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Tahmoor Coal Pty Ltd

SIX MONTHLY SUBSIDENCE IMPACT REPORT

Western Domain Longwalls West 1 – West 4

25 March 2022 – 18 November 2022

Report 6 – December 2022

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Document Control

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Executive Summary

This report is the sixth six-monthly report to be submitted since the commencement of extraction of Longwall West 1 (LW W1), in accordance with the requirements of the Longwall West 3 and West 4 (LW W3-W4) Extraction Plan. The reporting period of this report is from 25 March 2022 to 18 November 2022.

Extraction of coal from Longwalls West 1 to West 3 were completed on 6 November 2020, 17 June 2021 and 21 March 2022, respectively. Longwall West 4 (LW W4) commenced on 16 May 2022 and was completed on 13 September 2022. Subsidence impacts discussed in this report are for those observed during and after the extraction of LW W4.

Extraction Plan for Tahmoor A Series was granted on 20 September 2022, and extraction of LW S1A commenced 18 October 2022. No subsidence impacts have been encountered to date and environmental monitoring results will be reported in the next 6 monthly report.

The maximum observed vertical subsidence relating to the extraction of LW W4 was 897 mm recorded along the LW W1-W4 crossline survey.

There were eight (8) environmental aspects that were associated with Trigger Action Response Plans (TARPs) triggers. All triggers have been reviewed by the Environmental Response Group / Structural Response Group / specialists to determine if any further action is required. These TARP triggers included:

- Surface Water Quality TARP – Level 2 triggered due to elevated dissolved aluminium at various pools during March to July 2022, and variable pH levels at monitoring site SD in August and September 2022. These elevated concentrations were attributed to prevailing climatic conditions, and no further actions other than ongoing monitoring are required;
- Natural Drainage Behaviour TARP – Level 3 triggered due to laminar fracturing at SR17 Rockbar from November 2021 onwards, and fracturing at SR20 Rockbar from August 2022 onwards. A Level 3 TARP trigger was associated for both locations as the rockbar fracturing was formed during mining (was not present during baseline inspections), and there was no reduction in pool water level, drainage or overland connected flow (taking into account climatic conditions and observations during the baseline monitoring period). No further actions other than ongoing monitoring are required;
- Groundwater Quality TARP – Level 2 and potential Level 4 triggered due to water quality results exceeding trigger levels. Potential Level 4 triggers were identified for pH at P12B and strontium at P15A. Both potential Level 4 triggers have been resolved during this reporting period, and other than ongoing monitoring, purging of a number of shallow groundwater bores is required;
- Groundwater Bore Level TARP – Levels 2 and 3 triggered during the reporting period, however a trend in groundwater recovery was evident. Groundwater bore level will continue to be monitored in accordance with the LW W3-W4 Water Management Plan, and Tahmoor Coal will continue to provide 3-monthly reports to DPE for surface water and groundwater;
- Shallow Groundwater Pressures TARP – Levels 2 and 3 triggered during the reporting period, however a trend in groundwater recovery was evident. Groundwater bore level will continue to be monitored in accordance with the LW W3-W4 Water Management Plan, and Tahmoor Coal will continue to provide 3-monthly reports to DPE for surface water and groundwater;
- Deep Groundwater Pressures TARP – Level 2 triggered during the reporting period. Groundwater monitoring will continue under the existing monitoring program;

- Historical Heritage TARP – Level 3 Trigger for impacts to sandstone culverts at 88.400 km and 88.980 km. These impacts included cracking and minor spalling on the portal sides and cracking in the barrel of the culvert at 88.400 km. This Level 3 TARP trigger is a continuation of the TARP notification to DPE on 21 September 2021. Tahmoor Coal will undertake remediation now that the full effects of LW W3-W4 is complete; and
- Stonequarry Creek Rockbar TARP – Blue Triggers for extension of High Resolution Closure Lines and measured strains across the SR17 Rockbar, and a Yellow Trigger for fractures on the SR17 Rockbar. These triggers have been investigated, and no impacts were noted at the Aboriginal heritage items located on the SR17 Rockbar. Monitoring will shortly finish for these items as mining in the Western Domain has been completed.

During the reporting period, there was one exceedance of environmental performance measures or indicators, as adopted from DA 67/98 Modification 5 or the LW W1-W2 Extraction Plan Approval conditions. Cracking on sandstone culverts at 88.400 km and 88.980 km resulted in an exceedance of subsidence performance indicator for ‘other Aboriginal and heritage sites’, which was defined as ‘negligible subsidence impacts or environmental consequences’.

Tahmoor Coal notified DPE and Heritage NSW of the trigger via the NSW Major Projects Planning Portal on 21 September 2021. A site visit with DPE was completed on 12 April 2022. A warning letter from DPE was received on 16 May 2022 regarding the breach against Section 4.2(1)(b) of the *Environmental Planning and Assessment Act 1979*. Tahmoor Coal has committed to complete remediation by 31 March 2023.

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1 Introduction

This Six-Monthly Subsidence Impact Report fulfils the reporting requirement of the Extraction Plan approved for Longwall West 3 and West 4 (LW W3-W4) and covers the period of 25 March 2022 to 18 November 2022.

This report provides with a summary of subsidence and environment monitoring results, subsidence impacts and management actions undertaken during the reporting period.

In addition, this report forms part of the three-monthly reporting for surface water and groundwater following an investigation of Level 4 TARP triggers relating to depressurisation of groundwater aquifers and water level at surface water monitoring site CB (Pool CR14). This reporting requirement was requested by NSW Department of Planning, Industry and Environment (DPIE, now DPE) following the notification of these TARP triggers. This report includes a review and interpretation of monitoring data, assessment against performance measures and performance indicators for surface water and groundwater, and a summary and progress of any recommendations in relation to ongoing monitoring or corrective actions (refer to **Section 5, Appendix B, and Appendix C**).

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 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 for Australian domestic customers and export customers.

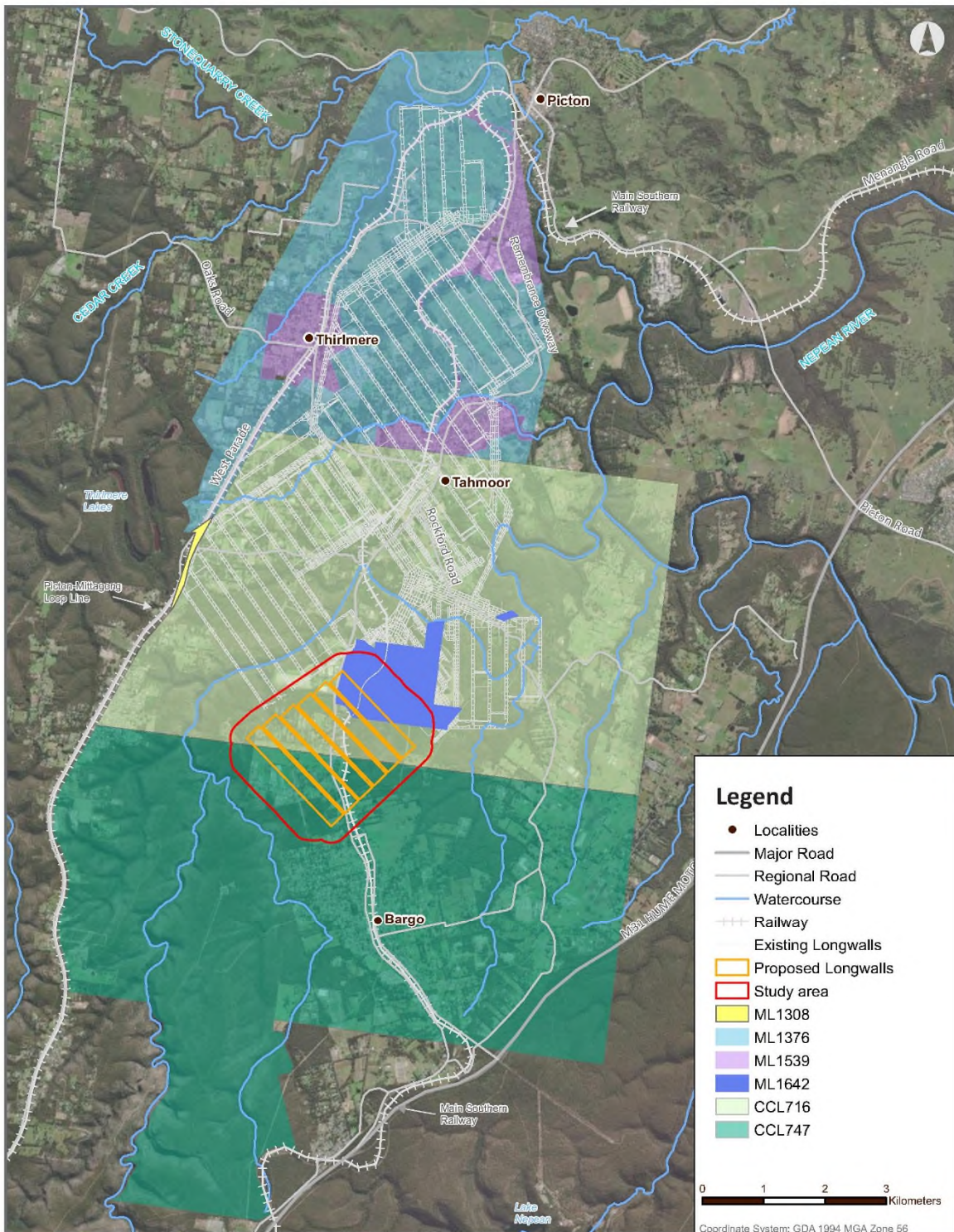
Tahmoor Mine has been operated by Tahmoor Coal Pty Ltd (Tahmoor Coal) since Tahmoor Mine commenced in 1979 using bord and pillar mining methods, and via longwall mining methods since 1987. Tahmoor Coal is a wholly owned entity within the SIMEC Mining Division of the GFG Alliance group.

Tahmoor Coal has mined 36 longwalls to the north and west of Tahmoor Mine's current pit top location. The 'Western Domain' is a mining area located north-west of the Main Southern Rail between the townships of Thirlmere and Picton (**Figure 1-1**). The Western Domain is within the Tahmoor North mining area and is within Mining Lease (ML) 1376 and ML 1539.

Extraction Plan approval for the third and fourth longwalls in the Western Domain (LW W3-W4) was granted by DPIE (now DPE) on 13 September 2021. A copy of this Project Approval is available on the Tahmoor Coal website (<http://www.simec.com/mining/tahmoor-coking-coal-operations/>). The Study Area for this extraction plan are provided in **Figure 1-2**.

Extraction of coal from Longwalls West 1 to West 3 were completed on 6 November 2020, 17 June 2021 and 21 March 2022, respectively. Longwall West 4 (LW W4) commenced on 16 May 2022 and was completed on 13 September 2022. Subsidence impacts discussed in this report are for those observed during and after the extraction of LW W4.

Extraction Plan approval for Tahmoor A Series was granted on 20 September 2022, and extraction of LW S1A commenced 18 October 2022. No subsidence impacts have been encountered to date and environmental monitoring results will be reported in the next 6 monthly report.



Tahmoor Mining Area and Tenure

Tahmoor South Domain Longwalls S1A to S6A
Extraction Plan

FIGURE 2
Date: 24/03/2022

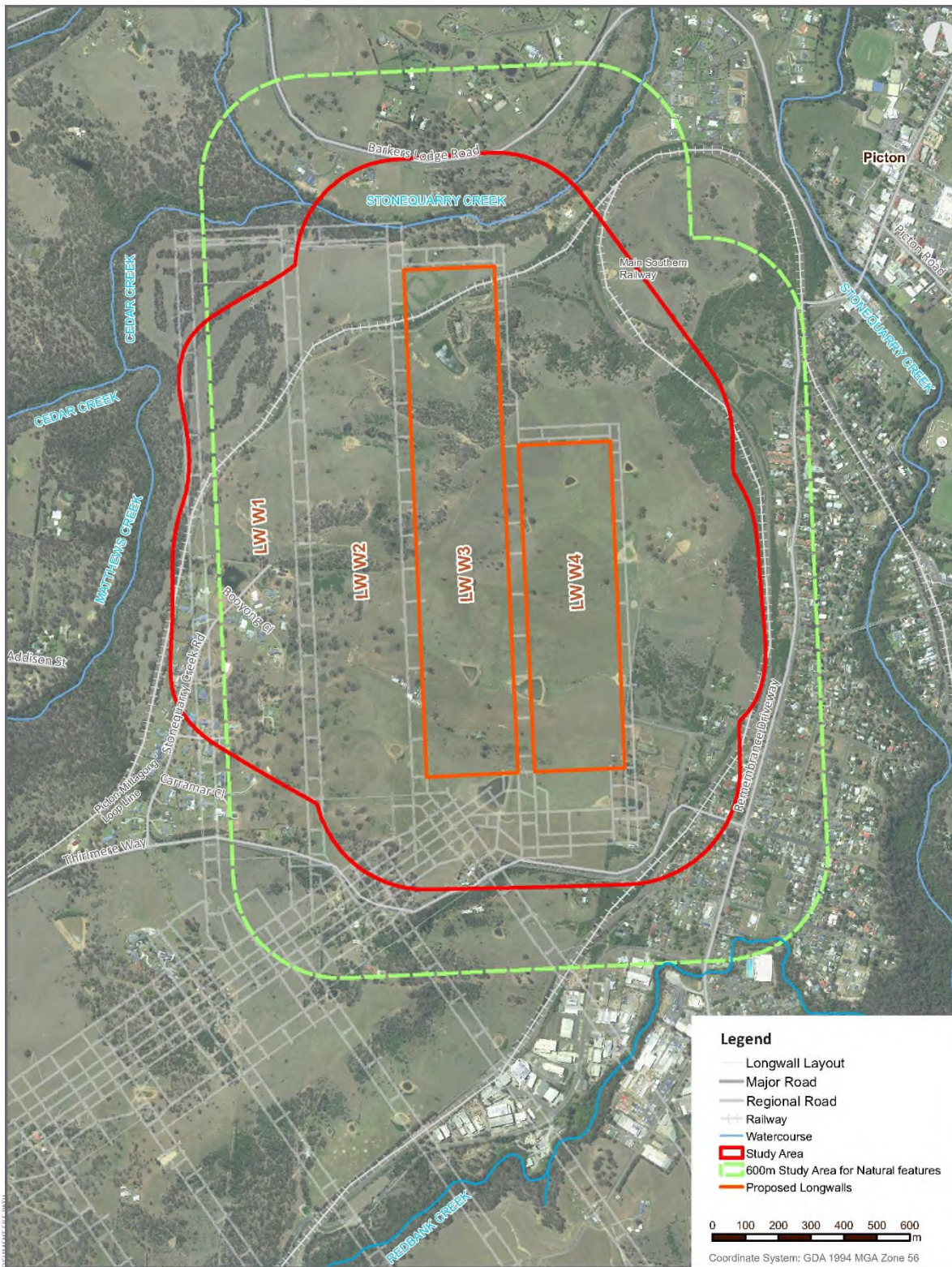
Data Sources:
© NSW DPSI (2019), © NSW Mining (2019), © SIMEC (2019)
Aerial Imagery: © Photomapping Services (November 2018)

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Figure 1-1

Tahmoor Mine Area and Tenure (source: Extraction Plan for Longwalls South 1A to South 6A)



EXTRACTION PLAN STUDY AREA

Tahmoor North Western Domain Longwalls West 3 and West 4
Extraction Plan

FIGURE 1-2

Date: 10/05/2021

Data Sources:
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Figure 1-2

LW W3-W4 Extraction Plan Study Area (source: LW W3-W4 Extraction Plan)

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 W3-W4. These requirements are outlined in Section 6.1.4 of the LW W3-W4 Extraction Plan, which are derived from the Section 6 of the DPE *Draft Guidelines for the Preparation of Extraction Plans V5* (DPE, 2015). It is noted that an updated version of the Guidelines were published in October 2022.

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 W3-W4 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 6.4**.

1.3 Scope

The Tahmoor Coal Environmental Management Structure, according to the LW W3-W4 Extraction Plan, is shown in **Figure 1-3**.

The Extraction Plan Study Area for LW W3-W4 is defined as the surface area that is likely to be affected by the extraction of LW W3-W4 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 W3-W4; and
- A 35° angle of draw line from the limit of proposed extraction for LW W3-W4.

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

As part of the LW W3-W4 Extraction Plan, a set of management plans was prepared to manage particular environment or built features with the LW W3-W4 Study Area, which consisted of the following:

- Water Management Plan;
- Land Management Plan;
- Biodiversity Management Plan;
- Heritage Management Plan;
- Stonequarry Creek Rockbar 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 W3-W4 Extraction Plan is provided in the relevant Subsidence Monitoring Programs.

Monitoring of features from the LW W1-W2 Extraction Plan as part of post-mining monitoring has been either completed or incorporated into the LW W3-W4 Subsidence Monitoring Programs, with the exception of post-mining monitoring of cliffs and rock outcrops in the LW W1-W2 Study Area.

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 in accordance with management plans listed above.

This report is the sixth six-monthly report to be submitted since the commencement of extraction of LW W1, in accordance with the requirements of the LW W3-W4 Extraction Plan. The reporting period of this report is from 25 March 2022 to 18 November 2022.

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.

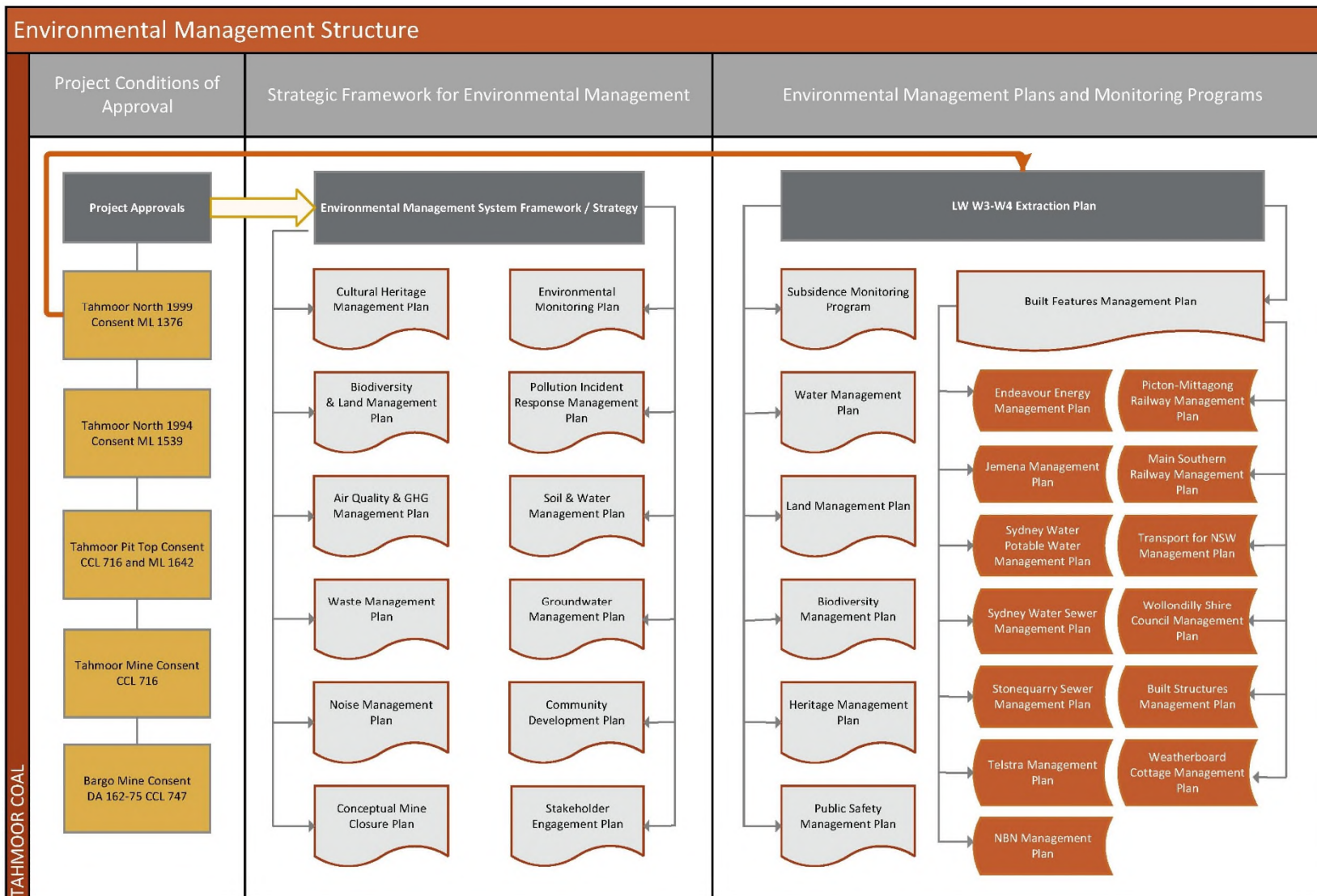


Figure 1-3 Overview of Environmental Management Structure for Tahmoor Coal (source: LW W3-W4 Extraction Plan)

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 | Reporting Frequency | Reference |
|-------------------------------|--|--|--|---|--|---|--------------------------------------|
| Subsidence Monitoring Program | Subsidence | General subsidence | <ul style="list-style-type: none"> SMEC Building Inspection Service Comms Network Solutions | <ul style="list-style-type: none"> Mine Subsidence Engineering Consultants (MSEC) | Subsidence Monitoring Reports for LW W4 extraction, reviewing data collected from 16 May 2022 to 18 November 2022 (Reports #1-20). | Weekly, end of panel report | Appendix A (referenced reports only) |
| Water Management Plan | Surface Water | Stonequarry Creek flow | <ul style="list-style-type: none"> WaterNSW | <ul style="list-style-type: none"> Hydro Engineering and Consulting (HEC) – now ATC Williams | Surface Water Monitoring Report reviewing data collected from 25 March 2022 to 7 September 2022. | Monthly, summarised in a 6-monthly report | Appendix B |
| | | Pool water level | <ul style="list-style-type: none"> ALS | | | | |
| | | Stream water quality | | | | | |
| | | Natural drainage behaviour | <ul style="list-style-type: none"> Brienan Environment and Safety | <ul style="list-style-type: none"> Brienan Environment and Safety | | | |
| | Groundwater | Groundwater quality | <ul style="list-style-type: none"> GeoTerra CES | <ul style="list-style-type: none"> SLR | Groundwater Monitoring Report reviewing data collected from 1 April 2022 to 30 September 2022. | Monthly, summarised in a 6-monthly report | Appendix C |
| | | Groundwater bore level | <ul style="list-style-type: none"> GeoTerra CES | | | | |
| | | Shallow groundwater pressures | | | | | |
| Deep groundwater pressures | | <ul style="list-style-type: none"> Groundwater Exploration Services SLR CES | | | | | |
| Groundwater Inflow | <ul style="list-style-type: none"> Tahmoor Coal | Included in 6-monthly Groundwater Monitoring Report reviewing data collected from 1 April 2022 to 30 September 2022. | 6-Monthly | | | | |

| Management Plan | Aspect | Feature | Monitoring Completed By | Monitoring Reported by | Monitoring Reports Completed during this Reporting Period | Reporting Frequency | Reference |
|------------------------------|---|--|--|---|--|---|--------------------------------------|
| Land Management Plan | Landscape | Cliff lines | <ul style="list-style-type: none"> Douglas Partners | <ul style="list-style-type: none"> Douglas Partners | Geotechnical Monitoring Reports reviewing data collected from 26 May 2022 to 18 October 2022. | Monthly and fortnightly (selected dams) | Appendix H (referenced reports only) |
| | | Steep Slopes | | | | | |
| | | Surface cracking (excluding railway corridor) | | | | | |
| | | Dams | | | | | |
| | Dams | <ul style="list-style-type: none"> Bloor Rail Newcastle Geotechnical | <ul style="list-style-type: none"> MSEC Bloor Rail Newcastle Geotechnical | Picton-Mittagong Loop Line (PMLL) Weekly Detailed Reports for LW W4 extraction, reviewing data collected from 16 May 2022 to 25 October 2022 (Reports #1-24). | Weekly | Available on request | |
| Dams | <ul style="list-style-type: none"> Building Inspection Service (BIS) | <ul style="list-style-type: none"> BIS | Dam inspection reports reviewing data collected from 22 April 2022 to 22 September 2022. | Weekly | Available on request | | |
| Agricultural Land | Agricultural Land | <ul style="list-style-type: none"> BIS | <ul style="list-style-type: none"> BIS | Agricultural Subsidence Monitoring Reports reviewing data collected from 30 May 2022 to 27 September 2022. | Monthly | Available on request | |
| Biodiversity Management Plan | Aquatic Ecology | Macroinvertebrates | <ul style="list-style-type: none"> Niche | <ul style="list-style-type: none"> Niche | Aquatic Ecology Monitoring Reports for Spring 2022 (September 2022). | Six Monthly | Available on request |
| | Terrestrial Ecology | Amphibians | <ul style="list-style-type: none"> Niche | <ul style="list-style-type: none"> Niche | Reporting of Terrestrial Ecology Monitoring for the Spring 2022 season is not currently available and will be incorporated in the next 6-monthly report. | Six Monthly | Not available |
| | | Riparian Vegetation | | | | | |

