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Tahmoor Coal Pty Ltd

# SIX MONTHLY SUBSIDENCE IMPACT REPORT

Western Domain Longwalls West 1 – West 4

1 January 2022 – 31 December 2022

Report 7 – March 2023

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Document Control

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# Executive Summary

This report is the seventh six-monthly report to be submitted since the commencement of extraction in the Western Domain, in accordance with the requirements of the Longwall West 1 and West 2 (LW W1-W2) Extraction Plan and the Longwall West 3 and West 4 (LW W3-W4) Extraction Plan. The reporting period of this report is a full calendar year from 1 January 2022 to 31 December 2022 to support the Annual Review (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 W3 and LW W4.

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 ten (10) 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:

- Pool Water Level TARP – Level 3 triggered due to pool water level reduction in Cedar Creek (pool CR14) between 9 and 20 December 2022. During the periods of water level decline the water level remained above the previously recorded minimum and did not decline atypically. This TARP was resolved on 31 December 2022 and no further actions other than ongoing monitoring are required. Tahmoor Coal is reporting on pool water level on a 3-monthly basis to DPE;
- 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;
- Surface Water Quality TARP – Level 2 triggered due to elevated dissolved aluminium at various pools throughout the reporting period, and variable pH levels at monitoring site SD in August and September 2022. These elevated aluminium concentrations were attributed to prevailing climatic conditions, while the variable pH levels were attributed to instrumentation or field measurement issues. No further actions other than ongoing monitoring are 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, 3 and 4 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;

- Groundwater Quality TARP – Levels 2 and 3 and potential Level 4 were triggered due to water quality results during the reporting period. Potential Level 4 triggers were identified for pH at P12B, and strontium at P15A, and EC and Barium at GW115860. All potential Level 4 triggers were resolved during this reporting period. A Level 3 TARP trigger was noted for elevated zinc concentration at P16C. Groundwater monitoring will continue under the existing monitoring program, and no actions are required;
- 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 of the rockbar has now finished as mining in the Western Domain has been completed;
- 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 is undertaking remediation now that the full effects of LW W3-W4 have been complete; and
- Main Southern Railway TARP – Blue Triggers at Ballast Top Subways (88.133 km and 86.838 km) and Picton Tunnel, which were attributed to impacts from rainfall rather than mining impacts. As these triggers have been resolved, ongoing monitoring is required.

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 30 June 2023.

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# 1 Introduction

## 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 is 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.

Extraction Plan approval for Tahmoor South Domain A Series was granted on 20 September 2022, and extraction of LW S1A commenced 18 October 2022. Subsidence Impact Reporting for Tahmoor South Domain is reported separately to that of the Western Domain.

## 1.2 Purpose

### 1.2.1 Six-Monthly Subsidence Impact Report Requirements

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 was published in October 2022.

This report provides with a summary of subsidence and environment monitoring results, subsidence impacts and management actions undertaken during the reporting period. The reporting period for this report is defined in **Section 1.3**.

In addition, a letter from DPE dated 19 December 2022 provided three additional reporting requirements for future Six-Monthly Subsidence Impact Reports for the Western Domain.

Reporting requirements 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 | Section Addressed |
|---|---|---|
| **Reporting Requirements as per Section 6.1.2 of the LW W3-W4 Extraction Plan** | | |
| 1 | A comprehensive summary of all impacts, including a revised characterisation according to the relevant TARP(s); | Section 3.1 |
| 2 | Any proposed actions resulting from triggers being met in the TARP, or other actions; | Section 3.2 |
| 3 | An assessment of compliance with all relevant performance measures and indicators; and | Section 4 |
| 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 2 |
| **Reporting Requirements as requested by DPE on 19 December 2022** | | |
| 1 | Continue to include an assessment against performance measures and performance indicators, and any recommendations in relation to ongoing monitoring or corrective actions; | Section 4, Section 3.2 |
| 2 | Continue to include a review and update on the status of recommendations made in previous reports; and | Section 2.2.6 and Section 2.3.5 |
| 3 | Include an update on the progress of remediation of the two sandstone culverts impacted by mining of LW W1-W4. | Section 3.2.9 |

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

### 1.2.2 Three-monthly Reporting Requirements

This report forms part of 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 and Environment 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 2.2.6** and **Section 2.3.5, Appendix B,** and **Appendix D**).

### 1.2.3 Annual Review Requirements

An Annual Review for Tahmoor Mine operations during the previous calendar year is required in accordance with Condition E13 (SSD 8445) and Condition 45 of DA 67/98, and is submitted by 31 March annually to Department of Planning and Environment and other stakeholders, as well as upload to the Tahmoor Coal Website. This Six-Monthly Subsidence Impact Report assists with the completion of the 2022 Annual Review, and will be provided as an appendix to the Annual Review.

## 1.3 Scope

### 1.3.1 Reporting Period

This report is the seventh six-monthly report to be submitted since the commencement of extraction of LW W1, in accordance with the requirements of the LW W1-W2 Extraction Plan and LW W3-W4 Extraction Plan.

The reporting period of this report is from 1 January 2022 to 31 December 2022 (full calendar year for 2022). This report includes data previously reported in the fifth six-monthly report (reporting period 1 October 2021 to 15 May 2022) and the sixth six-monthly report (reporting period 25 March 2022 to 18 November 2022). The compilation of a full calendar year of monitoring data has been completed in this report to assist with the Annual Review of all operations at Tahmoor Mine for the full calendar year.

This reporting period covers subsidence impacts observed during and after the extraction of LW W3 and LW W4.

**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.

### 1.3.2 LW W3-W4 Study Area

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**.

### 1.3.3 LW W3-W4 Extraction Plan Context

The LW W3-W4 Extraction Plan is part of the Tahmoor Coal Environmental Management Structure, which is illustrated in **Figure 1-3**.

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

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 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.

Subsidence monitoring results and any impacts for the Tahmoor South Domain will be reported separately to that of the Western Domain.

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

| Management Plan | Aspect | Feature | Monitoring Completed By | Monitoring Reported by | Monitoring Reports Completed during this Reporting Period | Reference |
|---|---|---|---|---|---|---|
| Subsidence Monitoring Program | Subsidence | General subsidence | • SMEC<br>• Building Inspection Service<br>• Comms Network Solutions | • Mine Subsidence Engineering Consultants (MSEC) | • Weekly reports during mining<br>• LW W3 and LW W4 end of panel reports | Appendix A (referenced reports only) |
| Water Management Plan | Surface Water | Stonequarry Creek flow | • WaterNSW | • ATC Williams | • 6-Monthly report for 1 October 2021 to 24 March 2022<br>• 6-Monthly report for 25 March 2022 to 7 September 2022<br>• Quarterly report for 1 September 2022 to 31 December 2022. | Appendix B |
| | | Pool water level | • ALS | | | |
| | | Stream water quality | | | | |
| | | Flooding | • SMEC | • WRM | • One report following completion of LW W4 | Available on request |
| | | Natural drainage behaviour | • Brienan Environment and Safety | • Brienan Environment and Safety | • Monthly reports during mining<br>• Post-mining reports for October and November 2022 monitoring (monitoring required on a 3-monthly basis during the post-mining period) | Appendix C (referenced reports only) |
| | Groundwater | Groundwater quality | • GeoTerra<br>• CES | • SLR | • 6-Monthly report for 1 November 2021 to 31 March 2022<br>• 6-Monthly report for 1 April 2022 to 30 September 2022<br>• Quarterly report for 1 October to 31 December 2022. | Appendix D |
| | | Groundwater bore level | • GeoTerra<br>• CES | | | |
| | | Shallow groundwater pressures | | | | |
| | | Deep groundwater pressures | • Groundwater Exploration Services<br>• SLR<br>• CES | | | |
| | | Groundwater Inflow | • Tahmoor Coal | | | |

| Management Plan | Aspect | Feature | Monitoring Completed By | Monitoring Reported by | Monitoring Reports Completed during this Reporting Period | Reference |
|---|---|---|---|---|---|---|
| Land Management Plan | Landscape | Cliff lines<br>Steep Slopes<br>Surface cracking (excluding railway corridor)<br>Dams | • Douglas Partners | • Douglas Partners | • Monthly reports for all geotechnical features during mining<br>• Fortnightly reports for selected dams during mining (as required)<br>• Post-mining reports for October and December 2022 (monitoring required on a 3-monthly basis during post-mining period) | Available on request |
| | | Dams | • Bloor Rail<br>• Newcastle Geotechnical | • MSEC<br>• Bloor Rail<br>• Newcastle Geotechnical | • Picton-Mittagong Loop Line (PMLL) Weekly Detailed Reports during mining | Available on request |
| | | Dams | • Building Inspection Service (BIS) | • BIS | • Weekly dam inspection reports during mining | Available on request |
| | Agricultural Land | Agricultural Land | • BIS | • BIS | • Monthly reporting during mining<br>• One post-mining report for December 2022 (monitoring required on a 3-monthly basis during post-mining period) | Available on request |
| Biodiversity Management Plan | Aquatic Ecology | Macroinvertebrates | • Niche | • Niche | • Aquatic Ecology Monitoring Reports for Autumn 2022 (March 2022) and Spring 2022 (September 2022) | Available on request |
| | Terrestrial Ecology | Amphibians<br>Riparian Vegetation | • Niche | • Niche | • Terrestrial Ecology Monitoring Reports for Autumn 2022 (March 2022) and Spring 2022 (September 2022) | Available on request |
| Heritage Management Plan and Stonequarry Creek Rockbar Management Plan | Aboriginal heritage | Grinding Grooves | • SMEC | • MSEC | • Weekly reports during mining<br>• LW W3 and LW W4 end of panel reports<br>• One post-mining report following completion of LW W4 | Appendix A (referenced reports only) |
| | | | • EMM Consulting | • EMM Consulting | • LW W3 and LW W4 end of panel reports for Aboriginal heritage | Available on request |

| Management Plan | Aspect | Feature | Monitoring Completed By | Monitoring Reported by | Monitoring Reports Completed during this Reporting Period | Reference |
|---|---|---|---|---|---|---|
| Heritage Management Plan and Stonequarry Creek Rockbar Management Plan | Aboriginal heritage | SR17 Rockbar | • SMEC<br>• Michael Nicholson Consulting<br>• PSM | • MSEC | • Weekly and Monthly Stonequarry Creek Rockbar reports during mining of LW W3 and LW W4 | Appendix F (referenced reports only) |
| | Historical heritage | Railway culverts | • Newcastle Geotechnical | • Newcastle Geotechnical | • Picton-Mittagong Loop Line (PMLL) Weekly Detailed Reports during mining to 2 November 2022 | Available on request |
| | | | • EMM Consulting | • EMM Consulting | • LW W3 end of panel report for historical heritage<br>• LW W4 end of panel reports for railway culverts and Weatherboard House | Appendix E (referenced reports only) |
| Built Features Management Plan | Built Features | Electricity Infrastructure | • SMEC<br>• BIS<br>• Comms Network Solutions<br>• | • MSEC | • Weekly reports during mining<br>• LW W3 and LW W4 end of panel reports | Appendix A (referenced reports only) |
| | | Gas Infrastructure | | | | |
| | | Potable Water | | | | |
| | | Sewerage Infrastructure | | | | |
| | | Telecommunications | | | | |
| | | Local roads, bridges and culverts | | | | |
| | | Built Structures | | | | |
| | | Picton-Mittagong Loop Line | • Southern rail Services<br>• Bloor Rail | • MSEC | • PMLL Weekly Status Reports during mining<br>• Weekly post-mining reports following completion of LW W4 till 2 November 2022 | Available on request |

| Management Plan | Aspect | Feature | Monitoring Completed By | Monitoring Reported by | Monitoring Reports Completed during this Reporting Period | Reference |
|---|---|---|---|---|---|---|
| Built Features Management Plan | Built Features | Transport for NSW (TfNSW) Infrastructure | • SMEC<br>• Southern Rail Services<br>• BIS | • MSEC | • Weekly Victoria Street Status Reports during mining and post-mining. Victoria Bridge Status Reports have been continued well beyond the extraction of LW4 due to a large rock mass movement towards the Stonequarry Creek incised valley. The rock mass anomalous movement was first observed in the mining of LW32 where relative survey ground movement vectors showed the ground moving towards the incised creek valley and away from the goaf. The rock mass only started to be seen at Victoria Bridge on the extraction of LW W3 and LW W4. Survey monitoring and status reports will continue to be provided on a monthly basis. | Available on request |
| | | Main Southern Railway (MSR) | • SMEC<br>• Southern rail Services<br>• Bloor Rail<br>• BIS<br>• Comms Network Solutions<br>• Newcastle Geotech | • MSEC | • MSR Weekly Status Reports during extraction<br>• Monthly MSR Status Reports during post-mining of LW W4 | Appendix G (referenced reports only) |

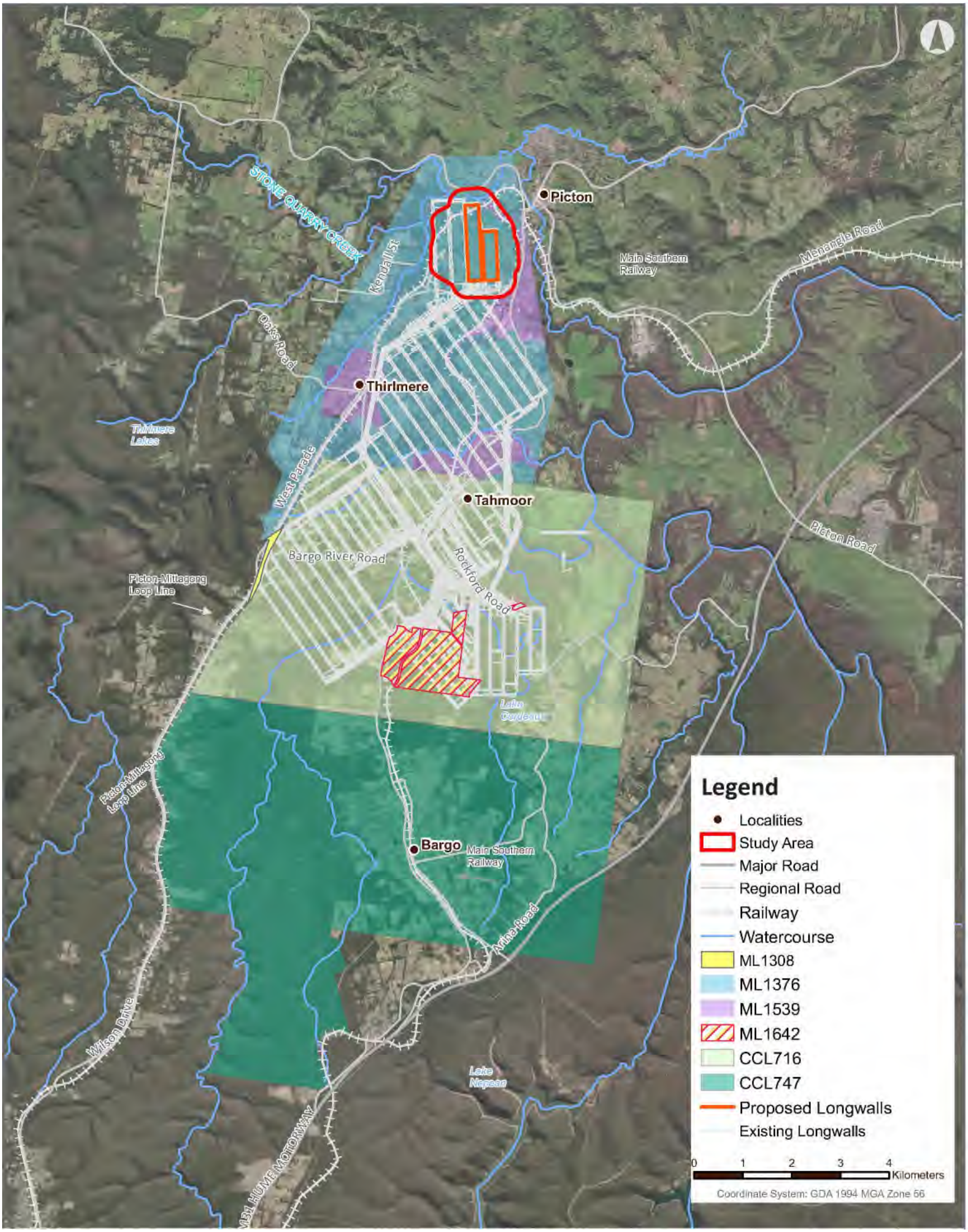



*Figure 1-1 Tahmoor Mine Area and Tenure (source: LW W3-W4 Extraction Plan)*

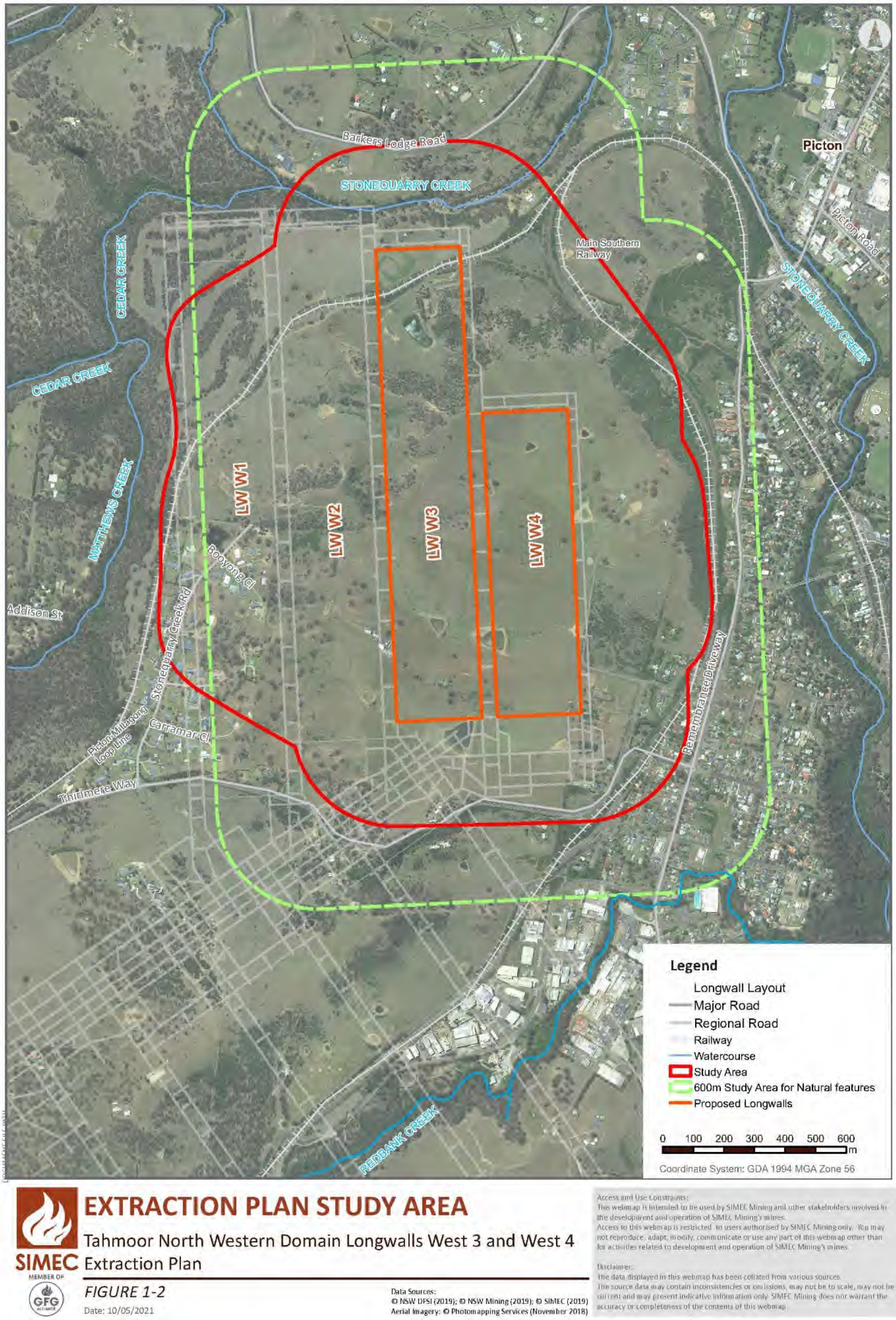



*Figure 1-2 LW W3-W4 Extraction Plan Study Area (source: LW W3-W4 Extraction Plan)*

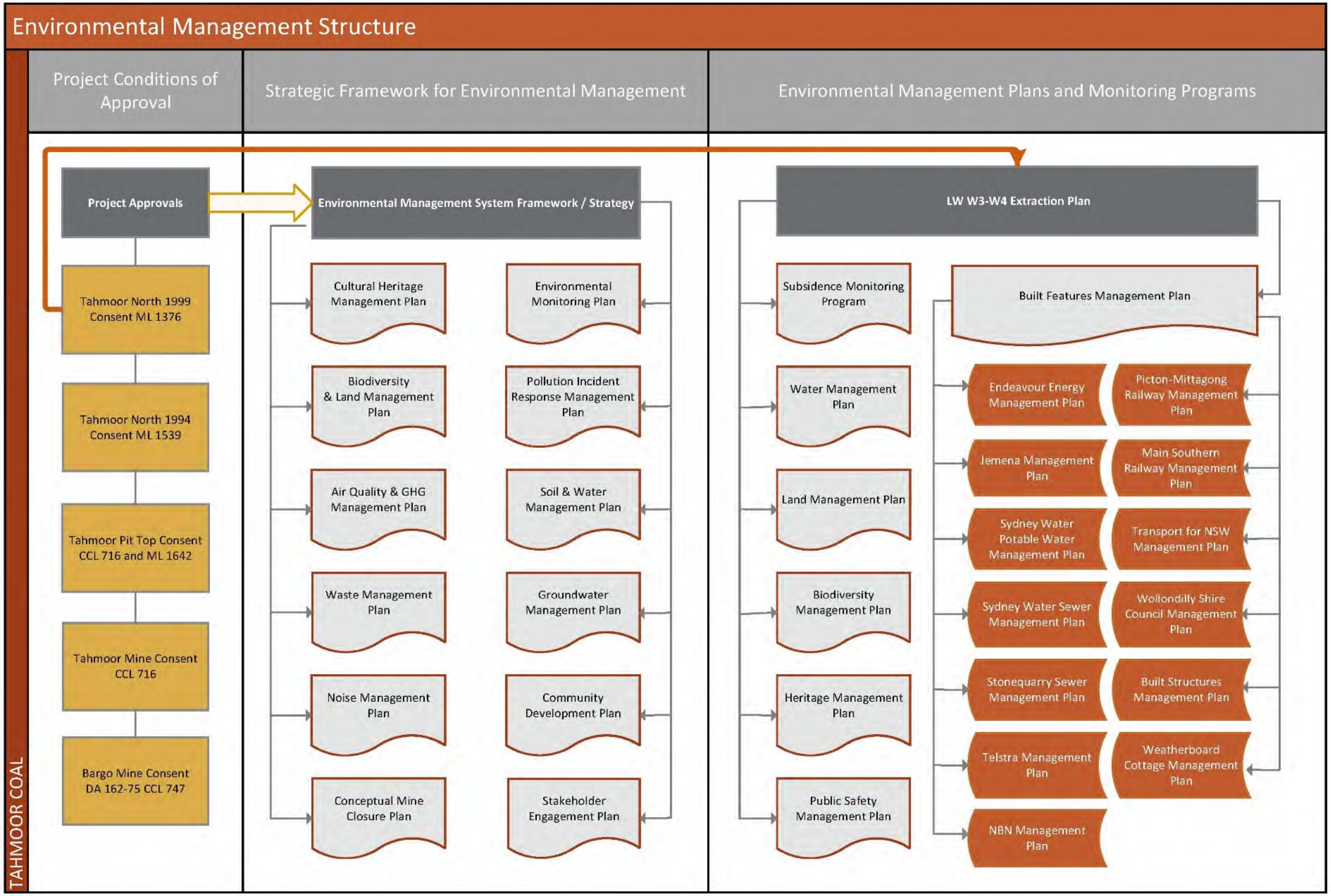



*Figure 1-3 Overview of Environmental Management Structure for Tahmoor Coal (source: LW W3-W4 Extraction Plan)*

# 2 Summary of Environmental Monitoring Results

## 2.1 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 2-4**. 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 MSEC1204 LW W3 Subsidence Monitoring Report 27 and MSEC1263 LW W4 Subsidence Monitoring Report 20 (refer **Appendix A**). A weekly review of the subsidence survey results was completed by Tahmoor Coal and MSEC during the extraction period.

Longwall West 3 (LW W3) commenced on 13 September 2021 and was completed on 21 March 2022. Longwall West 4 (LW W4) extraction commenced on 16 May 2022 was completed on 13 September 2022.

**Table 2-1** 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 W4 was recorded along the LW W1-W4 crossline survey. Very minor subsidence movements have been observed during the post-mining period of LW W4.

*Table 2-1 Subsidence Monitoring Observations at the end of LW W3 and LW W4 during this Reporting Period (source: MSEC reports included in Appendix A)*

| | Report 27 (MSEC1204) for LW W3 | | Report 20 (MSEC1263) for LW W4 | |
|---|---|---|---|---|
| Monitoring Period | 30/03/2022 – 15/05/2022 | | 16/05/2022 – 18/11/2022 | |
| Progress of extraction | LW W3 completed | | LW W4 completed | |
| **Observed Ground Movement Parameters** | **Maximum Observed Total** | **Location** | **Maximum Observed Total** | **Location** |
| Subsidence (mm) | 857 | LW W1-W3 Crossline | 897 | LW W1-W4 Crossline |
| Tilt (mm/m) | 3.8 | Stonequarry Creek Road | 9.8 | LW W1-W4 Crossline |
| Hogging Curvature ($km^{-1}$) | 0.22 | PMLL | 0.35 | LW W1-W4 Crossline |
| Sagging Curvature ($km^{-1}$) | -0.29 | LW W1-W3 Crossline | -0.33 | LW W3 Centreline |
| Tensile Strain (mm/m) | 1.4 | PMLL | 1.3 | LW W2 Centreline |
| Compressive Strain (mm/m) | -5.0 | PMLL | -5.6 | LW W4 Centreline |

### 2.1.1 Ground Survey Results

#### *2.1.1.1 Longwalls West 3 Mining*

The development of subsidence at pegs and GNSS units located on the LW W3 centreline that have been mined directly beneath by LW W3 are illustrated in **Figure 2-1**. This figure shows that subsidence observed along the centreline of LW W3, as well as that observed at GNSS Site 23 and 87.760 km on the Picton Mittagong Loop Line, was less than predicted.

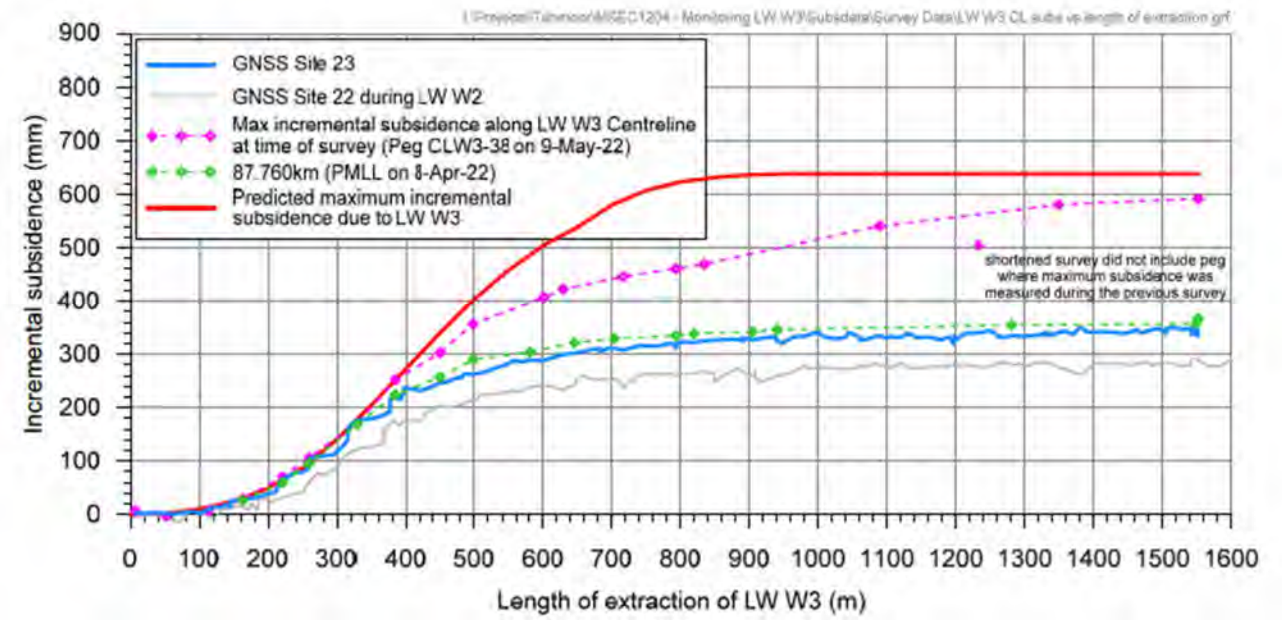



*Figure 2-1 Development of subsidence along centreline of LW W3 (source: MSEC, Subsidence Monitoring Report 27, Appendix A)*

Regular surveys were conducted along the Picton Mittagong Loop Line during the mining of LW W3. Compressive strains were noted above the centreline of LW W3 and across the creek crossing, however 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 W3. 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 W3. 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.

A comparison between assessed and observed impacts to surface features is summarised in Table 3 of the MSEC Subsidence Monitoring Report 27 (refer to **Appendix A**).

#### *2.1.1.2 Longwall West 4 Mining*

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 2-2**. 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.

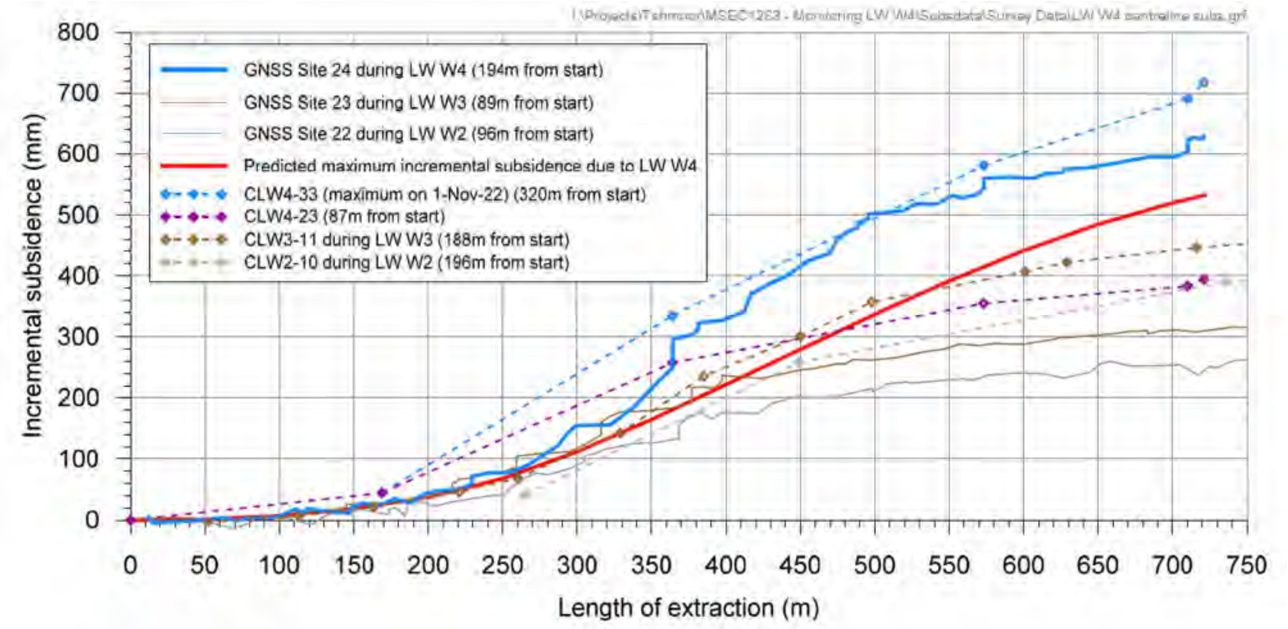



*Figure 2-2 Development of subsidence along centreline of LW W4 (source: MSEC, Subsidence Monitoring Report 20, Appendix A)*

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 showed a reduction throughout the remainder of and after LW W4 mining completion.

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**).

### 2.1.2 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 2-3**. During LW W4 extraction, only minor changes have been observed between the GNSS units.

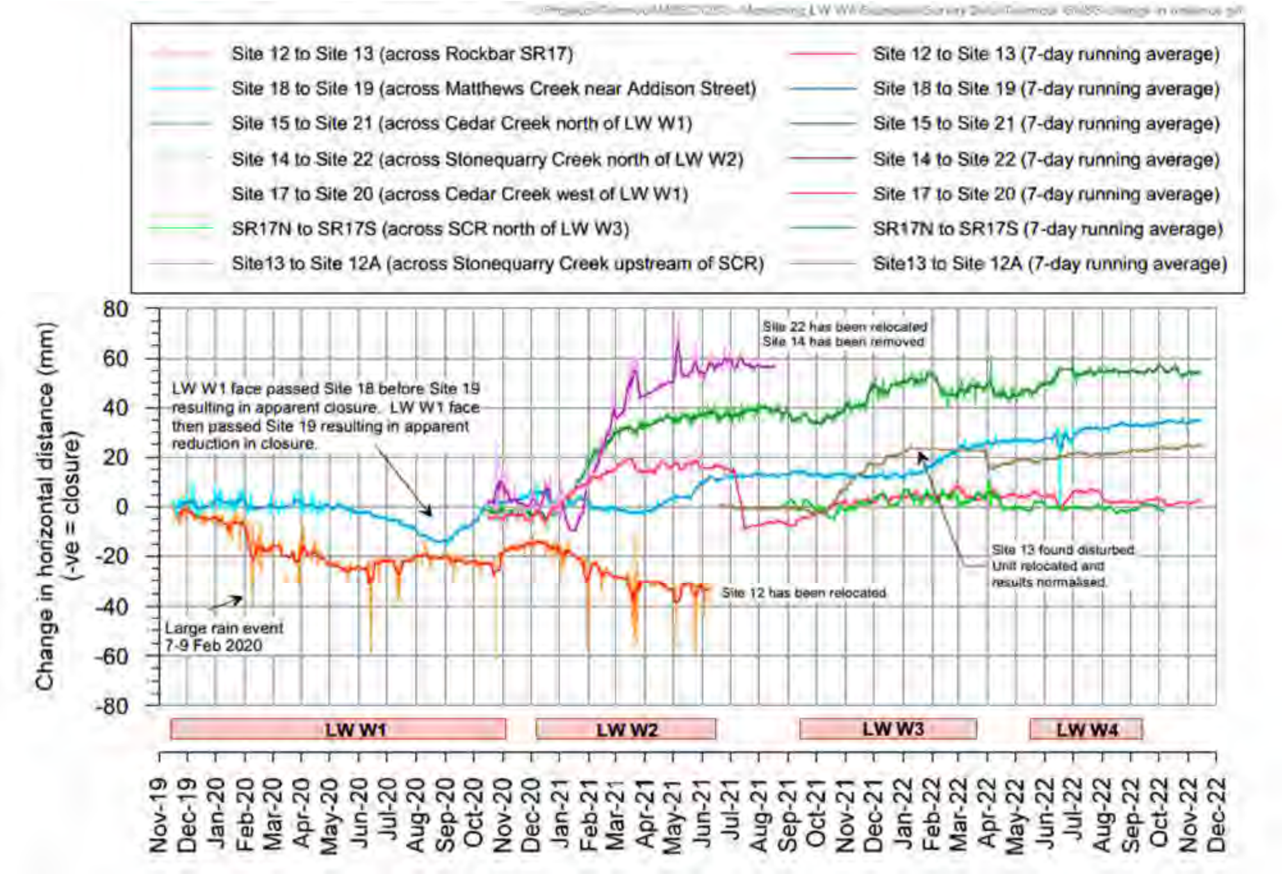



*Figure 2-3 Observed changes in horizontal distances between GNSS units during LW W1-W4 extraction (source: MSEC, Subsidence Monitoring Report 20, Appendix A).*

### 2.1.3 Valley Closure in Creeks

Survey marks installed across rockbars in Stonequarry Creek, Cedar Creek and Matthews Creek are illustrated in **Figure 2-4**.

During the extraction of LW W3, valley closure was measured to develop across Stonequarry Creek at SQ104 and SQ105, which are located near the confluence of Stonequarry Creek and Cedar Creek. Minor closure was developing across SQ104, SQ105, SQ106 and SQ107 up to 3 November 2021. The survey pegs for SQ101 to SQ109 were removed following the survey on 3 November, as requested by the landowner.

Survey completed at the end of LW W3 noted small changes in horizontal distances were observed both along and across the rockbar. Minor ground shortening was observed in the southeast corner of the rockbar, which is captured by measurements at Marks RBE11, RBF05 and RBF06. Survey completed at the end of LW W4 noted minor changes in horizontal distances both along and across Rockbar SR17. 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 W3 and W4. The most recent survey was on 21 November 2022 for Cedar Creek and 28 November 2022 for Matthews Creek, with minor changes observed.

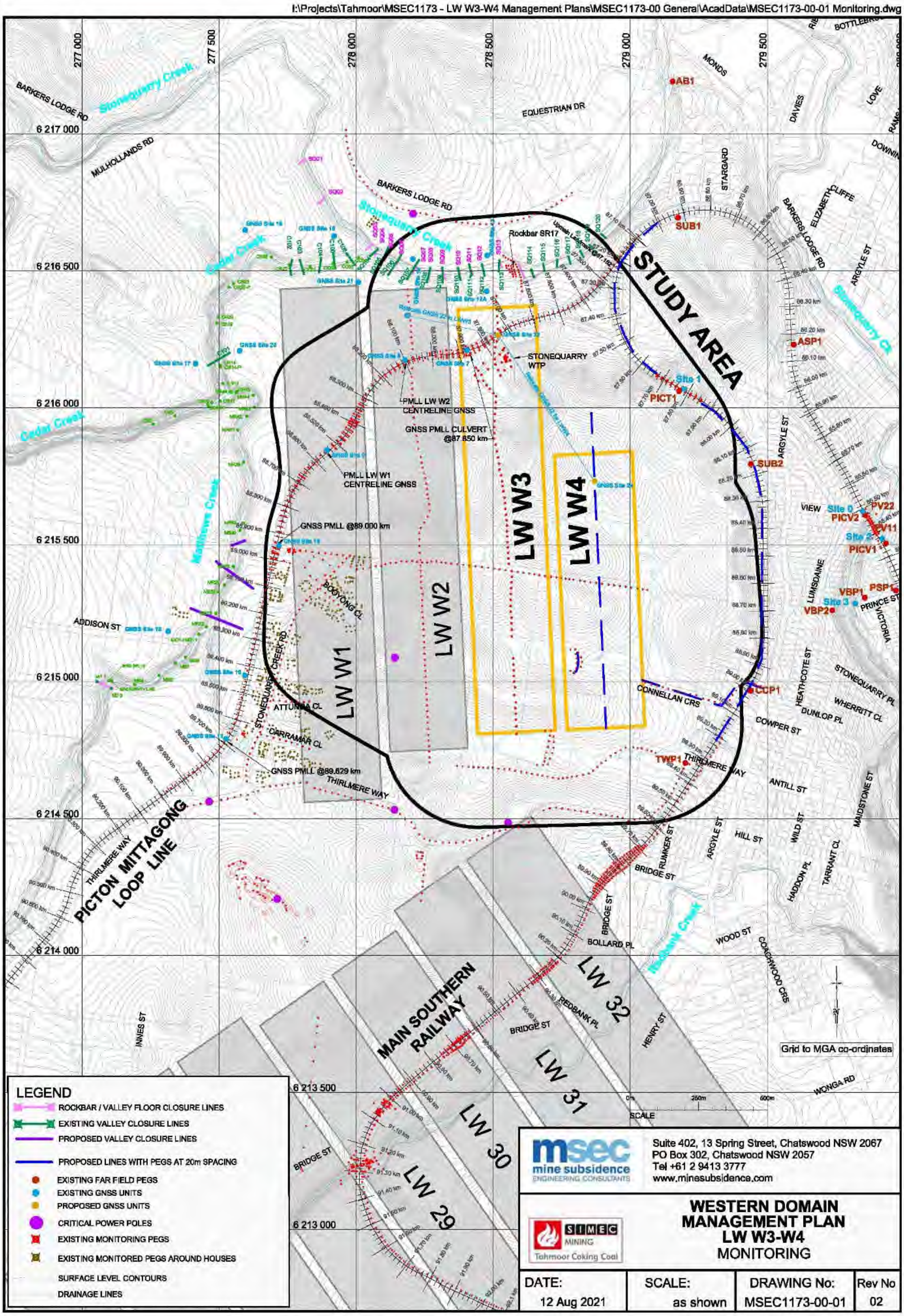



*Figure 2-4 LW W3-W4 Subsidence Monitoring Program (source: LW W3-W4 Subsidence Monitoring Program)*

## 2.2 Surface 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 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 surface water:

- Flow, pool water level and surface water quality monitored for Stonequarry Creek, Cedar Creek and Matthews Creek – monthly monitoring data reviewed and reported by ATC Williams on a monthly (during mining and post-mining) basis (refer to **Appendix B**);
- Creek monitoring for natural drainage behaviour – visual inspections and reporting by Brienan Environment and Safety completed on a monthly (during mining) and quarterly (post-mining) frequency (refer to **Appendix C** for references report);

The following sections summarise the observations made during the reporting period for each surface water category. Performance against all Surface Water Management Plan TARPs for the reporting period are summarised in **Table 3-3** and **Table 3-4**, and actions and responses completed relating to any TARP triggers are discussed in **Section 3.2**.

### 2.2.1 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 2-5**.

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.

### 2.2.2 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 2-5**. 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 2-5**.

With the exception of monitoring site CB (discussed further below), water levels at monitoring sites on Matthews Creek, Stonequarry Creek, and Cedar Creek remained above minimum baseline levels and/or were consistent with baseline conditions during the reporting period.

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

#### *2.2.2.1 Monitoring Site CB (Pool CR14)*

A Level 4 TARP significance was originally triggered in relation to surface water level decline for the period 19 to 29 January 2021 at monitoring site CB (pool CR14) in Cedar Creek. It is likely that mining induced subsidence had mobilised existing fractures resulting in changes in the water level recession rate of this site. In addition, it was likely that mining induced groundwater drawdown had resulted in the surface water system in the vicinity of pool CR14 transitioning from a gaining stream (baseflow discharge from the groundwater stream to the stream) to a weakly gaining or losing stream (surface water recharge to the groundwater system) (refer **Appendix B**).

From 9 to 30 December 2022, the water level recorded at monitoring site CB (pool CR14) declined below the baseline minimum by a maximum of 0.46 m. Similar water level decline was recorded at a number of monitoring sites during this period, although the water level did not decline below the baseline minimum at other water monitoring sites. The water level decline at monitoring site CB had negligible influence on the water level of downstream monitoring sites during the monitoring periods.

Groundwater levels recorded at groundwater monitoring site P40 (A, B, C and D) were recorded above the creek bed elevation from 9 to 30 December 2022. The decline in water level at monitoring site CB (pool CR14) from 9 to 30 December 2022 suggests that, although gaining conditions were prevailing in the vicinity of monitoring site CB, it is likely that fractures in the base of pool CR14 or in the subsurface, resulted in losing conditions occurring at monitoring site CB during this period.

The observations at monitoring site CB triggered a Level 3 TARP trigger. This trigger, as well as the actions and responses completed and proposed, are discussed further in **Section 3.2.1**.

### 2.2.3 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 W3 and 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 2-6**, 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 2022. These rainfall events resulted in catchment base-flow recharge;
- Surficial fracturing of the controlling rockbar at Pool SR17 and a rockbar at Pool SR20 have been noted;
- 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.

The surficial fracturing of the controlling rockbar at Pool SR17 was first 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. This surficial fracturing is discussed further in **Section 3.2.2** and **Appendix C**.

The surficial fracturing of a rockbar at Pool SR20 was noted following the inspection on 18 August 2022. Two fractures were noted and it was confirmed that one crack was the development of an existing (pre-mining) joint / discontinuity, while the other was first observed during mining of LW W4. During the latest inspection on 15 November 2022, it was noted that both cracks appear to be getting wider. The new crack was noted to have an increase in maximum width from 6 mm (noted on 27 October 2022) to 21 mm (noted on 15 November 2022). The development of the existing joint / discontinuity was also noted to have increased in maximum width from 7 mm (noted ton 27 October 2022) to 14 mm (noted on 15 November 2022). This surficial fracturing is discussed further in **Section 3.2.2** and **Appendix C**.

### 2.2.4 Surface Water Quality

Surface water quality data has been recorded at the following sites (refer to **Figure 2-5**):

- 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 2-2**. Charts illustrating water quality results for monitored pools on Matthews Creek, Cedar Creek and Stonequarry Creek are presented in Appendix C of the Surface Water Review reports (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 the reporting period, 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.

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 for much of the reporting period 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.

Further discussion of the elevated water quality occurrences and related TARP triggers is provided in **Section 3.2.3**.

