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Tahmoor Coal Pty Ltd

SIX MONTHLY SUBSIDENCE IMPACT REPORT

Tahmoor North, Western Domain Longwalls West 1 and West 2

15 November 2019 – 5 May 2020

Report 1 - May 2020

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Document Control

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1 Introduction

This Six Monthly Subsidence Impact Report fulfils the reporting requirement of the Extraction Plan approved for Longwall West 1 and West 2 (LW W1-W2), and covers the period of 15 November 2019 to 5 May 2020.

This report provides the Secretary of NSW Department of Planning, Industry and Environment (DPIE) with a summary of subsidence and environment monitoring results, subsidence impacts and management actions undertaken during the reporting period.

1.1 Background

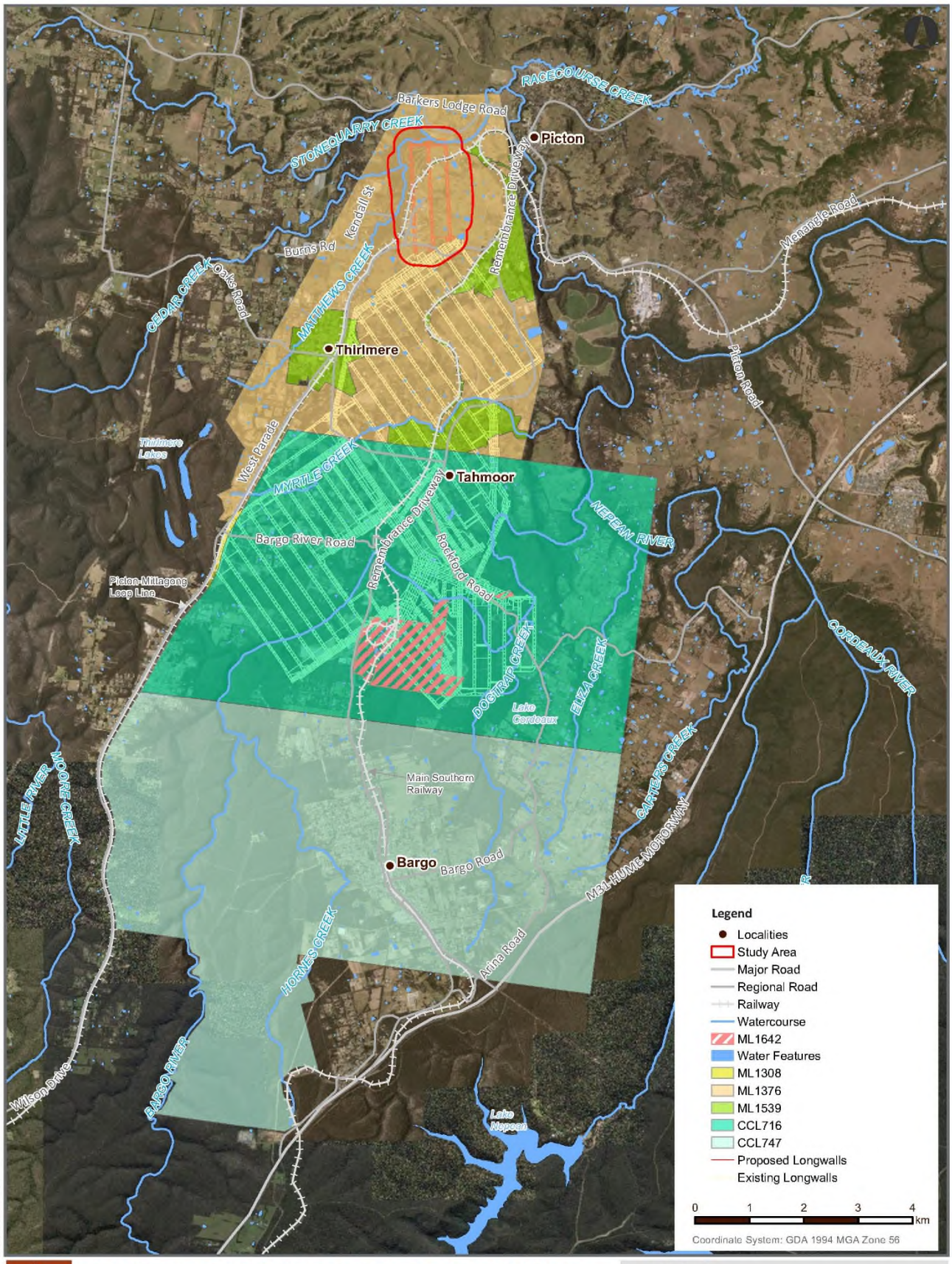
Tahmoor Coal Mine (Tahmoor Mine) is an underground coal mine located approximately 80 kilometres (km) south-west of Sydney between the towns of Tahmoor and Bargo, New South Wales (NSW) (refer to **Figure 1-1**). Tahmoor Mine produces up to three million tonnes of Run of Mine (ROM) coal per annum from the Bulli Coal Seam. Tahmoor Mine produces a primary hard coking coal product and a secondary higher ash coking coal product that are used predominantly for coke manufacture for steel production. Product coal is transported via rail to Port Kembla and Newcastle for Australian domestic customers and export customers.

Tahmoor Mine has been operated by Tahmoor Coal Pty Ltd (Tahmoor Coal) since Tahmoor Mine commenced in 1979 using bord and pillar mining methods, and via longwall mining methods since 1987. Tahmoor Coal, trading as Tahmoor Coking Coal Operations (TCCO), is a subsidiary within the SIMEC Mining Division (SIMEC) of the GFG Alliance (GFG).

Tahmoor Coal has previously mined 32 longwalls to the north and west of the Tahmoor Mine's current pit top location (refer to **Figure 1-1**). Tahmoor Coal is currently mining in the 'Western Domain', an area located north-west of the Main Southern Railway. The Western Domain is within Mining Lease (ML) 1376 and ML 1539.

Tahmoor Coal prepared an Extraction Plan for the first two longwalls in the Western Domain (LW W1-W2), as illustrated in **Figure 1-2**. Extraction Plan approval was granted by DPIE on 8 November 2019. A copy of the Project Approval is available on the Tahmoor Coal website (http://www.simec.com/mining/tahmoor-coking-coal-operations/).

Longwall West 1 (LW W1) is the first longwall to be extracted in the Western Domain, and extraction commenced on 15 November 2019. As of 5 May 2020 (the end of the reporting period for this report), 747 m of LW W1 had been extracted. The active subsidence area of LW W1 for 3 May 2020 is illustrated in **Figure 1-3**.



DOCUMENT FILE PATH

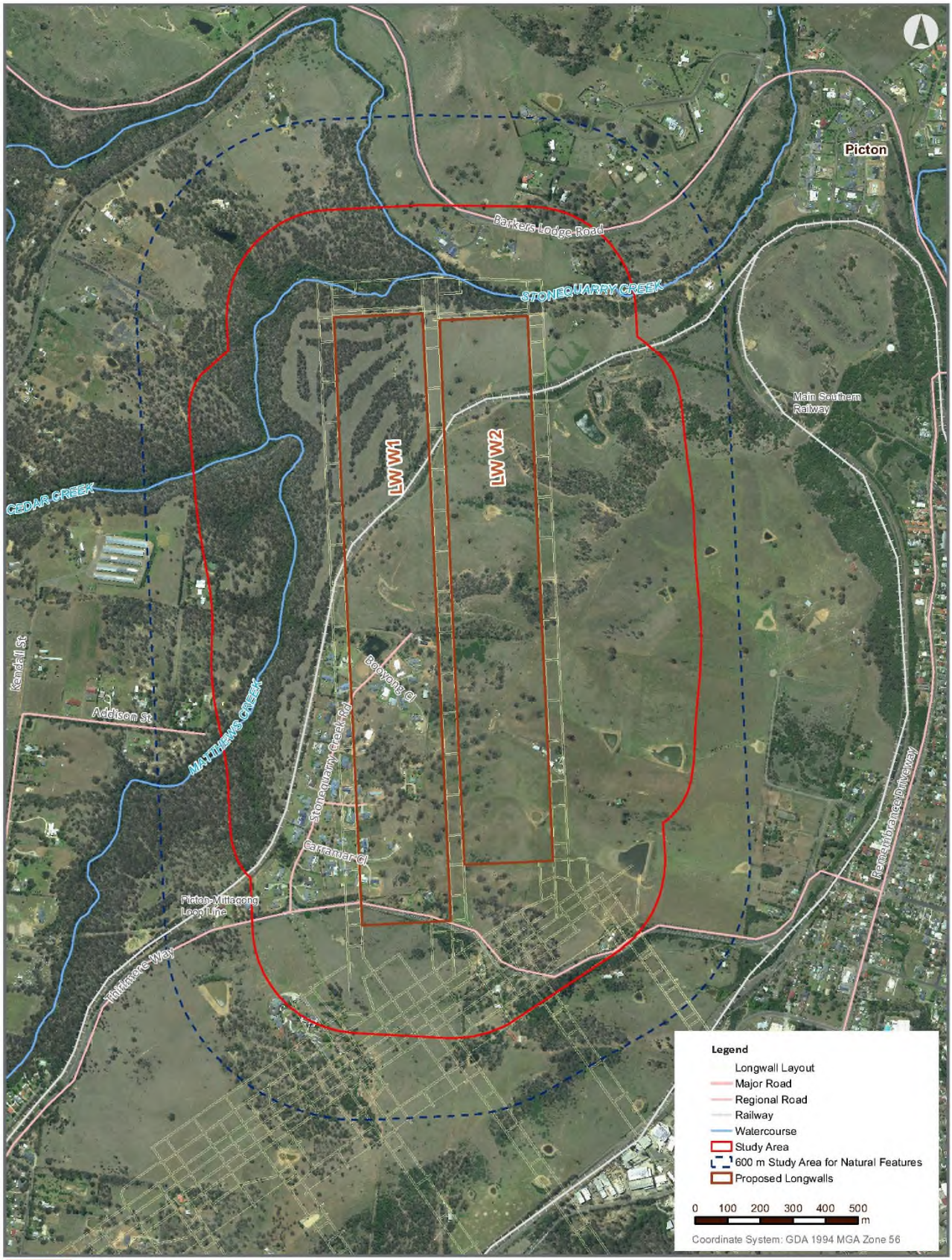
TAHMOOR MINING AREA AND TENURE

Tahmoor North Western Domain Longwalls West 1 and West 2 Extraction Plan

FIGURE 1-1

Date 27/05/2019

Data Sources:
© NSW DFSI (2019); © NSW Mining (2019); © SIMEC (2019)
Aerial Imagery: NSW DFSI MapServer (2019)



EXTRACTION PLAN STUDY AREA

Tahmoor North Western Domain Longwalls West 1 and West 2 Extraction Plan

FIGURE 1-2

Date 4/07/2019

Data Sources:
© NSW DFSI (2019); © NSW Mining (2019); © SIMEC (2019)
Aerial Imagery: © Photomapping Services (November 2018)

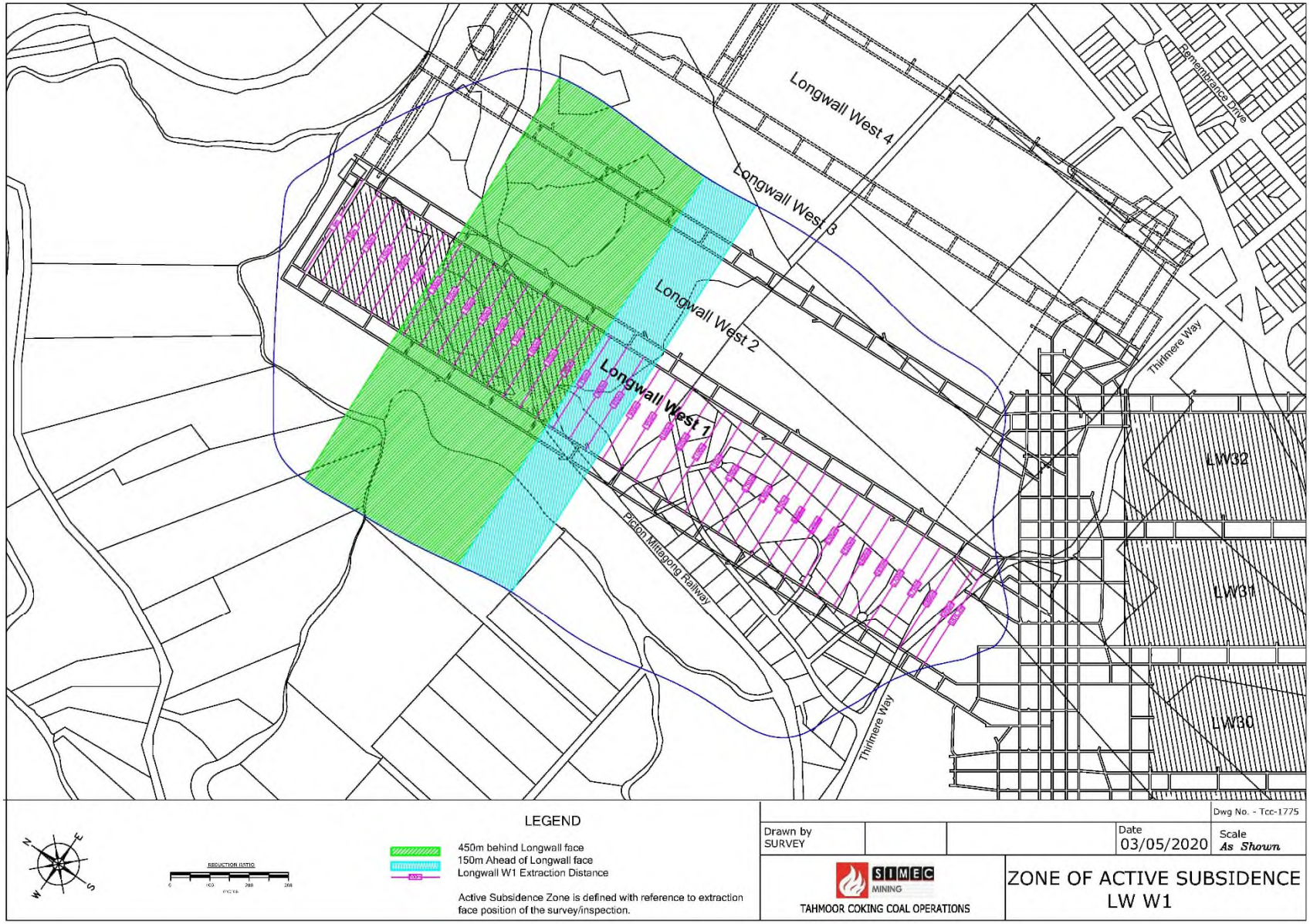


Figure 1-3 LW W1 Zone of Active Subsidence for 3 May 2020 (source: MSEC)

1.2 Purpose

The purpose of this report is to address the requirements for six-monthly reporting on impacts and environmental monitoring results associated with the extraction of LW W1 and LW W2. These requirements are outlined in **Section 6.1.4** of the LW W1-W2 Extraction Plan, which are derived from the Section 6 of the NSW Department of Planning and Environment (DPE) *Draft Guidelines for the Preparation of Extraction Plans V5* (DPE, 2015).

The requirements for this report are listed in **Table 1-1** below, together with the cross-reference where the requirements are addressed in this report.

Table 1-1 Six Monthly Subsidence Impact Report Requirements

Requirement No.	Requirement Description (as per Section 6.1.2 of the LW W1-W2 Extraction Plan)	Section Addressed
1	A comprehensive summary of all impacts, including a revised characterisation according to the relevant TARP(s);	Section 2.1
2	Any proposed actions resulting from triggers being met in the TARP, or other actions;	Section 2.2
3	An assessment of compliance with all relevant performance measures and indicators; and	Section 3
4	A comprehensive summary of all quantitative and qualitative environmental monitoring results, including landscape monitoring, water quality data, water flow and level data, piezometer readings.	Section 4

This report will be distributed to the stakeholders listed in **Section 5.4**.

1.3 Scope

The Tahmoor Coal Environmental Management Structure is shown in **Figure 1-4**.

The Extraction Plan Study Area is defined as the surface area that is likely to be affected by the extraction of LW W1-W2 from the Bulli Coal Seam. This Study Area has been calculated by combining the areas bound by the following limits:

- The predicted limit of vertical subsidence, taken as the 20 millimetre (mm) subsidence contour resulting from the extraction of LW W1-W2; and
- A 35° angle of draw line from the limit of proposed extraction for LW W1-W2.

The Study Area is illustrated in **Figure 1-1** and **Figure 1-2**.

As part of the LW W1-W2 Extraction Plan, a set of management plans have been prepared to manage particular environment or built features with the LW W1-W2 Study Area, which consists of the following:

- Water Management Plan;
- Land Management Plan;
- Biodiversity Management Plan;
- Heritage Management Plan;
- Built Features Management Plan, with a number of sub-plans to manage potential environmental consequences to infrastructure and specific building structures as a result of secondary extraction; and

- Public Safety Management Plan.

The overall framework for subsidence monitoring and management of impacts of the LW W1-W2 Extraction Plan is provided in the Subsidence Monitoring Program.

It is noted that the management requirements for public safety are covered in the Built Features Management Plan and the Land Management Plan.

Monitoring of environmental and built features has been completed by Tahmoor Coal and consultants in accordance with management plans listed above.

This report is the first to be submitted since the commencement of extraction of LW W1, in accordance with the requirements of the LW W1-W2 Extraction Plan. As this report is required to be submitted six months after the commencement of extraction (15 May 2020), the first reporting period is from 15 November 2019 to 5 May 2020.

Table 1-2 summarises the monitoring and reporting completed during the reporting period, as well as the timeframe of data reviewed for each monitoring component.

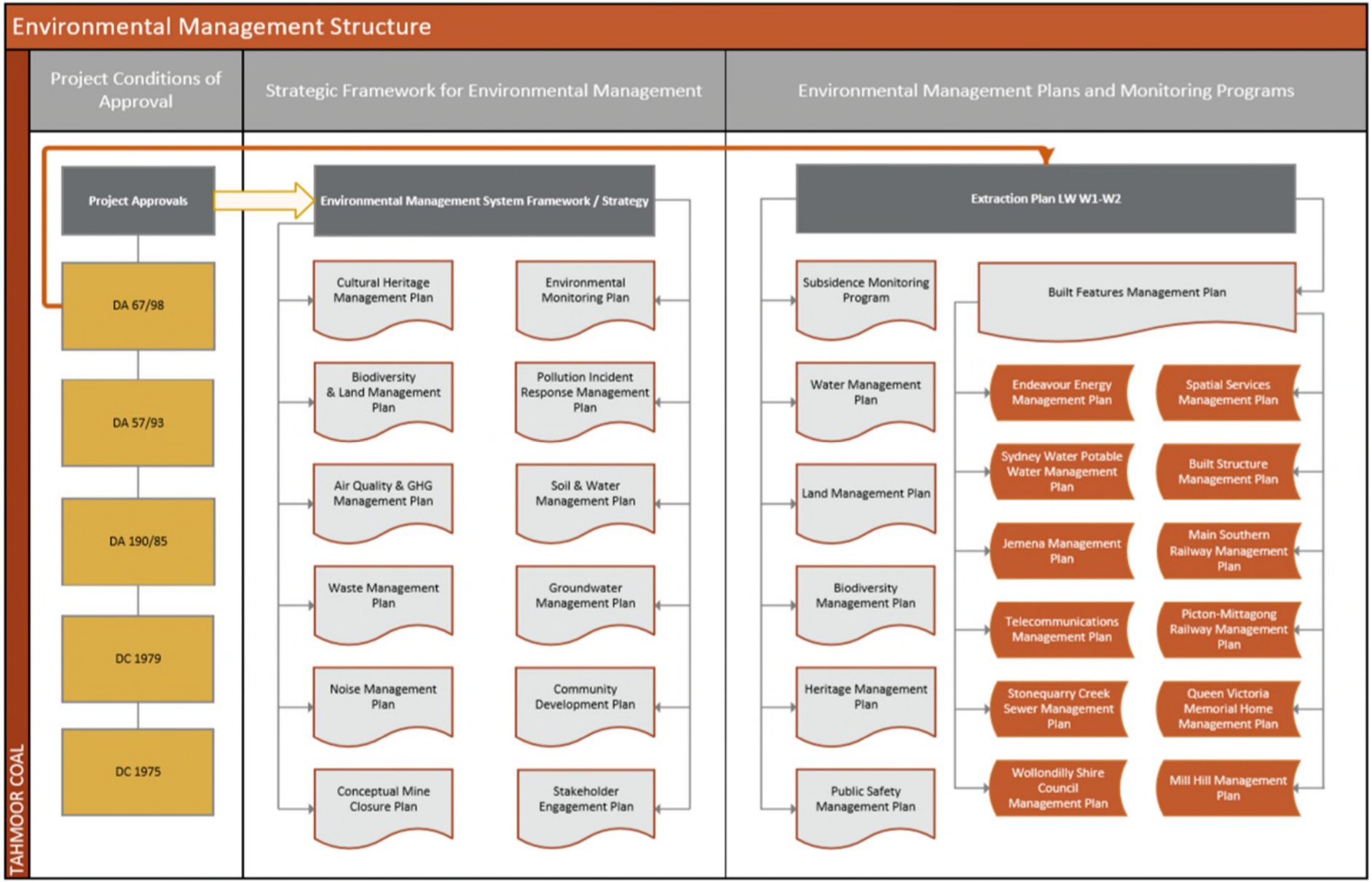


Figure 1-4 Overview of Environmental Management Structure for Tahmoor Coal (source: LW W1-W2 Extraction Plan)