| Management Plan | Aspect | Feature | Monitoring Completed By | Monitoring Reported by | Monitoring Reports Completed during this Reporting Period | Reporting Frequency | Reference |
|--|---------------------|------------------|---|--|---|--|--|
| Heritage Management Plan and Stonequarry Creek Rockbar Management Plan | Aboriginal heritage | Grinding Grooves | <ul style="list-style-type: none"> SMEC | <ul style="list-style-type: none"> MSEC | Subsidence Monitoring Reports for LW W4 extraction, reviewing data collected from 16 May 2022 to 18 November 2022 (Reports #1-20). | Weekly, end of panel report | Appendix A (referenced reports only) |
| | | | <ul style="list-style-type: none"> EMM Consulting | <ul style="list-style-type: none"> EMM Consulting | LW W4 End of Panel Report for Aboriginal Heritage. | Once following LW W4 Extraction completed. | Available on request |
| | | SR17 Rockbar | <ul style="list-style-type: none"> SMEC Michael Nicholson Consulting PSM | <ul style="list-style-type: none"> MSEC | Stonequarry Creek Rockbar reports for LW W4 extraction, reviewing data collected from 30 April 2022 to 16 September 2022 (Report #49-53). | Weekly, monthly | Appendix F (referenced report only) |
| | Historical heritage | Railway culverts | <ul style="list-style-type: none"> Newcastle Geotechnical | <ul style="list-style-type: none"> Newcastle Geotechnical | Picton-Mittagong Loop Line (PMLL) Weekly Detailed Reports for LW W4 extraction, reviewing data collected from 16 May 2022 to 25 October 2022 (Reports #1-24). | Weekly | Available on request |
| | | | <ul style="list-style-type: none"> EMM Consulting | <ul style="list-style-type: none"> EMM Consulting | LW W4 End of Panel Report for Historical Heritage (railway culverts and Weatherboard House). | Once following LW W4 Extraction completed. | Appendix E (Railway culvert report only) |

| Management Plan | Aspect | Feature | Monitoring Completed By | Monitoring Reported by | Monitoring Reports Completed during this Reporting Period | Reporting Frequency | Reference |
|--------------------------------|--|---|--|--|--|-----------------------------|--------------------------------------|
| Built Features Management Plan | Built Features | Electricity Infrastructure | <ul style="list-style-type: none"> • SMEC • BIS • Comms Network Solutions | <ul style="list-style-type: none"> • MSEC | Subsidence Monitoring Reports for LW W4 extraction, reviewing data collected from 16 May 2022 to 18 November 2022 (Reports #1-20). | Weekly, end of panel report | Appendix A (referenced reports only) |
| | | Gas Infrastructure | | | | | |
| | | Potable Water | | | | | |
| | | Sewerage Infrastructure | | | | | |
| | | Telecommunications | | | | | |
| | | Local roads, bridges and culverts | | | | | |
| | | Built Structures | | | | | |
| | Picton-Mittagong Loop Line | <ul style="list-style-type: none"> • Southern rail Services • Bloor Rail | <ul style="list-style-type: none"> • MSEC | PMLL Weekly Status Reports for LW W4 extraction, reviewing data collected from 16 May 2022 to 25 October (Report #1-24). | Weekly | Available on request | |
| | Transport for NSW (TfNSW) Infrastructure | <ul style="list-style-type: none"> • SMEC • Southern Rail Services • BIS | <ul style="list-style-type: none"> • MSEC | Victoria Street Status Reports for LW W4 extraction, reviewing data collected from 11 May 2022 to 25 October 2022 (Reports #1-24). | Weekly | Available on request | |
| | Main Southern Railway (MSR) | <ul style="list-style-type: none"> • SMEC • Southern rail Services • Bloor Rail • BIS • Comms Network Solutions • Newcastle Geotech | <ul style="list-style-type: none"> • MSEC | MSR Weekly Status Reports for LW W4 extraction, reviewing data collected from 11 May 2022 to 25 October 2022 (Reports #1-24). | Weekly | Available on request | |

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 TARPs (if required).

A summary of monitoring results for relevant TARPs 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 W3-W4 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 4 is only used in the Water Management Plan TARPs.

Table 2-2 Trigger Levels for Railway Features (applicable to Picton-Mittagong Loop Line, Main Southern Railway, Transport for NSW, and Stonequarry Creek Rockbar 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, 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 | March 2022 | April 2022 | May 2022 | June 2022 | July 2022 | August 2022 | September 2022 | October 2022 | November 2022 |
|---------------|----------------------------|---|---|---|---|---|--|---|--|---|---|
| Surface Water | Stonequarry Creek flow | Water Management Plan – Downstream reduction in catchment flow rate in Stonequarry Creek at Picton Gauging Station (GS212053) | NA – Assessment unable to be completed due to invalidation of current model calibration. ¹ | NA – Assessment unable to be completed due to invalidation of current model calibration. ¹ | NA – Assessment unable to be completed due to invalidation of current model calibration. ¹ | NA – Assessment unable to be completed due to invalidation of current model calibration. ¹ | NA – Assessment unable to be completed due to invalidation of current model calibration. ¹ | NA – Assessment unable to be completed due to invalidation of current model calibration. ¹ | NA – Assessment unable to be completed due to invalidation of current model calibration. ¹ | NA – Assessment unable to be completed due to invalidation of current model calibration. ¹ | NA – Assessment unable to be completed due to invalidation of current model calibration. ¹ |
| | Pool water level | Water Management Plan – Impact to pool water level | No pool water level triggers occurred. | No pool water level triggers occurred. | No pool water level triggers occurred. | No pool water level triggers occurred. | No pool water level triggers occurred. | No pool water level triggers occurred. | No pool water level triggers occurred. | NA – Monitoring data for October 2022 to be summarised in next report. | NA – Monitoring data for November 2022 to be summarised in next report. |
| | Stream water quality | Water Management Plan – Stream water quality impact | LEVEL 2 TRIGGERED² Surface water quality triggers occurred at CA (Al), CG (Al), SC2 (Al), SC (Al) and SD (Al). | LEVEL 2 TRIGGERED² Surface water quality triggers occurred at CG (Al), SC2 (Al) and SC (Al). | LEVEL 2 TRIGGERED² Surface water quality triggers occurred at CG (Al), SC2 (Al) and SC (Al). | LEVEL 2 TRIGGERED² Surface water quality triggers occurred at CG (Al). | LEVEL 2 TRIGGERED² Surface water quality triggers occurred at CG (Al), SC2 (Al) and SC (Al). | LEVEL 2 TRIGGERED² Surface water quality triggers occurred at SD (pH). | LEVEL 2 TRIGGERED² Surface water quality triggers occurred at SD (pH). | NA – Monitoring data for October 2022 to be summarised in next report. | NA – Monitoring data for November 2022 to be summarised in next report. |
| | Natural drainage behaviour | Water Management Plan – Impact to pool level, natural drainage behaviour or overland connected flow | NA - Monitoring during March 2022 was unable to be obtained at monitoring site SB (Pool SR17) in Stonequarry Creek due to high water flow over the rockbar. All other sites did not note any impacts to natural drainage behaviour. | LEVEL 3 TRIGGERED³ Natural drainage behaviour trigger occurred at monitoring site SB (Pool SR17) in Stonequarry Creek. | NA - Monitoring during May 2022 was unable to be obtained at monitoring site SB (Pool SR17) in Stonequarry Creek due to high water flow over the rockbar. All other sites did not note any impacts to natural drainage behaviour. | LEVEL 3 TRIGGERED³ Natural drainage behaviour trigger occurred at monitoring site SB (Pool SR17) in Stonequarry Creek. | NA - Monitoring during July 2022 was unable to be obtained at monitoring site SB (Pool SR17) in Stonequarry Creek due to high water flow over the rockbar. All other sites did not note any impacts to natural drainage behaviour. | LEVEL 3 TRIGGERED³ Natural drainage behaviour trigger occurred at monitoring site SB (Pool SR17) and Pool SR20 in Stonequarry Creek. | LEVEL 3 TRIGGERED³ Natural drainage behaviour trigger occurred at monitoring site SB (Pool SR17) and Pool SR20 in Stonequarry Creek. | LEVEL 3 TRIGGERED³ Natural drainage behaviour trigger occurred at monitoring site SB (Pool SR17) and Pool SR20 in Stonequarry Creek. | NA – Monitoring data for November 2022 to be summarised in next report. |
| | Flood levels | Water Management Plan – Impact to flood levels | NR – Flood modelling required after completion of LW W4. | NR – Flood modelling required after completion of LW W4. | NR – Flood modelling required after completion of LW W4. | NR – Flood modelling required after completion of LW W4. | NR – Flood modelling required after completion of LW W4. | NR – Flood modelling required after completion of LW W4. | NR – Flood modelling required after completion of LW W4. | NR – Flood modelling required after completion of LW W4. | NA – Post-mining flood modelling is currently being completed, and the results will be provided in the next Six Monthly Subsidence Impact Report. |
| Groundwater | Groundwater quality | Water Management Plan – Groundwater quality at monitoring bores and private groundwater bores | POTENTIAL LEVEL 4 TRIGGERED⁵ Groundwater quality triggers occurred at P12B (pH upper), P15A (Sr). | POTENTIAL LEVEL 4 TRIGGERED⁵ Groundwater quality triggers occurred at P12B (pH upper), P15A (Sr). | POTENTIAL LEVEL 4 TRIGGERED⁵ Groundwater quality triggers occurred at P12B (pH upper), P15A (Sr). | LEVEL 2 TRIGGERED⁴ Groundwater quality triggers occurred at P12C (Fe, Mn), P14A (Al), P15A (Mn, Li, Sr), P15B (EC, Sr), P15C (EC, Fe, Sr), P15D (EC, Fe, Mn), P16A (pH upper), P16C (Zn, Al) | LEVEL 2 TRIGGERED⁴ Groundwater quality triggers occurred at P12A (Pb, Al), P12B (Fe), P12C (Fe, Mn), P15A (Mn, Li, Sr), P15B (Sr), P15C (Sr), P15D (Fe), P16C (Cu, Zn), GW105228 (Li), GW115860 (EC, Sr) | LEVEL 2 TRIGGERED⁴ Groundwater quality triggers occurred at P12A (Pb, Al), P12B (Fe), P12C (Fe, Mn), P14A (Cu), P14C (Cu), P14D (Fe, Cu), P15A (Mn, Li, Sr), P15B (Sr), P15C (As, Sr), P15D (Fe), P16A (Cu), P16C (Cu, Zn) | LEVEL 2 TRIGGERED⁴ Groundwater quality triggers occurred at P12A (Pb, Al), P12B (Fe), P12C (Fe, Mn), P14A (Cu), P14B (Li, Ba, Sr), P14D (Cu), P15A (Mn, Li, Sr, EC), P15B (EC, Cu), P15C (EC, Al, Sr), P15D (Fe), P16C (Cu, Zn, Al) | NA – Monitoring data for October 2022 to be summarised in next report. | NA – Monitoring data for November 2022 to be summarised in next report. |

| Aspect | Feature | Corresponding Management Plan and TARP | March 2022 | April 2022 | May 2022 | June 2022 | July 2022 | August 2022 | September 2022 | October 2022 | November 2022 |
|---|---|--|--|--|--|--|--|--|--|--|--|
| | Groundwater bore level | Water Management Plan – Groundwater levels at monitoring bores and private groundwater bores | LEVEL 3 TRIGGERED ⁷ Water level trigger occurred at piezometers P12C and P16C. | LEVEL 3 TRIGGERED ⁷ Water level trigger occurred at piezometers P12C and P16C. | LEVEL 3 TRIGGERED ⁷ Water level trigger occurred at piezometer P16C. | LEVEL 3 TRIGGERED ⁷ Water level trigger occurred at piezometer P16C. | LEVEL 3 TRIGGERED ⁷ Water level trigger occurred at piezometer P16C. | LEVEL 3 TRIGGERED ⁷ Water level trigger occurred at piezometer P16C. | LEVEL 3 TRIGGERED ⁷ Water level trigger occurred at piezometer P16C. | NA – Monitoring data for October 2022 to be summarised in next report. | NA – Monitoring data for November 2022 to be summarised in next report. |
| | | | LEVEL 2 TRIGGERED ⁶ Water level trigger occurred at piezometer P16B. | LEVEL 2 TRIGGERED ⁶ Water level trigger occurred at piezometer P16B. | LEVEL 2 TRIGGERED ⁶ Water level trigger occurred at piezometers P12C and P16B. | LEVEL 2 TRIGGERED ⁶ Water level trigger occurred at piezometers P12C and P16B. | LEVEL 2 TRIGGERED ⁶ Water level trigger occurred at piezometers P12C. | LEVEL 2 TRIGGERED ⁶ Water level trigger occurred at piezometers P12C. | LEVEL 2 TRIGGERED ⁶ Water level trigger occurred at piezometers P12C. | | |
| | Shallow groundwater pressures | Water Management Plan – Shallow groundwater pressures at VMPs TNC036, TNC040, and TNC034 | LEVEL 3 TRIGGERED ⁹ Depressurisation trigger occurred at TNC36 (intake 97 mbgl). | LEVEL 3 TRIGGERED ⁹ Depressurisation trigger occurred at TNC36 (intake 97 mbgl). | LEVEL 3 TRIGGERED ⁹ Depressurisation trigger occurred at TNC36 (intake 97 mbgl). | LEVEL 3 TRIGGERED ⁹ Depressurisation trigger occurred at TNC36 (intake 97 mbgl). | LEVEL 2 TRIGGERED ⁸ Depressurisation trigger occurred at TNC36 (intakes 97 and 169 mbgl). | LEVEL 2 TRIGGERED ⁸ Depressurisation trigger occurred at TNC36 (intakes 97 and 169 mbgl). | NA – Monitoring data for September 2022 not available this month. | NA – Monitoring data for October 2022 to be summarised in next report. | NA – Monitoring data for November 2022 to be summarised in next report. |
| LEVEL 2 TRIGGERED ⁸ Depressurisation trigger occurred at TNC36 (intake 169 mbgl). | | | LEVEL 2 TRIGGERED ⁸ Depressurisation trigger occurred at TNC36 (intake 169 mbgl). | LEVEL 2 TRIGGERED ⁸ Depressurisation trigger occurred at TNC36 (intake 169 mbgl). | LEVEL 2 TRIGGERED ⁸ Depressurisation trigger occurred at TNC36 (intake 169 mbgl). | | | | | | |
| Deep groundwater pressures | Water Management Plan – Deep groundwater pressures at VMPs TNC036, TNC040, and TNC043 | LEVEL 2 TRIGGERED ¹⁰ Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl). | LEVEL 2 TRIGGERED ¹⁰ Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl). | LEVEL 2 TRIGGERED ¹⁰ Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl). | LEVEL 2 TRIGGERED ¹⁰ Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl). | LEVEL 2 TRIGGERED ¹⁰ Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl). | LEVEL 2 TRIGGERED ¹⁰ Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl). | NA – Monitoring data for September 2022 not available this month. | NA – Monitoring data for October 2022 to be summarised in next report. | NA – Monitoring data for November 2022 to be summarised in next report. | |
| Landscape | Cliff lines | Land Management Plan – Cliff line damage or instability | NA – No inspection completed in March 2022 due to heavy rainfall. | No signs of cliff line damage or instability | NR – Next quarterly inspection due in July 2022. | NR – Next quarterly inspection due in July 2022. | NA – No inspection completed in July 2022 due to heavy rainfall. | No signs of cliff line damage or instability | NA – No further monitoring is required. | NA – No further monitoring is required. | NA – No further monitoring is required. |
| | Steep Slopes | Land Management Plan – Steep slope damage or instability | NA – No inspection completed in March 2022 due to heavy rainfall. | No signs of cracking or movement on steep slopes near structures in the areas inspected that could be attributed to mine subsidence. | No signs of cracking or movement on steep slopes near structures in the areas inspected that could be attributed to mine subsidence. | NA – No inspection completed in June 2022 due to heavy rainfall. | No signs of cracking or movement on steep slopes near structures in the areas inspected that could be attributed to mine subsidence. | No signs of cracking or movement on steep slopes near structures in the areas inspected that could be attributed to mine subsidence. | No signs of cracking or movement on steep slopes near structures in the areas inspected that could be attributed to mine subsidence. | NR – Next quarterly inspection due in December 2022. | NR – Next quarterly inspection due in December 2022. |
| | Surface cracking | Land Management Plan – Surface cracking (excluding railway corridor) | NA – No inspection completed in March 2022 due to heavy rainfall. | 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 – No inspection completed in June 2022 due to heavy rainfall. | 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. | NR – Next quarterly inspection due in December 2022. | NR – Next quarterly inspection due in December 2022. |
| | Dams | Water Management Plan – Impacts to dams | NA – No inspection completed in March 2022 due to heavy rainfall. | No signs of change to farm dams inspected that could be attributed to mine subsidence. | No signs of change to farm dams inspected that could be attributed to mine subsidence. | NA – No inspection completed in June 2022 due to heavy rainfall. | No signs of change to farm dams inspected that could be attributed to mine subsidence. | No signs of change to farm dams inspected that could be attributed to mine subsidence. | No signs of change to farm dams inspected that could be attributed to mine subsidence. | No signs of change to farm dams inspected that could be attributed to mine subsidence. | NR – Next quarterly inspection due in December 2022. |
| Agricultural Land | Agricultural Land | Land Management Plan – Agricultural land | No signs of change since baseline at sites inspected. | No signs of change since baseline at sites inspected. | No signs of change since baseline at sites inspected. | No signs of change since baseline at sites inspected. | No signs of change since baseline at sites inspected. | No signs of change since baseline at sites inspected. | No signs of change since baseline at sites inspected. | NR – No monitoring required this month. Post-mining monitoring requires quarterly inspections. | NR – No monitoring required this month. Post-mining monitoring requires quarterly inspections. |

| Aspect | Feature | Corresponding Management Plan and TARP | March 2022 | April 2022 | May 2022 | June 2022 | July 2022 | August 2022 | September 2022 | October 2022 | November 2022 |
|---------------------|--------------------------------|---|---|--|--|--|--|--|---|--|---|
| Aquatic Ecology | Macroinvertebrates | Biodiversity Management Plan – Decline or significant negative change in macroinvertebrate indicators. | Monitoring macroinvertebrate indicators are within range of baseline data as supported by statistical analysis. | NR – Monitoring next required in Spring 2022. | NR – Monitoring next required in Spring 2022. | NR – Monitoring next required in Spring 2022. | NR – Monitoring next required in Spring 2022. | NR – Monitoring next required in Spring 2022. | Monitoring macroinvertebrate indicators are within range of baseline data as supported by statistical analysis. | NR – Monitoring next required in Autumn 2023. | NR – Monitoring next required in Autumn 2023. |
| | | Biodiversity Management Plan – Reduction in aquatic habitat through loss of pools or associated reduction in water quality (AURIVAS habitat assessment) | No signs of mining impact resulting in a reduction in aquatic habitat. | NR – Monitoring next required in Spring 2022. | NR – Monitoring next required in Spring 2022. | NR – Monitoring next required in Spring 2022. | NR – Monitoring next required in Spring 2022. | NR – Monitoring next required in Spring 2022. | No signs of mining impact resulting in a reduction in aquatic habitat. | NR – Monitoring next required in Autumn 2023. | NR – Monitoring next required in Autumn 2023. |
| Terrestrial Ecology | Amphibians | Biodiversity Management Plan – Decline in amphibian populations within watercourses of the Study Area | NR – Monitoring next required in Autumn 2022. | No signs of subsidence impacts to amphibian populations. | NR – Monitoring next required in Spring 2022. | NR – Monitoring next required in Spring 2022. | NR – Monitoring next required in Spring 2022. | NR – Monitoring next required in Spring 2022. | NA – Spring 2022 monitoring report not yet available. | NA – Spring 2022 monitoring report not yet available. | NA – Spring 2022 monitoring report not yet available. |
| | Riparian Vegetation | Biodiversity Management Plan – Dieback of riparian vegetation within watercourses of the Study Area | NR – Monitoring next required in Autumn 2022. | No signs of subsidence impacts to riparian vegetation. | NR – Monitoring next required in Spring 2022. | NR – Monitoring next required in Spring 2022. | NR – Monitoring next required in Spring 2022. | NR – Monitoring next required in Spring 2022. | NA – Spring 2022 monitoring report not yet available. | NA – Spring 2022 monitoring report not yet available. | NA – Spring 2022 monitoring report not yet available. |
| Aboriginal Heritage | Grinding grooves, scarred tree | Heritage Management Plan – Aboriginal heritage | NR – No monitoring required till LW W3 is finished. | No signs of change at SR17 (grinding groove site) or scarred tree. | NR – No monitoring required till LW W4 is finished. | NR – No monitoring required till LW W4 is finished. | NR – No monitoring required till LW W4 is finished. | No signs of change at SR17 (grinding groove site) or scarred tree. | NR – No further monitoring is required as mining is complete in the Western Domain. | NR – No further monitoring is required as mining is complete in the Western Domain. | NR – No further monitoring is required as mining is complete in the Western Domain. |
| | SR17 Rockbar | Stonequarry Creek Rockbar Management Plan | YELLOW TRIGGER Detailed visual inspection noted fractures on rockbar. | YELLOW TRIGGER Detailed visual inspection noted fractures on rockbar. | YELLOW TRIGGER Detailed visual inspection noted fractures on rockbar. | YELLOW TRIGGER Detailed visual inspection noted fractures on rockbar. | YELLOW TRIGGER Detailed visual inspection noted fractures on rockbar. | YELLOW TRIGGER Detailed visual inspection noted fractures on rockbar. | YELLOW TRIGGER Detailed visual inspection noted fractures on rockbar. | NA – Monitoring data for October 2022 to be summarised in next report. | NA – Monitoring data for November 2022 to be summarised in next report. |
| | | | BLUE TRIGGER High resolution closure lines across the rockbar noted. | BLUE TRIGGER High resolution closure lines across the rockbar noted. | BLUE TRIGGER High resolution closure lines across the rockbar noted. | BLUE TRIGGER High resolution closure lines across the rockbar noted. | BLUE TRIGGER High resolution closure lines across the rockbar noted. | BLUE TRIGGER High resolution closure lines across the rockbar noted. | BLUE TRIGGER High resolution closure lines across the rockbar noted. | | |
| Historical Heritage | Railway Culverts | Heritage Management Plan | NR – No monitoring required till LW W3 is finished. | LEVEL 3 TRIGGERED ¹¹ LW W2 End of Panel Monitoring confirmed cracking and spalling at sandstone culverts at 88.980 km and 88.400 km exceeds prediction. LW W3 End of Panel Monitoring did not note any additional impacts. | NR – No monitoring required till LW W4 is finished. | NR – No monitoring required till LW W4 is finished. | NR – No monitoring required till LW W4 is finished. | NR – No monitoring required till LW W4 is finished. | NR – No monitoring required till LW W4 is finished. | LEVEL 3 TRIGGERED ¹¹ No any additional impacts to cracking on the portal faces of culverts at 88.980 km and 88.400 km. Cracking inside the barrel of culvert at 88.400 km noted following removal of RCP sleeves, attributed to Western Domain mining. | NR – No further monitoring required. |

| Aspect | Feature | Corresponding Management Plan and TARP | March 2022 | April 2022 | May 2022 | June 2022 | July 2022 | August 2022 | September 2022 | October 2022 | November 2022 |
|----------------------------------|-----------------------------------|---|---|--|--|---|---|--|---|---|---|
| | Weatherboard House | Heritage Management Plan | NR – No monitoring required till LW W4 is finished. | NR – No monitoring required till LW W4 is finished. | NR – No monitoring required till LW W4 is finished. | NR – No monitoring required till LW W4 is finished. | NR – No monitoring required till LW W4 is finished. | NR – No monitoring required till LW W4 is finished. | NR – No monitoring required till LW W4 is finished. | No signs of change at Weatherboard House | NR – No further monitoring required. |
| Built Features | Picton-Mittagong Loop Line | Picton-Mittagong Railway Management Plan | Results are within survey tolerance. Visual inspections did not identify any issues. | Results are within survey tolerance. Visual inspections did not identify any issues. | Results are within survey tolerance. Visual inspections did not identify any issues. | Results are within survey tolerance. Visual inspections did not identify any issues. | Results are within survey tolerance. Visual inspections did not identify any issues. | Results are within survey tolerance. Visual inspections did not identify any issues. | Results are within survey tolerance. Visual inspections did not identify any issues. | Results are within survey tolerance. Visual inspections did not identify any issues. | NA – Monitoring data for November 2022 to be summarised in next report. |
| | Main Southern Railway | Main Southern Railway Management Plan | NA - Results from this month are discussed in the previous Six Monthly Subsidence Impact Report. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | NA – Monitoring data for November 2022 to be summarised in next report. |
| | Electricity Infrastructure | Endeavour Energy Management Plan | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. |
| | Gas Infrastructure | Jemena Management Plan | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. |
| | Potable Water | Sydney Water Potable Water Management Plan | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. |
| | Sewerage Infrastructure | Stonequarry Creek Sewer Management Plan | Minor settlement of backfill material following rainfall and minor erosion hole (not mining related). | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. |
| | Telecommunications | Telstra Management Plan | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. |
| | | NBN Co Management Plan | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. |
| | Local roads, bridges and culverts | Wollondilly Shire Council Management Plan | Impacts to pavement at Connellan Crescent, as well as deterioration of Thirlmere Way road surface (Report 22). Impacts to Carramar Close, Thirlmere Way and other streets due to heavy rainfall (Report 23 for LW W3). | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | Deterioration of Connellan Crescent road surface noted (Report 2), likely due to wet weather. | Deterioration of road curves along Connellan Crescent, Rumker Street and Star Street due to wet weather (Report 5 and 8). | No mining impacts observed in areas monitored this month. | Deterioration of the road surface on Rumker Street noted due to heavy vehicle traffic adjacent to a development site (Report 16). | Deterioration of the road surface along Thirlmere Way due to weather and traffic (Report 18). | No mining impacts observed in areas monitored this month. |
| | Built Structures | Built Structures Management Plan | Impacts to properties on Stonequarry Creek Road and Booyong Close (Report 23) | No impacts observed in areas monitored this month. | No impacts observed in areas monitored this month. | NR – No structures located above LW W4. | NR – No structures located above LW W4. | NR – No structures located above LW W4. | NR – No structures located above LW W4. | NR – No structures located above LW W4. | NR – No structures located above LW W4. |
| Transport for NSW Infrastructure | Transport for NSW Management Plan | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | No mining impacts observed in areas monitored this month. | |

Notes:

NR – Monitoring not required this month.