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

| Parameter | Matthews Creek | Cedar Creek | Stonequarry Creek |
|---|---|---|---|
| pH | • Near neutral pH conditions.<br>• Consistent with baseline values. | • Near neutral to slightly acidic pH conditions.<br>• Generally higher pH values were recorded during the review period in comparison to the baseline period. | • Near neutral to slightly alkaline pH conditions for most sites.<br>• Historically high pH values recorded at SD and SF in March and August 2022.<br>• Historically high pH values recorded at SG in March 2022.<br>• Historically low pH recorded at SD in September 2022.<br>• The pH values recorded at all other monitoring sites were generally consistent with baseline values. |
| Electrical Conductivity | • Field EC values were consistent with baseline values. | • Field EC values are slightly below the historical range. | • Field EC values were consistent with or slightly less than baseline values. |
| Dissolved Aluminium | • Concentrations were elevated in January, March, April, August and October 2022 following periods of above average rainfall.<br>• Concentrations were consistent with baseline values. | • Concentrations were elevated in January-April, July-August and October 2022 following periods of above average rainfall.<br>• Historically high concentrations recorded in at reference site CCR in January and February, at all monitoring sites except CC1 and CB in March, at Cedar US in April, and at CCR, Cedar US and CF in July. | • Concentrations were elevated and variable for the majority of the review period. The elevated concentrations occurred following a period of above average rainfall.<br>• Historically high concentrations were recorded at all monitoring sites except selected sites. |
| Dissolved Barium | • Concentrations generally stable over the review period and consistent with baseline values. | • Concentrations recorded over the duration of the review period were generally less than baseline values. | • Dissolved barium concentrations recorded over the duration of the review period were consistent with or less than baseline values. |
| Dissolved Iron | • Concentrations were slightly elevated for the review period, however were generally consistent with baseline values. | • Concentrations generally consistent over the review period and with baseline values. | • 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 | • Concentrations recorded at all sites were consistent with or less than baseline values. | • Concentrations recorded at all sites were consistent with or less than baseline values. | • Concentrations recorded at all sites were consistent with or less than baseline values. |
| Dissolved Nickel | • Concentrations recorded at all sites were consistent with or less than baseline values. | • 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 2022. | • Concentrations recorded at all sites were consistent with or less than baseline values. |

| Parameter | Matthews Creek | Cedar Creek | Stonequarry Creek |
|---|---|---|---|
| Dissolved Zinc | • Concentrations recorded at all sites were consistent with or less than baseline values. | • 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 2022. | • Concentrations recorded at all sites were consistent with or less than baseline values. |
| Sulphate | • Concentrations recorded at all sites were generally consistent with baseline values. | • Concentrations recorded at all sites were generally consistent with baseline values. | • A decreasing trend in sulphate concentrations was recorded at all sites over the duration of the reporting period.<br>• Concentrations recorded at all sites were generally consistent with baseline values. |

### 2.2.5 Flooding

Following the completion of mining in the Western Domain, a post-mining flood study was completed to assess the potential impacts of subsidence on flooding in Matthews Creek, Cedar Creek and Stonequarry Creek. This assessment was completed to fulfil the requirements of Condition 7 of DA 67/98, which requires that mining does not result in the subsidence of any habitable floors to below the 1 in 100 year flood level (1% annual exceedance probability [AEP] flood level).

The report (WRM, 2022) concluded that flooding is confined to the Matthews Creek system (which includes Matthews Creek, Cedar Creek and Stonequarry Creek), and subsidence has not resulted in any habitable floor areas to fall below the 1 in 100 year flood level.

### 2.2.6 Recommendations and Actions

#### *2.2.6.1 Current Surface Water Monitoring Recommendations*

As discussed in the Surface Water Review for September to December 2022 (**Appendix B**), ATC Williams recommended that re-calibration of field instrumentation be completed due to intermittent records of potentially erroneous field pH values. Progress of this recommendation will be provided in the next quarterly surface water and groundwater monitoring report for the Western Domain.

#### *2.2.6.2 Previous Surface Water Monitoring Recommendations*

**Table 2-3** provides the recommendations as made in the previous Surface Water Review for March to September 2022, along with an update on the progress of these recommendations.

*Table 2-3 Surface Water Monitoring Recommendations from the previous Surface Water Review and Current Progress*

| Item | Previous Recommendation | Progress of Recommendation |
|---|---|---|
| 1 | 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 was decommissioned in October 2022. |

| Item | Previous Recommendation | Progress of Recommendation |
| --- | --- | --- |
| 2 | 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 | Monitoring site SG was decommissioned in October 2022. |
| 3 | Re-calibration of field instrumentation has been recommended due to questionable pH results in the field. | Re-calibration of field instrumentation was completed as requested by field personnel. |

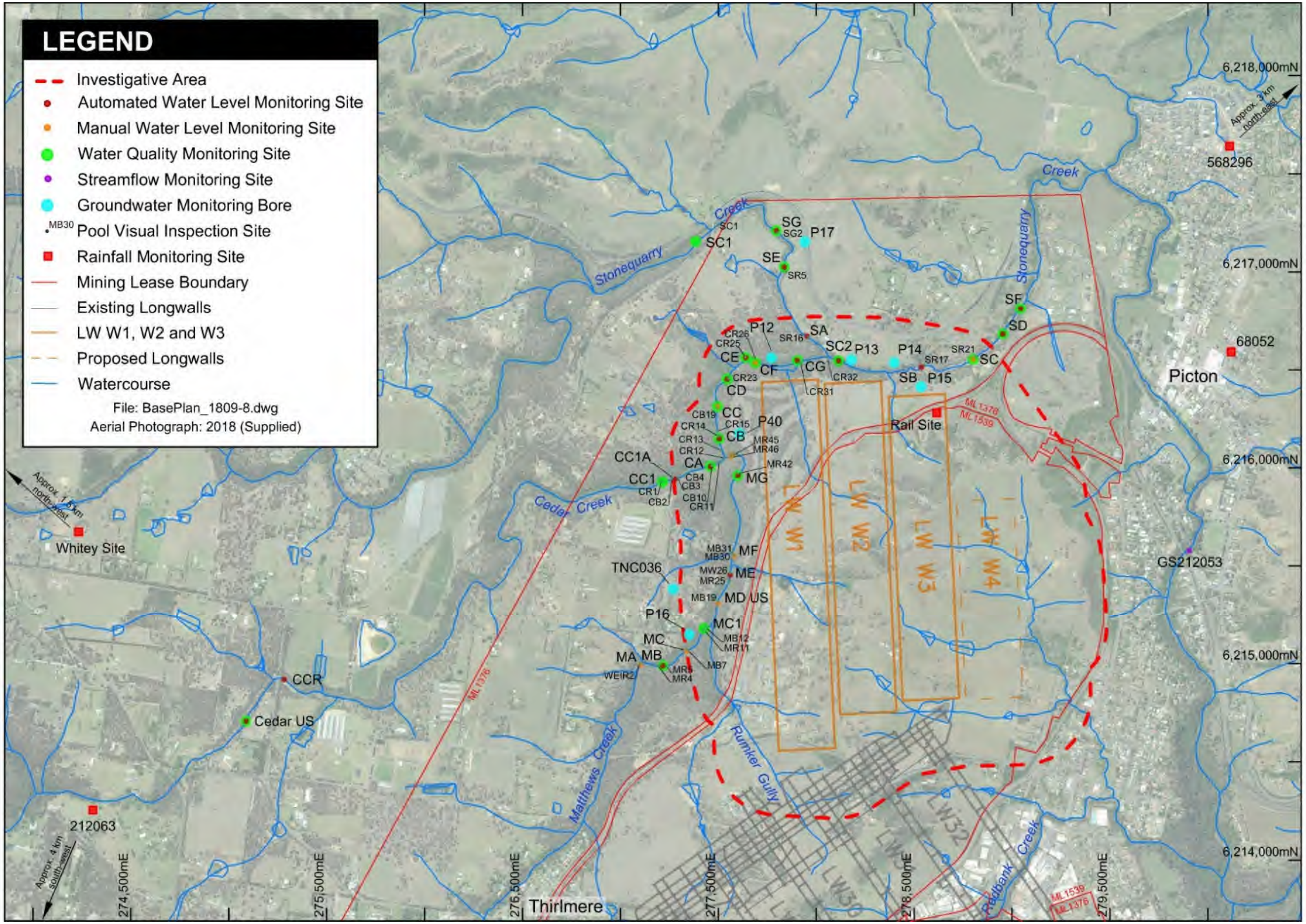



*Figure 2-5 LW W3-W4 Surface Water Monitoring Locations (source: ATC Williams, Surface Water Reviews, Appendix B)*

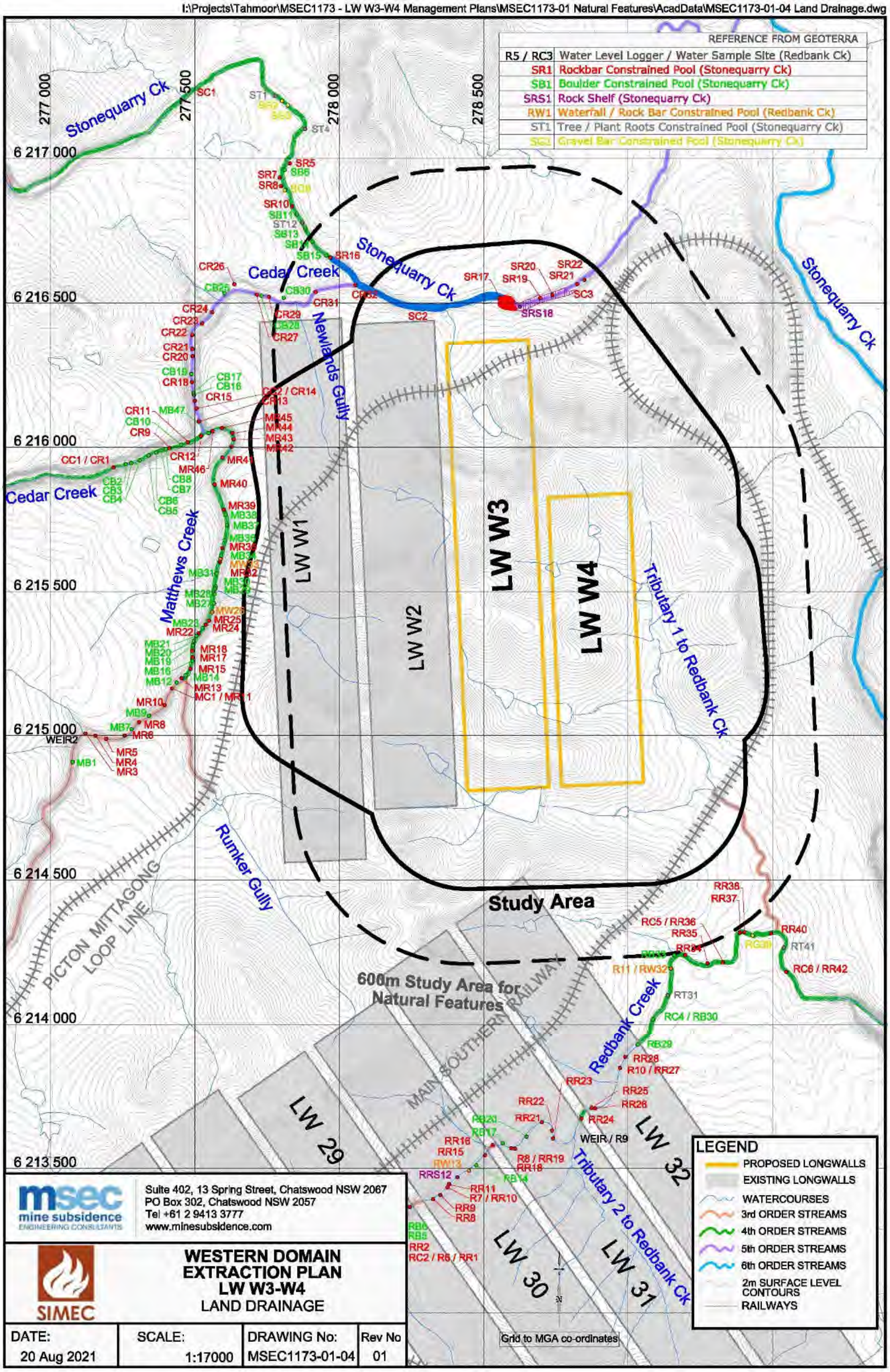



*Figure 2-6 LW W3-W4 Creek Monitoring Locations (source: MSEC, 2021; LW W3-W4 Subsidence Predictions and Impact Assessment Report)*

## 2.3 Groundwater Monitoring

The LW W3-W4 Water Management Plan were prepared to manage the potential environmental consequences of LW W3-W4 extraction on groundwater 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 groundwater:

- Shallow groundwater levels, quality and pressures, and deep groundwater levels / pressures – monthly monitoring data reviewed and reported by SLR on a monthly (during mining) and quarterly (post-mining) basis (refer to **Appendix D**); and
- Mine water intake – data for this reporting period reviewed and reported by SLR (refer to **Appendix D**).

The following sections summarise the observations made during the reporting period for each groundwater category. Performance against all Groundwater Management Plan TARPs for the reporting period are summarised in **Table 3-3** and **Table 3-4**, and actions and responses completed relating to any TARP triggers are discussed in **Section 3.2.**

### 2.3.1 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 2-7**.

Further detail on the below groundwater level triggers, including graphs showing progressive groundwater levels, are provided in the SLR groundwater reports (refer to **Appendix D**). Further detail and discussion of TARP triggers for groundwater level are also discussed in **Section 3.2.4**.

#### *2.3.1.1 Monitoring bores*

At most monitoring sites, groundwater levels have clearly responded to the above average rainfall condition observed throughout December 2021 to 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.

Groundwater level at P12 is still recovering from a maximum groundwater depressurisation of 11m in February 2021 at P12C. As of December 2022, groundwater levels at sites P12 are within baseline level for P12A, 0.5m above baseline level for P12B, and mostly recovered to a level of 178.4 mAHD at P12C by December 2022.

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. Groundwater levels at P14 and P15 sites remained above the creek bed elevation, suggested strengthening of baseflow conditions along Stonequarry Creek over the reporting period. Groundwater levels at P14A were observed at 1.2 m above baseline levels (at 169.9 mAHD) as of December 2022.

Groundwater levels at P16A remains with groundwater levels approximately 1m below baseline levels throughout the reporting period. A localised long-term impact on groundwater levels is to be considered at P16A. Deeper groundwater levels (P16B and P16C) 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. Additional groundwater monitoring data will inform whether post mining conditions (i.e. following valley closure) will allow groundwater to completely recover at P16 sites.

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 during mining, groundwater levels at P40 demonstrated overall recovery. At the end of the reporting period, groundwater levels at P40A, B, C and D remained above the surveyed creek bed elevation at Cedar Creek which favour baseflow condition (i.e. gaining condition) in the vicinity of surface monitoring site CB.

#### *2.3.1.2 Private bores*

No groundwater depressurisation or reduction in yield was observed at the private bores with available groundwater levels across the Western Domain. Groundwater levels in the private bores (i.e. where available) generally responded to rainfall events. No effects on groundwater levels due to post-mining operations at LW W4 during the reporting period were identified.

### 2.3.2 Groundwater Pressures

Five VWP arrays have been installed at locations TNC36, TNC40, TNC43 and WD01 and P41 (refer to **Figure 2-7**). TNC043 was decommissioned due to terminated site access and has been removed from the TARP assessment from July 2022 onwards.

Further detail on the below groundwater level triggers, including graphs showing progressive groundwater levels, are provided in the SLR groundwater reports (refer to **Appendix D**). Further detail and discussion of TARP triggers for groundwater level are also discussed in **Section 3.2.5** and **Section 3.2.6**.

LW W3 and LW W4 extraction had no significant effects on shallow and deep groundwater across the Western Domain throughout the reporting period.

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).

A period of stable groundwater level was identified between October 2021 and February 2022 in the upper Hawkesbury Sandstone aquifer at TNC36 in the three upper instruments HBSS-65m, HBSS-97m and BGSS-169m. From February 2022, groundwater recovery in the Hawkesbury Sandstone aquifer improved at TNC036 in the three upper instruments HBSS-65m, HBSS-97m and BGSS-169m. The rate of recovery accelerated in late February 2022 at all monitoring sites due to the completion of LW W3, and the exceptional wetter condition in February-March 2022. Groundwater level at TNC036 HBSS-97m and HBSS-169m had recovered to 188.3 mAHD and 181.8 mAHD at the end of the reporting period, respectively.

Deeper strata at TNC036 (BGSS-214m) showed 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). As of December 2022, levels at BGss-214m had recovered to above the modelled drawdown.

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).

### 2.3.3 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.

Water make calculations provide an indication of the groundwater pumped out of the total Tahmoor Mine underground workings, which include water make from the Western Domain.

SLR completed an analysis of water make for Tahmoor Mine recorded between 1 January 2009 to 31 December 2022 (**Appendix D**). During this period, observed inflows to Tahmoor Mine have been ranging between 2 to 6 ML/d.

The 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.

The Western Domain blocks have been sealed in October 2022 and since then an average groundwater inflow of 2.3 ML/day has been reported from the Tahmoor North workings. Groundwater entitlement was not exceeded for the 2022-23 water year and as of December 2022 remain below the limit for the 2022-23 water year (based on a pro-rata calculation).

### 2.3.4 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 2-7**.

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 reports included in **Appendix D**. Further detail and discussion of TARP triggers for groundwater quality are also discussed in **Section 3.2.7**.

#### 2.3.4.1 Electrical conductivity and pH

The recovery in groundwater levels at the open standpipes is accompanied by stable pH and EC across the Western Domain.

During the reporting period, elevated pH levels were noted at P12B and P16C. At P12B, the elevated pH was noted since October 2021 and was confirmed to be related to the integrity of the bore rather than mining impact. These elevated levels were recorded during a period of above average rainfall.

During the reporting period, elevated EC levels were noted at P15A-D, P16A and GW115860. An increasing trend in EC at these sites was noted to be minor, and the cause of the increase remains difficult to assess as baseline data is not available. The salinity at GW115860 has been steadily increasing from 621 µS/cm in January 2021 to 1,246 µS/cm in March 2022. The beneficial use classifications remain unchanged at the private bore GW115860 and no significant increase in EC was identified along Stonequarry Creek.

TARP triggers for groundwater quality are discussed are discussed further in **Section 3.2.7**.

#### 2.3.4.2 Metal concentrations

A number of elevated metal concentrations were noted during the review period, and these short-term increases (less than three months) were noted to be likely due to above average rainfall conditions during the reporting period or due to limited baseline data resulting in a conservative trigger level.

There are no clear trends in metal concentrations that may be linked to mining operations.

An increase in dissolved zinc concentrations at P16C was noted during December 2022. Natural fluctuations of zinc concentrations in nested bores P16A and P16B following rainfall events suggested that the increase at P16C (the lower Hawkesbury Sandstone) is localised. A sustained increase in groundwater levels at P16C since early 2022 could have locally mobilsed a naturally occurring source of zinc (in the range of 0.10-0.15 mg/L). Also, the mild steel casing at P16C could be contributing to a higher zinc concentration. It is likely that a natural fluctuation in groundwater quality and major flood events in 2022 are the reason for higher zinc concentrations at this bore.

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

Strontium levels at P15A exceeded the trigger of 2.31 mg/L from October 2021 to May 2022 monitoring rounds. The high remained localised during this period, 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 in June 2022, as the trigger was assessed to be too conservative for this site. Further discussion on strontium is provided in **Section 3.2.7**.

High concentrations of Ba at GW115860 were reported during the reporting period, with concentrations reaching 0.39 mg/L in January 2022. An investigation assessed that the levels were unlikely to be attributed to mining. A revised trigger level was calculated as it appeared that the trigger level was conservative and could not be based on pre-mining data.

### 2.3.5 Recommendations and Actions

#### 2.3.5.1 Current Groundwater Monitoring Recommendations

As discussed in the Groundwater Review for September to December 2022 (**Appendix D**), the following groundwater recommendations were made for this reporting period by SLR:

- Continue the monitoring program, reporting groundwater level and quality data in the next groundwater review report for January-March 2023;

- For P12C, P16B, P16C, TNC036 (HBSS-97m) and TNC036-169m with Level 2 TARPs in place for groundwater levels, continue monitoring and reviewing groundwater level response;
- 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;
- For all sites with Level 1 TARPs in place for groundwater quality, continue monitoring pH, EC and metal concentrations against TARP trigger levels;
- For all sites with Level 2 TARPs in place for groundwater quality (EC, pH and metals), continue monitoring concentrations against TARP trigger levels;
- For site P12C with a Level 2 TARP in place for groundwater quality (iron and manganese), continue closely monitoring Fe and Mn concentrations at the nearby monitoring bores (P12A and P12C);
- For site P15D with a Level 2 TARP in place for groundwater quality (iron), continue closely monitoring Fe concentrations at the nearby monitoring bores (P14A-D) and nearby private registered bores GW105228 and GW115860;
- For site P16C with a Level 3 TARP in place for groundwater quality (zinc), continue closely monitoring Zn concentrations at the nearby monitoring bores (P16A, B and private bore GW105546 and GW105467);
- For site P15A, B and C with a Level 2 TARP in place for groundwater quality (strontium), continue closely monitoring Sr concentrations at the nearby monitoring bores (P14A-D) and nearby private registered bores GW105228 and GW115860;
- For site P15A and GW105228 with a Level 2 TARP in place for groundwater quality (lithium), continue closely monitoring Li concentrations at the nearby monitoring bores (P14A-D) and nearby private registered bores GW115860;
- Complete an extended purge at P12C, P15A, P15D, P16C in the next round of monitoring to remove groundwater potentially contaminated with iron stain, grout or other localised source of metals before sampling;
- For the next round of monitoring, undertake sampling of groundwater levels and yield test at GW105546 and GW105467; and
- Investigate blockages at P16B and GW072402.

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

#### *2.3.5.2 Groundwater Recommendations from the previous Six Monthly Subsidence Impact Report (November 2022) and Quarterly Groundwater Report (September 2022)*

**Table 2-4** 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. This table also provides the recommendations as made in the previous Quarterly Groundwater Report (April to June 2022, dated 24 August 2022) that were unresolved in the previous Six Monthly Subsidence Impact Report, along with an update on the progress of these recommendations.

*Table 2-4 Groundwater recommendations from the previous Six Monthly Subsidence Impact Report and Quarterly Groundwater Report and Current Progress*

| Item | Previous Recommendation | Progress of Recommendation |
|---|---|---|
| 1 | 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. | Completed as part of this Six Monthly Subsidence Impact Report (**Sections 2.2, 2.3** and **3.2**) and **Appendix D**. |
| 2 | 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. | No exceedances of surface water level occurred during the September to December 2022 period at site SC, as discussed in **Section 2.2.2** and **Appendix B**. |
| 3 | 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. | Drilling of the new VWP borehole WD02 above LW W2 is in progress at time of writing. Trigger levels for groundwater levels for each VWP pressure sensor will be established following installation. Any exceedances in groundwater level at this site related to mining will be identified and the implications regarding height of fracturing will be considered following installation. |
| 4 | Confirm the installation depth of the pump at GW104090 and conduct work on the suspected blockage of bore GW072402. | Regarding GW104090, it has been confirmed that this private bore has no pump installed and has been reported to be sheared. An active subsidence claim with SA NSW is in place for this bore. This bore will be discontinued from the current monitoring program.<br>Regarding GW072402, it has been confirmed that this bore is blocked and there are no planned usages for this bore in the future. The reason for the blockage is unknown and unlikely to be related to mining effects. This bore will be discontinued from the current monitoring program. |

| Item | Previous Recommendation | Progress of Recommendation |
|---|---|---|
| 5 | Conduct groundwater purging at monitoring sites P15A and P16C in relation to higher strontium and zinc concentrations respectively. | Groundwater purging at monitoring sites P15A and P16C was conducted in December 2022. |
| 6 | 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. | Completed as part of this Six Monthly Subsidence Impact Report (**Sections 2.2.2, 2.2.3** and **3.2**) and **Appendix D**.<br>During October to December 2022, P16B, P16C, TNC036-97m and TNC036-169m all triggered a Level 2 TARP trigger for groundwater level. Only P16C triggered a groundwater quality TARP trigger (Level 3). |
| 7 | Continue to closely monitor concentrations of strontium at P15A and nearby groundwater monitoring sites and private bores. | Completed as part of this Six Monthly Subsidence Impact Report (**Sections 2.2.2, 2.2.3** and **3.2**) and **Appendix D**.<br>During October to December 2022, concentrations of strontium at P15A were still exceeding baseline conditions, however concentrations have continued to decrease following a peak in June 2022. |
| 8 | Convene Tahmoor Coal Environmental Response Group to review responses on a quarterly basis. | Completed on a monthly basis during this reporting period. |
| 9 | 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. | An extended purge at P15A was conducted in December 2022. Further groundwater monitoring will be conducted with groundwater quality analysed on a quarterly basis. |
| 10 | 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. |
| 11 | Complete an extended purge at P12B in the next round of monitoring to remove groundwater potentially contaminated with grout before sampling. | An extended purge at P12B was conducted in December 2022. pH at P12B was observed within normal condition during the reporting period. |

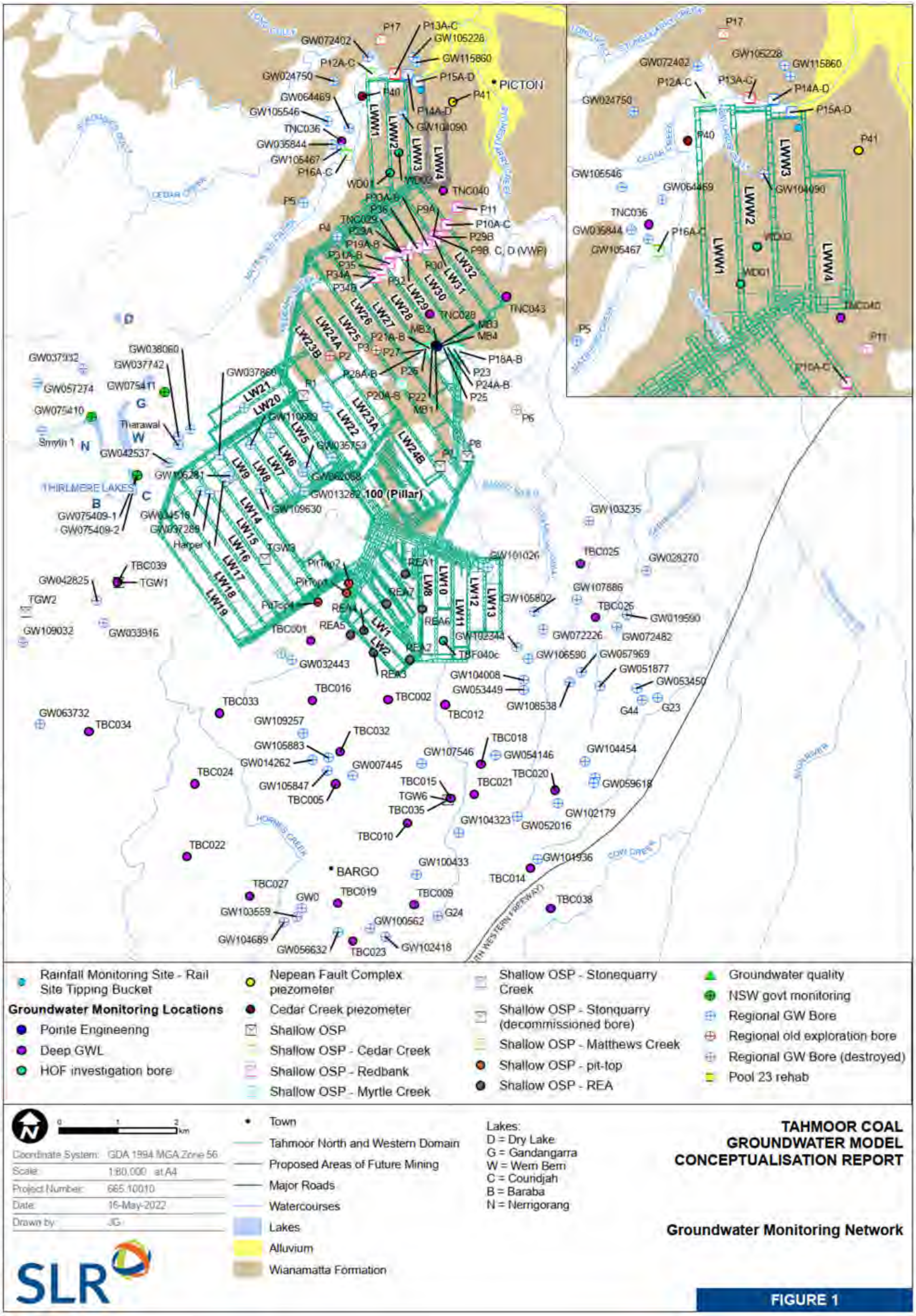



*Figure 2-7 LW W3-W4 Groundwater Monitoring Bores (source: Groundwater Six-Month Review, SLR; Appendix D)*

## 2.4 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 (during mining) and quarterly (post-mining) visual inspections and reporting by geotechnical engineers from Douglas Partners. Where deemed necessary, 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 during mining;
- Dams in active subsidence zone – weekly visual inspections and reporting by Building Inspection Services; and
- Agricultural land – monthly (during mining) and quarterly (post-mining) visual inspections and reporting by Building Inspection Service.

The following sections summarise the observations made during the reporting period for each land category. Performance against all Land Management Plan TARPs for the reporting period are summarised in **Table 3-3** and **Table 3-4**, and actions and responses completed relating to any TARP triggers are discussed in **Section 3.2.**

### 2.4.1 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 until August 2022. The purpose of the surveys was 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 2-8**.

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 2-9**), no monitoring of these features has been completed during the extraction of LW W4.

### 2.4.2 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 2-8**.

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.

### 2.4.3 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 2-10**.

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. 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, and remained unchanged since the October 2022 inspection.

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.

### 2.4.4 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 have been 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 2-11**.

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.

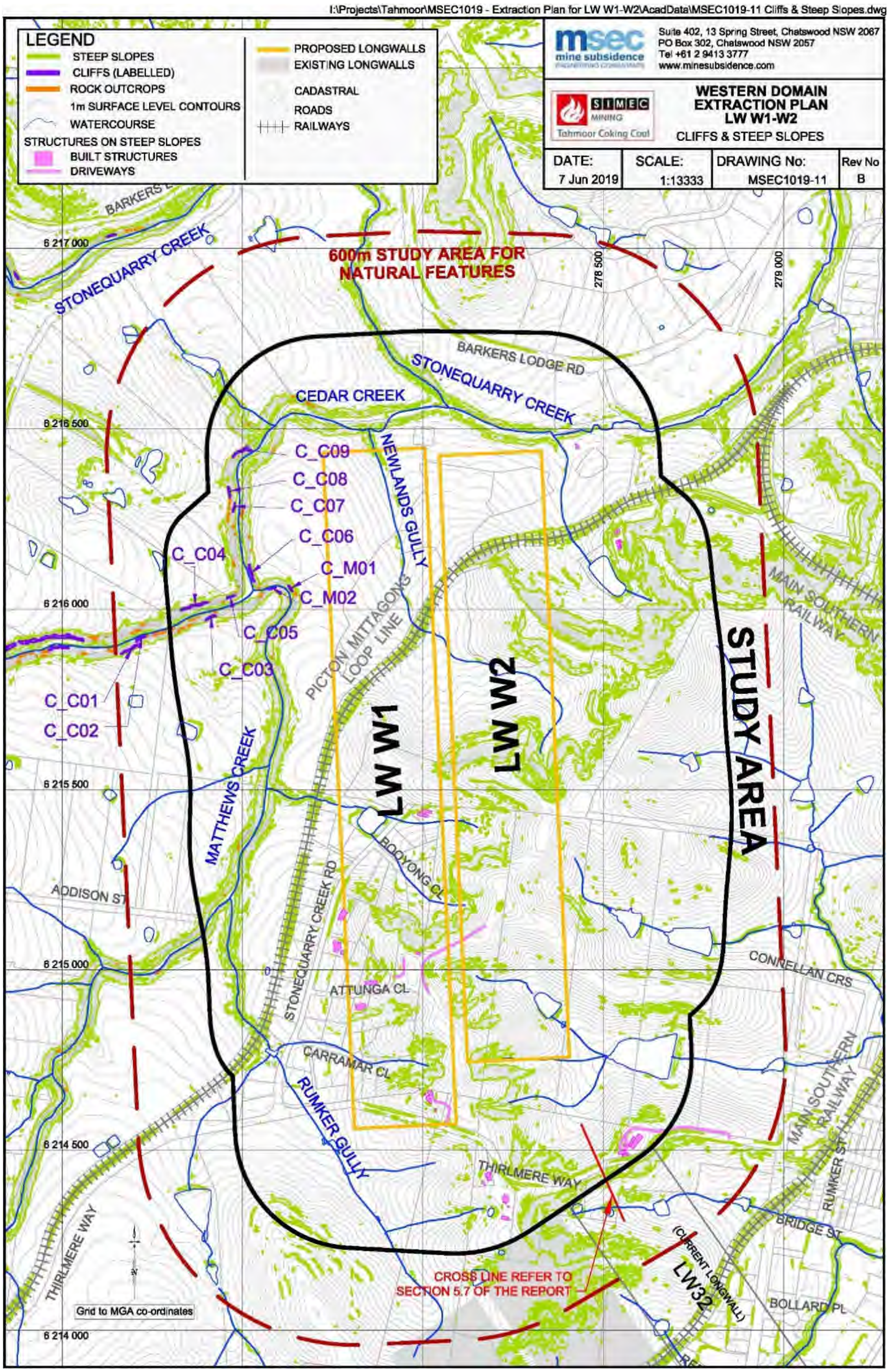



*Figure 2-8 Cliffs, rock outcrops and steep slopes within the LW W1-W2 Study Area (source: MSEC, 2019 - LW W1-W2 Subsidence Predictions and Impact Assessment Report)*

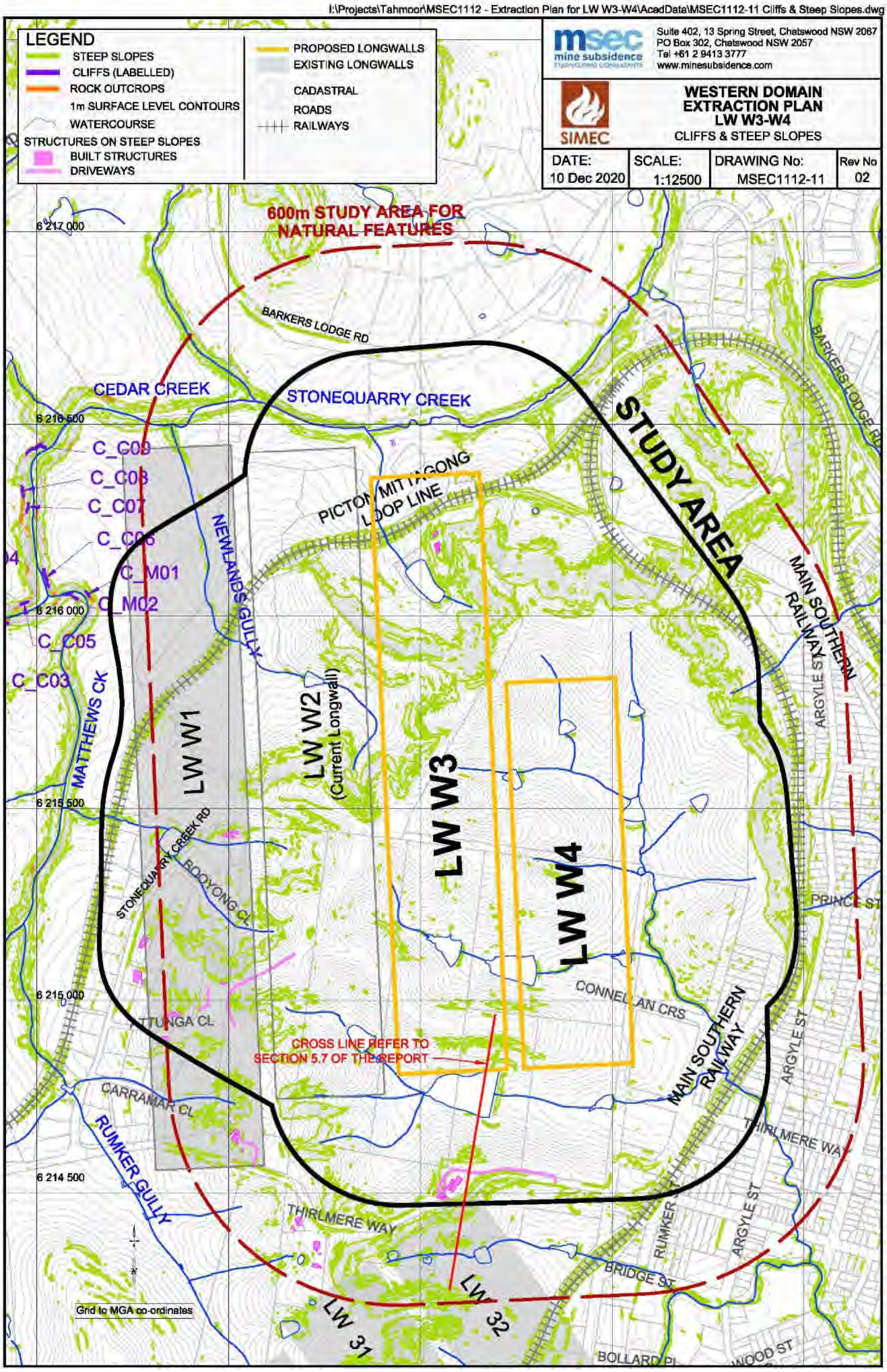



*Figure 2-9 Steep slopes within the LW W3-W4 Study Area (source: MSEC, 2021 - LW W3-W4 Subsidence Predictions and Impact Assessment Report)*

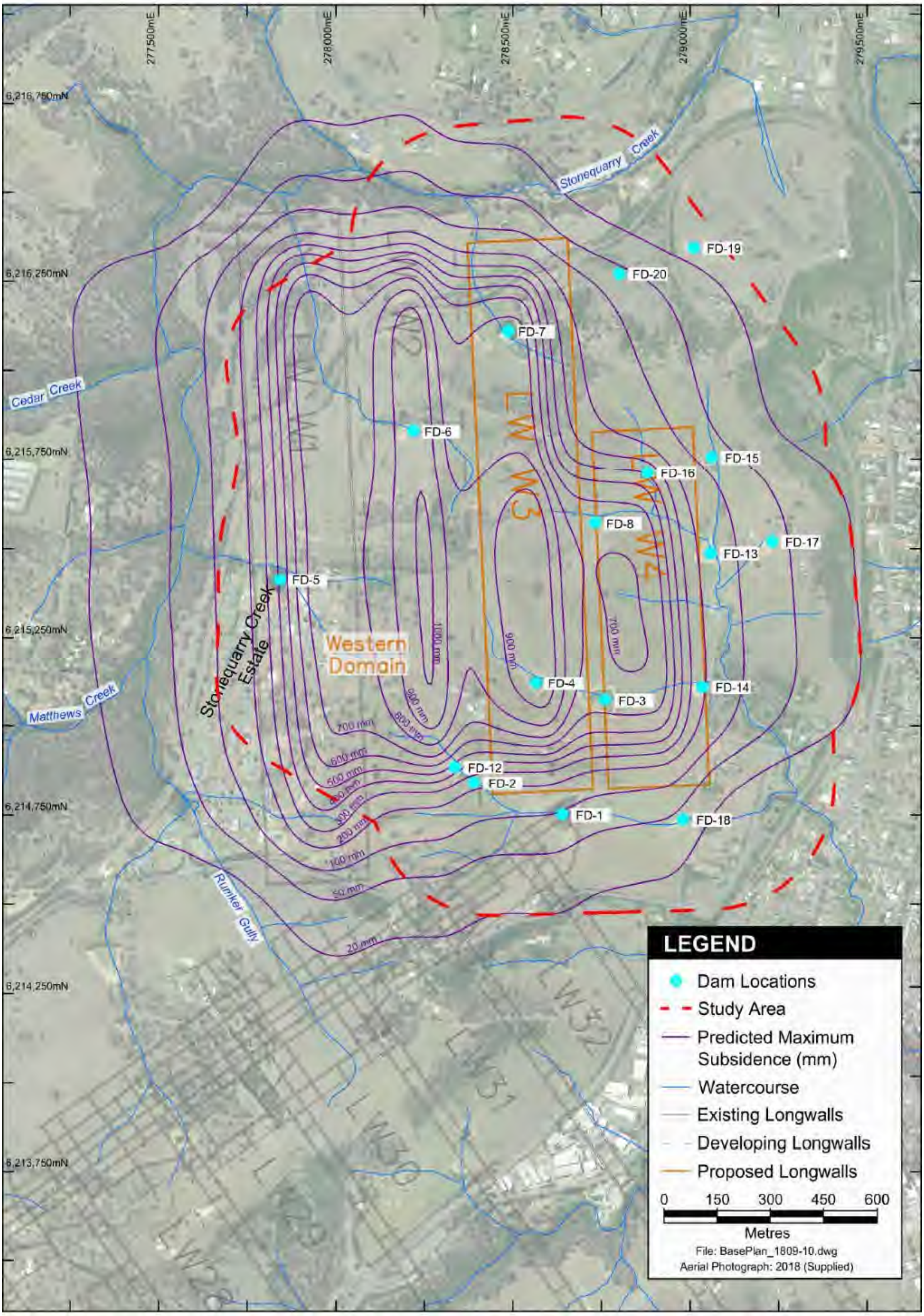



*Figure 2-10 Dams within the LW W3-W4 Study Area (source: LW W3-W4 Water Management Plan)*

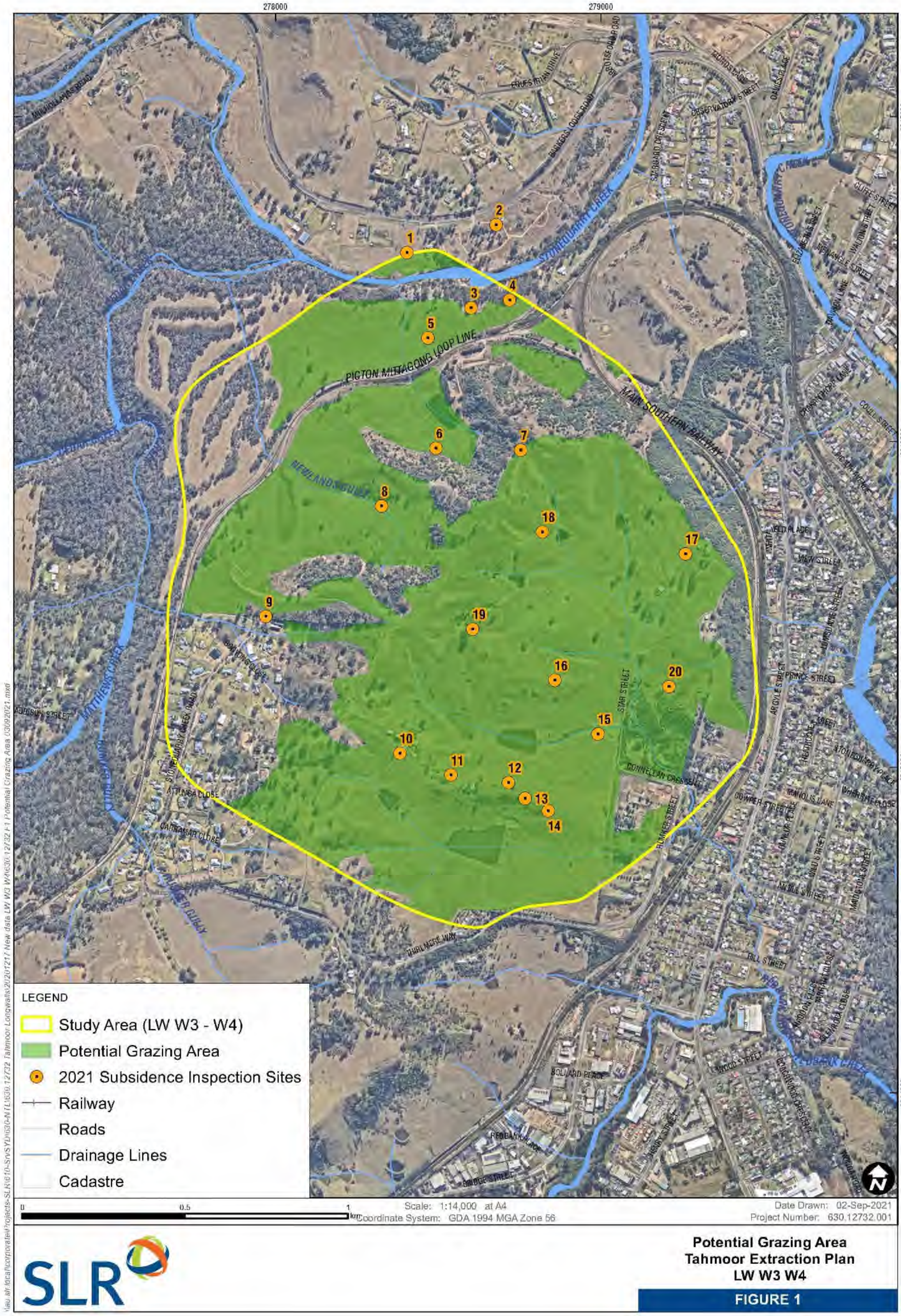



*Figure 2-11 Agricultural land and inspection points within the LW W3-W4 Study Area (source: SLR Agricultural Subsidence Monitoring LW W3-W4 Report (SLR, 2021))*

## 2.5 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 Autumn 2022 and Spring 2022 by Niche Environment and Heritage; and
- Terrestrial ecology – amphibian and riparian vegetation monitoring during Autumn 2022 and Spring 2022 by Niche Environment and Heritage.

The following sections summarise the observations made during the reporting period for aquatic and terrestrial ecology. Performance against all Biodiversity Management Plan TARPs for the reporting period are summarised in **Table 3-3** and **Table 3-4**, and actions and responses completed relating to any TARP triggers are discussed in **Section 3.2.**

### 2.5.1 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); and
    - Riparian Channel and Environment (RCE) Inventory.
- Macroinvertebrate survey:
    - AUSRIVAS macroinvertebrate sampling;
    - Quantitative benthic macroinvertebrate monitoring program; and
    - Water quality sampling.

The aquatic ecology monitoring program is primarily focused on macroinvertebrate monitoring regimes including AUSRIVAS and quantitative using Before After Control Impact (BACI) design. A total of 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 2-12**.

