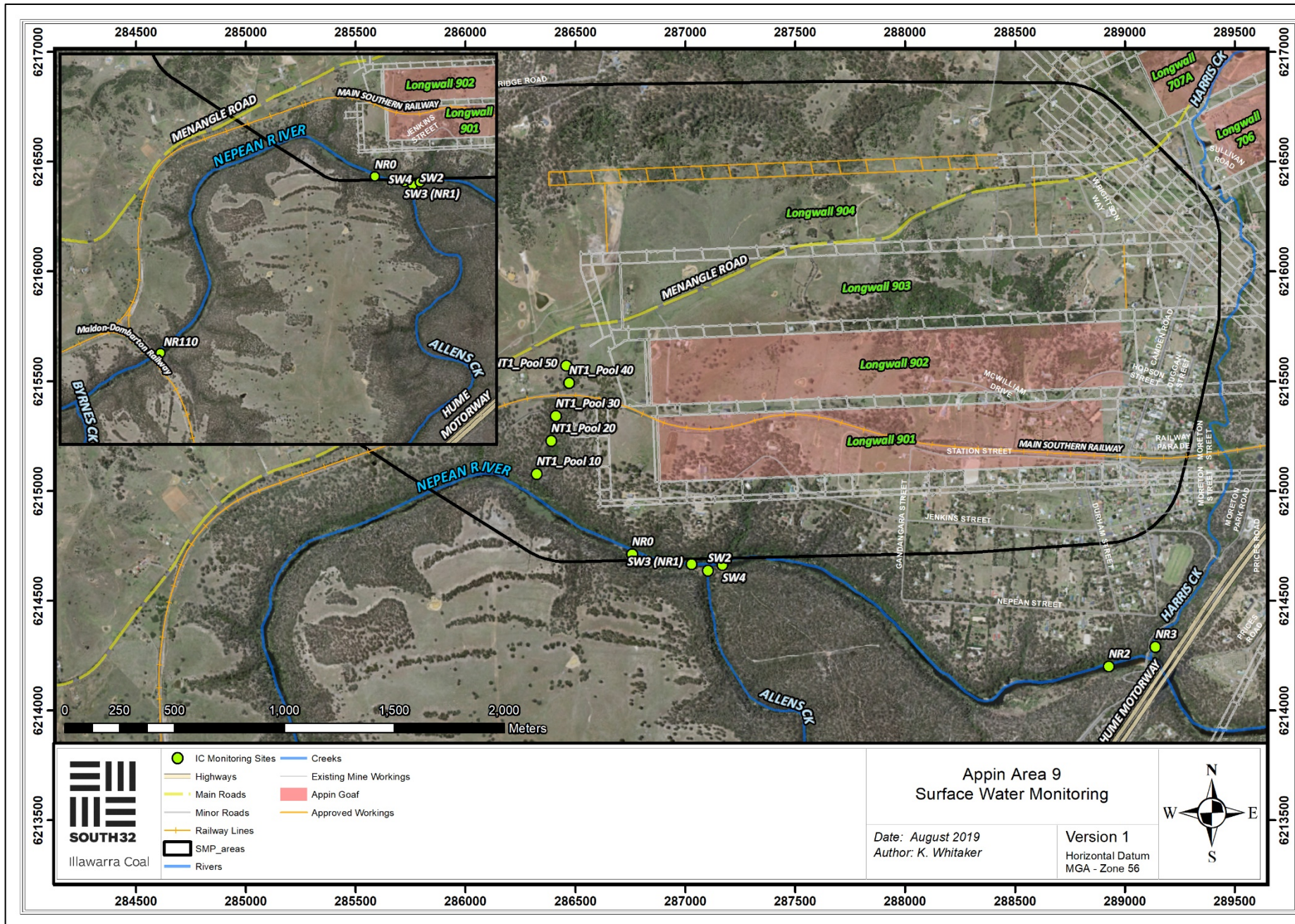


Figure 2-1: Map showing IC monitoring sites relevant to LW902.

3 SUMMARY OF IMPACTS

Monitoring and inspections of the Nepean River and its associated tributaries is undertaken in accordance with the approved Appin Area 9 Extraction Plan (EP). Monitoring is conducted by the Illawarra Coal Environmental Field Team (ICEFT) monthly, prior to 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 902, six new impacts were observed. These were gas releases on the Nepean River. These impacts are labelled as "AA9_LW902_001 to AA9_LW902_006" (Table 1).

3.1 Water Quality

In-situ water quality parameters are measured at the relevant monitoring sites on the Nepean River and its tributaries. In situ water quality parameters include: temperature, specific conductivity (SpC), Oxidation-Reduction Potential (ORP), pH, dissolved oxygen (DO) as well as visual observations. Water samples are also taken for lab analysis. Specialist assessment of water quality results is presented in the Surface Water and groundwater Assessment of the Longwall 902 EoP Report.

3.1.1 Gas Releases

Six gas release zones were reported as a Level 1 Triggers in accordance with the Trigger Action Response Plan (TARP) in the *Appin Area 9 EP: Annex B- Subsidence Monitoring Program* (Appendix B 1: AA9 TARPS, Key Monitoring, Triggers and Response); specifically:

- Identification of strata gas plume of flow rate <3000 L/min

The following actions were initiated in response to these impacts:

- Continue monitoring program
- Submit an Impact Report to relevant stakeholders
- Report in the End of Panel Report
- Summarise actions and monitoring in the AEMR

AA9_LW902_001 (287733, 6214551)

Impact AA9_LW902_001 was identified on 16 July 2018 and consisted of a gas release zone on the Nepean River (Figure 2). The zone was comprised of three light intermittent releases within an area of approximately 1 m by 5 m (Photo 1). This site was passed by Longwall 902 at an approximate distance of 976 m. During the latest inspection on 24 May 2019, this gas zone was observed as active.