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

¹ Stonequarry Creek flow assessment unable to be completed due to invalidation of current model calibration as a result of revision of the rating curve for Stonequarry Creek at Picton (GS 212053) in July 2020 and change of streamflow records from December 2015.

² Level 2 TARP for stream water quality (LW W3-W4 Water Management Plan): 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 precipitation that was not observed in the baseline period.

³ Level 3 TARP for natural drainage behaviour (LW W3-W4 Water Management Plan): Rock bar and/or stream base cracking, gas release, or iron precipitation noted during visual inspection (in excess of baseline conditions) AND no reduction in pool water level, drainage or overland connected flow, taking in account climatic conditions and observations during baseline monitoring period.

⁴ Level 2 TARP for groundwater quality (LW W3-W4 Water Management Plan): Short term increase (<3 months) in salinity and/or metals, or change in pH outside of baseline variability. The effect does not persist after a significant rainfall recharge event. AND/OR a similar trend or response has been noted at other monitored bores or private groundwater bores.

⁵ Level 4 TARP for groundwater quality (LW W3-W4 Water Management Plan): Medium to long term increase in salinity and/or metals or a change in pH outside of baseline variability with the effect persisting for greater than 3 months or after a significant rainfall recharge event AND the reduction in water quality is determined not to be controlled by climatic or anthropogenic factors.

⁶ Level 2 TARP for groundwater bore level (LW W3-W4 Water Management Plan): Greater than 2 m water level reduction following the commencement of extraction at LW W1 (and LW W2, W3, W4) AND the reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.

⁷ Level 3 TARP for groundwater bore level (LW W3-W4 Water Management Plan): Water level declines below the water level of TARP Significance Level 3 (calculated as the average of TARP Significance Level 2 and Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4) AND the reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.

⁸ Level 2 TARP for shallow groundwater pressures (LW W3-W4 Water Management Plan): Greater than 5 m water level reduction in VWP intakes located at or above (i.e. shallower than 200 m depth) following the commencement of extraction at LW W1 (and LW W2, W3 and W4) AND the reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.

⁹ Level 3 TARP for shallow groundwater pressures (LW W3-W4 Water Management Plan): Water level declines below the water level of TARP Significance Level 3 following the commencement of extraction at LW W1 (and LW W2, W3 and W4) AND the reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.

¹⁰ Level 2 TARP for deep groundwater pressures (LW W3-W4 Water Management Plan): Calculated or observed drawdown (based on 2009 – 2015 baseline data) for VWP intakes below 200 m depth (excluding those within the Bulli Coal Seam) is within 30 m of predicted (modelled) drawdown.

¹¹ Level 3 TARP for historical heritage (LW W3-W4 Heritage Management Plan): Historical heritage site monitoring indicates environmental consequences to heritage site(s).

2.2 Summary of Actions

During the reporting period, there were eight (8) environmental aspects that were associated with TARP triggers. This section provides a summary of actions resulting from triggers being met in the TARPs, as well as required remediation actions. All triggers have been reviewed by the Environmental Response Group / Structural Response Group / specialists to determine any further actions (if required).

2.2.1 Surface Water Quality TARP – Level 2 Trigger for Surface Water Quality

Background

The following TARP triggers occurred during the current reporting period for surface water quality (refer **Appendix B**):

- Monitoring Site CG – Level 2 TARP trigger for Aluminium in March to July 2022;
- Monitoring Site SC2 – Level 2 TARP trigger for Aluminium in March to May and July 2022;
- Monitoring Site SC – Level 2 TARP trigger for Aluminium in March to May and July 2022; and
- Monitoring Site SD – Level 2 TARP trigger for high pH levels in August 2022, and low pH levels in September 2022.

A detailed discussion of these triggers is provided in the Surface Water Review (refer **Appendix B**), and a summary is provided below.

The elevated concentrations of dissolved aluminium recorded in March to July 2022 occurred during and following above average rainfall. Additionally, a historically high concentration of dissolved aluminium was recorded at reference sites in the same months. These results at the reference sites indicate that the elevated dissolved aluminium concentrations were likely catchment-wide and related to the prevailing climatic conditions.

The variability of pH at monitoring site SD during August and September 2022 was noted to be only slightly above/below the trigger levels. The pH values recorded at monitoring site SD follow a similar trend to the reference sites for the majority of the review period. It is likely that these two consecutive results are an anomaly or a result of field sampling issues including calibration of field instrumentation.

Actions Completed

The following actions have been completed in response to the Level 2 TARP triggers during this reporting period:

- *Continue monitoring as per monitoring program* - monthly monitoring is ongoing according to the monitoring program;
- *Continue monthly review of data including analysis of water quality trend along creek (upstream to downstream) to identify spatial changes* – completed on a monthly basis during the reporting period. Reporting will now be completed on a quarterly basis during the post-mining stage;
- *Convene Tahmoor Coal Environmental Response Group to review response* – completed following the reporting of this data, which included the discussion of these TARP triggers; and
- *Response as defined by Environmental Response Group* – there were no actions regarding this TARP trigger.

Proposed Actions

The current monitoring program will continue in accordance with the LW W3-W4 Water Management Plan.

2.2.2 Natural Drainage Behaviour TARP - Level 3 Trigger for Fracturing

Background

The following TARP triggers occurred during the current reporting period for natural drainage behaviour (refer **Appendix B**):

- Pool SR17 – Level 3 TARP trigger for laminar fracturing on the SR17 rockbar from November 2021. It is noted that due to high water flow in Stonequarry Creek, observation at the rockbar was unable to be made during the March, May and July 2022 monitoring events; and
- Pool SR20 – Level 3 TARP trigger for fracturing on a rockbar at SR20 from August 2022.

A detailed discussion of these triggers is provided in the Surface Water Review (refer **Appendix B** and **Appendix D**), and a summary is provided below.

Pool SR17 was initially reported at a Level 3 TARP trigger on 28 October 2021 due to surficial fracturing of the controlling rockbar (pers. comm. MSEC). Brienens Environment & Safety reported this as laminar fracturing and extension of a natural crack in the rockbar following their inspection on 17 November 2021.

Since the initial observation of the laminar fracturing, no gas release or iron precipitation has been noted during visual inspections. In addition, the continuous water level records and manual water levels indicate that the fracturing of the rockbar has not resulted in an impact to the pool water holding capacity.

Consequently, a Level 3 trigger significance in relation to physical features and natural behaviour of pool SR17 has been derived for this observation (17 November 2021 to current). Further details of this TARP trigger and the actions taken are provided in the previous Six Monthly Subsidence Impact Report (Report #5).

Pool SR20 was reported by Brienens Environment & Safety (BES, 2022) as a Level 3 significance due to surface fracturing (Natural Drainage Behaviour TARP - Rock bar and/or stream base cracking, gas release, or iron precipitation noted during visual inspection (in excess of baseline conditions) AND no reduction in pool water level, drainage or overland connected flow, taking in account climatic conditions and observations during baseline monitoring period), and was first observed on 18 August 2022. No gas release or iron precipitation were observed during the visual inspections and actions completed are discussed below.

Actions Completed

The following actions have been completed in response to the Level 3 TARP triggers during this reporting period:

- *Continue monitoring as per monitoring program* – monthly monitoring has been ongoing during the reporting period, during both the active subsidence period and the post-mining period. The frequency of monitoring going forward will be quarterly during the post-mining monitoring phase;
- *Continue monthly review of data* – completed on a monthly basis during the reporting period. Reporting will now be completed on a quarterly basis during the post-mining stage;
- Convene Tahmoor Coal Environmental Response Group to undertake an investigation to assess if the change in behaviour is related to LW W3-W4 mining effects, other catchment changes or the prevailing climate:
 - Pool SR17 – In response to the Level 3 trigger exceedances in relation to physical features at pool SR17, the Environmental Response Group convened and the surface water level data was reviewed. The water level records for monitoring site SB indicated that the surficial fracturing of the rockbar has not resulted in an impact to the pool water holding capacity. The water levels recorded at monitoring site SB (pool SR17) have not declined below the baseline minimum water level and no atypical water level behaviour was

- recorded at this site between 1 October 2021 and 7 September 2022 (extent of available monitoring data).
- Pool SR20 – In response to the Level 3 trigger exceedances in relation to physical features at pool SR17, the Environmental Response Group convened and surface water level data, pre-mining drone footage and subsidence measurements were reviewed. From a review of pre-mining drone footage, it was determined that one of the fractures was initially observed in July 2019 during pre-mining survey. The water level records for monitoring sites SB (upstream), SC and SD (downstream) indicated that the fracturing has not resulted in an impact to pool water holding capacity. The water level recorded at monitoring sites SB, SC and SD has not declined below the baseline minimum water level between 18 August 2022 (date that cracking was initially observed and 7 September 2022 (extent of available monitoring data). Additionally, MSEC indicated that there was no measurable change in closure associated with the fracturing based on the latest survey.
- *Response as defined by Environmental Response Group* – there were no actions regarding this TARP trigger; and
- *Consider increasing inspection and review of data frequency to fortnightly for sites where Level 3 has been reached* - an increase in the frequency of visual inspections and review of data in relation to pool physical features, natural drainage behaviour and pool water level is not considered to be required at this stage. However monthly visual inspections has continued into the post-mining period, which is an increase in the monitoring frequency for this stage compared to that which has been described in the WMP.

Proposed Actions

The current monitoring program will continue in accordance with the LW W3-W4 Water Management Plan.

2.2.3 Groundwater Quality TARP – Level 2 and 4 Triggers for Groundwater Quality

Background

The following potential Level 4 TARP triggers occurred during the current reporting period for groundwater quality:

- P12B – ‘Potential’ Level 4 TARP trigger for pH from March to May 2022; and
- P15A – ‘Potential’ Level 4 TARP trigger for Strontium from March to May 2022.

A number of Level 2 TARP triggers occurred for groundwater quality (refer to **Table 2-3**). These short-term increases in groundwater quality are considered to be due to natural fluctuations rather than mining related effects.

A summary of the water quality trends for potential Level 4 TARP triggers is provided below. Further discussion of these triggers is provided in the Groundwater Six-Month Report (refer **Appendix C**).

pH at P12B

P12B triggered the upper trigger level for pH between December 2021 and May 2022. A potential TARP Level 4 was identified in March 2022 as four consecutive recordings (greater than three months) were recorded during a period of above average rainfalls. The higher pH at this bore was likely due to an issue with the integrity of the bore, with recent high surface runoff flushing cement/grout into the bore. This was reduced to a TARP Level 1 in June 2022 as the source of the pH increase was determined not to be related to mining but to grout contamination. Since July 2022, pH has reduced within the baseline limit.

Strontium at P15A

Strontium levels at P15A have continually exceeded the trigger of 2.31 mg/L from October 2021 to May 2022 monitoring rounds resulting in a potential TARP Level 4 exceedance. The high strontium concentration at P15A remain localised and unlikely to be a mining related impact though mining was not excluded as a potential cause.

Six months following the potential TARP Level 4 for strontium at P15A, no significant increases were observed at adjacent site P14 and deeper bores at site P15 (concentration of strontium increased by approximately 0.2 mg/L at P15B and P15C in the previous reporting period). Hence the trigger level at P15A for Sr was revised to 4 mg/L in June 2022, as the trigger was assessed to be too conservative for this site.

The concentration of strontium is reported as a TARP Level 2 from June 2022. Strontium concentrations at site P15B and P15C have started to increase above the trigger level in July 2022 however the overall increase to September 2022 is within the range of 0.2 mg/L, considerably less than previously observed at P15A. Actions completed and proposed are detailed below.

Actions Completed

As discussed in **Appendix C**, the following actions were completed in response to the potential Level 4 TARP triggers for this reporting period:

- *Continue monitoring as per monitoring program* - monthly groundwater monitoring is ongoing according to the monitoring program;
- *Continue monthly review of data and consideration of mining and external stresses (in groundwater monthly report)* – completed monthly during the reporting period. Result analysis and reporting will now be completed on a quarterly basis as monitoring has entered the post-mining stage. Analysis of the potential Level 4 TARP triggers is complete, and these trigger levels have been resolved in this reporting period; and
- *Convene Tahmoor Coal Environmental Response Group to review response* - completed following the reporting of this data, which included the discussion of these TARP triggers.

Proposed Actions

The current monitoring program will continue in accordance with the LW W3-W4 Water Management Plan. In addition, the following actions are proposed for groundwater quality investigations:

- At all sites with Level 2 trigger for groundwater quality, to continue monitoring program and a review of water quality data in the next quarterly groundwater report;
- Continue to closely monitor concentrations of strontium at P15A and nearby groundwater monitoring sites and private bores;
- Conduct groundwater purging at monitoring sites P15A and P16C; and
- Convene Tahmoor Coal Environmental Response Group to review response.

2.2.4 Groundwater Bore Level TARP – Level 2 and 3 Triggers for Open Standpipe Piezometer Groundwater Levels

Background

During this reporting period, a number of groundwater intakes in open standpipe piezometers (OSPs) have recorded reduced water level elevation below the baseline range. This was noted in the following OSP intakes (refer to **Appendix C**):

- P12C – Level 3 TARP trigger from March to April 2022, and Level 2 TARP trigger from May to September 2022;

- P16B – Level 2 TARP trigger from March to June 2022; and
- P16C – Level 3 TARP trigger from March to September 2022.

P12C

In the previous reporting period, groundwater levels at P12C had triggered a TARP Level 3. During this reporting period, groundwater levels recovered above the trigger TARP Level 3 (175 mAHD) in May 2022 which reduced the TARP to Level 2 (179.5 mAHD). At the end of the reporting period in September 2022, groundwater levels at P12C were stable at 176.7 mAHD.

P16B

Since July 2022 no groundwater levels have been recorded for P16B due to blockage of the bore. Tahmoor Coal has since unblocked this bore. Groundwater levels were at approximately 205 mAHD in July 2022 and a TARP Level 2 was applied at P16B. A drain to divert surface run-off and resealing of the bore were completed in early November at this location.

P16C

In September 2022, groundwater levels at P16C were observed above the trigger TARP Level 3 (193.9 mAHD). However, as there were discrepancies between groundwater levels (mAHD) from the data logger and the manual measurements since June 2022, showing differences in the range of 3 m, a TARP Level 3 was applied as a conservative measure.

Actions Completed

On 30 December 2020, Level 4 TARP triggers for the reduced water level elevations at P13C, P16B, P16C and TNC036 were notified to DPE and NRAR. This reduction was attributed to mining induced depressurisation of deeper groundwater aquifer, however this also correlated to a reduction in rainfall recharge events.

In light of the Level 4 TARP triggers, Tahmoor Coal have been providing quarterly (3-monthly) monitoring reports for surface water and groundwater as per the request by DPE on 25 June 2021. This Six Monthly Subsidence Impact Report includes this 3-monthly monitoring reporting. These reporting requirements include a review and interpretation of monitoring data, assessment against performance measures and performance indicators for surface water and groundwater, and any recommendations in relation to ongoing monitoring or corrective actions.

The following actions have been completed in light of the Level 2 and Level 3 TARP triggers during this reporting period:

- *Continue monitoring program* - monthly monitoring is ongoing according to the monitoring program;
- *Ongoing review of water level data and consideration of mining and external stresses* – monthly result analysis and reporting was completed during the reporting period. Result analysis and report will now be completed on a quarterly basis as monitoring has entered the post-mining stage;
- *Review relevant surface water level, groundwater level and streamflow data to assess comparative trends* – completed as part of 3-monthly Monitoring Reporting for surface water and groundwater. The next monitoring report will be provided to DPE in February 2023;
- *Compare against base case and deterministic model scenarios* – completed as part of the Groundwater Report (**Appendix C**);
- *Convene Tahmoor Coal Environmental Response Group to review response* – completed on a monthly basis, including the discussion of any groundwater level TARP triggers; and

- *Response as defined by Environmental Response Group* – there were no actions regarding this TARP trigger.

In addition, a drain to divert surface run-off was installed in early November 2022 at P16B and P16C along with re-sealing the monitoring bores so that that no surface water run-off flows into the bore.

Proposed Actions

Groundwater monitoring will continue under the existing monitoring program, and the next 3-monthly Monitoring Report will be provided to DPE in February 2023.

2.2.5 Shallow Groundwater Pressures TARP – Level 2 and 3 Triggers for Shallow Vibrating Wire Piezometer Groundwater Pressure

Background

During this reporting period, a number of groundwater intakes in shallow (<200 mbgl) Vibrating Wire Piezometers (VWPs) have recorded a trend of depressurisation below the baseline range. This trend has been noted in the following VWP intakes (refer to **Appendix C**):

- TNC036 intake 97 mbgl – Level 3 TARP trigger from March to June 2022, and a Level 2 TARP trigger from July to August 2022; and
- TNC036 intake 169 mbgl – Level 2 TARP trigger from March to August 2022.

At TNC036, HBSS-97m groundwater levels triggered a Level 3 TARP from March to June 2022 and gradually recovered above the TARP Level 3 threshold in July 2022 (and therefore moved to TARP Level 2). A TARP Level 2 applies in August 2022 as groundwater levels are observed at 187.2 mAHD still below the threshold for TARP Level 2 (191.3 mAHD).

In HBSS-169m, were observed at 174.2 mAHD in late August 2022. The latest measurement taken on the 31 August 2022 indicated a decline of 12m in groundwater levels to 162.2mAHD. Further monitoring is required to confirm this sudden change against the general trend. As of August 2022, groundwater levels remain below the trigger TARP Level 2 (192.5 mAHD), hence a TARP Level 2 still applies.

Actions Completed

On 30 December 2020, Level 4 TARP triggers for the reduced water level elevations at P13C, P16B, P16C and TNC036 were notified to DPE and NRAR. This reduction was attributed to mining induced depressurisation of deeper groundwater aquifer, however this also correlated to a reduction in rainfall recharge events. The Level 4 TARP triggers observed during this reporting period are a continuation of the trend as previously notified.

In light of the Level 4 TARP triggers, Tahmoor Coal have been providing quarterly (3-monthly) monitoring reports for surface water and groundwater as per the request by DPE on 25 June 2021. This report incorporates the 3-monthly monitoring reporting requirement, including a review and interpretation of monitoring data, assessment against performance measures and performance indicators for surface water and groundwater (Section 4.2 and Section 4.3; Appendix B; Appendix C), and any recommendations in relation to ongoing monitoring or corrective actions (Section 5).

The following actions have been completed in light of the Level 2 and Level 3 TARP triggers during this reporting period:

- *Continue monitoring program* - monthly monitoring is ongoing according to the monitoring program;

- *Ongoing review of water level data and consideration of mining and external stresses* – monthly result analysis and reporting was completed during the reporting period. Result analysis and report will now be completed on a quarterly basis as monitoring has entered the post-mining stage;
- *Compare against base case and deterministic model scenarios* – completed as part of the Groundwater Report (**Appendix C**);
- *Convene Tahmoor Coal Environmental Response Group to review response* – completed on a monthly basis, including the discussion of any groundwater level TARP triggers; and
- *Response as defined by Environmental Response Group* – there were no actions regarding this TARP trigger.

Proposed Actions

Groundwater monitoring will continue under the existing monitoring program, and the next 3-monthly Monitoring Report will be provided to DPE in February 2023.

2.2.6 Deep Groundwater Pressures TARP – Level 2 Trigger for Deep Vibrating Wire Piezometer Groundwater Pressure

Background

During this reporting period, groundwater intakes in deep (>200 mbgl) VWP's have recorded a trend of depressurisation below the baseline range. These trends have been noted in the following VWP intakes (refer to **Appendix C**):

- TNC036 intake 214 mbgl – Level 2 TARP triggered from March to August 2022; and
- TNC036 intake 412.5 mbgl – Level 2 TARP trigger from March to August 2022.

Actions Completed

The following actions have been completed in light of the Level 2 TARP triggers during this reporting period:

- *Continue monitoring program* - monthly monitoring is ongoing according to the monitoring program;
- *Ongoing review of water level data* – monthly result analysis and reporting was completed during the reporting period. Result analysis and report will now be completed on a quarterly basis as monitoring has entered the post-mining stage;
- *Convene Tahmoor Coal Environmental Response Group to review response* – completed on a monthly basis, including the discussion of any groundwater level TARP triggers; and
- *Response as defined by Environmental Response Group* – there were no actions regarding this TARP trigger.

Proposed Actions

Groundwater monitoring will continue under the existing monitoring program.

2.2.7 Historical Heritage TARP – Level 3 Trigger for Sandstone Culvert Impacts

Background

Visual inspections during the previous reporting period noted the development of a number of minor cracks and spalling of sandstone blocks on sandstone culverts at 88.400 km and 88.980 km along the Picton-Mittagong Loop Line. The end of panel inspection confirmed that impacts to the two culverts had triggered a Level 3 TARP trigger for historical heritage in accordance with the LW W1-W2 Heritage Management Plan.

During the current reporting period, it was confirmed that no new impacts to the portal faces of the culverts have been observed during the monitoring throughout the extraction of LW W4, and the end of panel heritage inspection confirmed that no additional cracking, worsening of existing cracks or spalling had occurred (**Appendix E**). A Level 3 TARP trigger remains relevant.

A full inspection of the Picton-Mittagong Loop Line culverts was able to be completed during the LW W4 end of panel inspection as reinforced concrete pipe (RCP) sleeves from the barrel of the culverts had been removed. This inspection noted that several cracks had formed since the commencement of mining in the Western Domain in the barrel of the sandstone culvert at 88.400 km. These cracks were not noted in the pre-mining inspection report by Robinson Rail in July 2019 (refer **Appendix E**).

Cracking on the portal ends of the sandstone culverts at 88.980 km and 88.400 km and the barrel of the culvert at 88.400 km results in a Level 3 TARP trigger due to confirmed mining-related impacts.

Cracking and spalling of the sandstone blocks on these culverts are illustrated in **Figure 2-1**, **Figure 2-2** and **Figure 2-3**.



Figure 2-1 Cracking on the portal ends at culvert 88.400 km. This cracking has not worsened during the mining of LW W4.