#### *2.5.1.1 Autumn 2022 Monitoring Results*

Aquatic monitoring for autumn 2022 was conducted by Niche Environment and Heritage in March 2022. The following results were observed for Autumn 2022 monitoring:

- There was aquatic habitat present at all sites in autumn 2022;
- All sites had similar riparian and channel condition prior to pre-mining sampling, except for SQC4 which has been subject to habitat modifications a result of causeway construction by a landowner;
- AUSRIVAS OE50 scores were generally comparable to pre-mining stream surveys, despite fluctuations in scores and associated Bands in autumn 2022 when compared to spring 2021;
- SIGNAL2 scores were low but were comparable to pre-mining scores and indicated more moderate levels of pollution or environmental stress in autumn 2022 than in recent surveys;
- Ephemeroptera Plecoptera Trichoptera (EPT) scores at all sites were similar or slightly increased when compared to pre-mining surveys;

- Number of taxa 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); and
- The assemblage results in autumn 2022 were different to those of previous surveys, reflecting the prevailing elevated flows and associated changes in habitats present.

#### *2.5.1.2 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; and
- 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 and subsidence impact monitoring 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.

### 2.5.2 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

- o 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 2-13**.

#### *2.5.2.1 Autumn 2022 Monitoring Results*

Riparian vegetation monitoring for Autumn 2022 was conducted by Niche Environment and Heritage between 21-26 April 2022, and amphibian monitoring for Autumn 2022 was conducted between 11-19 April 2022.

The following results were observed for Autumn 2022 monitoring:

**Riparian monitoring:**

- River-flat Eucalypt Forest, which is listed as an EEC under the BC Act, was recorded at control Site 9 and impact Site 11, along Stonequarry Creek;
- Autumn 2022 impact Sites had a slightly higher mean flora species richness than control Sites. However, control Sites had higher percentage vegetation cover than impact Sites. This is likely due to persistent rainfall patterns, stream morphology, human disturbance and altered flow regimes (e.g., flood events) increasing weed dominance at control Sites;
- Sites 3, 5, 6, 7, 8 and 9 appeared to be more influenced by seasonal changes and flooding events (e.g. witnessed in 2020, 2021 and 2022) than Sites further up the catchment (Sites 4, 10 and 11) which tended to be protected in deep gullies and canyons; and
- Statistical analyses identified a significant difference between vegetation cover for 'After' data between control and impact Sites, specifically, Autumn 2021 and Autumn 2022. Given that there were noticeable reductions in vegetation cover across control Sites 6, 7, 8 and 9, as well as impact Site 5, impacts cannot be attributed to mining. Based on stream morphology, persistent rainfall during the La Niña climatic period, and other associated factors, these Sites appeared to be heavily affected by the recent (March 2022) flooding event (e.g. destabilisation of the embankments, loss of riparian vegetation and large accumulation of flood debris). Continuation of monitoring is recommended to observe the recovery of vegetation cover with time, at impact and control Sites post-natural disaster event.

**Amphibian monitoring:**

- Amphibian detection rates were variable between Before and After monitoring for most Sites. In Autumn 2022, the most widespread and abundant amphibian species was the Common Eastern Froglet (*Crinia signifera*), which was detected at all but two of the Sites. Stony Creek Frog (*Litoria lesueuri*) was detected at two of the nine Sites, one of which is an impact Site (Sites 3). The greatest number of amphibians detected were at Site 11 (impact) with 35 Common Eastern Froglet individuals recorded;
- For all Autumn data, there was a significant difference in amphibian assemblages at the control Sites and impact Sites, and a significant difference in amphibian assemblages Before and After. There was also a significant BACI interaction for amphibian assemblages. This means the 'Impact' had a significantly different effect on control Sites, when compared with impact Sites. However, amphibian numbers appear to have increased at impact Sites (After), while control Sites appear to have a similar number of individuals for before and after. Given amphibian numbers are increasing at impact Sites, the BACI interaction for this round of monitoring appears not to be a viable indicator of mining impacts;

- The two amphibian species detected represent an otherwise normal assemblage of common species that may be expected to be present in the Study Area under the current climatic conditions;
- The targeted threatened amphibian species were not detected during the survey and appear not to be present in the Study Area, at least not in numbers that can be detected by the current monitoring program. While the Study Area contains superficially suitable habitat, it is possible that the species would no longer be able to survive in the area due to the impact of the multiple flooding events that have occurred over the past three years, including a major flooding event that preceded the Autumn 2022 surveys. Predation pressures from two introduced predators: the Plague Minnow and the Freshwater Crayfish (*Cherax destructor*), both of which were detected at all Sites, may also be impacting on the suitability of the habitat for these threatened frogs; and
- Amphibian detection rates fluctuated between monitoring events for most Sites, likely due to the highly variable weather and climatic conditions experienced across all monitoring events.

#### *2.5.2.2 Spring 2022 Monitoring Results*

Riparian vegetation monitoring for Spring 2022 was conducted by Niche Environment and Heritage between 30 October and 4 November 2022, and amphibian monitoring for Spring 2022 was conducted between 25–27 October 2022.

The following results were observed for Spring 2022 monitoring:

**Riparian monitoring:**

- River-flat Eucalypt Forest, which is listed as an Endangered Ecological Community (EEC) under the NSW Biodiversity Conservation Act 2016 (BC Act), and Critically Endangered Ecological Community (CEEC) under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) was recorded at control Site 9 and impact Site 11, along Stonequarry Creek;
- Spring 2022 impact Sites had a slightly lower mean flora species richness than control Sites. Similarly, vegetation cover was lower at impact Sites, when compared to control Sites. This is likely due to persistent rainfall patterns, human disturbance and altered flow regimes increasing weed dominance at control Sites;
- For Spring 2022, there was a significant BACI interaction for vegetation cover between control and impact Sites. The results of the analyses indicate that vegetation cover at control Sites is shifting differently to impact Sites. Exotic vegetation cover had increased at control sites compared to impact sites. However, the native cover has reduced at both control and impact Sites, indicating they were affected in a similar way in response to severe flooding. Given that the reduction in native cover was observed at both impact and control Sites, there are no detectable subsidence related impacts on riparian vegetation; and
- Sites 3, 7, 8 and 9 tended to have higher soil fertility and organic matter loads, which lead to higher species diversity and generally more exotic species. These Sites appeared to be more influenced by seasonal changes and flooding events (e.g., 2021 and 2022) than those Sites further up the catchment (Sites 4, 5, 6 and 10) that tended to be protected in deep gullies and canyons.

**Amphibian monitoring:**

- Amphibian detection rates were variable between Before and After monitoring for most Sites. In Spring 2022, the most widespread amphibian species was the Common Eastern Froglet (*Crinia signifera*), which was detected at all but one of the Sites. Striped Marsh Frog (*Limnodynastes peronii*) and Stony Creek Frog (*Litoria lesueuri*) were both detected at five of the nine Sites, three of which are impact Sites (Sites 4, 5, 11). The greatest number of amphibians detected was at Site 4 with 38 Stony Creek Frog individuals recorded;
- There was no significant difference in species diversity between control Sites and impact Sites;
- The seven amphibian species detected represent an otherwise normal assemblage of common species that may be expected to occur in the Study Area under the current climatic conditions;
- The targeted threatened amphibian species were not detected during the survey and appear not to be present in the Study Area, at least not in numbers that can be detected by the current monitoring program. While the Study Area contains superficially suitable habitat, it is possible that the species would no longer be able to survive in the area due to the presence of two introduced predators: the Plague Minnow and the Yabby, both of which were detected at all Sites;
- The amphibian community present contains at least seven species which are likely still viable indicators of impending or current environmental change; and
- Amphibian detection rates fluctuated between monitoring events for most Sites, likely due to the highly variable weather and climatic conditions experienced across all monitoring events.

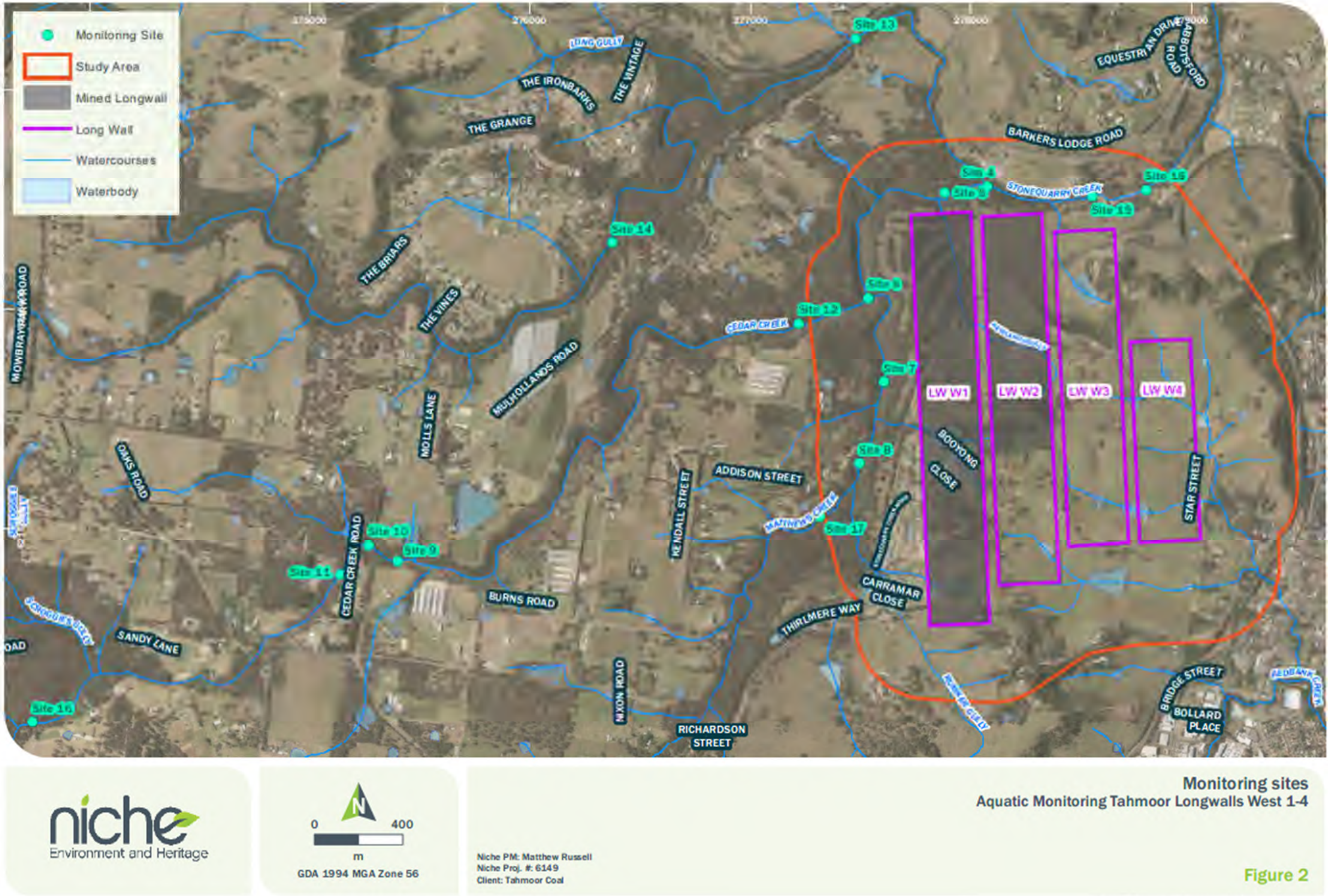



*Figure 2-12 LW W1-W4 Aquatic Ecology Monitoring Locations (source: Niche, 2022a)*

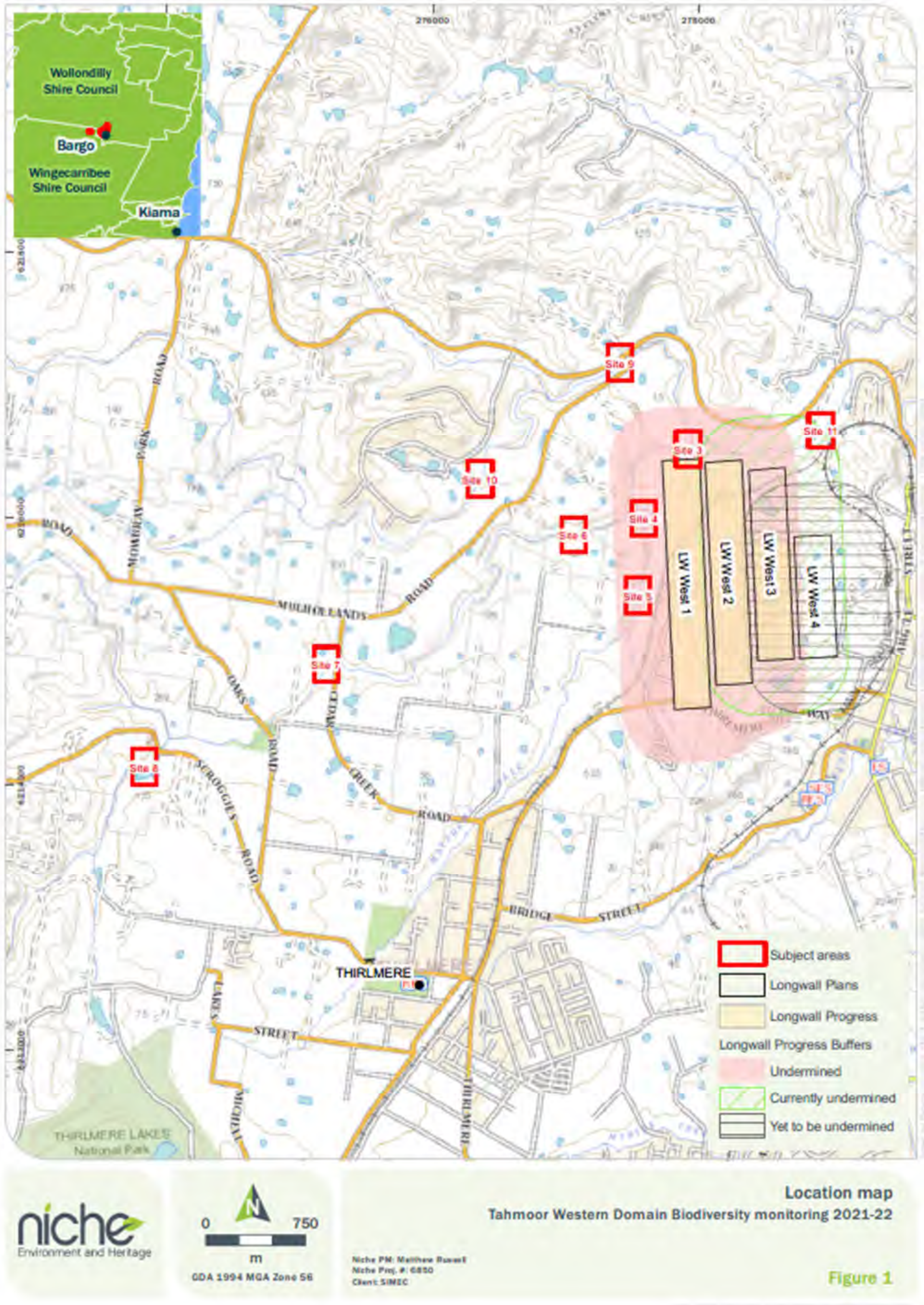



*Figure 2-13 LW W1-W4 Terrestrial Ecology Monitoring Locations (source: Niche, 2022b)*

## 2.6 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.

The following sections summarise the observations made during the reporting period for Aboriginal and historical heritage items. Performance against all Heritage Management Plan TARPs for the reporting period are summarised in **Table 3-3** and **Table 3-4**, and actions and responses completed relating to any TARP triggers are discussed in **Section 3.2.**

### 2.6.1 Aboriginal Heritage

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 Aboriginal heritage items:

- 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** for referenced reports); and
    - LW W3 and LW W4 End of panel review of Aboriginal heritage items by an EMM Archaeologist and RAP representatives (EMM, 2022a; EMM, 2022b).
- Scarred Tree:
    - LW W3 and LW W4 end of panel review of Aboriginal heritage items by an EMM Archaeologist and RAP representatives (EMM, 2022a; EMM, 2022b).

#### LW W3 End of Panel Aboriginal Heritage Review

An end of panel monitoring inspection following LW W3 extraction was carried out by an EMM archaeologist and a RAP representative on 26 April 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 W3 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 2-14**.

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

The grinding groove site (AHIMS #52-2-2068) has been monitored during LW W3 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 3.2.8**. The Subsidence Technical Committee confirmed that fracturing was identified approximately 40 m downstream of the nearest grinding grove 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.

### LW W4 End of Panel Aboriginal Heritage 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, 2022c). 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 2-14**.

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 3.2.8**. The Subsidence Technical Committee confirmed that the fracturing was identified approximately 40 m downstream of the nearest grinding grove 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.

### 2.6.2 Historical Heritage

During this reporting period, the LW W3-W4 Heritage Management Plan was implemented to monitor subsidence impacts for the following historical heritage items:

- Sandstone and brick culverts along the PMLL:
  - Monthly visual inspection by Newcastle Geotechnical; and
  - End of panel review of PMLL historical heritage items by an EMM Archaeologist (refer to **Appendix E** for referenced reports; EMM, 2022c; EMM, 2022d).
- Weatherboard House:
  - End of panel review by an EMM Archaeologist (EMM, 2022e).

### LW W3 End of Panel Historical Heritage Review

EMM consultants completed an end of panel monitoring inspection on 5 April 2022 focused on the eight historical brick and sandstone culverts within the Study Area of LW W3-W4 (**Appendix E**). The locations of historical heritage items are illustrated in **Figure 2-15** and **Figure 2-16**.

During the extraction of LW W3, the culverts have been continuously monitored at weekly intervals by Mark Delaney, principal engineering geologist at Newcastle Geotech, as part of the subsidence monitoring program.

As discussed in **Section 3.2.9** of this report, visual inspections during the previous reporting period noted the development of a number of 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 occurred.

Following the completion of LW W3 mining, 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 following the completion of LW W3 mining.

### LW W4 End of Panel Historical Heritage Review

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 2-15** and **Figure 2-16**.

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.

Following the completion of LW W4 mining, 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**).

The removal of the RCP sleeves from the PMLL culverts following the completion of mining in the Western Domain enabled a full inspection of the culverts. This inspection noted cracking in the sandstone culvert at 88.400 km that had formed during the extraction of longwalls in the Western Domain.

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.

This information has been retracted

- For more information contact Tahmoor Coal


*Figure 2-15 Historical Heritage Sites (registered sites) in the LW W3-W4 Study Area and Surrounds (Source LW W3-W4 Heritage Management Plan)*

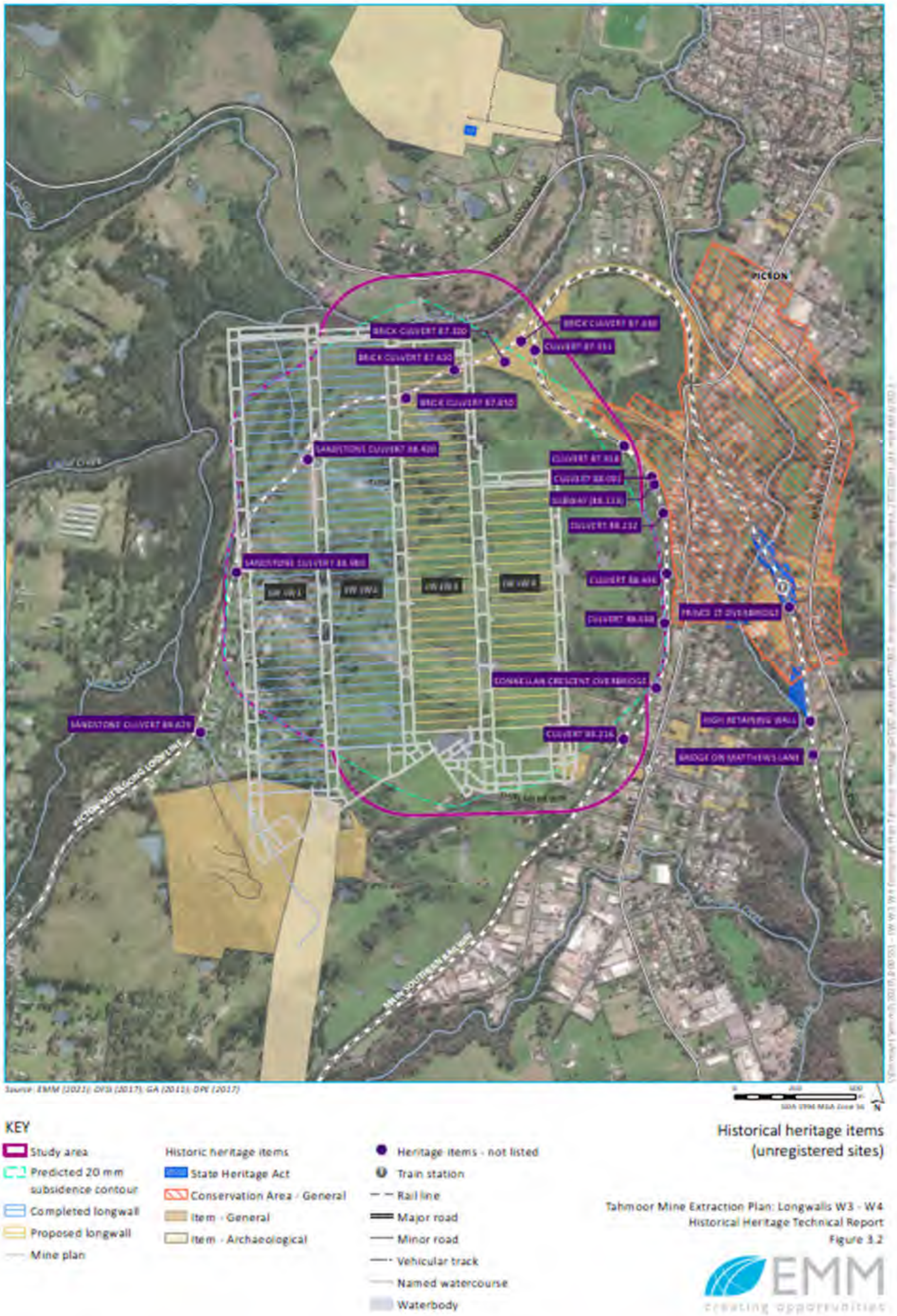



*Figure 2-16 Historical Heritage Sites (unregistered sites) in the LW W3-W4 Study Area and Surrounds (Source LW W3-W4 Heritage Management Plan)*

## 2.7 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 2-4**.

A weekly review of the subsidence survey results during the reporting period has been completed by MSEC, in addition to end of panel reports following the completion of LW W3 and LW W4, and one post-mining report following the completion of LW W4 (referred documents provided in **Appendix A**).

The following sections summarise the observations made during the reporting period for built infrastructure. Performance against all built infrastructure TARPs for the reporting period are summarised in **Table 3-3** and **Table 3-4**, and actions and responses completed relating to any TARP triggers are discussed in **Section 3.2.**

A comparison between assessed and observed impacts to surface features is summarised in Table 3 of the MSEC LW W3 Subsidence Monitoring Report 27 and Table 3 of the MSEC LW W4 Subsidence Monitoring Report 20 (refer to **Appendix A**).

### 2.7.1 Local Roads and Built Structures

A number of impacts to local roads and built structures occurred during the reporting period, as summarised below:

- Stonequarry Creek Road - impacts to kerb drain (January 2022) and a property (March 2022);
- Connellan Crescent - impacts to road surface (March 2022);
- Carramar Close - impacts to road surface (March 2022);
- Booyong Close - impacts to a property (March 2022); and
- Thirlmere Way - impacts to road surface (March 2022).

Impacts noted during LW W3 and LW W4 extraction were noted to be largely related to large rain events (end February to early March 2022) and heavy traffic as opposed to subsidence.

Where appropriate, Tahmoor Coal has completed temporary repairs to roads and built structures within the Stonequarry Estate and Thirlmere Way. All residential impacts have been referred to SA NSW.

### 2.7.2 Main Southern Railway

Two Blue Level Triggers were noted on the Main Southern Railway during the reporting period (as discussed in **Section 3.2.10**), however these changes were also attributed to rainfall events rather than mine subsidence.

### 2.7.3 Picton Mittagong Loop Line

The two sandstone culverts on the PMLL that have been impacted by subsidence (as discussed in **Section 2.6**) will be remediated.

### 2.7.4 Transport NSW Infrastructure

Very gradual and minor closure was observed to develop across Stonequarry Creek at Victoria Bridge, which is located approximately 1000 metres from LW W3. The timing of the closure coincided with the final stages of mining LW W3, a period of heavy rainfall and completion of abutment strengthening works by TfNSW. Visual inspections did not identify any impacts associated with mine subsidence however 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 showed a reduction throughout the remainder of and after LW W4 mining completion. TfNSW has agreed to continue surveys on a monthly period, unless adverse changes are observed. Automated, continuous monitoring of GNSS units and laser distance meters will continue to monitor continuously and results will be reported once a month.

### 2.7.5 Other Built Features

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

## 2.8 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 2.4** 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 2.7** 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.

# 3 Overview of Impacts and Actions

## 3.1 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).

**Table 3-1** and **Table 3-2** provides a summary of the TARP levels that support the LW W3-W4 Extraction Plan. A summary of monitoring results for relevant TARPs is given in **Table 3-3** and **Table 3-4**. A full list of TARPs for environmental features that are applicable is provided in Appendix D of the LW W3-W4 Extraction Plan.

*Table 3-1 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 3-2 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 3-3 Summary of TARP Triggers for January to June 2022*

| Aspect | Feature | Corresponding Management Plan and TARP | January 2022 | February 2022 | March 2022 | April 2022 | May 2022 | June 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] |
| | 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. |
| | Natural drainage behaviour | Water Management Plan – Impact to pool level, natural drainage behaviour or overland connected flow | LEVEL 3 TRIGGERED[2] Natural drainage behaviour trigger occurred at monitoring site SB (Pool SR17) in Stonequarry Creek. | LEVEL 3 TRIGGERED[2] Natural drainage behaviour trigger occurred at monitoring site SB (Pool SR17) in Stonequarry Creek. | 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 TRIGGERED[2] 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 TRIGGERED[2] Natural drainage behaviour trigger occurred at monitoring site SB (Pool SR17) in Stonequarry Creek. |
| | 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. |
| | Stream water quality | Water Management Plan – Stream water quality impact | LEVEL 2 TRIGGERED[3] Surface water quality triggers occurred in CB (AI), SC2 (AI), SC (AI) and SD (AI). | LEVEL 2 TRIGGERED[3] Surface water quality triggers occurred in CG (AI). | LEVEL 2 TRIGGERED[3] Surface water quality triggers occurred at CA (AI), CG (AI), SC2 (AI), SC (AI) and SD (AI). | LEVEL 2 TRIGGERED[3] Surface water quality triggers occurred at CG (AI), SC2 (AI) and SC (AI). | LEVEL 2 TRIGGERED[3] Surface water quality triggers occurred at CG (AI), SC2 (AI) and SC (AI). | LEVEL 2 TRIGGERED[3] Surface water quality triggers occurred at CG (AI). |
| Groundwater | Groundwater bore level | Water Management Plan – Groundwater levels at monitoring bores and private groundwater bores | LEVEL 3 TRIGGERED[4] Water level trigger occurred at piezometers P12C and P16C. | LEVEL 3 TRIGGERED[4] Water level trigger occurred at piezometers P12C and P16C. | LEVEL 3 TRIGGERED[4] Water level trigger occurred at piezometers P12C and P16C. | LEVEL 3 TRIGGERED[4] Water level trigger occurred at piezometers P12C and P16C. | LEVEL 3 TRIGGERED[4] Water level trigger occurred at piezometer P16C. | LEVEL 3 TRIGGERED[4] Water level trigger occurred at piezometer P16C. |
| | | | LEVEL 2 TRIGGERED[5] Water level trigger occurred at piezometers P16B. | LEVEL 2 TRIGGERED[5] Water level trigger occurred at piezometers P16B. | LEVEL 2 TRIGGERED[5] Water level trigger occurred at piezometer P16B. | LEVEL 2 TRIGGERED[5] Water level trigger occurred at piezometer P16B. | LEVEL 2 TRIGGERED[5] Water level trigger occurred at piezometers P12C and P16B. | LEVEL 2 TRIGGERED[5] Water level trigger occurred at piezometers P12C and P16B. |
| | Shallow groundwater pressures | Water Management Plan – Shallow groundwater pressures at VMPs TNC036, TNC040, and TNC034 | LEVEL 4 TRIGGERED[6] Depressurisation trigger occurred at TNC36 (intakes 97 mbgl). | LEVEL 4 TRIGGERED[6] Depressurisation trigger occurred at TNC36 (intakes 97 mbgl). | LEVEL 3 TRIGGERED[7] Depressurisation trigger occurred at TNC36 (intake 97 mbgl). | LEVEL 3 TRIGGERED[7] Depressurisation trigger occurred at TNC36 (intake 97 mbgl). | LEVEL 3 TRIGGERED[7] Depressurisation trigger occurred at TNC36 (intake 97 mbgl). | LEVEL 3 TRIGGERED[7] Depressurisation trigger occurred at TNC36 (intake 97 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). | 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[9] Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl). | LEVEL 2 TRIGGERED[9] Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl). | LEVEL 2 TRIGGERED[9] Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl). | LEVEL 2 TRIGGERED[9] Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl). | LEVEL 2 TRIGGERED[9] Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl). | LEVEL 2 TRIGGERED[9] Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl). |

| Aspect | Feature | Corresponding Management Plan and TARP | January 2022 | February 2022 | March 2022 | April 2022 | May 2022 | June 2022 |
|---|---|---|---|---|---|---|---|---|
| | Groundwater quality | Water Management Plan – Groundwater quality at monitoring bores and private groundwater bores | POTENTIAL LEVEL 4 TRIGGERED[10] Groundwater quality triggers occurred in P15A (Sr), GW115860 (EC and Ba). | POTENTIAL LEVEL 4 TRIGGERED[10] Groundwater quality triggers occurred in P15A (Sr). | POTENTIAL LEVEL 4 TRIGGERED[10] Groundwater quality triggers occurred at P12B (pH upper), P15A (Sr). | POTENTIAL LEVEL 4 TRIGGERED[10] Groundwater quality triggers occurred at P12B (pH upper), P15A (Sr). | POTENTIAL LEVEL 4 TRIGGERED[10] Groundwater quality triggers occurred at P12B (pH upper), P15A (Sr). | LEVEL 2 TRIGGERED[11] 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 TRIGGERED[11] Groundwater quality triggers occurred in P12B (pH upper), P14B (Al), GW104090 (Ba, Sr), GW105228 (Ba), GW072402 (Ba). | LEVEL 2 TRIGGERED[11] Groundwater quality triggers occurred in P12A (Cu, Pb), P12B (pH upper), P14A (Li), P14C (Al), P15B (Sr), P15A (EC), P15C (Sr, Al), P15D (Fe, Ba), P16B (Sr). | LEVEL 2 TRIGGERED[11] Groundwater quality triggers occurred at P12B (Li), P15A (EC), P15B (EC), P15C (Sr, Mn), P16B (Fe). | LEVEL 2 TRIGGERED[11] Groundwater quality triggers occurred at P12B(Al), P15A (EC), P15B (EC, Zn, Sr), P15D (Fe), GW115860 (EC) | LEVEL 2 TRIGGERED[11] Groundwater quality triggers occurred at P14A (Zn), P14C (Zn), P14D (Zn), P15A (EC), P15B (EC, Zn), P15C (Fe), P15D (Fe), P16A (Zn), P16B (Zn, Li), P16C (Zn) | |
| Landscape | Cliff lines | Land Management Plan – Cliff line damage or instability | NR – Next 3-monthly inspection of cliffs due in April 4022. | NR – Next 3-monthly inspection of cliffs due in April 2022. | 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. |
| | Steep Slopes | Land Management Plan – Steep slope damage or instability | 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 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. |
| | Surface cracking | Land Management Plan – Surface cracking (excluding railway corridor) | 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 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. |
| | Dams (monthly) | Water Management Plan – Impacts to dams | 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 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. |
| | Dams (weekly) | Water Management Plan – Impacts to dams | 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 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. | |
| 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. |
| Aquatic Ecology | Macroinvertebrates | Biodiversity Management Plan – Decline or significant negative change in macroinvertebrate indicators. | NR – Monitoring next required till Autumn 2022. | NR – Monitoring next required till Autumn 2022. | 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. |
| | | Biodiversity Management Plan – Reduction in aquatic habitat through loss of pools or associated reduction in water quality (AURIVAS habitat assessment) | NR – Monitoring next required till Autumn 2022. | NR – Monitoring next required till Autumn 2022. | 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. |
| Terrestrial Ecology | Amphibians | Biodiversity Management Plan – Decline in amphibian populations within watercourses of the Study Area | NR – Monitoring next required till Autumn 2022. | NR – Monitoring next required till Autumn 2022. | 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. |

| Aspect | Feature | Corresponding Management Plan and TARP | January 2022 | February 2022 | March 2022 | April 2022 | May 2022 | June 2022 |
|---|---|---|---|---|---|---|---|---|
| | **Riparian Vegetation** | Biodiversity Management Plan – Dieback of riparian vegetation within watercourses of the Study Area | NR – Monitoring next required till Autumn 2022. | NR – Monitoring next required till Autumn 2022. | 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. |
| **Aboriginal Heritage** | **Grinding grooves, scarred tree** | Heritage Management Plan – Aboriginal heritage | NR – No monitoring required till LW W3 is finished. | NR – No monitoring required till LW W3 is finished. | 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. |
| | **SR17 Rockbar** | Stonequarry Creek Rockbar Management Plan | YELLOW TRIGGER<br>Detailed visual inspection noted fractures on rockbar. | YELLOW TRIGGER<br>Detailed visual inspection noted fractures on rockbar. | YELLOW TRIGGER<br>Detailed visual inspection noted fractures on rockbar. | YELLOW TRIGGER<br>Detailed visual inspection noted fractures on rockbar. | YELLOW TRIGGER<br>Detailed visual inspection noted fractures on rockbar. | YELLOW TRIGGER<br>Detailed visual inspection noted fractures on rockbar. |
| | | | BLUE TRIGGER<br>High resolution closure lines across the rockbar were noted to have extended.<br>Relative 3D surveys noted measured strains. | BLUE TRIGGER<br>High resolution closure lines across the rockbar were noted to have extended. | BLUE TRIGGER<br>High resolution closure lines across the rockbar noted. | BLUE TRIGGER<br>High resolution closure lines across the rockbar noted. | BLUE TRIGGER<br>High resolution closure lines across the rockbar noted. | BLUE TRIGGER<br>High resolution closure lines across the rockbar noted. |
| **Historical Heritage** | **Railway Culverts** | Heritage Management Plan | NR – No monitoring required till LW W3 is finished. | NR – No monitoring required till LW W3 is finished. | NR – No monitoring required till LW W3 is finished. | LEVEL 3 TRIGGERED[12]<br>LW W2 End of Panel Monitoring confirmed cracking and spalling at sandstone culverts at 88.980 km and 88.400 km exceeds prediction.<br>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. |
| | **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. |
| **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. |
| | **Main Southern Railway** | Main Southern Railway Management Plan | BLUE TRIGGER<br>Ballast Top Subway (86.838 km) – Small increase in closure near the top of the arch on the Up side. | BLUE TRIGGER<br>Ballast Top Subway (86.838 km) – Small increase in closure near the top of the arch on the Up side. | BLUE TRIGGER<br>Picton Tunnel (87.85 km) – Increasing change in Cant observed at southern end of Tunnel. | 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. |
| | **Electricity Infrastructure** | Endeavour Energy Management Plan | No impacts observed in areas monitored this month. | No 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 impacts observed in areas monitored this month. | No 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 impacts observed in areas monitored this month. | No 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 | No impacts observed in areas monitored this month. | No impacts observed in areas monitored this month. | **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. |

| Aspect | Feature | Corresponding Management Plan and TARP | January 2022 | February 2022 | March 2022 | April 2022 | May 2022 | June 2022 |
|---|---|---|---|---|---|---|---|---|
| | **Telecommunications** | Telstra Management Plan | No impacts observed in areas monitored this month. | No 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 impacts observed in areas monitored this month. | No 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 | **Impact to concrete kerb drain on Stonequarry Creek Road (Report 17).** | No impacts observed in areas monitored this month. | Impacts to pavement at Connellan Crescent, as well as deterioration of Thirlmere Way road surface (Report 22).<br>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. |
| | **Built Structures** | Built Structures Management Plan | No impacts observed in areas monitored this month. | No impacts observed in areas monitored this month. | **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. |
| | **Transport for NSW Infrastructure** | Transport for NSW Management Plan | No impacts observed in areas monitored this month. | No 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 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.

[3] 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.

[4] 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.

[5] 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.

[6] Level 4 TARP for shallow groundwater pressures (LW W3-W4 Water Management Plan): Water level reduction greater than the maximum modelled drawdown 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 anthropogenic factors.

[7] 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.

[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 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.

[10] 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.

[11] 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.

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

*Table 3-4 Summary of TARP Triggers for July to December 2022*

| Aspect | Feature | Corresponding Management Plan and TARP | July 2022 | August 2022 | September 2022 | October 2022 | November 2022 | December 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] |
| | 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. | LEVEL 3 TRIGGERED[2]<br>Pool water level at monitoring site CB (Pool CR14) for the period 9 to 30 December 2022. |
| | Natural drainage behaviour | Water Management Plan – Impact to pool level, natural drainage behaviour or overland connected flow | 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 TRIGGERED[3]<br>Natural drainage behaviour trigger occurred at monitoring site SB (Pool SR17) and Pool SR20 in Stonequarry Creek. | LEVEL 3 TRIGGERED[3]<br>Natural drainage behaviour trigger occurred at monitoring site SB (Pool SR17) and Pool SR20 in Stonequarry Creek. | LEVEL 3 TRIGGERED[3]<br>Natural drainage behaviour trigger occurred at monitoring site SB (Pool SR17) and Pool SR20 in Stonequarry Creek. | LEVEL 3 TRIGGERED[3]<br>Natural drainage behaviour trigger occurred at monitoring site SB (Pool SR17) and Pool SR20 in Stonequarry Creek. | NA – Monitoring is not required till February 2023 in accordance with the post-mining monitoring schedule. |
| | 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. | No dwellings that were outside the pre-mine 1% AEP flood extent are within the post-mine 1% AEP flood extent. |
| | Stream water quality | Water Management Plan – Stream water quality impact | LEVEL 2 TRIGGERED[4]<br>Surface water quality triggers occurred at CG (Al), SC2 (Al) and SC (Al). | LEVEL 2 TRIGGERED[4]<br>Surface water quality triggers occurred at SD (pH). | LEVEL 2 TRIGGERED[4]<br>Surface water quality triggers occurred at SD (pH). | LEVEL 2 TRIGGERED[4]<br>Surface water quality triggers occurred for aluminium at MC1, CA, CB, CG, SC2, SC and SD. | LEVEL 2 TRIGGERED[4]<br>Surface water quality triggers occurred for aluminium at CG, SC2, SC and SD. | No stream water quality triggers occurred. |
| Groundwater | Groundwater bore level | Water Management Plan – Groundwater levels at monitoring bores and private groundwater bores | LEVEL 3 TRIGGERED[5]<br>Water level trigger occurred at piezometer P16C.<br>LEVEL 2 TRIGGERED[6]<br>Water level trigger occurred at piezometers P12C and P16B. | LEVEL 3 TRIGGERED[5]<br>Water level trigger occurred at piezometer P16C.<br>LEVEL 2 TRIGGERED[6]<br>Water level trigger occurred at piezometers P12C and P16B. | LEVEL 3 TRIGGERED[5]<br>Water level trigger occurred at piezometer P16C.<br>LEVEL 2 TRIGGERED[6]<br>Water level trigger occurred at piezometers P12C and P16B. | LEVEL 2 TRIGGERED[6]<br>Water level trigger occurred at piezometers P12C, P16B and P16C. | LEVEL 2 TRIGGERED[6]<br>Water level trigger occurred at piezometers P12C, P16B and P16C. | LEVEL 2 TRIGGERED[6]<br>Water level trigger occurred at piezometers P12C, P16B and P16C. |
| | Shallow groundwater pressures | Water Management Plan – Shallow groundwater pressures at VMPs TNC036, TNC040, and TNC034 | LEVEL 2 TRIGGERED[7]<br>Depressurisation trigger occurred at TNC36 (intakes 97 and 169 mbgl). | LEVEL 2 TRIGGERED[7]<br>Depressurisation trigger occurred at TNC36 (intakes 97 and 169 mbgl). | LEVEL 2 TRIGGERED[7]<br>Depressurisation trigger occurred at TNC36 (intakes 97 and 169 mbgl). | LEVEL 2 TRIGGERED[7]<br>Depressurisation trigger occurred at TNC36 (intakes 97 and 169 mbgl). | LEVEL 2 TRIGGERED[7]<br>Depressurisation trigger occurred at TNC36 (intakes 97 and 169 mbgl). | LEVEL 2 TRIGGERED[7]<br>Depressurisation trigger occurred at TNC36 (intakes 97 and 169 mbgl). |
| | Deep groundwater pressures | Water Management Plan – Deep groundwater pressures at VMPs TNC036, TNC040, and TNC043 | LEVEL 2 TRIGGERED[8]<br>Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl). | LEVEL 2 TRIGGERED[8]<br>Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl). | LEVEL 2 TRIGGERED[8]<br>Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl). | LEVEL 2 TRIGGERED[8]<br>Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl). | LEVEL 2 TRIGGERED[8]<br>Depressurisation triggers occurred in TNC36 (intakes 214 and 412.5 mbgl). | LEVEL 2 TRIGGERED[8]<br>Depressurisation triggers occurred in TNC36 (intake 412.5 mbgl). |

| Aspect | Feature | Corresponding Management Plan and TARP | July 2022 | August 2022 | September 2022 | October 2022 | November 2022 | December 2022 |
|---|---|---|---|---|---|---|---|---|
| | Groundwater quality | Water Management Plan – Groundwater quality at monitoring bores and private groundwater bores | LEVEL 2 TRIGGERED[9] 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 TRIGGERED[9] 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 TRIGGERED[9] 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) | LEVEL 2 TRIGGERED[9] Groundwater quality triggers occurred at P12A (Al), P12C (Mn), P14A (Cu), P14C (Cu), P15A (Sr, EC), P15B (Sr, EC), P16A (Cu, pH upper), P16B (EC), P16C (Cu, Zn, Sr), GW104090 (Sr, pH upper), GW115860 (pH upper), GW105228 (pH upper) | LEVEL 2 TRIGGERED[9] Groundwater quality triggers occurred at P12C (Mn, Fe), P14A (Cu), P14D (Cu, Al), P15A (Sr, EC), P15B (Sr, EC), P15C (As), P15D (Mn), P16B (Cu, Sr, EC), P16C (Zn) | LEVEL 3 TRIGGERED[10] Groundwater quality trigger occurred at P16C (Zn).<br>LEVEL 2 TRIGGERED[9] Groundwater quality triggers occurred at P12C (Mn, Fe), P14C (Cu), P15A (Sr), P15B (Sr), P15D (Cu), P16A (pH lower), P16B (Cu, Sr), P16C (Cu) |
| Landscape | Cliff lines | Land Management Plan – Cliff line damage or instability | 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. | NA – No further monitoring is required. |
| | Steep Slopes | Land Management Plan – Steep slope damage or instability | 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. | No signs of cracking or movement on steep slopes near structures in the areas inspected that could be attributed to mine subsidence. |
| | Surface cracking | Land Management Plan – Surface cracking (excluding railway corridor) | 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. | No signs of change in the areas inspected that could be attributed to mine subsidence. |
| | Dams | Water Management Plan – Impacts to dams | 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. | No signs of change to farm dams inspected that could be attributed to mine subsidence. |
| 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. | NR – No monitoring required this month. Post-mining monitoring requires quarterly inspections. | NR – No monitoring required this month. Post-mining monitoring requires quarterly inspections. | No signs of change since baseline at sites inspected. |
| Aquatic Ecology | Macroinvertebrates | Biodiversity Management Plan – Decline or significant negative change in macroinvertebrate indicators. | 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. | 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) | 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. | 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 Spring 2022. | NR – Monitoring next required in Spring 2022. | NR – Monitoring next required in Spring 2022. | No signs of subsidence impacts to amphibian populations. | NR – Monitoring next required in Autumn 2023. | NR – Monitoring next required in Autumn 2023. |
| | Riparian Vegetation | Biodiversity Management Plan – Dieback of riparian vegetation within watercourses of the Study Area | NR – Monitoring next required in Spring 2022. | NR – Monitoring next required in Spring 2022. | NR – Monitoring next required in Spring 2022. | No signs of subsidence impacts to riparian vegetation. | NR – Monitoring next required in Autumn 2023. | NR – Monitoring next required in Autumn 2023. |
| Aboriginal Heritage | Grinding grooves, scarred tree | Heritage Management Plan – Aboriginal heritage | 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. | NR – No further monitoring is required as mining is complete in the Western Domain. |

| Aspect | Feature | Corresponding Management Plan and TARP | July 2022 | August 2022 | September 2022 | October 2022 | November 2022 | December 2022 |
|---|---|---|---|---|---|---|---|---|
| | SR17 Rockbar | Stonequarry Creek Rockbar Management Plan | YELLOW TRIGGER<br>Detailed visual inspection noted fractures on rockbar.<br>BLUE TRIGGER<br>High resolution closure lines across the rockbar noted. | YELLOW TRIGGER<br>Detailed visual inspection noted fractures on rockbar.<br>BLUE TRIGGER<br>High resolution closure lines across the rockbar noted. | YELLOW TRIGGER<br>Detailed visual inspection noted fractures on rockbar.<br>BLUE TRIGGER<br>High resolution closure lines across the rockbar noted. | NR – No further monitoring required. | NR – No further monitoring required. | NR – No further monitoring required. |
| Historical Heritage | Railway Culverts | 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. | LEVEL 3 TRIGGERED[11]<br>No additional impacts to cracking on the portal faces of culverts at 88.980 km and 88.400 km.<br>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. | NR – No further monitoring required. |
| | 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. | No signs of change at Weatherboard House | NR – No further monitoring required. | 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. | NR – No further monitoring required. |
| | Main Southern Railway | Main Southern Railway 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. |
| | 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. | NR – No further monitoring required. |
| | 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. | NR – No further monitoring required. |
| | 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. | NR – No further monitoring required. |
| | Sewerage Infrastructure | Stonequarry Creek Sewer 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. | NR – No further monitoring required. |
| | 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. | NR – No further monitoring required. |
| | | 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. | NR – No further monitoring required. |
| | Local roads, bridges and culverts | Wollondilly Shire Council Management Plan | Deterioration of road surves 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. | NR – No further monitoring required. |
| | Built Structures | Built Structures Management Plan | 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 further monitoring required. |
| | 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. |

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 3 TARP for pool water level (LW W3-W4 Water Management Plan): The recorded water level has declined, although not atypically, below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) AND the above has not occurred at one of the upstream pools (beyond mining effects).