AA9_LW902_002 (287704, 6214562)

Impact AA9_LW902_002 was identified on 4 of September 2018 and consisted of a gas release zone on the Nepean River (Figure 2). The zone was comprised of five constant releases over an area of approximately 1 m by 10 m (Photo 2). This site was passed by Longwall 902 at an approximate distance of 870 m (Figure 2). During the latest inspection on 24 May 2019, this gas zone was observed as inactive.



Photo 1: Gas release zone AA9_LW902_001 close-up.
Taken on 16/07/2018.



Photo 2: Gas release zone AA9_LW902_002 close-up.
Taken on 04/09/2018.

AA9_LW902_003 (288805, 6214172)

Impact AA9_LW902_003 was identified on 29 of January 2019 and consisted of a gas release zone on the Nepean River (Figure 2). The zone was comprised of four light intermittent releases over an area of approximately 1.5 m by 3 m (Photo 3) This site was passed by Longwall 902 at an approximate distance of 1300 m (Figure 2). During the latest inspection on 24 May 2019, this gas zone was observed as active.

AA9_LW902_004 (289876, 6214000)

Impact AA9_LW902_004 was identified on 26 April 2019 and consisted of a gas release zone on the Nepean River (Figure 2). The zone was comprised of five light, intermittent releases over an area of approximately 5m² (Photo 4). The site is approximately 1720m horizontal distance from the end of the Longwall 902 panel (Figure 2). It is also noted that this gas zone is on the edge of Longwall 16 panel, extracted during the Tower Colliery Operations. During the latest inspection on 24 May 2019, this gas zone was observed as inactive.



Photo 3: Gas release zone AA9_LW902_003 close-up.
Taken on 29/01/2019.



Photo 4: Gas release zone AA9_LW902_004 close-up.
Taken on 29/01/2019

AA9_LW902_005 (288692, 6214136)

Impact AA9_LW902_005 is a gas release zone on the Nepean River, comprised of five light releases approximately 70 metres downstream of gas release zone AA9_LW901_022 (Figure 2) (Photo 5). The site is approximately 1330m horizontal distance from the Longwall 902 panel (Figure 2). During the latest inspection on 24 May 2019, this gas zone was observed as active.

AA9_LW902_006 (E 288955, N 6214209)

Impact AA9_LW902_006 is a gas release zone on the Nepean River, comprised of three light, intermittent releases within an area of approximately 1.5m by 0.5m (Photo 6). The site is approximately 1260m from Longwall 902 at its closest point (Figure 2). During the latest inspection on 24 May 2019, this gas zone was observed as active.



Photo 5: Gas release zone AA9_LW902_005 on the Nepean River. Taken 24/05/2019.



Photo 6: Gas release zone AA9_LW902_006 on the Nepean River. Taken on 24/05/2019.

Continued monitoring of gas release zones previously reported during the extraction of Longwall 901 also occurred. The status of these releases during the latest inspection are summarised in Table 2.

3.1.2 Water Level and Flow

Water levels in the Nepean River and its tributaries were monitored by the ICEFT using photo observations and installed benchmark measurements (where available) where access was safe and granted. No subsidence induced flooding of river banks was observed. Additionally, no areas of dry river bed were observed. For assessment of water level and flow refer to Surface Water and Groundwater Assessment the Longwall 902 EoP Report.

3.1.3 Appearance

The appearance of the Nepean River and its tributaries was monitored by the ICEFT where access was safe and granted. Photographs are taken of 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 902.

3.1.4 Groundwater

Boreholes relevant to Longwall 902 are: EAW9, EAW18, EAW58, S2280 and S2281. Specialist assessment of groundwater data (level and quality) will be included in the Surface Water and Groundwater Assessment of the Longwall 902 EoP Report.

3.1.5 Landscape Features

Observations of clifflines and steep slopes along the Nepean Gorge and associated tributaries were conducted by the ICEFT on a monthly basis. Observational and photographic monitoring; piezometers and slope inclinometers were used to monitor. No impacts to cliffs were identified during the extraction of Longwall 902. Observations above the active longwall were conducted where access was available.

3.1.6 Terrestrial Ecology

Terrestrial ecology in Appin Area 9 is monitored by the ICEFT 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 902.

3.1.7 Private Property Inspections

Built Feature Management Plans (BFMPs) have been prepared by South32 Illawarra Coal for landholders above Appin Area 9. Post-mining inspection of dams, boreholes and natural features set out in the BFMPs are conducted by the ICEFT with the consent of the relevant property/infrastructure owner and tenant (if applicable). Post-mining inspections were undertaken at properties Lot 15 DP 803255 and Lot 22 DP203255 (Figure 3). This included collection of in-situ water quality parameters and water samples for further laboratory analysis. Results of water quality will be included in the Surface Water and Groundwater Assessment of the Longwall 902 EoP Report Post-mining inspections were unable to be undertaken at properties Lot 59-64 DP1321 and Lot 2 DP8999 due to access issues.

3.1.8 Aboriginal Archaeology

Archaeological Sites are not located within the Study Area. There is one Shelter with Art which has been identified just outside the Study Area, as shown in MSEC (2012) Drawing No. MSEC448-33. 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

Heritage Sites listed in the Study Area comprise the Railway Cottage at Douglas Park Station, which is listed in the Wollondilly Local Environmental Plan 1999. The Illawarra Coal Community Team (ICCT) attempted to contact the resident (by site visit and letter box drop) to conduct a baseline inspection. However, no contact was made, thus, no baseline property inspection was conducted. No impacts have been reported by the resident.