Table 1-2 Monitoring and Reports Reviewed for this Reporting Period

Management Plan	Aspect	Feature	Monitoring Completed By	Monitoring Reported by	Monitoring Reports Completed during this Reporting Period	Reference
Subsidence Monitoring Program	Subsidence	General subsidence	• SMEC • Building Inspection Service • Comms Network Solutions	Mine Subsidence Engineering Consultants (MSEC)	Subsidence Monitoring Reports (15 November 2019 – 5 May 2020): • Report 1: 15/11/2019 – 31/12/2019 • Report 2: 1/1/2020 – 4/2/2020 • Report 3: 5/2/2020 – 3/3/2020 • Report 4: 4/3/2020 – 7/4/2020 • Report 5: 8/4/2020 – 5/5/2020	Appendix A
Water Management Plan	Surface Water	Stonequarry Creek flow	WaterNSW	Hydro Engineering and Consulting (HEC)	Surface Water Review (1 December 2019 – mid-April 2020) for data collected up to: • Stonequarry Creek Flow: 30/4/2020 • Pool Water Level: 15/4/2020 • Water quality: 14/42020 • Creek review: 24/4/2020	Appendix B
		Pool water level	Hydrometric Consulting Service	HEC		
		Stream water quality	HCS	HEC		
		Natural drainage behaviour	GeoTerra	GeoTerra	Creek Monitoring Reports (December 2019 to April 2020) for creek monitoring completed on: • Report 1: 23/12/2019 • Report 2: 22/1/2020 • Report 3: 27/2/2020 • Report 4: 24/3/2020 • Report 5: 24/4/2020	Appendix C
	Groundwater	Groundwater quality	GeoTerra	GeoTerra	Groundwater Monthly Reports (January 2020 to April 2020) for monitoring completed on: • Report 1: 29/1/2020 • Report 2: 28/2/2020 • Report 3: 24/3/2020 • Report 4: 24/4/2020, and private groundwater bores monitored between 1-6/5/2020	Appendix D
		Groundwater bore level	GeoTerra	GeoTerra		
		Shallow groundwater pressures	GeoTerra	GeoTerra		

		Deep groundwater pressures	Groundwater Exploration Services	GeoTerra	It is noted that groundwater quality laboratory data for groundwater monitoring bores was not available in Report 4, and groundwater quality assessment was based on field results.	
Land Management Plan	Landscape	Cliff lines	Douglas Partners	Douglas Partners	Geotechnical Monitoring Reports (December 2019 to April 2020) for monitoring completed on: • Report 1: 17/12/2019 • Report 2: 20/1/2020 • Report 3: 24/2/2020 • Report 4: 14/4/2020 Surface cracking along the railway corridor is noted in the PMLL Weekly Detailed Reports.	Appendix E
		Steep Slopes	Douglas Partners	Douglas Partners		
		Surface cracking (excluding railway corridor)	Douglas Partners	Douglas Partners		
		Dams (monthly)	Douglas Partners	Douglas Partners		
		Dams (weekly)	Newcastle Geotechnical	Newcastle Geotechnical	PMLL Weekly Detailed Reports (25 November 2019 to 4 May 2020) including dam monitoring completed on: • Report 2: 25/11/2019 • Report 3: 5/12/2019 • Report 4: 12/12/2019 • Report 5: 16/12/2019 • Report 6: 23/12/2019 • Report 7: 30/12/2019 • Report 8: 6/1/2020 • Report 9: 13/1/2020 • Report 10: 20/1/2020 • Report 11: 28/1/2020 • Report 12: 1/2/2020 • Report 13: 7/2/2020 • Report 14: 17/2/2020 • Report 15: 24/2/2020 • Report 16: 2/3/2020 • Report 17: 9/3/2020 • Report 18: 18/3/2020 • Report 19: 23/3/2020 • Report 20: 30/3/2020 • Report 21: 6/4/2020 • Report 22: 14/4/2020	Appendix F

					• Report 23: 20/4/2020 • Report 24: 27/4/2020 • Report 25: 4/5/2020	
	Agricultural Land	Agricultural Land	• Tahmoor Coal • Building Inspection Service	Building Inspection Service	Agricultural Subsidence Monitoring Reports (December 2019 to April 2020) for monitoring completed on: • Report 1: 11/12/2019 • Report 2: 23/1/2020 • Report 3: 28/2/2020 • Report 4: 27/3/2020 • Report 5: 22/4/2020	Appendix G
Biodiversity Management Plan	Aquatic Ecology	Macroinvertebrates	Niche	Niche	Aquatic Ecology Monitoring Report (2017 – Autumn 2020 (March 2020)).	Appendix H
	Terrestrial Ecology	Amphibians	Niche	Niche	Terrestrial Ecology Monitoring Report (Autumn 2018 - Autumn 2020 (March 2020)).	Appendix I
		Riparian Vegetation	Niche	Niche		
Heritage Management Plan	Aboriginal heritage	Rock shelters	GeoTerra	GeoTerra	Creek Monitoring Reports (December 2019 to April 2020) for creek monitoring completed on: • Report 1: 23/12/2019 • Report 2: 22/1/2020 • Report 3: 27/2/2020 • Report 4: 24/3/2020 • Report 5: 24/4/2020	Appendix C
		Grinding Grooves	SMEC	MSEC	Subsidence Monitoring Reports (15 November 2019 – 5 May 2020): • Report 1: 15/11/2019 – 31/12/2019 • Report 2: 1/1/2020 – 4/2/2020 • Report 3: 5/2/2020 – 3/3/2020 • Report 4: 4/3/2020 – 7/4/2020 • Report 5: 8/4/2020 – 5/5/2020	Appendix A
	Historical heritage	Railway culverts	Newcastle Geotechnical	Newcastle Geotechnical	PMLL Weekly Detailed Reports (25 November 2019 to 4 May 2020) including railway culvert monitoring completed on: • Report 2: 25/11/2019 • Report 3: 5/12/2019 • Report 4: 12/12/2019	Appendix F

					• Report 5: 16/12/2019 • Report 6: 23/12/2019 • Report 7: 30/12/2019 • Report 8: 6/1/2020 • Report 9: 13/1/2020 • Report 10: 20/1/2020 • Report 11: 28/1/2020 • Report 12: 1/2/2020 • Report 13: 7/2/2020 • Report 14: 17/2/2020 • Report 15: 24/2/2020 • Report 16: 2/3/2020 • Report 17: 9/3/2020 • Report 18: 18/3/2020 • Report 19: 23/3/2020 • Report 20: 30/3/2020 • Report 21: 6/4/2020 • Report 22: 14/4/2020 • Report 23: 20/4/2020 • Report 24: 27/4/2020 • Report 25: 4/5/2020	
Built Features Management Plan	Built Features	Electricity Infrastructure Gas Infrastructure Potable Water Telecommunications Local roads, bridges and culverts Built Structures Sewerage Infrastructure Queen Victoria Memorial Home (QVMH) Mill Hill	• SMEC • Building Inspection Service • Comms Network Solutions	MSEC	Subsidence Monitoring Reports (15 November 2019 – 5 May 2020): • Report 1: 15/11/2019 – 31/12/2019 • Report 2: 1/1/2020 – 4/2/2020 • Report 3: 5/2/2020 – 3/3/2020 • Report 4: 4/3/2020 – 7/4/2020 • Report 5: 8/4/2020 – 5/5/2020	Appendix A

		Picton-Mittagong Loop Line	• Southern rail Services • Bloor Rail	MSEC	PMLL Weekly Status Reports (15 November 2019 – 5 May 2020): • Report 1: 15/11/2019 – 20/11/2019 • Report 2: 20/11/2019 – 26/11/2019 • Report 3: 27/11/2019 – 3/12/2019 • Report 4: 4/12/2019 – 10/12/2019 • Report 5: 11/12/2019 – 17/12/2019 • Report 6: 18/12/2019 – 24/12/2019 • Report 7: 25/12/2019 – 31/12/2019 • Report 8: 1/1/2020 – 7/1/2020 • Report 9: 8/1/2020 – 14/1/2020 • Report 10: 15/1/2020 – 21/1/2020 • Report 11: 22/1/2020 – 28/1/2020 • Report 12: 29/1/2020 – 4/2/2020 • Report 13: 5/2/2020 – 11/2/2020 • Report 14: 12/2/2020 – 18/2/2020 • Report 15: 19/2/2020 – 25/2/2020 • Report 16: 26/2/2020 – 3/3/2020 • Report 17: 4/3/2020 – 10/3/2020 • Report 18: 11/3/2020 – 17/3/2020 • Report 19: 18/3/2020 – 24/3/2020 • Report 20: 25/3/2020 – 31/3/2020 • Report 21: 1/4/2020 – 7/4/2020 • Report 22: 8/4/2020 – 14/4/2020 • Report 23: 15/4/2020 – 21/4/2020 • Report 24: 22/4/2020 – 28/4/2020 • Report 25: 29/4/2020 – 5/5/2020	Appendix J
		Roads and Maritime Services (**RMS**) Infrastructure	• SMEC • Southern Rail Services • Building Inspection Service	MSEC	RMS Status Reports (15 November 2019 – 7 April 2020): • Report 1: 15/11/2019 – 11/2/2020 • Report 2: 29/1/2020 – 3/3/2020 • Report 3: 4/3/2020 – 7/4/2020	Appendix K
		Main Southern Railway	• SMEC • Southern rail Services • Bloor Rail	MSEC	Main Southern Railway Status Reports (15 November 2019 – 5 May 2020): • Report 1: 15/11/2019 – 17/12/2019 • Report 2: 18/12/2019 – 24/12/2019	Appendix L

			• Building Inspection Service • Comms Network Solutions • Newcastle Geotech		• Report 3: 25/12/2019 – 31/12/2019 • Report 4: 1/1/2020 – 7/1/2020 • Report 5: 8/1/2020 – 14/1/2020 • Report 6: 15/1/2020 – 21/1/2020 • Report 7: 22/1/2020 – 28/1/2020 • Report 8: 29/1/2020 – 4/2/2020 • Report 9: 5/2/2020 – 11/2/2020 • Report 10: 12/2/2020 – 18/2/2020 • Report 11: 19/2/2020 – 25/2/2020 • Report 12: 26/2/2020 – 3/3/2020 • Report 13: 4/3/2020 – 10/3/2020 • Report 14: 11/3/2020 – 17/3/2020 • Report 15: 18/3/2020 – 24/3/2020 • Report 16: 25/3/2020 – 31/3/2020 • Report 17: 1/4/2020 – 7/4/2020 • Report 18: 8/4/2020 – 14/4/2020 • Report 19: 15/4/2020 – 21/4/2020 • Report 20: 22/4/2020 – 28/4/2020 • Report 21: 29/4/2020 – 5/5/2020	

2 Overview of Impacts and Actions

2.1 Summary of Impacts

This section provides a comprehensive summary of all impacts during the reporting period, including a revised characterisation according to the relevant Trigger Action Response Plan (TARP)(s) (if required).

A summary of monitoring results for relevant TARP's is given in Table 2-3. Triggers that were activated are denoted in Table 2-3 with colours defined in **Table 2-1** and **Table 2-2**. A full list of TARPs for environmental features that are applicable is provided in Appendix D of the LW W1-W2 Extraction Plan.

Table 2-1 Risk Levels for Environmental Feature TARPs

Risk Level	Trigger Description
Level 1	Normal – Operations within predicted impacts.
Level 2	Within Prediction - Operations within predicted impacts but exceeds or potentially exceeds predictions.
Level 3*	Almost Exceeds Prediction - Operations within predicted impacts but are likely to almost exceed predictions.
Level 4	Exceeds Prediction - Operations exceed predicted impact.

Note: * Level 3 is only used in the Water Management Plan TARPs.

Table 2-2 Trigger Levels for Railway Features (applicable to Picton-Mittagong Loop Line and Main Southern Railway features)

Trigger Level	Trigger Description
Green	Observations within predictions. Operate as normal.
Blue	Observations outside predictions but within operating tolerance. Investigate cause. Some action may be required to prevent operating restrictions.
Yellow	Restrictions on operations. Action required. Appropriate speed restriction applied until altered to Green or Blue level.
Red	Stop trains until altered to Green or Blue level.

As all results during this report period are consistent with the current TARPs, hence a revision of the TARPs for environmental features is not considered necessary at this point in time.

Table 2-3 Summary of TARP Triggers for the Current Reporting Period

Aspect	Feature	Corresponding Management Plan and TARP	November 2019	December 2019	January 2020	February 2020	March 2020	April 2020
Surface Water	Stonequarry Creek flow	Water Management Plan - Downstream reduction in catchment flow rate in Stonequarry Creek at Picton Gauging Station (GS212053)	NA	LEVEL 2 TRIGGERED Although the ratio of the monitored to modelled flows fell slightly below the 20th percentile in January 2020, the very low streamflow rates were due to prevailing climatic conditions rather than mining of LW W1. [1]	LEVEL 2 TRIGGERED Although the ratio of the monitored to modelled flows fell slightly below the 20th percentile in January 2020, the very low streamflow rates were due to prevailing climatic conditions rather than mining of LW W1. [1]	LEVEL 2 TRIGGERED Although the ratio of the monitored to modelled flows fell slightly below the 20th percentile in January 2020, the very low streamflow rates were due to prevailing climatic conditions rather than mining of LW W1. [1]	LEVEL 2 TRIGGERED Although the ratio of the monitored to modelled flows fell slightly below the 20th percentile in January 2020, the very low streamflow rates were due to prevailing climatic conditions rather than mining of LW W1. [1]	LEVEL 2 TRIGGERED Although the ratio of the monitored to modelled flows fell slightly below the 20th percentile in January 2020, the very low streamflow rates were due to prevailing climatic conditions rather than mining of LW W1. [1]
	Pool water level	Water Management Plan - Impact to pool water level	NA	LEVEL 2 TRIGGERED Pool water level trigger occurred at sites MF, MG, SB, SC, CA, CD. [2]	LEVEL 2 TRIGGERED Pool water level trigger occurred at sites MA, MF, SB, SC, CA. [2]	No pool water level triggers occurred.	No pool water level triggers occurred.	No pool water level triggers occurred.
	Stream water quality	Water Management Plan - Stream water quality impact	NA	LEVEL 2 TRIGGERED Triggers occurred at Site MG (pH) and Site SC (Electrical Conductivity). [3]	LEVEL 2 TRIGGERED A trigger occurred at Site SC (Electrical Conductivity). [3]	LEVEL 2 TRIGGERED A trigger occurred at Site MC1 (dissolved nickel). [3]	LEVEL 2 TRIGGERED A trigger occurred at Site MC1 (pH). [3]	No surface water quality triggers occurred.
	Natural drainage behaviour	Water Management Plan - Impact to pool level, natural drainage behaviour or overland connected flow	NA	LEVEL 2 TRIGGERED Impacts to pool level to pools CR1 to CR9, CR11, CR31, CR32 and MR44 to MR46 noted. Impacts included partially or totally dried up pools and no observable overland flow due to	No impacts to natural drainage behaviour observed.	LEVEL 3 TRIGGERED Gas emissions were observed in pool MR45 downstream of monitoring site MG. [5]	LEVEL 3 TRIGGERED Gas emissions were observed in pool MR45 downstream of monitoring site MG. [5]	LEVEL 3 TRIGGERED Gas emissions were observed in pool MR45 downstream of monitoring site MG. [5]

Aspect	Feature	Corresponding Management Plan and TARP	November 2019	December 2019	January 2020	February 2020	March 2020	April 2020
				the long-standing drought. [4]				
	Flood levels	Water Management Plan - Impact to flood levels	NR Flood modelling required after completion of LW W1-W2.	NR Flood modelling required after completion of LW W1-W2.	NR Flood modelling required after completion of LW W1-W2.	NR Flood modelling required after completion of LW W1-W2.	NR Flood modelling required after completion of LW W1-W2.	NR Flood modelling required after completion of LW W1-W2.
Groundwater	Groundwater quality	Water Management Plan – Groundwater quality at monitoring bores and private groundwater bores *	NA	NA	No observable change in salinity, pH or metals outside of the baseline variability.	No observable change in salinity, pH or metals outside of the baseline variability.	No observable change in salinity, pH or metals outside of the baseline variability.	No observable change in salinity or pH (field results only) outside of the baseline variability.
	Groundwater bore level	Water Management Plan – Groundwater levels at monitoring bores and private groundwater bores *	NA	NA	Groundwater level remains consistent within baseline variability and/or pre-mining trends, with reductions in groundwater level not persisting after significant rainfall recharge events.	Groundwater level remains consistent within baseline variability and/or pre-mining trends, with reductions in groundwater level not persisting after significant rainfall recharge events.	Groundwater level remains consistent within baseline variability and/or pre-mining trends, with reductions in groundwater level not persisting after significant rainfall recharge events.	Groundwater level remains consistent within baseline variability and/or pre-mining trends, with reductions in groundwater level not persisting after significant rainfall recharge events.
	Shallow groundwater pressures	Water Management Plan – Shallow groundwater pressures at VMPs TNC036, TNC040, and TNC034	NA	NA	No observable mining induced change at VWP intakes at or above 200 m depth.	No observable mining induced change at VWP intakes at or above 200 m depth.	No observable mining induced change at VWP intakes at or above 200 m depth.	No observable mining induced change at VWP intakes at or above 200 m depth.
	Deep groundwater pressures	Water Management Plan – Deep groundwater pressures at VMPs TNC036, TNC040, and TNC043	NA	NA	Observed data does not exceed predicted (modelled) impacts at VWP intakes located below (i.e. deeper than)	Observed data does not exceed predicted (modelled) impacts at VWP intakes located below (i.e. deeper than)	Observed data does not exceed predicted (modelled) impacts at VWP intakes located below (i.e. deeper than)	Observed data does not exceed predicted (modelled) impacts at VWP intakes located below (i.e. deeper than)

Aspect	Feature	Corresponding Management Plan and TARP	November 2019	December 2019	January 2020	February 2020	March 2020	April 2020
					200 m depth (excluding those monitoring the Bulli Coal Seam).	200 m depth (excluding those monitoring the Bulli Coal Seam).	200 m depth (excluding those monitoring the Bulli Coal Seam).	200 m depth (excluding those monitoring the Bulli Coal Seam).
Landscape	Cliff lines	Land Management Plan – Cliff line damage or instability	NA	No signs of distress or change in the areas inspected that could be attributed to mine subsidence.	No signs of distress or change in the areas inspected that could be attributed to mine subsidence.	No signs of distress or change in the areas inspected that could be attributed to mine subsidence.	NA (Assuming no signs of distress or change due to no change noted in April 2020).	No signs of distress or change in the areas inspected that could be attributed to mine subsidence.
	Steep Slopes	Land Management Plan – Steep slope damage or instability	NA	NR No steep slopes close to structures in the active subsidence zone this month.	NR No steep slopes close to structures in the active subsidence zone this month.	NR No steep slopes close to structures in the active subsidence zone this month.	NR No steep slopes close to structures in the active subsidence zone this month.	NR No steep slopes close to structures in the active subsidence zone this month.
	Surface cracking	Land Management Plan – Surface cracking (excluding railway corridor)	NA	No signs of change in the areas inspected that could be attributed to mine subsidence.	No signs of change in the areas inspected that could be attributed to mine subsidence.	No signs of change in the areas inspected that could be attributed to mine subsidence.	NA (Assuming no signs of change due to no change noted in April 2020).	No signs of change in the areas inspected that could be attributed to mine subsidence.
	Dams (monthly)	Water Management Plan – Impacts to dams	NA	No signs of change to FD7.	No signs of change to FD7.	No signs of change to FD7.	NA (Assuming no signs of change due to no change noted in April 2020).	No signs of change to FD7.
	Dams (weekly)	Water Management Plan – Impacts to dams	No signs of change to FD7.	No signs of change to FD7.	No signs of change to FD7.	No signs of change to FD7.	No signs of change to FD7.	No signs of change to FD7.
Agricultural Land	Agricultural Land	Land Management Plan – Agricultural land	NA	No signs of change since baseline.	No signs of change since baseline.	No signs of change since baseline.	No signs of change since baseline.	No signs of change since baseline.
Aquatic Ecology	Macroinvertebrates	Biodiversity Management Plan – Decline or significant	NR	NR	NR	NR	Monitoring macroinvertebrate indicators are within	NR Monitoring next required in Spring 2020.

Aspect	Feature	Corresponding Management Plan and TARP	November 2019	December 2019	January 2020	February 2020	March 2020	April 2020
		negative change in macroinvertebrate indicators. These indicators include: • Density • Family richness • Community assemblages • EPT index • SIGNAL score • AUSRIVAS score	Monitoring next required in Autumn 2020.	Monitoring next required in Autumn 2020.	Monitoring next required in Autumn 2020.	Monitoring next required in Autumn 2020.	range of baseline data as supported by statistical analysis.	
		Biodiversity Management Plan – Reduction in aquatic habitat through loss of pools or associated reduction in water quality (AURIVAS habitat assessment)	NR Monitoring next required in Autumn 2020.	NR Monitoring next required in Autumn 2020.	NR Monitoring next required in Autumn 2020.	NR Monitoring next required in Autumn 2020.	Visual monitoring indicates aquatic habitat parameters are similar to baseline observations at aquatic ecology monitoring sites.	NR Monitoring next required in Spring 2020.
Terrestrial Ecology	Amphibians	Biodiversity Management Plan – Decline in amphibian populations within watercourses of the Study Area	NR Monitoring next required in Autumn 2020.	NR Monitoring next required in Autumn 2020.	NR Monitoring next required in Autumn 2020.	NR Monitoring next required in Autumn 2020.	Monitoring indicates amphibian population parameters are predominantly within a reasonable range of baseline data as supported by statistical analysis.	NR Monitoring next required in Spring 2020.