[3] Level 3 TARP for physical features and natural behaviour of pools (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 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.

[5] 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.

[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 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.

[8] 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.

[9] 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.

[10] Level 3 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 the change in water quality is determined not to be controlled by climatic or anthropogenic factors.

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

## 3.2 Summary of Actions

During the reporting period, there were ten (10) 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).

### 3.2.1 Pool Water Level TARP – Level 3 Triggers for Pool Water Level Reduction

#### *3.2.1.1 Background*

The following TARP trigger occurred during the current reporting period for water level (refer **Appendix B**):

- Monitoring Site CB – Level 3 TARP triggers occurred at pool CR14 (Cedar Creek) between 9 to 30 December 2022.

Water level decline at monitoring site CB (pool CR14) below the baseline minimum from 9 to 30 December 2022 by a maximum of 0.46 m. The recorded water level declined, although not atypically, below the recorded baseline minimum level (for more than one 24 hour period) during these periods and the same did not occur at an upstream pool (beyond mining effects). Therefore, in accordance with the LW W3-W4 Water Management Plan, a Level 3 TARP significance in relation to pool water level decline at monitoring site CB has been derived for this period.

Further discussion of this trigger is provided in **Section 2.2.2** and the Surface Water Review (refer **Appendix B**).

#### *3.2.1.2 Actions Completed*

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

- *Continue monitoring as per monitoring program* - monthly monitoring is ongoing according to the monitoring program;
- *Continue monthly review of data* – quarterly result analysis and reporting in accordance with the post-mining monitoring program;
- *Review relevant surface water level, groundwater level and streamflow data to assess comparative trends* – completed as part of this report (refer to **Appendix B**), which suggested that gaining conditions (groundwater contribution to the surface water system) were occurring during this time period in the vicinity of monitoring site CB (pool CR14);
- *Convene Tahmoor Coal Environmental Response Group to review response* – completed and included a discussion of this TARP trigger;
- *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* – considered as part of the Surface Water Review (**Appendix B**). Given the decline in water level at monitoring site CB has occurred intermittently since late 2020 and there has been negligible indication of an associated impact to downstream monitoring sites, increased frequency of monitoring is not deemed to be required. The water level records for this site will continue to be monitored in accordance with the LW W3-W4 Water Management Plan.

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, including the current report provided in **Appendix B**. These reports 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.

#### 3.2.1.3 Proposed Actions

The current monitoring program will continue in accordance with the LW W3-W4 Water Management Plan, and the next 3-monthly Monitoring Report will be provided to DPE in June 2023.

### 3.2.2 Natural Drainage Behaviour TARP - Level 3 Trigger for Fracturing

#### 3.2.2.1 Background

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

- Rockbar 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
- Rockbar 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 C**), and a summary is provided below.

Rockbar 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). Brienen 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 rockbar SR17 has been derived for this observation (17 November 2021 to current).

Rockbar SR20 was reported by Brienen 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.

#### 3.2.2.2 Actions Completed

In accordance with the Stonequarry Creek Rockbar Management Plan, mining of LW W3 was temporarily suspended on 28 October 2021 following initial identification of surficial fracturing of the rockbar at pool SR17. Subsequently, the Subsidence Technical Committee convened to review the required actions and responses in accordance with the Stonequarry Creek Rockbar Management Plan TARP. Additional monitoring, inspection and reporting was then implemented in accordance with the TARP. Subsequent visual inspections identified an increase in the extent of fracturing. On 1 November 2021, approval was granted to recommence mining of LW W3 subject to the continuation of monitoring at an increased frequency and initial progress of the longwall capped to a maximum of 50 metres per week.

It is noted that this fracturing has not affected the water level at Pool SR17.

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.

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

- *Continue monitoring as per monitoring program* - monthly monitoring was 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:*
  - Rockbar SR17 – In response to the Level 3 trigger exceedances in relation to physical features at rockbar 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 (rockbar 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); and
  - Rockbar SR20 – In response to the Level 3 trigger exceedances in relation to physical features at rockbar 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 during the reporting period. 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 rockbar physical features, natural drainage behaviour and pool water level is not considered to be required at this stage. However monthly visual inspections have 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.

#### 3.2.2.3 Proposed Actions

The current monitoring program will continue in accordance with the LW W3-W4 Water Management Plan, with monthly visual inspections to continue at rockbars SR17 and SR20.

### 3.2.3 Surface Water Quality TARP – Level 2 Trigger for Surface Water Quality

#### *3.2.3.1 Background*

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

- Monitoring Site CA – Level 2 TARP trigger for Aluminium in October 2022;
- Monitoring Site CB – Level 2 TARP trigger for Aluminium in January, March and October 2022;
- Monitoring Site CG – Level 2 TARP trigger for Aluminium in February to July, and October to November 2022;
- Monitoring Site SC2 – Level 2 TARP trigger for Aluminium in January, March to May and July and October to November 2022;
- Monitoring Site SC – Level 2 TARP trigger for Aluminium in January, March to May, July, and October to November 2022;
- Monitoring Site SD – Level 2 TARP trigger for high pH levels in August 2022, low pH levels in September 2022, and Aluminium in January, March, October and November 2022; and
- Monitoring Site MC1 – level 2 TARP trigger for Aluminium in October 2022.

As discussed in **Section 2.2.4**, the elevated concentrations of dissolved aluminium across Matthews, Cedar and Stonequarry Creek were noted to be catchment wide and related to the prevailing climatic conditions. In addition, the pH variability at Monitoring Site SD appeared to be anomalous and may be related to instrumentation or field measurement issues.

A detailed discussion of these triggers is provided in the Surface Water Review documents (refer **Appendix B**), and a summary is provided in **Section 2.2.4**.

#### *3.2.3.2 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, including discussions of these TARP triggers; and
- *Response as defined by Environmental Response Group* – there were no actions regarding this TARP trigger.

#### *3.2.3.3 Proposed Actions*

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

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

#### *3.2.4.1 Background*

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

- P12C – Level 3 TARP trigger from January to April 2022, and Level 2 TARP trigger from May to December 2022;
- P16B – Level 2 TARP trigger from the entire reporting period; and

- P16C – Level 3 TARP trigger from January to September 2022, and Level 2 TARP trigger from October to December 2022.

During the reporting period, groundwater level at this bore recovered above the 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, groundwater level at P12C was stable at 178.4 mAHD, just below the TARP level 2.

P16B recorded a Level 4 TARP trigger from December 2020 to August 2021. During the reporting period, a TARP Level 2 applied at P16B for the entire reporting period. Groundwater levels are observed at 197.4 mAHD in December 2022, and a Level 2 TARP trigger could remain in the short to medium term as a long-term groundwater impact is likely at P16.

P16C recorded a Level 4 TARP trigger from December 2020 to August 2021. During the reporting period a Level 3 TARP trigger applied to P16C from January to September 2022, which was then reduced to a Level 2 TARP trigger in October 2022. Groundwater levels were observed at 197.4 mAHD in December 2022, and a Level 2 TARP trigger could remain in the short to medium term as a long-term groundwater impact is likely at P16.

#### *3.2.4.2 Actions Completed*

On 30 December 2020, Level 4 TARP triggers for the reduced water level elevations at P12C, 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 mining period. Result analysis and report will 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 June 2023;
- *Compare against base case and deterministic model scenarios* – completed as part of the groundwater reports (**Appendix D**);
- *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.

It is noted that 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.

#### 3.2.4.3 Proposed Actions

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

### 3.2.5 Shallow Groundwater Pressures TARP – Level 2, 3 and 4 Triggers for Shallow Vibrating Wire Piezometer Groundwater Pressure

#### 3.2.5.1 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 D**):

- TNC036 HBSS-97m – Level 4 TARP trigger from January to February 2022, Level 3 TARP trigger from March to June 2022, and a Level 2 TARP trigger from July to December 2022; and
- TNC036 HBSS-169m – Level 2 TARP trigger from the entire reporting period.

At TNC036 HBSS-97m, groundwater levels declined marginally below the trigger TARP Level 4 (180 mAHD) for short periods of time (five days) in February 2022. A recovery of groundwater level at this intake was noted shortly after this trigger to a Level 2 TARP trigger in July 2022. Groundwater levels have remained below the threshold for TARP Level 2 till the end of the reporting period and are likely to reduce to a TARP Level 1 in the next reporting period.

At TNC036 HBSS-169m, groundwater levels remained below the trigger TARP Level 2 (192.5 mAHD) for the entire reporting period.

#### 3.2.5.2 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 (Refer to **Section 2.2**; **Appendix B**; **Appendix D**), and any recommendations in relation to ongoing monitoring or corrective actions (**Section 2.3.5**).

The following actions have been completed in light of the Level 2, 3 and 4 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 mining. Result analysis and report will 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 D**);
- *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.

#### 3.2.5.3 Proposed Actions

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

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

#### 3.2.6.1 Background

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

- TNC036 BGSS-214m – Level 2 TARP triggered from January to November 2022; and
- TNC036 BGSS-412.5m – Level 2 TARP trigger from the full reporting period.

The groundwater level observed at TNC036-BGSS-214m exceeded the modelled drawdown from mid-2020 but remains within the 30 m predicted drawdown in October and November 2022, resulting in a TARP Level 2 exceedance. As of December 2022, the observed drawdown does not exceed the modelled drawdown resulting in a TARP Level 1.

#### 3.2.6.2 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 mining. Result analysis and report will 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.

#### 3.2.6.3 Proposed Actions

Groundwater monitoring will continue under the existing monitoring program.

### 3.2.7 Groundwater Quality TARP – 'Potential' Level 4 and 3 Triggers for Groundwater Quality

#### 3.2.7.1 Background

The following potential Level 4 and 3 TARP triggers occurred during the current reporting period for groundwater quality:

- P12B – 'Potential' Level 4 TARP trigger for pH from March to May 2022;
- P15A – 'Potential' Level 4 TARP trigger for Strontium from January to May 2022;
- GW115860 – 'Potential' Level 4 TARP trigger for Electrical Conductivity and Barium in January 2022; and
- P16C – Level 3 TARP trigger for Zinc in December 2022.

A number of Level 2 TARP triggers occurred for groundwater quality (refer to **Table 3-3** and **Table 3-4**). 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 in the section below. Further discussion of these triggers is provided in the groundwater report located in **Appendix D**.

Dissolved zinc concentrations at P16C triggered a Level 3 TARP trigger in December 2022, likely due to a natural fluctuation in groundwater quality and major flood events in 2022. A TARP Level 4 may be considered in the next review period if further increase in dissolved zinc concentrations is observed at P16C, and if similar increases in zinc concentrations above the trigger level are also seen at P16A and P16B.

#### *3.2.7.2 Actions Completed*

As discussed in the groundwater reports in **Appendix D**, 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 mining. Result analysis and reporting will 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.

Investigations into these potential Level 4 TARP triggers were completed to the cause of these triggers (i.e. has or has not been attributed to mining-related impacts). A summary of the investigations is provided below.

*pH at P12B*

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. Investigations by SLR in January 2022 found that the reason for the increase in pH at P12B is unclear and could potentially be related to compromised bore integrity, however an increasing trend was also observed at GW072402. At this time, a mining-related effect is plausible, however the consequences of this effect (if it is mining-related) are considered minor.

The TARP trigger level 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 to within the baseline limit.

*Strontium at P15A*

SLR investigated the recent Sr exceedances at P15A in January 2022 with no clear mining-impact identified. The following presents a summary of the findings:

- Since the start of monitoring at site P15A-D, the Sr concentrations are above the ranges reported at unaffected sites and above the pre-mining Sr concentrations at P14A-P14D except for P15D within pre-mining Sr concentrations at P14;
- No exceedances in Sr concentrations were identified at surface water monitoring sites along Stonequarry Creek, with all surface water monitoring sites across the Western Domain within TARP Level 1 for water quality during the reporting period;
- From the U.S Environmental Protection Agency, Sr concentrations in drinking water are assessed relative to the health-based screening level benchmark of 4 mg/L. Values greater than 4 mg/L are considered high, between 2 mg/L and less than 4 mg/L are considerate moderate and less than 2.0 mg/L are considered low. At P15A, Sr concentrations are considered moderate (less than 4.0 mg/L);
- Since monitoring started at P15A, the higher Sr concentrations observed at P15A compared to other sites (i.e. P14, GW105228 and GW115860) and compared to the deeper piezometers (i.e. P15B-D) suggest a localised Sr source in groundwater at piezometer P15A;

- The range of strontium in natural soils is highly variable, from 50 mg/kg to 1000 mg/kg. P15A is located within the mapped alluvium and may be screened within alluvial soil with a higher Sr concentration compared to the deeper lithology of weathered and fresh Hawkesbury Sandstone. No bore logs are available to review and verify the lithology at this location; and
- The Sr concentrations at nearby registered bores GW105228 and GW115860 are considered low (less than 2 mg/L) suggesting no risk of human-health concerns and that the increase in Sr concentrations at P15A is possibly localised.

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 were 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.

*Barium at GW115860*

SLR investigated the potential TARP Level 4 for Ba at GW115860 (refer to **Appendix D**). The following summarises the findings:

- Ba concentration at GW105228 (110 m from GW115860) are stable within 0.20-0.25 mg/L since monitoring started;
- The short record of Ba concentrations at site P15A-D shows fluctuation within the range of 0.08 to 0.21 mg/L, generally lower than at GW105228; and
- No exceedances or increasing trends in Ba concentrations were identified at sites P14A-D and P15A-C (only 180 m and 65 m from LW W3) between October 2021 and January 2022 (SLR, 2021a, 2022a) except at P15D (TARP Level 2) in February 2022 slightly increasing at the trigger level.

A mining-related effect on Ba at GW115860 was assessed to be unlikely but could not be excluded at the time of the investigation. A revision to the Ba trigger level was undertaken as it appeared that the trigger level was conservative and could not be based on pre-mining data. The revised trigger level for Ba at bore GW115860 is 0.51 mg/L and remains conservative (i.e. lower than) with respect to the relevant guideline values considered.

*EC at GW115860*

SLR investigated the trigger exceedances at GW115860 for EC (refer to **Appendix D**). The following summarises the findings:

- The reason for the increased EC at GW115860 is unclear, although it is consistent with the trend observed at nearby bore GW105228. Therefore, this trigger is a 'potential' Level 4 TARP trigger, and it has not been confirmed that the cause is mining;
- No drawdown was observed during the extraction of LW LW3 at GW115860, and hence drawdown does seem to be the cause of the change in EC;
- The increase in EC at GW115860 (to 1,246 µS/cm) does not change the beneficial use classification of the groundwater extracted at this site, and therefore the currently observed effects are considered to be immaterial. Indeed, salinity (TDS) at GW115860 remains within the desirable palatability of less than 600 mg/L (class A1 category). Groundwater quality at GW115860 remains suitable for all beneficial uses, including the current purpose; and

- Given the low salinity of groundwater at GW115860, and the small incremental change in that salinity in relation to the beneficial use classifications it is recommended to continue observing this bore over the next monitoring period (April 2022) to see if EC decreases, otherwise to revise the trigger. The most reliable method to revise the trigger would be to adopt the EC trigger from GW105228 for use at GW115860 as it has been derived from a longer record period.

EC concentrations naturally lowered in February 2022, resulting in a return to Level 1.

#### *3.2.7.3 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 monitoring Zn concentrations at P16C and nearby P16A, P16B and private bores; and
- Continue monitoring Sr concentration at P15A and nearby groundwater monitoring sites (P15B-D, P14A-D) and private bores (GW105228 and GW115860).

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

#### *3.2.8.1 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**);
- 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**); and
- Blue Trigger for measured strains in Relative 3D Surveys, noted on 14 February 2022 for measured strain between RBF04 and RBF05 (Stonequarry Creek Rockbar Status Report 41, **Appendix F**).

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

#### *3.2.8.2 Actions Completed*

Following the Blue Trigger for the extension of High Resolution Closure Lines across the SR17 Rockbar on 11 October 2021, the Stonequarry Creek Rockbar Technical Committee met and reviewed the results, considered the Key Assessment Criteria and determined that the current survey, visual inspections, monitoring and management measures remained suitable. The results were then reviewed on a twice weekly basis. Regular updates were also provided to DPE on the status of the rockbar throughout mining, including the outcomes of the Technical Committee meetings.

In accordance with the Stonequarry Creek Rockbar Management Plan, mining of LW W3 was temporarily suspended on 28 October 2021 following initial identification of surficial fracturing of the rockbar at pool SR17. Subsequently, the Subsidence Technical Committee convened to review the required actions and responses in accordance with the Stonequarry Creek Rockbar Management Plan TARP. The Subsidence Technical Committee confirmed that the fracturing was identified approximately 40m downstream of the nearest grinding grove site on the north-eastern side of the access track. No evidence of fracturing was evident at any of the grinding groove sites.

Additional monitoring, inspection and reporting was then implemented in accordance with the TARP. Subsequent visual inspections identified an increase in the extent of fracturing. On 1 November 2021, approval was granted to recommence mining of LW W3 subject to the continuation of monitoring at an increased frequency.

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.

A final survey was conducted in October 2022, one month after the completion of LW W4 mining. This survey noted minor changes in horizontal distances both along and across the rockbar, and minor ground shortening in the southeast corner of the rockbar.

Following the Blue Trigger for the measured strain across the SR17 Rockbar on 14 February 2022, the Stonequarry Creek Rockbar Technical Committee noted that this site has been managed in accordance with the yellow trigger level since fractures were first observed on 28 October 2021.

#### *3.2.8.3 Proposed Actions*
No further monitoring is required as LW W3 and LW W4 mining is complete.

### 3.2.9 Historical Heritage TARP – Level 3 Trigger for Sandstone Culvert Impacts

#### *3.2.9.1 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 LW W4 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 both LW W3 and LW W4, and the LW W3 and LW W4 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 3-1, Figure 3-2** and **Figure 3-3**.

*Figure 3-1 Cracking on the portal ends at culvert 88.400 km. This cracking has not worsened during the mining of LW W4.*

*Figure 3-2 Cracking in the barrel of culvert 88.400 km. This cracking has formed during the mining of the Western Domain.*

*Figure 3-3 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.*

#### *3.2.9.2 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 was discussed during the December 2022 ERG meeting;
- *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* – see discussion below.

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 (JMA, 2022). All repair work on the impacted heritage structures will be completed as prescribed in the TfNSW Structures Repair Standard TMC302. Tahmoor Coal also provided the rehabilitation methodology to the Heritage Division of TfNSW on 19 May 2022.

#### *3.2.9.3 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.

Rehabilitation of the two culverts will be undertaken now that the full effects of Western Domain longwall mining has been completed.

Tahmoor Coal has approached a number of heritage stonemasons to seek input into the repair methodology for the sandstone culverts. The proposed rehabilitation methodology (JMA, 2022) specifies detailed grout injection along the cracks and other associated repair methods consistent with cracks within masonry structure. Tahmoor Coal has been advised that the prescribed repair specifications within the rehabilitation methodology are not within the skill set of a Heritage Stonemason. Tahmoor Coal are therefore currently engaging an experienced grout injection company, who will also arrange for a repointing subcontractor to complete the mortar joint repairs following the grout injection task.

Tahmoor Coal previously advised DPE that a proposed completion date of 31 March 2023 was likely to be achievable. Tahmoor Coal advised DPE that the works are more likely that they could be completed by 30 June 2023, and approval of this extended works completion date from DPE was received on 27 February 2023.

### 3.2.10 Main Southern Railway TARP – Blue Trigger at Ballast Top Subway (88.133 km), Ballast Top Subway (86.838 km) and Picton Tunnel (87.85 km)

#### *3.2.10.1 Background*

During the reporting period, the following TARP triggers occurred related to Main Southern Railway features:

- Ballast Top Subway (86.838 km) - Blue Level Trigger for small increase in closure near the top of the arch on the Up side, first noted in January 2022 (MSR Status Report 19); and
- Picton Tunnel (87.85 km) – Blue Level Trigger for increasing change in Cant observed at southern end of the Tunnel, observed in March 2022 (MSR Status Report 28).

These triggers are documented in the reports referenced, which are included in **Appendix G**.

#### *3.2.10.2 Actions Completed*

Following the Blue Level Trigger for the Ballast Top Subway (86.838 km), a structural inspection was completed on 7 January 2022 and noted no immediate concern. Trains on the PMLL track were suspended until 5 February 2022. A geotechnical investigation confirmed that substantial footing was located in competent clay soils, and advised that the changes are not due to mine subsidence. The Rail Management Group reviewed the results and the structural report and agreed to increase the Blue Trigger Level from 20 mm to 25 mm, which resolved this Blue Level Trigger (refer to MSR Status Report 23, **Appendix G**).

Following the Blue Level Trigger for the Picton Tunnel (87.85 km), it was determined that the changes in track centres at 87.780 km was likely due to effects of weather as there was no measurable change across the width of the tunnel. This Blue Level Trigger was resolved (refer to MSR Status Report 29, **Appendix G**).

#### *3.2.10.3 Proposed Actions*

Visual inspection of MSR infrastructure will continue under the existing monitoring program during the Western Domain post-mining stage.

# 4 Assessment of Environmental Performance

## 4.1 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 4-1**, as well as an assessment of performance.

*Table 4-1 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:<br>• More than 10% of pools located within the 600 m Study Area for Natural Features; and/or<br>• Pool SR17. | **No**<br>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 2.2.2 and 2.2.3 |
| | 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**<br>*Note: Post-mining goaf centreline bore data not yet available.* | Section 2.3.3 |
| Public Safety (DA 67/98 Condition 13E) | Negligible additional risk**. | Flooding<br>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** | Section 2.2.5 |

| Feature | Subsidence Performance Measure | Subsidence Performance Indicator | Subsidence Performance Measure Exceeded? | Section Discussed |
|---|---|---|---|---|
| **Land Management** | | | | |
| Public Safety<br>(DA 67/98 Condition 13E) | Negligible additional risk**. | Landscape Features<br>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 2.4 |
| **Biodiversity Management** | | | | |
| Threatened species, threatened populations, or endangered ecological communities<br>(DA 67/98 Condition 13A) | Negligible environmental consequences**. | This performance indicator will be considered to be triggered if:<br>• Changes in macroinvertebrate and stream health indicators are statistically significant;<br>• If visual assessment of aquatic habitat identifies mining subsidence induced impacts.<br>• Statistically significant changes in amphibian diversity is detected toward baseline attributed to mining, as detected during amphibian monitoring; and/or<br>• Statistically significant changes in riparian vegetation is detected toward baseline attributed to mining, as detected during riparian monitoring. | **No** | Section 2.5 |

| Feature | Subsidence Performance Measure | Subsidence Performance Indicator | Subsidence Performance Measure Exceeded? | Section Discussed |
|---|---|---|---|---|
| **Heritage Management** | | | | |
| Heritage sites<br>(DA 67/98 Condition 13A) | Negligible subsidence impacts or environmental consequences**.<br>Negligible loss of heritage value**. | Isolated finds/artefact scatters (AHIMS items)<br>No performance indicators are currently established as impacts are predicted to be negligible. | **No**<br>*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.* | Not applicable |
| | | Scarred tree (AHIMS item)<br>This performance indicator will be considered to be triggered if:<br>• subsidence monitoring identifies a perceptible tilt increase that places the tree at risk of falling; and/or<br>• subsidence monitoring identifies a perceptible cracking in the tree unrelated to natural weathering or trauma damage | **No**<br>*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.*<br>*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.* | Section 2.6.1 |
| | | Grinding grooves (AHIMS item)<br>This performance indicator will be considered to be triggered if:<br>• subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking; and<br>• these subsidence impacts result in impacts to the heritage values of the site. | **No** | Section 2.6.1 |

| Feature | Subsidence Performance Measure | Subsidence Performance Indicator | Subsidence Performance Measure Exceeded? | Section Discussed |
|---|---|---|---|---|
| **Heritage Management** | | | | |
| Heritage sites<br>(DA 67/98 Condition 13A) | Negligible subsidence impacts or environmental consequences**.<br>Negligible loss of heritage value**. | Main Southern Railway Heritage Items (Mushroom Tunnel, Picton Tunnel, Antill Street Underbridge, Picton Viaduct, Argyle Street Underbridge)<br>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 2.6.2 |
| | | 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)<br>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 2.6.2 |
| | | Cottage (Weatherboard)<br>This performance indicator will be considered to be triggered if subsidence monitoring identifies damage to external cladding or internal finishes. | **No** | Section 2.6.2 |
| | | Redbank Uniting Church<br>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 2.6.2 |

| Feature | Subsidence Performance Measure | Subsidence Performance Indicator | Subsidence Performance Measure Exceeded? | Section Discussed |
|---|---|---|---|---|
| **Heritage Management** | | | | |
| | | Rural Landscape – Thirlmere Way<br>This performance indicator will be considered to be triggered if subsidence monitoring identifies visual subsidence, surface cracks. | **No** | Section 2.6.2 |
| | | Rural landscape – Thirlmere Way (local heritage significance)<br>No performance indicators are currently established as impacts are predicted to be negligible. | **No** | Section 2.6.2 |
| Other Aboriginal and heritage sites<br>(DA 67/98 Condition 13A) | Negligible subsidence impacts or environmental consequences**. | Loop line Sandstone culverts (local heritage significance)<br>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**<br>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 2.6.2 and 3.2.9 |
| | | Loop line brick culverts (local heritage significance)<br>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 2.6.2 |

| Feature | Subsidence Performance Measure | Subsidence Performance Indicator | Subsidence Performance Measure Exceeded? | Section Discussed |
|---|---|---|---|---|
| **Built Feature Management** | | | | |
| Key Public Infrastructure:<br>• Main Southern Railway;<br>• Picton-Mittagong Loop Line; and<br>• Electricity transmission lines and towers.<br>(DA 67/98 Condition 13E) | Always safe and serviceable. | None allocated. | **No** | Section 2.7 |
| | Damage that does not affect safety or serviceability must be fully repairable, and must be fully repaired. | None allocated. | **No** | Section 2.7 |
| Other Infrastructure:<br>• Electricity distribution lines, poles and associated towers;<br>• Unsealed roads and road culverts, fire trails, fences and other built features; and<br>• Other public infrastructure.<br>(DA 67/98 Condition 13E) | Always safe. | None allocated. | **No** | Section 2.7 |
| | 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 2.7 |
| Privately-owned residences<br>(DA 67/98 Condition 13E) | Always safe. | None allocated. | **No** | Section 2.7 |
| | 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 2.7 |

| 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<br>(DA 67/98 Condition 13E) | Always safe. | None allocated. | **No** | Section 2.7 |
| | 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 2.7 |
| Public Safety<br>(DA 67/98 Condition 13E) | Negligible additional risk**. | None allocated. | **No** | Section 2.7 |
| **Mine workings** | | | | |
| First workings<br>(DA 67/98 Condition 13A) | To remain long term stable and non-subsiding. | None allocated. | **No** | Not applicable |
| Second workings<br>(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.

# 5 Document Information

## 5.1 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.

EMM Consulting (2022a), Aboriginal heritage monitoring report: Tahmoor Mine Longwall West 3 (LW W3) End Of Panel Monitoring Inspection.

EMM Consulting (2022b), Historical heritage monitoring report: Tahmoor Mine Longwall West 3 (LW W3) End of Panel Monitoring Inspection.

EMM Consulting (2022c), Aboriginal heritage monitoring report: Tahmoor Mine Longwall West 4 (LW W4) End Of Panel Monitoring Inspection.

EMM Consulting (2022d), Historical heritage monitoring report: Tahmoor Mine Longwall West 4 (LW W4) End of Panel Monitoring Inspection – Railway Culverts.

EMM Consulting (2022e), Historical heritage monitoring report: Tahmoor Mine Longwall West 4 (LW W4) End of Panel Monitoring Inspection – Weatherboard Cottage.

JMA (2022), Post-Mining Inspection Report, Picton-Mittagong Loop Line Culverts.

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

WRM (2022), Matthews Creek Post-mining Flood Study, LW W1-W4, 15 December 2022, document 1072-08-B1.

<u>Tahmoor Coal Documents:</u>

- 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

## 5.2 Glossary of Terms

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

*Table 5-1 Glossary of Terms*

| Term | Definition |
|---|---|
| Active Subsidence Zone | The active subsidence zone for each longwall is defined by the area bounded by the predicted 20 mm subsidence contour for the active longwall and a distance of 150 m in front of the active longwall face and 450 m behind the active longwall face or following 500 m of longwall extraction. |
| Angle of draw | The angle of inclination from the vertical of the line connecting the goaf edge of the workings and the limit of subsidence (which is usually taken as 20 mm of subsidence). |
| Built features | Includes any building or work erected or constructed on land, including dwellings and infrastructure such as a formed road, street, path, walk, or driveway; any pipeline, water sewer, telephone, gas or other infrastructure service main. |
| 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.<br>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. |
| Curvature | Second derivative of subsidence, or the rate of change of tilt, and is calculated as the change in tilt between two adjacent sections of the tilt profile divided by the average length of those sections. Curvature is usually expressed as the inverse of the Radius of Curvature with the units of 1/km (km-1), but the value of curvature can be inverted, if required, to obtain the radius of curvature, which is usually in km. Curvature can be either hogging (i.e. convex) or sagging (e.g. concave). |
| 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 | 1 January 2022 to 31 December 2022. |
| Run of mine (ROM) | Raw coal production. The unprocessed mined coal that is conveyed to the CPP. ROM may consist of coal and rock. |

| Term | Definition |
|---|---|
| Strain | The change in the horizontal distance between two points divided by the original horizontal distance between the points, i.e. strain is the relative differential displacement of the ground along or across a subsidence monitoring line. Strain is dimensionless and can be expressed as a decimal, a percentage or in parts per notation.<br>Tensile Strains are measured where the distance between two points or survey pegs increases and Compressive Strains where the distance between two points decreases. Whilst mining induced strains are measured along monitoring lines, ground shearing can occur both vertically, and horizontally across the directions of the monitoring lines. |
| 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<br>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.<br>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. |
| Subsidence consequences | The knock-on results of subsidence impacts, i.e. any change in the amenity or function of a natural feature or built structure that arises from subsidence impacts. Consequence considerations include public safety, loss of flows, reduction in water quality, damage to artwork, flooding, draining of aquifers, the environment, community, land use, loss of profits, surface improvements and infrastructure. Consequences related to environmental features are referred to as environmental consequences. |
| Tilt | The change in the slope of the ground as a result of differential subsidence, and is calculated as the change in subsidence between two points divided by the horizontal distance between those points. Tilt is, therefore, the first derivative of the subsidence profile. Tilt is usually expressed in units of mm/m. A tilt of 1 mm/m is equivalent to a change in grade of 0.1 %, or 1 in 1000. |
| Western Domain | Area to the north-west of the Main Southern Railway. |

## 5.3 Abbreviations

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

*Table 5-2 Abbreviations*

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

| Abbreviation | Definition |
|---|---|
| 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 | Wastewater treatment plant |

## 5.4 Document Distribution

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

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

| Agency | Contact Person | Position | Electronic Copy |
|---|---|---|---|
| DPE - Planning | (Planning Portal) | (Planning Portal) | (https://www.planningportal.nsw.gov.au/major-projects) |
| | Jessie Evans | Director – Resource Assessments | Jessie.evans@planning.nsw.gov.au |
| | Gabrielle Allan | Team Leader | Gabrielle.Allan@planning.nsw.gov.au |
| DPE - Resources Regulator (Subsidence) | (General email) | (General email) | subsidence.monitoring@planning.nsw.gov.au<br>nswresourcesregulator@service-now.com |
| | Ray Ramage | Mine Safety Officer - Subsidence | ray.ramage@planning.nsw.gov.au |
| DRNSW – Mining Exploration and Geoscience | (General email) | (General email) | resource.operations@planning.nsw.gov.au |
| DRNSW – Resources Regulator – Mining Act Inspectorate | (General email) | (General email) | nswresourcesregulator@service-now.com |
| | Greg Kininmonth | Manager Environmental Operations (Southern) | greg.kininmonth@planning.nsw.gov.au |
| Wollondilly Shire Council | (General email) | (General email) | council@wollondilly.nsw.gov.au |
| | David Henry | Acting Team Leader Environmental Services | david.henry@wollondilly.nsw.gov.au |
| Subsidence Advisory NSW | (General email) | (General email) | subsidencetechnical@customerservice.nsw.gov.au |
| | John Johnston | Technical Manager | John.Johnston@customerservice.nsw.gov.au |

| Agency | Contact Person | Position | Electronic Copy |
|---|---|---|---|
| NRAR | (General email) | (General email) | nrar.servicedesk@dpie.nsw.gov.au |
| | Guy Ohandja | Manager Compliance Monitoring & Audit | guy.ohandja@nrar.nsw.gov.au |
| EPA | (General email) | (General email) | epa.illawarra@epa.nsw.gov.au |
| | Andrew Couldridge | Senior Operations Officer - Metropolitan Illawarra | andrew.couldridge@epa.nsw.gov.au |
| TCCCC Committee Members | Documents sent to TCCCC Committee Members at private email addresses. | | |

# Appendix A – Subsidence Monitoring Reports

## End of Panel Subsidence Monitoring Report for Tahmoor Longwall W3

| Summary | |
|---|---|
| Monitoring period | 30 March to 15 May 2022 |
| Length of extraction of LW W3 | LW W3 completed extraction on 21 March 2022<br>LW W4 commenced extraction on 16 May2022 |
| Distance travelled by longwall since previous report | |
| Distance to completion of LW W3 | |

## Summary of observed ground movements

| Subsidence Parameter | | Maximum observed at completion of LW W3 | Location |
|---|---|---|---|
| Subsidence (mm) | *Inc*<br>*Total* | 592<br>857 | LW W3 Centreline<br>LW W1-W3 Crossline |
| Tilt (mm/m) | *Inc*<br>*Total* | 3.5<br>3.8 | LW W3 Centreline & LW W1-W3 Crossline<br>Stonequarry Creek Rd |
| Hogging Curvature (km$^{-1}$) | *Inc*<br>*Total* | 0.22<br>0.22 | LW W3 Centreline<br>PMLL |
| Sagging Curvature (km$^{-1}$) | *Inc*<br>*Total* | -0.29<br>-0.28 | LW W1-W3 Crossline<br>LW W3 Centreline |
| Tensile Strain (mm/m) | *Inc*<br>*Total* | 1.4<br>1.4 | LW W3 Centreline & PMLL<br>PMLL |
| Compressive Strain (mm/m) | *Inc*<br>*Total* | -2.7<br>-5.0 | LW W3 Centreline<br>PMLL |

## Actions

| | |
|---|---|
| HAVE ANY DEFINED TRIGGERS BEEN REACHED SINCE PREVIOUS REPORT? | NO. |
| IS ANY URGENT ACTION REQUIRED? | NO. |

This monitoring report provides the results of the latest ground surveys during the mining of LW W3, in accordance with the requirements of subsidence management plans.

## Longwall face position

LW W3 commenced on 13 September 2021 and completed extraction on 21 March 2022. A map showing the mine layout and the monitoring peg positions is shown in Drawing No. MSEC1204-01.

## Summary of surveys and inspections completed

Surveys and inspections are being conducted to meet the requirements of the LW W1-W2 Extraction Plan. A timeline showing when each type of survey and inspection was conducted is shown Figure A.

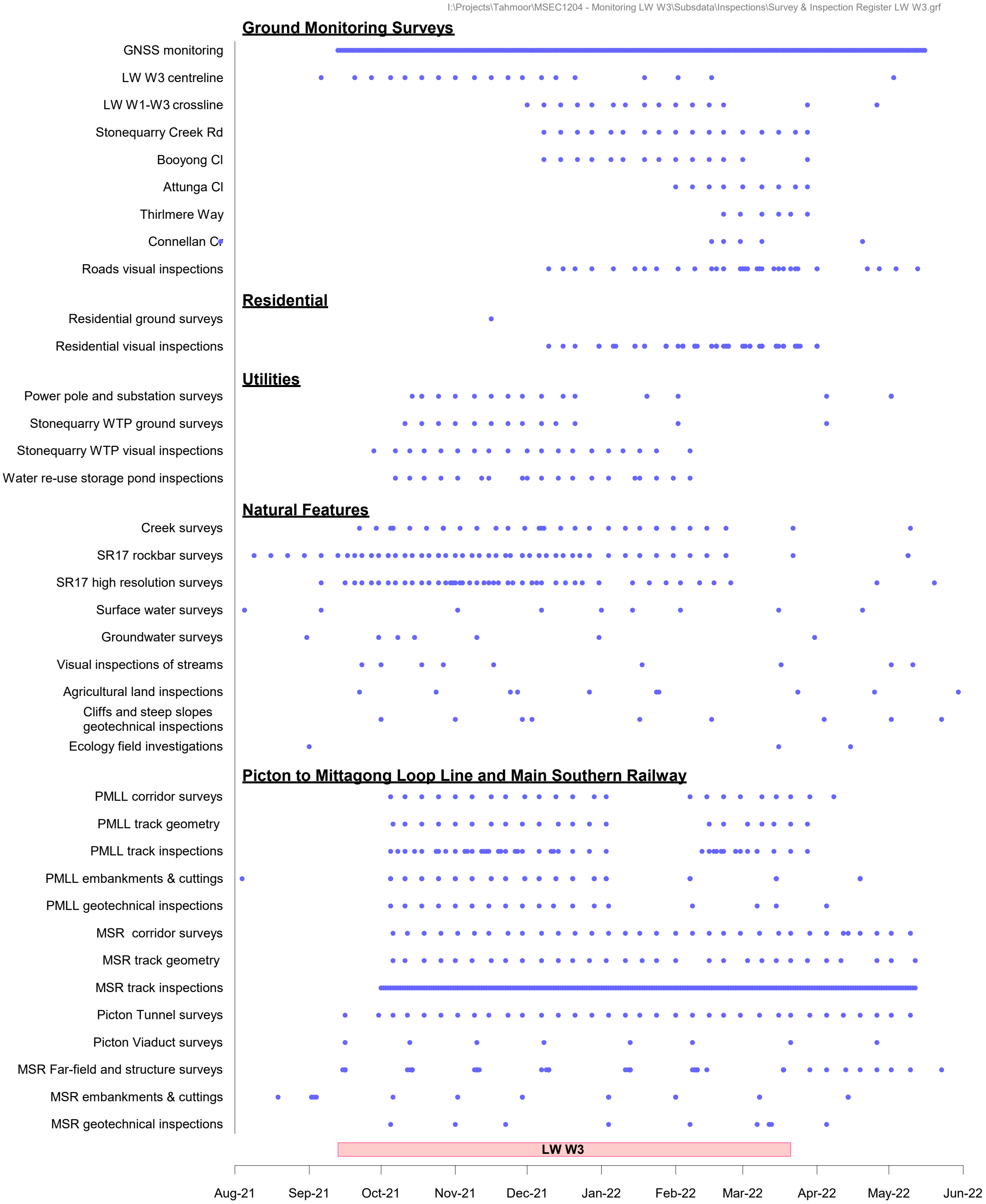



**Figure A Surveys and inspections during LW W3**

A summary of surveys and inspections is provided in Table 1.

**Table 1 Surveys and inspections conducted during LW W3**

| Inspection / Survey | Responsibility | Number of Inspections / Surveys |
|---|---|---|
| **Ground Monitoring Surveys** | | |
| LW centreline and crossline surveys | SMEC | 34 |
| Local road surveys | SMEC | 52 |
| Local road inspections | BIS | 33 |
| **Sub-Total** | | **119** |
| **Natural Features** | | |
| Rockbar SR17 surveys | SMEC | 52 |
| Rockbar SR17 high resolution & 3D surveys | MNC | 45 |
| Stonequarry, Cedar and Matthews Creek Survey Lines | SMEC | 35 |
| Stonequarry, Cedar and Matthews Creek Visual inspections | Brienen Environment & Safety | 9 |
| Surface water manual monitoring | ATC Williams | 9 |
| Groundwater manual monitoring | SLR | 7 |
| Agricultural land inspections | BIS | 10 |
| Cliffs and steep slopes geotechnical inspections | Douglas Partners | 9 |
| Terrestrial ecology field investigations | Niche | 2 |
| Aquatic ecology field investigations | Niche | 2 |
| **Sub-Total** | | **180** |
| **Picton-Mittagong Loop Line** | | |
| Ground Surveys | Southern Rail Surveys | 23 |
| Track Geometry Surveys | BloorRail | 21 |
| Track Inspections | BloorRail | 42 |
| Embankments and cutting surveys | Southern Rail Surveys | 78 |
| Embankments and cuttings geotechnical inspections | Newcastle Geotech | 18 |
| **Sub-Total** | | **182** |
| **Main Southern Railway** | | |
| Ground Surveys | Southern Rail Surveys | 33 |
| Track Geometry Surveys | BloorRail | 30 |
| Track Inspections | BloorRail | 224 |
| Picton Tunnel surveys | Southern Rail Surveys | 34 |
| Picton Viaduct surveys | Southern Rail Surveys | 8 |
| Main Southern Railway structure surveys | Southern Rail Surveys | 87 |
| Far-field Surveys | Southern Rail Surveys | 7 |
| Embankments and cutting surveys | Southern Rail Surveys | 28 |
| Embankments and cuttings geotechnical inspections | Newcastle Geotech | 9 |
| **Sub-Total** | | **460** |
| **Utilities** | | |
| Endeavour Energy Power Pole and substation Surveys | SMEC | 22 |
| Water Re-use Storage Pond and sewer rising main visual inspections | Newcastle Geotech | 18 |
| Stonequarry wastewater treatment plant ground surveys | SMEC | 13 |
| Stonequarry wastewater treatment plant visual inspections | BIS | 19 |
| **Sub-Total** | | **72** |
| **Residential** | | |
| Pre-mining Front of House inspections | JMA Solutions | 78 |
| Pre-mining Structural Hazard Identification inspection and PMI | JMA Solutions | 114 |
| Pre-mining Geotechnical Hazard Identification inspections | Douglas Partners | 127 |
| Private property ground surveys | SMEC | 1 |
| Private property visual inspections | BIS | 119 |
| **Sub-Total** | | **439** |
| | | |
| **Total** | | **1452** |

## Monitoring Results

Ground monitoring has been undertaken within the active subsidence zone during LW W3. Monitoring results are shown graphically at the back of this report. Maximum incremental subsidence parameters from the most recent surveys are summarised in Table 2.

**Table 2 Summary of maximum observed subsidence parameters**

| Monitoring Line | | Maximum observed subs (mm) | Maximum observed tilt (mm/m) | Maximum observed hogging curvature ($km^{-1}$) | Maximum observed sagging curvature ($km^{-1}$) | Maximum observed tensile strain (mm/m) | Maximum observed comp. strain (mm/m) |
|---|---|---|---|---|---|---|---|
| LW W3 Centreline | *Inc*<br>*Total* | 592<br>629 | 3.5<br>3.3 | 0.22<br>0.19 | -0.26<br>-0.28 | 1.4<br>2.3 | -2.7<br>-2.8 |
| LW W1-W3 Crossline | *Inc*<br>*Total* | 586<br>857 | 3.5<br>3.4 | 0.14<br>0.07 | -0.29<br>-0.08 | 0.7<br>0.9 | -1.0<br>-1.6 |
| Stonequarry Creek Rd | *Inc*<br>*Total* | 94<br>619 | 0.6<br>3.8 | 0.03<br>0.07 | -0.02<br>-0.11 | 0.2<br>0.2 | -0.2<br>-0.9 |
| Attunga Cl | *Inc*<br>*Total* | 44<br>195 | 0.6<br>1.8 | 0.02<br>0.06 | -0.01<br>-0.01 | 0.4<br>0.4 | -0.2<br>-0.7 |
| Connellan Cr | *Inc* | 12 | 0.4 | 0.03 | -0.03 | 0.2 | -0.3 |
| Thirlmere Way | *Inc*<br>*Total* | 42<br>188 | 0.5<br>2.4 | 0.03<br>0.12 | -0.03<br>-0.08 | 0.3<br>0.5 | -0.4<br>-1.0 |
| Optic Fibre West | *Inc* | 72 | 0.7 | 0.04 | -0.03 | 0.2 | -0.4 |
| PMLL railway | *Inc*<br>*Total* | 387<br>697 | 2.5<br>3.7 | 0.09<br>0.22 | -0.07<br>-0.17 | 1.4<br>1.4 | -1.7<br>-5.0 |
| Main Southern Railway | *Inc* | 4 | 0.9 | 0.08 | -0.05 | 0.4 | -0.6 |

## Ground survey results

A map showing the locations of survey marks is provided in Drawing No. MSEC1204-01. A map showing the spatial distribution of incremental subsidence is shown in Drawing No. MSEC1204-02.

*Subsidence along centreline of LW W3*

GNSS Site 23 was located directly above the centreline of LW W3, approximately 100 metres from the commencing end. The unit recorded approximately 345 mm subsidence. With the mining of LW W3 finished, the GNSS unit has been relocated to its planned position above the commencing end of LW W4.

Survey marks were installed along the centreline of LW W3. The purpose of the centreline was to provide early subsidence information to confirm the magnitude of subsidence above LW W3. The development of subsidence along the centreline of LW W3 is shown in Fig. 1, where a maximum of 581 mm has been measured on 16 February at Peg CLW3-24, which is located on the ridge to the south of the Stonequarry Estate Wastewater Treatment Plant. Observed subsidence remains less than prediction.

The development of subsidence relative to the length of longwall extraction at sites of interest along the centreline is shown in Figure B.