Table 3-1: Summary table of LW902 impacts

Site ID	Easting	Northing	Impact Type	Identification Date	Status	Description	Impact Level	Report Date
AA9_LW902_001	287733	6214551	Gas Release	16/07/2018	Active	Three light intermittent releases within an area of approximately 1 m by 5 m	1	18/07/2018
AA9_LW902_002	287704	6214562	Gas Release	4/09/2018	Inactive	Five small, constant releases within an area of approximately 1 m by 10 m	1	4/09/2018
AA9_LW902_003	288805	6214172	Gas Release	29/01/2019	Active	Four small intermittent releases within an area of approximately 1 m	1	30/01/2019
AA9_LW902_004	289876	6214000	Gas Release	26/04/2019	Inactive	Five light, intermittent releases within an area of approximately 5 m by 5 m	1	1/05/2019
AA9_LW902_005	288692	6214136	Gas Release	26/04/2019	Active	Five light releases approximately 70 metres downstream of gas release zone AA9_LW901_022	1	1/05/2019
AA9_LW902_006	288955	6214209	Gas Release	24/05/2019	Active	Three light, intermittent releases within an area of approximately 1.5m by 0.5m	1	31/05/2019

Table 3-2: Summary table of LW901 impacts as of 24 May 2019.

Site ID	Easting	Northing	Impact Type	Identification Date	Status	Description	Impact Level	Report Date
AA9_LW901_001	286880	6214670	Gas Release	2/03/2016	Inactive	Four individual releases in a 5 m ² area. One is moderate and constant; the others are light and intermittent.	1	3/03/2016
AA9_LW901_002	286712	6214745	Gas Release	7/03/2016	Inactive	Approx. 12 releases, low to moderate intensity within 12x4m area; releases are both constant and intermittent.	1	8/03/2016
AA9_LW901_003	286766	6214713	Gas Release	7/03/2016	Inactive	Multiple releases (too many to count). Low to moderate intensity, releases are both intermittent and constant within a 45x6 m area.	1	8/03/2016
AA9_LW901_004	286820	6214695	Gas Release	7/03/2016	Inactive	Approx. 20 releases, most releases are constant with a low to moderate intensity. Covers approx. 20X8m area	1	8/03/2016
AA9_LW901_005	286962	6214666	Gas Release	7/03/2016	Active	Approx. 10 releases, releases are constant with a low to moderate intensity across approx. 7x2m area	1	8/03/2016
AA9_LW901_006	286997	6214667	Gas Release	7/03/2016	Inactive	Approx. 6 releases, releases are constant with low intensity. 3x4m area	1	8/03/2016
AA9_LW901_007	287506	6214668	Gas Release	15/03/2016	Inactive	Approx. 30 light gas releases across the width of the river in a 15x24m area. Releases are both constant and intermittent.	1	16/03/2016
AA9_LW901_008	287065	6214662	Gas Release	18/03/2016	Inactive	approx. 8 releases, light. 4 constant and 4 intermittent in a 7x4m area	1	22/03/2016
AA9_LW901_009	287249	6214679	Gas Release	18/03/2016	Active	>35 releases, light, 4 intermittent, 4 constant; 7x4m area	1	22/03/2016
AA9_LW901_010	287317	6214697	Gas Release	18/03/2016	Active	Multiple (>80), constant and intermittent, 15x30m area	1	22/03/2016
AA9_LW901_011	287036	6214664	Gas Release	21/03/2016	Inactive	Approx. 22 releases, light, constant, 7x8m area. Approx. 10m DS of SW3	1	22/03/2016

AA9_LW901_012	287191	6214670	Gas Release	21/03/2016	Active	2 areas of release separated by approx.8m. US area has 12 light constant releases in a 6x5m area. DS area has 10 similar releases in a 5x5m area	1	22/03/2016
AA9_LW901_013	287377	6214698	Gas Release	21/03/2016	Inactive	Approx. 20 constant releases, light to moderate in intensity, extending across the river, approx. 8m long	1	22/03/2016
AA9_LW901_014	287575	6214652	Gas Release	21/03/2016	Active	>25 releases, all light and constant, predominately on southern bank, approx. 30x10m in area	1	22/03/2016
AA9_LW901_015	287103	6214639	Gas Release	29/03/2016	Inactive	Allens Ck Gas zone. 3/4 releases. light. Intermittent	1	29/03/2016
AA9_LW901_016	287651	6214611	Gas Release	4/04/2016	Inactive	5 releases, 2 constant, 3 intermittent (5secs), southern bank. 1x2m area.	1	4/04/2016
AA9_LW901_017	287156	6214658	Gas Release	8/04/2016	Inactive	14 light constant releases on southern bank (RHS) between LW901_008 and 012. Area is approx. 50m from Allens Ck confluence.	1	8/04/2016
AA9_LW901_018	287429	6194691	Gas Release	21/04/2016	Active	~20 releases on the northern bank of the Nepean River. All releases are light and constant. Area is 2x25m.	1	22/04/2016
AA9_LW901_019	288075	6214239	Gas Release	4/04/2017	Inactive	Approximately 15 light releases, intermittent to constant, stretching along approximately 20m section.	1	5/04/2017
AA9_LW901_020	288157	6214154	Gas Release	4/04/2017	Inactive	Approximately 15 light constant releases along a stretch of approximately 12m	1	5/04/2017
AA9_LW901_021	288455	6214091	Gas Release	26/04/2017	Active	45 intermittent releases mostly low strength with a few medium. Area of approximately 30x10m ²	1	9/05/2017
AA9_LW901_022	288620	6214128	Gas Release	26/04/2017	Inactive	Approximately 20 light intermittent releases with an area of 5x8m ²	1	9/05/2017
AA9_LW901_023	288292	6214083	Gas Release	17/07/2017	Inactive	Approx. 10 Light constant releases within 1 m ²	1	19/07/2017
AA9_LW901_024	288253	6214102	Gas Release	24/05/2017	Inactive	One intermittent release of light intensity	1	30/05/2019

AA9_LW901_025	288218	6214128	Gas Release	24/05/2017	Inactive	One intermittent release of light intensity	1	30/05/2019
AA9_LW901_026	288016	6214314	Gas Release	31/01/2018	Inactive	One constant, light intensity release in the centre of the river	1	01/02/2018