Aspect	Feature	Corresponding Management Plan and TARP	November 2019	December 2019	January 2020	February 2020	March 2020	April 2020
	Riparian Vegetation	Biodiversity Management Plan – Dieback of riparian vegetation within watercourses of the Study Area	NR Monitoring next required in Autumn 2020.	NR Monitoring next required in Autumn 2020.	NR Monitoring next required in Autumn 2020.	NR Monitoring next required in Autumn 2020.	Monitoring indicates riparian vegetation parameters are predominantly within a reasonable range of baseline data as supported by statistical analysis.	NR Monitoring next required in Spring 2020.
Aboriginal Heritage	Rock shelters and grinding grooves	Heritage Management Plan – Aboriginal heritage	NA	No subsidence related rock face cracking or spalling. No signs of change at SR17 (grinding groove site).	No subsidence related rock face cracking or spalling. No signs of change at SR17 (grinding groove site).	No subsidence related rock face cracking or spalling. No signs of change at SR17 (grinding groove site).	No subsidence related rock face cracking or spalling. No signs of change at SR17 (grinding groove site).	No subsidence related rock face cracking or spalling. No signs of change at SR17 (grinding groove site).
Historical Heritage	Railway Culverts	Heritage Management Plan – Historical heritage (culverts only)	No signs of change to culverts.	No signs of change to culverts.	No signs of change to culverts.	No signs of change to culverts.	No signs of change to culverts.	No signs of change to culverts.
Built Features	Picton-Mittagong Loop Line	Picton-Mittagong Railway Management Plan	Results are within survey tolerance. Visual inspections did not identify any issues. *Note: Track geometry survey of railway track noted a blue trigger, however this was not related to mining.*	Results are within survey tolerance. Visual inspections did not identify any issues. *Note: Track geometry survey of railway track noted a blue trigger, however this was not related to mining.*	Results are within survey tolerance. Visual inspections did not identify any issues. *Note: Track geometry survey of railway track noted a blue trigger, however this was not related to mining.*	Results are within survey tolerance. Visual inspections did not identify any issues. *Note: Track geometry survey of railway track noted a blue trigger, however this was not related to mining.*	Results are within survey tolerance. Visual inspections did not identify any issues. *Note: Track geometry survey of railway track noted a blue trigger, however this was not related to mining.*	**BLUE TRIGGER** Embankment and Culvert (88.400 km) – tension crack along the crest of the embankment on down side at 88.387 km noted on 16 April 2020.

Aspect	Feature	Corresponding Management Plan and TARP	November 2019	December 2019	January 2020	February 2020	March 2020	April 2020
	Main Southern Railway	Main Southern Railway Management Plan	Minor changes observed by monitoring equipment this month.	Minor changes observed by monitoring equipment this month.	Minor changes observed by monitoring equipment this month.	Minor changes observed by monitoring equipment this month.	**BLUE TRIGGER** Ballast Top Subway (86.838 km) – changes in distances across the abutments exceeded the monitoring review point trigger level.	**BLUE TRIGGER** Ballast Top Subway (86.838 km) – changes in distances across the abutments exceeded the monitoring review point trigger level.
	Electricity Infrastructure	Endeavour Energy Management Plan	No measurable change observed for power pole 631136 on Barkers Lodge Road.	No measurable change observed for power pole 631136 on Barkers Lodge Road.	No measurable change observed for power pole 631136 on Barkers Lodge Road.	NR No electrical infrastructure located within the LW W1 active subsidence area this month.	NR No electrical infrastructure located within the LW W1 active subsidence area this month.	NR No electrical infrastructure located within the LW W1 active subsidence area this month.
	Gas Infrastructure	Jemena Management Plan	NR No gas infrastructure located within the LW W1 active subsidence area this month.	NR No gas infrastructure located within the LW W1 active subsidence area this month.	NR No gas infrastructure located within the LW W1 active subsidence area this month.	NR No gas infrastructure located within the LW W1 active subsidence area this month.	NR No gas infrastructure located within the LW W1 active subsidence area this month.	NR No gas infrastructure located within the LW W1 active subsidence area this month.
	Potable Water	Sydney Water Potable Water Management Plan	NR No potable water infrastructure located within the LW W1 active subsidence area this month.	NR No potable water infrastructure located within the LW W1 active subsidence area this month.	NR No potable water infrastructure located within the LW W1 active subsidence area this month.	NR No potable water infrastructure located within the LW W1 active subsidence area this month.	NR No potable water infrastructure located within the LW W1 active subsidence area this month.	NR No potable water infrastructure located within the LW W1 active subsidence area this month.
	Telecommunications	Telstra Management Plan	No impacts observed on optical fibre cable along Barkers Lodge Road.	No impacts observed on optical fibre cable along Barkers Lodge Road.	No impacts observed on optical fibre cable along Barkers Lodge Road.	NR No telecommunications infrastructure located within the LW W1 active subsidence area this month.	NR No telecommunications infrastructure located within the LW W1 active subsidence area this month.	NR No telecommunications infrastructure located within the LW W1 active subsidence area this month.

Aspect	Feature	Corresponding Management Plan and TARP	November 2019	December 2019	January 2020	February 2020	March 2020	April 2020
		NBN Co Management Plan	No impacts observed on optical fibre cable along Barkers Lodge Road.	No impacts observed on optical fibre cable along Barkers Lodge Road.	No impacts observed on optical fibre cable along Barkers Lodge Road.	NR No telecommunications infrastructure located within the LW W1 active subsidence area this month.	NR No telecommunications infrastructure located within the LW W1 active subsidence area this month.	NR No telecommunications infrastructure located within the LW W1 active subsidence area this month.
	Local roads, bridges and culverts	Wollondilly Shire Council Management Plan	NR No local roads located within the LW W1 active subsidence area this month.	NR No local roads located within the LW W1 active subsidence area this month.	NR No local roads located within the LW W1 active subsidence area this month.	NR No local roads located within the LW W1 active subsidence area this month.	NR No local roads located within the LW W1 active subsidence area this month.	NR No local roads located within the LW W1 active subsidence area this month.
	Built Structures	Built Structures Management Plan	NR No structures located within the LW W1 active subsidence area this month.	NR No structures located within the LW W1 active subsidence area this month.	NR No structures located within the LW W1 active subsidence area this month.	NR No structures located within the LW W1 active subsidence area this month.	NR No structures located within the LW W1 active subsidence area this month.	NR No structures located within the LW W1 active subsidence area this month.
	RMS Infrastructure	RMS management Plan	Minor changes observed by monitoring equipment this month.	Minor changes observed by monitoring equipment this month.	Minor changes observed by monitoring equipment this month.	Minor changes observed by monitoring equipment this month.	Minor changes observed by monitoring equipment this month.	Minor changes observed by monitoring equipment this month.
	Sewerage Infrastructure	Stonequarry Creek Sewer Management Plan	No signs of change to retention basin at the Stonequarry Sewage Treatment Plant (FD7).	No signs of change to retention basin at the Stonequarry Sewage Treatment Plant (FD7).	No signs of change to retention basin at the Stonequarry Sewage Treatment Plant (FD7).	No signs of change to retention basin at the Stonequarry Sewage Treatment Plant (FD7).	No signs of change to retention basin at the Stonequarry Sewage Treatment Plant (FD7).	No signs of change to retention basin at the Stonequarry Sewage Treatment Plant (FD7).
	Queen Victoria Memorial Home (QVMH)	QVMH Management Plan	NR QVMH is not located within the LW W1 active subsidence area this month.	NR QVMH is not located within the LW W1 active subsidence area this month.	NR QVMH is not located within the LW W1 active subsidence area this month.	NR QVMH is not located within the LW W1 active subsidence area this month.	NR QVMH is not located within the LW W1 active subsidence area this month.	NR QVMH is not located within the LW W1 active subsidence area this month.

Aspect	Feature	Corresponding Management Plan and TARP	November 2019	December 2019	January 2020	February 2020	March 2020	April 2020
	Mill Hill	Mill Hill Management Plan	NR Mill Hill is not located within the LW W1 active subsidence area this month.	NR Mill Hill is not located within the LW W1 active subsidence area this month.	NR Mill Hill is not located within the LW W1 active subsidence area this month.	NR Mill Hill is not located within the LW W1 active subsidence area this month.	NR Mill Hill is not located within the LW W1 active subsidence area this month.	NR Mill Hill is not located within the LW W1 active subsidence area this month.

Notes:

NR – Monitoring not required this month.

NA – Monitoring data not available as monitoring not completed this month.

* Groundwater quality and level monitoring was not completed at private groundwater bores during the reporting period.

[1] Level 2 TARP description: The median of the ratios falls below the 40th percentile but does not fall below the 20th percentile of the baseline data at GS212053.

[2] Level 2 TARP description: The recorded water level has dropped below the previously recorded minimum level AND the above has occurred at one of the upstream pools (beyond mining effects) AND visual monitoring of pools has not noted any mining related impacts.

[3] Level 2 TARP description: The trigger for pH, EC or dissolved metals defined below occurs in one month and there is no visual evidence of an increase in iron staining that was not observed in the baseline period.

[4] Level 2 TARP description: Visually observed reduction in pool level, drainage or overland connected flow AND the above has occurred at one of the upstream pools (beyond mining effects) AND visual monitoring of pools has not noted any mining related impacts.

[5] Level 3 TARP description: Rock bar and/or stream base cracking, or gas release, or iron precipitation noted during visual inspection AND no reduction in pool water level, drainage or overland connected flow, taking into account climatic conditions and observations during baseline monitoring period.

2.2 Summary of Actions

This section provides a summary of actions resulting from triggers being met in the TARPs.

During the reporting period, there were three (3) TARP triggers that required further actions, as discussed below.

2.2.1 Natural Drainage Behaviour TARP - Level 3 Trigger for Gas Emissions

Background

Gas bubbling was observed at Stonequarry Creek (Pool SR17) and Matthews Creek (Pool MR45) as detailed below:

- 24 February 2020 - Stonequarry Creek (Pool SR17) and Matthews Creek (Pool MR45):
  - Air bubbles rising to the surface along sections of Stonequarry Creek and Mathews Creek (refer Photo 1 and 2). In Stonequarry Creek, there were 7 – 8 locations where bubbles were observed rising at intervals of 1 – 3 minutes. At the junction of Matthews Creek and Cedar Creek, continuous streams of bubbles were observed at 4 – 5 locations (Ref: Douglas Partners Geotechnical Monitoring Report 3, refer to Appendix E);
- 27 February 2020 - Matthews Creek (Pool MR45):
  - Evidence of three adjacent, reasonably persistent, although small, gas emissions were observed in Pool MR45 (Ref: GeoTerra Creek Monitoring Report 3, refer to Appendix C); and
- 24 March 2020 – Matthews Creek (Pool MR45):
  - Evidence of at least six adjacent, reasonably persistent, although small, gas emissions were observed in Pool MR45 (Ref: GeoTerra Creek Monitoring Report 4, refer to Appendix C).

However, gas bubbling in Pool SR17 (Stonequarry Creek) was not noted by GeoTerra during the creek monitoring event on 27 February 2020. It is also noted that gas bubbling was observed in Pool SR17 (Stonequarry Creek) by Tahmoor Coal on 6 June 2019 prior to the commencement of LW W1 extraction. Gas bubbling in Pool SR17 was therefore concluded to most likely be as a result of gas release from anoxic muds rather than as a result of longwall mining (refer to Creek Monitoring Report 4, **Appendix C**).

A Level 3 TARP trigger for gas bubbling occurred due to gas release in Matthews Creek (Pool MR45).

Actions Completed

In accordance with the TARP, the Tahmoor Coal Environmental Reponses Group discussed the observation on 10 March 2020 and concluded that gas samples from MR45 should be taken.

Gas sampling was completed by Tahmoor Coal on 2 April 2020. A sample was taken from Pool MR45, and a gas composition report for the sample was received from the Illawarra Coal laboratory on 9 April 2020. The gas composition report for Pool MR45 indicated that the gas originated from the shallow Hawkesbury Sandstone stratas and/or shallow anoxic muds. It was not possible to definitively determine that gas release at Pool MR45 was related to longwall mining in the local area.

Proposed Actions

If frequency of gas bubbling is noted to increase, further gas sampling at Pool MR45 will be completed. The purpose of future gas sampling would be to determine the composition of gases, a change in which could indicate a change in gas source and/or impacts from longwall mining.

Recent visual inspection of Pool MR45 on 24 April 2020 noted that gas emissions had decreased to two infrequent gas bubble sites (refer to Creek Monitoring Report 5, **Appendix C**).

2.2.2 Picton-Mittagong Loop Line TARP – Blue Trigger at Embankment and Culvert (88.387 km)

Background

On 16 April 2020, the observation of a tension crack along the crest of the embankment on Down side at 88.387 km during an inspection of the Embankment and Culvert (88.400 km) on the Picton-Mittagong Loop Line triggered a blue TARP trigger (refer to Report 22 in **Appendix J**). Tensile stains and lateral shearing movements were measured across this section of the embankment.

Actions Completed

A geotechnical inspection was conducted on 17 April. No immediate concerns to embankment stability were observed.

The embankment sub-committee met on 21 and 24 April 2020 and agreed to cut a trench across the tension crack to investigate its depth and potential cause.

Inspection on 27 April found that crack at 88.387 km have substantially closed. Test pit excavation across the crack found it was shallow in depth. An old steel water pipe was uncovered 150 mm to 200 mm below the access track, and while it does not line up with the crack, it may have influenced crack development.

The embankment sub-committee met on 28 April 2020 and agreed that there are currently no concerns with embankment stability.

The crack was noted to have closed on 27 April 2020, with no changes observed on 4 May 2020.

Proposed Actions

Visual inspection of the location will continue under the existing monitoring program.

2.2.3 Main Southern Railway TARP – Blue Trigger at Ballast Top Subway (86.838 km)

Background

Changes in distances across the Ballast Top Subway (86.838 km) abutment exceeded the monitoring review point trigger level during the local 3D survey of the structure in March 2020 (refer to Report 17 in **Appendix L**).

A check survey was completed in the week of 15 April 2020 and confirmed that the Country side of the structure has continued to move inwards towards the Sydney side in the week of 15 April 2020, possibly as a result of the heavy rainfall event in February 2020. Survey on 22 April 2020 measured continued inwards movement. Survey on 27 April and 5 May have measured minor changes.

Actions Completed

An inspection by a structural engineer advised that slight changes to pre-existing damage is consistent with survey results. The inwards movement of the abutment walls appear to be related to a continuation of pre-existing conditions and unlikely to be mining induced. No significant change in wall stability is inferred. It is recommended to continue surveys on a weekly basis to track changes (refer to Report 18 in **Appendix L**).

Proposed Actions

Visual inspection of the structure will continue under the existing monitoring program.

3 Assessment of Environmental Performance

This section provides an assessment of compliance with all relevant performance measures and indicators.

3.1 Environmental Performance Measures and Indicators

The following development consents include subsidence impact performance measures as conditions for the extraction of LW W1-W2:

- DA 67/98 Modification 4:
  - Condition 13A – Performance Measures for Natural and Heritage Features;
  - Condition 13E – Performance Measures for Built Features;
- LW W1-W2 Extraction Plan Approval:
  - Condition 1 – Performance Measures for Stonequarry Creek, Cedar Creek and Matthews Creek.

The subsidence impact performance measures were adopted as part of the LW W1-W2 Extraction Plan and associated management plans. To assist in defining the performance measures, each measure has been assigned subsidence performance indicator(s).

These performance measures and indicators are provided in **Table 3-1**, as well as an assessment of performance.

Table 3-1 Assessment of Environmental Performance

Feature	Subsidence Performance Measure	Subsidence Performance Indicator	Subsidence Performance Measure Exceeded?	Section Discussed
Water Management				
Stonequarry Creek, Cedar Creek and Matthews Creek (LW W1-W2 Extraction Plan Approval)	No subsidence impact or environmental consequence greater than minor*	This performance indicator will be considered to be exceeded if mining-induced fracturing in a rockbar or stream bed results in a reduction in pool water level below historically recorded water levels, taking into account rainfall and observations during the baseline monitoring period, for: • More than 10% of pools located within the 600 m Study Area for Natural Features; and/or • Pool SR17.	**No**	Sections 4.2.2 and 4.2.4
	No connective cracking between the surface, or the base of the alluvium, and the underground workings.	This performance indicator will be considered to be exceeded if analysis of inflow data suggests high correlation to rainfall events and significant departure from recent groundwater model predictions. This would be supported by analysis of pre- and post-mining goaf centreline bore data.	**No** *Note: Pre-mining and post-mining goaf centreline bore data not yet available.*	Section 4.2.8
Public Safety (DA 67/98 Condition 13E)	Negligible additional risk***.	Flooding This performance indicator will be considered to be exceeded if subsidence results in the post-mining 1% AEP flood level being above the floor level of one or more dwelling.	**No** *Note: LW W1-W2 mining is still in progression, and therefore post-mining flood modelling has not been completed.*	Not applicable
Land Management				
Public Safety (DA 67/98 Condition 13E)	Negligible additional risk***.	Landscape Features This performance indicator will be considered to be triggered if subsidence impacts to landscape features result in the collapse of cliffs, rock outcrops or steep slopes in proximity to members of the public.	**No**.	Section 4.3.1

Biodiversity Management				
Threatened species, threatened populations, or endangered ecological communities (DA 67/98 Condition 13A)	Negligible environmental consequences***.	This performance indicator will be considered to be triggered if: • Changes in macroinvertebrate and stream health indicators are statistically significant; • If visual assessment of aquatic habitat identifies mining subsidence induced impacts. • Statistically significant changes in amphibian diversity is detected toward baseline attributed to mining, as detected during amphibian monitoring; and/or • Statistically significant changes in riparian vegetation is detected toward baseline attributed to mining, as detected during riparian monitoring.	**No**	Section 4.4
Heritage Management				
Heritage sites show in the figures in Appendix 7** (DA 67/98 Condition 13A)	Negligible subsidence impacts or environmental consequences***.	<u>Isolated finds/artefact scatters (AHIMS items)</u> No performance indicators are currently established as impacts are predicted to be negligible.	**No** *Note: The LW W1-W2 Heritage Management Plan assessed the probability of impacts to isolated finds / artefact scatters from the proposed longwall mining as very unlikely. Impacts to open sites, such as artefact scatters, are limited to cracking in the surface soils which is unlikely to affect the artefacts. Therefore monitoring of these sites have not been included in the monitoring program.*	Not applicable
		<u>Scarred tree (AHIMS item)</u> This performance indicator will be considered to be triggered if: • subsidence monitoring identifies a perceptible tilt increase that places the tree at risk of falling; and/or	**No** *Note: The LW W1-W2 Heritage Management Plan assessed the probability of impacts to the scarred tree from the proposed longwall mining as very unlikely. Impacts to open sites, such as scar trees, are limited to cracking in the*	Not applicable

		• subsidence monitoring identifies a perceptible cracking in the tree unrelated to natural weathering or trauma damage	*surface soils which is unlikely to affect the item. Therefore monitoring of this item has not been included in the monitoring program.*	
		<u>Grinding grooves (AHIMS item)</u> This performance indicator will be considered to be triggered if: • subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking; and • these subsidence impacts result in impacts to the heritage values of the site.	**No**	Section 4.5
		<u>Rockshelters (AHIMS items)</u> This performance indicator will be considered to be triggered if: • subsidence monitoring identifies visible perceptible change, e.g. rockfall, cracking, or toppling within rockshelters; and • these subsidence impacts result in impacts to the heritage values of the sites.	**No** *Note: It should be noted that only external visual inspections of rockshelters has been able to be completed during the reporting period due to safety concerns. Internal inspections of the rockshelters will be completed following the completion of the longwalls.*	Section 4.5
	Negligible loss of heritage value***.	<u>Queen Victoria Memorial Hospital (local heritage significance)</u> This performance indicator will be considered to be triggered if subsidence monitoring identifies cracking of external brick work or other physical impacts to the historical heritage values of the building, measurable tilt and internal damage, or cracks in foundations.	**No** *Note: The Queen Victoria Memorial Hospital has not been located within the active subsidence zone for LW W1 during the reporting period. Monitoring for this heritage item is scheduled to commence towards the end of LW W1 extraction.*	Not applicable.
		<u>Mill Hill, Miller's House and archaeological relics (local heritage significance)</u> This performance indicator will be considered to be triggered if subsidence monitoring identifies damage to external cladding or internal finishes.	**No** *Note: Mill Hill has not been located within the active subsidence zone for LW W1 during the reporting period. Monitoring for this heritage item is scheduled to*	Not applicable.

			commence towards the end of LW W1 extraction.	
		Harmony House archaeological site (local heritage significance) No performance indicators are currently established as impacts are predicted to be negligible. However, if the pre-mining assessment identifies that the cistern is located within the Study Area, this may need to be re-evaluated.	**No** *Note: The LW W1-W2 Heritage Management Plan assessed the probability of impacts to this heritage item from the proposed longwall mining as very unlikely. Therefore monitoring of this site has not been included in the monitoring program.*	Not applicable
		Rural landscape – Thirlmere Way (local heritage significance) No performance indicators are currently established as impacts are predicted to be negligible.	**No** *Note: The LW W1-W2 Heritage Management Plan assessed the probability of impacts to this heritage item from the proposed longwall mining as very unlikely. Therefore monitoring of this site has not been included in the monitoring program.*	Not applicable
Other Aboriginal and heritage sites (DA 67/98 Condition 13A)	Negligible subsidence impacts or environmental consequences***.	Sandstone culverts (local heritage significance) This performance indicator will be considered to be triggered if subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, exfoliation, block movement or block fall.	**No**	Section 4.6
		Brick culverts (local heritage significance) This performance indicator will be considered to be triggered if subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, exfoliation, brick movement or brick fall.	**No**	Section 4.6

Built Feature Management				
Key Public Infrastructure: • Main Southern Railway; • Picton-Mittagong Loop Line; and • Electricity transmission lines and towers. (DA 67/98 Condition 13E)	Always safe and serviceable.	None allocated.	**No**	Section 4.6
	Damage that does not affect safety or serviceability must be fully repairable, and must be fully repaired.	None allocated.	**No**	Section 4.6
Other Infrastructure: • Electricity distribution lines, poles and associated towers; • Unsealed roads and road culverts, fire trails, fences and other built features; and • Other public infrastructure. (DA 67/98 Condition 13E)	Always safe.	None allocated.	**No**	Section 4.6
	Serviceability should be maintained wherever practicable.	None allocated.		
	Loss of serviceability must be fully compensated.	None allocated.		
	Damage must be fully repairable, and must be fully repaired or else replaced or fully compensated.	None allocated.	**No**	Section 4.6
Privately-owned residences (DA 67/98 Condition 13E)	Always safe.	None allocated.	**No**	Section 4.6
	Serviceability should be maintained wherever practicable.	None allocated.		
	Loss of serviceability must be fully compensated.	None allocated.		
	Damage must be fully repairable, and must be fully repaired or else replaced or fully compensated.	None allocated.	**No**	Section 4.6
Other privately-owned built features and improvements, including farm dams, swimming pools, tennis	Always safe.	None allocated.	**No**	Section 4.6
	Serviceability should be maintained wherever practicable.	None allocated.		
	Loss of serviceability must be fully compensated.	None allocated.		

courts, roads, tracks and fences (DA 67/98 Condition 13E)	Damage must be fully repairable, and must be fully repaired or else replaced or fully compensated.	None allocated.	**No**	Section 4.6
Public Safety (DA 67/98 Condition 13E)	Negligible additional risk***.	None allocated.	**No**	Section 4.6
Mine workings				
First workings (DA 67/98 Condition 13A)	To remain long term stable and non-subsiding.	None allocated.	**No**	Not applicable
Second workings (DA 67/98 Condition 13A)	To be carried out only within the approved mine plan, in accordance with an approved Extraction Plan.	None allocated.	**No**	Not applicable

NOTES:

* minor is defined as *not very large, important or serious* by DPIE.