A plot showing the development of subsidence relative to the position of the longwall face at the time of each survey is shown in Figure C.

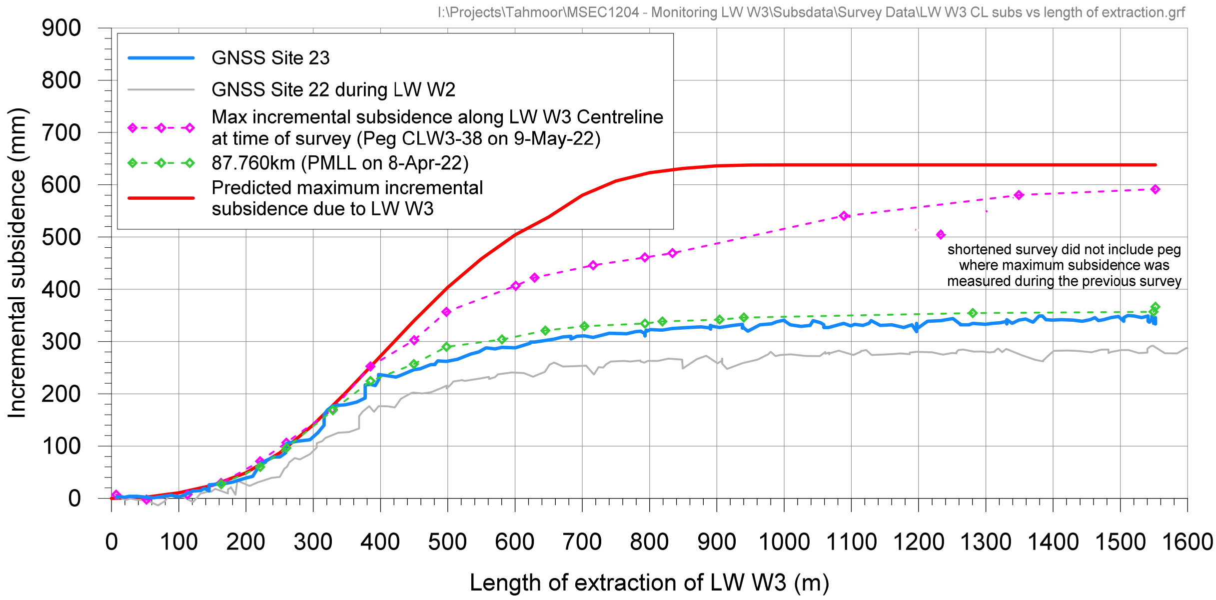



**Figure B Development of subsidence along centreline of LW W3**

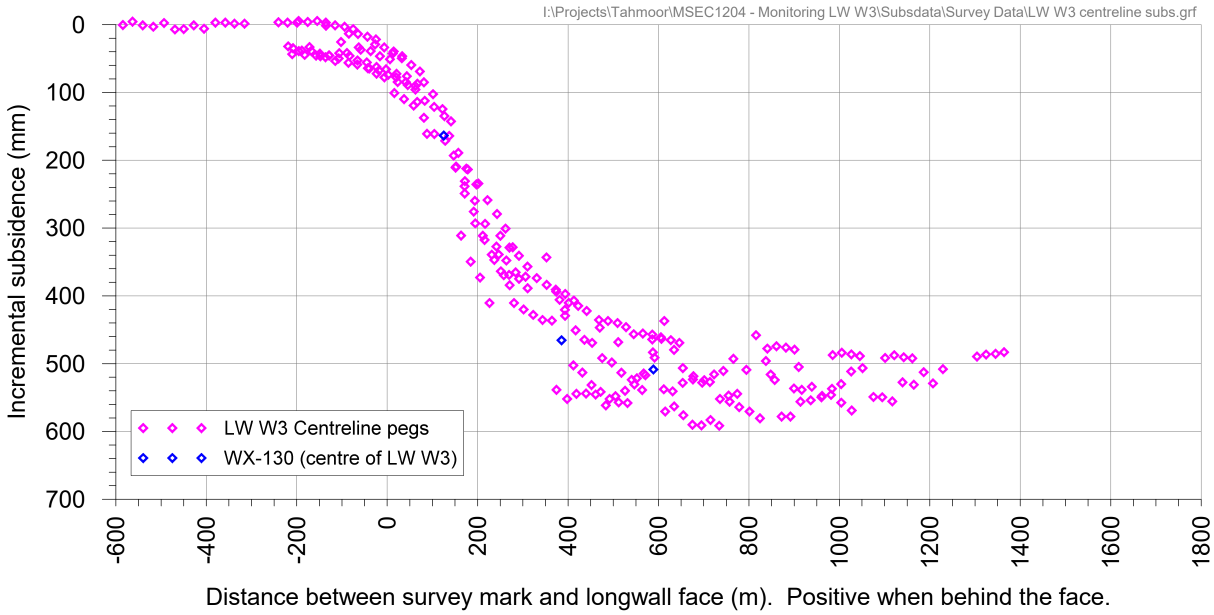



**Figure C Development of subsidence along centreline of LW W3 relative to position of LW face at times of the surveys**

### *Picton – Mittagong Loop Line*

Regular surveys were conducted along the Picton to Mittagong Loop Line during the mining of LW W3. Compressive strains were observed above the centreline of LW W3 and across the creek crossing. Visual inspections did not identify any issues associated with mine subsidence.

### *Main Southern Railway*

Regular surveys were conducted along the Main Southern Railway during the mining of LW W3. Results were within survey tolerances during mining. Visual inspections did not identify any issues associated with mine subsidence.

### *Victoria Bridge*

Regular surveys were conducted at the Victoria Bridge over Stonequarry Creek during the mining of LW W3. 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. Transport for NSW is currently in the process of reinstating a gap prior to the influence of LW W4.

## GNSS monitoring

Global Navigation Satellite System (GNSS) units are fixed survey stations that continuously measure their absolute horizontal and vertical positions in real time. There are 18 units located directly above and adjacent to LW W3-W4. These include two units above the commencing end, and along the centreline of, LW W2, being Sites 23 and 7.

The measured positions of each GNSS unit varies depending on atmospheric conditions and the array of satellites that are present in the sky at each time, and the vegetation cover surrounding each unit. Measured variations in height are typically greater than the variations for eastings and northings.

The results from the GNSS units are shown in Fig. G07 to Fig. G23. The 7-day running average readings are the most appropriate reflection of measured changes to date. Some trends can be seen from the results, with the closest GNSS units generally moving towards the extracted panel.

Changes in horizontal distances can be calculated between GNSS units that are stationed close together and results are shown in Figure D. Minor changes are currently observed between the GNSS units.

The GNSS unit at Site 14 has been removed at the request of the landowner. The last reading was on 4 November 2021.

The GNSS unit at Site 13 has been confirmed as disturbed in January, likely during removal of the surrounding fencing. Minor changes have been observed since this time. The unit was relocated on 28 March and results normalised.

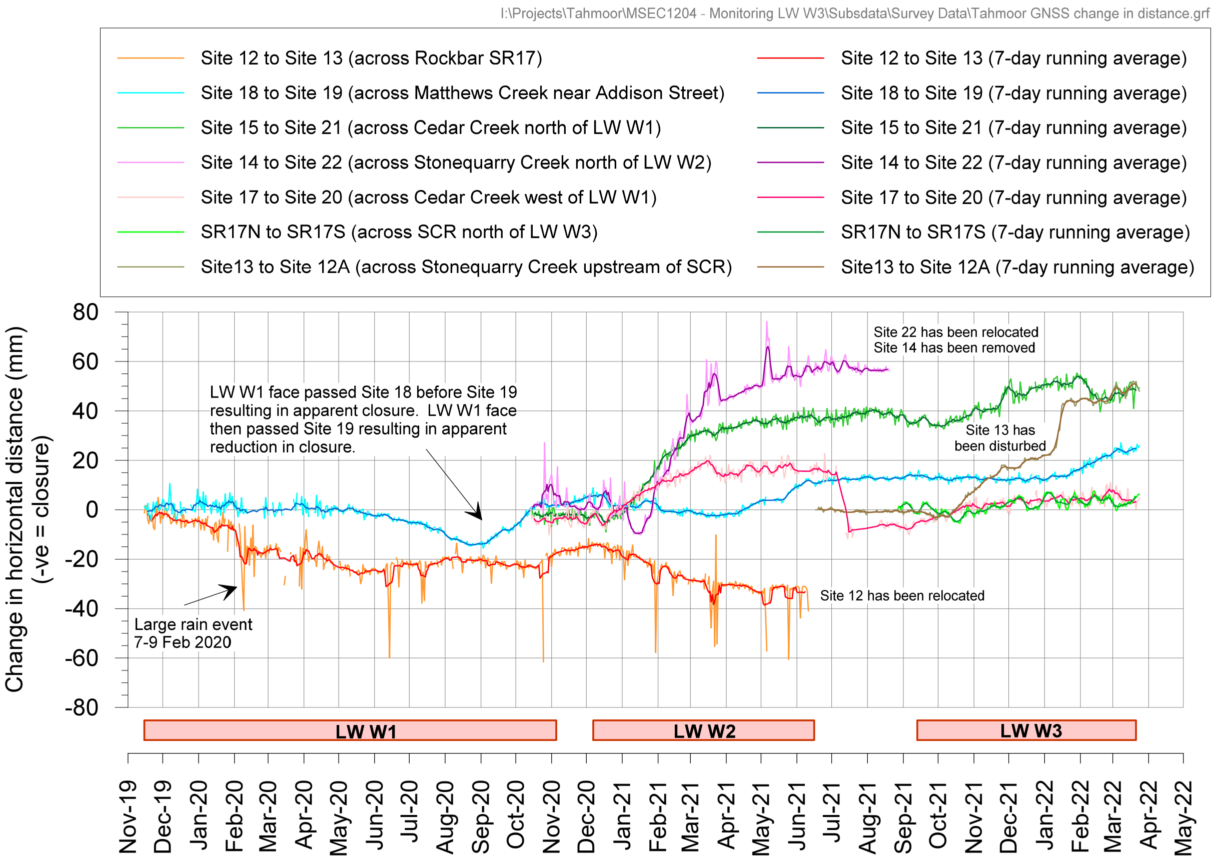



**Figure D** **Observed changes in horizontal distances between GNSS units**

## Summary of impacts to surface features

A comparison between assessed and observed impacts to surface features is summarised in Table 3. The assessed and observed impacts to surface features compare reasonably well with predictions.

**Table 3 Summary of predicted and observed impacts during LW W3**

| Surface Feature | Predicted Impacts | Observed Impacts |
|---|---|---|
| **Natural Features** | | |
| Stonequarry, Cedar and Matthews Creek | Potential cracking in creek bed. Potential surface flow diversion (less than 10% of pools in Study Area) Potential reduction in water quality during times of low flow. Potential gas emissions. | Minor fracturing observed in south-east corner of Rockbar SR17. No reduction in pool levels below baseline levels. Pools currently full following multiple rainfall events, particularly in March 2022. No reduction in water quality observed. Refer to report below for further details and report by Brienen and HEC. |
| Aquifers or known groundwater resources | Temporary lowering of piezometric surface by up to 15m which may stay at that level until maximum subsidence develops. Groundwater levels should recover with no permanent post mining reduction in water levels in bores on the plateau unless a new outflow path develops Potential impacts to privately owned groundwater bores. Please refer report by SLR. | Groundwater levels gradually recovered during mining of LW W3 in response to above average rainfall. Please refer report summarising 6 months of results by SLR. |
| Steep slopes and cliffs | Potential soil slippage and cracking to slopes. Large scale slope failures or cliff instabilities unlikely. | No impacts observed during LW W3. |
| Natural vegetation | No impacts anticipated. | No impacts observed during LW W3. |
| **Public Utilities** | | |
| Picton to Mittagong Loop Line (PMLL) | Railway will remain safe and serviceable with management plans in place. | Railway maintained in safe and serviceable condition during mining. No issues were observed. Refer to report below for further details. |
| Main Southern Railway | Unlikely to experience adverse impacts. Monitoring program in place to measure far field movements. | No adverse impacts observed. Minor far field movements observed. |
| Roads and Bridges (all types) | Minor cracking and buckling may occur in isolated locations. | Kerb damage and cracking of concrete drain on Stonequarry Creek Road. No impacts observed to Victoria Bridge but gap between bridge deck and eastern abutment almost closed. The gap is in the process of being reinstated prior to the influence of LW W4. Refer to report below for further details. |
| Water pipelines | Minor impacts possible to pipelines, particularly at creek crossings. | No impacts observed during LW W3. |
| Sewer pipelines | Minor impacts possible to pipelines, particularly at creek crossings. | No impacts observed to rising main and gravity sewers during LW3. |
| Wastewater Treatment Plant (WTP) | WTP unlikely to experience impacts and will remain safe and serviceable with management plans in place. | Minor settlement of backfill material following rainfall and minor erosion hole (not mining related). No impacts observed to Water Re-use Storage Dam wall from visual inspections from rail corridor. No impacts observed to pumping stations. |
| Gas pipelines | Unlikely to experience adverse impacts with management plan in place. | No impacts observed during LW W3. |

| Surface Feature | Predicted Impacts | Observed Impacts |
|---|---|---|
| Electricity infrastructure | Some adjustments of power poles, catenaries or aerial powerline connections may be required. | No impacts observed during LW W3 |
| Telecommunication infrastructure | Unlikely to experience adverse impacts with management plan in place. | No impacts observed during LW W3 |
| **Public Amenities** | No public amenities within influence of LW W3. | No impacts observed during LW W3. |
| **Farmland and Facilities** | | |
| Farm buildings, sheds, tanks | Negligible to slight impacts predicted for all farm buildings and sheds with management plan in place. | No impacts observed during LW W3. |
| Fences | Potential for impacts to fences and gates. | No impacts reported to fences on farm properties during LW W3. |
| Farm dams | Potential adverse effects on dam walls and storage capacity. | No impacts observed during LW W3. |
| Wells or bores | Potential impact on one NOW registered bore directly above LW W2. | No impacts reported. |
| **Areas of Archaeological Significance** | Open camp sites, the modified tree and rock shelter sites are unlikely to experience impacts.<br>Grinding groove site 52-2-2068 on Rockbar SR17 may experience fracturing but unlikely to occur. | End of Panel report by EMM confirmed no impacts to archaeological sites. Negligible impact at grinding groove site 52-2-2068. Minor fracturing observed in south-east corner of rockbar away from the grooves. |
| **Areas of Heritage Significance** | Potential low-level impacts at weatherboard cottage at 796 Thirlmere Way but will remain safe, serviceable and repairable with management plan in place.<br>Impacts may occur to culverts along the PMLL but will remain safe, serviceable and repairable with management plans in place. | No impacts reported during mining of LW W3. |
| **Permanent Survey Control Marks** | Ground movement predicted at identified survey marks. | Ground movement occurred. |
| **Residential Establishments** | | |
| Houses | All houses expected to remain safe, serviceable and repairable provided that they are in sound condition prior to mining. Impacts predicted to some houses. | Minor impacts have occurred to some houses, including impacts to plasterboard walls, door and window frames and floor tiles. Houses have remained safe, serviceable and repairable.<br>Refer to report below for further details. |
| Swimming pools | While predicted tilts are not expected to cause a loss in capacity, tilts are more readily noticeable in pools as the height of the freeboard will vary along the length of the pool. While predicted strain impacts are low, many of the pools are inground, which are more susceptible. | Minor impacts reported.<br>No pool gates have required adjustment. |
| Associated structures such as workshops, garages, on-site wastewater systems, water or gas tanks or tennis courts | Potential impact to pipes connected to inground septic tanks.<br>Negligible impacts predicted for non-residential domestic structures, including sheds and tanks. | No impacts reported during LW W3. |
| External residential pavements | Cracking and buckling likely to occur, though majority of impacts are expected to be minor. | Minor impacts to some external pavements. |
| Fences in urban areas | Some fences and gates could be slightly damaged. Most vulnerable are Colorbond fences. | No impacts to fences reported. |

## Natural Features

Survey marks have been installed across rockbars in Cedar, Matthews and Stonequarry Creeks prior to the commencement of LW W1, at locations shown in Drawing No. MSEC1204-01.

Valley closure has been measured to develop across Stonequarry Creek at SQ104 and SQ105, which are located near the confluence of Stonequarry Creek and Cedar Creek. Minor closure was developing across SQ104, SQ105, SQ106 and SQ107 up to 3 November. The survey pegs for SQ101 to SQ109 were removed following the survey on 3 November, as requested by the landowner. Results are shown in Figure E.

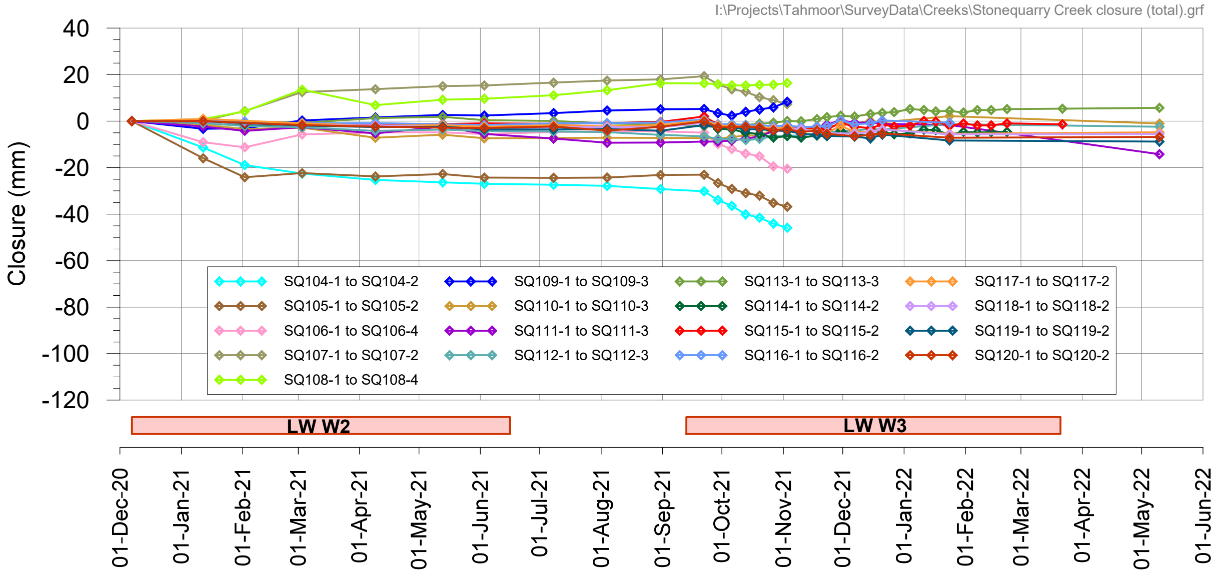



**Figure E Development of observed valley closure along Stonequarry Creek (new closure marks)**

The most recent monthly survey for Rockbar SR17 was on 22 February. Small changes in horizontal distances were observed both along and across the rockbar, as shown in Figure F. Minor ground shortening is observed in the southeast corner of the rockbar, which is captured by measurements at Marks RBE11, RBF05 and RBF06.

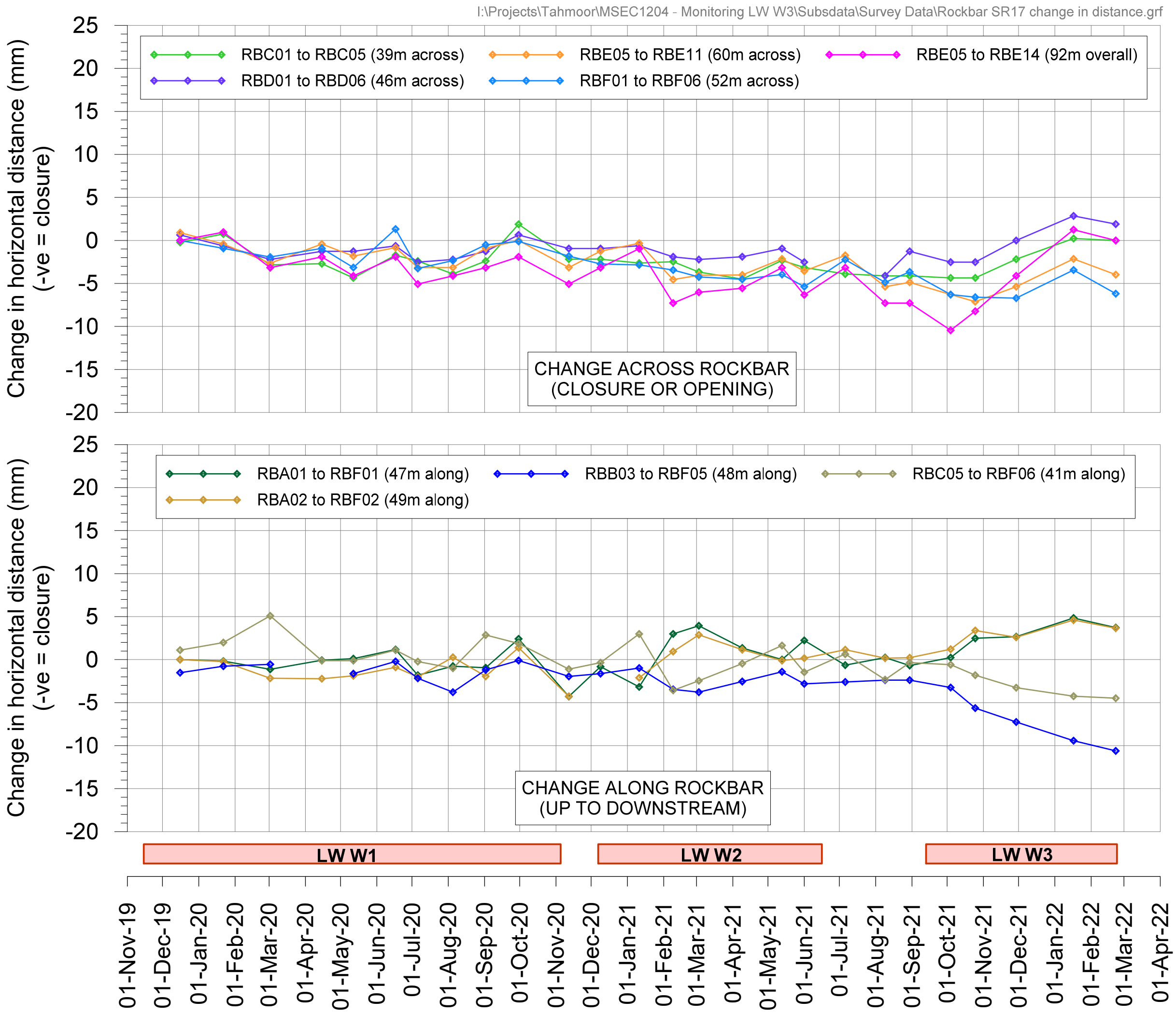
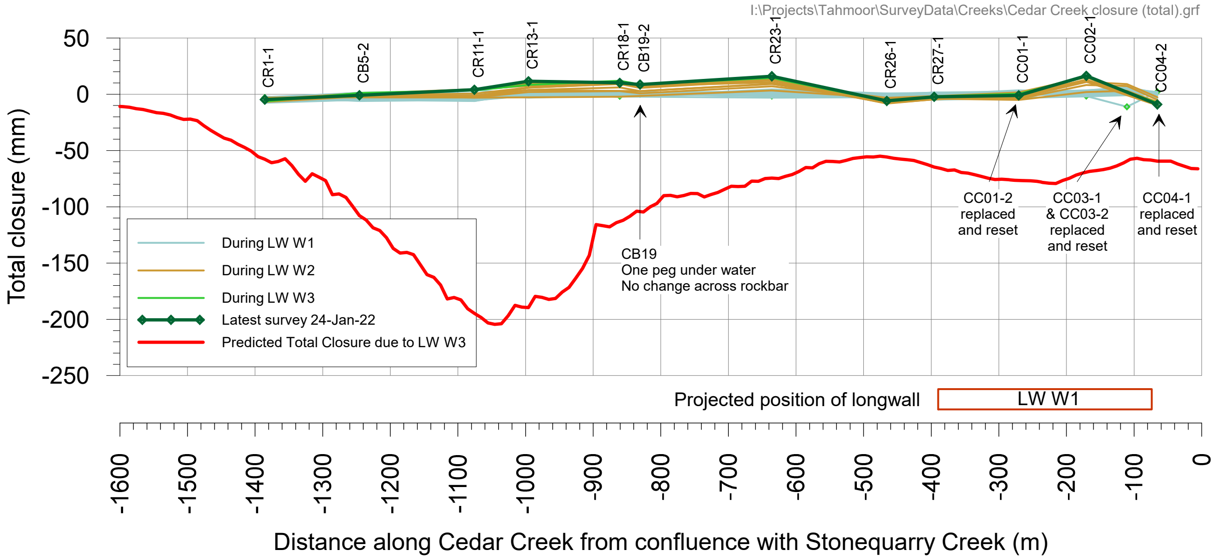



**Figure F Changes in distance across and along Rockbar SR17 during LW W1-W3**

A comparison between observed and predicted valley closure along Cedar Creek is shown in Figure G. Very little change in closure was observed during the mining of LW W3. The most recent survey was on 24 January, with minor changes observed.



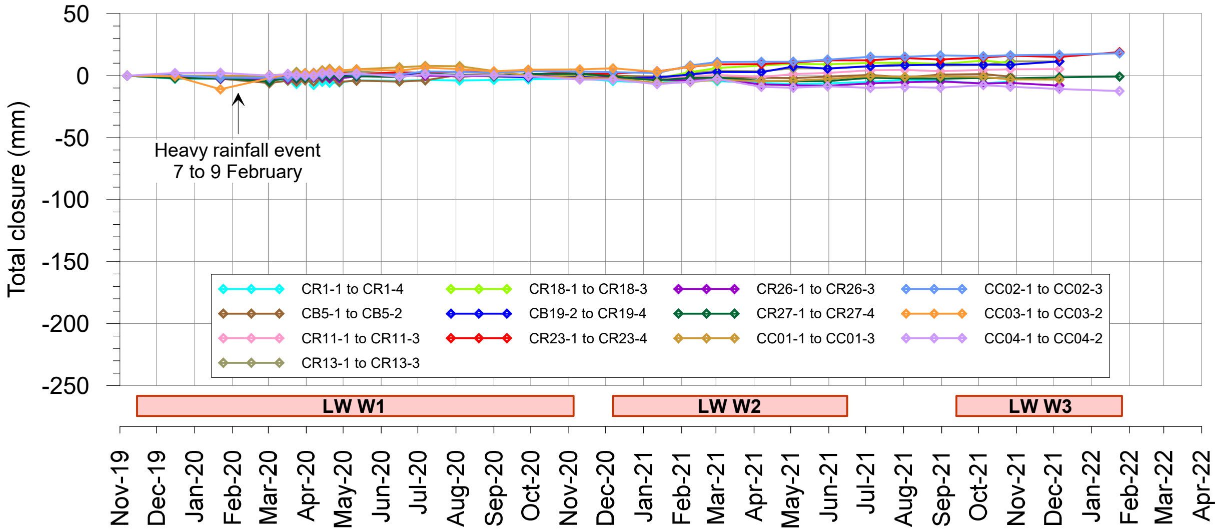




**Figure G Comparison between observed and predicted valley closure along Cedar Creek**

Surveys across the newly installed closure marks are shown in Figure H.  The most recent survey was on 10 May with minor changes observed.

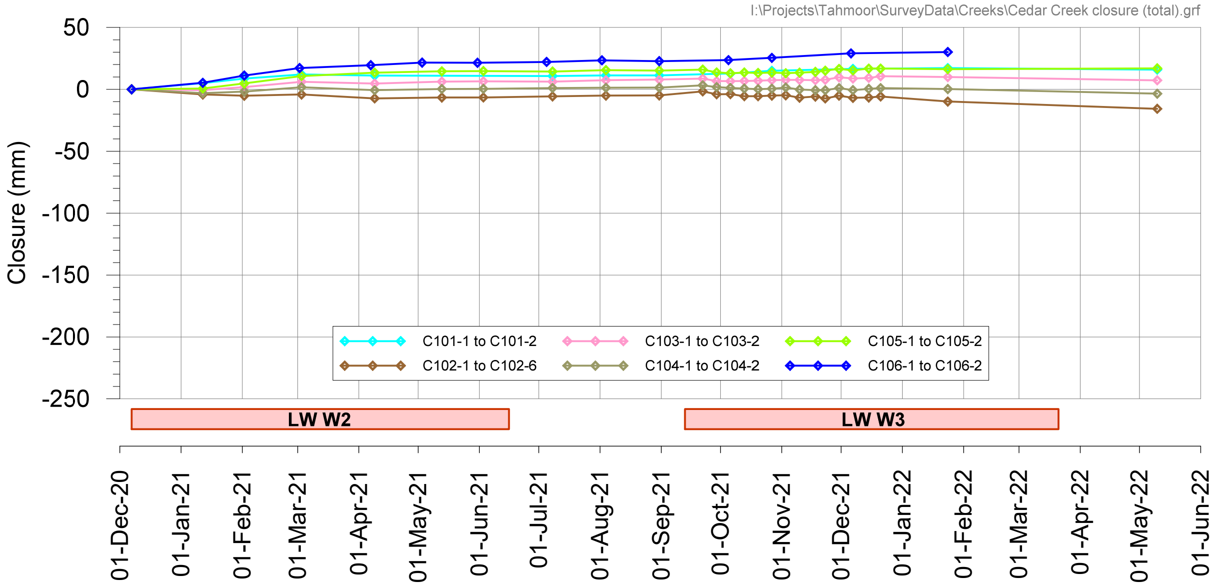



**Figure H Development of observed valley closure along Cedar Creek (new closure marks)**

Survey pegs C101-1 and C101-2 are aligned with GNSS sites 17 and 20.  A reasonable comparison in measured changes in distance between the two survey sites is shown in Figure I, though one of the GNSS units appears to have been disturbed in July 2021 between the completion of LW W2 and commencement of LW W3.

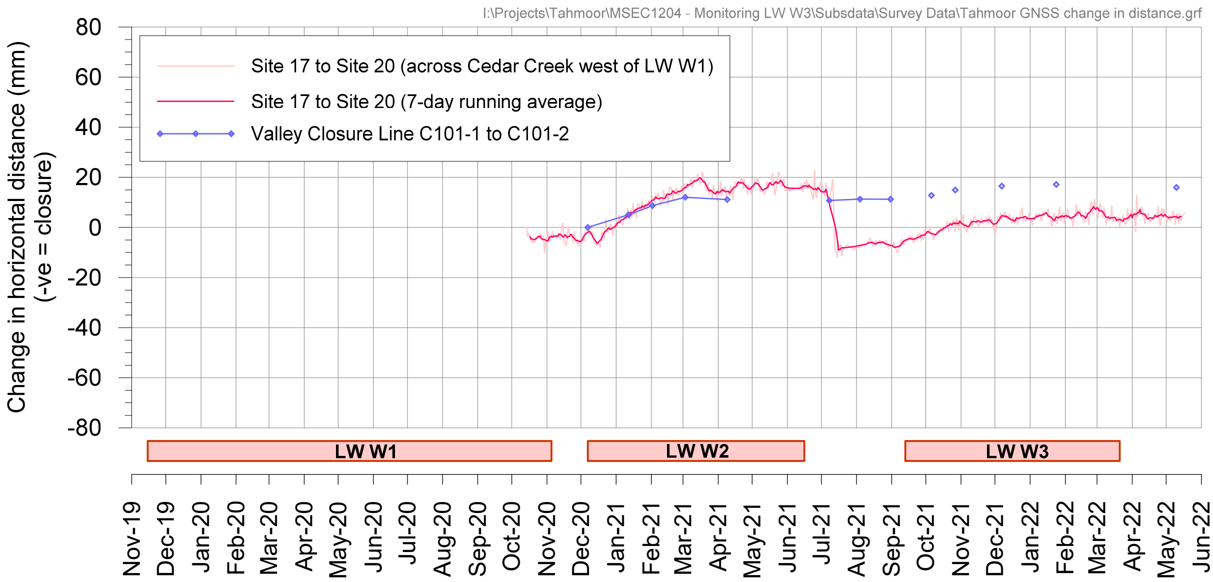



**Figure I Development of observed valley closure along and across Cedar Creek**

A comparison between observed and predicted valley closure along Matthews Creek is shown in Figure J. The most recent survey was on 8 December, with minor changes observed.

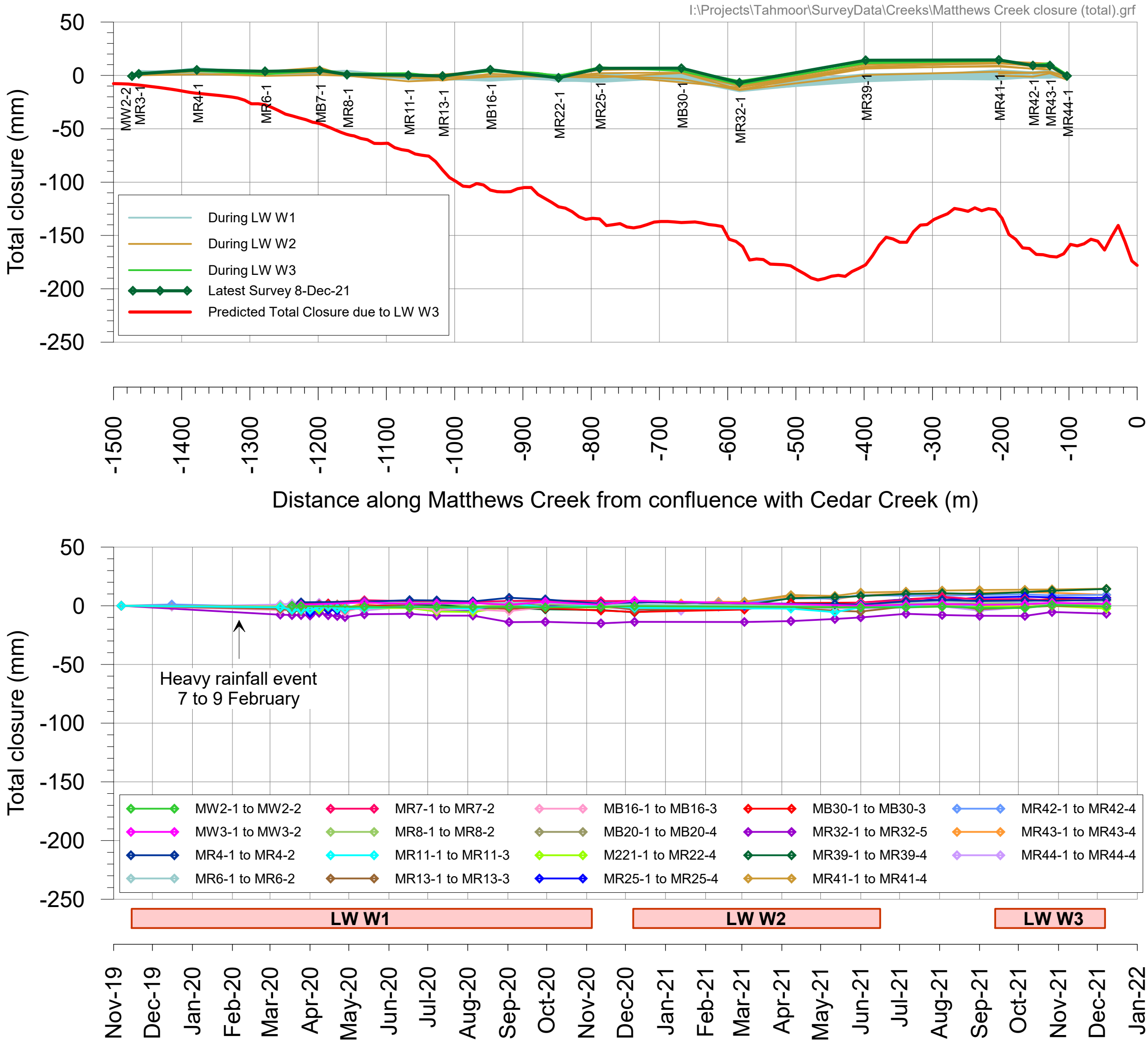



**Figure J Comparison between observed and predicted valley closure along Matthews Creek**

Visual inspections prior to the commencement of LW W1 and in December 2019 found that there was no connective overland water flows in Matthews Creek due to the prolonged drought. Most pools were dry with a few pools holding water at low to medium levels. No connective overland water flows were observed in Cedar Creek upstream of the confluence with Matthews Creek due to the prolonged drought. Most pools were dry with a few pools holding water at low to medium levels. Downstream of Matthews Creek, pools in Cedar Creek were full with a trickle flow observed out of the majority of the pools. There was no flow over the sand substrate at the lower reaches of Cedar Creek. The water level in the long pool in Stonequarry Creek fell below the Cease to Flow level in late October prior to the start of LW W1.

An inspection was conducted on 22 January 2020 following a series of rain events between 8 and 21 January. Pools that were previously dry were observed to contain water and the overland flow was observed over the previously dry lower reaches of Cedar Creek. An inspection was conducted on 27 February 2020 following a large rain event on 7 to 9 February 2020. Higher volumes of connective flow and flood levels were observed in Matthews, Cedar and Stonequarry Creeks.

Monthly monitoring and inspections during the mining of LW W1 observed rising and falling of water levels consistent with rainfall events. No mining-induced impacts were identified in the visual inspections.

No mining-induced impacts were observed to Stonequarry and Matthews Creeks during the mining of LW W2, including the pool at Rockbar SR17 in Stonequarry Creek.

A focussed visual inspection was conducted on 19 January 2021, which confirmed low water levels in 7 pools, which were Pools CB10, CR12, CR13, CR14 and CR15 in Cedar Creek and Pools MR45 and MR46 in Matthews Creek. Rainfall events occurred intermittently during January 2021 and follow up inspections in February 2021 found a return to normal water levels and overland flows. A substantial rainfall event occurred in mid to late March 2021 and inspections in March and April found pool water levels to be full.

Following observations of atypical water level behaviour at Pools CB3, CB10 and CR14 in Cedar Creek in late 2020 and early 2021, water levels returned to normal levels during February in response to a series of rainfall events.

Water level monitoring in March did, however, detect a reduction in water levels in only Pool CR14 until a large storm event refilled the pool in late March 2021. Water levels in Pools CB3 and CB10 remained consistent with baseline conditions during this time.

Visual inspections and water level monitoring have found that water levels have returned to normal since March 2021 at Pool CR14. They have not declined atypically during periods of dry weather. Water levels have remained above minimum levels in response to above average rainfall during the mining of LW W3. No changes were observed during the most recent inspection in May 2022.

Previously observed gas bubbling at Pool MR45 have not been found during the mining of LW W3, including the end of panel inspection in May 2022. Iron-oxy hydroxide precipitation was observed during the October 2021 inspections that was similar to previously observed precipitations during pre-mining baseline inspections and at sites in Stonequarry Creek located well upstream from the longwalls, beyond the influence of mine subsidence. No changes were observed during the most recent inspection on 17 March 2022.

Minor surface fracturing has been observed on Rockbar SR17 in the south-east corner of the rockbar, downstream of the access road. The fractures are in a localised area and limited to the laminar surface rocks only.

### Local Roads

Ground surveys and visual inspections were conducted along Stonequarry Creek Road, Booyong Close and Attunga Close. No issues were observed along Booyong Close and Attunga Close. Minor deterioration was observed on 19 January 2022 to a concrete kerb drain at the northern end of Stonequarry Creek Road, which was previously damaged during the mining of LW W2. No significant change was observed as mining continued.

Surveys and visual inspections along Connellan Crescent found pavement damage at the intersection of Rumker Street and Thirlmere Way on 3 March. Running and ponding water has resulted in erosion of the unsealed surface of Star Street. The changes are not mining related.

Surveys and inspections along Thirlmere Way was conducted, with approximately 30 mm residual subsidence measured since the completion of LW W2. Minor changes in horizontal distances were measured across the pavement since the completion of LW W2. Deterioration of the road surface was observed on 1 March, accelerated by heavy rainfall. On 7 March several small landslips due to heavy rainfall were observed. The debris was cleared by Council and was not mining related. No significant change was observed after this time.

### Victoria Bridge across Stonequarry Creek

Very gradual and minor closure was observed to develop across Stonequarry Creek at Victoria Bridge, which is located approximately 1000 metres from LW W3. The timing of the closure coincided with the final stages of mining LW W3, a period of heavy rainfall and completion of abutment strengthening works by Transport for NSW (TfNSW). Inspections were conducted by a structural engineer and bridge maintenance engineers from TfNSW. While no immediate concerns were observed, the gap between the bridge deck and the eastern abutment was observed to almost close. TfNSW is currently arranging to reinstate the gap prior to the influence of LW W4.

### Structures

There are no structures located above LW W3. No claims have been received for structures located above or near LW W3 since mining commenced.

Weekly inspections were conducted for properties along Booyong Close, Stonequarry Creek Road and Attunga Close.

A property on Booyong Close experienced a wet sub floor area and minor collapse of shale material in the same location as previously reported during LW W2. The owner reported water running through the garage.

### Stormwater Detention Basin

Ground surveys and visual inspections were conducted during the mining of LW W3. Minor changes were measured since the completion of LW W2 with no issues observed from visual inspections.

### Gas Infrastructure

No gas infrastructure is located above the commencing end of LW W3.

No impacts were detected from ground surveys and visual inspections along Stonequarry Creek Road, Booyong Close and Attunga Close during the mining of LW W3.

### Electrical Infrastructure

Monthly surveys were conducted for power pole 762531 located on Rockbar SR17 with very minor subsidence measured during the mining of LW W3.

Surveys were also conducted around the substation during the mining of LW W3, with measured changes in horizontal distances around the substation within survey tolerance. Visual inspections were conducted with no significant changes observed.

No impacts were detected from ground surveys and visual inspections along Stonequarry Creek Road, Booyong Close and Attunga Close during the mining of LW W3.

### Telecommunications Infrastructure

No telecommunications infrastructure was located above the commencing end of LW W3.

No impacts were detected from ground surveys and visual inspections along Stonequarry Creek Road, Booyong Close and Attunga Close during the mining of LW W3.

Surveys and visual inspections were conducted along the optical fibre cable beyond the finishing end of LW W3. The pegs were installed and initially surveyed when LW W2 was approximately 450 metres from the finishing end. The results, therefore, included a measure of total subsidence due to the mining of LW W2 and LW W3. A reasonable correlation was found between predicted and observed subsidence. Observed tilts and strains were close to survey tolerance.

### Potable Water Infrastructure

No potable water infrastructure was located above the commencing end of LW W3.

No impacts were detected from ground surveys and visual inspections along Stonequarry Creek Road, Booyong Close and Attunga Close during the mining of LW W3.

### Sewer Infrastructure

Subsidence was observed to develop gradually at the Wastewater Treatment Plant (WTP) and Re-use Water Storage Pond during the mining of LW W3, as expected.

Visual inspections of the WTP were conducted on a weekly basis during the period of active subsidence. An inspection on 15 November found further erosion near the stormwater pit after rainfall (not mining related). Backfill material around the stormwater pit was relevelled. No mining-induced impacts were observed.

Visual inspections of the Re-Use Water Storage Dam wall were conducted regularly during the mining of LW W3. No impacts were observed.

A sewer rising main associated with the Stonequarry Estate follows the alignment of the Picton-Mittagong Loop Line, and is partly located directly above LW W3. No impacts have been observed from visual inspections.

Ground surveys and visual inspections were conducted during the mining of LW W3 around the detention basin and Pumping Station 2. No impacts have been observed.

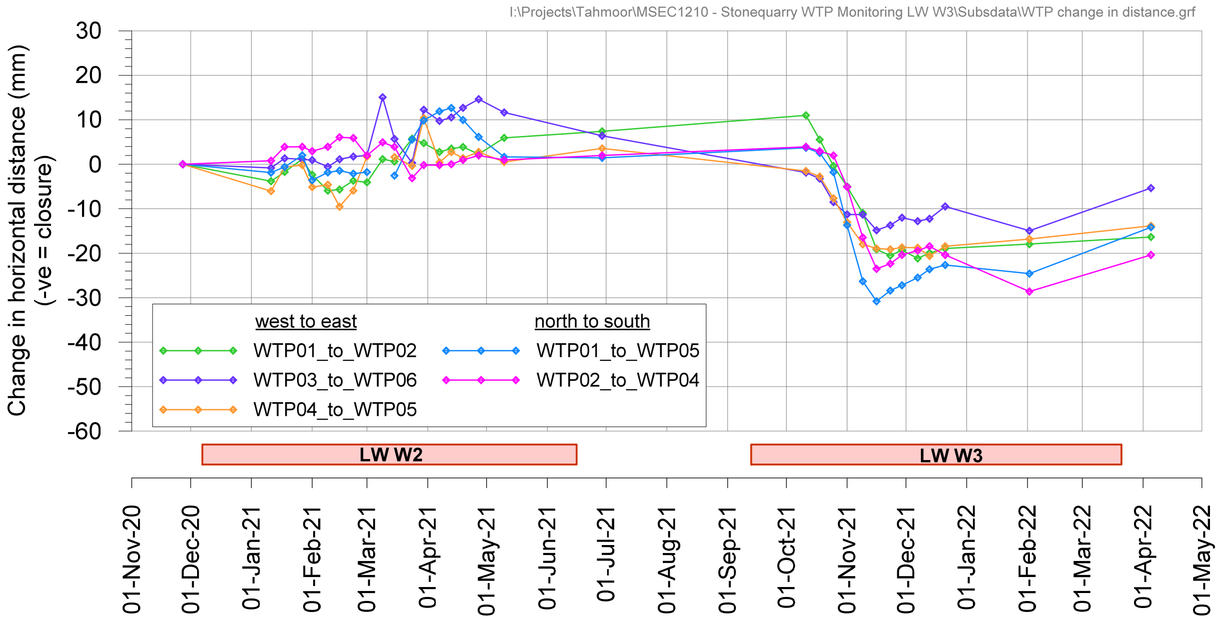



**Figure K Total changes in distance over time**

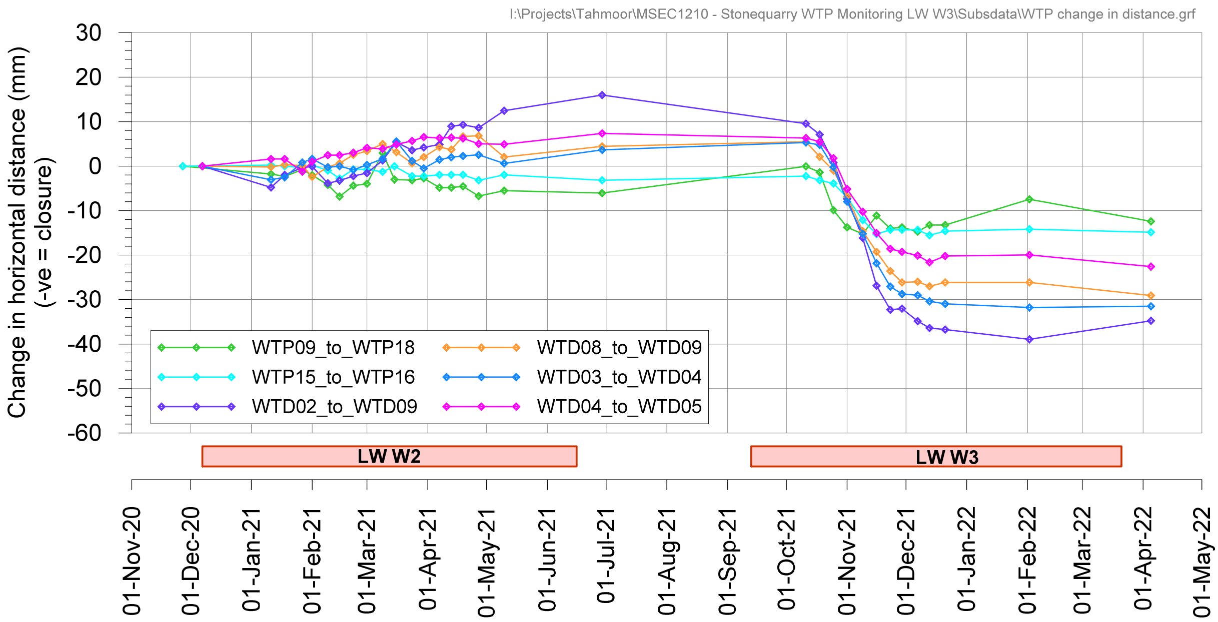



**Figure L Total changes in distance over time**

## Dams

Regular surveys and inspections were conducted at Farm Dam FD-1 and Farm Dam FD-3.