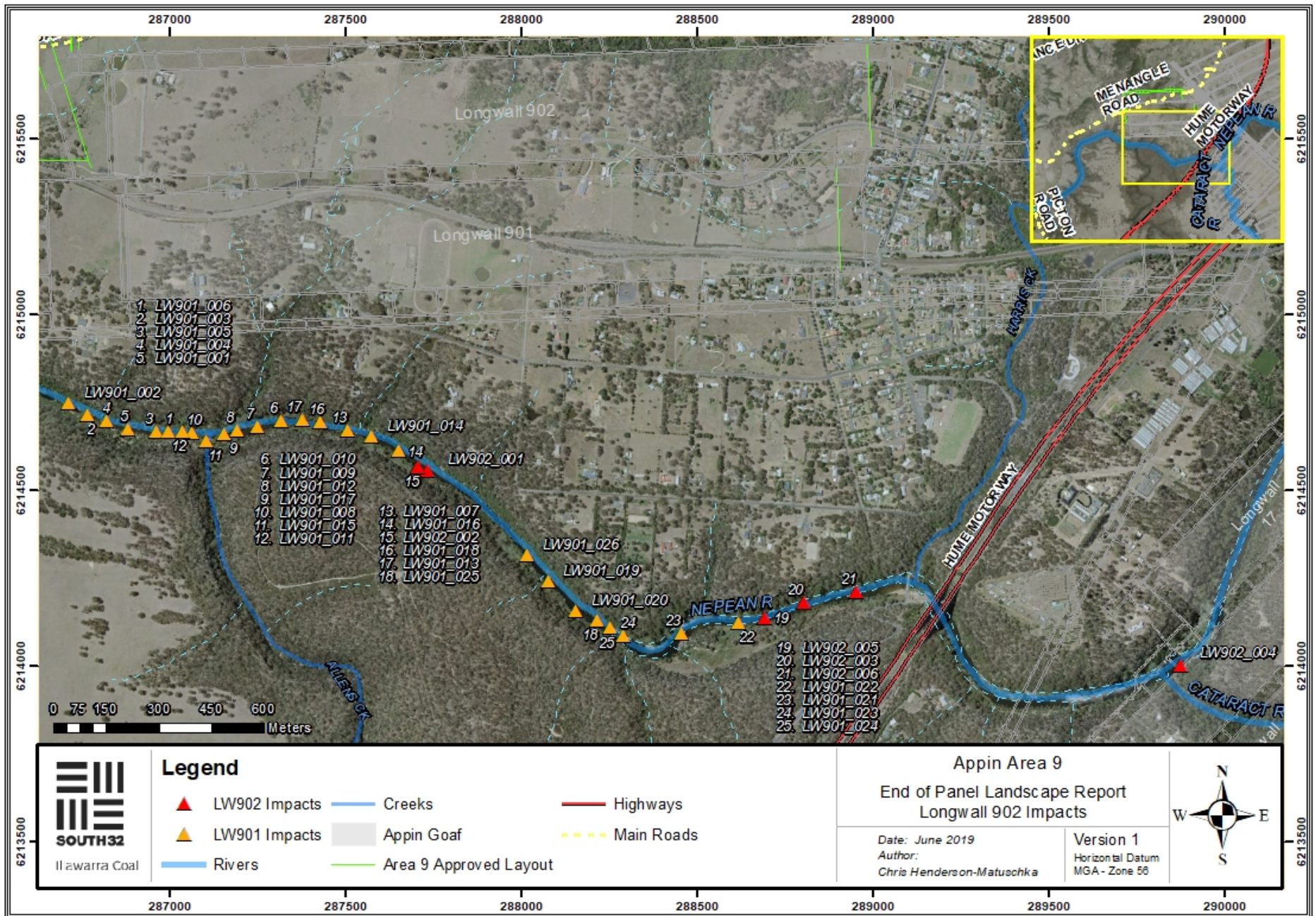


Figure 3-1: Map showing landscape impacts relevant to Longwall 902.