** As there is no Appendix 7 in DA 67/98 Modification 4, it is interpreted that this refers to the Aboriginal heritage sites listed on the Aboriginal Heritage Information Management System, *Wollondilly Local Environmental Plan 2011*, State Heritage Register, and the Australian Heritage Database.

*** For the purpose of this Extraction Plan and associated documents, 'negligible' is defined as being 'so small and insignificant as to not be worth considering'. A negligible impact is viewed with regards to a long term context, causing little or no impact. If a short term impact causes a greater than negligible impact, the impact can still be considered negligible if the impacts are of a limited duration and are considered negligible when considered over the long term.

4 Summary of Environmental Monitoring Results

This section provides a comprehensive summary of all quantitative and qualitative environmental monitoring results.

4.1 Subsidence Monitoring

4.1.1 General Subsidence Observations

During the reporting period, the LW W1-W2 Subsidence Monitoring Program has been implemented to monitor subsidence impacts within the Study Area. The details of the Subsidence Monitoring Program are illustrated in **Figure 4-1**. The Subsidence Monitoring Program includes thirteen (13) Global Navigation Satellite System (GNSS) units measuring absolute horizontal and vertical positions in real time have been installed directly above and adjacent to LW W1.

A summary of all surveys and inspections completed during the reporting period is provided in Figure A and Figure B of the MSEC LW W1 Subsidence Monitoring Report 5 (refer **Appendix A**). A monthly review of the subsidence survey results during the reporting period has been completed by MSEC (refer **Appendix A**).

As of 5 May 2020 (the end of the reporting period for this report), 747 m of LW W1 had been extracted. The active subsidence area of LW W1 for 3 May 2020 is illustrated in **Figure 1-3**.

Table 4-1 summarises the observed ground movements from these monthly reports. During the reporting period, a maximum of 83 mm of vertical subsidence was measured on 4 May 2020 at 88.440 km on the Picton-Mittagong Loop Line (PMLL) railway.

Table 4-1 Subsidence Monitoring Observations for the Reporting Period (source: MSEC, Subsidence Monitoring Reports, **Appendix A**)

	Report 1		**Report 2**		**Report 3**		**Report 4**		**Report 5**	
General Information										
Monitoring Period	15/11/2019 – 31/12/2019		1/1/2020 – 4/2/2020		5/2/2020 – 3/3/2020		4/3/2020 – 7/4/2020		8/4/2020 – 5/5/2020	
Length of extraction	122 m		296 m		441 m		638 m		747 m	
Distance travelled by longwall since previous report	First report		174 m since 31/12/2019		145 m since 4/2/2020		197 m since 4/3/2020		109 m since 7/4/2020	
Observed Ground Movement Parameters	**Maximum Observed**	**Location**	**Maximum Observed**	**Location**	**Maximum Observed**	**Location**	**Maximum Observed**	**Location**	**Maximum Observed**	**Location**
Subsidence (mm)	4	PMLL Line	7	PMLL Line	14	PMLL Line	47	PMLL Line	83	PMLL Line
Tilt (mm/m)	0.2	PMLL Line	0.2	PMLL Line	1.0	PMLL Line	0.8	PMLL Line	0.9	PMLL Line
Hogging Curvature (km^{-1})	0.01	PMLL Line	0.03	PMLL Line	0.07	PMLL Line	0.07	PMLL Line	0.07	PMLL Line
Sagging Curvature (km^{-1})	-0.01	PMLL Line	-0.02	PMLL Line	-0.05	PMLL Line	-0.06	PMLL Line	-0.06	PMLL Line
Tensile Strain (mm/m)	0.2	PMLL Line	0.2	PMLL Line	0.5	PMLL Line	0.6	PMLL Line	0.6	PMLL Line
Compressive Strain (mm/m)	-0.2	PMLL Line	-0.3	PMLL Line	-0.6	PMLL Line	-0.7	PMLL Line	-0.9	PMLL Line
Subsidence since previous survey (mm)	5	NA	4	PMLL Line	17	PMLL Line	34	PMLL Line	55	PMLL Line

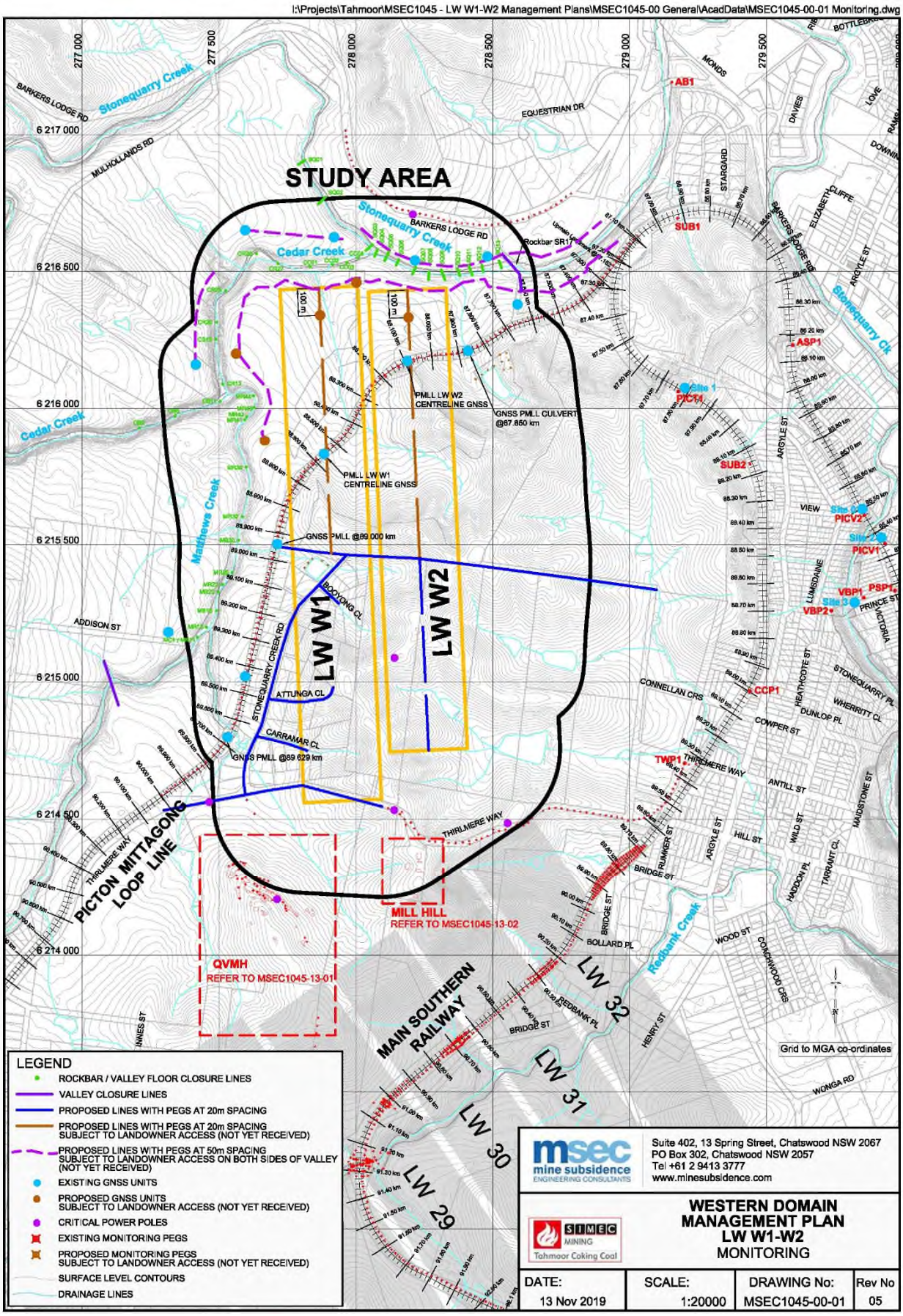


Figure 4-1 LW W1-W2 Subsidence Monitoring Program (source: MSEC, LW W1-W2 Subsidence Monitoring Program)

The development of subsidence at Peg 88.560 km and GNSS Peg 9 (both located on the centreline of LW W1) are illustrated in **Figure 4-2**. This figure shows that subsidence currently observed along the centreline of LW W1 are similar to that observed during the extraction of Appin LW901, which was a similar single panel extraction.

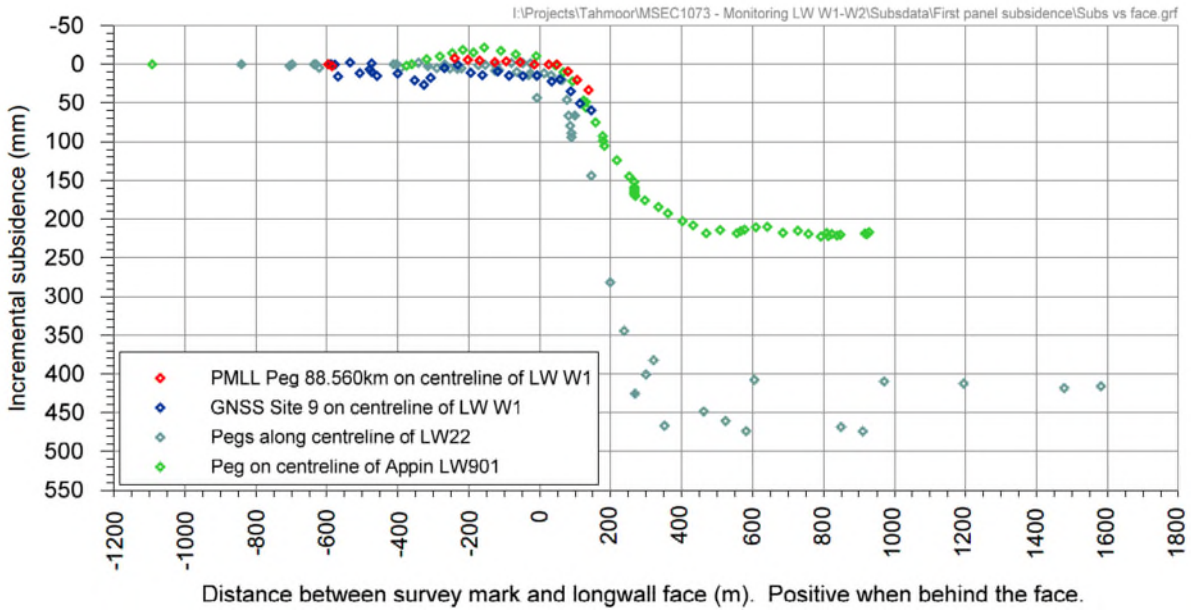


Figure 4-2 Development of subsidence along centreline of LW W1 compared to previously extracted single panels (source: MSEC, Subsidence Monitoring Report 5, **Appendix A**).

Whilst observed ground strains are generally small, a small bump in the subsidence profile (upsidence) has gradually developed at 88.400 km, accompanied by increased compressive ground strain between 88.400 km and 88.420 km. Rates of change have been noted to reduce with further surveys. These observations are illustrated in **Figure 4-3**.

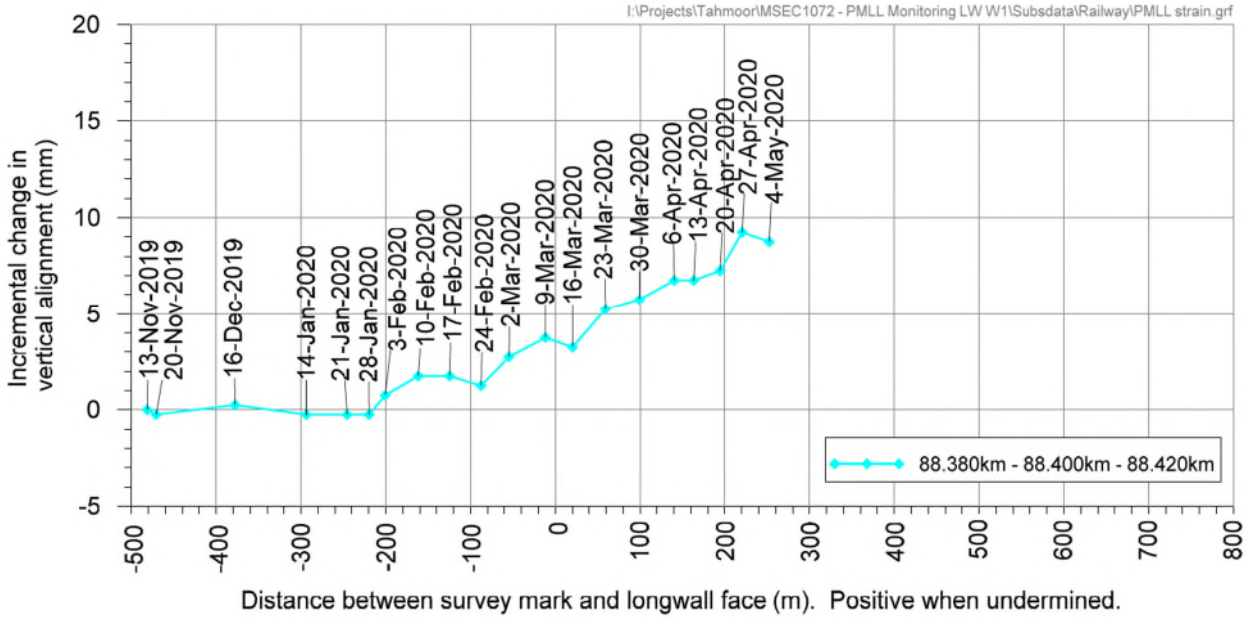


Figure 4-3 Observed development of ground strains and changes in vertical alignment at selected locations along PMLL (source: MSEC, Subsidence Monitoring Report 5, **Appendix A**).

Results from all GNSS units, including incremental horizontal movements, are presented in the MSEC Subsidence Monitoring Reports (refer **Appendix A**). Some trends can be seen from the results, with the closest GNSS units generally moving towards the extracted panel.

4.1.2 Valley Closure in Creeks

Survey marks installed across rockbars in Stonequarry Creek, Cedar Creek and Matthews Creek prior to the commencement of LW W1 are illustrated in **Figure 4-1**. During the heavy rainfall events in late January to mid-late February 2020, several survey pegs in Stonequarry Creek and Cedar Creek were damage or destroyed, and survey was not able to be completed in all three creeks due to flooding. Damaged / destroyed survey pegs have since been reinstated in Stonequarry Creek and Cedar Creek, and the survey frequency was increased from monthly to weekly to capture any mining-induced closure that may have developed during this period.

Survey results have indicated that very little change in closure (if any) has been observed since the pegs were reinstated in Stonequarry Creek and Cedar Creek, and only minor changes were also observed in Matthews Creek (refer to **Figure 4-4**). Monitoring frequency has therefore been returned to monthly for all three creeks.

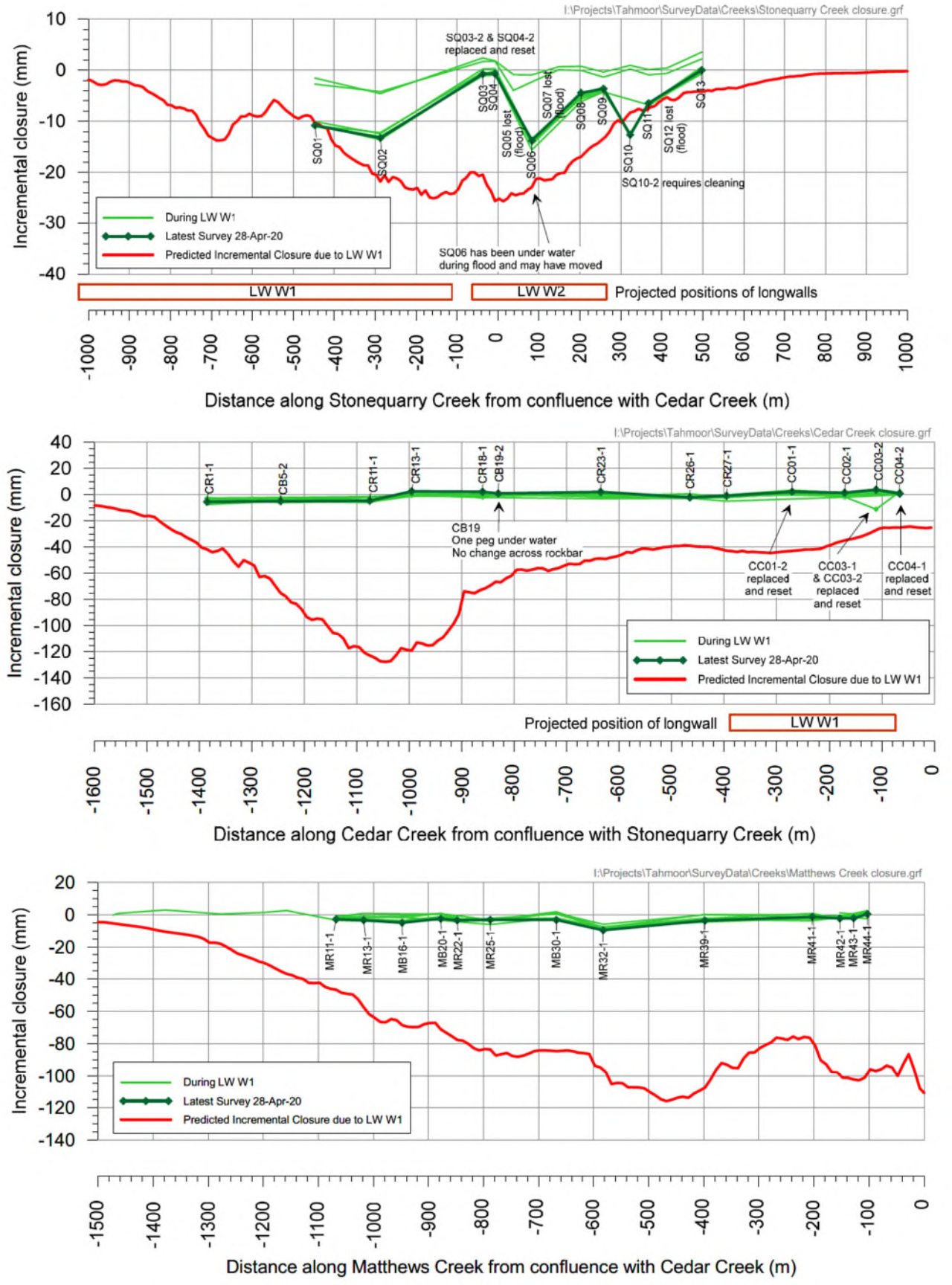


Figure 4-4 Comparison between observed and predicted valley closure along Stonequarry Creek, Cedar Creek and Matthews Creek (source: MSEC, Subsidence Monitoring Report 5, **Appendix A**).

4.2 Water Monitoring

The Tahmoor Coal LW W1-W2 Water Management Plan was prepared to manage the potential environmental consequences of LW W1-W2 extraction on surface water and groundwater systems in accordance with Condition 13H(vii)(c) of DA 67/98.

During this reporting period, the LW W1-W2 Water Management Plan has been implemented to monitor the following surface water and groundwater systems:

- Surface Water:
  - Stonequarry Creek flow, pool water level and surface water quality – monitoring data reviewed and reported by Hydro Engineering & Consulting (refer to **Appendix B**).
  - Creek monitoring for natural drainage behaviour – visual inspections and reporting by GeoTerra (refer to **Appendix C** for monthly reports);
- Groundwater:
  - Shallow groundwater levels, quality and pressures, and deep groundwater levels / pressures – monitoring data reviewed and reported by GeoTerra (refer to **Appendix D** for monthly reports); and
  - Mine water intake – data up to 21 April 2020 reviewed and reported by GeoTerra (refer to Report 4 in **Appendix D**).

Performance against all Water Management Plan TARPs for the reporting period are summarised in **Table 2-3**. The following sections summarise the observations made during the reporting period for each surface water and groundwater category.

4.2.1 Stonequarry Creek Flow

Streamflow data has been analysed to assess whether a statistically significant reduction in the quantity of water recorded at Stonequarry Creek at Picton (GS212053) in the period post-mine commencement relative to the pre-mine period has occurred, that has not also occurred in the control catchment(s). The locations of GS212053 is illustrated in **Figure 4-5**.

Measured flows versus modelled flows at Stonequarry Creek at Picton (GS212053) have been analysed using a catchment model calibrated to data from the period pre-mine commencement. **Figure 4-6** shows a plot of the sliding 12-month median of the ratio of 14 day sums of monitored flow at Stonequarry Creek at Picton (GS212053) to flows simulated via the catchment model to 30 April 2019.

The results show that the moving 12-month median of the 14 day filtered low flow ratio fell below the 40th percentile during the baseline period and was close to the 20th percentile at the commencement of mining of LW W1. In January 2020, following the substantial decline in streamflow which occurred in late December 2019, the ratio of monitored to modelled flows fell slightly but remained just above the 20th percentile low flow ratio for the duration of the review period.

The decline in streamflow and the associated decline in the ratio of monitored to modelled flows is likely due to the substantial decline in rainfall during this period. Consequently, although the ratio of the monitored to modelled flows fell close to the 20th percentile low flow ratio, this is considered a result of the prevailing low rainfall conditions rather than as a result of mining of LW W1.