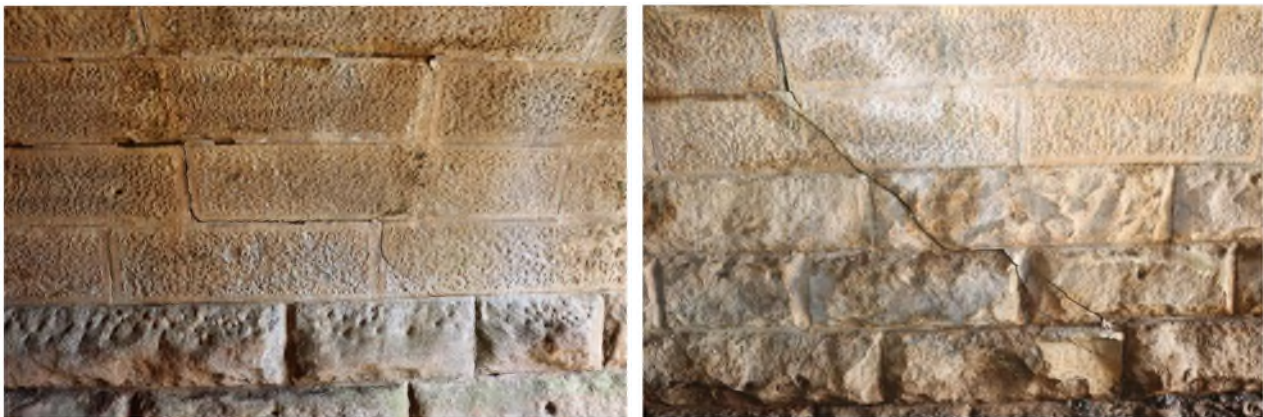


Figure 2-2 Cracking in the barrel of culvert 88.400 km. This cracking has formed during the mining of the Western Domain.



Figure 2-3 Cracking at culvert 88.980 km. Pre-mining (left) and post-mining (right) inspection photographs. Cracking along the mortar and spalling of the arch stones has not worsened significantly during extraction of LW W4.

Actions Completed

As per the Historical Heritage TARP, the following actions have been completed:

- *Continue monitoring program as per monitoring program* - monitoring according to the monitoring program has now finished with the completion of LW W4;
- *Convene Tahmoor Coal Environmental Response Group to review response* – completed on a monthly basis. This TARP trigger was discussed shortly after the identification of the trigger on 14 September 2021. Discussion of the cracking in the barrel of culvert 88.400 km is scheduled for December 2022;
- *Co-ordinate a site inspection with a structural engineer and qualified archaeologist or heritage architect* – completed as part of the LW W2 End of Panel inspection, as well as during the LW W3 End of Panel inspection and LW W4 End of Panel inspection;
- *Investigate exceedance of subsidence prediction* – completed as part of the LW W2 End of Panel Historical Heritage Report;
- *Review mine design / predictions against mine criteria* - completed as part of the LW W2 End of Panel Historical Heritage Report;
- *Review monitoring program and modify if necessary* - completed as part of the LW W2 End of Panel Historical Heritage Report, with no modifications were deemed required;
- *Notify DPE and Heritage NSW within one week of awareness of the event* – Tahmoor Coal notified DPE and Heritage NSW of the trigger via the NSW Major Projects Planning Portal on 21 September 2021. A site visit was undertaken with DPE representatives on 12 April 2022 and a warning letter from DPE was received on 16 May 2022 regarding the breach against Section 4.2(1)(b) of the *Environmental Planning and Assessment Act 1979*. Cracking in the barrel of culvert 88.400 km is likely to be part of the same subsidence impact event that caused the identified cracking on the portal face. Therefore, as the cracking in the barrel is not likely to indicate a new subsidence impact event, no further notification is deemed required; and
- *Investigate and implement any additional management measures as required in consultation with Heritage NSW and DPE* – rehabilitation of the two culverts will be completed following the full effects of LW W4 in accordance with the Transport for NSW (TfNSW) Structures Repair Standard TMC302. A works program for the rehabilitation of the two culverts was submitted to DPE on 10 May 2022, as well as a report on the proposed rehabilitation methodology. Tahmoor Coal also provided the rehabilitation methodology to the Heritage Division of TfNSW on 19 May 2022.

Proposed Actions

In accordance with the LW W3-W4 Heritage Management Plan, monitoring of the sites is no longer required as mining in the Western Domain has been completed.

Tahmoor Coal has approached a number of heritage stonemasons to seek input into the repair methodology for the sandstone culverts. However, to date, no contributions have been received.

Rehabilitation of the two culverts will be undertaken now that the full effects of Western Domain longwall mining has been completed. All repair work on the impacted heritage structures will be completed in accordance with the Transport for NSW (TfNSW) Structures Repair Standard TMC302. Tahmoor Coal has committed to complete remediation by 31 March 2023.

2.2.8 Stonequarry Creek Rockbar TARP – Yellow Trigger for visual inspection and Blue Trigger for High Resolution Closure Lines and Relative 3D Surveys

Background

During this reporting period, a number of triggers continued to occur in accordance with the Stonequarry Creek Rockbar Management Plan TARPs. These TARP triggers included:

- Blue Trigger for extension of High Resolution Closure Lines across the SR17 Rockbar, first observed in October 2021, continued with extensions of HRC-A to HRC-H lines by 1.0 mm to 7.0 mm (Stonequarry Creek Rockbar Status Report 53, **Appendix F**); and
- Yellow Trigger for fractures on the SR17 Rockbar during detailed visual inspection, first observed on 28 October 2021, with fractures noted in the south-east corner of the rockbar. This included a 2 mm wide crack and opening of natural joint near prism RBF02, a 3 mm extension between prisms RBF01 and RBF02, a reduction in the holding water level of a small man-made pond in the rockbar below historical norm, re-emergence of iron staining at times of low water flow, and evidence of vehicle movement by non-Tahmoor Coal constituents across the rockbar on 11 August near the Aboriginal heritage grinding grooves (Stonequarry Creek Rockbar Status Report 53, **Appendix F**).

A copy of the referenced report is provided in **Appendix F**.

Actions Completed

Additional monitoring, inspection and reporting was implemented following the first Blue Trigger for the extension of High Resolution Closure Lines across the SR17 Rockbar, and the Yellow Trigger for observation of fractures in the rockbar.

Geotechnical reviews of the rockbar identified that:

- The fractures occurred in thinly bedded, laminated sandstone and were considered a response to mining related differential compression in combination with the presence of existing delamination in the rockbar surface formed by natural weathering processes;
- There was no evidence of new cracking outside the existing fractured area;
- The extension of the fractured area was associated with a veneer of sandstone sitting on top of competent sandstone;
- The fracturing was considered consistent with subsidence monitoring results and was effectively an extension of the original fracture site; and
- The fracturing provided a release for mining induced stress and was confined to the sheeted sandstone above the competent sandstone.

In addition, no evidence of fracturing was evident at any of the grinding groove sites.

The Technical Committee reviewed the latest observations on 26 September 2022. Monitoring results indicate that little to no measurable change has been observed at the rockbar where the fracturing has occurred. The water level in the small man-made pond is also holding water and has returned to normal level.

Proposed Actions

Based on the findings, the Technical Committee advised on 26 September 2022 that one more survey will be conducted in October 2022, one month after the completion of LW W4 mining. The results of this survey will be provided in the next Six Monthly Subsidence Impact Report.

It was also agreed that no further Technical Committee meetings are required.

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 W3-W4:

- DA 67/98 Modification 5:
- Condition 13A – Performance Measures for Natural and Heritage Features;
- Condition 13E – Performance Measures for Built Features;
- LW W3-W4 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 W3-W4 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 W3-W4 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: <ul style="list-style-type: none"> • More than 10% of pools located within the 600 m Study Area for Natural Features; and/or • Pool SR17. | No Less than 10% of the pools within the Investigative Area have been impacted and the surficial fracturing of the rockbar at pool SR17 and surface cracking of SR20 in Stonequarry Creek has not resulted in an impact to pool water level. Consequently, there is negligible evidence to date of subsidence impacts with environmental consequences greater than minor associated with mining in the Western Domain. | Sections 4.2.2 and 4.2.3 |
| | 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 <i>Note: Post-mining goaf centreline bore data not yet available.</i> | Section 4.2.8 |
| Public Safety (DA 67/98 Condition 13E) | Negligible additional risk**. | <u>Flooding</u> 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 <i>Note: LW W3-W4 mining was completed in September 2022, and post-mining flood modelling is currently being completed. Results will be provided in the next Six Monthly Subsidence Impact Report.</i> | Not applicable |

| Feature | Subsidence Performance Measure | Subsidence Performance Indicator | Subsidence Performance Measure Exceeded? | Section Discussed |
|--|--|---|--|-------------------------|
| Land Management | | | | |
| Public Safety (DA 67/98 Condition 13E) | Negligible additional risk**. | <u>Landscape Features</u> 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 and 4.3.2 |
| 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: <ul style="list-style-type: none"> • 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 4.4.1 and 4.4.2 |

| Feature | Subsidence Performance Measure | Subsidence Performance Indicator | Subsidence Performance Measure Exceeded? | Section Discussed |
|--|---|--|---|-------------------|
| Heritage Management | | | | |
| Heritage sites (DA 67/98 Condition 13A) | Negligible subsidence impacts or environmental consequences**. Negligible loss of heritage value**. | <u>Isolated finds/artefact scatters (AHIMS items)</u> No performance indicators are currently established as impacts are predicted to be negligible. | No <i>Note: The LW W3-W4 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.</i> | Not applicable |
| | | <u>Scarred tree (AHIMS item)</u> This performance indicator will be considered to be triggered if: <ul style="list-style-type: none"> • subsidence monitoring identifies a perceptible tilt increase that places the tree at risk of falling; and/or • subsidence monitoring identifies a perceptible cracking in the tree unrelated to natural weathering or trauma damage | No <i>Note: The LW W3-W4 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 the scarred trees, are limited to cracking in the surface soils which is unlikely to affect the item. Therefore monitoring of this item has not been included in the monitoring program.</i> | Not applicable |
| | | <u>Grinding grooves (AHIMS item)</u> This performance indicator will be considered to be triggered if: <ul style="list-style-type: none"> • 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 4.5.1 |

| Feature | Subsidence Performance Measure | Subsidence Performance Indicator | Subsidence Performance Measure Exceeded? | Section Discussed |
|--|---|--|--|-------------------|
| Heritage Management | | | | |
| Heritage sites (DA 67/98 Condition 13A) | Negligible subsidence impacts or environmental consequences**. Negligible loss of heritage value**. | <u>Main Southern Railway Heritage Items (Mushroom Tunnel, Picton Tunnel, Antill Street Underbridge, Picton Viaduct, Argyle Street Underbridge)</u> This performance indicator will be considered to be triggered if subsidence monitoring identifies cracking of external brick work or physical impacts to the historical heritage values of the structure, measurable tilt or visible perceptible impacts such as subsidence induced cracking, exfoliation, brick movement or brick fall. | No | Section 4.5.2 |
| | | <u>Main Southern Railway Heritage Items (Pedestain overbridge 86.1 km, MSR culverts, Subway 88.133 km, high retaining wall 84.687 km, bridge on Matthews Lane, Prince Street overbridge, Connellan Crescent Overbridge)</u> This performance indicator will be considered to be triggered if subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall. | No | Section 4.5.2 |
| | | <u>Cottage (Weatherboard)</u> This performance indicator will be considered to be triggered if subsidence monitoring identifies damage to external cladding or internal finishes. | No | Section 4.5.2 |
| | | <u>Redbank Uniting Church</u> This performance indicator will be considered to be triggered if subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, brick movement or brick fall. | No | Section 4.5.2 |

| Feature | Subsidence Performance Measure | Subsidence Performance Indicator | Subsidence Performance Measure Exceeded? | Section Discussed |
|---|--|--|--|-------------------------------|
| Heritage Management | | | | |
| | | <u>Rural Landscape – Thirlmere Way</u> This performance indicator will be considered to be triggered if subsidence monitoring identifies visual subsidence, surface cracks. | No | Not applicable |
| | | <u>Rural landscape – Thirlmere Way (local heritage significance)</u> No performance indicators are currently established as impacts are predicted to be negligible. | No | Not applicable |
| Other Aboriginal and heritage sites (DA 67/98 Condition 13A) | Negligible subsidence impacts or environmental consequences**. | <u>Loop line Sandstone culverts (local heritage significance)</u> 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. | Yes Cracking on sandstone culverts at 88.400 km and 88.980 km resulted in exceedance of subsidence performance indicators. DPE and Heritage NSW were notified of this exceedance on 21 September 2021. Tahmoor Coal will complete remediation now that the full effects of LW W3-W4 have been completed. | Sections 2.2.8, 4.5.2 and 4.6 |
| | | <u>Loop line brick culverts (local heritage significance)</u> 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 | Sections 4.5.2 and 4.6 |

| Feature | Subsidence Performance Measure | Subsidence Performance Indicator | Subsidence Performance Measure Exceeded? | Section Discussed |
|---|--|----------------------------------|--|-------------------|
| Built Feature Management | | | | |
| Key Public Infrastructure: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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 |

| Feature | Subsidence Performance Measure | Subsidence Performance Indicator | Subsidence Performance Measure Exceeded? | Section Discussed |
|---|---|----------------------------------|--|-------------------|
| Built Feature Management | | | | |
| Other privately-owned built features and improvements, including farm dams, swimming pools, tennis courts, roads, tracks and fences (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 |
| 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 DPE.

** 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

During the reporting period, the LW W3-W4 Subsidence Monitoring Program have 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 eighteen (18) Global Navigation Satellite System (GNSS) units measuring absolute horizontal and vertical positions in real time installed directly above and adjacent to LW W3-W4.

A summary of all surveys and inspections completed during the reporting period is provided in Figure A and Table 1 of the MSEC1263 LW W4 Subsidence Monitoring Report 20 (refer **Appendix A**). A weekly review of the subsidence survey results during the reporting period has been completed by Tahmoor Coal and MSEC.

Longwall West 4 (LW W4) extraction commenced on 16 May 2022 was completed on 13 September 2022.

Table 4-1 summarises the maximum observed ground movements within the active subsidence zone at the start and end of this reporting period. During the reporting period, a maximum of 897 mm of vertical subsidence relating to the extraction of LW W1-W4 has been recorded along the LW W1-W4 crossline survey.

Table 4-1 Subsidence Monitoring Observations for the start and end of this Reporting Period (source: MSEC, Subsidence Monitoring Report 30, Appendix A)

| | Report 20 (MSEC1263) | |
|--|-------------------------------|--------------------|
| Monitoring Period | 16/05/2022 – 18/11/2022 | |
| Length of extraction | LW W4 completed | |
| Distance travelled by longwall since previous report | NA, longwall completed | |
| Observed Ground Movement Parameters | Maximum Observed Total | Location |
| Subsidence (mm) | 897 | LW W1-W4 Crossline |
| Tilt (mm/m) | 9.8 | LW W1-W4 Crossline |
| Hogging Curvature (km ⁻¹) | 0.35 | LW W1-W4 Crossline |
| Sagging Curvature (km ⁻¹) | -0.33 | LW W3 Centreline |
| Tensile Strain (mm/m) | 1.3 | LW W2 Centreline |
| Compressive Strain (mm/m) | -5.6 | LW W4 Centreline |

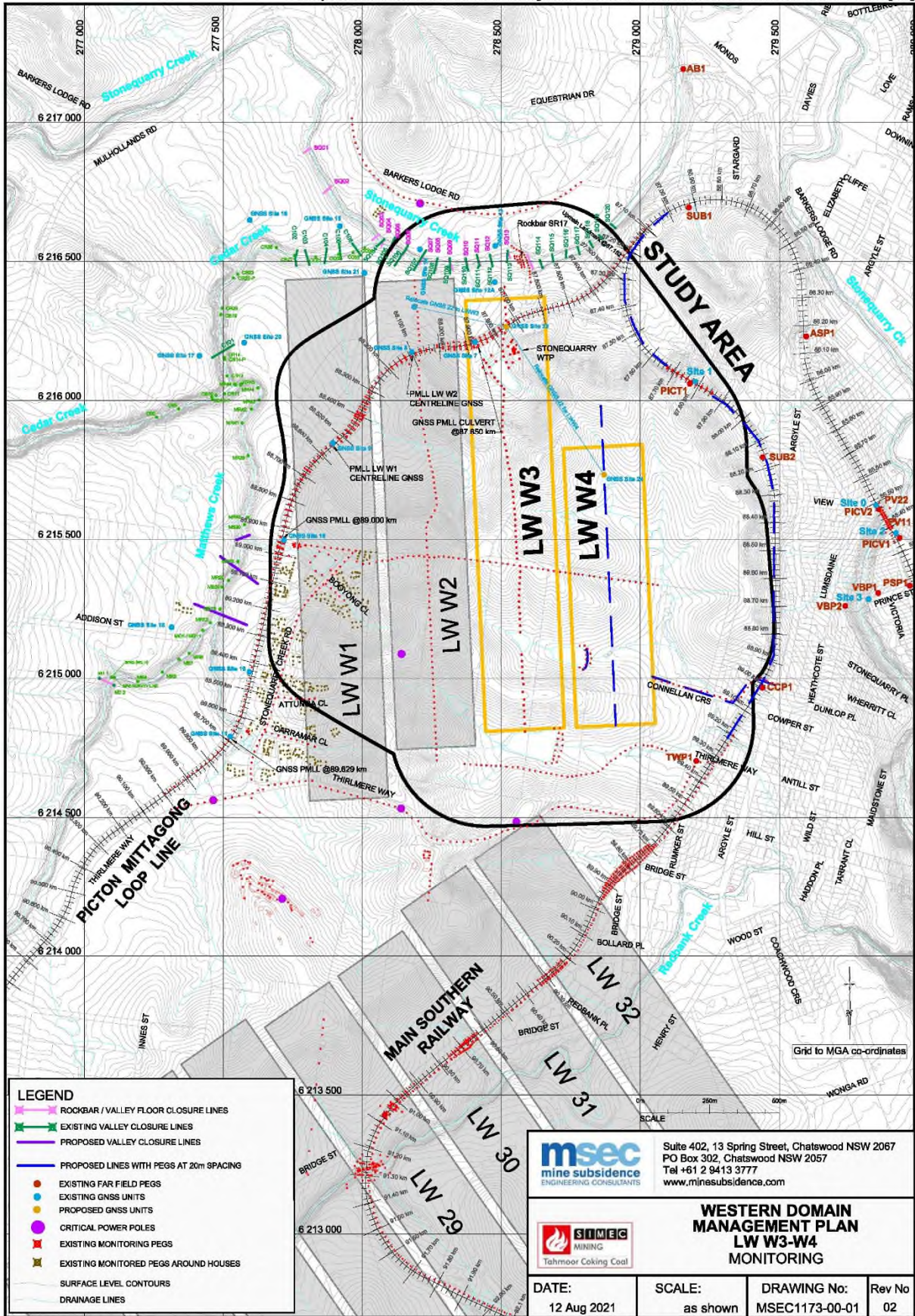


Figure 4-1 LW W3-W4 Subsidence Monitoring Program (source: LW W3-W4 Subsidence Monitoring Program)

4.1.1 Ground Survey Results

The development of subsidence at pegs and GNSS units located on the LW W4 centreline that have been mined directly beneath by LW W4 are illustrated in **Figure 4-2**. Observed subsidence exceeded predicted subsidence above the northern portion of LW W4, however returned to within predictions above the southern portion of LW W4. The subsidence observations above the northern portion of LW W4 is similar to previously observed increased subsidence above LWs 24A to 28 and LW 32, which were influenced by the Nepean Fault. The Nepean Fault is also located close to LW W4, and the potential for increased subsidence was raised in the subsidence prediction report for LW W3-W4 Extraction Plan.

GNSS unit 24 has experienced greater subsidence than predicted and greater subsidence than was previously experienced at equivalent locations during the mining of LW W2 and LW W3.

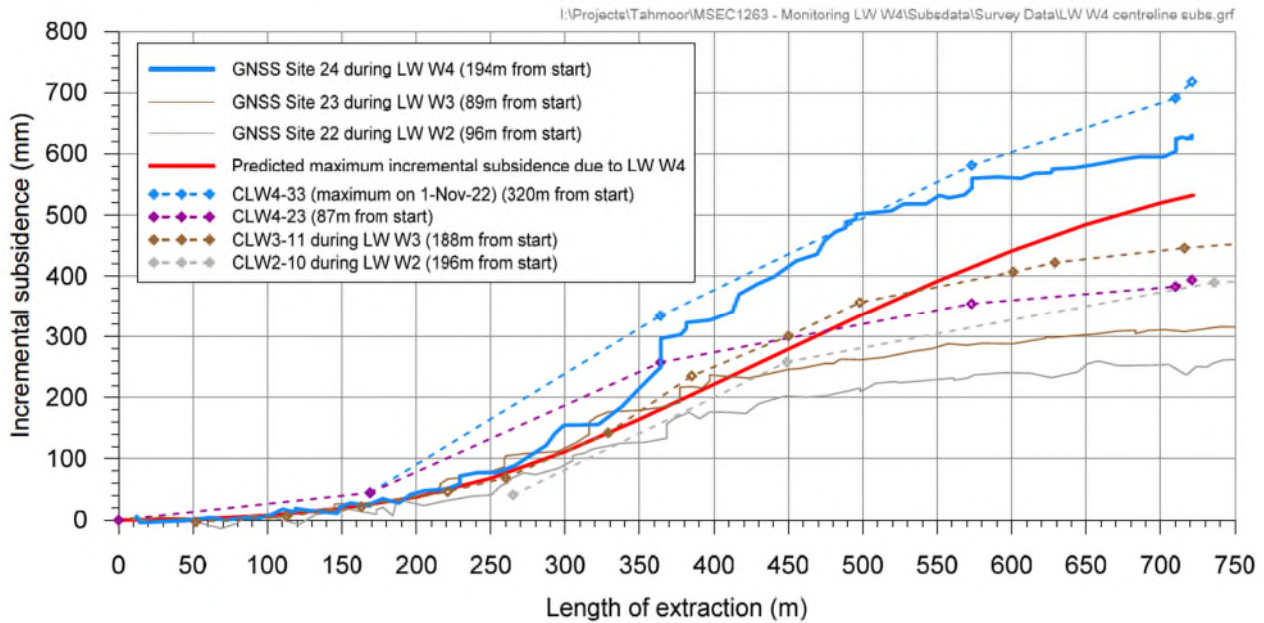


Figure 4-2 Development of subsidence along centreline of LW W4 (source: MSEC, Subsidence Monitoring Report 20, Appendix A)

Regular surveys were conducted along the Picton Mittagong Loop Line during the mining of LW W4, until the end of panel survey completed on 27 October 2022. Visual inspections did not identify any issues associated with mine subsidence.

Regular surveys were conducted along the Main Southern Railway during the mining of LW W4. All results were within survey tolerance during mining, and visual inspections did not identify any issues associated with mine subsidence.

Regular surveys were conducted at the Victoria Bridge over Stonequarry Creek during the mining of LW W4. Very small and gradual closure was observed across Stonequarry Creek. Visual inspections did not identify any impacts associated with mine subsidence but the gap between the deck and the eastern abutment was observed to almost close during the mining of LW W3. The buffer board was replaced on 7 June 2022 and the gap reinstated. A gap of 35 mm was measured between the structural cross beam and abutment on 10 June. The gap has gradually reduced over time to 19 mm. Rates of change are reducing.

A comparison between assessed and observed impacts to surface features is summarised in Table 3 of the MSEC Subsidence Monitoring Report 20 (refer to **Appendix A**).

4.1.2 GNSS Monitoring Observations

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

Changes in horizontal distances between GNSS units stationed near each other and on opposite sides of a waterway as a result of the extraction of LW W1-W4 are shown in **Figure 4-3**. During LW W4 extraction, only minor changes have been observed between the GNSS units.

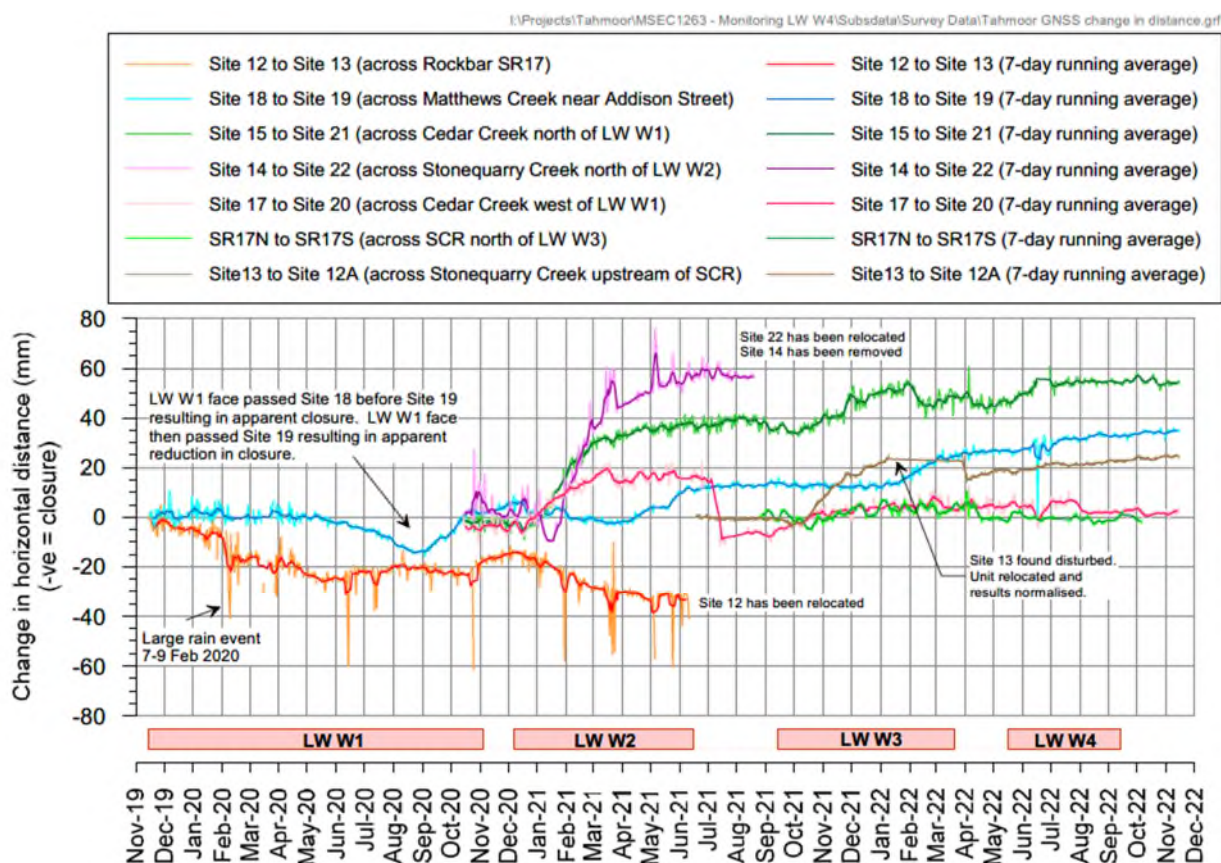


Figure 4-3 Observed changes in horizontal distances between GNSS units during LW W1-W4 extraction (source: MSEC, Subsidence Monitoring Report 20, Appendix A).