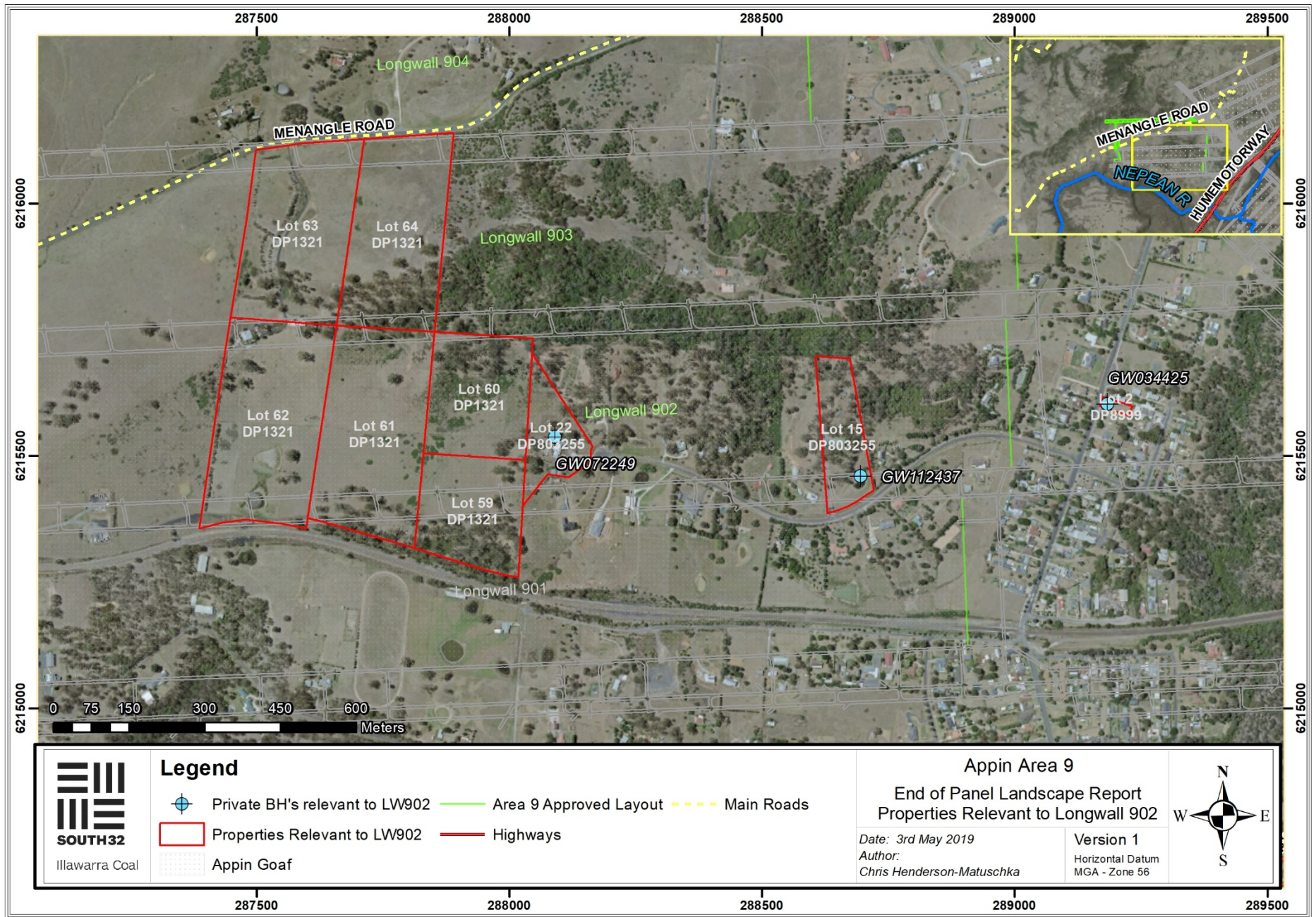


Figure 3-2: Map showing private properties with boreholes relevant to Longwall 902.

4 FUTURE MONITORING

Recommendations for future monitoring in Appin Area 9, particularly concerning Longwall 902, are outlined in Appendix A 1. These recommendations are based on monitoring commitments in the Appin Area 9 EP and the proximity of Longwall 903 to established monitoring sites.

5 APPENDIX A

Appendix A 1: Appin Area 9 Key Monitoring

Monitoring Site	Monitoring Type	Monitoring Frequency	Parameters	Future Monitoring (LW 903)
SURFACE WATER				
<p style="text-align: center; font-weight: bold;">AREA 9</p> <p>Nepean River and tributaries</p> <ul style="list-style-type: none"> • NR110 (Lab, Field, Level, Obs) • NR0 (Lab, Field, Level, Obs) • SW2 (Lab, Field, Obs) • SW3 (NR1) (Field, Obs) • SW4 (Field, Obs) • NR2 (Lab, Field, Obs) • NR3 (Lab, Field, Obs) • NT1_Pool 10 (Lab, Field, Level, Obs) • NT1_Pool 20 (Field, Level, Obs) • NT1_Pool 30 (Field, Level, Obs) • NT1_Pool 40 (Field, Level, Obs) • NT1_Pool 50 (Field, Level, Obs) • If and where strata gas emission plumes above 3000 L/min are detected (Lab, Field, Obs) 	<ul style="list-style-type: none"> • Lab sample • Field parameters • Water levels • Observations 	<ul style="list-style-type: none"> • 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 	<p>Field Parameters:</p> <ul style="list-style-type: none"> • Temperature • Dissolved Oxygen (DO) • Specific Conductivity • pH • ORP <p>Standard Lab Sample:</p> <ul style="list-style-type: none"> • pH and EC • Filtered, Na, K, Ca, Mg, Cl, Ni, Zn, Fe, Mn, Al, SO₄ • Total Fe, Mn, Al • Total Alkalinity • TKN, TP, NH₃-N, NO_x-N (TON), FRP, TSS, DOC <p>Lab Sample for Gas Releases:</p> <ul style="list-style-type: none"> • CH₄ • C₂H₆ • Trace Phenols • Sulphide <p>Observations:</p> <ul style="list-style-type: none"> • 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 	<p>No changes</p>

AREA 9	<p>Flow monitoring</p> <ul style="list-style-type: none"> • Maldon Weir • Broughtons Pass Weir • Menangle Weir 	<ul style="list-style-type: none"> • Gauged flow station 	<ul style="list-style-type: none"> • Daily flow 	<p>Analysis:</p> <ul style="list-style-type: none"> • 51 baseline dry weather recession periods for Menangle minus Maldon minus Broughtons Pass Weirs with recession curve slope ranging from 0.76 to 0.99 • Recession curves calculated during and post mining • These recessions will be compared from the period of mining to the pre-mining period 	<p>These sites are no longer monitored by WaterNSW</p>
GROUNDWATER					
AREA 9	<p>Private Bores</p> <ul style="list-style-type: none"> • GW 34425 • GW 35033 • GW 72249 • GW 100673 • GW 101133 • GW 102043 • GW 102584 • GW 102798 • GW 103161 • GW 104068 • GW 104602 • GW 104661 • GW 110671 <p><i>(in consultation with bore owner)</i></p>	<ul style="list-style-type: none"> • Lab sample • Field parameters • Water levels • Observations 	<ul style="list-style-type: none"> • Where access is available and granted, water level and water quality monitoring at least once before and once after the bore is mined under 	<p>Field Parameters:</p> <ul style="list-style-type: none"> • Temperature • Dissolved Oxygen (DO) • Specific Conductivity • pH • ORP <p>Standard Lab Sample:</p> <ul style="list-style-type: none"> • pH and EC • Filtered, Na, K, Ca, Mg, Cl, Ni, Zn, Fe, Mn, Al, SO₄ • Total Fe, Mn, Al • Total Alkalinity • TKN, TP, NH₃-N, NO_x-N (TON), FRP, TSS, TDS, DOC 	<p>No Changes</p>
	<p>BHPBIC Piezometers:</p> <ul style="list-style-type: none"> • Potentiometric head; <ul style="list-style-type: none"> – EAW9 – EAW18 – EAW58 • Piezometers and water samples between Longwall 901 and the Nepean River <ul style="list-style-type: none"> – S2280 (POSP A) – S2281 (POSP B) 	<ul style="list-style-type: none"> • Lab sample • Field parameters • Water levels • Observations 	<ul style="list-style-type: none"> • Water levels to be logged at least twice daily in the pre-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 	<p>Lab Sample for Gas Releases:</p> <ul style="list-style-type: none"> • CH₄ • C₂H₆ • Trace Phenols • Sulphide <p>Observations:</p> <ul style="list-style-type: none"> • Iron or salinity staining (e.g. orange or white staining in water or in the bores) • Evidence of inflows to the bores e.g. sound of falling water 	<p>No Changes</p>