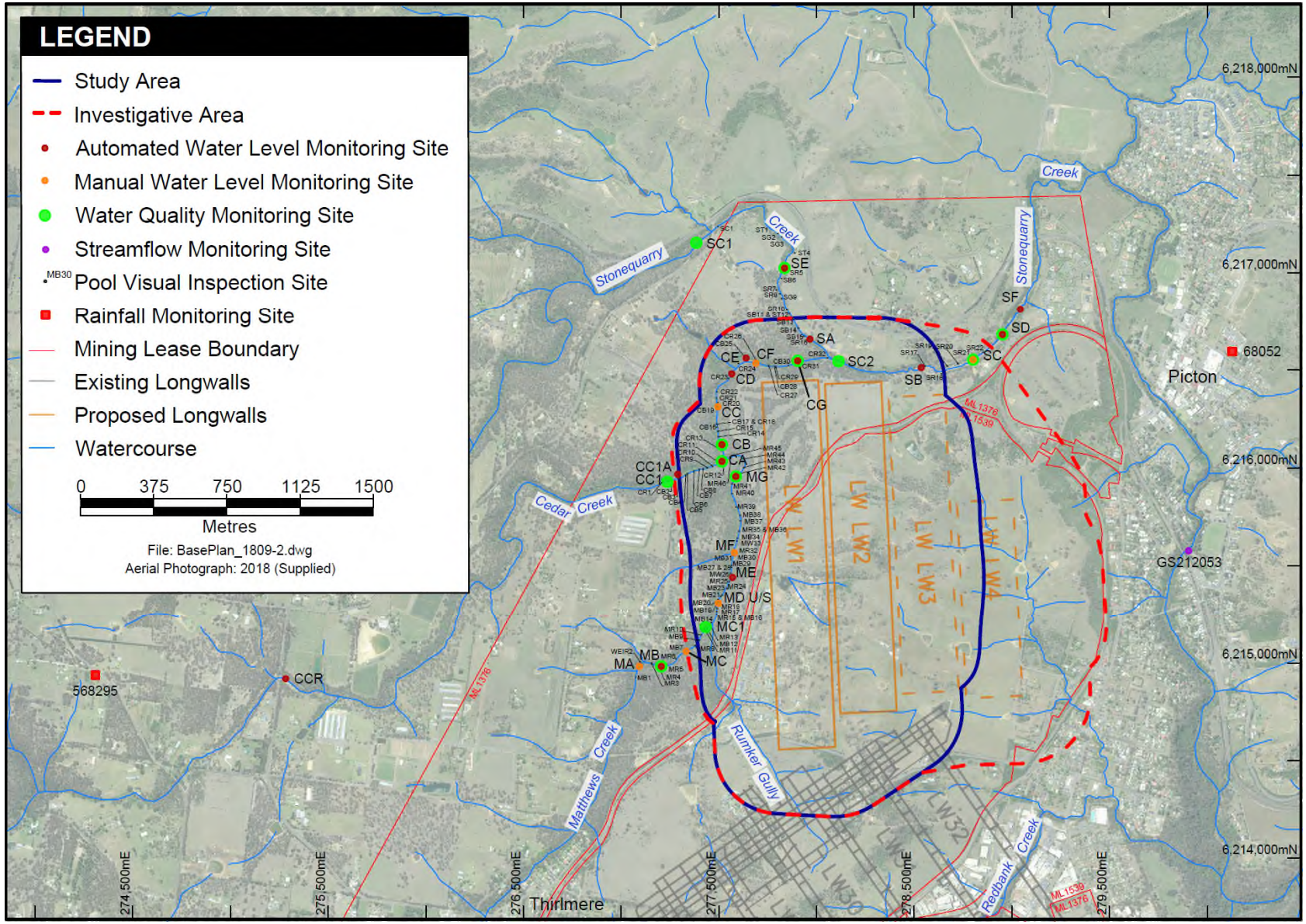


Figure 4-5 LW W1-W2 Surface Water Monitoring Locations (source: HEC, Surface Water Monitoring Report, **Appendix B**)

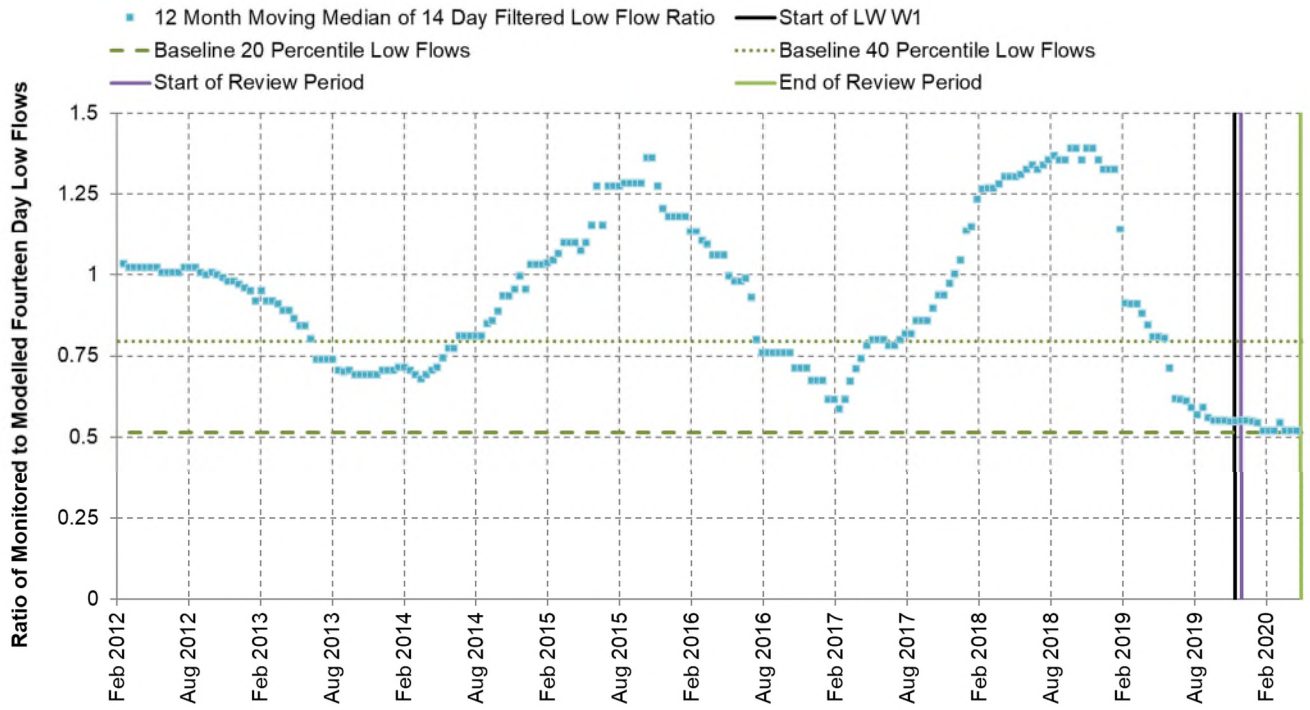


Figure 4-6 One Year Sliding Median for the Ratios of the 14 Day Sums of Monitored and Modelled Flow Rates at Stonequarry Creek at Picton (GS212053) (source: HEC, Surface Water Technical Report, **Appendix B**)

4.2.2 Pool Water Level

Surface water level data has been recorded at the pool monitoring sites on Matthews Creek, Cedar Creek and Stonequarry Creek as shown in **Figure 4-5**. Continuous surface water level data has been recorded at three pool monitoring sites on Matthews Creek, six monitoring sites on Cedar Creek and two monitoring sites on Stonequarry Creek. Manual water level measurements have also been undertaken monthly at the sites shown in **Figure 4-5**.

Two additional water level monitoring sites have recently been installed on Stonequarry Creek, SE and SF, however little water level data has been recorded at these sites to date and, as such, are not included in this review report.

During the reporting period, monitoring sites on Matthews Creek and Stonequarry Creek were dry or the water level fell below the previously recorded minimum during December 2019 and January 2020, including at reference sites MB and SD. Monitoring sites CCR (reference site), CC1A (reference site) and CA on Cedar Creek were dry or below the previously recorded minimum in January 2020. Monitoring site CD on Cedar Creek fell below the previously recorded minimum in December 2019, though the water level remained above the Cease To Flow level. Following substantial rainfall from mid-January to February 2020, the water level rose above the previously recorded minimum at all sites.

Charts illustrating monitored pool water level hydrographs for pools on Matthews Creek, Cedar Creek and Stonequarry Creek are presented in Charts A1-20 in Appendix A of the Surface Water Monitoring Report (refer to **Appendix B**).

4.2.3 Natural Drainage Behaviour

Visual and photographic surveys for subsidence impacts on creeks have been completed monthly for pools on Stonequarry Creek, Cedar Creek and Matthews Creek within the active subsidence zone of LW W1 (refer to **Appendix C**). The purpose of these surveys is to note whether change has occurred to pool level, drainage or overland flow, and to assist in determining if any change can be attributed to mining impacts. Surveys noted the presence of rock bar and/or stream base cracking, gas release, or increased iron precipitation.

Creek monitoring locations are illustrated on **Figure 4-7**.

During the early months of the reporting period, natural drainage behaviour in all three creeks was highly influenced by long term drought resulting in low or no pool water levels and low or no overland flow. However, significant rain events in January and February 2020 greatly improved pool water level and overland flow, as well as flushing out highly ferruginous standing pools in Cedar Creek.

Small yet reasonably persistent gas emissions have been observed at Pool MR45 since February 2020 (triggering Level 3 of the Natural Drainage Behaviour TARP), however gas analysis indicated that the gas originated from shallow Hawkesbury Sandstone and/or shallow anoxic muddy alluvium rather than deeper Hawkesbury Sandstone strata. The data does not enable a definitive assessment to be made of the potential linkage between LW W1 extraction and subsidence impacts in the area. The number of gas emission locations has decreased over time at Pool MR45.

To date, there have been no observable mining subsidence related impacts such as creek bed cracking or increased iron hydroxide precipitation evident in Cedar Creek, Matthews Creek or Stonequarry Creek.

A summary of creek observations for the reporting period is provided in **Table 4-2**.

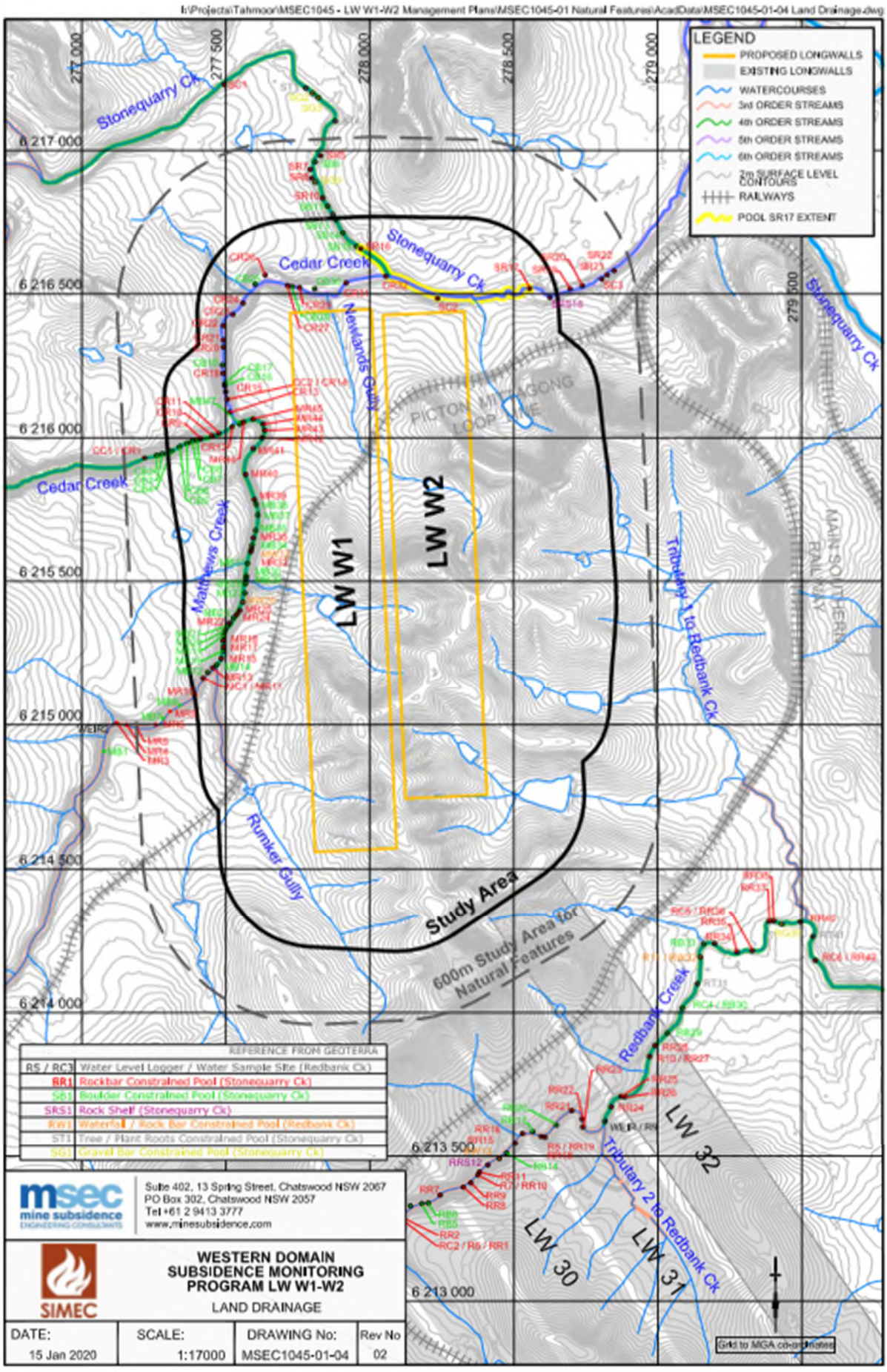


Figure 4-7 LW W1-W2 Creek Monitoring Locations (source: MSEC, LW W1-W2 Subsidence Predictions and Impact Assessment Report)

Table 4-2 Creek Monitoring Observations for the Reporting Period (source: GeoTerra, Creek Monitoring Reports, **Appendix C**)

	Report 1 23 December 2019	**Report 2 22 January 2020**	**Report 3 27 February 2020**	**Report 4 24 March 2020**	**Report 5 24 April 2020**
Stonequarry Creek (SR16 and SR17 monitored during the reporting period)					
Observations of individual pool water level and flow	• Large / long pondage between SR16 and SR17 is full and overflowing (albeit at a low rate).	• Large / long pondage between SR16 and SR17 is full and overflowing.	• Large / long pondage between SR16 and SR17 is full and overflowing.	• Large / long pondage between SR16 and SR17 is full and overflowing.	• Large / long pondage between SR16 and SR17 is full and overflowing.
Surface cracking	No surface cracking was reported during the review period.				
Iron hydroxide precipitation	No increase in iron hydroxide precipitation was observed during the review period.				
Gas Releases	No gas releases were observed in pools on Cedar Creek.				
Cedar Creek (CR1-CR32 monitored during the reporting period)					
Observations of individual pool water level and flow	• Pools CR1 to CR9 and CR11 had naturally partially or totally dried up as a result of the lack of recharge / runoff in the catchment due to the long-standing drought. • Pool CR10 at medium level and does not flow over into CR11. • Pools CR12-CR30 are full and overflowing. • Pools CR31 and CR32 have no observable overland flow and no or very low pondages.	• Pools that had previously been dry in last month's survey were observed to contain water and a low volume of connective overland flow due to recent rain. • Impacts of long-standing drought still prevalent with all pools being at low to medium volume. • Sandy based pools between CR31-CR32 have filled and have overland connective flow.	• Higher volume of overland connective flow evident. • Evidence of very high flood levels - high vegetation debris accumulations and numerous large trees uprooted and fallen over. • Sandy based pools between CR31-CR32 are full and have overland connective flow.	• Lower pool levels and less overland connective flow due to reduced catchment base-flow recharge. • Pool CR20 water level notably lower than last month, however not below baseline. • Evidence of very high flood levels - high vegetation debris accumulations and numerous large trees uprooted and fallen over. • Sandy based pools between CR31-CR32 are full and have overland connective flow.	• Lower pool levels and less overland connective flow due to reduced catchment base-flow recharge. • Pool CR20 not notably drier compared to last month. • Sandy based pools between CR31-CR32 are full and have overland connective flow.
Surface cracking	No surface cracking was reported during the review period.				

	Report 1 23 December 2019	Report 2 22 January 2020	Report 3 27 February 2020	Report 4 24 March 2020	Report 5 24 April 2020
Iron hydroxide precipitation	No increase in iron hydroxide precipitation was observed during the review period.				
Gas Releases	No gas releases were observed in pools on Cedar Creek.				
Matthews Creek (MR32-MR46 monitored during the reporting period)					
Observations of individual pool water level and flow	• Low to medium ponded water with no connective overland flow.	• Pools that had previously been dry in last month's survey were observed to contain water and a low volume of connective overland flow due to recent rain. • Impacts of long-standing drought still prevalent with all pools being at low to medium volume. • MR41-MR46 full and overflowing. • MR45 and MR46 have filled up and joined into one pool. • MR41-MR44 have stepped rock shelf / waterfall features.	• Higher volume of overland connective flow evident. • Evidence of very high flood levels - high vegetation debris accumulations and numerous large trees uprooted and fallen over. • MR41-MR46 full and overflowing. • MR45 and MR46 are full and have joined into one pool. • MR41-MR44 have stepped rock shelf / waterfall features.	• Lower pool levels and less overland connective flow due to reduced catchment base-flow recharge. • Evidence of very high flood levels - high vegetation debris accumulations and numerous large trees uprooted and fallen over. • MR45 and MR46 are full and have joined into one pool. • MR41-MR44 have stepped rock shelf / waterfall features.	• Lower pool levels and less overland connective flow due to reduced catchment base-flow recharge. • MR32-MR37 contains ponded water with low interconnected flow. • MR39-MR46 has greater pool depth and overflow flow than upstream reaches. • Pool MR38 did not contain visible ponded water.
Surface cracking	No surface cracking was reported during the review period.				
Iron hydroxide precipitation	No increase in iron hydroxide precipitation was observed during the review period.				
Gas Releases	• None observed.	• None observed.	• Three small, reasonably persistent gas bubble sites observed at MR45. • No environmental effects resulting from the gas releases (such as riparian vegetation dieback or impact to	• Six adjacent, reasonably persistent (although small) gas emissions observed at MR45. • No environmental effects resulting from the gas releases (such as riparian vegetation	• Two infrequent gas emissions observed at MR45. • Results from analysis indicate that gas originates from shallow Hawkesbury Sandstone

	Report 1 23 December 2019	Report 2 22 January 2020	Report 3 27 February 2020	Report 4 24 March 2020	Report 5 24 April 2020
			aquatic biota) have been observed.	dieback or impact to aquatic biota) have been observed.	and/or shallow anoxic muddy alluvium. • Data does not enable a definitive assessment to be made of the potential linkage between LW W1 extraction and subsidence impacts in the area. • No environmental effects resulting from the gas releases (such as riparian vegetation dieback or impact to aquatic biota) have been observed.

4.2.4 Surface Water Quality

Surface water quality data has been recorded at the following sites (refer to **Figure 4-5**):

- Cedar Creek: CC1, CA, CB and CG;
- Matthews Creek: MB, MC1 and MG; and
- Stonequarry Creek: SC1, SC2, SC and SD.

Field analyses are undertaken for pH, electrical conductivity (EC), dissolved oxygen, temperature and oxidation reduction potential. Laboratory analyses are undertaken for pH, EC, total dissolved solids, alkalinity, sulphate, chloride, calcium, magnesium, sodium, potassium, fluoride, nitrate and nitrite, total kjeldahl nitrogen, phosphorus and the following total and dissolved metals: aluminium, arsenic, barium, copper, lead, lithium, manganese, nickel, selenium, strontium, zinc and iron.

During the early months of the reporting period, surface water quality in all three creeks was highly influenced by long term drought. During this period, low or no pool water levels resulted in a general increasing trend in electrical conductivity at all sites.

Following significant rain events in January and February 2020, water quality at most monitoring sites was noted to increase in pH, decrease in electrical conductivity, and elevate dissolved iron and dissolved manganese concentrations to historical highs. Dissolved iron and dissolved manganese have since declined to within baseline concentrations at all sites. Dissolved aluminium at all sites except SC1 were low during the reporting period.

To date, there have been no observable mining subsidence related impacts to the water quality of Cedar Creek, Matthews Creek or Stonequarry Creek.

A summary of observations for the reporting period is provided in **Table 4-3**.

Charts illustrating water quality results for monitored pools on Matthews Creek, Cedar Creek and Stonequarry Creek are presented in Charts B1-9 in Appendix B of the Surface Water Monitoring Report (refer to **Appendix B**).

Table 4-3 Summary of Notable Results for Key Water Quality Parameters for the Reporting Period

Parameter	Matthews Creek	Cedar Creek	Stonequarry Creek
pH	• An increase in pH values was recorded at all monitoring sites on Matthews Creek in February to April 2020 (following significant rainfall after an extended dry period).	• An increase in pH values was recorded at all monitoring sites on Cedar Creek in February to April 2020 (following significant rainfall after an extended dry period).	• An increase in pH values was recorded at SC, SC1 and SC2 in February to April 2020 (following significant rainfall after an extended dry period). The pH values recorded at SD were consistent with baseline values during the review period.
Electrical Conductivity	• A general increasing trend in EC values was recorded at all monitoring sites in 2019 during low rainfall conditions. • Following considerable rainfall in February 2020, a decrease in EC values was recorded at all sites.	• A general increasing trend in EC values was recorded at all monitoring sites in 2019 during low rainfall conditions. • Following considerable rainfall in February 2020, a decrease in EC values was recorded at all sites.	• A general increasing trend in EC values was recorded at all monitoring sites in 2019 during low rainfall conditions. • Following considerable rainfall in February 2020, a decrease in EC values was recorded at all sites.
Dissolved Aluminium	• Dissolved aluminium concentrations recorded at MG and MC1 remained below 0.1 mg/L, and below 0.15 mg/L at reference site MB.	• Dissolved aluminium concentrations were low at sites CA, CB and CG (less than 0.05 mg/L) and less than 0.1 mg/L at site CC1 during the review period.	• A slightly elevated concentration of dissolved aluminium was recorded at SC1 in January 2020 (0.08 mg/L) • Dissolved aluminium concentrations recorded at SC2, SC and SD remained within baseline concentrations during the review period.
Dissolved Iron	• A historically high dissolved iron concentration was recorded at monitoring site MG (3.5 mg/L) and MC1 (4.54 mg/L) and at reference site MB (13.7 mg/L) in February 2020 following the onset of substantial rainfall. • The dissolved iron concentrations subsequently declined to baseline concentrations at all sites.	• Dissolved iron concentrations were generally consistent with baseline concentrations though a historically high concentration of 6.34 mg/L was recorded at site CA in January 2020. • Following the onset of rainfall, the dissolved iron concentration reduced to 2.4 mg/L in February 2020, which is consistent with baseline concentrations.	• A historically high concentration of 5.62 mg/L was recorded at SC1 (reference site) in February 2020. • Dissolved iron concentrations were consistent with baseline concentrations at sites SC2, SC and SD.
Dissolved Manganese	• Historically high concentrations of 4.41 mg/L and 0.725 mg/L dissolved manganese were recorded at MC1 and MG respectively, and at reference site MB (6.21 mg/L), in February 2020 following the onset of substantial rainfall.	• Dissolved manganese concentrations were elevated at sites CA, CG and CC1 during the review period in comparison with baseline conditions, likely due to extended dry conditions followed by “flushing” following substantial rainfall.	• Historically high concentrations of dissolved manganese were recorded at site SC1 (1.43 mg/L), SC2 (1.58 mg/L) and SC (0.858 mg/L) in February 2020. • The dissolved manganese concentrations subsequently declined to

Parameter	Matthews Creek	Cedar Creek	Stonequarry Creek
	• The dissolved manganese concentrations subsequently declined to baseline concentrations at all sites.	• The dissolved manganese concentrations subsequently declined to baseline concentrations at all sites.	baseline concentrations at all sites.