4.1.3 Valley Closure in Creeks

Survey marks installed across rockbars in Stonequarry Creek, Cedar Creek and Matthews Creek are illustrated in **Figure 4-1**.

Along Stonequarry Creek, survey at SQ117 to SQ120 was conducted on 10 November 2022 with minor changes observed. At the end of LW W4 survey for Rockbar SR17 (completed on 7 November 2022), minor changes in horizontal distances were observed both along and across the rockbar. Minor ground shortening was also observed in the south-east corner of the rockbar.

Very little change in closure along Cedar Creek and Matthews Creek was observed during the mining of LW W4. The most recent survey was on 21 November 2022 for Cedar Creek and 28 November 2022 for Matthews Creek, with minor changes observed.

4.2 Water Monitoring

The LW W3-W4 Water Management Plan were prepared to manage the potential environmental consequences of LW W3-W4 extraction on surface water and groundwater systems in accordance with Condition 13H(vii)(c) of DA 67/98.

During this reporting period, the LW W3-W4 Water Management Plan have been implemented to monitor the following surface water and groundwater systems:

- Surface Water:
 - Flow, pool water level and surface water quality monitored for Stonequarry Creek, Cedar Creek and Matthews Creek – monitoring data reviewed and reported by ATC Williams (refer to **Appendix B**);
 - Creek monitoring for natural drainage behaviour – visual inspections and reporting by Brienan Environment and Safety (refer to **Appendix D** for references report);
- Groundwater:
 - Shallow groundwater levels, quality and pressures, and deep groundwater levels / pressures – monitoring data reviewed and reported by SLR (refer to **Appendix C** for Six Monthly Report); and
 - Mine water intake – data for this reporting period reviewed and reported by SLR (refer to **Appendix C** for Six Monthly Report).

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

The assessment of downstream reduction in catchment flow rate recorded at the WaterNSW gauging station Stonequarry Creek at Picton (GS212053) relies on a calibrated streamflow model which enabled comparison of modelled and monitored streamflow rates. The locations of GS212053 is illustrated in **Figure 4-4**.

The rating curve for Stonequarry Creek at Picton (GS212053) was revised by WaterNSW in July and November 2020 and, as such, the streamflow records for the site have changed thereby invalidating the previous model calibration. Despite attempts to recalibrate the streamflow model, challenges were encountered due to the limitations of the gauging station at Stonequarry Creek at Picton (GS212053), the limitations of catchment rainfall records, water extraction from Stonequarry Creek catchment and the inability to adequately match the monitored and modelled flows. As such, the assessment method, and subsequently assessment of trigger exceedances in relation to catchment flow rate in Stonequarry Creek at Picton, have been discontinued.

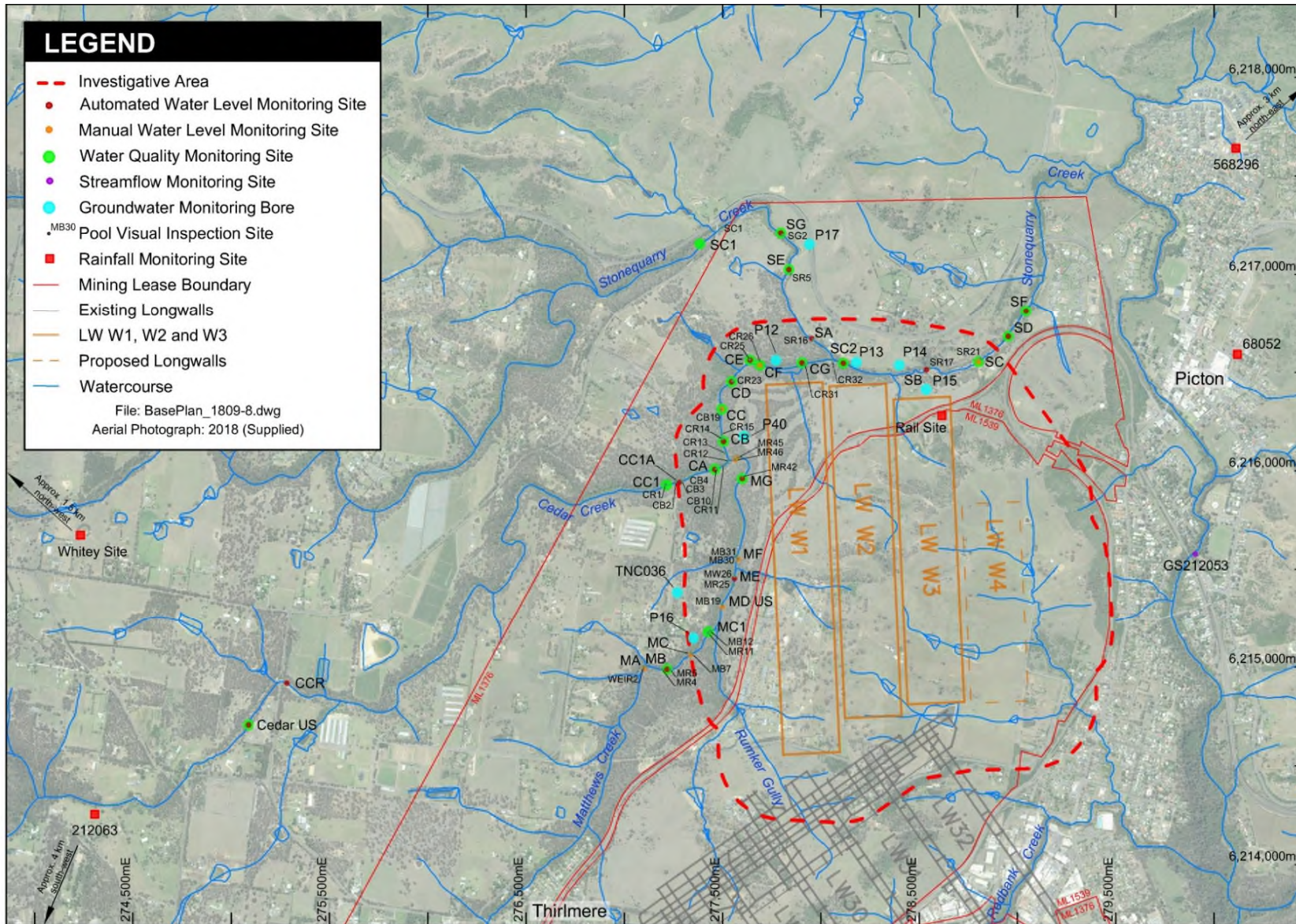


Figure 4-4 LW W3-W4 Surface Water Monitoring Locations (source: ATC Williams, Surface Water Review, Appendix B)

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

During the reporting period, monitoring sites on Matthews Creek, Stonequarry Creek, and Cedar Creek water levels remained above minimum baseline levels and/or consistent with baseline conditions. Charts illustrating monitored pool water level hydrographs for pools on Matthews Creek, Cedar Creek and Stonequarry Creek are presented in Figures B1-25 in Attachment B 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 all monitoring pools on Stonequarry Creek, Cedar Creek and Matthews Creek within the active subsidence zone of LW W4. 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 are carried out to identify rock bar and/or stream base cracking, gas release, or increased iron precipitation.

Creek monitoring locations are illustrated on **Figure 4-5**, and a summary of creek observations for the reporting period is provided below:

- Pool water level and overland connective flow was influenced by a major rainfall event that occurred from late February to early March 2022, as well as during May and July. These rainfall events resulted in catchment base-flow recharge;
- Surficial fracturing of the controlling rockbar at Pool SR17 was noted following the visual inspection on 17 November 2021. The fractures occurred in thinly bedded, laminated sandstone and were likely in response to mining related differential compression in combination with the presence of existing delamination in the rockbar surface formed by natural weathering processes. The formation of fractures resulted in a Level 3 TARP trigger for physical features and natural behaviour of pool SR17. Further information on this TARP trigger and the actions completed and proposed are provided in **Section 2.2.2**;
- Surficial fracturing of a rockbar at Pool SR20 was noted following the inspection on 18 August 2022. Two fractures were noted, being approximately 1 metre long and 1-2 mm wide. The formation of fractures resulted in a Level 3 TARP trigger for physical features and natural behaviour of pool SR20. Further information on this TARP trigger and the actions completed and proposed are provided in **Section 2.2.2**;
- There were no other surface fracturing or cracking noted in the waterways during the reporting period;
- No reduction in pool flow or connective overland flow was observed in the waterways during the reporting period;
- Some minor iron hydroxide precipitation was observed in Stonequarry Creek, Cedar Creek and Matthews Creek during the reporting period, however these levels did not exceed pre-Longwall West 1 baseline levels; and
- No gas release was noted in the waterways during the reporting period.

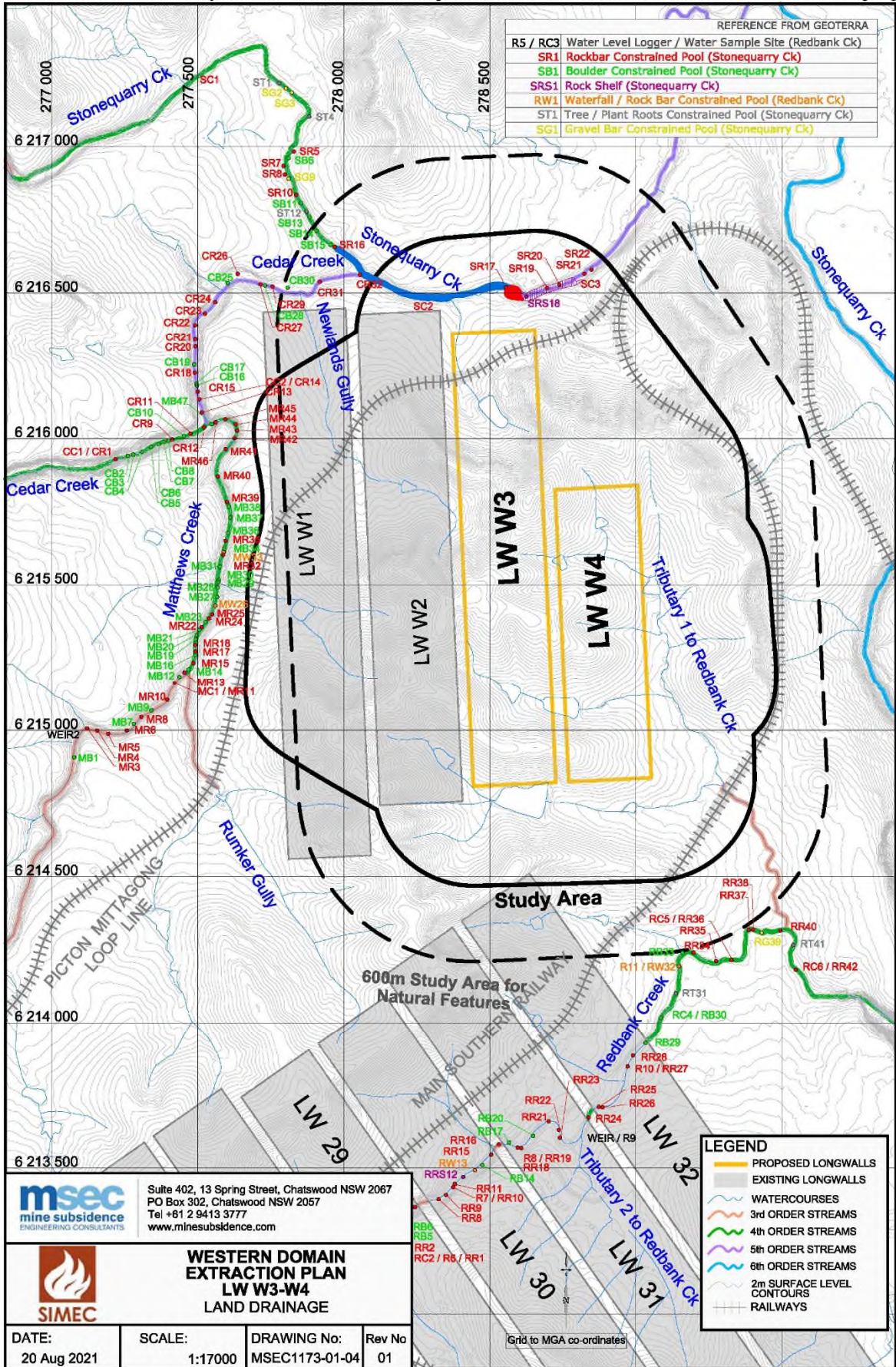


Figure 4-5 LW W3-W4 Creek Monitoring Locations (source: MSEC, 2021; LW W3-W4 Subsidence Predictions and Impact Assessment Report)

4.2.4 Surface Water Quality

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

- Cedar Creek: Cedar US, CC1A, CA, CB, CD, CE, CG;
- Matthews Creek: ME, MB, MG; and
- Stonequarry Creek: SA, SB, SD, SE, SF.

Field analyses are undertaken for pH, electrical conductivity (EC), dissolved oxygen, temperature and oxidation reduction potential. Laboratory analyses are undertaken for pH, EC, TDS, alkalinity, sulphate, chloride, calcium, magnesium, sodium, potassium, fluoride, nitrate+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.

A summary of observations for the reporting period is provided in **Table 4-2**. Charts illustrating water quality results for monitored pools on Matthews Creek, Cedar Creek and Stonequarry Creek are presented in Figures C1-11 in Appendix C of the Surface Water Review (refer to **Appendix B**).

To date, there has been negligible evidence of an influence of mining LW W1-W4 on surface water quality in Matthews Creek, Cedar Creek or Stonequarry Creek. The water quality characteristics of monitoring sites following commencement of mining LW W1-W4 have been largely consistent with baseline conditions and / or consistent with reference site conditions.

Although isolated occurrences of elevated dissolved aluminium were recorded at some monitoring sites on Cedar Creek and Stonequarry Creek during March to September 2022, these levels occurred during and following above average rainfall. Additionally, a historically high concentration of dissolved aluminium was recorded at reference sites during this period, indicating that the elevated dissolved aluminium concentrations were likely catchment wide and related to the prevailing climatic conditions.

Further discussion of the elevated water quality occurrences and related TARP triggers is provided in **Section 2.2.1**.

Table 4-2 Summary of Notable Results for Key Water Quality Parameters for the Reporting Period

| Parameter | Matthews Creek | Cedar Creek | Stonequarry Creek |
|-------------------------|---|---|--|
| pH | <ul style="list-style-type: none"> • Near neutral pH conditions. • Consistent with baseline values. | <ul style="list-style-type: none"> • Near neutral to slightly acidic pH conditions. • Generally higher pH values were recorded during the review period in comparison to the baseline period. | <ul style="list-style-type: none"> • The field pH values indicate near neutral to slightly alkaline pH conditions for most sites. • Historically high pH values were recorded at SD and SF in August 2022 • Historically low pH recorded at SD in September 2022 • The pH values recorded at all other monitoring sites were generally consistent with baseline values |
| Electrical Conductivity | <ul style="list-style-type: none"> • Field EC values were consistent with baseline values. | <ul style="list-style-type: none"> • Field EC values are slightly below the historical range. | <ul style="list-style-type: none"> • Field EC values were slightly less than recorded historically. |

| Parameter | Matthews Creek | Cedar Creek | Stonequarry Creek |
|---------------------|---|---|---|
| Dissolved Aluminium | <ul style="list-style-type: none"> Dissolved aluminium concentrations were elevated in April and August in comparison to the remainder of the review period. The elevated concentrations occurred following a period of above average rainfall. Concentrations were consistent with baseline values (≤ 0.15 mg/L at all sites). | <ul style="list-style-type: none"> Dissolved aluminium concentrations were elevated in April and July-August in comparison to the remainder of the review period. The elevated concentrations occurred following a period of above average rainfall. A historically high concentration of dissolved aluminium was recorded at Cedar US in April and CCR, Cedar US and CF in July. | <ul style="list-style-type: none"> Dissolved aluminium concentrations were elevated and variable for the majority of the review period. The elevated concentrations occurred following a period of above average rainfall. A historically high concentration of dissolved aluminium was recorded at SD, SC and SC1 in May and at SG and SE in July. |
| Dissolved Barium | <ul style="list-style-type: none"> Concentrations generally stable over the review period and consistent with baseline values. | <ul style="list-style-type: none"> Concentrations recorded over the duration of the review period were ≤ 0.2 mg/L at all sites and generally less than baseline values. | <ul style="list-style-type: none"> Dissolved barium concentrations recorded over the duration of the review period were ≤ 0.05 mg/L at all sites and consistent with or less than baseline values. |
| Dissolved Iron | <ul style="list-style-type: none"> Concentrations were slightly elevated for the review period, however were generally consistent with baseline values. | <ul style="list-style-type: none"> Concentrations generally consistent over the review period and with baseline values. | <ul style="list-style-type: none"> A slight decline in the dissolved iron concentration was recorded at all sites during the review period, however, values were generally consistent with baseline values. |
| Dissolved Manganese | <ul style="list-style-type: none"> Concentrations recorded at all sites were consistent with or less than baseline values. | <ul style="list-style-type: none"> Concentrations recorded at all sites were consistent with or less than baseline values. | <ul style="list-style-type: none"> Concentrations recorded at all sites were consistent with or less than baseline values. |
| Dissolved Nickel | <ul style="list-style-type: none"> Concentrations recorded at all sites were consistent with or less than baseline values. | <ul style="list-style-type: none"> Concentrations recorded at all sites were consistent with or less than baseline values with the exception of a historical elevated concentration recorded at Cedar US in August. | <ul style="list-style-type: none"> Concentrations recorded at all sites were consistent with or less than baseline values. |
| Dissolved Zinc | <ul style="list-style-type: none"> Concentrations recorded at all sites were consistent with or less than baseline values. | <ul style="list-style-type: none"> Concentrations recorded at all sites were consistent with or less than baseline values with the exception of a historically elevated value recorded at Cedar US in August. | <ul style="list-style-type: none"> Concentrations recorded at all sites were consistent with or less than baseline values. |
| Sulphate | <ul style="list-style-type: none"> Concentrations recorded at all sites were generally consistent with baseline values. | <ul style="list-style-type: none"> Concentrations recorded at all sites were generally consistent with baseline values. | <ul style="list-style-type: none"> Concentrations recorded at all sites were generally consistent with baseline values. |

4.2.5 Groundwater Quality

A total of 17 open standpipe piezometers (OSPs) have been installed at six locations in the Western Domain – P12 to P17, and a number of private groundwater bores form part of the groundwater monitoring program for LW W3-W4. It is noted that Tahmoor Coal no longer has access to piezometers P13 and P17 due to land access constraints. The locations of these groundwater bores are illustrated in **Figure 4-6**.

Further detail on the above groundwater quality triggers, including graphs showing progressive groundwater quality results for pH, EC and selected metals, are provided in the SLR Groundwater Six-month Review (refer to **Appendix C**). Further detail and discussion of TARP triggers for groundwater quality are also discussed in **Section 2.2.3**.

Electrical conductivity and pH

During this reporting period, four monitoring sites have triggered EC and pH trigger levels:

- P15A, B, C and D – TARP Level 2 trigger for EC;
- GW115860 – TARP Level 2 trigger for EC;
- P16C – TARP level 2 trigger for upper pH; and
- P12B – potential TARP Level 4 trigger reducing to TARP Level 1 trigger in June 2022.

All others EC measurements from the OSPs and private bores are within the Level 1 TARP.

The recovery in groundwater levels at the open standpipes is accompanied with a stable pH and EC across the Western Domain. An increasing trend in EC was noted at site P15A, P15B and GW115860. The cause of the rise in salinity, although minor, remains difficult to assess as baseline data is not available. The beneficial use classifications remain unchanged at the private bore GW115860 and no significant increase in EC was identified along Stonequarry Creek.

Metal concentrations

Most of the exceedances in metal concentrations reported during the review period are short-term increase (less than three months) likely due to above average rainfall conditions during the reporting period or due to limited baseline data resulting in a conservative trigger level. This includes Level 2 TARP triggers as outlined in **Table 2-3**. For further discussion on all Level 2 TARP triggers for this monitoring period, refer to **Appendix C**.

There are no clear trends in metal concentrations that may be linked to mining operations. Recent rise in Zinc at P16C is likely the results of surface water runoff ingress into the bore. At P16B and P16C a diversion drains to divert the surface run-off away from the well heads has been developed in early November as per the previous six-monthly recommendations.

Higher concentrations in Fe at sites P12 are likely due to iron staining in the bore (previously observed at P16 and during bore census conducted by GeoTerra in 2019).

The concentration of strontium stabilised during the reporting period at site P15A piezometer and requires further monitoring although it remains localised as of September 2022 with no significant increases observed at other nearby monitoring sites (i.e. less than 0.3 mg/L increase). The trigger level at P15A for strontium was revised to 4 mg/L in line with the US health benchmark (SLR, 2022). SLR (2022b) investigated the rise as being localised and further information on stratigraphy in this area may assist assessing reasons for the increasing concentrations.

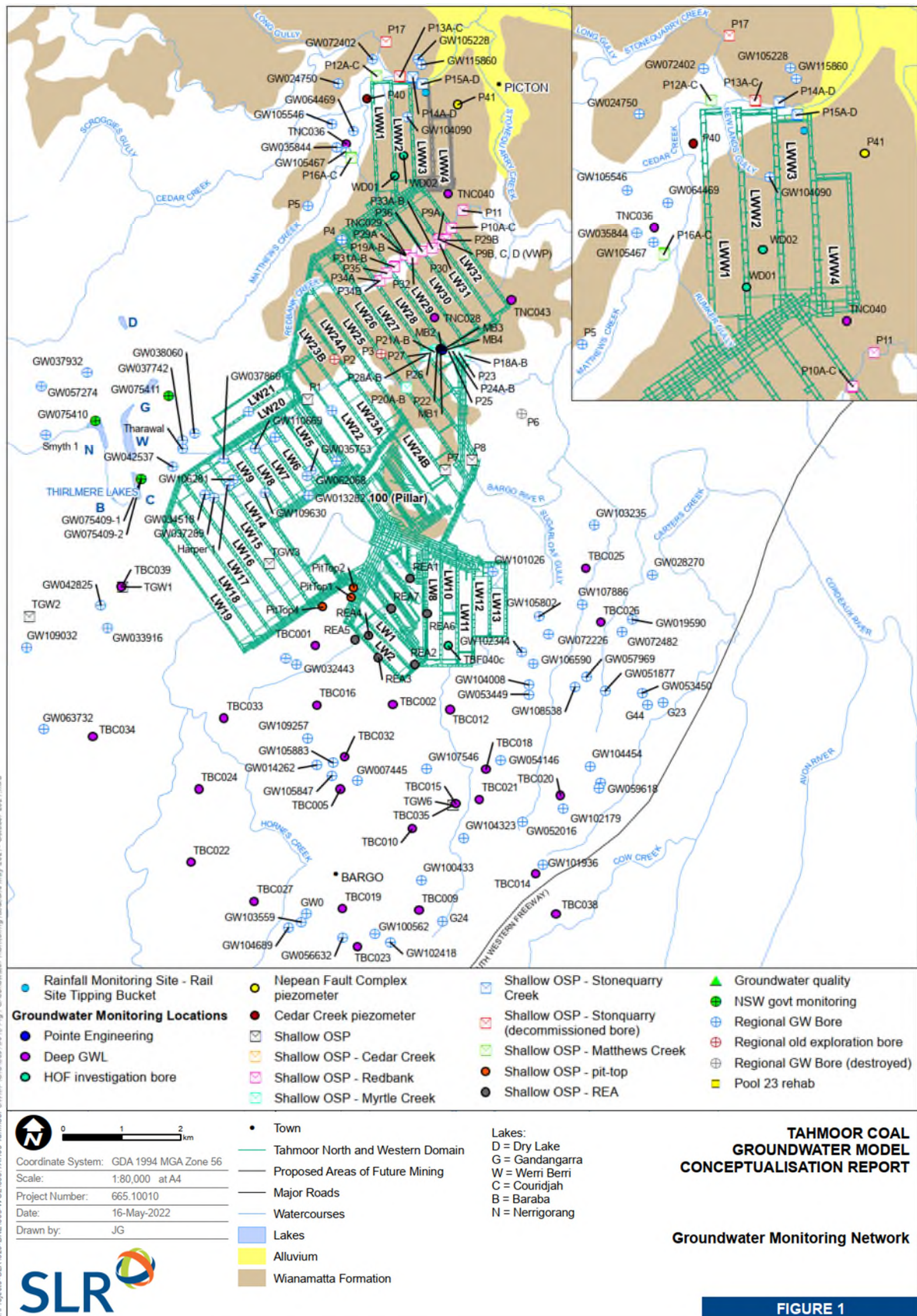


Figure 4-6 LW W3-W4 Groundwater Monitoring Bores (source: Groundwater Six-Month Review, SLR; Appendix C)

4.2.6 Groundwater Bore Levels

A total of 17 open standpipe piezometers (OSPs) have been installed at six locations in the Western Domain – P12 to P17, and a number of private groundwater bores form part of the groundwater monitoring program for LW W3-W4. It is noted that Tahmoor Coal no longer has access to piezometers P13 and P17 due to land access constraints. The locations of these groundwater bores are illustrated in **Figure 4-6**.