				<ul style="list-style-type: none"> • Visual signs of impacts (i.e. cracking, fracturing near the bore or changes in water colour etc.) 	
	Groundwater inflows to the mine	<ul style="list-style-type: none"> • Mine water budget • Observations 	<ul style="list-style-type: none"> • Flow meters 	Water flow from the goaf to the mine (analyzed as a moving average i.e. 20 day average)	No Changes
AQUATIC ECOLOGY					
AREA 9	Nepean River <ul style="list-style-type: none"> • Sites 1 and 2 (downstream) • Sites X3 and X4 (adjacent to Longwalls 901 and 902) • Sites X5 and X6 (upstream) • Sites X7 and X8 to be identified (upstream) 	<ul style="list-style-type: none"> • Water quality - field parameters • Survey and sampling • Observations 	<ul style="list-style-type: none"> • Twice in spring for two years prior to the commencement of mining • Once every two years during mining • Once every two years after mining 	<ul style="list-style-type: none"> • Habitat surveys • Aquatic macrophyte observations • Macroinvertebrate monitoring • AUSRIVAS sampling • Fish sampling • Observations of threatened species • Assessments of: <ul style="list-style-type: none"> ○ Water quality ○ Flow ○ River morphology 	No Changes

TERRESTRIAL ECOLOGY					
AREA 9	<ul style="list-style-type: none"> • Inspection of the area will be conducted as outlined in the Landscape TARP 	<ul style="list-style-type: none"> • As indicated in the Landscape TARP 	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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
ABORIGINAL ARCHAEOLOGY					
AREA 9	<ul style="list-style-type: none"> • Impacts to the cliff lines on the southern side of the Nepean River will trigger an inspection of Bradcorp 1 and any adjacent sections of the river and creek valleys that have not been inspected 	<ul style="list-style-type: none"> • Observational and photographic monitoring 	<ul style="list-style-type: none"> • In accordance with Landscape TARP 	<ul style="list-style-type: none"> • Subsidence Impacts to cliff lines on the southern side of the Nepean River (e.g. directly north of Bradcorp 1) 	No Changes
	<ul style="list-style-type: none"> • Bradcorp 1 (if required) 	<ul style="list-style-type: none"> • Observational and photographic monitoring 	<ul style="list-style-type: none"> • Baseline archival recording (when triggered by above) • During the extraction of Longwalls 901, 902 and 903 • Final impact assessment recording twelve months after final subsidence movement at the site 	<ul style="list-style-type: none"> • Macro and micro recording using digital photography • Detailed elevation plans of shelter walls recording structural and surface features including but not limited to the art, graffiti, joints, bedding planes, exfoliation scars, cracks, mineral and 	No Changes

				micro-organism growth, drip line and water seepage locations	
EUROPEAN HERITAGE					
AREA 9	<ul style="list-style-type: none"> • Douglas Park Railway Cottage – Item 30 	<ul style="list-style-type: none"> • Observational monitoring 	<ul style="list-style-type: none"> • Baseline archival recording prior to commencement of mining • Impact assessment recording following the identification of impacts or when a MSB claim is lodged • Final assessment recording following the completion of mining of Longwalls 901 and 902 and/or after any repairs 	<ul style="list-style-type: none"> • With the consent of the owner, the subsidence monitoring program will include: <ul style="list-style-type: none"> • Pre-mining inspection and assessment (as part of PSMP) • Observational monitoring to identify potential subsidence impacts to the fabric of the building and/or its interior • Assessment of heritage impacts by a suitably qualified heritage expert (if required) • This assessment would be made available to the MSB and include recommendations for management of heritage value during any repairs 	No Changes

LANDSCAPE FEATURES

AREA 9

- Nepean River cliff lines
- Harris Creek cliff lines
- Sensitive terrain near built features (Razorback Range, Douglas Park Ridge)

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
 - 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

- Visual inspections
- Photographic records
- Ground survey (mid to high terrain sensitivity)
- Piezometers (high terrain sensitivity)
- Slope inclinometers (high terrain sensitivity)

No Changes

6 APPENDIX B

Appendix B 1: AA9 TARPS, Key Monitoring, Triggers and Response

Monitoring	Trigger	Action
WATER QUALITY		
Adjacent and downstream sites: <ul style="list-style-type: none"> • Nepean River: <ul style="list-style-type: none"> – NR0 – SW3 (NR1) – NR2 – If and where strata gas emission plumes above 3000 L/min are detected 	Level 1* Impact monitoring sites when comparing the baseline period to the mining period for that site: <ul style="list-style-type: none"> • pH reduction greater than 1 standard deviation but less than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months • DO reduction greater than 1 standard deviation but less than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months • Identification of strata gas plume of flow rate < 3000 L/min 	<ul style="list-style-type: none"> • Continue monitoring program • Submit an Impact Report to OEH, DoPI, DPI and other relevant resource managers • Report in the End of Panel Report • Summarise actions and monitoring in AEMR
	Level 2* Impact monitoring sites when comparing the baseline period to the mining period for that site: <ul style="list-style-type: none"> • pH reduction greater than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months • DO reduction greater than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months • EC, total Fe and total Mn increases greater than 2 standard deviation from pre-mining mean resulting from the mining for two consecutive months • Identification of strata gas plume of flow rate >3000 L/min 	<ul style="list-style-type: none"> • <i>Actions stated for Level 1</i> • Review monitoring program • Notify relevant technical specialists and seek advice on any CMA required • Implement agreed CMAs as approved <p><i>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</i></p> <p>Strata Gas Emission Plume:</p> <ul style="list-style-type: none"> • Estimate gas emission flow rates. Re-estimate should significant change be observed • Take sample of plume (if possible) for: <ul style="list-style-type: none"> – chemical composition – dissolved methane from exactly above gas plume and at established downriver monitoring site