4.2.5 Groundwater Quality

A total of 14 open standpipe piezometers (OSPs) have been installed at five locations in the Western Domain – P12, P13, P14, P16, and P17. A number of private groundwater bores also form part of the groundwater monitoring program for LW W1-W2. The locations of these groundwater bores are illustrated in **Figure 4-9**.

During the reporting period, there were no observable changes in salinity, pH or metals outside of the baseline variability.

During April, the deepest intake at piezometer Site 12 (P12C) showed a reduction in pH (acidification) below the pre-mining baseline range (refer to **Figure 4-8**). However, this observation did not trigger a Level 2 TARP as:

- There has not been a greater than 3-month change in pH outside the pH baseline variability; and
- The effect is potentially a re-equilibration response following significant rainfall in January and February 2020.

It was also noted that a similar trend was observed at piezometer P16C, however was absent in other deeper piezometers within the Western Domain monitoring area.

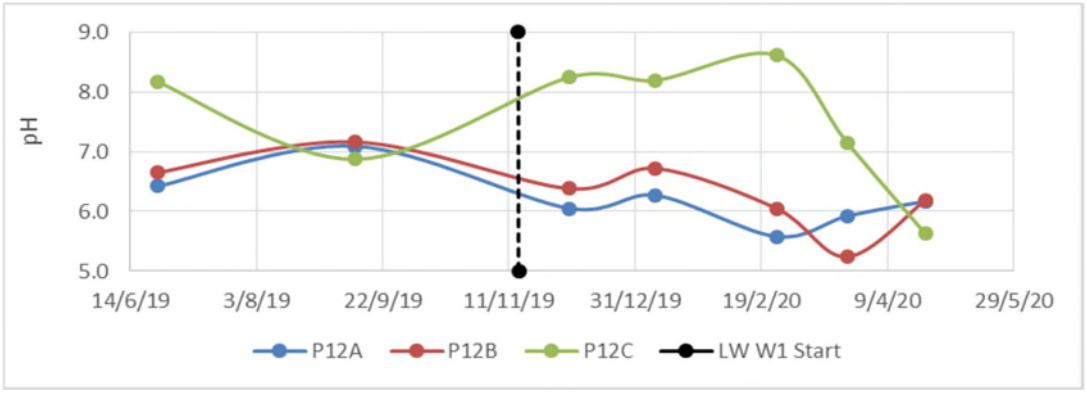


Figure 4-8 Groundwater quality for reporting period – pH at P12 (source: GeoTerra, Groundwater Monitoring Report 4, **Appendix D**)

Graphs showing progressive groundwater quality results for pH, electrical conductivity and selected metals are presented in the GeoTerra Groundwater Monitoring Report 4 (**Appendix D**).

Four private bores were inspected between 1-6 May 2020 where property access was granted. Field measurements for pH, salinity and yield data were collected after the pump had flowed for at least 15 minutes (refer to Groundwater Monitoring Report 4, **Appendix D**). However, groundwater quality results for samples taken from private groundwater bores are currently being analysed and results are not currently available for laboratory results.

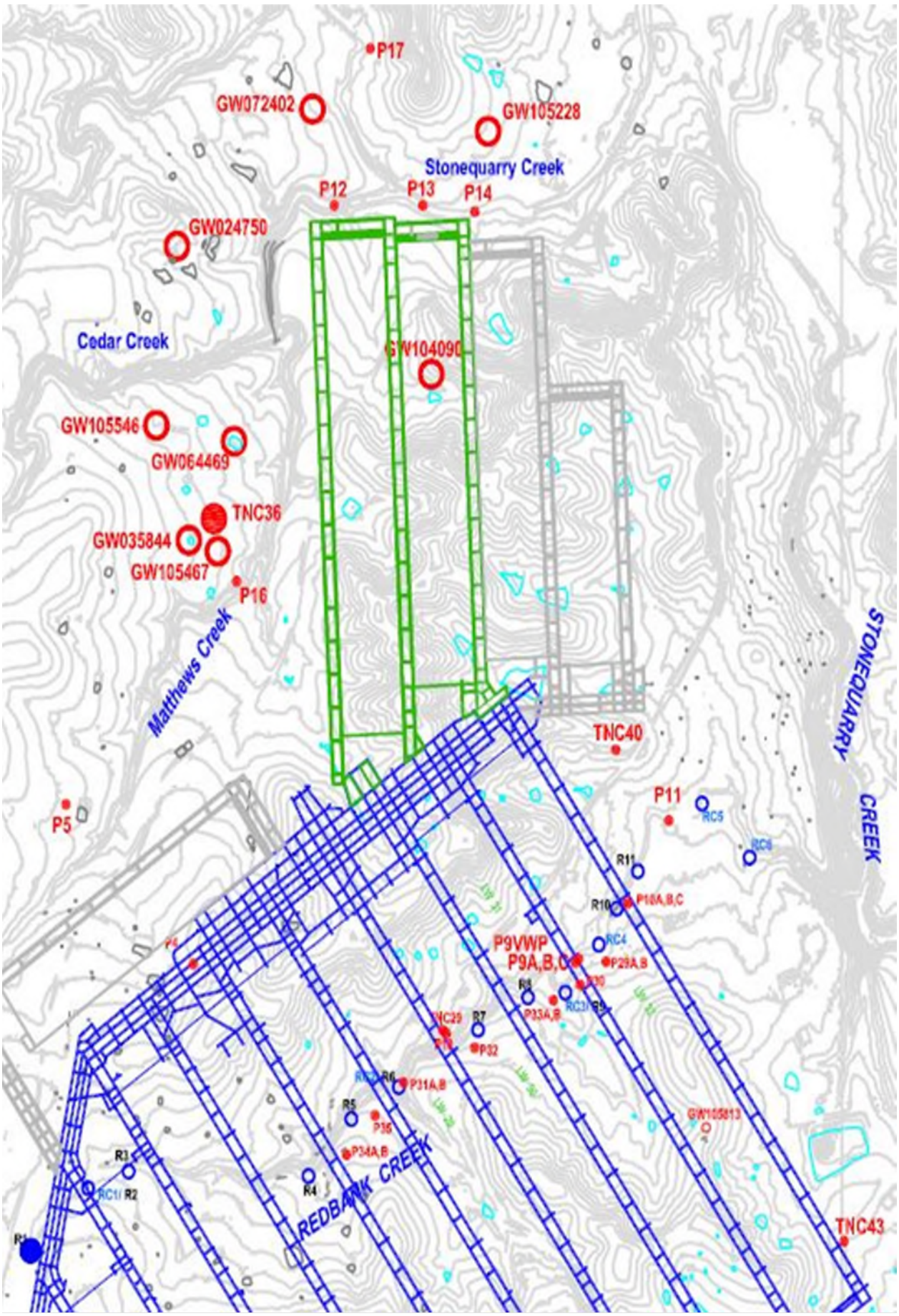


Figure 4-9 LW W1-W2 Groundwater Monitoring Bores (source: GeoTerra, Groundwater Monitoring Report 4, **Appendix D**)

4.2.6 Groundwater Bore Levels

A total of 14 open standpipe piezometers (OSPs) have been installed at five locations in the Western Domain – P12, P13, P14, P16, and P17. A number of private groundwater bores also form part of the groundwater monitoring program for LW W1-W2. The locations of these groundwater bores are illustrated in **Figure 4-9**.

During the reporting period, groundwater levels have remained consistent within baseline variability and/or pre-mining trends, and any reductions in groundwater level were not persistent after significant rainfall recharge events.

However, the deepest intake at piezometer site 12 (P12C) has shown a reduction in water level below the pre-mining baseline range in the last month (refer to **Figure 4-10**). However, this observation did not trigger a Level 2 TARP as:

- The water level reduction was not persistent over a period of up to 3 months; and
- A groundwater level rise in response to a significant rainfall recharge event was observed.

The reduction in water level at P12C was attributed to climatic factors.

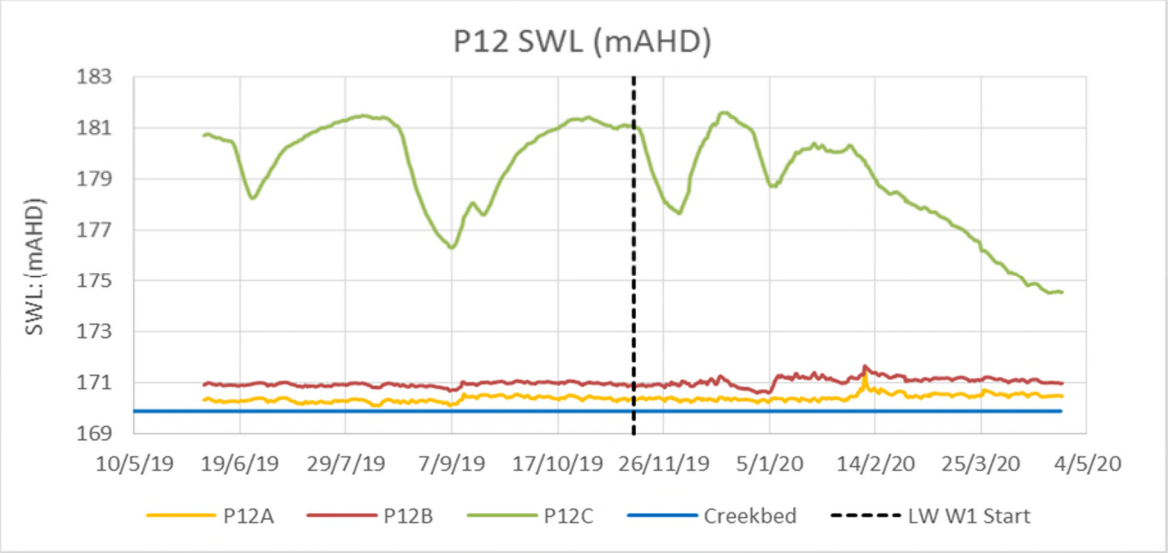


Figure 4-10 Groundwater bore levels during the reporting period – P12 (source: GeoTerra, Groundwater Monitoring Report 4, **Appendix D**)

Graphs showing progressive groundwater bore levels are presented in the GeoTerra Groundwater Monitoring Report 4 (**Appendix D**).

4.2.7 Groundwater Pressures

A combination of OSP and Vibrating Wire Piezometer (VWP) arrays were installed at location P9 over the previously mined longwall LW32, however these arrays no longer provide data since the commencement of LW W1. Three additional VWP arrays have been installed at locations TNC36, TNC40 and TNC43. The locations of these groundwater bores are illustrated in **Figure 4-9**.

During the reporting period, there were no observable mining induced changes at VWP intakes above, at or below 200 m depths (excluding those monitoring the Bulli Coal Seam).

It is noted that prior to the commencement of extraction of LW W1, a depressurisation trend had started to occur in the Hawkesbury Sandstone (at 65 metres below ground level (mbgl) and 97 mbgl), as well as in the Bulgo Sandstone (at 169 mbgl and 214 mbgl). However, these trends currently have not persisted longer than 3 months following the start of the extraction of LW W1.

Graphs showing progressive groundwater pressures are presented in the GeoTerra Groundwater Monitoring Report 4 (**Appendix D**).

4.2.8 Mine Water Intake

Tahmoor Coal have a Groundwater Licence to extract 1642 ML/year of groundwater make from underground.

The inferred water make (groundwater that has seeped into the mine from the strata) is calculated from the difference between total mine inflows and total mine outflows. This calculation is assisted by input from flow meters installed on fresh water supply lines that pump water into the mine (mine inflow from Sydney Water supply to underground workings), and flow meters on three pipelines that extract water from underground (mine outflow). In addition, mine inflow and outflow also includes a measurement of water that enters and exits the mine through other means such as moisture in air pumped in and out of the mine (water in vented air), and moisture in coal extracted from the mine.

GeoTerra completed an analysis of water make for Tahmoor Mine (recorded between 1 January 2009 to 21 April 2020) on 4 May 2020 (results summarised in Groundwater Monthly Report 4 (**Appendix D**)). Although this water make calculated does not just measure water make from the Western Domain, it provides an indication of the groundwater pumped out of the total Tahmoor Mine underground workings.

Water make into the Tahmoor Mine underground workings (as plotted in **Figure 4-11**) does not indicate that there has been any observable increase in mine water make since extraction of LW W1 commenced.

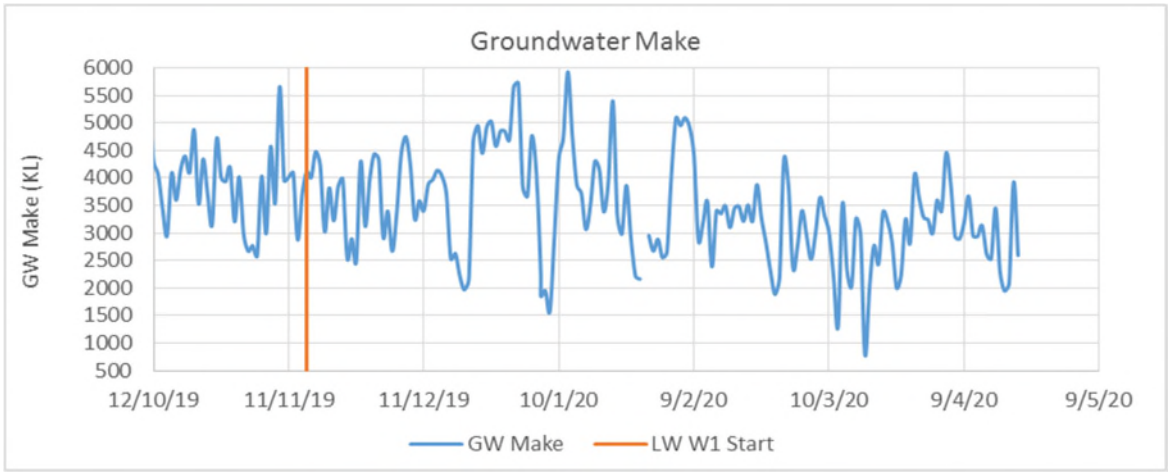


Figure 4-11 Tahmoor Mine daily water make since LW W1 extraction commencement (source: GeoTerra, Groundwater Monitoring Report 4, **Appendix D**)

4.3 Land Monitoring

The Tahmoor Coal LW W1-W2 Land Management Plan was prepared to manage the potential environmental consequences of LW W1-W2 extraction on cliffs, rock outcrops, steep slopes, dams, agricultural land, and land in general in accordance with Condition 13H(vii)(e) of DA 67/98.

During this reporting period, the LW W1-W2 Land Management Plan has been implemented to monitor the following landscape features:

- Cliffs, rock outcrops, steep slopes, and dams – monthly visual inspections and reporting by geotechnical engineers from Douglas Partners (refer to **Appendix E**);
- Stonequarry Sewage Treatment Plan retention basin, or Dam FD7 – weekly visual inspections and reporting by Newcastle Geotechnical (refer to **Appendix F**); and
- Agricultural land – monthly visual inspections and reporting by Tahmoor Coal and Building Inspection Service (refer to **Appendix G**).

Performance against all Land Management Plan TARPs for the reporting period are summarised in **Table 2-3**. The following sections summarised the observations made during the reporting period for each landscape feature.

4.3.1 Cliffs, Rock Outcrops and Steep Slopes

Visual and photographic surveys for subsidence impacts on cliffs have been completed monthly for features within the LW W1 active subsidence zone. The purpose of the surveys is to note any new instabilities in the cliff structures that have occurred since the commencement of LW W1 mining, including freshly exposed rock face, debris scattered around the base of a cliff or overhang, and tension cracks. Surveys were completed by a walk through along the valley bed was conducted from Stonequarry Creek to the intersection of Cedar Creek and Matthew Creek.

The locations of cliffs, rock outcrops and steep slopes within the Study Area are illustrated in **Figure 4-12**.

During the reporting period, cliffs C03 to C09 along Cedar Creek and M01 and M02 along Matthews Creek were inspected, and there were no indications of recent rockfalls or signs of stress relief (tension cracking) along the sections of cliff monitored.

It is noted that during the reporting period, there were no rock outcrops or steep slopes located within the LW W1 active subsidence zone.

4.3.2 Dams

Visual and photographic surveys for subsidence impacts on dams were completed on a weekly and monthly basis of dams within the LW W1 active subsidence zone.

The location of dams within the Study Area are illustrated on **Figure 4-13**.

During the reporting period, the only dam to be surveyed was FD7, a retention basin at the Stonequarry Sewage Treatment Plant. Due to land access issues, this dam was viewed during all monitoring events from a distance from the Picton-Mittagong Loop Line.

During the reporting period, there were no observable changes to FD7 in comparison to pre-mining baseline data.

4.3.3 Agricultural Land

Visual and photographic surveys for subsidence impacts on agricultural land have been completed monthly at inspection points within the LW W1-W2 Study Area. Inspections points were set up prior to the commencement of LW W1 mining to provide vantage of agricultural land within the Study Area. The purpose of the surveys is to note whether change has occurred to agricultural land, and to assist in determining if any change can be attributed to mining impacts. Surveys noted the presence of erosion, condition of boundary and internal fencing components, paddock gate condition, out-building condition, paddock dam condition, presence of any surface slumping or cracking, and the presence of vegetation dieback.

Agricultural land identified within the Study Area is illustrated on **Figure 4-14**.

During the reporting period, there were no observable changes to agricultural land in comparison to pre-mining baseline data.