Further detail on the below groundwater level triggers, including graphs showing progressive groundwater levels, are provided in the SLR Groundwater Six-month Review (refer to **Appendix C**). Further detail and discussion of TARP triggers for groundwater level are also discussed in **Section 2.2.4**.

Monitoring bores

The following groundwater bore level exceedances occurred during the six-monthly monitoring period in the respective bores (**Appendix C**):

- TARP Level 3 at the shallow open standpipe P12C, reducing to a TARP Level 2 during the reporting period;
- TARP Level 3 at the shallow open standpipe P16C for the reporting period;
- TARP Level 2 at the shallow open standpipe P16B for the reporting period;

All other groundwater monitoring sites remained within TARP Level 1 across the reporting period.

At most of the monitoring sites, groundwater levels have clearly responded to the above average rainfall condition observed throughout April 2022 and early July 2022 (i.e. marked by significant flood events in the region). Potential mining effect in the range of 0.5 m to 3 m water level reduction were observed at some sites in the eastern and southern parts of the Western Domain during the extraction of LW W4.

To the north-west (P12 sites), no mining effect due to LW W3 and LW W4 was observed during the reporting period. Groundwater levels have responded to rainfalls and a change in the local vertical head gradient was observed between the upper and mid Hawkesbury Sandstone (now being upward). The upward vertical gradient was also confirmed to the west and adjacent to LW W1.

A minor decline was observed in the shallow Hawkesbury Sandstone at P40A, either a result of LW W4 and/or delayed post mining effect related to LW W1, W2, or LW W3. This is consistent with previous observations made regarding consistent and minor declines at P14-P15 during the extraction of LW W3. Although minor declines were observed at P40, the overall increase in groundwater levels at P40 and the TARP level 1 at surface water monitoring site CB during the reporting period, confirms that hydrogeological conditions near CB would likely result in increased baseflow to Cedar Creek.

A long-term impact previously identified on shallow groundwater levels at site P16A remains with groundwater levels 0.8 m below baseline levels which is consistent with observations made in the previous six-monthly review. Deeper groundwater levels at this site have also recovered more slowly than at other sites (e.g. P12, P13, P14). This long-term impact remains localised and is possibly related to its position near the centre of the long edge of LW W1.

To the north of LW W3-W4 (sites P14-P15), groundwater levels continued to respond to rainfalls although minor declines (less than 1m) were observed during the early part of LW W4 but could also be associated with lower rainfall in June 2022 and/or aquifer column being close to saturation. However, all groundwater levels remained above or within the approximate creek bed elevation which suggest no baseflow impact (reduction) along Stonequarry Creek in the vicinity of P14-P15 sites.

At P16B and P16C a diversion drains to divert the surface run-off away from the well heads has been developed in early November as per the previous six-monthly recommendations.

Private bores

No groundwater depressurisation or reduction in yield was observed at the private bores with available groundwater levels across the Western Domain. Further data will confirm trends and to identify whether any delayed post mining effects occur.

In terms of yield and groundwater level at the private bores, the following observations are noted over the reporting period:

- GW105228: There was no significant change in groundwater yield at GW105228 that could impede groundwater use during the reporting period. In July 2022, groundwater yield was recorded between 1.1-2.5 L/sec compared to 1.82 L/sec during the baseline period. As of July 2022, groundwater levels were observed within baseline level. TARP Level 1 applies.
- GW115860: There was no significant change in groundwater yield at GW115860 that could impede groundwater use. In July, groundwater yield at this location was recorded at 2.5 L/sec compared to 2.3 L/sec during the baseline period. As of July 2022, groundwater levels were observed within baseline level. TARP Level 1 applies.
- GW105467: This bore is not actively used for groundwater extraction and no site access was possible during the reporting period due to infrastructure access constraints.
- GW105546: There was no site access at GW105546 throughout the reporting period, hence the assessment of trigger assessment exceedances at this location was not possible.
- GW072402: No mining effect on groundwater levels is identified at this location at least until May 2022 (i.e. latest available records). The bore is suspected to be blocked at a depth of approximately 3 m. Further investigation is required to be completed to identify the cause of blockage and options to unblock the bore.

4.2.7 Groundwater Pressures

Five VWP arrays have been installed at locations TNC36, TNC40, TNC43 and WD01 and P41 (refer to **Figure 4-6**). TNC043 is planned to be decommissioned due to site access, and has been removed from the TARP assessment from July 2022.

Further detail on the below groundwater level triggers, including graphs showing progressive groundwater levels, are provided in the SLR Groundwater Six-month Review (refer to **Appendix C**). Further detail and discussion of TARP triggers for groundwater level are also discussed in **Section 2.2.5** and **Section 2.2.6**.

The following groundwater bore level exceedances occurred during the six-monthly monitoring period in the respective bores (**Appendix C**):

- TARP Level 3 at the shallow VWP sensors at TNC036 (HBSS-97m) from March to June 2022, with a reduction to a TARP Level 2 in July 2022;
- TARP Level 2 at the shallow VWP sensors at TNC036 (BGSS-169m) during the reporting period; and
- TARP Level 2 at the two deep VWP sensors at TNC036 (BGSS-214m and BGSS-412.5m) during the reporting period.

LW W4 extraction throughout the reporting period had no significant effects on shallow and deep groundwater across the Western Domain.

To the east of the Western Domain, no depressurisation was observed above and within the Lower Fault Zone at P41 which suggests the unlikely activation of the Nepean Fault during LW W4 (i.e. unlikely increase in hydraulic properties nor increased in aquifers connectivity). In addition, the lack of anomalous behaviour in the inflow hydrograph (i.e. no unexpected and sustained increase in inflow) suggests that the LW W3 and W4 have not interacted with the Nepean Fault Complex (or that the fault complex is not 'hydraulically charged' in this area).

To the south, a mild depressurisation (in the range of 3 m) was observed at TNC040 during August 2022 and likely due to the progression of LW W4 toward this site. TNC040 is located approximately 430 m from the southern edge of LW W4 which makes it the closest groundwater monitoring site to the south. This depressurisation does not appear to be transmitted to the next site located further south (i.e. P9).

At HBSS-97m (TNC036), groundwater levels gradually recovered above the TARP Level 3 threshold in July 2022 and therefore moved to TARP Level 2. A TARP Level 2 applies in August 2022 as groundwater levels are observed at 187.2 mAHD still below the threshold for TARP Level 2 (191.3 mAHD).

At HBSS-169m (TNC036), were observed at 174.2 mAHD in late August 2022. The latest measurement taken on the 31 August 2022 indicated a decline of 12m in groundwater levels to 162.2mAHD. Further monitoring is required to confirm this sudden change against the general trend. As of August 2022, groundwater levels remain below the trigger TARP Level 2 (192.5 mAHD), hence a TARP Level 2 still applies.

Deeper strata at TNC036 (BGSS-214m) shows depressurisation as of September 2022 with an ongoing clear depressurisation in BGSS-412m (i.e. due to Tahmoor Mine and possibly to other regional mining), as expected for deep strata near to a longwall, within a magnitude that exceed the predicted modelled drawdown (+ 15-20 m of observed).

4.2.8 Mine Water Intake

Tahmoor Coal has a Groundwater Licence (WAL 36442) 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 vented in and out of the mine (water in vented air), and moisture in coal extracted from the mine.

SLR completed an analysis of water make for Tahmoor Mine recorded between 1 January 2009 to 30 September 2022 (Appendix C, **Figure 4-7**). Although this water make calculation 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.

The latest observations of water make confirm that during extraction of LW W3 and LW W4 groundwater inflow to the mine stayed within ranges previously observed which suggest that no anomalous inflow to the mine occurred, which was a potential risk related to the faults mapped in the Nepean Fault Complex to the west of LW W4. During LW W3 and LW W4, the average inflow to the mine was 4.2 ML/d and 4.3 ML/d respectively, remaining below the average annual entitlement of 4.5 ML/d.

Groundwater entitlement was not exceeded for the 2021-22 water year and as of September 2022 remain below the limit for the 2022-23 water year (based on a pro-rata calculation).

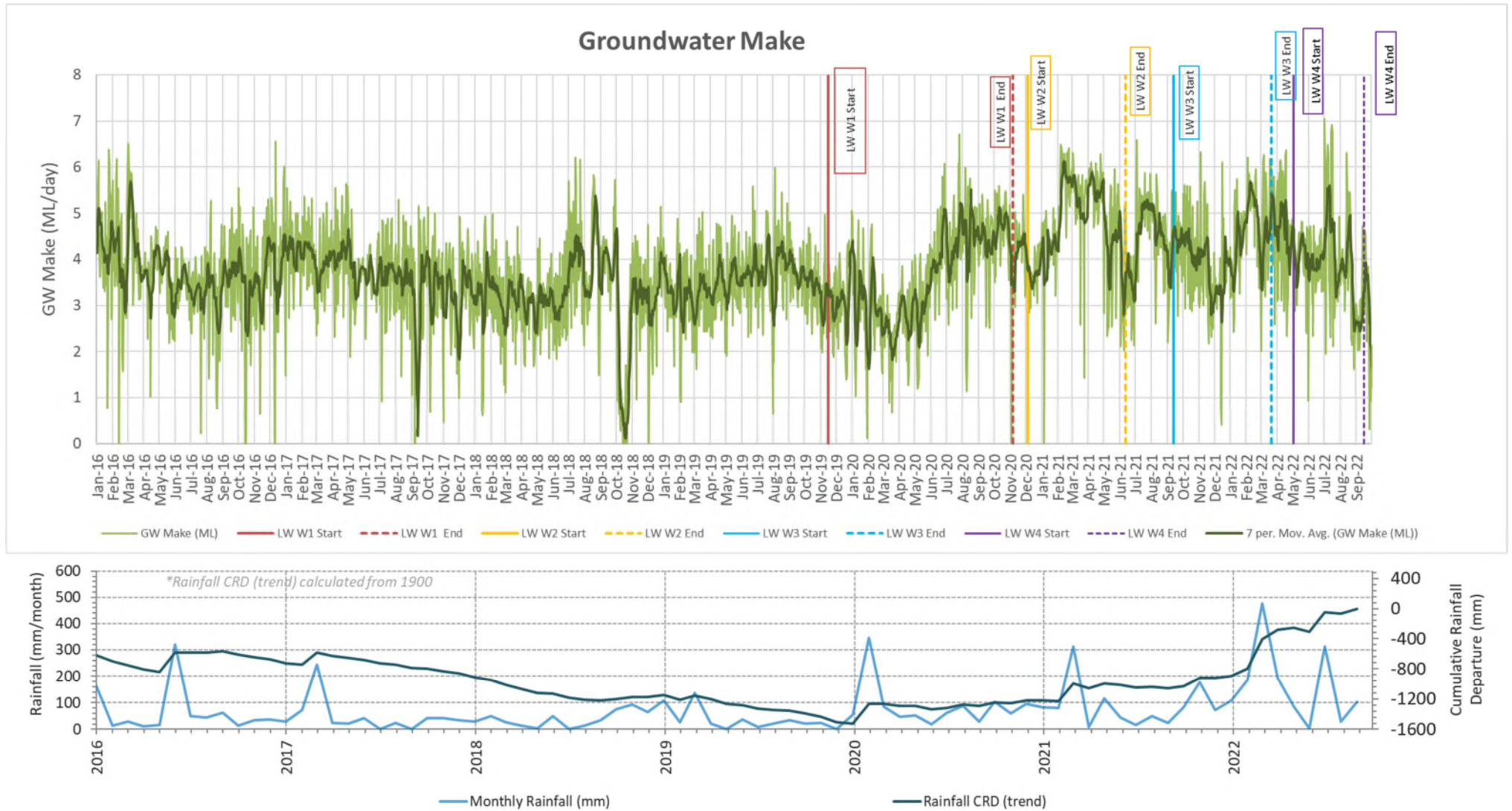


Figure 4-7 Historical record of inflows at Tahmoor Mine (source SLR, Groundwater Monitoring Report, Appendix C)

4.3 Land Monitoring

The LW W3-W4 Land Management Plan was prepared to manage the potential environmental consequences of LW W3-W4 extraction on steep slopes, dams, agricultural land, and land in general in accordance with Condition 13H(vii)(e) of DA 67/98. In addition, monitoring of cliffs and rock outcrops in the LW W1-W2 Study Area in accordance with the LW W1-W2 Land Management Plan was completed as part of post-mining monitoring for LW W2.

During this reporting period, the LW W1-W2 Land Management Plan and LW W3-W4 Land Management Plan have been implemented to monitor the following landscape features:

- Cliffs and rock outcrops – 3-monthly visual inspections and reporting by geotechnical engineers from Douglas Partners;
- Steep slopes, and dams – monthly visual inspections and reporting by geotechnical engineers from Douglas Partners. Where deemed required, the monitoring frequency of selected dams was increased to fortnightly;
- Stonequarry Sewage Treatment Plan retention basin (Dam FD7) – weekly visual inspections and reporting by Newcastle Geotechnical;
- Dams in active subsidence zone – weekly visual inspections and reporting by Building Inspection Services; and
- Agricultural land – monthly visual inspections and reporting by Building Inspection Service.

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 and Rock Outcrops

Visual and photographic surveys for subsidence impacts on cliffs have been completed every three months in accordance with the LW W1-W2 Land Management Plan. The purpose of the surveys is to note any new instabilities in the cliff structures that have occurred since the commencement of LW W1-W2 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 and rock outcrops within the LW W1-W2 Study Area are illustrated in **Figure 4-8**.

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.

As there are no cliffs or rock outcrops within the LW W3-W4 Study Area (refer to **Figure 4-9**), no monitoring of these features has been completed during the extraction of LW W4.

4.3.2 Steep Slopes

Visual and photographic surveys for subsidence impacts on structures near steep slopes have been completed monthly for features within the LW W3-W4 active subsidence zone. The locations of steep slopes within the LW W3-W4 Study Area are illustrated in **Figure 4-9**.

During the reporting period, structures located on Stonequarry Creek Road, Booyong Close, Attunga Close, Carramar Close, Thirlmere Way, Star Street, Connellan Crescent, and the Waste Water Treatment Plant (WWTP) were inspected. There were no signs of distress or changes in the areas inspected that could be attributed to mine subsidence.

4.3.3 Dams

Visual and photographic surveys for subsidence impacts on dams were completed on a weekly and monthly basis of dams within the LW W3-W4 active subsidence zone. The location of dams within the LW W3-W4 Study Area are illustrated in **Figure 4-10**.

During the reporting period, the dams monitored were considered to be within the normal ranges as defined in the TARP for dams.

High rainfall was noted from June 2022 onwards, resulting in water flowing over the spillways of numerous dams including farm dams 1-6, 8, 10, 12-18, and 20. At these dams, wet and boggy conditions were also noted due to overflow from the spillways. Many of the dams in the Study Area were also noted to have sections of subvertical upstream faces, which are probably the result of cattle trafficking the water edges where the dam levels are below full capacity. Shallow soil slumping at some dams were noted to have resulted as a result.

In particular, farm dam 3 (FD3) was noted to progress to localised slumping in the southern spillway cut batter and the upstream embankment face. In September 2022, a larger landslide was noted to be developing in the hillside to the south of the southern spillway. During monitoring, Tahmoor Coal reduced the pond level of FD3 by syphoning method as a precautionary action. This change was not considered to be due to mine subsidence.

None of the above items were considered to be due to mine subsidence. However, due to active mining in the area, monitoring frequency was increased by Douglas Partners (monthly to fortnightly) and Building Inspection Services (weekly to thrice weekly) for selected dams. The monitoring frequency from November 2022 onwards was reduced back to that prescribed in the monitoring program.

4.3.4 Agricultural Land

Visual and photographic surveys for subsidence impacts on agricultural land have been completed monthly at inspection points within the LW W3-W4 active subsidence zone and will be completed on a quarterly basis during the post-mining monitoring period. Inspections points were set up prior to the commencement of LW W3 mining to provide vantage of agricultural land within the LW W3-W4 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 LW W3-W4 Study Area are illustrated on **Figure 4-11**.

During the reporting period, it was noted that seasonal changes had affected vegetation growth, however there were no observable changes to agricultural land in comparison to pre-mining baseline data.

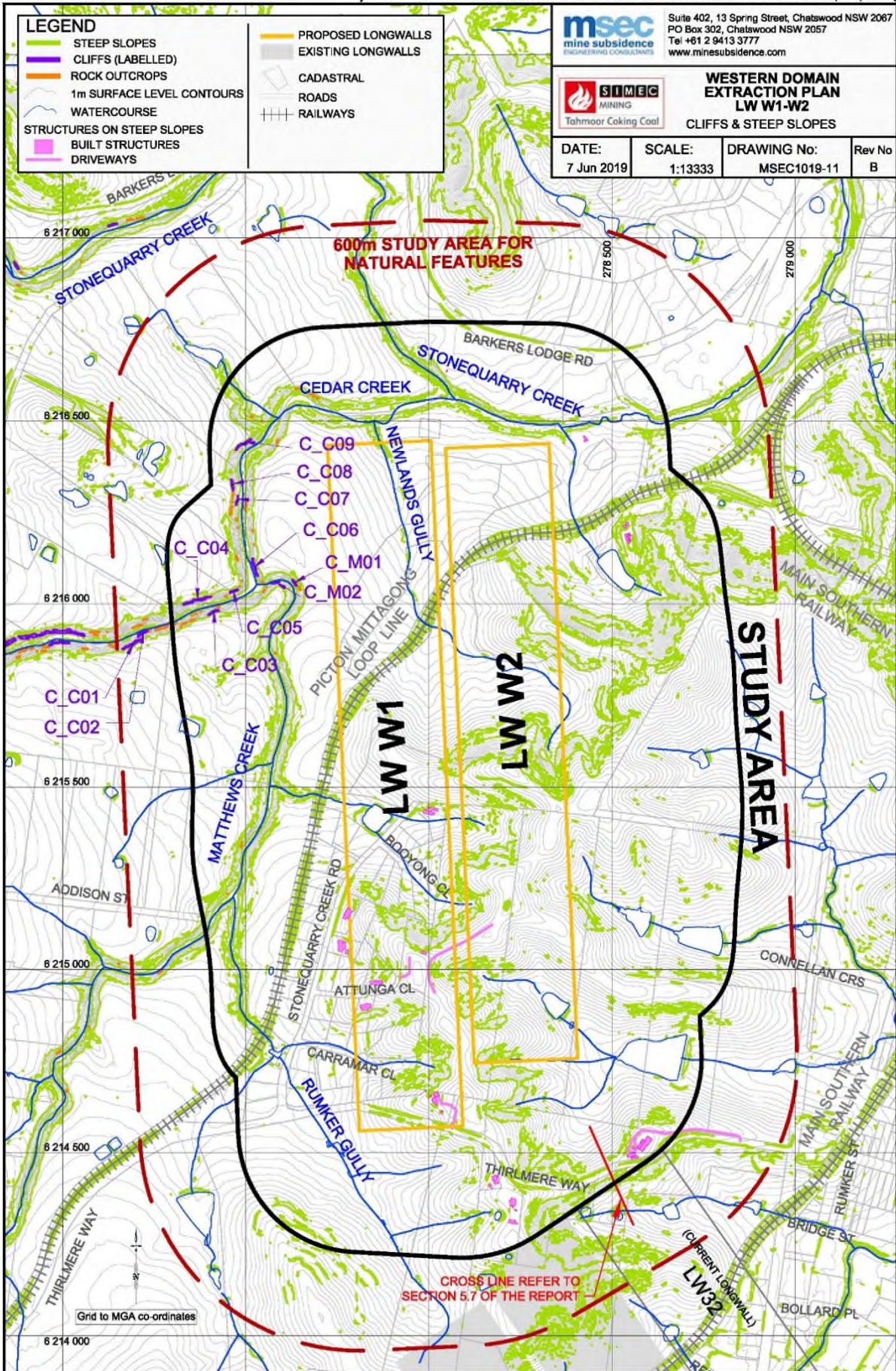


Figure 4-8 Cliffs, rock outcrops and steep slopes within the LW W1-W2 Study Area (source: MSEC, 2019 - LW W1-W2 Subsidence Predictions and Impact Assessment Report)

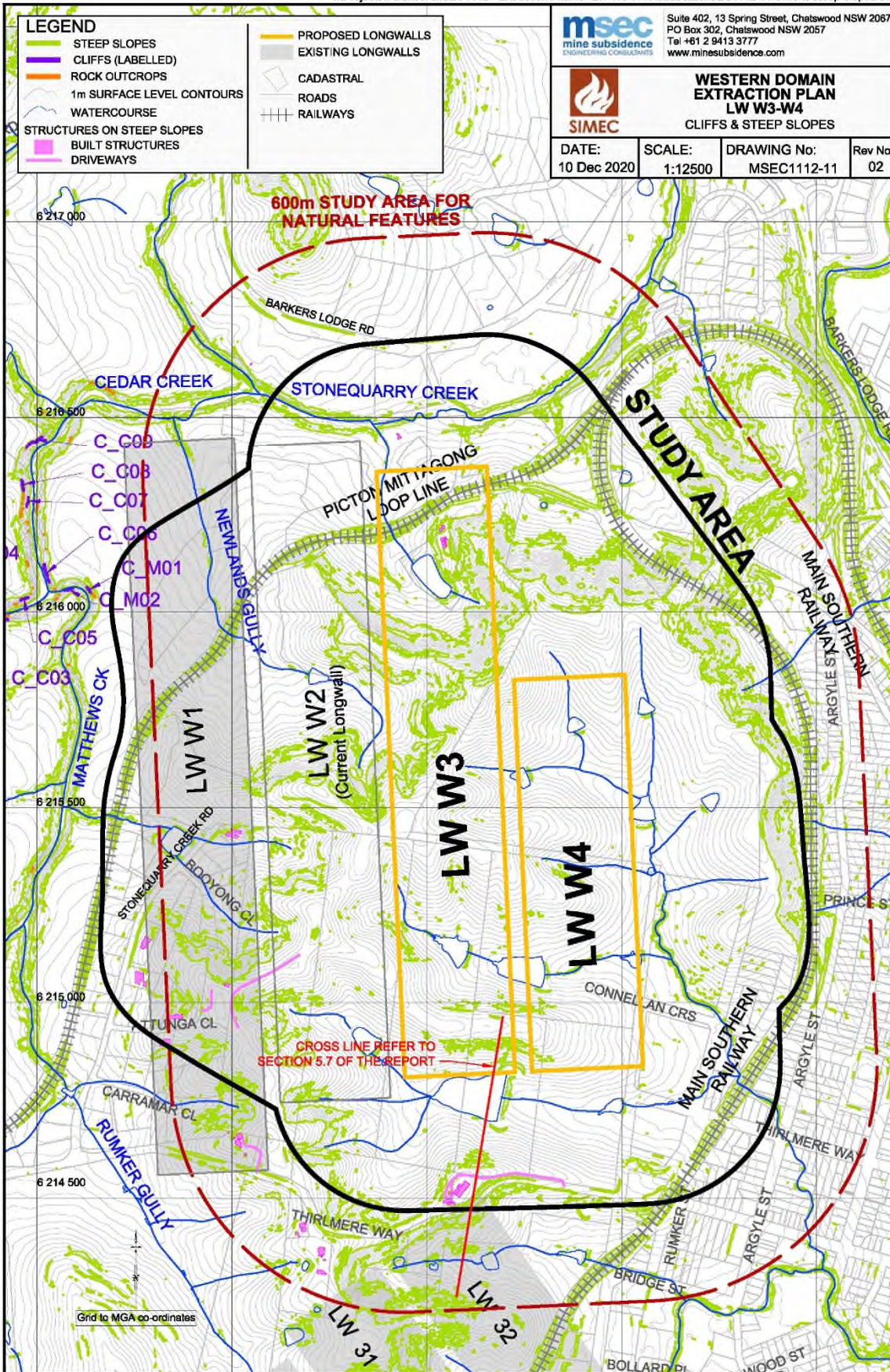


Figure 4-9 Steep slopes within the LW W3-W4 Study Area (source: MSEC, 2021 - LW W3-W4 Subsidence Predictions and Impact Assessment Report)