Monitoring	Trigger	Action
		<ul style="list-style-type: none"> – dissolved sulfide and total phenols from exactly above gas plume and at nearest downriver monitoring site
	<p>Level 3* Impact monitoring sites when comparing the baseline period to the mining period for that site:</p> <ul style="list-style-type: none"> • Level 2-type reduction in water quality resulting from the mining observed for more than 6 consecutive months 	<ul style="list-style-type: none"> • <i>Actions stated for Level 2</i> • Notify OEHL, DP&I, NoW, DPI, DRE, 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 <p><i>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</i></p>
	<p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> • Mining results in more than negligible gas releases, iron staining or water cloudiness 	<ul style="list-style-type: none"> • <i>Actions stated for Level 3</i> • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation • Provide environmental offset if CMAs are unsuccessful
GROUNDWATER		
<p>Groundwater flow into the mine</p> <p>Registered Bores: GW 34425 GW 35033 GW 72249</p>	<p>Level 1*</p> <ul style="list-style-type: none"> • Increase in water flow from the goaf between 2.7 to 3 ML/day (over 20 day average) • 5.0 – 7.5 m reduction in the Hawkesbury Sandstone greater than predicted standing water level or pressure (outside of pumping influences in private bores) over a minimum 2 month period 	<ul style="list-style-type: none"> • Continue monitoring program • Submit an Impact Report to OEHL, DoPI, DPI and other relevant resource managers • Report in the End of Panel Report • Summarise actions and monitoring in AEMR

Monitoring	Trigger	Action
GW 100673 GW 101133 GW 102043 GW 102584 GW 102798 GW 103161 GW 104068 GW 104602 GW 104661	Level 2* <ul style="list-style-type: none"> Increase in water flow from the goaf between 3 to 3.4ML (over 20 day average) 7.5 – 10 m reduction in the Hawkesbury Sandstone greater than predicted standing water level or pressure (outside of pumping influences in private bores) over a minimum 2 month period 	<ul style="list-style-type: none"> Actions stated for Level 1 Review monitoring program Notify relevant technical specialists and seek advice on any CMA required Implement agreed CMAs as approved <p><i>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</i></p>
GW 110671 BHPBIC Piezometers: EAW9 EAW18 EAW58 PROSP A PROSP B	Level 3* <ul style="list-style-type: none"> Abnormal increase in water flow from the goaf >3.4ML (20 day average) >10m reduction in the Hawkesbury Sandstone standing water level or pressure (outside of pumping influences in private bores) over a minimum 2 month period Mining results in groundwater bores unsafe, unserviceable or damaged 	<ul style="list-style-type: none"> Actions stated for Level 2 Notify OEH, DP&I, DPI, NoW, DRE, 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: <ul style="list-style-type: none"> 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 MSB to repair any infrastructure damaged by mining Completion of works following approvals, including monitoring and reporting on success Review the Groundwater Model, TARP and Management Plan in consultation with key stakeholders <p><i>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</i></p>

Monitoring	Trigger	Action
LANDSCAPE FEATURES		
<p>Cliffs and Steep Slopes</p> <ul style="list-style-type: none"> • Nepean River cliff lines • Harris Creek cliff lines • Sensitive terrain near built features (Razorback Range, Douglas Park Ridge) <p>Monitoring locations on private properties to be determined as appropriate/required in consultation with landowner</p>	<p>Level 1</p> <ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • Continue monitoring program • Submit an Impact Report to OEH, DoPI, DPI and other relevant resource managers • Report in the End of Panel Report • Summarise actions and monitoring in AEMR
	<p>Level 2</p> <ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • <i>Actions stated for Level 1</i> • Report trigger to key stakeholders • Review monitoring program • Notify relevant specialists and develop and implement any CMA required. • Provide safety signage and barricades where appropriate in areas as required for public safety (refer PSMP) • Implement agreed CMA's as approved <p><i>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</i></p>
	<p>Level 3 *</p>	<ul style="list-style-type: none"> • <i>Actions stated for Level 2</i> • Notify OEH, DP&I, DPI, NoW, DRE, 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:

Monitoring	Trigger	Action
	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> - 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 <p><i>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</i></p>
	<p><i>Exceeding Performance Measures</i></p> <ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • <i>Actions stated for Level 3</i> • 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		
<p>Nepean River</p> <ul style="list-style-type: none"> Sites 1 and 2 (downstream) Sites X3 and X4 (adjacent to Longwalls 901 and 902) 	<p>Level 1*</p> <ul style="list-style-type: none"> Reduction in aquatic habitat resulting from the mining over 1 season 	<ul style="list-style-type: none"> Continue monitoring program Submit an Impact Report to OEHL, DoPI, DPI and other relevant resource managers Report in the End of Panel Report Summarise actions and monitoring in AEMR
	<p>Level 2*</p> <ul style="list-style-type: none"> Reduction in aquatic habitat resulting from the mining over 2 seasons 	<ul style="list-style-type: none"> Actions stated for Level 1 Report trigger to key stakeholders Review monitoring program Notify relevant specialists and develop and implement any CMA required. Implement agreed CMA's as approved <p><i>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</i></p>
	<p>Level 3*</p> <ul style="list-style-type: none"> Reduction in aquatic habitat resulting from the mining for >2 consecutive seasons or complete loss of habitat 	<ul style="list-style-type: none"> Actions stated for Level 2 Notify OEHL, DP&I, DPI, NoW, DRE, 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: <ul style="list-style-type: none"> 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 <i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to</i>