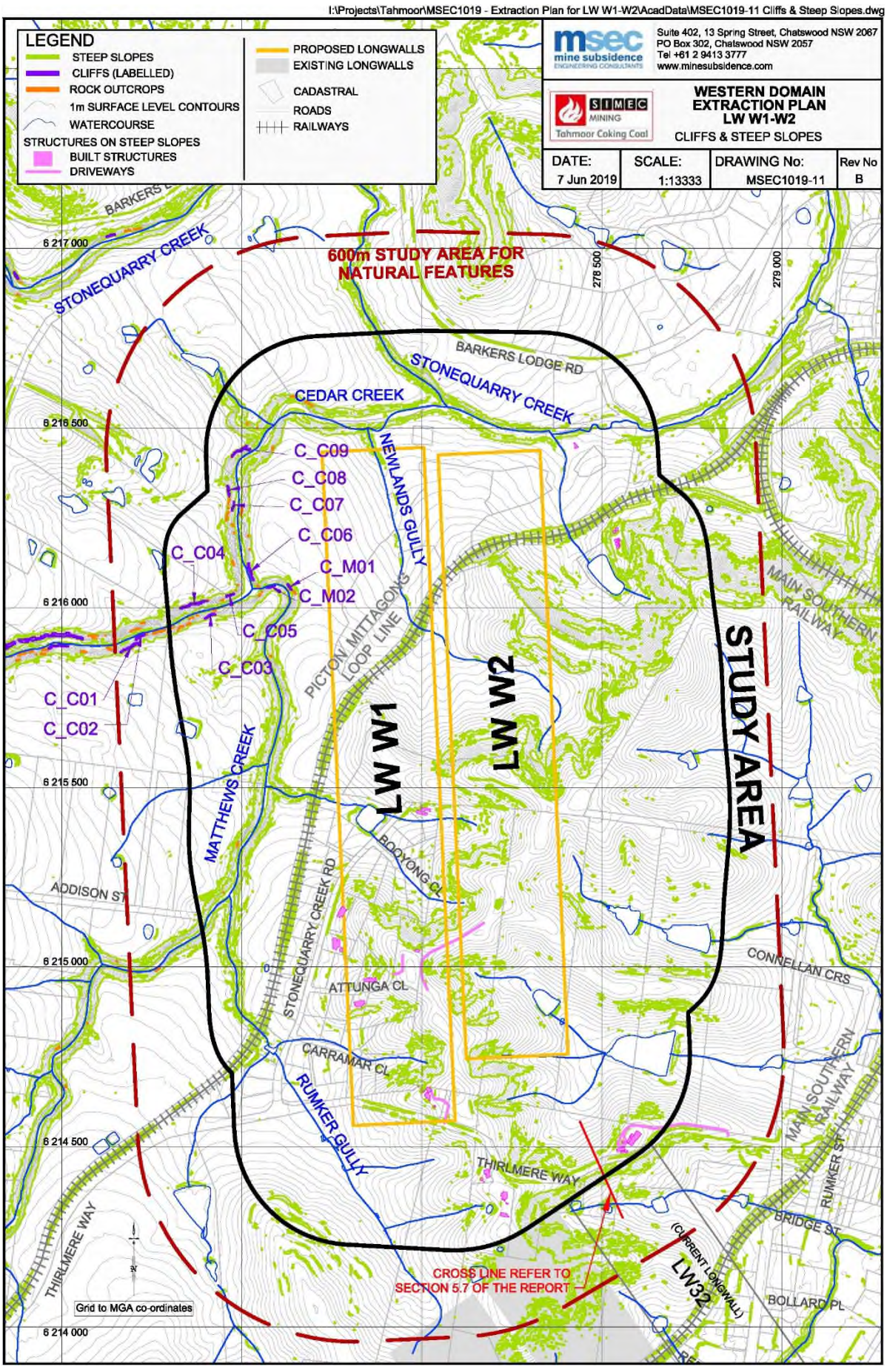


Figure 4-12 Cliffs, rock outcrops and steep slopes within the LW W1-W2 Study Area (source: MSEC, LW W1-W2 Subsidence Predictions and Impact Assessment Report)

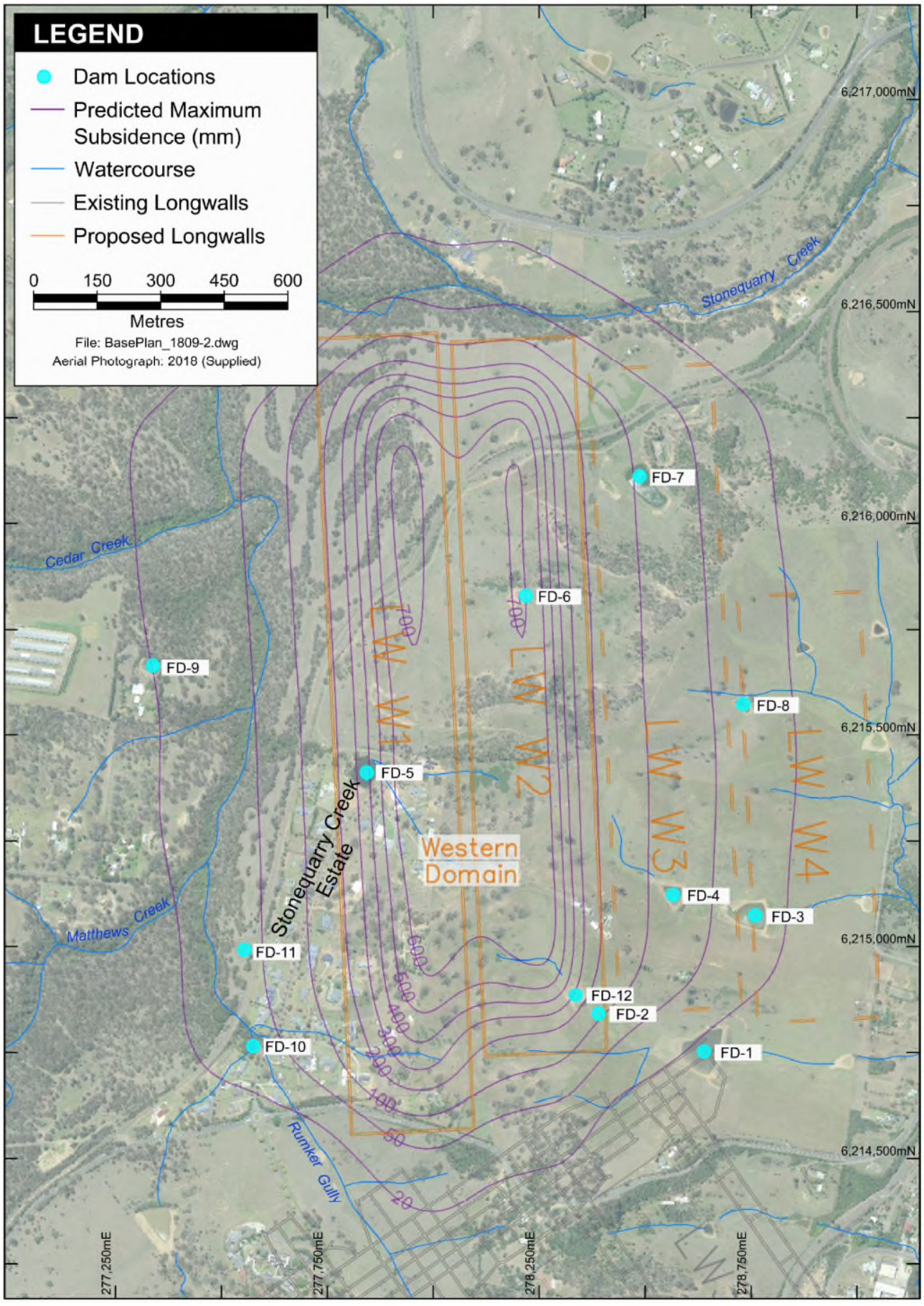


Figure 4-13 Dams within the LW W1-W2 Study Area (source: HEC, LW W1-W2 Surface Water Technical Report)

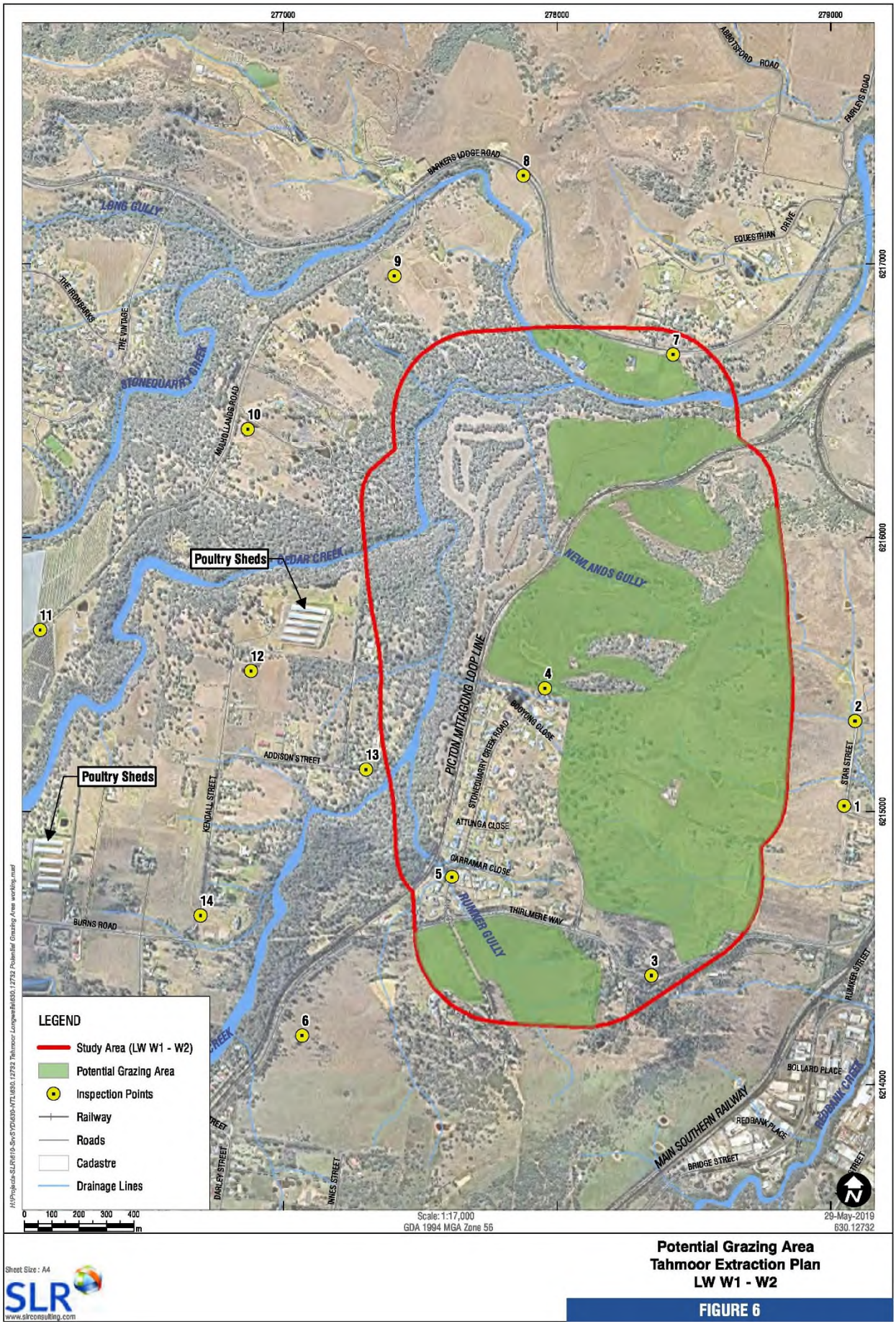


Figure 4-14 Agricultural land and inspection points within the LW W1-W2 Study Area (source: SLR, LW W1-W2 Land and Agricultural Resource Assessment)

4.4 Biodiversity Monitoring

The Tahmoor Coal LW W1-W2 Biodiversity Management Plan was prepared to manage the potential environmental consequences of LW W1-W2 extraction on aquatic and terrestrial flora and fauna in accordance with Condition 13H(vii)(d) of DA 67/98.

During the reporting period, the LW W1-W2 Biodiversity Management Plan has been implemented to monitor ecology in the Study Area, as outlined below:

- Aquatic ecology – macroinvertebrate monitoring during Autumn 2020 and reporting by Niche Environment and Heritage (refer to **Appendix H**); and
- Terrestrial ecology – amphibian and riparian vegetation monitoring during Autumn 2020 and reporting by Niche Environment and Heritage (refer to **Appendix I**).

Performance against all Biodiversity Management Plan TARPs for the reporting period are summarised in **Table 2-3**. The following sections summarised the observations made during the reporting period for aquatic and terrestrial ecology.

4.4.1 Aquatic Ecology

The aquatic ecology monitoring program for LW W1-W2 has been designed to monitor subsidence-induced impacts on aquatic ecology. The following survey methods have been completed during baseline and during mining monitoring sampling:

- Aquatic habitat assessment:
  - The Australian River Assessment System (AUSRIVAS);
  - Riparian Channel and Environment (RCE) Inventory;
- Macroinvertebrate survey:
  - AUSRIVAS macroinvertebrate sampling;
  - Quantitative benthic macroinvertebrate monitoring program; and
- Water quality sampling.

The aquatic ecology monitoring program is primarily focused on macroinvertebrate monitoring regimes including AUSRIVAS and quantitative using Before After Control Impact (BACI) design. A total of fifteen locations were sampled within Stonequarry Creek, Cedar Creek and Matthews Creek comprised of seven impact sites and eight control sites. The locations of monitoring sites are illustrated in **Figure 4-15**.

The Aquatic Ecology Monitoring Report prepared by Niche Environment and Heritage is provided in **Appendix H**. This report provided results for the Autumn 2020 sampling completed since the commencement of LW W1 extraction, and compared these results to five seasons of biannual baseline monitoring from spring 2017, autumn 2018, spring 2018, autumn 2019 and spring 2019. This information was then used to interpret whether there have been any triggers in accordance with the TARP and to determine whether associated actions were required.

It is noted that this report includes results from AUSRIVAS monitoring only, as quantitative macroinvertebrate monitoring results and associated statistical analysis of quantitative macroinvertebrate data was not available for the submission of this report. However, enough information has been obtained from the AUSRIVAS monitoring results to determine that it is unlikely that any Aquatic Ecology Biodiversity TARPs have been triggered.

During the reporting period, the following results were observed:

- Autumn 2020 was considered wetter than previous years with one high rainfall event and one moderate rainfall event occurring in the month before sampling;
- All sites had similar riparian and channel condition to that prior to sampling, however there was more aquatic habitat available in autumn 2020 and less iron floc at Cedar Creek site CC6. The flow path in the Cedar Creek site CC5 had changed, however the new path provided similar habitat compared to previous surveys. In general, there were less macrophytes present at some sites (CC6, SQC4 and SQC17), however similar species were present;
- Water quality appeared to have improved, with electrical conductivity within ANZECC guidelines. The pH exceeded guidelines however was more alkaline and above default trigger levels compared to previous surveys;
- AUSRIVAS scores in autumn 2020 were either comparable to previous results or higher than any scores observed pre-mining. This reflects improved aquatic habitat and availability.
- Signal scores in autumn 2020 for some sites (CC5, MC7 and MC8) were marginally lower than any pre-mining scores.
- Number of taxa were above or within the range of pre-mining results.

Statistical analysis of quantitative macroinvertebrate data was not available at this time.

To date, there have been no observable mining subsidence related impacts to aquatic ecology of Cedar Creek, Matthews Creek or Stonequarry Creek.

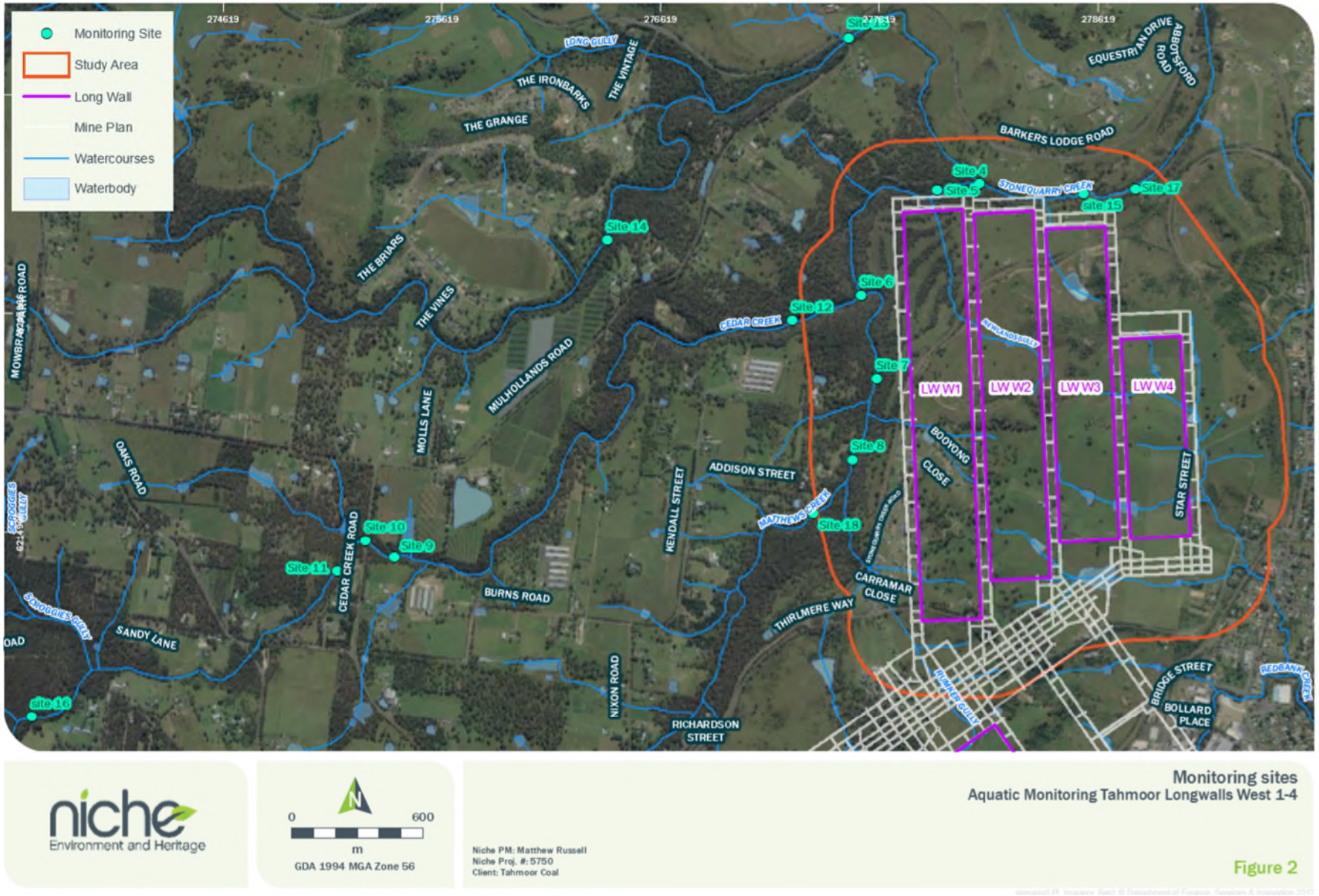


Figure 4-15 LW W1-W2 Aquatic Ecology Monitoring Locations (source: Niche, Aquatic Ecology Monitoring Report, **Appendix H**)

4.4.2 Terrestrial Ecology

The terrestrial ecology monitoring program for LW W1-W2 has been designed to monitor subsidence-induced impacts on terrestrial ecology. The following survey methods have been completed during baseline and during mining monitoring sampling:

- Riparian vegetation monitoring involving floristic surveys within established vegetation monitoring plots;
- Amphibian monitoring along established transects:
  - Spotlighing;
  - Call provocation;
  - Listening for diagnostic frog calls; and
  - Tadpole identification.

In particular, two threatened frog species – the Gian Burrowing Frog (*Heleioporus australiacus*) and the Red-crowned Toadlet (*Pseudophryne australis*) – were targeted in the amphibian monitoring.

A total of eight locations were sampled within Stonequarry Creek, Cedar Creek and Matthews Creek comprised of three impact sites and five control sites. The locations of monitoring sites are illustrated in **Figure 4-16**.

The Terrestrial Ecology Monitoring Report prepared by Niche Environment and Heritage is provided in **Appendix I**. This report provided results for the Autumn 2020 sampling completed since the commencement of LW W1 extraction, and compared these results to the previous two years of autumn baseline monitoring data collected in 2018 and 2019. This information was then used to interpret whether there have been any triggers in accordance with the TARP and to determine whether associated actions were required.

During the reporting period, the following results were observed:

- River-flat Eucalypt Forest, which is listed as an Endangered Ecological Community under the *Biodiversity Conservation Act 2016* was recorded at control site 9 with a high level of weed infestation;
- Floristic composition and vegetation cover at each site were relatively consistent over all autumn monitoring events.
- Impact sites had a slightly lower mean species richness and percentage vegetation cover than control sites.
- Anthropogenic influences were observed at sites that had been impacted by human disturbance, particularly weeds and altered flow regimes.
- Sites 7, 8, 9 tended to have higher fertility and nutrient loads, which lead to higher species diversity and generally more exotic species. These sites appeared to be more influenced by seasonal changes than sites further up the catchment (Sites 4, 5, 6 and 10), which tended to be protected in deep gullies and canyons.
- Frog detection rates were variable between monitoring events for most sites. There was a significant difference between control sites and impact sites but not across seasons within monitoring years 2018-2020. This is likely to due to the relatively small data set and the highly variable climatic conditions experienced across the survey periods.
- The targeted threatened frog species were not detected. The 6 species detected represent an otherwise normal array of common and robust species for the study environments and conditions.

- The targeted threatened frog species appear not to be present in the Study Area, at least not in a population that can be meaningfully monitored. While the study environment contains superficially suitable habitat, it is possible that the species would no longer be able to survive in the area due to predation pressures from two introduced predators: the Plague Minnow (*Gambusia holbrooki*) and the Yabby (*Cherax destructor*), both of which were detected at all sites. The frog community present contains at least 12 species which are likely still viable indicators of impending or current environmental change.
- The frog community of the Study Area was significantly different comparing impact and control sites. Both containing sites with low diversity and abundance of frogs, although control sites are consistently having higher abundance than impact sites.
- Frog detection rates were variable between monitoring events for most sites, most likely due to the highly variable weather and climatic conditions across the survey periods. There was a significant difference between control sites and impact sites (detection being greater at control sites), but not across monitoring years 2018-2020. This is due to the relatively small data set.

To date, there have been no observable mining subsidence related impacts to terrestrial ecology of Cedar Creek, Matthews Creek or Stonequarry Creek.

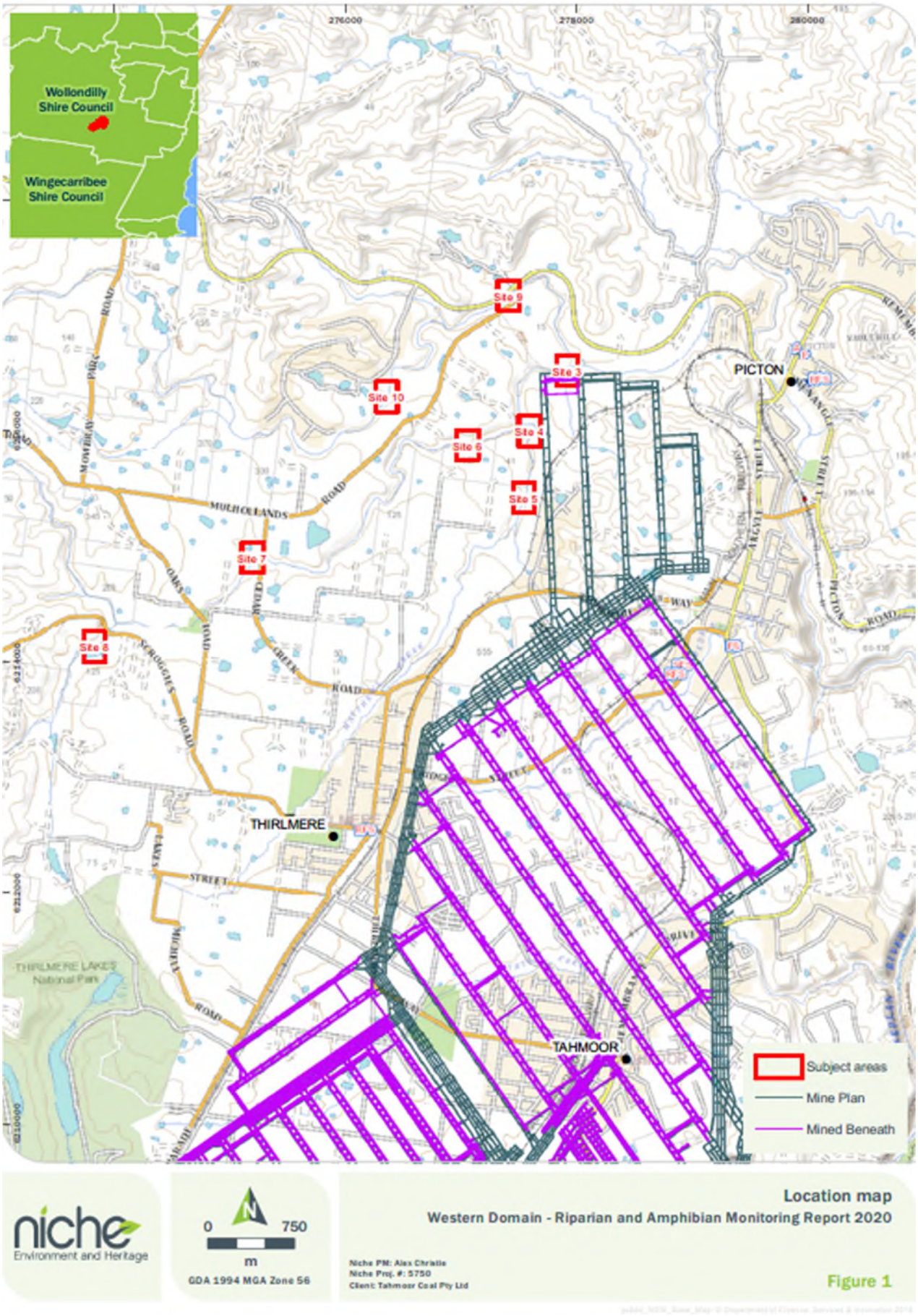


Figure 4-16 LW W1-W2 Terrestrial Ecology Monitoring Locations (source: Niche Environment and Heritage, Terrestrial Ecology Monitoring Report, **Appendix I**)

4.5 Heritage Monitoring

The Tahmoor Coal LW W1-W2 Heritage Management Plan was prepared to manage the potential environmental consequences of LW W1-W2 extraction on Aboriginal heritage and historical heritage sites and values in accordance with Condition 13H(vii)(f) of DA 67/98.