Minor subsidence movements were observed, with compressive strains developing across the bases of the valleys. The dams are currently full following above rainfall during the mining of LW W3. No mining-induced impacts were observed.

## Archaeological Sites

Very minor ground movements have been measured across Rockbar SR17, with no impacts observed at the grinding groove sites. Surface fractures were observed on the rockbar approximately 40 metres downstream of the grinding grooves since late October 2021. The fractures have been assessed to have negligible impact on the heritage value of the site.

Aboriginal rock shelters show no subsidence related rock face cracking or spalling.

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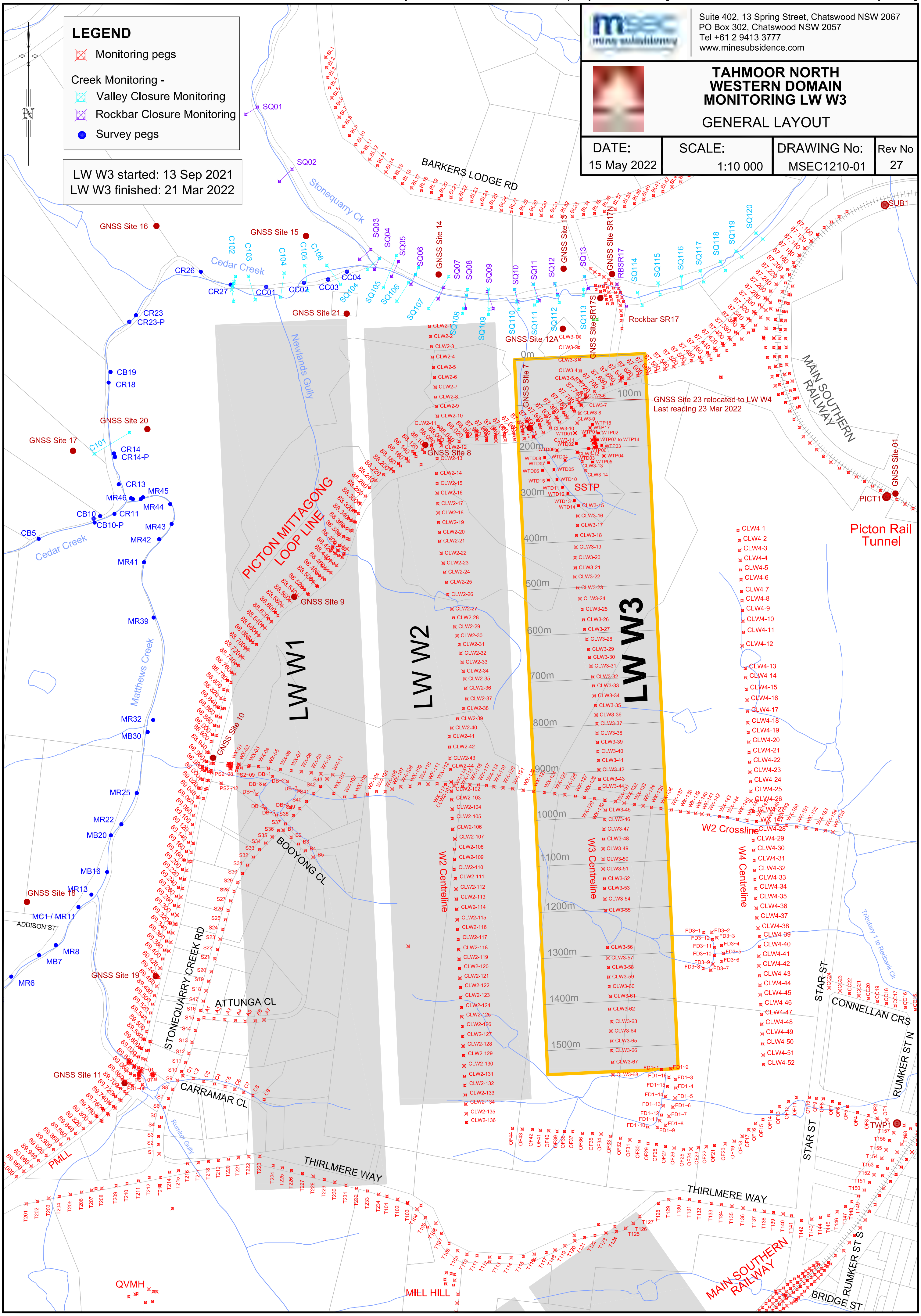
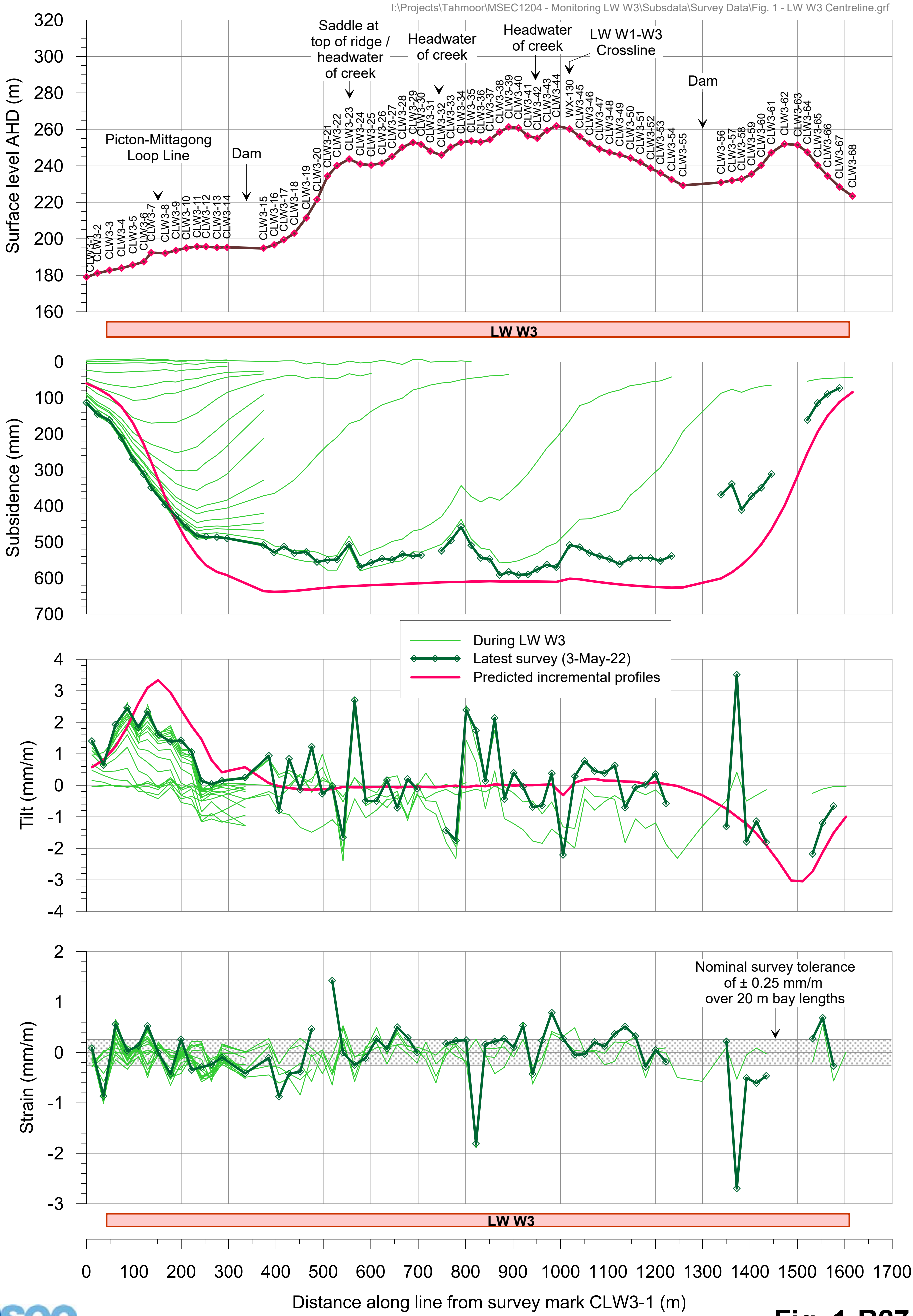


# Tahmoor LW W3
# Incremental subsidence profiles along LW W3 Centreline




msec

Fig. 1-R27

# Tahmoor LW W3
# Incremental subsidence profiles along Rockbar SR17

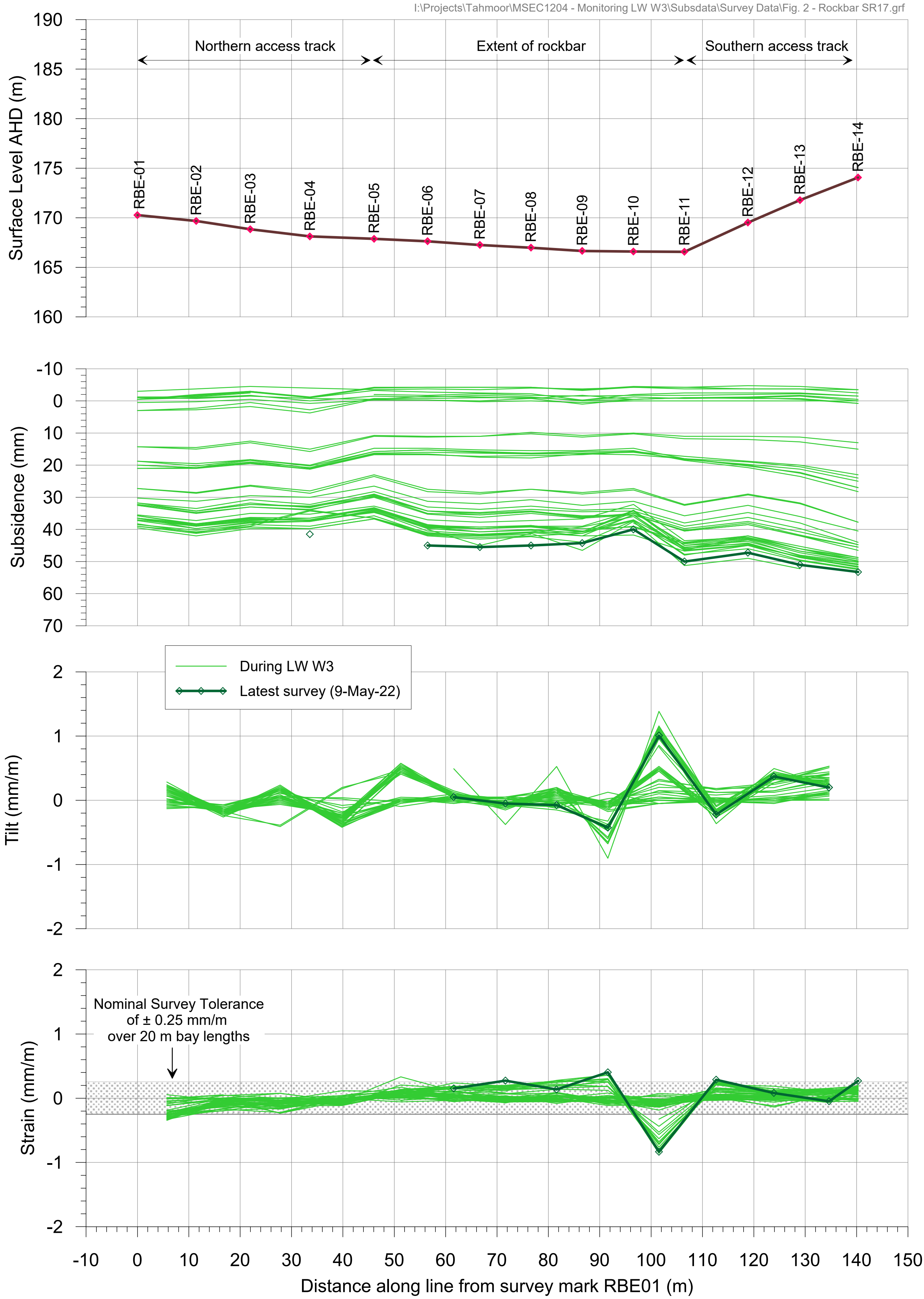



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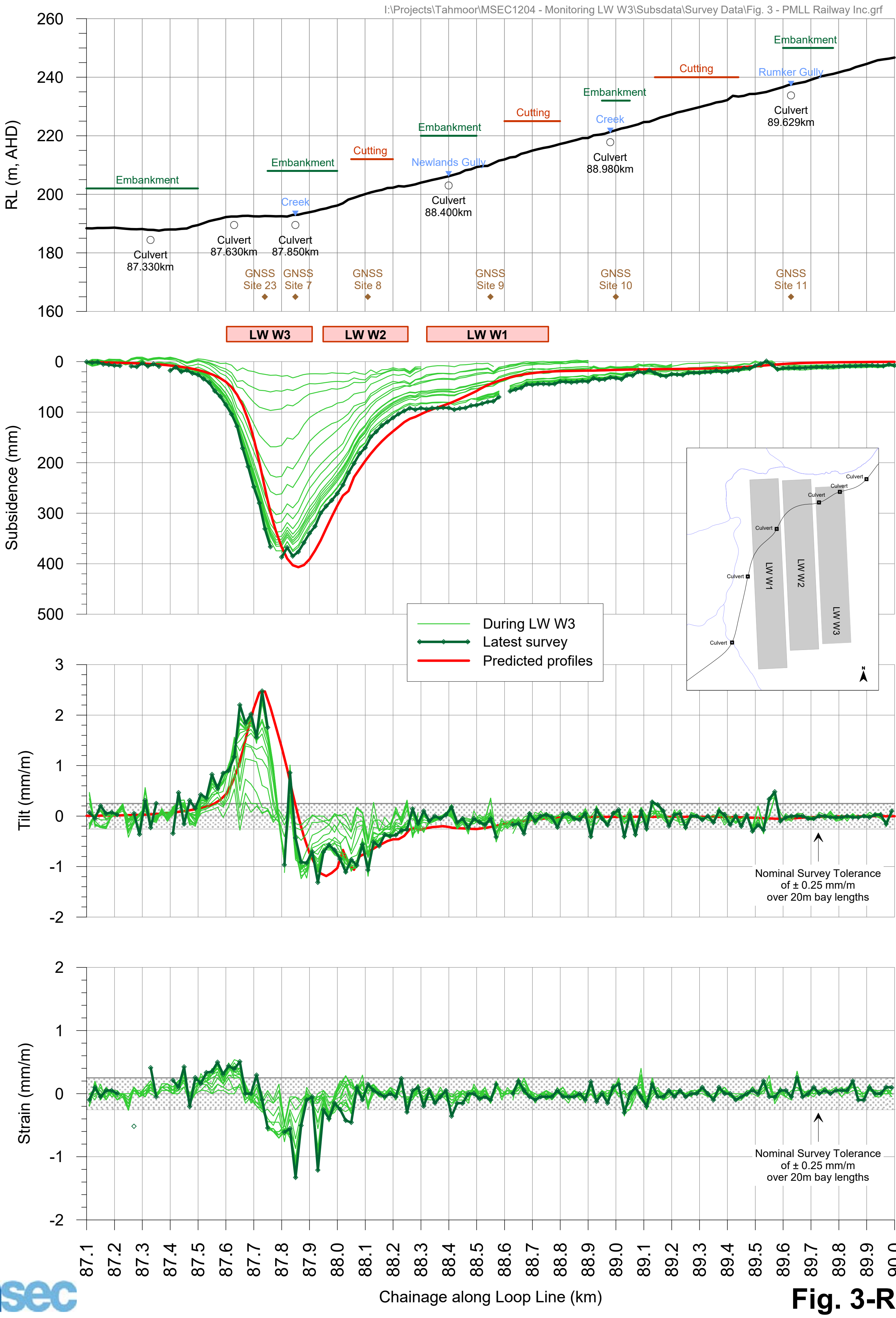
Fig. 2-R27

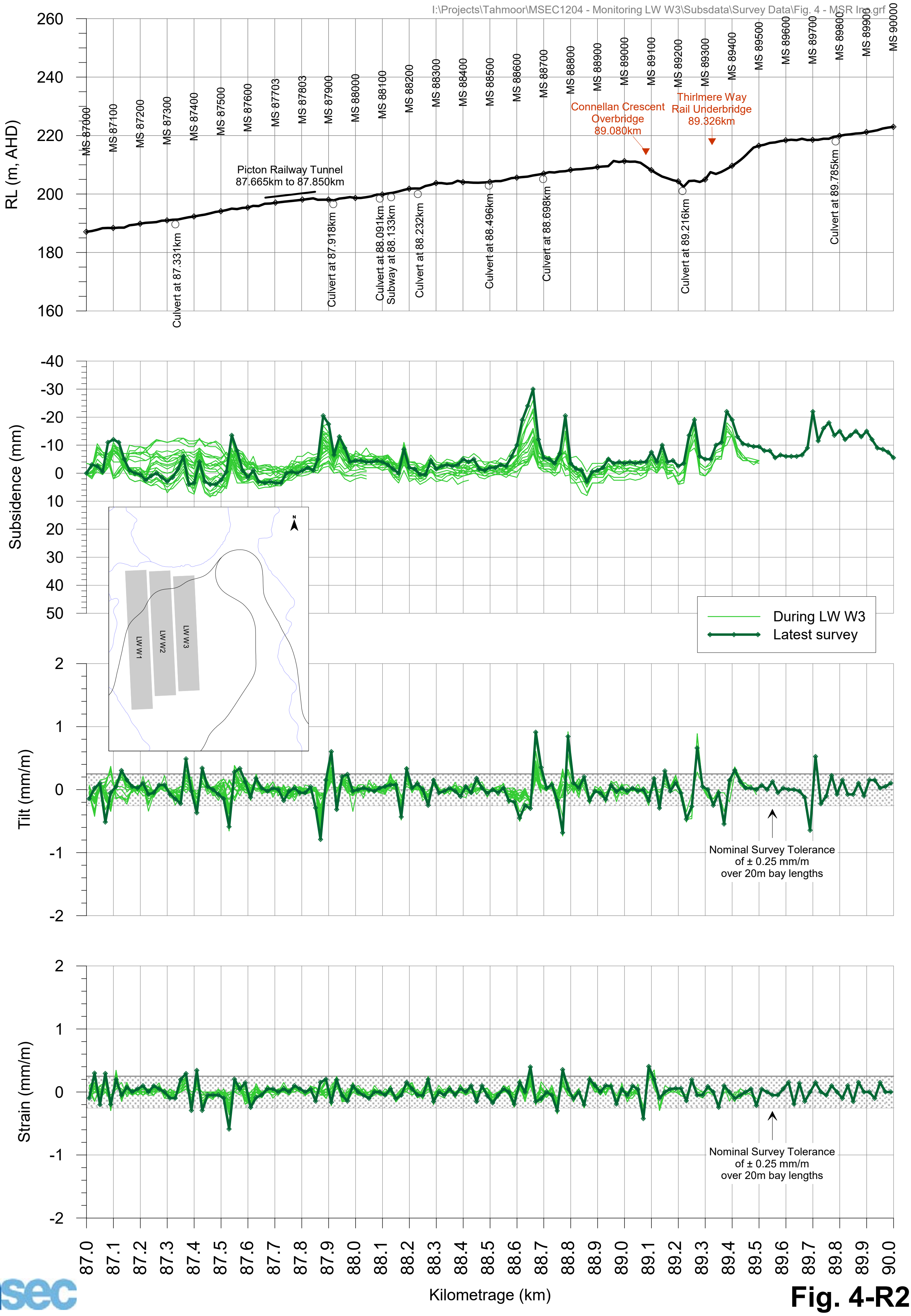
# Tahmoor LW W3 - Picton-Mittagong Loop Line
# Incremental subsidence profiles
# Survey date: 8 April 2022




msec

Fig. 3-R27

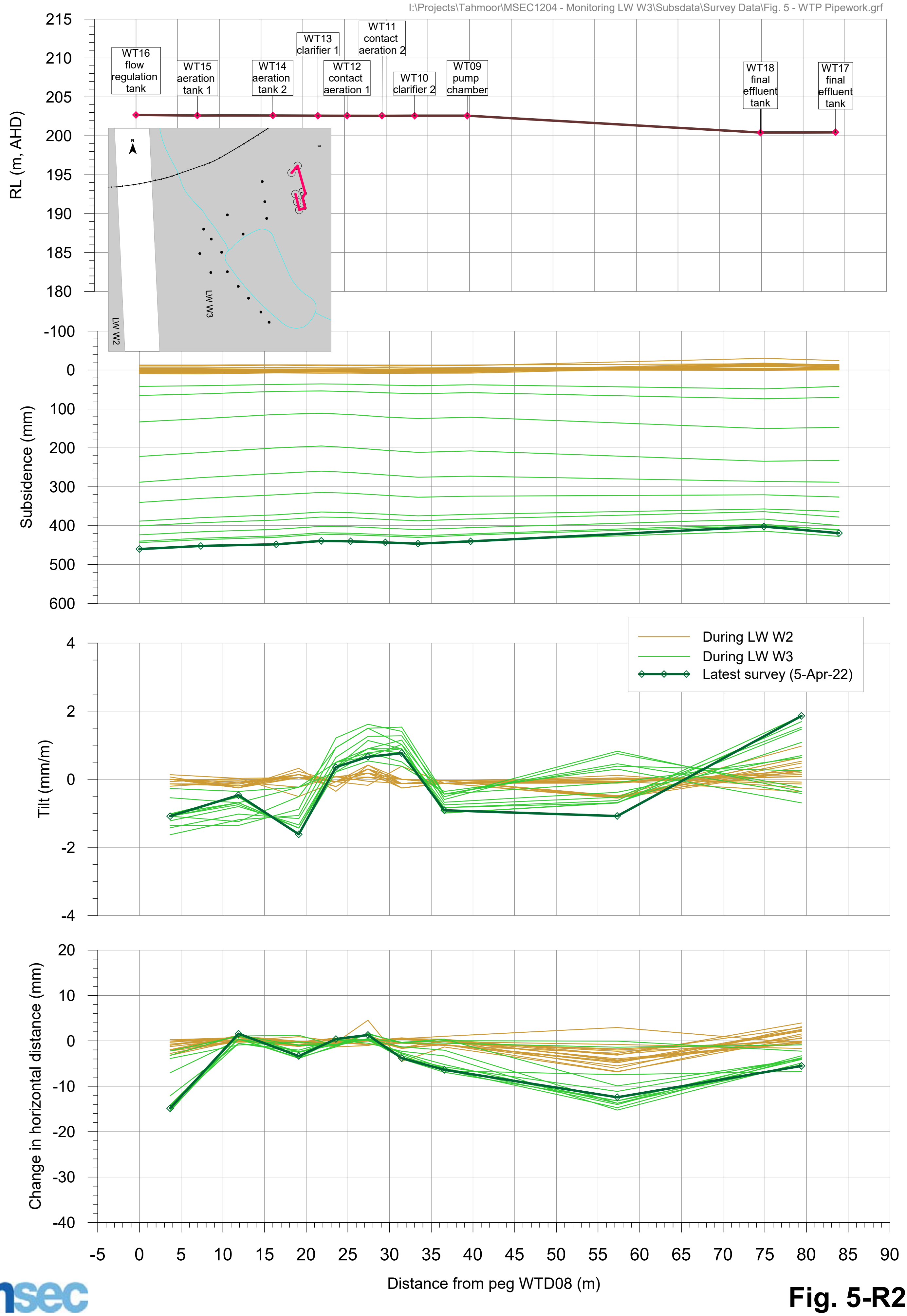
# Tahmoor LW W3 - Main Southern Railway
# Incremental subsidence profiles
# Survey date: 14 April 2022




msec

Fig. 4-R27

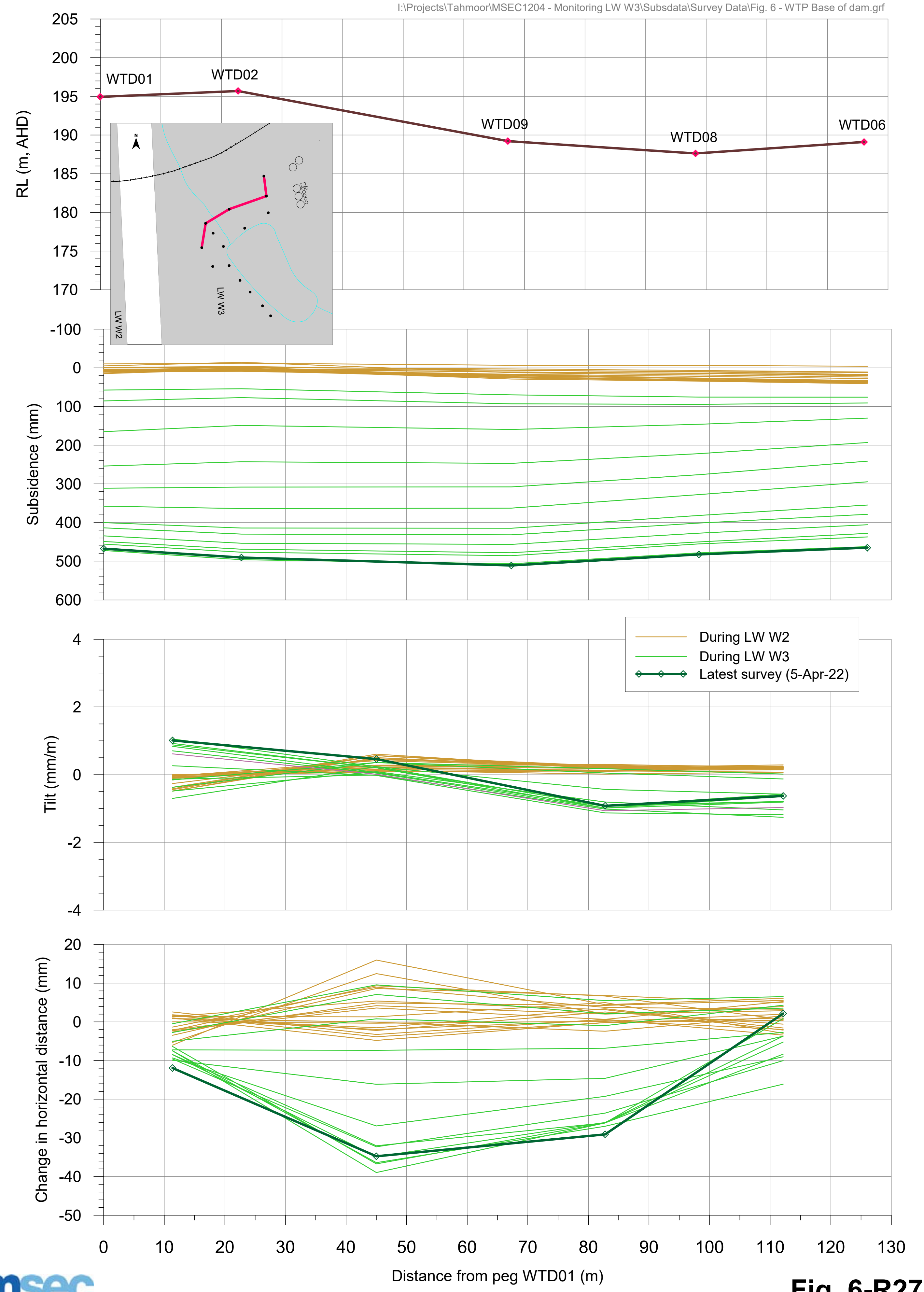
# Tahmoor LW W3 - Stonequarry WTP
# Total subsidence profiles along path of treated effluent




msec

Fig. 5-R27

# Tahmoor LW W3 - Stonequarry WTP
# Total subsidence profiles along base of dam




msec

Fig. 6-R27

# Tahmoor LW W3 - Stonequarry WTP
# Total subsidence profiles along crest of dam

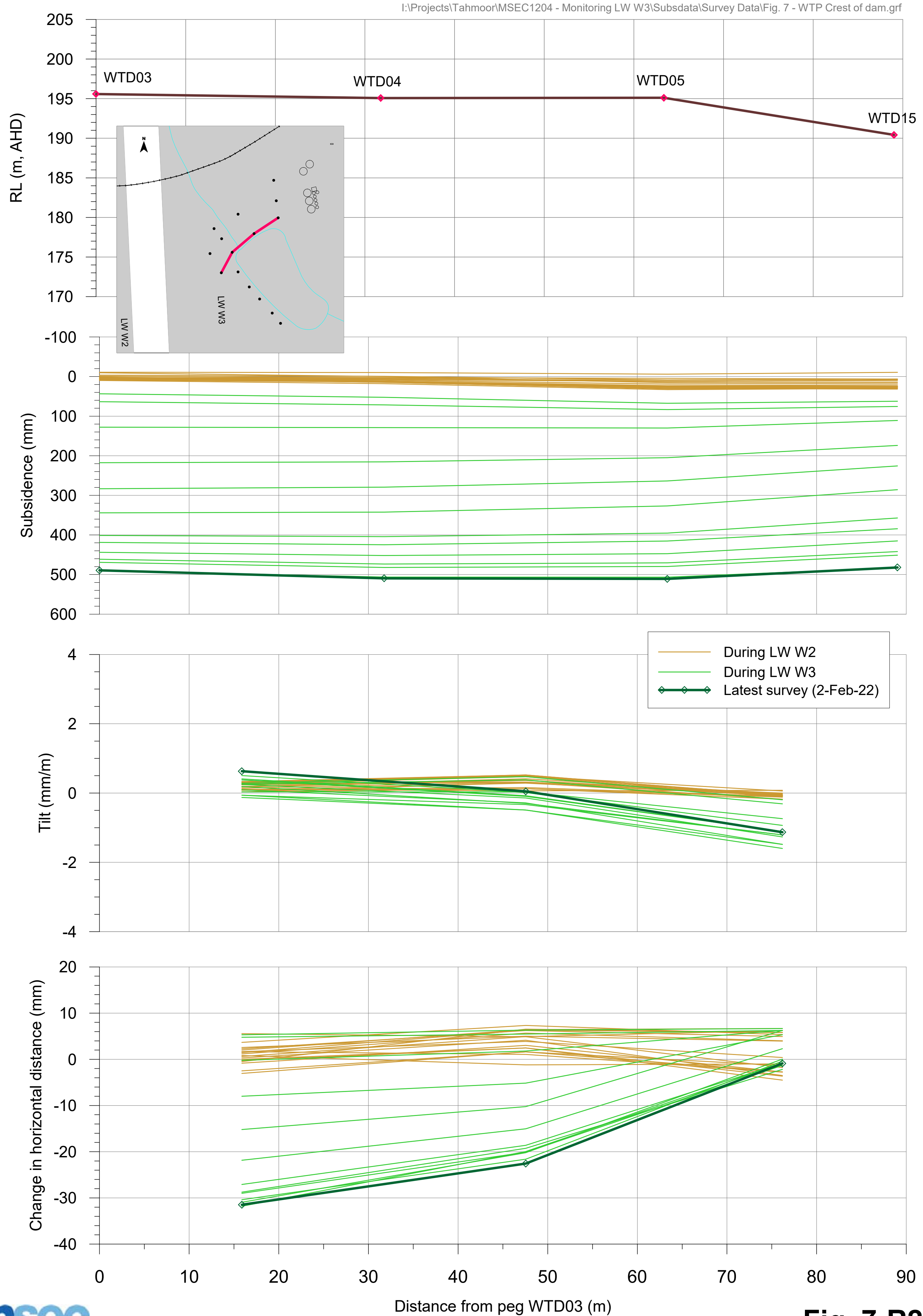
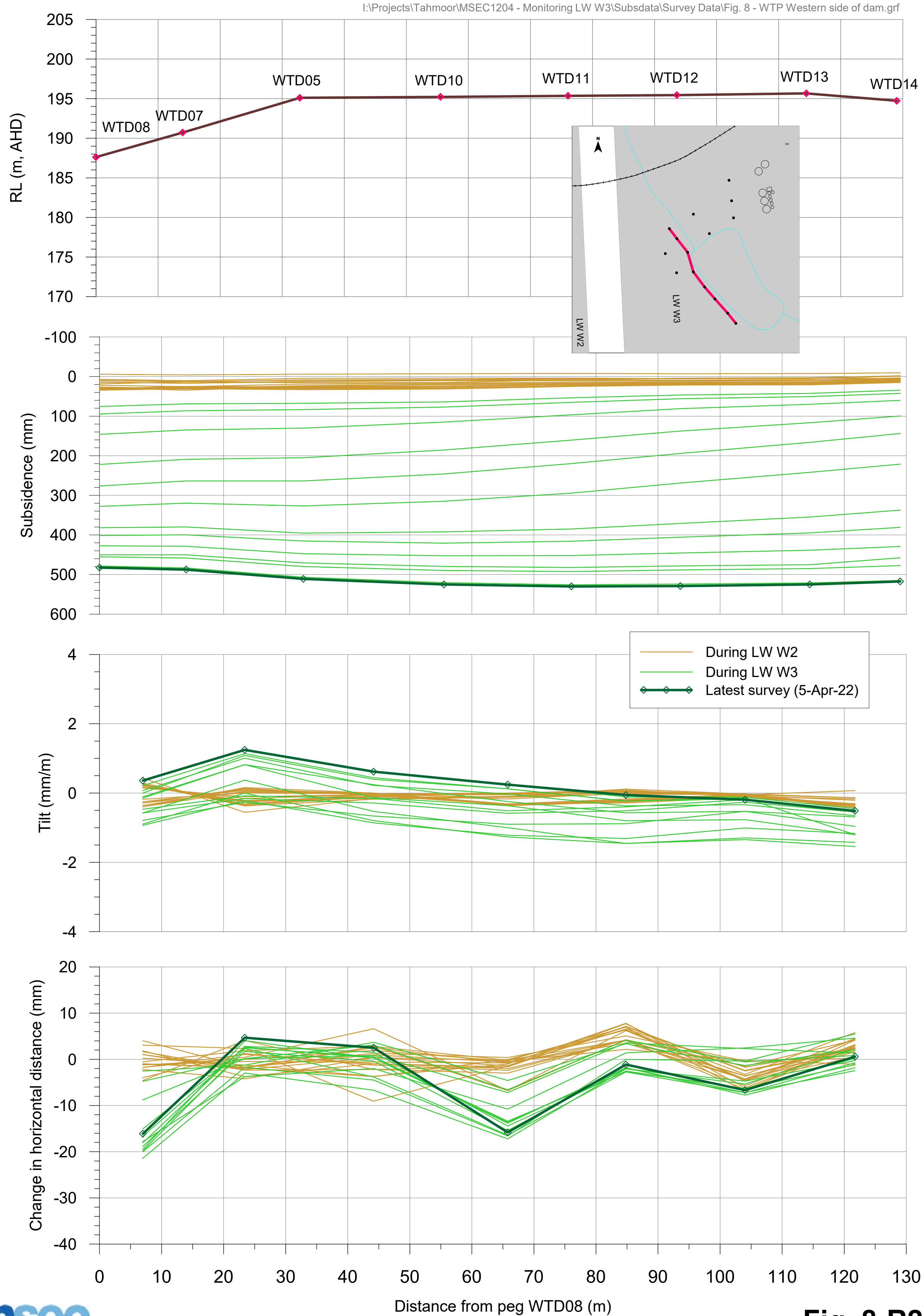



Fig. 7-R27

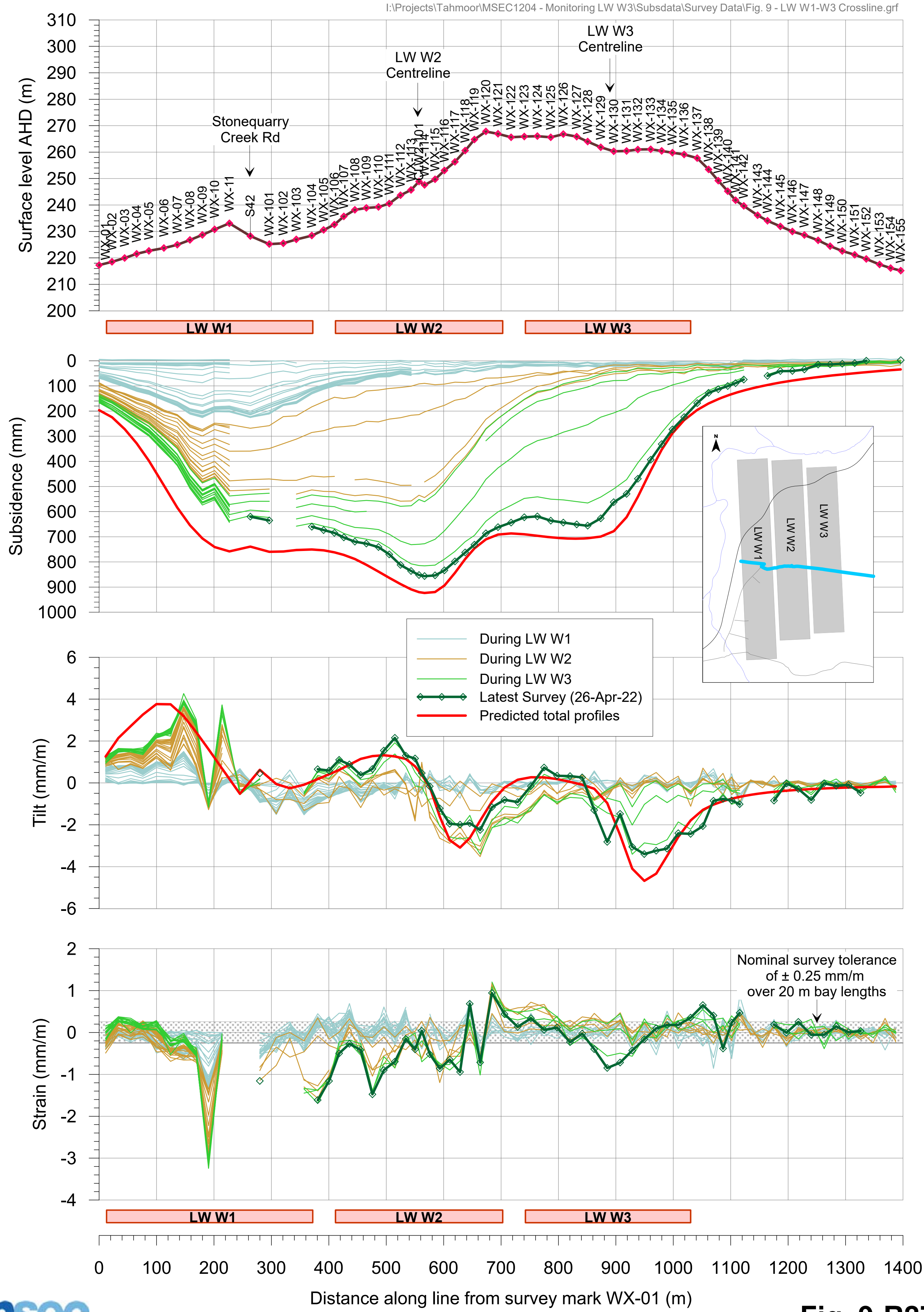
# Tahmoor LW W3 - Stonequarry WTP
# Total subsidence profiles along western side of dam




msec

Fig. 8-R27

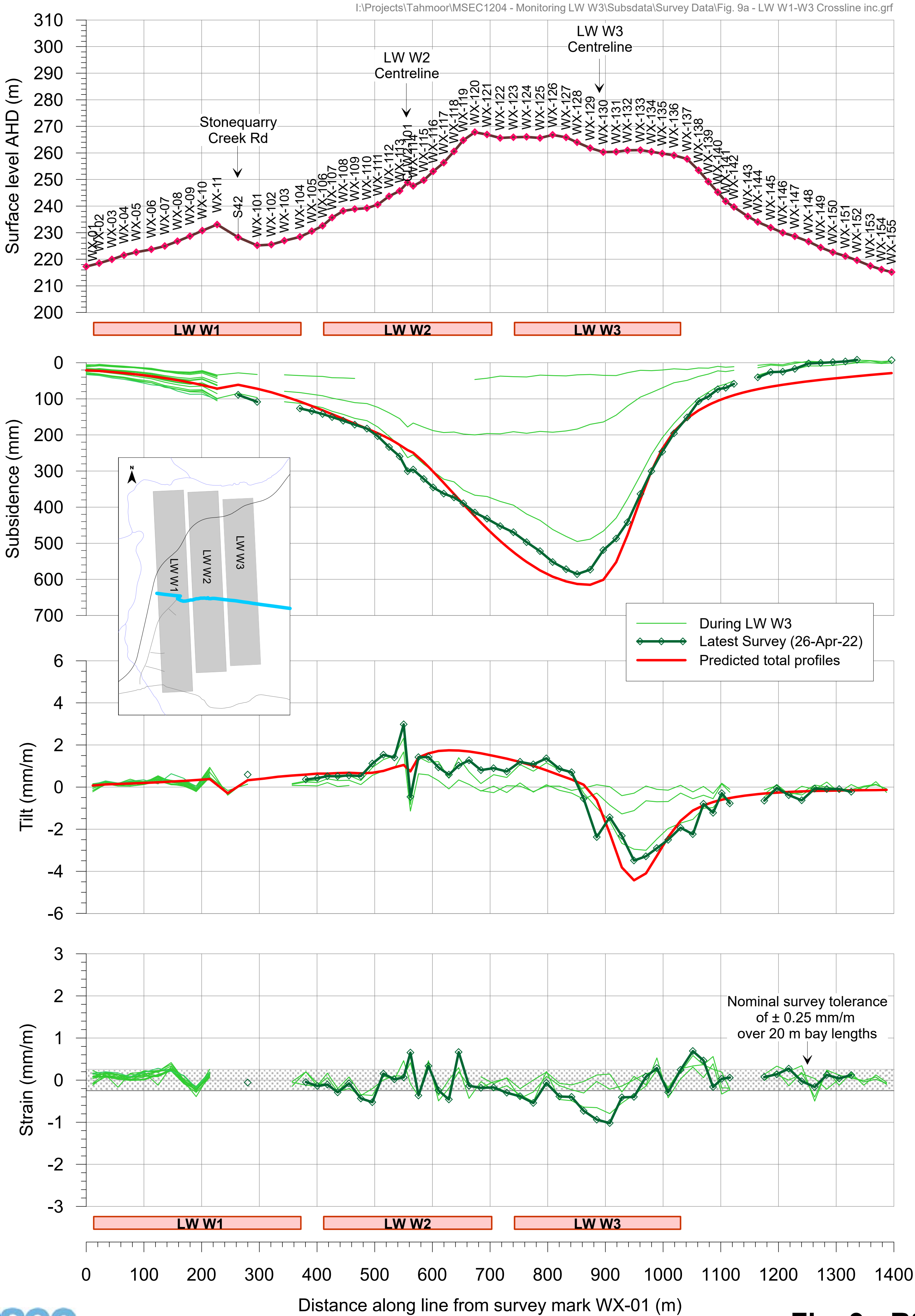
# Tahmoor LW W3
# Total subsidence profiles along LW W1-W3 Crossline