		<p><i>aquatic ecology with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
	<p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> • Mining results in more than negligible environmental consequences for a threatened species, threatened population or endangered ecological communities 	<ul style="list-style-type: none"> • 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
TERRESTRIAL ECOLOGY		
Visual inspections as part of landscape and water monitoring programs in active mining areas	<p>Level 1*</p> <ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • Continue monitoring program • Submit an Impact Report to OEH, DoPI, DPI and other relevant resource managers • Report in the End of Panel Report • Summarise actions and monitoring in AEMR
	<p>Level 2*</p> <ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • Actions stated for Level 1 • Report trigger to key stakeholders • Review monitoring program • Notify relevant specialists and develop and implement any CMA required. • Implement agreed CMA's as approved <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to terrestrial with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
	<p>Level 3*</p> <ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • Actions stated for Level 2 • Notify OEH, DP&I, DPI, NoW, DRE, 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:

	<ul style="list-style-type: none"> Negligible environmental consequences to threatened species, populations or EEC 	<ul style="list-style-type: none"> 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 <p><i>Note: CMAs are to be proposed based on appropriate management of environmental and other consequences of mining impacts i.e. impacts to terrestrial ecology with insignificant consequences may not require specific CMAs other than ongoing monitoring to confirm there are no ongoing impacts</i></p>
	<p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> Mining results in more than negligible environmental consequences on threatened species, threatened populations, or endangered ecological communities 	<ul style="list-style-type: none"> 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
ABORIGINAL ARCHAEOLOGY		
<ul style="list-style-type: none"> Impacts to the cliff lines on the southern side of the Nepean River will trigger an inspection of Bradcorp 1 and any sections of the river and creek valleys that have not been surveyed for Aboriginal heritage 	<p>Level 1*</p> <ul style="list-style-type: none"> Change in shelter conditions not attributable to natural weathering or preservation that do not alter the heritage values of the place e.g. mineral growth or micro-organism growth Changes external to shelter conditions that effect the sites context e.g. ground cracking, boulder slumping, rock and/or tree falls 	<ul style="list-style-type: none"> Continue with monitoring program Condition assessment and photographic record Notify relevant specialists and key stakeholders (e.g. Registered Aboriginal Parties) Summarise impacts and report in the End of Panel Report and AEMR
	<p>Level 2*</p> <ul style="list-style-type: none"> Change in shelter conditions not attributable to natural weathering or preservation e.g. change in drip line or seepage, cracking or exfoliation of overhang or shelter, movement or opening of existing planes and joints 	<ul style="list-style-type: none"> Actions stated for Level 1 Review monitoring program Review impacts against the Performance Measures Develop site management plan to mitigate effects in consultation with Registered Aboriginal Parties and the landowner
	<p>Level 3*</p>	<ul style="list-style-type: none"> Actions stated for Level 2

• Change in shelter conditions not attributable to natural weathering or preservation e.g. cracking or exfoliation of art panel, movement of existing planes and joints at panel, block fall within shelter or overhang, shelter or overhang collapse

• Investigate reasons for impacts

• Update future predictions based on outcomes of the investigation

	<p>Exceeding Performance Measures</p> <ul style="list-style-type: none"> • More than 10% of sites across the mining area are affected by subsidence impacts (other than negligible impacts or environmental consequence) 	<ul style="list-style-type: none"> • <i>Actions stated for Level 3</i> • Investigate reasons for the exceedance • Update future predictions based on the outcomes of the investigation
EUROPEAN HERITAGE		
<ul style="list-style-type: none"> • Douglas Park Railway Cottage – Item 30 from the BSOP EA 	<p>Level 1*</p> <ul style="list-style-type: none"> • Cracks or warping of external weatherboards, • Cracks or movement < 5 mm in width in any external or internal wall claddings, linings, or finish • Isolated cracked, loose, or drummy floor or wall tiles • No impact to heritage values of the site 	<ul style="list-style-type: none"> • Continue monitoring program • Condition assessment and photographic record • Notify relevant specialists and key stakeholders • Summarise impacts and report in the End of Panel Report and AEMR
	<p>Level 2*</p> <ul style="list-style-type: none"> • Continuous cracking or warping of weatherboards, • Slippage along the damp proof course of 5 to 15 mm • Loss of bearing to isolated walls, piers, columns, or other load-bearing elements • Loss of stability of isolated structural elements • Loss of heritage value no greater than predicted in HMP 	<ul style="list-style-type: none"> • <i>Actions stated for Level 1</i> • Review monitoring program • Review impacts against the Performance Measures • Develop site management plan to mitigate effects in consultation with stakeholders, where appropriate
	<p>Level 3*</p> <ul style="list-style-type: none"> • Continuous cracking or warping of weatherboards • Slippage along the damp proof course of 15 mm or greater anywhere in the total external façade • Re-leveling of building • Loss of stability of several structural elements • Loss of heritage value greater than predicted in HMP 	<ul style="list-style-type: none"> • <i>Actions stated for Level 2</i> • Investigate reason for impacts • Notify DP&I and MSB as soon as practicable • Seek advice on any CMA required. • Consultation with stakeholders (undertake site inspection if required). • Review the relevant TARP and Management Plan in consultation with key stakeholders
	<p>Exceeding Performance Measures</p>	<ul style="list-style-type: none"> • <i>Actions stated for Level 3</i>

	<ul style="list-style-type: none">• Loss of heritage value greater than predicted under the Heritage Management Plan	<ul style="list-style-type: none">• Investigate reasons for the exceedance• Update future predictions based on the outcomes of the investigation
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* These may be revised in consultation with DoPE and DT&I and other key stakeholders following analysis of natural variability within the pre-mining baseline data.

Office of Environment and Heritage (OEH)

Department of Planning and Environment (DoPE)

NSW Trade and Investment: including Division of Resources and Energy (DRE), and Fisheries (DPI)

NSW Office of Water (NoW)

Mine Subsidence Board (MSB)