During this reporting period, the LW W1-W2 Heritage Management Plan has been implemented to monitor subsidence impacts for the following heritage items:

- Aboriginal heritage:
  - Rockshelters – monthly external visual inspections of rockshelters by GeoTerra (refer to **Appendix C**);
  - Grinding grooves – monthly review of GNSS unit movements by MSEC (refer to **Appendix A**);
- Historical heritage:
  - Sandstone and brick culverts along the PMLL – weekly visual inspection by Newcastle Geotechnical (refer to **Appendix F**).

The locations of these heritage items are illustrated in **Figure 4-17** and **Figure 4-18**.

Monitoring observations for heritage items from the weekly and monthly reports, as well as performance against all Heritage Management Plan TARPs for the reporting period have been summarised in **Table 2-3**.

No subsidence related rock face cracking or spalling in the vicinity of the rockshelters. In addition, there were no signs of change to the grinding groove site or culverts during this reporting period. Some cracking was noted on the access track along the embankment at 88.400 km in April 2020, however there were no changes noted to the culvert associated with the embankment.

A visual inspection of Aboriginal heritage items in the Study Area will be completed by an archaeologist (with experience in rock art recordings and management) and Aboriginal stakeholder representatives once LW W1 extraction has reached 1,000 m. Internal inspection of the rockshelters may not be possible during this review due to the proximity of the longwall face and associated safety concerns (e.g. rock falls as a result of subsidence). This review will assist with the Adaptive Management Process to determine whether the start position of LW W2 will be modified.

A detailed visual inspection of all heritage items will be completed following the completion of the longwalls.

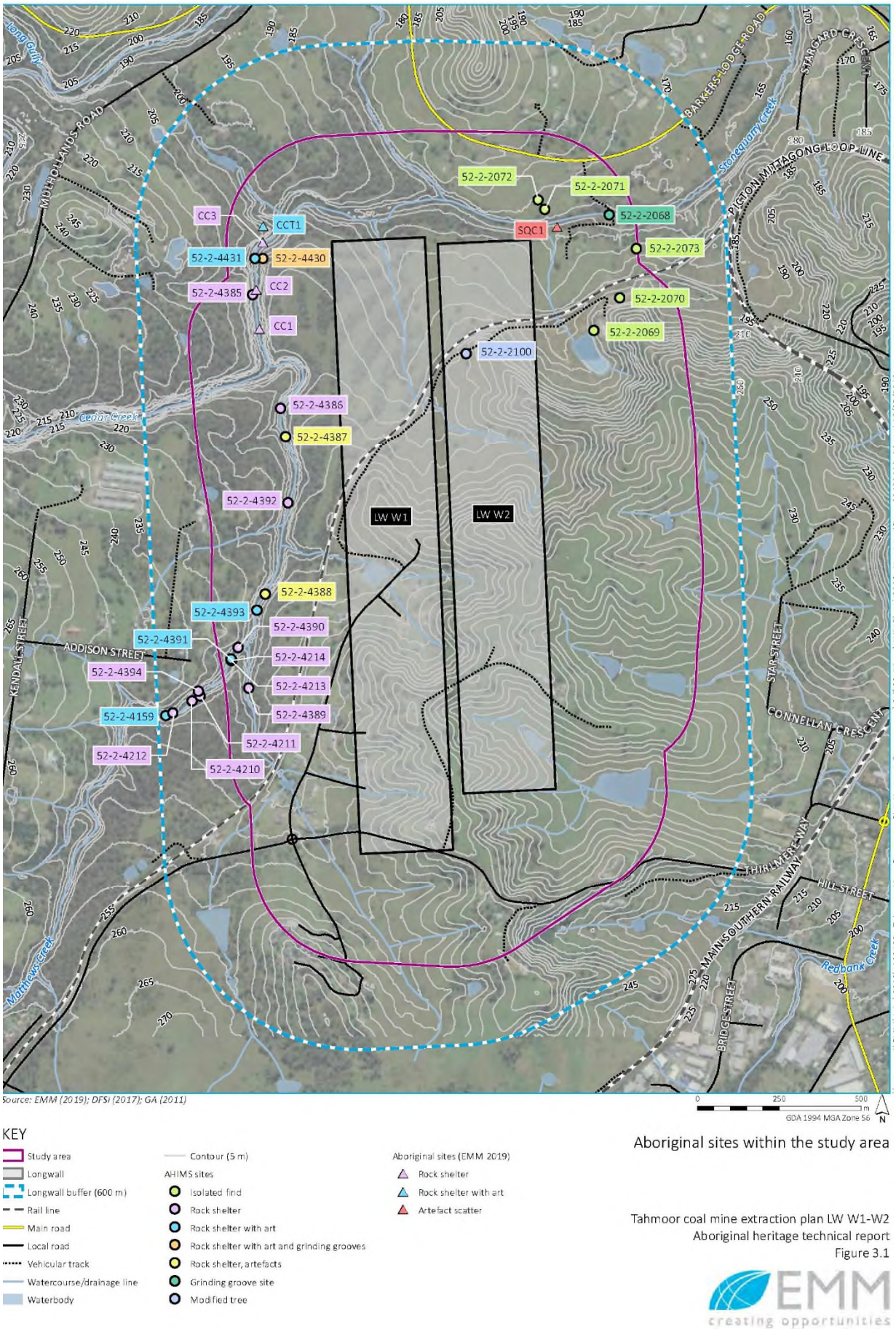


Figure 4-17 Aboriginal heritage and historical heritage items within the LW W1-W2 Study Area (source: EMM, LW W1-W2 Aboriginal Heritage Technical Report)

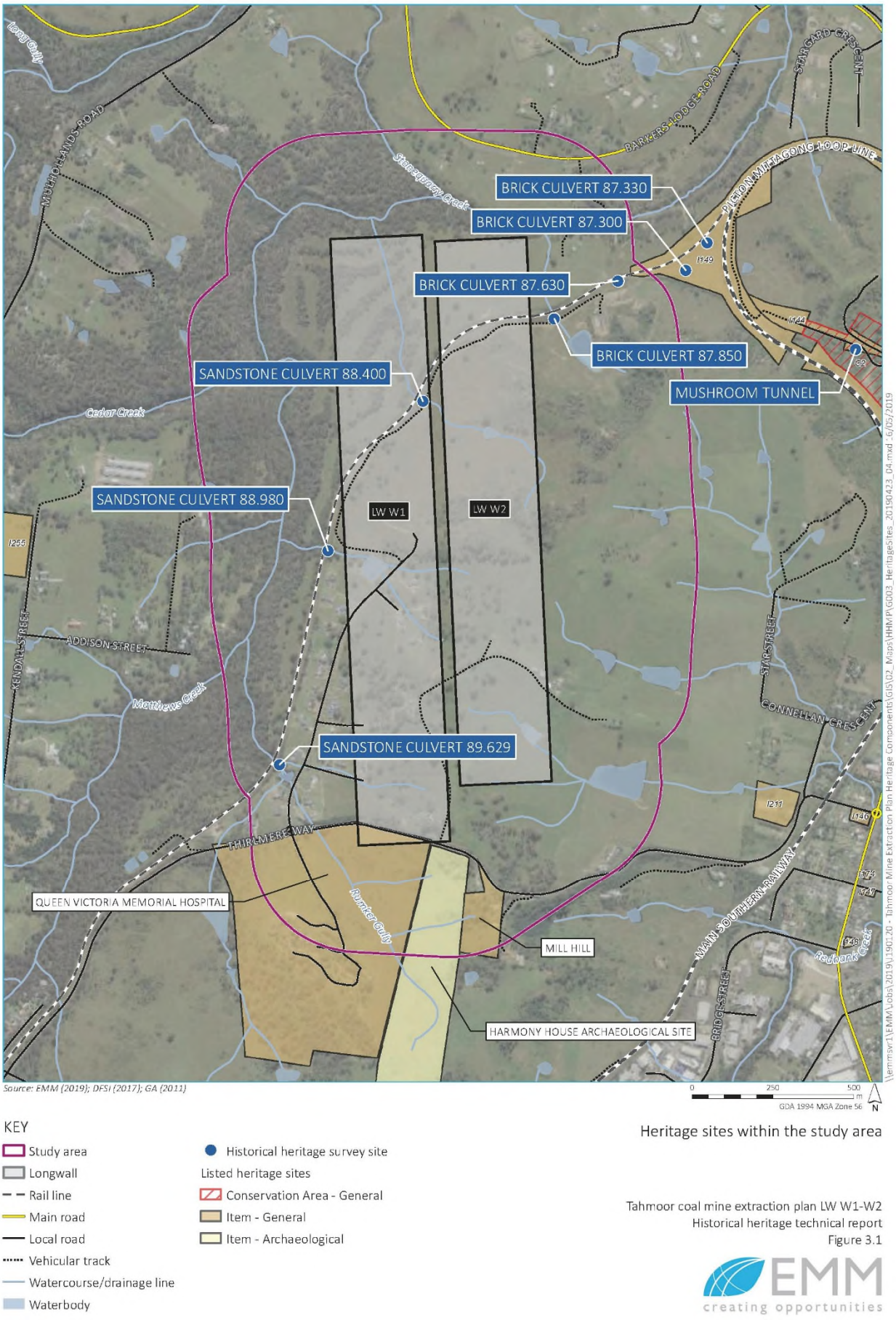


Figure 4-18 Historical Heritage Sites in the Study Area and Surrounds (source: EMM, LW W1-W2 Historical Heritage Technical Report)

4.6 Built Features Monitoring

The Tahmoor Coal LW W1-W2 Built Features Management Plan and associated sub-plans were prepared to manage the potential environmental consequences of LW W1-W2 extraction on built features in accordance with Condition 13H(vii)(b) of DA 67/98.

During this reporting period, the LW W1-W2 Subsidence Monitoring Program has been implemented to monitor subsidence impacts on infrastructure owned by Endeavour Energy (electrical infrastructure), Sydney Water (potable water infrastructure), Bradcorp (sewer infrastructure), Jemena (gas infrastructure), Wollondilly Shire Council (roads, bridges and culverts), Telstra (telecommunications infrastructure), NBN (telecommunications infrastructure), ARTC (rail infrastructure), Transport Heritage NSW (rail infrastructure), Queen Victoria Memorial Home (historical building and nursing home), Mill Hill (historical building), and private property owners. The details of the Subsidence Monitoring Program are illustrated in **Figure 4-1**.

A monthly review of the subsidence survey results during the reporting period has been completed by MSEC (refer **Appendix A**). Monitoring observations for built infrastructure from the monthly reports, as well performance against all Infrastructure Management Plan TARPs for the reporting period have been summarised in **Table 2-3**.

One observation of subsidence impact to a built feature was observed during this reporting period. A tension crack along the crest of the embankment on Down side at 88.400 km was observed on 16 April 2020 (refer to Report 22 in **Appendix J**). Tensile stains and lateral shearing movements were measured across this section of the embankment. A geotechnical inspection was conducted on 17 April 2020, and test pit excavation across the crack was completed on 27 April 2020. The investigations confirmed that there are no concerns with embankment stability. The crack was noted to have closed on 27 April 2020, with no changes observed on 4 May 2020.

No other subsidence impacts to built features were observed during this reporting period.

Changes in distances across the Ballast Top Subway (86.838 km) abutment exceeded the monitoring review point trigger level on 31 March 2020. This movement was investigated by a structural engineer who advised that the movement appeared to be related to a continuation of pre-existing conditions and was unlikely to be mining induced.

4.7 Public Safety Monitoring

The Tahmoor Coal LW W1-W2 Public Safety Management Plan was prepared to manage the potential consequences as a result of LW W1-W2 extraction on public safety within the Study Area in accordance with Condition 13H(vii)(g) of DA 67/98.

As noted in **Section 1.3** of this report, management requirements for public safety are covered in the Built Features Management Plan and the Land Management Plan. Monitoring of cliffs, rock outcrops and steep slopes and other landscape features has been conducted for the reporting period in accordance with the LW W1-W2 Land Management Plan (refer to **Section 4.3.1** for a summary of monitoring results). In addition, monitoring of infrastructure items has also been conducted for the reporting period in accordance with the LW W1-W2 Built Features Management Plan (refer to **Section 4.6** for a summary of monitoring results).

No subsidence impacts were identified during the reporting period that were considered to pose a risk to public safety.

5 Document Information

5.1 References

Department of Planning and Environment (DPE) (2015), Guidelines for the Preparation of Extraction Plans V5.

EMM Consulting (2019a), Tahmoor Mine Extraction Plan: Longwalls West 1 – West 2 – Aboriginal Heritage Technical Report, report for Tahmoor Coal.

EMM Consulting (2019b), Tahmoor Mine Extraction Plan: Longwalls West 1 – West 2 – Historical Heritage Technical Report, report for Tahmoor Coal.

Hydro Engineering & Consulting (2019), Tahmoor Mine Extraction Plan LW W1-W2 – Surface Water Technical Report, prepared for Tahmoor Coal, document J1809-2_R1c.

Mine Subsidence Engineering Consultants (2019), Tahmoor Coking Coal Operations – Longwalls W1 and W2, Subsidence Predictions and Impact Assessments for Natural and Built Features due to the Extraction of the Proposed Longwalls W1 and W2 in Support of the Extraction Plan Application. Prepared for Tahmoor Coal, May 2019, document MSEC1019.

SLR (2019), Tahmoor Extraction Plan LW W1-W2 Land and Agricultural Resource Assessment, prepared for Tahmoor Coal, document 630.12732-R01-v0.1.

Tahmoor Coal Documents:

- Extraction Plan LW W1-W2 Extraction Plan Main Document, TAH-HSEC-00248
- Extraction Plan LW W1-W2 Water Management Plan, TAH-HSEC-00244
- Extraction Plan LW W1-W2 Land Management Plan, TAH-HSEC-00247
- Extraction Plan LW W1-W2 Biodiversity Management Plan, TAH-HSEC-00246
- Extraction Plan LW W1-W2 Heritage Management Plan, TAH-HSEC-00242
- Extraction Plan LW W1-W2 Subsidence Monitoring Program, TAH-HSEC-00249

5.2 Glossary of Terms

Terms references to this document are provided below in **Table 5-1**.

Table 5-1 Glossary of Terms

Term	Definition
Active Subsidence Zone	The active subsidence zone for each longwall is defined by the area bounded by the predicted 20 mm subsidence contour for the active longwall and a distance of 150 m in front of the active longwall face and 450 m behind the active longwall face or following 500 m of longwall extraction.
Angle of draw	The angle of inclination from the vertical of the line connecting the goaf edge of the workings and the limit of subsidence (which is usually taken as 20 mm of subsidence)
Cliffs	Continuous rockfaces having minimum heights of 10 m, minimum lengths of 20 m and minimum slopes of 2 to 1, i.e. having minimum angles to the horizontal of 63o.
Closure	The reduction in the horizontal distance between the valley sides. The magnitude

Term	Definition
	of closure, which is typically expressed in the units of mm, is the greatest reduction in distance between any two points on the opposing valley sides. It should be noted that the observed closure movement across a valley is the total movement resulting from various mechanisms, including conventional mining induced movements, valley closure movements, far-field effects, downhill movements and other possible strata mechanisms.
Longwall	A system of mining coal in which the seam is extracted on a broad front or long face using a coal shearer and the roof is supported by hydraulic roof supports.
Reporting period	15 November 2019 to 5 May 2020
Run of mine (ROM)	Raw coal production; the unprocessed mined coal that is conveyed to the CPP. ROM may consist of coal and rock.
Study Area	Study Area as defined in the LW W1-W2 Extraction Plan
Subsidence	The vertical movement of a point on the surface of the ground as it settles above an extracted panel, but, 'subsidence of the ground' in some references can include both a vertical and horizontal movement component. The vertical component of subsidence is measured by determining the change in surface level of a peg that is fixed in the ground before mining commenced and this vertical subsidence is usually expressed in units of mm. Sometimes the horizontal component of a peg's movement is not measured, but in these cases, the horizontal distances between a particular peg and the adjacent pegs are measured.
Subsidence impacts	The physical changes or damage to the fabric or structure of the ground, its surface and environmental features, or built structures that are caused by the subsidence effects. These impacts considerations can include tensile and shear cracking of the rock mass, localised buckling of strata, bed separation, rock falls, collapse of overhangs, failure of pillars, failure of pillar floors, dilation, slumping and also include subsidence depressions or troughs.
Upsidence	Upsidence results from the dilation or buckling of near-surface strata at or near the base of the valley. The term uplift is used for the cases where the ground level is raised above the pre-mining level, i.e. when the upsidence is greater than the subsidence. The magnitude of upsidence, which is typically expressed in the units of mm, is the difference between the observed subsidence profile within the valley and the conventional subsidence profile which would have otherwise been expected in flat terrain.
Western Domain	Area to the north-west of the Main Southern Railway.

5.3 Abbreviations

Abbreviations used in this document are provided below in **Table 5-2**.

Table 5-2 Abbreviations

Abbreviation	Definition
AHIMS	Aboriginal Heritage Information System
ARTC	Australian Rail Track Corporation

Abbreviation	Definition
AUSRIVAS	The Australian River Assessment System
BACI	Before After Control Impact design
DA	Development Approval
DRNSW	Department of Regional NSW
DPE	NSW Department of Planning and Environment (now DPIE)
DPIE	NSW Department of Planning, Industry and Environment
EC	Electrical conductivity
EPA	NSW Environment Protection Authority
GFG	GFG Alliance
GNSS	Global Navigation Satellite System units
HEC	Hydro Engineering and Consulting
Km	Kilometres
LW W1	Longwall West 1
LW W1-W2	Longwalls West 1 to West 2
LW W3-W4	Longwalls West 3 to West 4
m	metres
mbgl	Metres below ground level
mg/L	Milligrams per litre
ML	Mining Lease
mm	millimetre
MSEC	Mine Subsidence Engineering Consultants
NRAR	NSW Industry – Land & Water – Natural Resources Access Regulator – East
NSW	New South Wales
OSP	Open Standpipe Piezometers
pH	pH units
PMLL	Picton-Mittagong Loop Line railway
RCE	Riparian Channel and Environment Inventory
ROM	Run of Mine coal per annum
SIMEC	SIMEC Mining Division
Tahmoor Coal	Tahmoor Coal Pty Ltd
Tahmoor Mine	Tahmoor Coal Mine
TARP	Trigger Action Response Plan
TCCCC	Tahmoor Colliery Community Consultative Committee
TCCO	Tahmoor Coking Coal Operations
VMP	Vibrating Wire Piezometer

5.4 Document Distribution

This report and associated documents have been distributed according to **Table 5-3**.

Table 5-3 Distribution List for Six Monthly Subsidence Impact Report

Agency	Contact Person	Position	Electronic Copy
DPIE - Planning	Steven O'Donoghue	Director – Resource Assessments	Stephen.ODonoghue@planning.nsw.gov.au
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DPIE - Resources Regulator (Subsidence)	Dr. Gang Li	Principal Subsidence Engineer	subsidence.monitoring@planning.nsw.gov.au
DRNSW – Resources and Geosciences	Alex Love	Advisory Officer - Assessment Coordination	alex.love@planning.nsw.gov.au
DPRNSW – Resources Regulator – Mining Act Inspectorate	Greg Kininmonth	Manager Environmental Operations (Southern)	greg.kininmonth@planning.nsw.gov.au nswresourcesregulator@service-now.com
Wollondilly Shire Council	David Henry	Environmental Assessment Planner	david.henry@wollondilly.nsw.gov.au
	Bruce Davenport	Environmental Services Team Leader	bruce.devonport@wollondilly.nsw.gov.au
Subsidence Advisory NSW	Matthew Montgomery	Infrastructure Manager	matthew.montgomery@finance.nsw.gov.au
NRAR	Ellie Randall	Water Regulation Officer	ellie.randall@nrar.nsw.gov.au
EPA	Andrew Couldridge	Senior Operations Officer - Metropolitan Illawarra	andrew.couldridge@epa.nsw.gov.au
TCCCC Committee Members	Documents sent to TCCCC Committee Members at private email addresses.		

Appendix A – Subsidence Monitoring Reports

Appendix B – Surface Water Monitoring Report

Appendix C – Creek Monitoring Reports

Appendix D – Groundwater Monitoring Reports

Appendix E – Geotechnical Monitoring Reports

Appendix F – Railway Monitoring Reports

Appendix G – Agricultural Monitoring Reports

Appendix H – Aquatic Ecology Monitoring Report

Appendix I – Terrestrial Ecology Monitoring Report

Appendix J – Picton-Mittagong Loop Line Status Reports

Appendix K – RMS Status Reports

Appendix L – Main Southern Rail Status Reports