msec

Fig. 9-R27

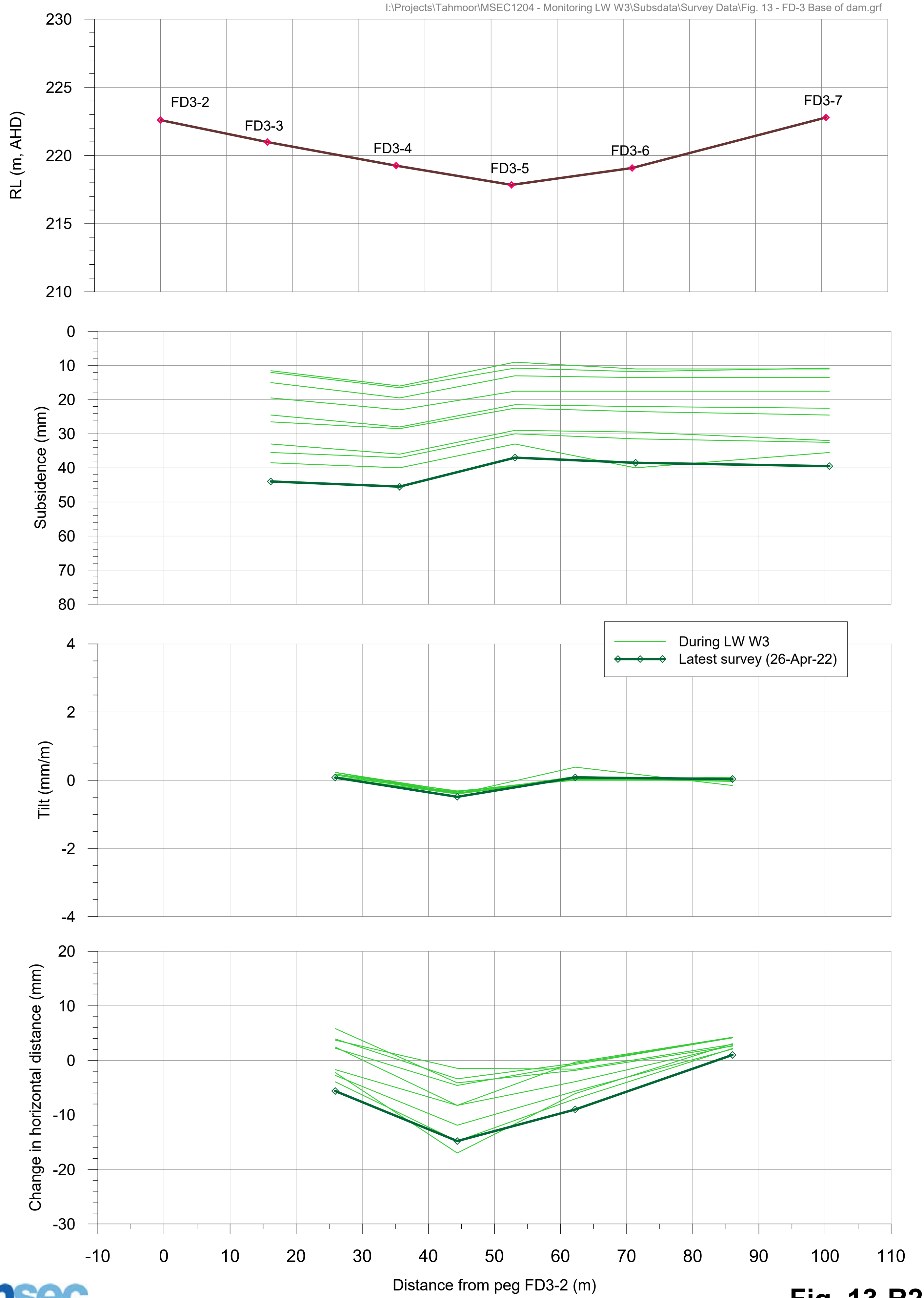
# Tahmoor LW W3
# Incremental subsidence profiles along LW W1-W3 Crossline




msec

Fig. 9a-R27

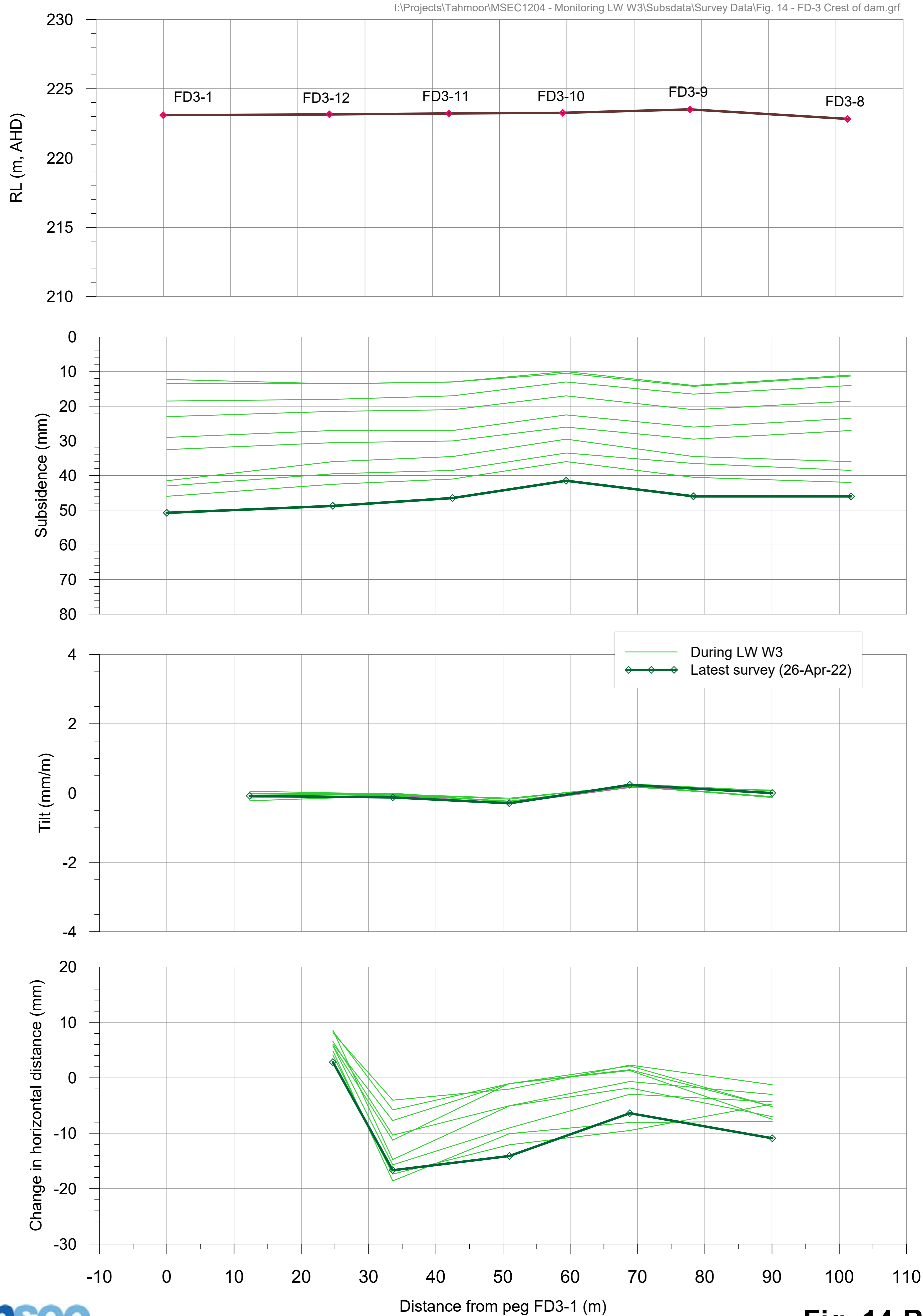
# Tahmoor LW W3
# Incremental subsidence profiles along base of dam FD-3




msec

Fig. 13-R27

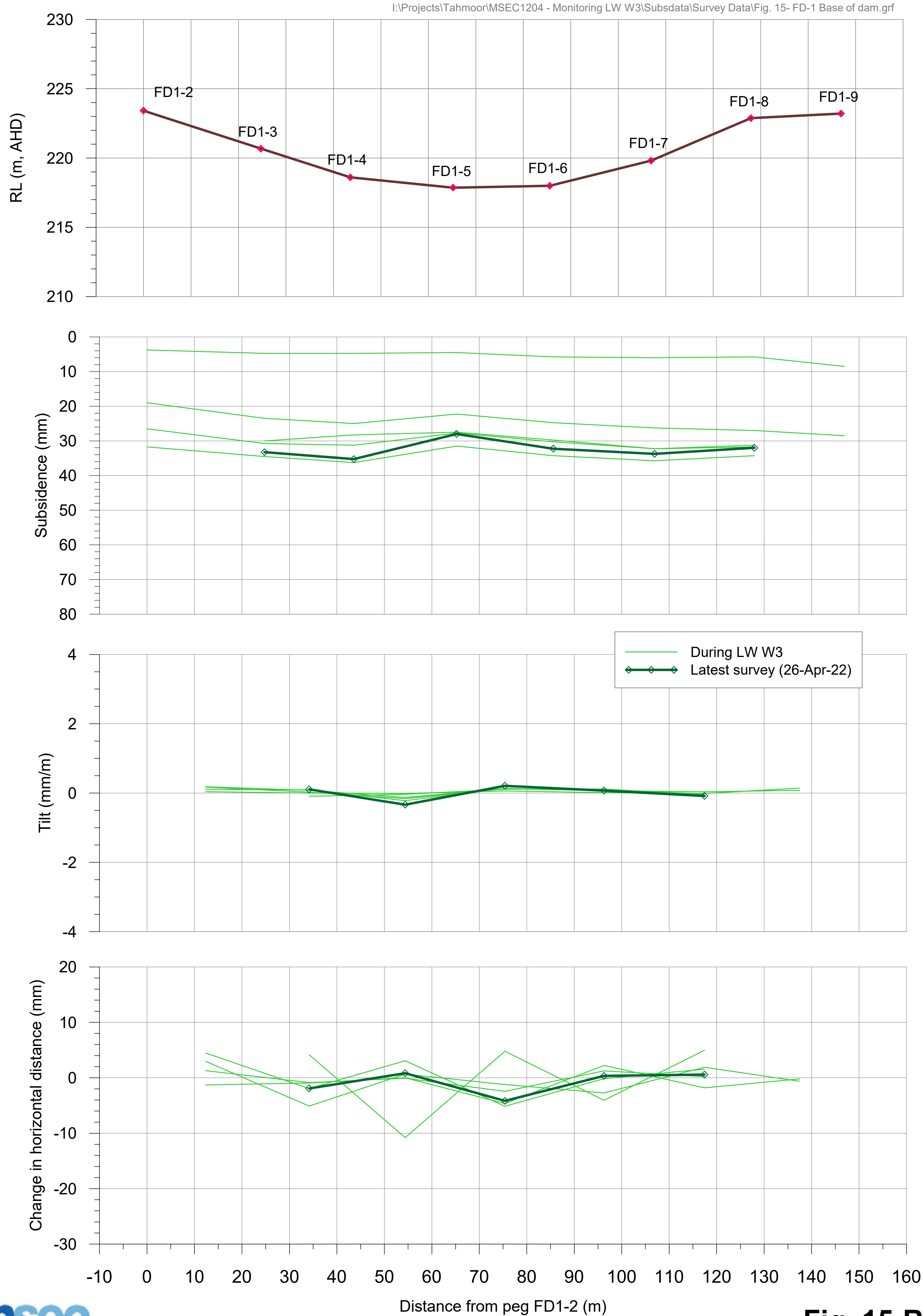
# Tahmoor LW W3
# Incremental subsidence profiles along crest of dam FD-3




msec

Fig. 14-R27

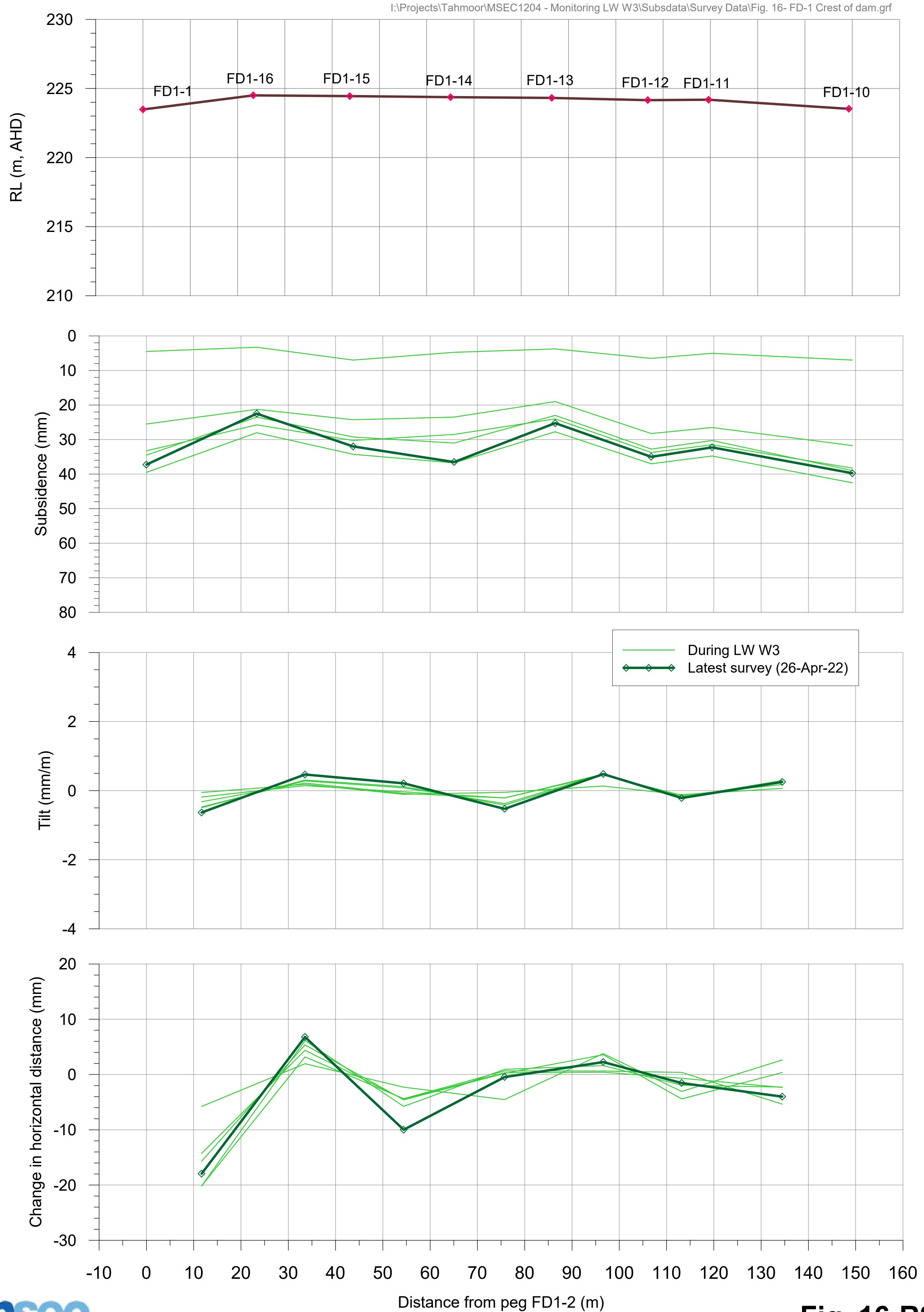
# Tahmoor LW W3
# Incremental subsidence profiles along base of dam FD-1




msec

Fig. 15-R27

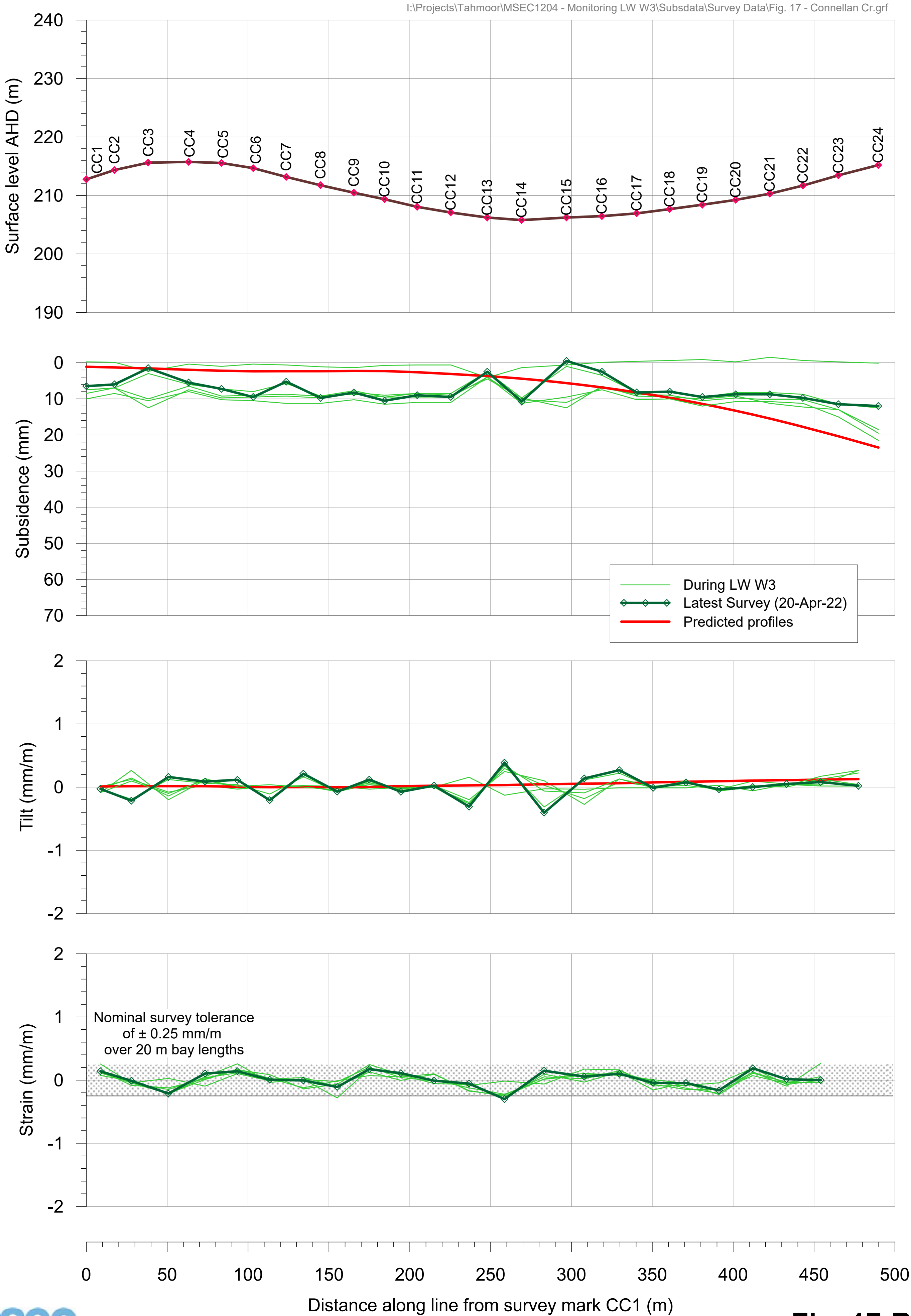
# Tahmoor LW W3
# Incremental subsidence profiles along crest of dam FD-1




msec

Fig. 16-R27

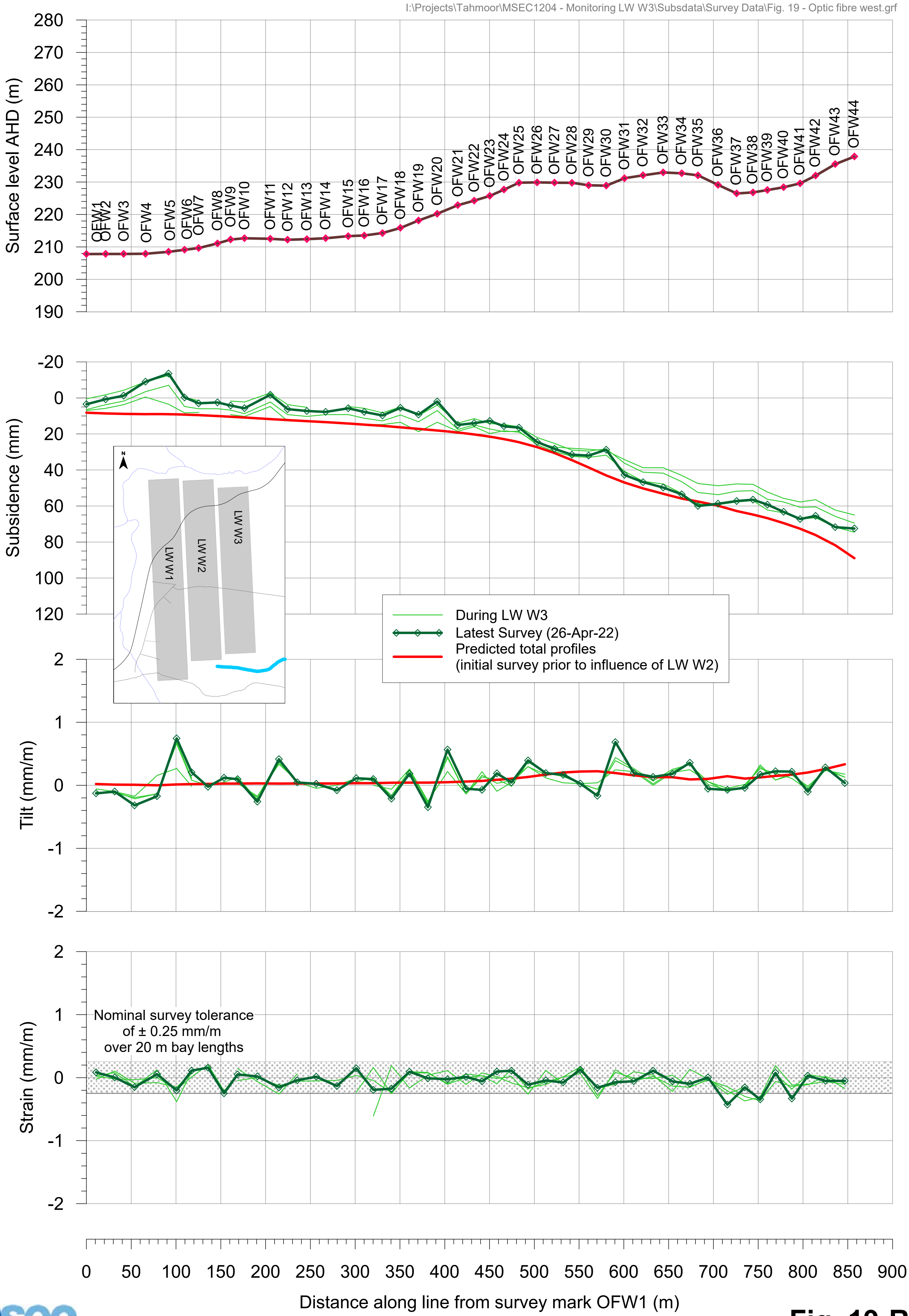
# Tahmoor LW W3
# Incremental subsidence profiles along Connellan Crescent




msec

Fig. 17-R27

# Tahmoor LW W3
# Total subsidence profiles along Optic Fibre West line




msec

Fig. 19-R27

# Tahmoor LW W3
# Incremental subsidence profiles along LW W4 Centreline


Fig. 20-R27

SIMEC

# End of Panel Subsidence Monitoring Report for Tahmoor Longwall W4

| **Summary** | |
|---|---|
| Monitoring period | 16 May 2022 to 18 November 2022 |
| Length of extraction of LW W4 | LW W4 commenced extraction on 16 May 2022 and finished extraction on 13 September 2022 |
| Distance travelled by longwall since previous report | |
| Distance to completion of LW W4 | |

## Summary of observed ground movements

| Subsidence Parameter | | Maximum observed at completion of LW W4 | Location |
|---|---|---|---|
| Subsidence (mm) | *Inc*<br>*Total* | 718<br>897 | LW W4 Centreline<br>LW W1-W4 Crossline |
| Tilt (mm/m) | *Inc*<br>*Total* | 9.7<br>9.8 | LW W1-W4 Crossline<br>LW W1-W4 Crossline |
| Hogging Curvature ($km^{-1}$) | *Inc*<br>*Total* | 0.37<br>0.35 | LW W1-W4 Crossline<br>LW W1-W4 Crossline |
| Sagging Curvature ($km^{-1}$) | *Inc*<br>*Total* | -0.19<br>-0.33 | LW W1-W4 Crossline<br>LW W3 Centreline |
| Tensile Strain (mm/m) | *Inc*<br>*Total* | 0.9<br>1.3 | LW W4 Centreline<br>LW W2 Centreline |
| Compressive Strain (mm/m) | *Inc*<br>*Total* | -4.8<br>-5.6 | LW W4 Centreline<br>LW W4 Centreline |

## Actions

| | |
|---|---|
| HAVE ANY DEFINED TRIGGERS BEEN REACHED SINCE PREVIOUS REPORT? | NO |
| IS ANY URGENT ACTION REQUIRED? | NO |

This monitoring report provides the results of the latest ground surveys during the mining of LW W4, in accordance with the requirements of subsidence management plans.

## Longwall face position

LW W4 commenced on 16 May 2022 finished extraction on 13 September 2022. A map showing the mine layout and the monitoring peg positions is shown in Drawing No. MSEC1204-01.

## Summary of surveys and inspections completed

Surveys and inspections are being conducted to meet the requirements of the LW W3-W4 Extraction Plan. A timeline showing when each type of survey and inspection was conducted is shown in Figure A.


**Figure A Surveys and inspections during LW W4**

A summary of surveys and inspections is provided in Table 1.

**Table 1 Surveys and inspections conducted during LW W4**

| Inspection / Survey | Responsibility | Number of Inspections / Surveys |
|---|---|---|
| **Ground Monitoring Surveys** | | |
| LW centreline and crossline surveys | SMEC | 10 |
| Local road surveys | SMEC | 34 |
| Local road inspections | BIS | 44 |
| **Sub-Total** | | **88** |
| **Natural Features** | | |
| Rockbar SR17 surveys | SMEC | 5 |
| Rockbar SR17 high resolution & 3D surveys | MNC | 5 |
| Stonequarry, Cedar and Matthews Creek Survey Lines | SMEC | 4 |
| Stonequarry, Cedar and Matthews Creek Visual inspections | Brienan Environment & Safety | 3 |
| Surface water manual monitoring | ATC Williams | 4 |
| Groundwater manual monitoring | SLR | 3 |
| Agricultural land inspections | BIS | 5 |
| Cliffs and steep slopes geotechnical inspections | Douglas Partners | 7 |
| Terrestrial ecology field investigations | Niche | 1 |
| Aquatic ecology field investigations | Niche | 1 |
| **Sub-Total** | | **38** |
| **Picton-Mittagong Loop Line** | | |
| Ground Surveys | Southern Rail Surveys | 1 |
| Track Geometry Surveys | BloorRail | 1 |
| Track Inspections | BloorRail | 1 |
| Embankments and cutting surveys | Southern Rail Surveys | 8 |
| Embankments and cuttings geotechnical inspections | Newcastle Geotech | 1 |
| **Sub-Total** | | **12** |
| **Main Southern Railway** | | |
| Ground Surveys | Southern Rail Surveys | 21 |
| Track Geometry Surveys | BloorRail | 21 |
| Track Inspections | BloorRail | 224 |
| Picton Tunnel surveys | Southern Rail Surveys | 15 |
| Picton Viaduct surveys | Southern Rail Surveys | 22 |
| Main Southern Railway structure surveys | Southern Rail Surveys | 88 |
| Far-field Surveys | Southern Rail Surveys | 8 |
| Embankments and cutting surveys | Southern Rail Surveys | 36 |
| Embankments and cuttings geotechnical inspections | Newcastle Geotech | 6 |
| **Sub-Total** | | **441** |
| **Utilities** | | |
| Endeavour Energy Power Pole and substation Surveys | SMEC | 2 |
| Stonequarry wastewater treatment plant and Water Re-use Storage Pond ground surveys | SMEC | 10 |
| Stonequarry wastewater treatment plant and Water Re-use Storage Pond visual inspections | BIS | 10 |
| **Sub-Total** | | **22** |
| **Residential** | | |
| Pre-mining Front of House inspections (LW W1-W4) | JMA Solutions | 78 |
| Pre-mining Structural Hazard Identification inspection and PMI (LW W1-W4) | JMA Solutions | 114 |
| Pre-mining Geotechnical Hazard Identification inspections (LW W1-W4) | Douglas Partners | 127 |
| Private property ground surveys | SMEC | 16 |
| Private property visual inspections | BIS | 15 |
| **Sub-Total** | | **350** |
| | | |
| **Total** | | **951** |

## Monitoring Results

Ground monitoring has been undertaken within the active subsidence zone of LW W4. Monitoring results are shown graphically at the back of this report. Maximum incremental subsidence parameters from the most recent surveys are summarised in Table 2.

**Table 2 Summary of maximum observed subsidence parameters**

| Monitoring Line | | Maximum observed subs (mm) | Maximum observed tilt (mm/m) | Maximum observed hogging curvature ($km^{-1}$) | Maximum observed sagging curvature ($km^{-1}$) | Maximum observed tensile strain (mm/m) | Maximum observed comp. strain (mm/m) |
|---|---|---|---|---|---|---|---|
| LW W4 Centreline | *Inc*<br>*Total* | 718<br>751 | 3.9<br>4.0 | 0.10<br>0.13 | -0.07<br>-0.11 | 0.9<br>1.2 | -4.8<br>-5.6 |
| LW W1-W4 Crossline | *Inc*<br>*Total* | 649<br>897 | 9.7<br>9.8 | 0.37<br>0.35 | -0.19<br>-0.19 | 0.4<br>1.2 | -1.2<br>-2.9 |
| Picton Rising Main | *Inc* | 0 | 0.2 | 0.01 | -0.01 | 0.1 | -0.1 |
| Main Southern Railway | *Inc*<br>*Total* | 15<br>15 | 0.5<br>1.3 | 0.05<br>0.10 | -0.04<br>-0.08 | 0.2<br>0.5 | -0.3<br>-0.4 |
| Connellan Crescent | *Inc*<br>*Total* | 95<br>106 | 1.9<br>2.0 | 0.05<br>0.05 | -0.02<br>-0.04 | 0.2<br>0.4 | -0.2<br>-0.3 |
| Thirlmere Way | *Inc*<br>*Total* | 29<br>214 | 0.5<br>2.4 | 0.05<br>0.15 | -0.02<br>-0.12 | 0.4<br>0.6 | -0.3<br>-0.9 |
| Optic Fibre West line | *Inc*<br>*Total* | 39<br>97 | 0.8<br>1.3 | 0.07<br>0.11 | -0.05<br>-0.06 | 0.3<br>0.4 | -0.4<br>-0.5 |
| Stonequarry Creek Road | *Inc*<br>*Total* | 11<br>625 | 0.3<br>3.8 | 0.02<br>0.06 | -0.02<br>-0.12 | 0.1<br>0.5 | -0.1<br>-1.0 |
| Attunga Close | *Inc*<br>*Total* | 10<br>205 | 0.2<br>1.9 | 0.01<br>0.07 | -0.01<br>-0.02 | 0.1<br>0.4 | -0.0<br>-0.7 |
| Booyong Close | *Inc*<br>*Total* | 44<br>578 | 0.1<br>3.5 | 0.01<br>0.14 | -0.01<br>-0.11 | 0.3<br>0.4 | -0.1<br>-0.9 |
| Carramar Close | *Inc*<br>*Total* | 19<br>124 | 0.4<br>0.8 | 0.03<br>0.03 | -0.02<br>-0.04 | 0.2<br>0.5 | -0.2<br>-0.3 |
| LW W2 Centreline | *Inc*<br>*Total* | 78<br>915 | 0.8<br>5.3 | 0.07<br>0.43 | -0.04<br>-0.31 | 0.8<br>1.3 | -0.9<br>-5.7 |
| LW W3 Centreline | *Inc*<br>*Total* | 264<br>825 | 1.3<br>4.5 | 0.07<br>0.26 | -0.06<br>-0.33 | 0.7<br>1.2 | -1.4<br>-4.2 |
| Barkers Lodge Road | *Inc*<br>*Total* | 4<br>56 | 0.1<br>0.7 | 0.00<br>0.05 | -0.01<br>-0.05 | 0.2<br>0.3 | -0.1<br>-0.9 |
| PMLL railway | *Inc*<br>*Total* | 18<br>706 | 0.6<br>3.7 | 0.05<br>0.22 | -0.03<br>-0.18 | 0.3<br>1.2 | -0.3<br>-5.2 |

## Ground survey results

A map showing the locations of survey marks is provided in Drawing No. MSEC1263-01. A map showing the spatial distribution of incremental subsidence is shown in Drawing No. MSEC1263-02.

*Subsidence along centreline and cross line of LW W4*

GNSS Site 24 is located directly above the centreline of LW W4, approximately 200 metres from the commencing end. The unit has recorded approximately 640 mm subsidence. Rates of change have reduced to very low levels. The unit has also moved to the east and south.

Survey marks have been installed along the centreline of LW W4. The purpose of the centreline is to confirm the magnitude of subsidence above LW W4. The development of subsidence along the centreline of LW W4 is shown in Fig. 1, where a maximum of 718 mm has been measured.

It can be seen from Fig. 1 that observed subsidence has exceeded predicted subsidence above the northern portion of LW W4, but has returned to within predictions above the southern portion of LW W4. The location of the crossover coincides with where the centreline crosses over a small creek between Pegs CLW4-39 and CLW4-40. The observed increased subsidence 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 potential for increased subsidence was raised in the subsidence prediction report for LW W3-W4 as the longwalls are located close to the Nepean Fault.

The change in subsidence behaviour is clearly observed along the crossline above LW W4, which has also exceeded prediction. It can be seen from Fig. 2 that the subsidence profile above LW W4 is steeper subsidence compared to the previously observed subsidence profiles above LW W1-W3.

The development of subsidence relative to the length of longwall extraction, and over time, at sites of interest along the centreline is shown in Figure B. 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.

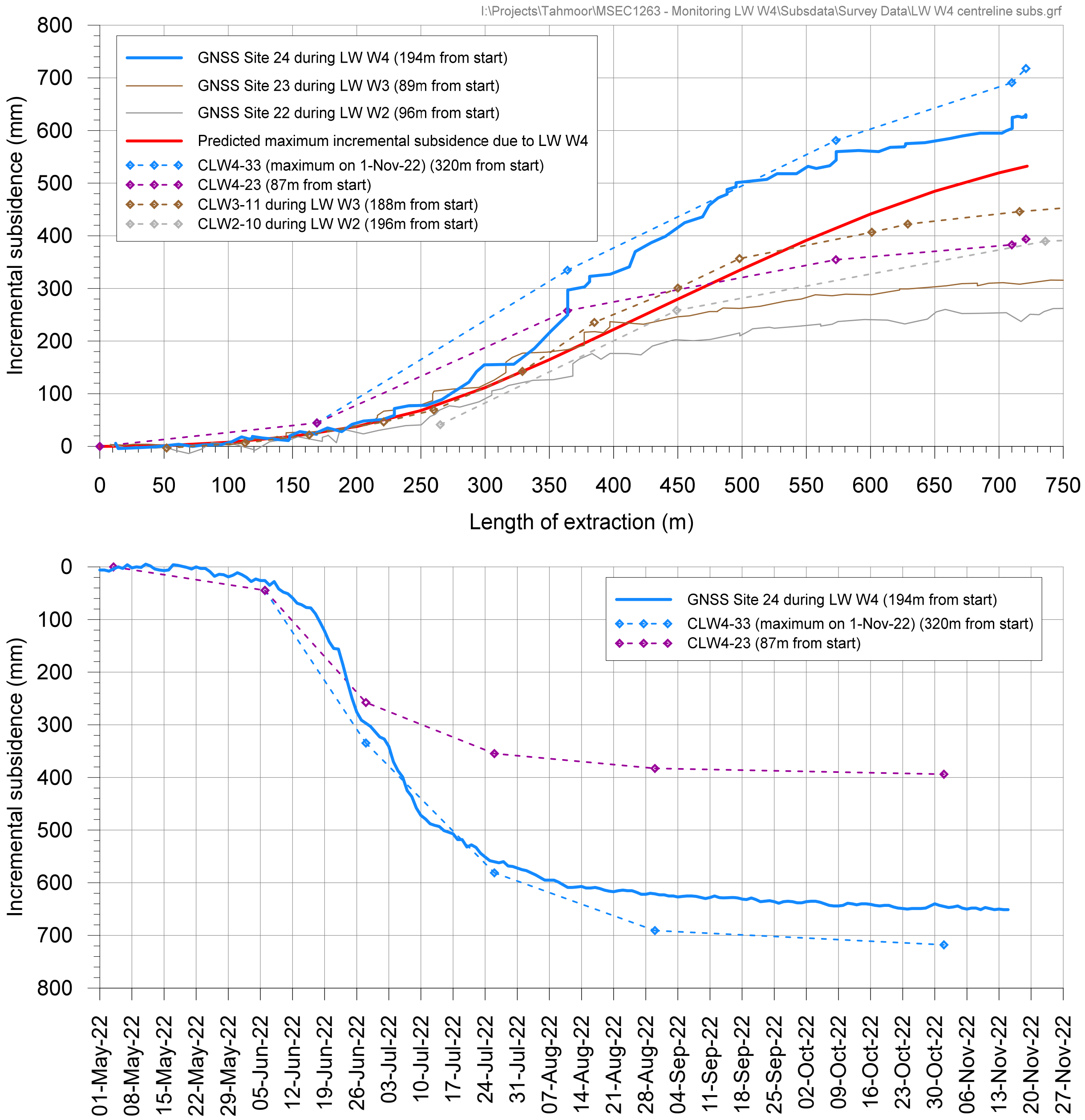



**Figure B Development of subsidence along centreline of LW W4**

### *Picton – Mittagong Loop Line*

End of LW W4 surveys were conducted along the Picton to Mittagong Loop Line on 27 October 2022. Less than 20 mm subsidence was measured during LW W4. Visual inspections did not identify any issues associated with mine subsidence.

### *Main Southern Railway*

Regular surveys were conducted along the Main Southern Railway during the mining of LW W4. Results were within survey tolerances during mining. Visual inspections did not identify any issues associated with mine subsidence.

### *Victoria Bridge*

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 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.

### GNSS monitoring

Global Navigation Satellite System (GNSS) units are fixed survey stations that continuously measure their absolute horizontal and vertical positions in real time. There are 17 units located directly above and adjacent to LW W3-W4. These include one unit above the commencing end, and along the centreline of, LW W4, being Site 24.

The measured position of each GNSS unit varies depending on atmospheric conditions and the array of satellites that are present in the sky at each time, and the vegetation cover surrounding each unit. Measured variations in height are typically greater than the variations for eastings and northings.

The results from the GNSS units are shown in Fig. G07 to Fig. G21, Fig. G24, Fig. GSR17N and Fig. GSR17S. The 7-day running average readings are the most appropriate reflection of measured changes to date. Some trends can be seen from the results, with the closest GNSS units generally moving towards the extracted panel.

Changes in horizontal distances can be calculated between GNSS units that are stationed close together and results are shown in Figure C.

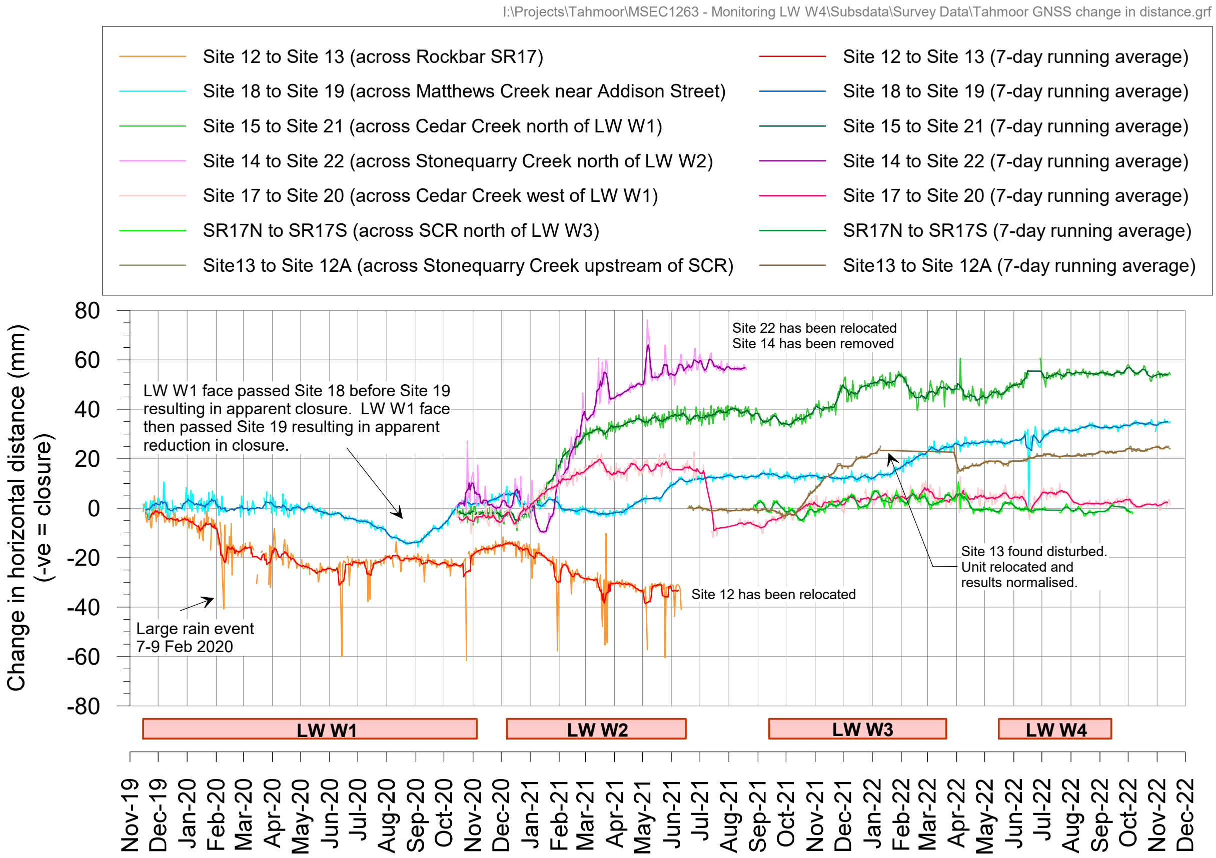



**Figure C Observed changes in horizontal distances between GNSS units**

## Summary of impacts to surface features

A comparison between assessed and observed impacts to surface features is summarised in Table 3. The assessed and observed impacts to surface features compare reasonably well with predictions.

**Table 3 Summary of predicted and observed impacts during LW W4**

| Surface Feature | Predicted Impacts | Observed Impacts |
|---|---|---|
| **Natural Features** | | |
| Stonequarry, Cedar and Matthews Creek | Potential cracking in creek bed.<br>Potential surface flow diversion (less than 10% of pools in Study Area)<br>Potential reduction in water quality during times of low flow.<br>Potential gas emissions. | Minor fracturing observed in south-east corner of Rockbar SR17. Minor fracture observed in Rockbar SR20.<br>No reduction in pool levels below baseline levels, including where fractures were observed. Pools currently at typical levels.<br>A small man-made pond in Rockbar SR17 was observed to have reduced below historical norm in June 2022 but has recovered.<br>Iron staining upstream of access track has re-emerged at times of low water flow<br>No reduction in water quality observed.<br>Refer to report below for further details and report by Brienan Environment and Safety and ATC Williams. |
| Aquifers or known groundwater resources | Temporary lowering of piezometric surface by up to 15m which may stay at that level until maximum subsidence develops.<br>Groundwater levels should recover with no permanent post mining reduction in water levels in bores on the plateau unless a new outflow path develops<br>Potential impacts to privately owned groundwater bores.<br>Please refer report by SLR. | Groundwater levels gradually recovered during mining of LW W3-W4 in response to above average rainfall.<br>Please refer report summarising 6 months of results by SLR. |
| Steep slopes and cliffs | Potential soil slippage and cracking to slopes. Large scale slope failures or cliff instabilities unlikely. | No impacts observed during LW W4. |
| Natural vegetation | No impacts anticipated. | No impacts observed during LW W4. |
| **Public Utilities** | | |
| Picton to Mittagong Loop Line (PMLL) | Railway will remain safe and serviceable with management plans in place. | Railway maintained in safe and serviceable condition during mining.<br>No issues were observed.<br>Refer to report below for further details. |
| Main Southern Railway | Unlikely to experience adverse impacts.<br>Railway will remain safe and serviceable with management plans in place. | No adverse impacts observed. |
| Roads and Bridges (all types) | Minor cracking and buckling may occur in isolated locations. | No impacts observed to roads. No impacts to Victoria Bridge but gap between bridge deck and eastern abutment has closed since it was reinstated prior to the start of LW W4. |
| Water pipelines | Minor impacts possible to pipelines, particularly at creek crossings. | No impacts observed during LW W4. |
| Sewer pipelines | Minor impacts possible to pipelines, particularly at creek crossings. | No impacts observed to rising main and gravity sewers during LW4. |
| Wastewater Treatment Plant (WTP) | WTP unlikely to experience impacts and will remain safe and serviceable with management plans in place. | No impacts observed to WTP and Water Re-use Storage Dam wall. |

| Surface Feature | Predicted Impacts | Observed Impacts |
|---|---|---|
| Gas pipelines | Unlikely to experience adverse impacts with management plan in place. | No impacts observed during LW W4. |
| Electricity infrastructure | Some adjustments of power poles, catenaries or aerial powerline connections may be required. | No impacts observed during LW W4 |
| Telecommunication infrastructure | Unlikely to experience adverse impacts with management plan in place. | No impacts observed during LW W4 |
| **Public Amenities** | No public amenities within influence of LW W4. | - |
| **Farmland and Facilities** | | |
| Farm buildings, sheds, tanks | Negligible to slight impacts predicted for all farm buildings and sheds with management plan in place. | No impacts observed during LW W4. |
| Fences | Potential for impacts to fences and gates. | No impacts reported to fences on farm properties during LW W4. |
| Farm dams | Potential adverse effects on dam walls and storage capacity. | No impacts observed during LW W4. |
| Wells or bores | Potential impact on one NOW registered bore directly above LW W2. | Lowering of groundwater level but recovering during 2022. No significant change in yield observed. |
| **Areas of Archaeological Significance** | Open camp sites, the modified tree and rock shelter sites are unlikely to experience impacts.<br>Grinding groove site 52-2-2068 on Rockbar SR17 may experience fracturing but unlikely to occur. | End of Panel report by EMM confirmed no impacts to archaeological sites. Negligible impact at grinding groove site 52-2-2068. Minor fracturing observed in south-east corner of rockbar away from the grooves. |
| **Areas of Heritage Significance** | Potential low-level impacts at weatherboard cottage at 796 Thirlmere Way but will remain safe, serviceable and repairable with management plan in place. | No impacts reported to weatherboard cottage during mining of LW W4. |
| **Permanent Survey Control Marks** | Ground movement predicted at identified survey marks. | Ground movement occurred. |
| **Residential Establishments** | | |
| Houses | All houses expected to remain safe, serviceable and repairable provided that they are in sound condition prior to mining. Impacts predicted to some houses. | No impacts reported. Houses have remained safe, serviceable and repairable.<br>Refer to report below for further details. |
| Swimming pools | While predicted tilts are not expected to cause a loss in capacity, tilts are more readily noticeable in pools as the height of the freeboard will vary along the length of the pool. While predicted strain impacts are low, many of the pools are inground, which are more susceptible. | No impacts reported.<br>No pool gates have required adjustment. |
| Associated structures such as workshops, garages, on-site wastewater systems, water or gas tanks or tennis courts | Potential impact to pipes connected to inground septic tanks.<br>Negligible impacts predicted for non-residential domestic structures, including sheds and tanks. | No impacts reported during LW W4. |
| External residential pavements | Cracking and buckling likely to occur, though majority of impacts are expected to be minor. | Minor impacts to some external pavements. |
| Fences in urban areas | Some fences and gates could be slightly damaged. Most vulnerable are Colorbond fences. | No impacts to fences reported. |

## Natural Features

Survey marks have been installed across rockbars in Cedar, Matthews and Stonequarry Creeks prior to the commencement of LW W1, at locations shown in Drawing No. MSEC1204-01.