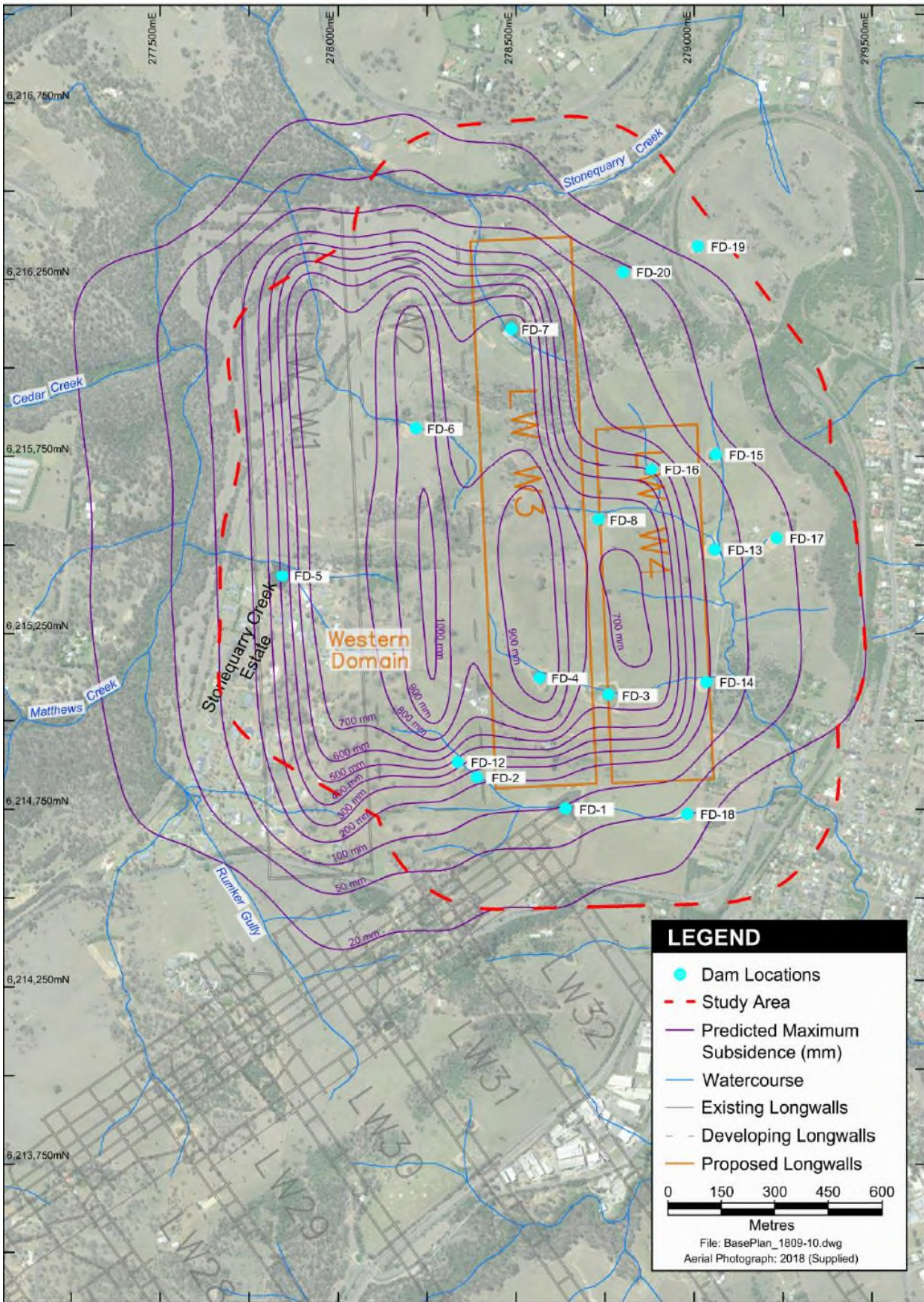


Figure 4-10 Dams within the LW W3-W4 Study Area (source: LW W3-W4 Water Management Plan)

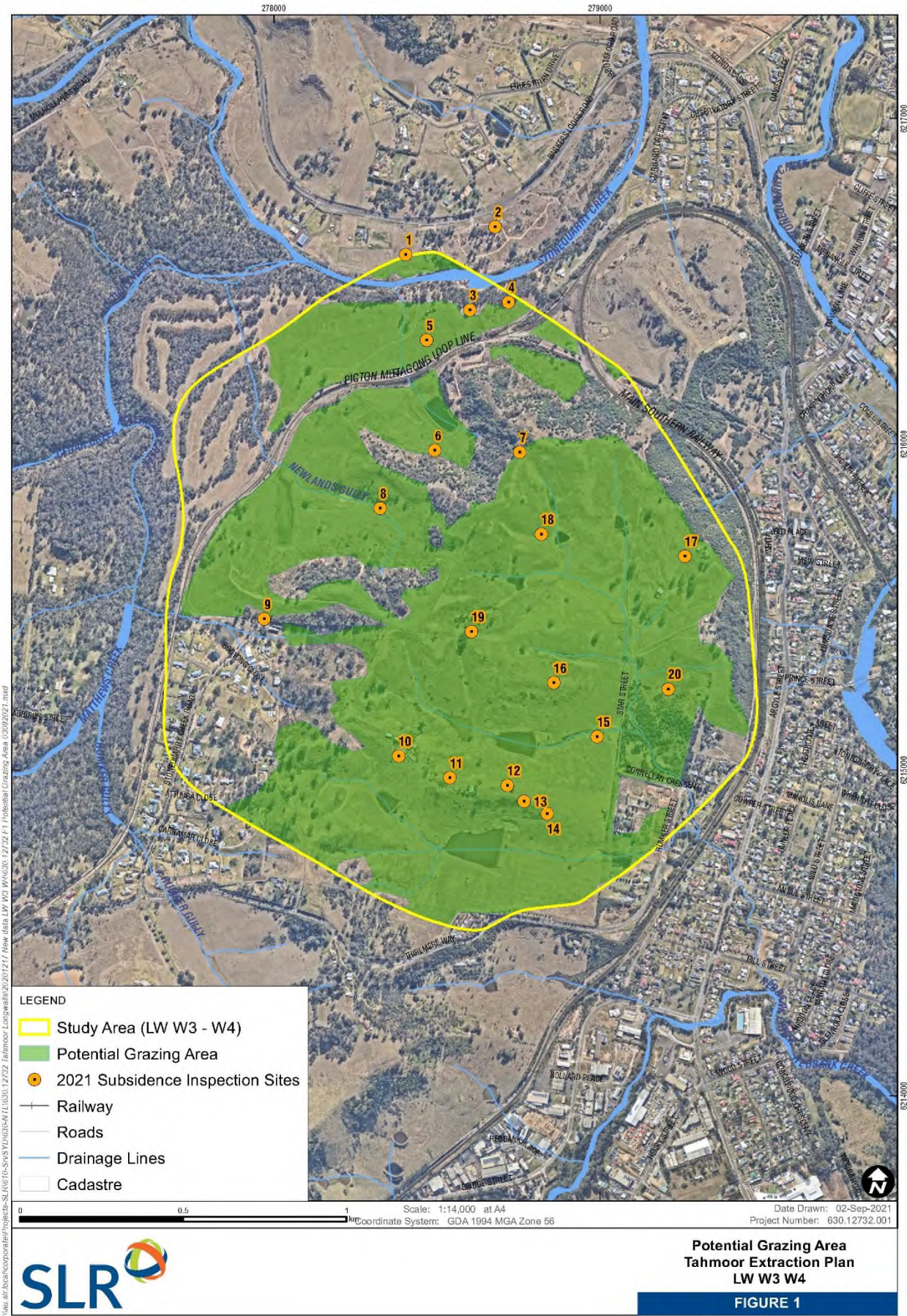


Figure 4-11 Agricultural land and inspection points within the LW W3-W4 Study Area (source: SLR Agricultural Subsidence Monitoring LW W3-W4 Report (SLR, 2021))

4.4 Biodiversity Monitoring

The LW W3-W4 Biodiversity Management Plan were prepared to manage the potential environmental consequences of LW W3-W4 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 W3-W4 Biodiversity Management Plan has been implemented to monitor ecology in the Study Area, as outlined below:

- Aquatic ecology – macroinvertebrate monitoring during Spring 2022 by Niche Environment and Heritage; and
- Terrestrial ecology – amphibian and riparian vegetation monitoring during Spring 2022 by Niche Environment and Heritage. However the monitoring report for terrestrial ecology is not yet available.

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.

4.4.1 Aquatic Ecology

The aquatic ecology monitoring program for LW W3-W4 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;
- 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 sixteen locations were sampled within Stonequarry Creek, Cedar Creek and Matthews Creek comprised of eight impact sites and eight control sites. The locations of monitoring sites are illustrated in **Figure 4-12**.

Spring 2022 Monitoring Results

Aquatic monitoring for spring 2022 was conducted by Niche Environment and Heritage in September 2022. The following results were observed for this monitoring:

- There was aquatic habitat present at all sites in spring 2022.
- All sites had similar RCE condition scores prior to pre-mining sampling, except for a general increase in aquatic habitat.
- AUSRIVAS OE50 scores were generally higher or comparable to pre-mining stream surveys and the previous autumn 2022 survey.
- SIGNAL2 scores were low but were comparable to pre-mining scores and indicated more moderate levels of pollution or environmental stress in spring 2022 than in previous surveys.
- Ephemeroptera Plecoptera Trichoptera (EPT) scores at all sites were similar or slightly increased when compared to pre-mining surveys.

- The number of taxa recorded were within the range of pre-mining results but were generally slightly reduced when compared to recent surveys, which is anticipated in seasons of elevated flows.
- The macroinvertebrate assemblages showed variability spatially (site level) and temporally (between surveys).
- Despite some changes observed spatially and temporally, the quantitative results in spring 2022 did not indicate a deterioration or change in assemblage, density or richness indicative of subsidence impact.
- The results are likely the response to the variability of existing stressors within the catchment and influence of above-average rainfall and flows.

The quantitative macroinvertebrate analysis identified some spatial and temporal differences that indicate changes in the sample reaches, however these changes do not necessarily indicate that mining has caused an impact to the waterway. It is likely that the changes observed are the result of natural variability responding to catchment-scale influences. Additionally, the surface water and ground water monitoring (ATC Williams 2022) and subsidence impact monitoring (Tahmoor 2022) did not identify any ecologically significant changes to the water level, water quality, flow and flow paths, or new physical impacts to the structure of the bedrock within the sample reaches. This indicates that there are unlikely to be subsidence related impacts that could influence stream health at this time.

No thresholds within the Aquatic Ecology TARPs in the LW W3-W4 Biodiversity Management Plan were triggered for Spring 2022 monitoring, and therefore, no remedial management actions are required.

4.4.2 Terrestrial Ecology

The terrestrial ecology monitoring program for LW W3-W4 has been designed to monitor subsidence-induced impacts on terrestrial ecology including riparian vegetation and amphibian monitoring. 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:
 - Spotlighting;
 - Call provocation;
 - Listening for diagnostic frog calls; and
 - Tadpole identification.

In particular, two threatened frog species – the Giant 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 four impact sites and five control sites. The locations of monitoring sites are illustrated in **Figure 4-13**.

Terrestrial monitoring for spring 2022 has been completed by Niche Environment and Heritage, however the report for this monitoring is not yet available. Monitoring results will be shared in the next Six Monthly Subsidence Impact Report.

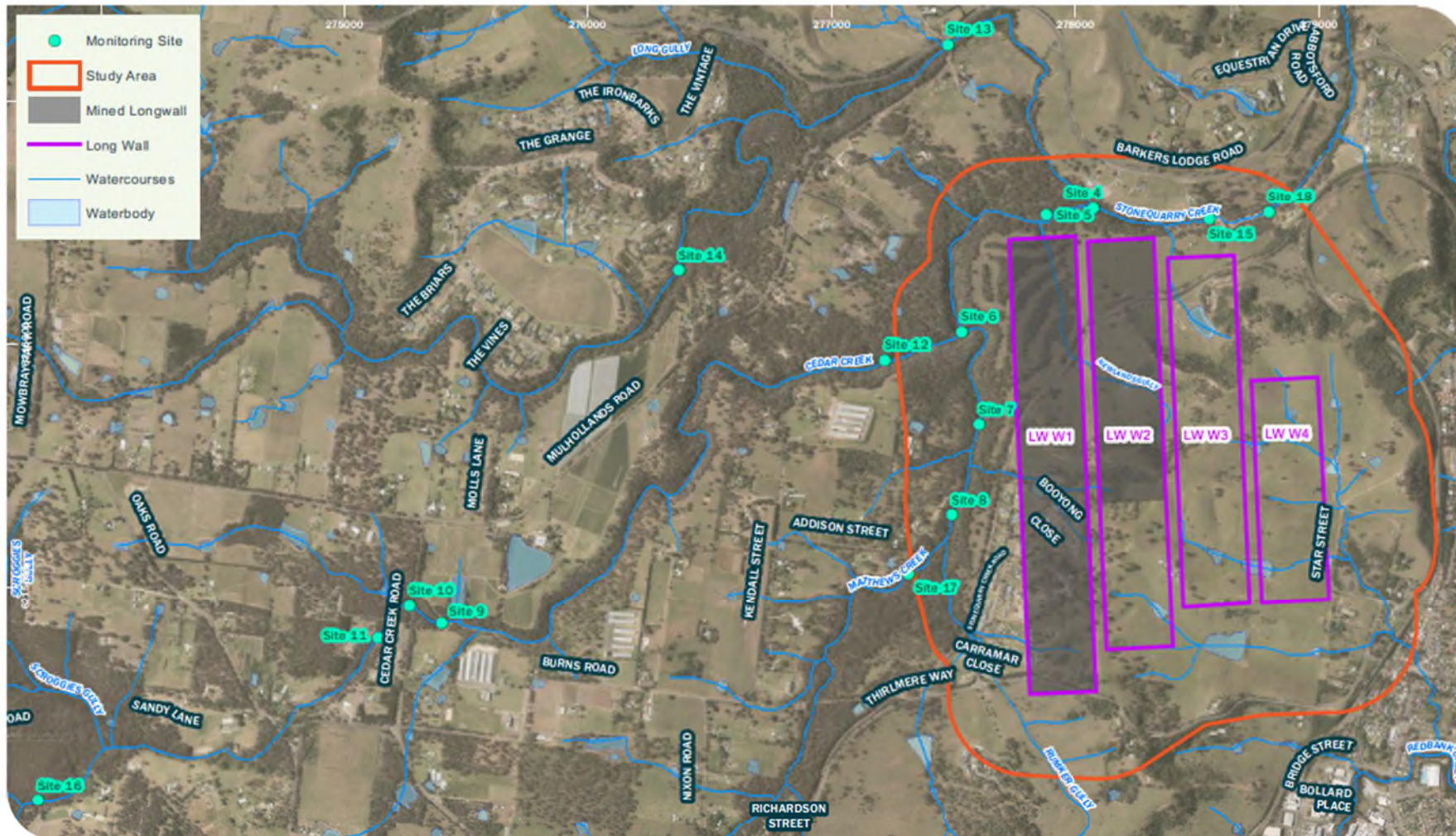


Figure 4-12 LW W1-W4 Aquatic Ecology Monitoring Locations (source: Niche, 2022a)

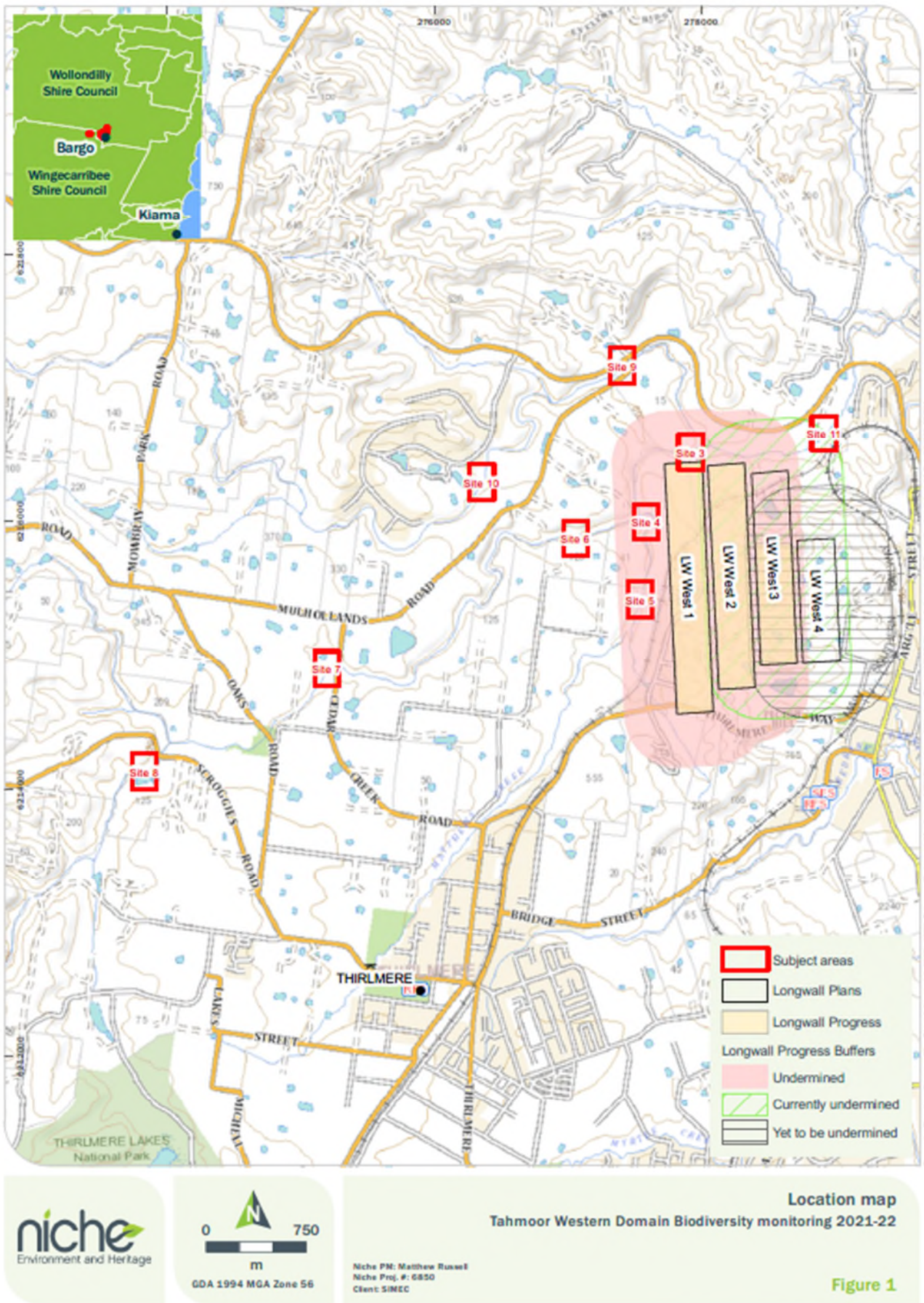


Figure 4-13 LW W1-W4 Terrestrial Ecology Monitoring Locations (source: Niche, 2022b)

4.5 Heritage Monitoring

The LW W3-W4 Heritage Management Plan were prepared to manage the potential environmental consequences of LW W3-W4 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 W3-W4 Heritage Management Plan and the LW W3-W4 Stonequarry Creek Rockbar Management Plan has been implemented to monitor subsidence impacts for the following heritage items:

- Aboriginal heritage:
- Grinding grooves:
- Monthly review of GNSS unit movements by MSEC (refer to **Appendix A** for referenced reports);
- Weekly or monthly monitoring of the SR17 Rockbar in accordance with the Stonequarry Creek Rockbar Management Plan (refer to **Appendix F**);
- End of panel review of items by an EMM Archaeologist and a RAP representative (EMM, 2022a);
- Scarred Tree – end of panel review of items by an EMM Archaeologist and a RAP representative (EMM, 2022a);
- Historical heritage:
- Sandstone and brick culverts along the PMLL:
- Monthly visual inspection by Newcastle Geotechnical; and
- End of panel review of items by an EMM Archaeologist (refer to **Appendix E**; EMM, 2022b; EMM, 2022c).

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

4.5.1 Aboriginal Heritage

Archaeological Item Review

An end of panel monitoring inspection following LW W4 extraction was carried out by an EMM archaeologist and a RAP representative on 23 August 2022, and the findings of this inspection reported in an end of panel report (EMM, 2022a). The focus of the fieldwork was to conduct archaeological monitoring of Aboriginal sites associated with the underground coal mining of LW W4 after completion of its panel extraction in the Tahmoor Mine Western Domain. The locations of Aboriginal heritage items within the Study Area of LW W3-W4 are illustrated in **Figure 4-14**.

In accordance with the subsidence monitoring program, the inspection related to one grinding groove site and one modified tree. The six open artefact sites do not require monitoring.

The grinding groove site (AHIMS #52-2-2068) has been monitored during LW W4 extraction through the GNSS units and various other monitoring strategies as outlined in the Stonequarry Creek Rockbar Management Plan. Two triggers to the Stonequarry Creek Rockbar TARPs were noted during the reporting period, as discussed in **Section 2.2.8**. The Subsidence Technical Committee confirmed that the fracturing was identified approximately 40 m downstream of the nearest grinding groove site on the north-eastern side of the access track. No evidence of fracturing was evident at any of the grinding groove sites.

During the end of panel inspection, no subsidence related impacts were observed to any of the Aboriginal sites inspected, and as such no additional management strategies are required.

4.5.2 Historical Heritage

EMM consultants completed an end of panel monitoring inspection on 11 November 2022 of the eight historical brick and sandstone culverts within the Study Area of LW W3-W4 (**Appendix E**), and an end of panel monitoring inspection on 17 October 2022 of the Weatherboard House (local heritage item listed on the *Wollondilly Local Environment Plan 2011*). The locations of historical heritage items are illustrated in **Figure 4-15** and **Figure 4-16**.

During the extraction of LW W4, the culverts have been continuously monitored at monthly intervals by Newcastle Geotech as part of the subsidence monitoring program.

As discussed in **Section 2.2.7** of this report, visual inspections during the previous reporting period noted the development of a number of cracks and spalling of sandstone blocks on the portal ends of sandstone culverts at 88.400 km and 88.980 km along the Picton-Mittagong Loop Line. In addition, a full inspection of the culverts following the removal of the RCP sleeves noted cracking in the sandstone culvert at 88.400 km that had formed during the extraction of longwalls in the Western Domain. The end of panel inspection confirmed that impacts to the two culverts had triggered a Level 3 TARP trigger for historical heritage in accordance with the LW W3-W4 Heritage Management Plan.

Tahmoor Coal notified DPE and Heritage NSW of the trigger via the NSW Major Projects Planning Portal on 21 September 2021. A site visit with DPE was completed on 12 April 2022. A warning letter from DPE was received on 16 May 2022 regarding the breach against Section 4.2(1)(b) of the *Environmental Planning and Assessment Act 1979*.

Rehabilitation of the two culverts will be undertaken now that the full effects of LW W4 have been completed. A works program for the rehabilitation of the two culverts was submitted to DPE on 10 May 2022, as well as a report on the proposed rehabilitation methodology. All repair work on the impacted heritage structures will be completed as prescribed in the TfNSW Structures Repair Standard TMC302.

Tahmoor Coal has approached a number of heritage stonemasons to seek input into the repair methodology for the sandstone culverts. However, to date, no contributions have been received. Tahmoor Coal provided the rehabilitation methodology to the Heritage Division of TfNSW on 19 May 2022.

During the current reporting period, it was confirmed that no new impacts to the portal ends of the culverts have been observed during the monitoring throughout the extraction of LW W4, and the end of panel heritage inspection confirmed that no additional cracking, worsening of existing cracks or spalling had occurred (**Appendix E**).

No other impacts to historical heritage were observed during this reporting period. An inspection of the Weatherboard House (Item 221 in Schedule 5 of the *Wollondilly Local Environment Plan 2011*) at the end of mining in the Western Domain confirmed that negligible changes to pre-existing cracks and to the overall structure of the weatherboard cottage and garage are likely to have occurred. The buildings remain stable and in generally good condition with no significance changes, impacts to or loss of original fabric or built elements.

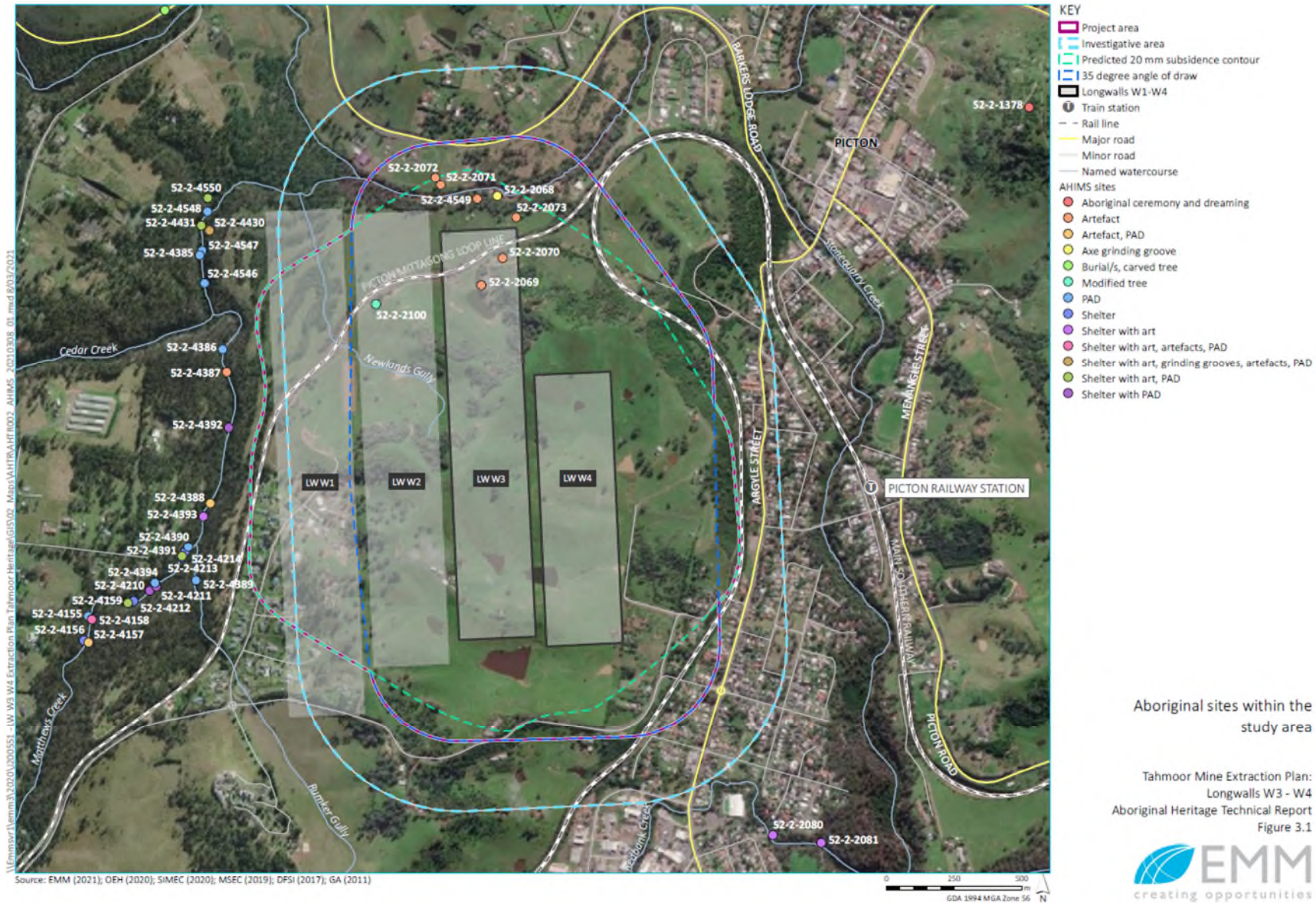


Figure 4-14 Aboriginal heritage Sites in the LW W3-W4 Study Area and Surrounds (Source LW W3-W4 Heritage Management Plan)



Source: EMM (2021); DFSI (2017); GA (2011); DPE (2017)

KEY

- | | | |
|------------------------------------|-----------------------------|-------------------|
| Study area | State Heritage Act | Train station |
| Predicted 20 mm subsidence contour | Conservation Area - General | Rail line |
| Completed longwall | Item - General | Major road |
| Proposed longwall | Item - Archaeological | Minor road |
| Mine plan | | Vehicular track |
| | | Named watercourse |
| | | Waterbody |

Historical heritage items (registered sites)

Tahmoor Mine Extraction Plan: Longwalls W3 - W4
 Historical Heritage Technical Report
 Figure 3.1



Figure 4-15 Historical Heritage Sites (registered sites) in the LW W3-W4 Study Area and Surrounds (Source LW W3-W4 Heritage Management Plan)



Source: EMM (2021); DFS (2017); GA (2011); DPE (2017)

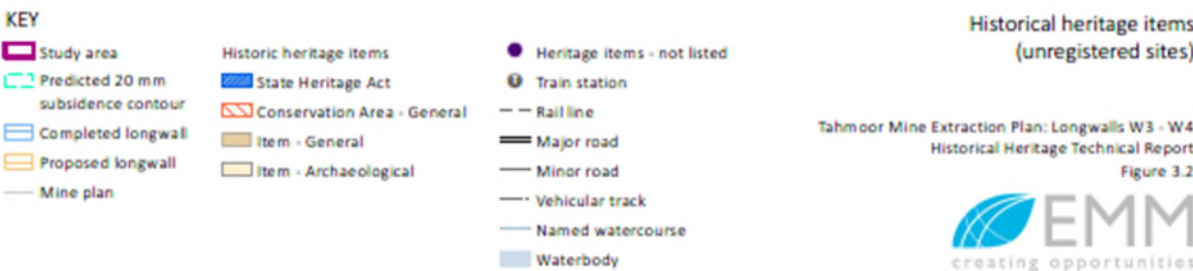


Figure 4-16 Historical Heritage Sites (unregistered sites) in the LW W3-W4 Study Area and Surrounds (Source LW W3-W4 Heritage Management Plan)

4.6 Built Features Monitoring

The LW W3-W4 Built Features Management Plan and associated sub-plans were prepared to manage the potential environmental consequences of LW W3-W4 extraction on built features in accordance with Condition 13H(vii)(b) of DA 67/98.

During this reporting period, the LW W3-W4 Subsidence Monitoring Program have been implemented to monitor subsidence impacts on infrastructure owned by Endeavour Energy (electrical infrastructure), Sydney Water (potable water infrastructure and sewer 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), Weatherboard House (historical building) and private property owners. The details of the Subsidence Monitoring Program are illustrated in **Figure 4-1**.

A weekly 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 weekly and monthly reports, as well performance against all Infrastructure Management Plan TARPs for the reporting period have been summarised in **Table 2-3**.

A comparison between assessed and observed impacts to surface features is summarised in Table 3 of the MSEC LW W3 Subsidence Monitoring Report 20 (refer to **Appendix A**).

A number of impacts to local roads and built structures occurred during the reporting period, however these impacts were related to heavy rainfall and heavy traffic as opposed to subsidence from LW W4 extraction (as discussed in **Section 2.1**).

The two sandstone culverts on the PMLL that have been impacted by subsidence will be remediated.

No triggers were noted on the Main Southern Railway during the reporting period, nor for any other built features during this reporting period.

4.7 Public Safety Monitoring

The LW W3-W4 Public Safety Management Plan were prepared to manage the potential consequences as a result of LW W3-W4 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 and LW W3-W4 Land Management Plan (refer to **Section 4.3** 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 W3-W4 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 Recommendations

5.1 Surface Water Monitoring Recommendations

5.1.1 Current Surface Water Monitoring Recommendations

As discussed in the Surface Water Review for this reporting period (**Appendix B**), the following surface water monitoring recommendations were made by ATC Williams:

- Monitoring site CCR: This site is recommended for decommissioning as the reference bolt has not been located and as such the raw data recorded from 8 December 2021 has not been able to be converted to a water level measurements. In addition, this site is influenced by backwater effects from the downstream weir. Cedar US is considered more of a representative reference site for Cedar Creek;
- Monitoring site CCR: This site is recommended for decommissioning as the flow control at this site, comprised predominantly of sand and rubble, was washed away in recent flood events and is therefore no longer a suitable monitoring site for water level measurements. Two alternative representative reference sites are located on Stonequarry Creek (sites SC1 and SE); and
- Re-calibration of field instrumentation has been recommended due to questionable pH results in the field.

Progress of these recommendations will be provided in the next quarterly surface water and groundwater monitoring report for the Western Domain.

5.2 Groundwater Monitoring Recommendations

5.2.1 Current Groundwater Monitoring Recommendations

As discussed in the Groundwater Review for this reporting period (**Appendix C**), the following groundwater recommendations were made for this reporting period by SLR:

- Ongoing monthly collection and quarterly analysis of monitoring data post mining: monthly monitoring and quarterly analysis of surface water and groundwater level and water quality data recorded in the vicinity of the Investigative Area and at upstream reference sites should continue to be undertaken and the investigation findings updated to incorporate additional monitoring data and analysis findings (HEC, 2021). The surface water and groundwater monitoring data should continue to be assessed in accordance with the TARP, as documented in the WMP;
- If surface water exceedances at site SC (SC3) are identified following mining of LW W4, groundwater levels at site P41C could be used to infer groundwater levels beneath site SC, or sites SD and SF further downstream, acknowledging that the distance from the piezometers and the creek reduces reliability, but these piezometers provide the best data to assess the potential exceedance. Observed groundwater levels were used in the past to identify or infer potential change in groundwater-surface water interaction at surface water monitoring sites. Extrapolation of groundwater levels from piezometers P41C-D could be used to assess possible groundwater-surface water interactions prior to, during and post-mining of LW W4;
- Analysis and incorporation of post-mining groundwater level data from proposed new VWP borehole WD02 above LW W2 and establish trigger level for groundwater levels for each VWP pressure sensor. Identify any exceedances in groundwater level at this site related to mining and consider implication regarding height of fracturing;

- Confirm the installation depth of the pump at GW104090 and conduct work on the suspected blockage of bore GW072402. This recommendation was also made in the previous quarterly groundwater report, and is discussed in **Section 5.2.2**;
- Conduct groundwater purging at monitoring sites P15A and P16C in relation to higher strontium and zinc concentrations respectively. This recommendation was also made in the previous quarterly groundwater report, and is discussed in **Section 5.2.2**; and
- Continue to monitor and review groundwater quality and groundwater level, as per the monitoring program. In particular, close attention will be paid to groundwater level at P16B, P16C, TNC036 (HBSS-97m and BGSS-169m), and all sites associated with a Level 2 TARP trigger for groundwater quality;
- Continue to closely monitor concentrations of strontium at P15A and nearby groundwater monitoring sites and private bores; and
- Convene Tahmoor Coal Environmental Response Group to review responses on a quarterly basis.

5.2.2 Groundwater Monitoring Recommendations from the previous Quarterly Groundwater Report (September 2022)

As requested in the letter dated 19 September 2022 from DPE, **Table 5-1** provides the recommendations as made in the previous Quarterly Groundwater Report (April to June 2022, dated 24 August 2022), along with an update on the progress of these recommendations.

Table 5-1 Groundwater Monitoring Recommendations from the previous Quarterly Groundwater Report and Current Progress

| # | Previous Recommendation | Progress of Recommendation |
|---|--|---|
| 1 | Continue the monitoring program, reporting groundwater level and quality data in the next groundwater review report for July 2022. | Completed as part of this Six Monthly Subsidence Impact Report (Sections 2.1, 2.2 and 4.2) and Appendix C. |
| 2 | For P12A, P16B and TNC036-169m with Level 2 TARPs in place for groundwater levels, continue monitoring and reviewing groundwater level response. | Completed as part of this Six Monthly Subsidence Impact Report (Sections 2.1, 2.2 and 4.2) and Appendix C. During this reporting period, P12A resolved to a Level 1 TARP, while P16B and TNC036-169m remained at a Level 2 TARP. |
| 3 | For P12C, P16C and TNC036 (HBSS-97m) with Level 3 TARPs in place for groundwater levels, continue monitoring and reviewing groundwater level response. | Completed as part of this Six Monthly Subsidence Impact Report (Sections 2.1, 2.2 and 4.2) and Appendix C. During this reporting period, P12C and TNC03 (HBSS-97m) reduced to a Level 2 TARP trigger, while P16C remained as a Level 3 TARP trigger. |
| 4 | For TNC036 (BGSS-214m and BGSS-412.5m) with Level 2 TARPs in place for groundwater levels, continue to evaluate groundwater levels against model predictions and the rate of depressurisation over time. | Completed as part of this Six Monthly Subsidence Impact Report (Sections 2.1, 2.2 and 4.2) and Appendix C. During this reporting period, these two deep intakes at TNC036 remained as Level 2 TARP triggers. |
| 5 | For all sites with Level 1 TARPs in place for groundwater quality, continue monitoring pH, EC and metal concentrations against TARP trigger levels. | Completed as part of this Six Monthly Subsidence Impact Report (Sections 2.1, 2.2 and 4.2) and Appendix C. |

| # | Previous Recommendation | Progress of Recommendation |
|----|--|--|
| 6 | For all sites with Level 2 TARPs in place for groundwater quality (EC, pH and metals), continue monitoring concentrations against TARP trigger levels. | Completed as part of this Six Monthly Subsidence Impact Report (Sections 2.1, 2.2 and 4.2) and Appendix C. |
| 7 | For site P15A with a Level 2 TARP in place for groundwater quality (strontium), continue closely monitoring Sr concentrations at the nearby monitoring bores (P15B-D and P14A-D) and nearby private registered bores GW105228 and GW115860. | Completed as part of this Six Monthly Subsidence Impact Report (Section 2.2.3) and Appendix C. No significant increases were observed at adjacent site P14 and deeper bores at site P15 during the reporting period, and only a single measurement in strontium concentration observed marginally above the trigger levels was noted in September 2022. |
| 8 | Complete an extended purge at P15A in the next round of monitoring to remove at least three screen length volumes (screen length being 1.5 m) before sampling. | This purge was unable to be completed during the last three months, and is scheduled for early December 2022. |
| 9 | At P16B and P16C (and potentially P16A), it is recommended to develop a diversion drain to divert the surface run-off away from the well heads. If bore P16B and P16C are damaged, repair/resealing is required followed by measurement of groundwater levels. | A diversion drains to divert the surface run-off away from the well heads of P16B and P16C was developed in early November 2022. At the same time, the bore seals for these bores were cleaned and re-installed. Further monitoring will be able to determine if these actions have eliminated the issues at these bores. |
| 10 | Complete an extended purge at P12B in the next round of monitoring to remove groundwater potentially contaminated with grout before sampling. | This purge was unable to be completed during the last three months, and is scheduled for early December 2022. |
| 11 | For the next round of monitoring, measure the depth of the bore at GW115860. | As discussed in Table 9 of Appendix C , the depth of GW115860 was measured on July 2022 as 10.6 mbgl. |
| 12 | Convene the Tahmoor Coal Environmental Response Group to review results. | Completed on a monthly basis during this reporting period. |

5.2.3 Groundwater Recommendations from the previous Six Monthly Subsidence Impact Report (June 2022)

Table 5-2 provides the recommendations as made in the previous Six Monthly Subsidence Impact Report (October 2021 to May 2022, dated 17 June 2022) for groundwater, along with an update on the progress of these recommendations.

Table 5-2 Groundwater recommendations from the previous Six Monthly Subsidence Impact Report and Current Progress

| # | Previous Recommendation | Progress of Recommendation |
|---|--|---|
| 1 | At all sites with Level 2 trigger for groundwater quality, to continue monitoring program and a review of water quality data in the next groundwater monthly report. | Completed as part of this Six Monthly Subsidence Impact Report (Sections 2.1, 2.2 and 4.2) and Appendix C. |
| 2 | For pH at P12B, continue monitoring to confirm trends. | Completed as part of this Six Monthly Subsidence Impact Report (Section 2.2.3) and Appendix C. The higher pH at this bore was likely due to an issue with the integrity of the bore, with recent flooding flushing cement/grout into the bore. This was reduced to a TARP Level 1 in June 2022 as the source of the pH |

| # | Previous Recommendation | Progress of Recommendation |
|---|--|--|
| | | increase was determine not to be related to mining but to grout contamination. Since July 2022, pH has reduced within the baseline limit. |
| 3 | For Sr at P15A in the short term, continue monitoring Sr concentration at site P15A-D, P14A-D and at the two nearby registered bores (GW105228 and GW115860). | Completed as part of this Six Monthly Subsidence Impact Report (Section 2.2.3) and Appendix C. No significant increases were observed at adjacent site P14 and deeper bores at site P15 during the reporting period, and only a single measurement in strontium concentration observed marginally above the trigger levels was noted in September 2022. |
| 4 | For Sr at P15A in the medium term, if Sr concentrations at P15A remain within a potential TARP Level 4, (i.e. show fluctuations between 2 mg/L and 4 mg/L) and no significant increase in Sr concentration was observed at other monitoring piezometers P15B, P15C and P15D and the nearby registered bores (i.e. not resulting in a TARP Level 4) over the period January-June 2022 (i.e. six months), it is suggested to revise the Sr concentration trigger level at P15A to 4 mg/L (i.e. based on US health-based screening level benchmark, and in the absence of an ANZECC guideline). | Completed as part of this Six Monthly Subsidence Impact Report (Section 2.2.3) and Appendix C. Six months following the potential TARP Level 4 for strontium at P15A, no significant increases were observed at adjacent site P14 and deeper bores at site P15 (concentration of strontium increased by approximately 0.2 mg/L at P15B and P15C in the previous reporting period). Hence the trigger level at P15A for Sr was revised to 4 mg/L in June 2022, as the trigger was assessed to be too conservative for this site. |
| 5 | For Br at GW115860, continue monitoring to confirm trends, particularly in light of the amended trigger value. | Completed as part of this Six Monthly Subsidence Impact Report (Section 2.2.3) and Appendix C. During this reporting period, Br remained at a Level 1 at GW115860. |
| 6 | For EC at GW115860, continue monitoring to confirm trends and consider revision of the trigger. | Completed as part of this Six Monthly Subsidence Impact Report (Section 2.1) and Appendix C. During this reporting period, EC at GW115860 continues to trigger a Level 2 TARP. However, it was noted in the 6 monthly groundwater report that the increase in EC and pH at the groundwater monitoring bores was not assessed as a result of a mining effect in the Western Domain. No changes of the trigger have been made at GW115860 for EC in the reporting period. |

6 Document Information

6.1 References

Brienan Environment and Safety (2022), Longwall West 4 Creek Monitoring Report (for monitoring completed on 27 October 2022).

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

Douglas Partners (2022), Geotechnical Subsidence Impact Inspections – Longwall W4; September 2022.

EMM Consulting (2022a), Aboriginal heritage monitoring report: Tahmoor Mine Longwall West 4 (LW W3) End Of Panel Monitoring Inspection.

EMM Consulting (2022b), Historical heritage monitoring report: Tahmoor Mine Longwall West 4 (LW W3) End of Panel Monitoring Inspection – Railway Culverts.

EMM Consulting (2022c), Historical heritage monitoring report: Tahmoor Mine Longwall West 4 (LW W3) End of Panel Monitoring Inspection – Weatherboard Cottage.

Mine Subsidence Engineering Consultants (MSEC) (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.

Mine Subsidence Engineering Consultants (MSEC) (2021), Tahmoor Coal – Longwalls W3 and W4, Subsidence Predictions and Impact Assessments for Natural and Built Features due to the Extraction of the Proposed Longwalls W3 and W4 in Support of the Extraction Plan Application. Prepared for Tahmoor Coal, March 2021, document MSEC1112.

Niche (2022a), Aquatic Ecology Monitoring Report 2017-2022, report to Tahmoor Coal, 17 June 2022.

Niche (2022b), Terrestrial Ecology Monitoring Report, Riparian vegetation and amphibian monitoring Autumn 2022, report to Tahmoor Coal, 7 June 2022.

SLR (2021), Agricultural Subsidence Monitoring LW W3-W4, letter report to Tahmoor Coal, 26th August 2021, document 630.12953.001

Tahmoor Coal Documents:

- Extraction Plan LW W3-W4 Extraction Plan Main Document, TAH-HSEC-326
- Extraction Plan LW W3-W4 Water Management Plan, TAH-HSEC-328
- Extraction Plan LW W3-W4 Land Management Plan, TAH-HSEC-330
- Extraction Plan LW W3-W4 Biodiversity Management Plan, TAH-HSEC-325
- Extraction Plan LW W3-W4 Heritage Management Plan, TAH-HSEC-331
- Extraction Plan LW W3-W4 Stonequarry Creek Rockbar Management Plan, TAH-HSEC-352
- Extraction Plan LW W3-W4 Built Features Management Plan, TAH-HSEC-332
- Extraction Plan LW W3-W4 Public Safety Management Plan, TAH-HSEC-333
- Extraction Plan LW W3-W4 Subsidence Monitoring Program, TAH-HSEC-329

6.2 Glossary of Terms

Terms references to this document are provided below in **Table 6-1**.

Table 6-1 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 63°. |
| Closure | The reduction in the horizontal distance between the valley sides. The magnitude 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. |

| Term | Definition |
|----------------|---|
| 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. |

6.3 Abbreviations

Abbreviations used in this document are provided below in **Table 6-2**.

Table 6-2 Abbreviations

| Abbreviation | Definition |
|--------------|--|
| AHIMS | Aboriginal Heritage Information System |
| ARTC | Australian Rail Track Corporation |
| AUSRIVAS | The Australian River Assessment System |
| BACI | Before After Control Impact design |
| BGSS | Bargo Sandstone |
| BIS | Building Inspection Service |
| CTF | Cease to flow |
| DA | Development Approval |
| DRNSW | Department of Regional NSW |
| DPE | NSW Department of Planning and Environment (formerly DPIE) |
| DPIE | NSW Department of Planning, Industry and Environment (now DPE) |
| EC | Electrical conductivity |
| EPA | NSW Environment Protection Authority |
| EPT | Ephemeroptera Plecoptera Trichoptera scores |
| GFG | GFG Alliance |
| GNSS | Global Navigation Satellite System units |
| HBSS | Hawkesbury Sandstone |
| HEC | Hydro Engineering and Consulting, now ATC Williams |
| Km | Kilometres |
| LW W1 | Longwall West 1 |
| LW W1-W2 | Longwall West 1 to West 2 |
| LW W2 | Longwalls West 2 |
| LW W3 | Longwall West 3 |
| LW W3-W4 | Longwalls West 3 to West 4 |
| LW W4 | Longwall West 4 |
| m | metres |
| mbgl | Metres below ground level |

| Abbreviation | Definition |
|--------------|---|
| mg/L | Milligrams per litre |
| ML | Mining Lease |
| mm | millimetre |
| MSEC | Mine Subsidence Engineering Consultants |
| MSR | Main Southern Railway |
| NRAR | NSW Industry – Land & Water – Natural Resources Access Regulator – East |
| NSW | New South Wales |
| OE | Observed expected score |
| OSP | Open Standpipe Piezometers |
| pH | pH units |
| PMLL | Picton-Mittagong Loop Line railway |
| RCE | Riparian Channel and Environment Inventory |
| RCP | Reinforced Concrete Pipe |
| Tahmoor Coal | Tahmoor Coal Pty Ltd |
| Tahmoor Mine | Tahmoor Coal Mine |
| TARP | Trigger Action Response Plan |
| TDS | Total dissolved solids |
| TfNSW | Transport for NSW |
| VMP | Vibrating Wire Piezometer |
| WWTP | Waste water treatment plant |

6.4 Document Distribution

This report and associated documents have been distributed according to **Table 6-3**.

Table 6-3 Distribution List for Six Monthly Subsidence Impact Report

| Agency | Contact Person | Position | Electronic Copy |
|---|-------------------|----------------------------------|---|
| DPE - Planning | (Planning Portal) | (Planning Portal) | (https://www.planningportal.nsw.gov.au/major-projects) |
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| Agency | Contact Person | Position | Electronic Copy |
|---|---|--|--|
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| | 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 Report



Appendix B – Surface Water Monitoring Report



Appendix C – Groundwater Monitoring Report



Appendix D – Creek Monitoring Report



Appendix E – Historical Heritage Monitoring Report (Railway Culverts)

Appendix F – Stonequarry Creek Rockbar Status Report