Results are shown in Figure D. Valley closure has been measured to develop across Stonequarry Creek at SQ104 and SQ105, which are located near the confluence of Stonequarry Creek and Cedar Creek. Minor closure was developing across SQ104, SQ105, SQ106 and SQ107 up to 3 November 2021, when the pegs were removed as requested by the landowner. Survey peg SQ114-1 has been destroyed during flooding. Minor changes have been observed during the mining of LW W4 across SQ113 to SQ120, including where a new fracture was observed near SQ116. Minor additional closure was observed across SQ111.

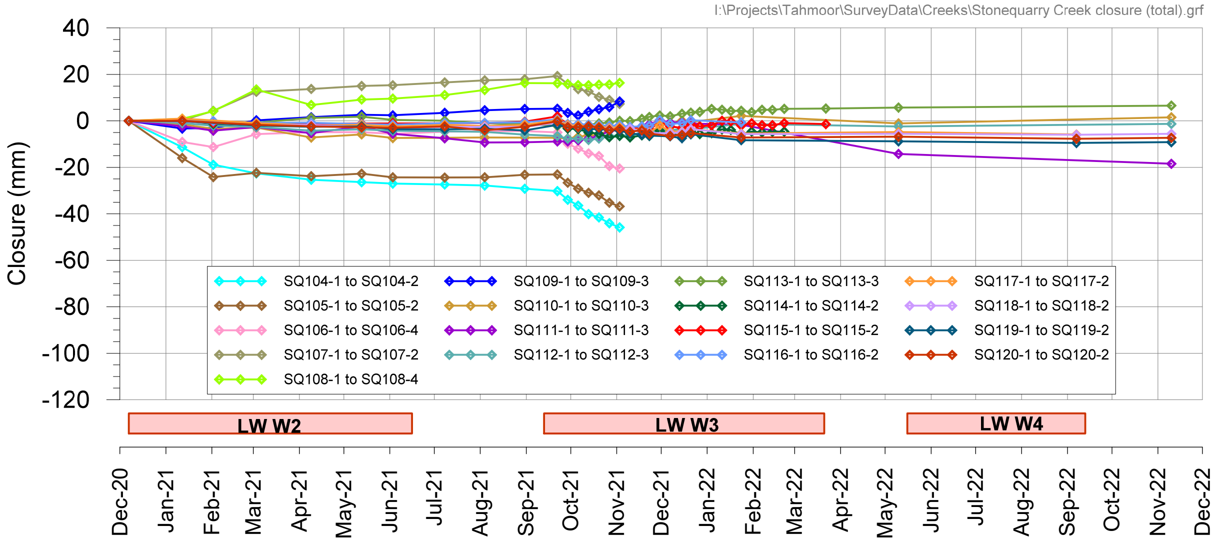



**Figure D Development of observed valley closure along Stonequarry Creek (new closure marks)**

An end of LW W4 survey for Rockbar SR17 was conducted on 7 November. Minor changes in horizontal distances were observed both along and across the rockbar, as shown in Figure E. Minor ground shortening is observed in the southeast corner of the rockbar, which is captured by measurements at Marks RBE11, RBF05 and RBF06.

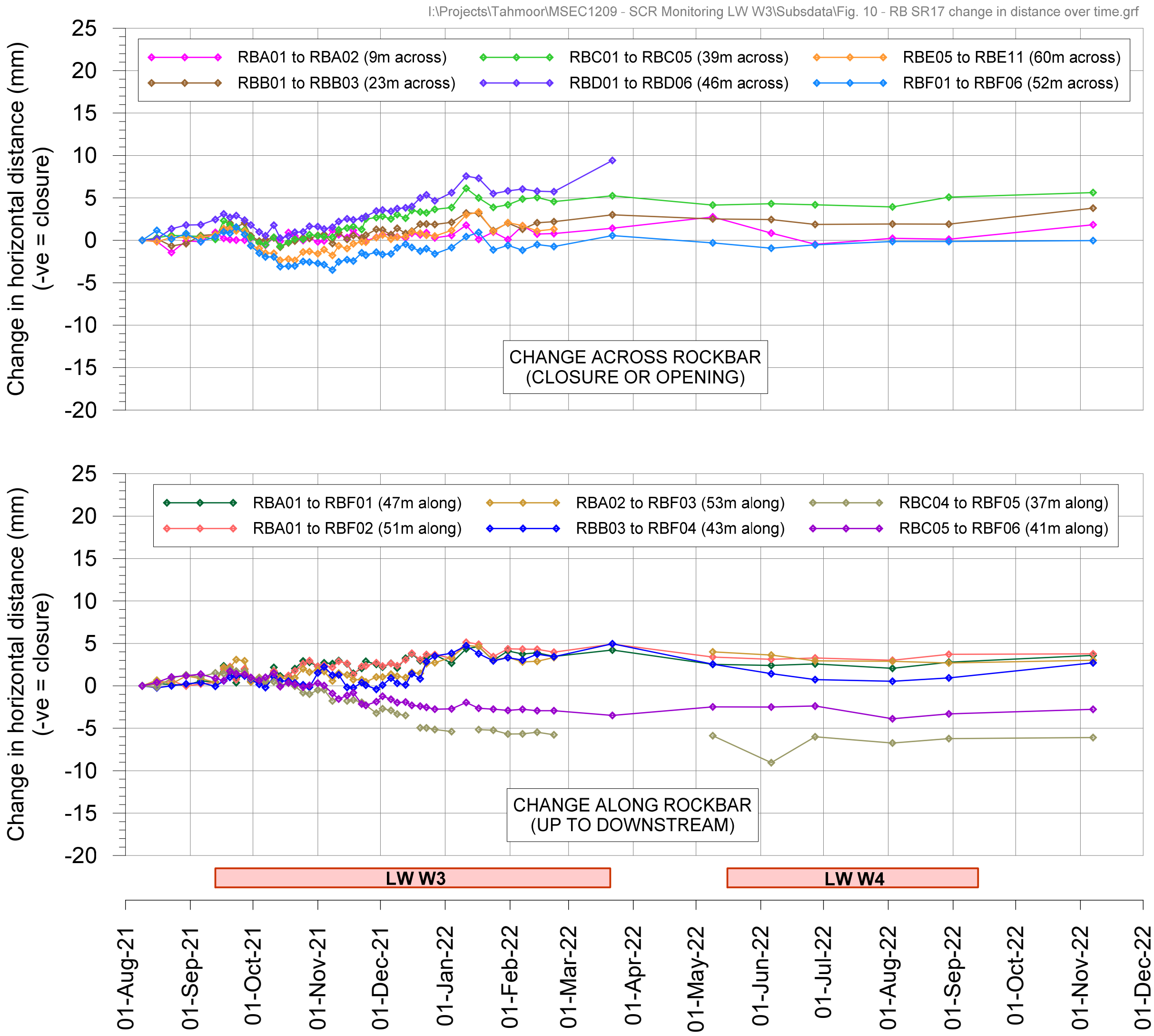
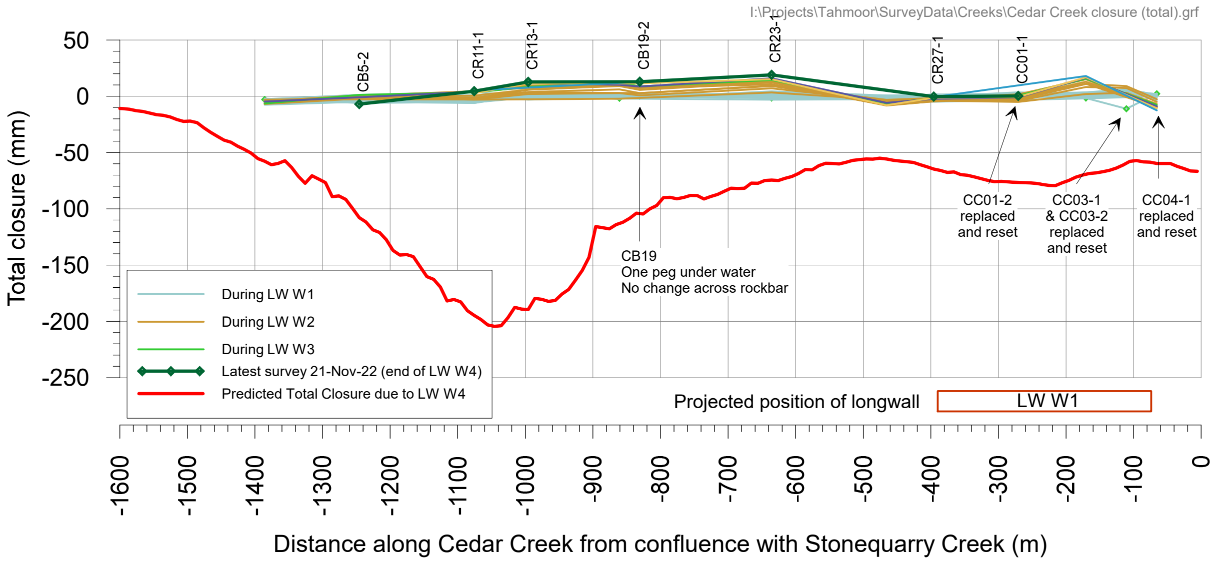



**Figure E Changes in distance across and along Rockbar SR17 during LW W3-W4**

A comparison between observed and predicted valley closure along Cedar Creek is shown in Figure F. Very little change in closure was observed during the mining of LW W3 and LW W4. The most recent survey was on 21 November 2022 at the end of LW W4, with very minor changes observed.



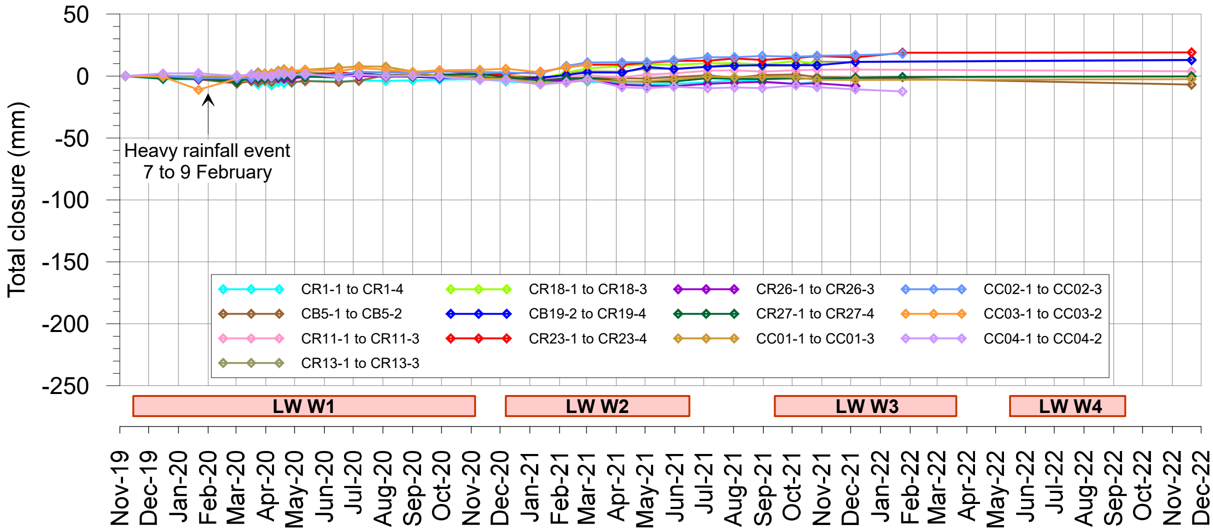




**Figure F    Comparison between observed and predicted valley closure along Cedar Creek**

Surveys across the newly installed closure marks are shown in Figure G. A final survey was conducted on 10 November 2022 with minor changes observed.

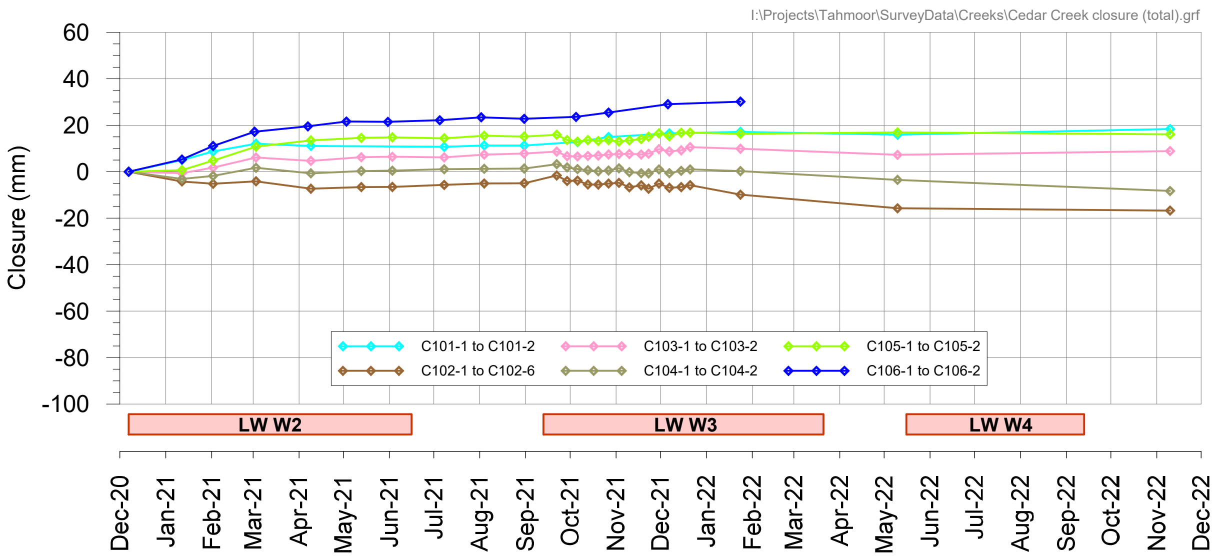



**Figure G    Development of observed valley closure along Cedar Creek (new closure marks)**

Survey pegs C101-1 and C101-2 are aligned with GNSS sites 17 and 20. A reasonable comparison in measured changes in distance between the two survey sites is shown in Figure H, though one of the GNSS units appears to have been disturbed in July 2021 between the completion of LW W2 and commencement of LW W3.

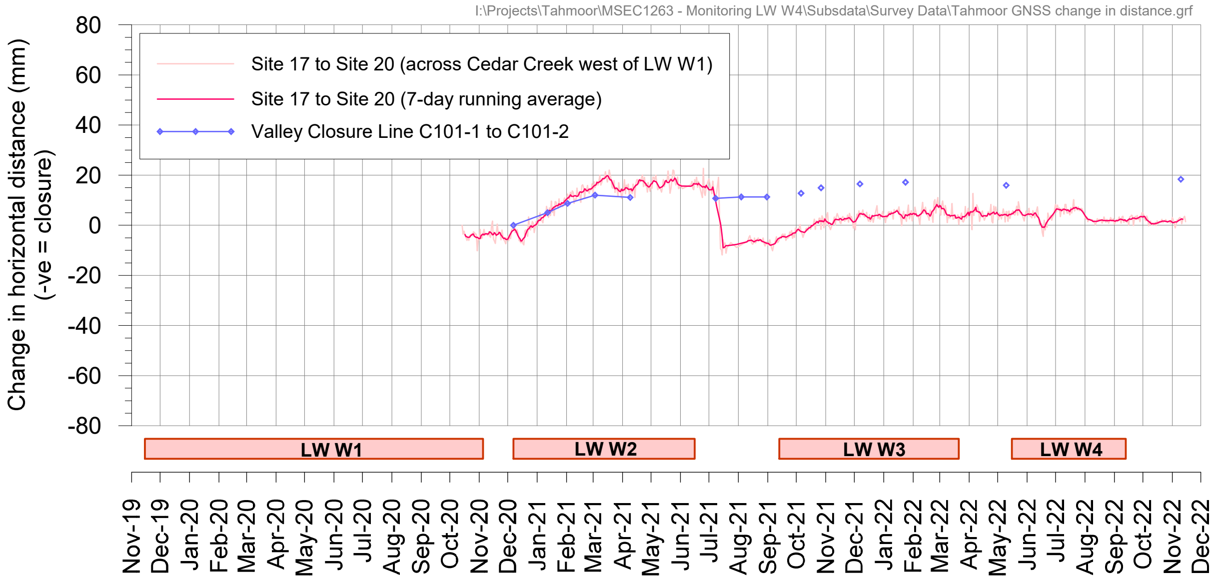



**Figure H Development of observed valley closure along and across Cedar Creek**

Surveys were also conducted across additional marks across the impact sites on Cedar Creek, including at Pool CR14. The survey on 21 November 2022 measured very small changes (less than 2 mm).

A comparison between observed and predicted valley closure along Matthews Creek is shown in Figure I. The most recent survey was on 28 November 2022 at the end of LW W4, with very minor changes observed.

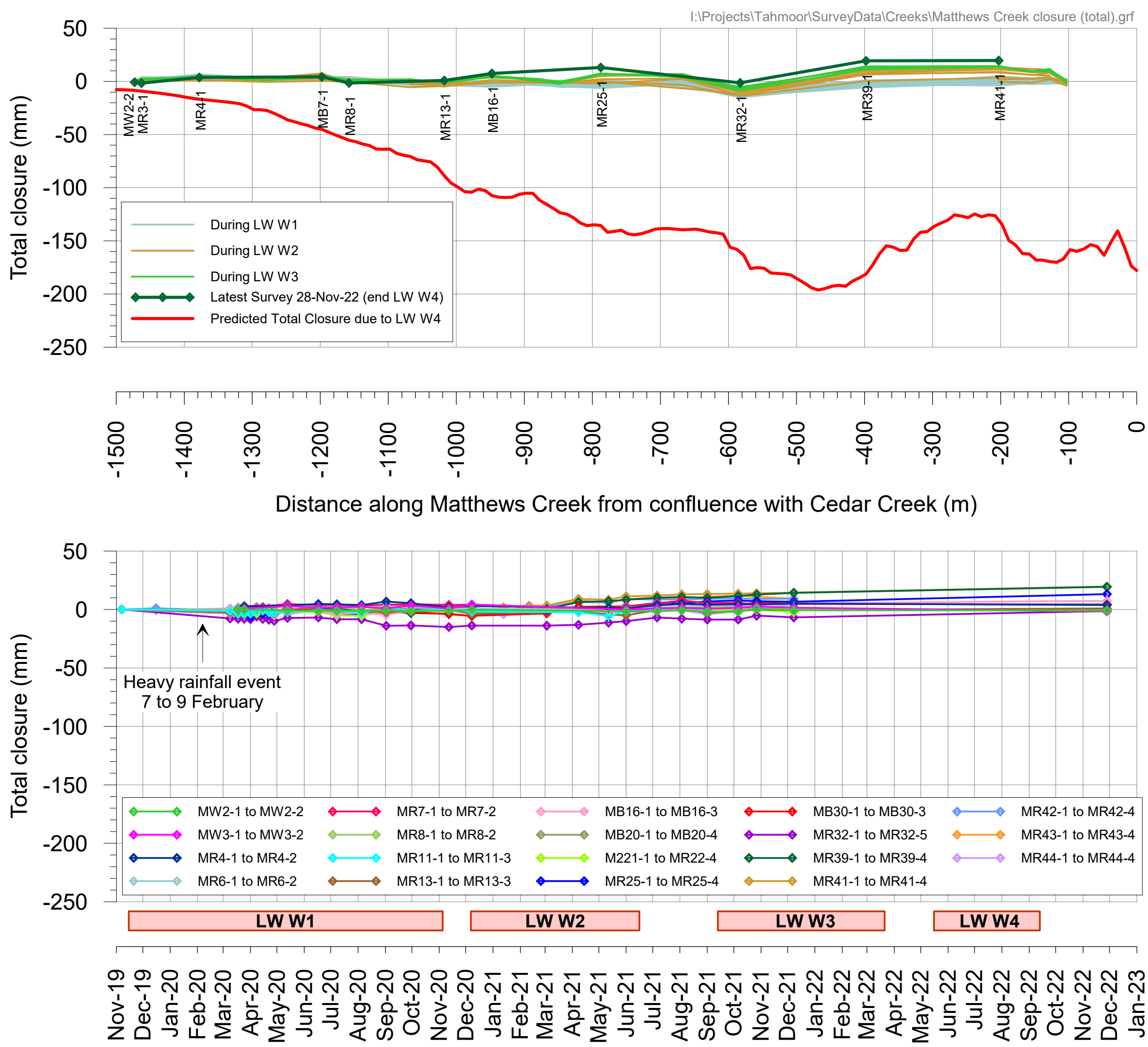



**Figure I Comparison between observed and predicted valley closure along Matthews Creek**

Visual inspections prior to the commencement of LW W1 and in December 2019 found that there was no connective overland water flows in Matthews Creek due to the prolonged drought. Most pools were dry with a few pools holding water at low to medium levels. No connective overland water flows were observed in Cedar Creek upstream of the confluence with Matthews Creek due to the prolonged drought. Most pools were dry with a few pools holding water at low to medium levels. Downstream of Matthews Creek, pools in Cedar Creek were full with a trickle flow observed out of the majority of the pools. There was no flow over the sand substrate at the lower reaches of Cedar Creek. The water level in the long pool in Stonequarry Creek fell below the Cease to Flow level in late October 2019 prior to the start of LW W1.

An inspection was conducted on 22 January 2020 following a series of rain events between 8 and 21 January. Pools that were previously dry were observed to contain water and the overland flow was observed over the previously dry lower reaches of Cedar Creek. An inspection was conducted on 27 February 2020 following a large rain event on 7 to 9 February 2020. Higher volumes of connective flow and flood levels were observed in Matthews, Cedar and Stonequarry Creeks.

Monthly monitoring and inspections during the mining of LW W1 observed rising and falling of water levels consistent with rainfall events. No mining-induced impacts were identified in the visual inspections.

No mining-induced impacts were observed to Stonequarry and Matthews Creeks during the mining of LW W2 and LW W3, including the pool at Rockbar SR17 in Stonequarry Creek.

A focussed visual inspection was conducted on 19 January 2021, which confirmed low water levels in 7 pools, which were Pools CB10, CR12, CR13, CR14 and CR15 in Cedar Creek and Pools MR45 and MR46 in Matthews Creek. Rainfall events occurred intermittently during January 2021 and follow up inspections in February 2021 found a return to normal water levels and overland flows. A substantial rainfall event occurred in mid to late March 2021 and inspections in March and April found pool water levels to be full.

Following observations of atypical water level behaviour at Pools CB3, CB10 and CR14 in Cedar Creek in late 2020 and early 2021, water levels returned to normal levels during February in response to a series of rainfall events.

Water level monitoring in March did, however, detect a reduction in water levels in only Pool CR14 until a large storm event refilled the pool in late March 2021. Water levels in Pools CB3 and CB10 remained consistent with baseline conditions during this time.

Visual inspections and water level monitoring have found that water levels have returned to normal since March 2021 at Pool CR14. They have not declined atypically during periods of dry weather. Changes during October 2021 were consistent with periods of rainfall and dry weather. No changes were observed during the most recent inspection on 22 June 2022.

Previously observed gas bubbling at Pool MR45 have not been found in October 2021. Iron-oxy hydroxide precipitation was observed during the October 2021 inspections that was similar to previously observed precipitations during pre-mining baseline inspections and at sites in Stonequarry Creek located well upstream from the longwalls, beyond the influence of mine subsidence. No changes were observed during the most recent inspection on 18 August 2022.

Minor surface fracturing has been observed on Rockbar SR17 in the south-east corner of the rockbar, downstream of the access road. The fractures are in a localised area and limited to the laminar surface rocks only. High water flows prevented an inspection on 21 July 2022. Manual water level measurements remain above Cease to Flow levels. Both loggers in the main pool upstream of Rockbar SR17 were lost after major rainfall events. Site SB has been reinstated this month.

A new minor fracture of approximately 1 metre long and 1-2 mm wide was observed on 18 August 2022 at Site SR20. Pre-mining photographs were checked to confirm that the fracture was new. The fracture is located near survey line SQ116, which had not recorded any measurable closure during the mining of LW W2-W3 up until the last survey on 24 January 2022. A survey prism was lost during subsequent floods. No measurable closure was observed across adjacent closure line SQ115 until the last survey on 22 March 2022. A re-survey of adjacent SQ117 found no measurable change between 24 January 2022 and September 2022. As the surveys only measure closure across the valley, it is possible that closure or extension has occurred along Stonequarry Creek. No changes are observed from surface water monitoring.

The fracture is located 170 metres from the commencing end of LW W3, which is within range of observed mining-induced fractures due to previous longwall mining in the Southern Coalfield. While the observation of the fracture is within expectations, it is surprising that no measurable closure has been observed across SQ116. It is possible, however, that ground closure or extension occurred transverse to the creek, which was not measured.

### Local Roads

There are no roads located above LW W4. No mining-induced impacts were detected from ground surveys and visual inspections.

Deterioration of the road surface and a small compression hump was observed along Connellan Crescent following significant rainfall.

Deterioration of the road surface was observed on Rumker Street due to heavy vehicle traffic adjacent a development site.

Deterioration of the road surface on was observed on Star Street due to weather and heavy vehicle traffic. Erosion at the northern end the street partially undermined a stormwater pipe. Council undertook repairs.

Council repaired the culvert and pavement near the intersection of Argyle Street and Prince Street, which were damaged during wet weather events.

No issues observed along Stonequarry Creek Road, Booyong Close, Attunga Close and Carramar Close. Deterioration of the road surface along Thirlmere Way, and land slips on the high side of the road, were observed due to weather and traffic.

### Structures

There are no structures located above LW W4.

### Stormwater Detention Basin

A ground survey and visual inspection were conducted at the completion of LW W4. Very minor changes were measured since the completion of LW W3 with no issues observed from visual inspections.

### Gas Infrastructure

No gas infrastructure is located above LW W4.

No impacts were detected from ground surveys and visual inspections along Thirlmere Way during the mining of LW W4. Deterioration of the road surface was observed along Connellan Crescent following significant rainfall.

### Electrical Infrastructure

No telecommunications infrastructure is located above LW W4.

No impacts were detected from ground surveys and visual inspections along Thirlmere Way during the mining of LW W4. Deterioration of the road surface was observed along Connellan Crescent following significant rainfall.

### Telecommunications Infrastructure

No telecommunications infrastructure is located above LW W4.

No impacts were detected from ground surveys and visual inspections along Thirlmere Way during the mining of LW W4. Deterioration of the road surface was observed along Connellan Crescent following significant rainfall.

Surveys and visual inspections were conducted along the optical fibre cable beyond the finishing end of LW W4. The pegs were installed and initially surveyed when LW W2 was approximately 450 metres from the finishing end. The results, therefore, included a measure of total subsidence due to the mining of LW W2 to LW W4. A reasonable correlation was found between predicted and observed subsidence. Observed tilts and strains were close to survey tolerance.

### Potable Water Infrastructure

No potable water infrastructure is located above LW W4.

No impacts were detected from ground surveys and visual inspections along Thirlmere Way during the mining of LW W4. Deterioration of the road surface was observed along Connellan Crescent following significant rainfall.

### Sewer Infrastructure

Surveys have been conducted along the Picton rising main located along Wild and Lumsdaine Streets during the period of active subsidence. Observed subsidence, tilts and changes in horizontal distances were within survey tolerances. Focussed visual inspections did not detect any impacts.

## Wastewater Treatment Plant

Minor changes in subsidence and differential movements were measured at the Wastewater Treatment Plant (WTP) and Re-use Water Storage Pond during LW W4, as expected.

Visual inspections of the WTP were conducted on a monthly basis during the period of active subsidence. A pipe joint separated on aeration tank 1, and minor ground deterioration was observed at the southern edge of the Re-Use Water Storage Dam after rainfall and cattle movement (not mining related). No mining-induced impacts were observed.

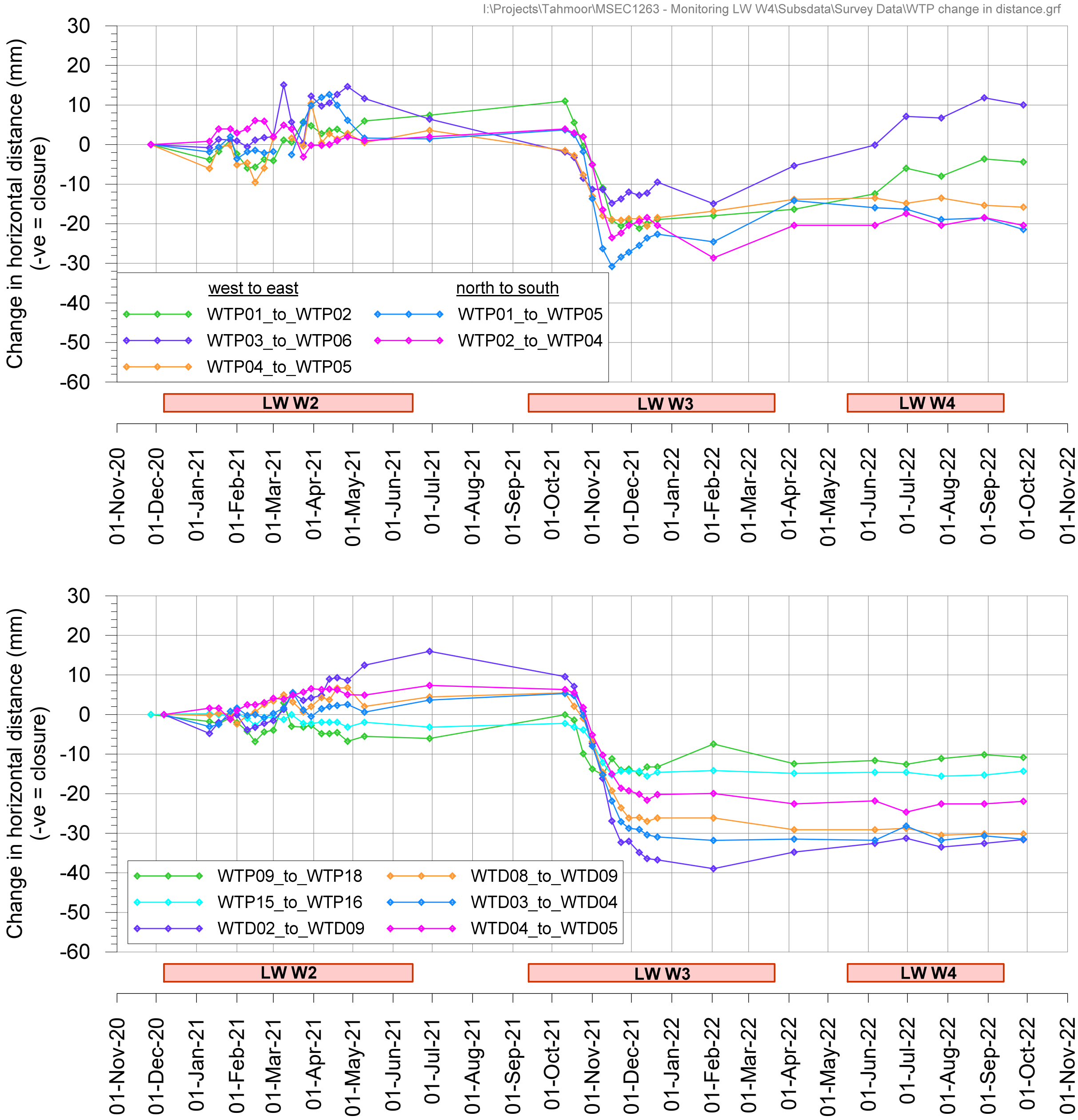



**Figure J Total changes in distance over time**

## Dams

Regular surveys and inspections were conducted at Farm Dam FD-1 and Farm Dam FD-3 during LW W4.

Subsidence was observed to develop gradually at both dams, with compressive strains developing across and along the dam walls. The dams are full following significant rainfall during the mining of LW W4. No mining-induced-impacts were observed.

The development of subsidence and ground strains at Farm Dam FD-3 are plotted relative to the position of the longwall face at times of survey in Figure K. The development of subsidence and ground strains along and across the dam over time are shown in Figure L. The development of changes in vertical and horizontal alignment along the crest and base of the dam over time are shown in Figure M.

Visual inspections were conducted at Farm Dam FD-3. Deterioration of the uphill bank resulted from wet weather and cattle movement. The dam was at full capacity on 27 and 29 July and overflowing the northern spillway as intended. No impacts were observed to the dam wall.

A small section of earth had slumped at the southern end of the dam wall (not mining related). A syphon was installed to gradually lower the water level by approximately 400 mm. There was no evidence of the dam wall leaking. A geotechnical inspection was completed with no concerns observed regarding the dam wall.

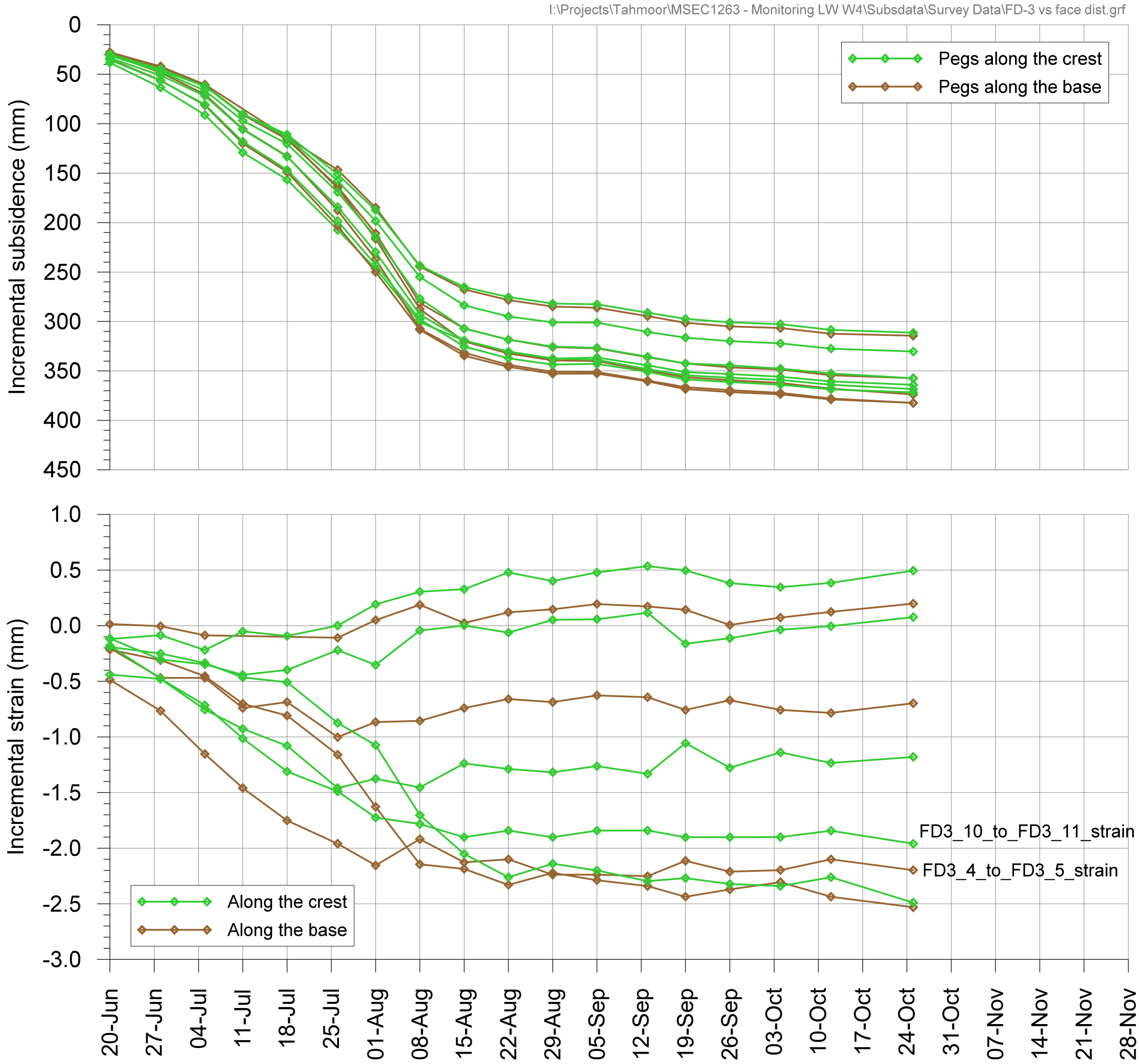



**Figure K Development of subsidence and ground strains at Farm Dam FD-3**

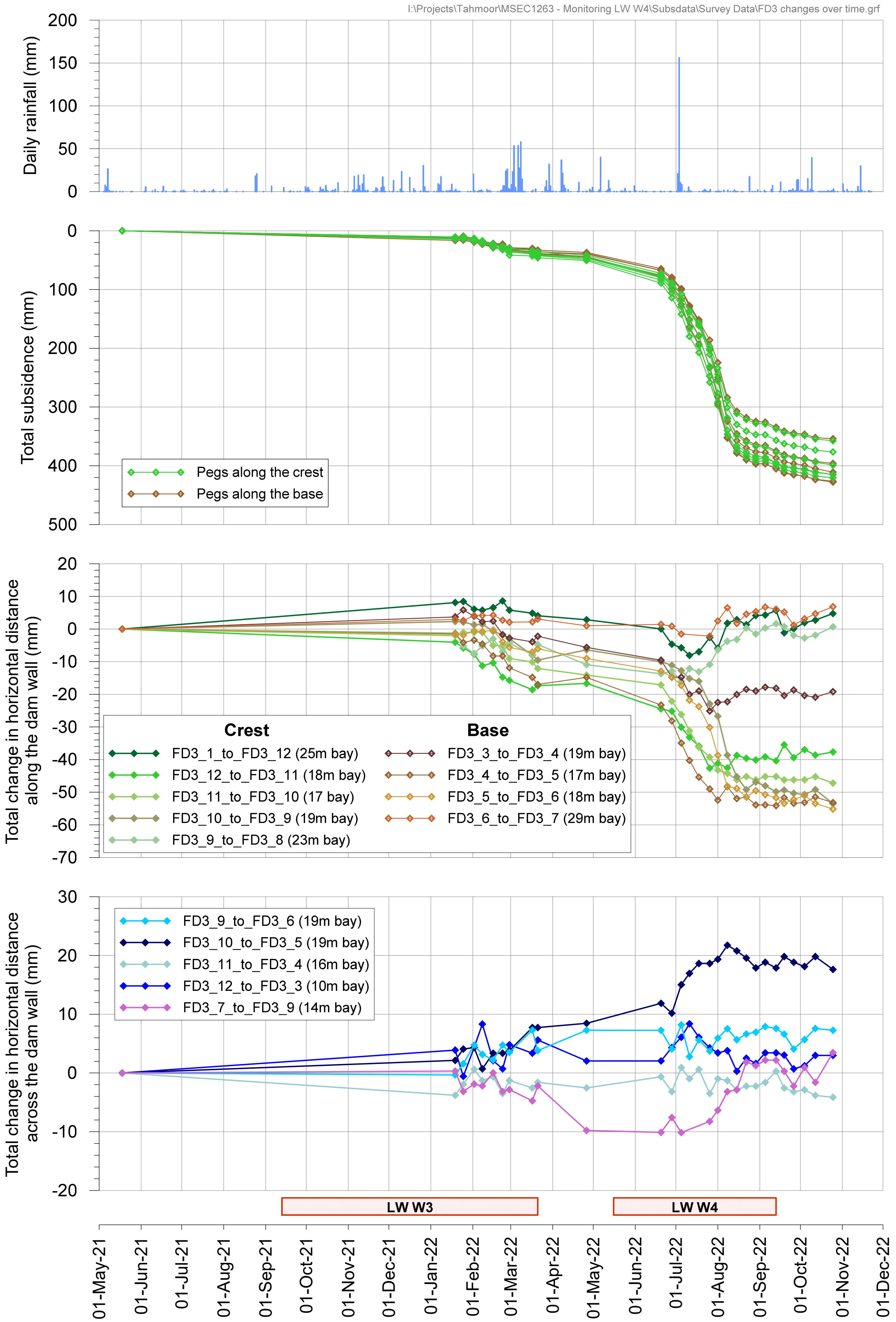



**Figure L** Development of subsidence and ground strains at Farm Dam FD-3 over time

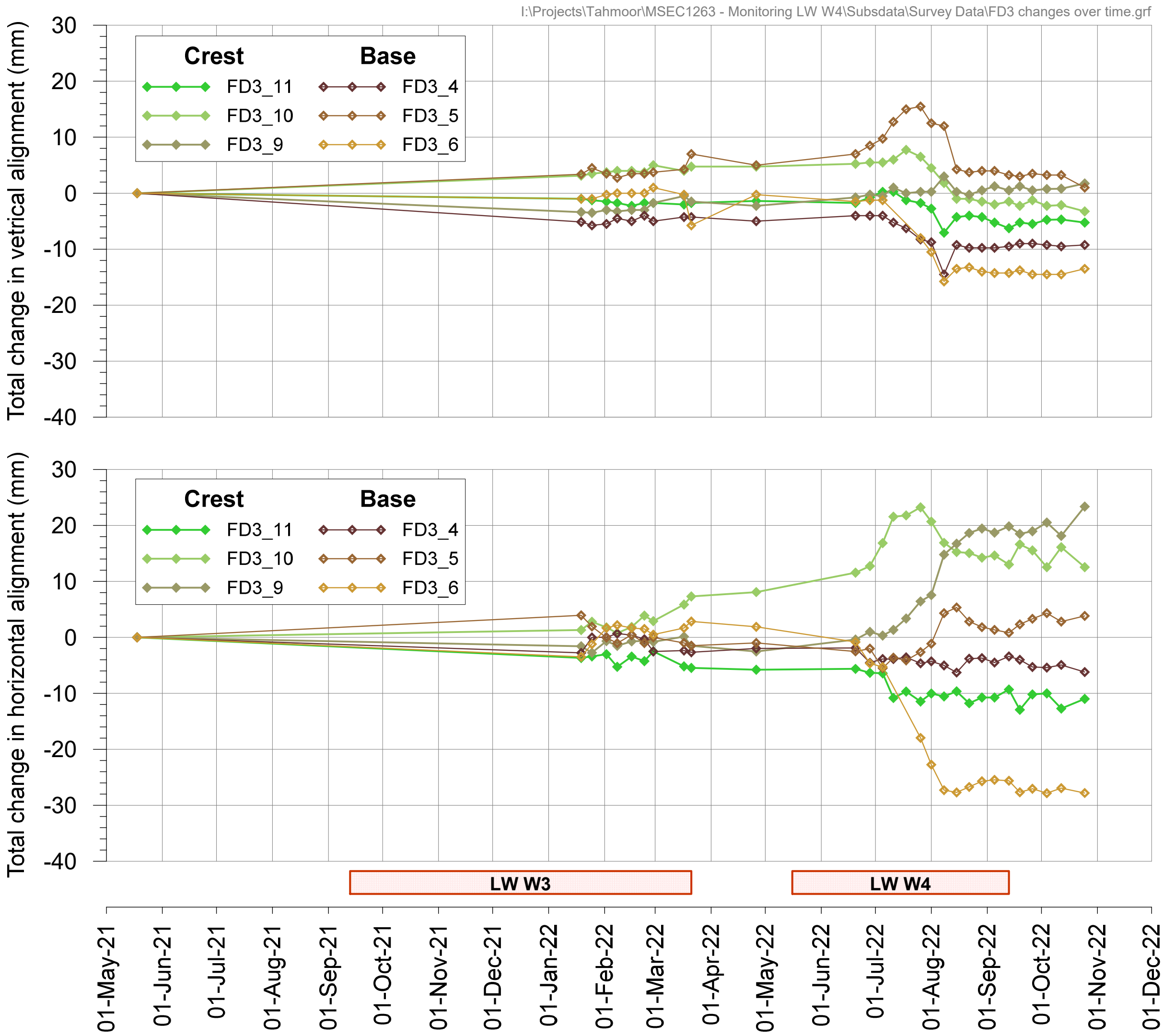



**Figure M Development of changes in vertical and horizontal alignment along Farm Dam FD-3 over time**

## Archaeological Sites

Very minor ground movements have been measured across Rockbar SR17, with no impacts observed at the grinding groove sites. Surface fractures have been observed on the rockbar approximately 40 metres downstream of the grinding grooves since late October 2021. The fractures have been assessed to have negligible impact on the heritage value of the site.

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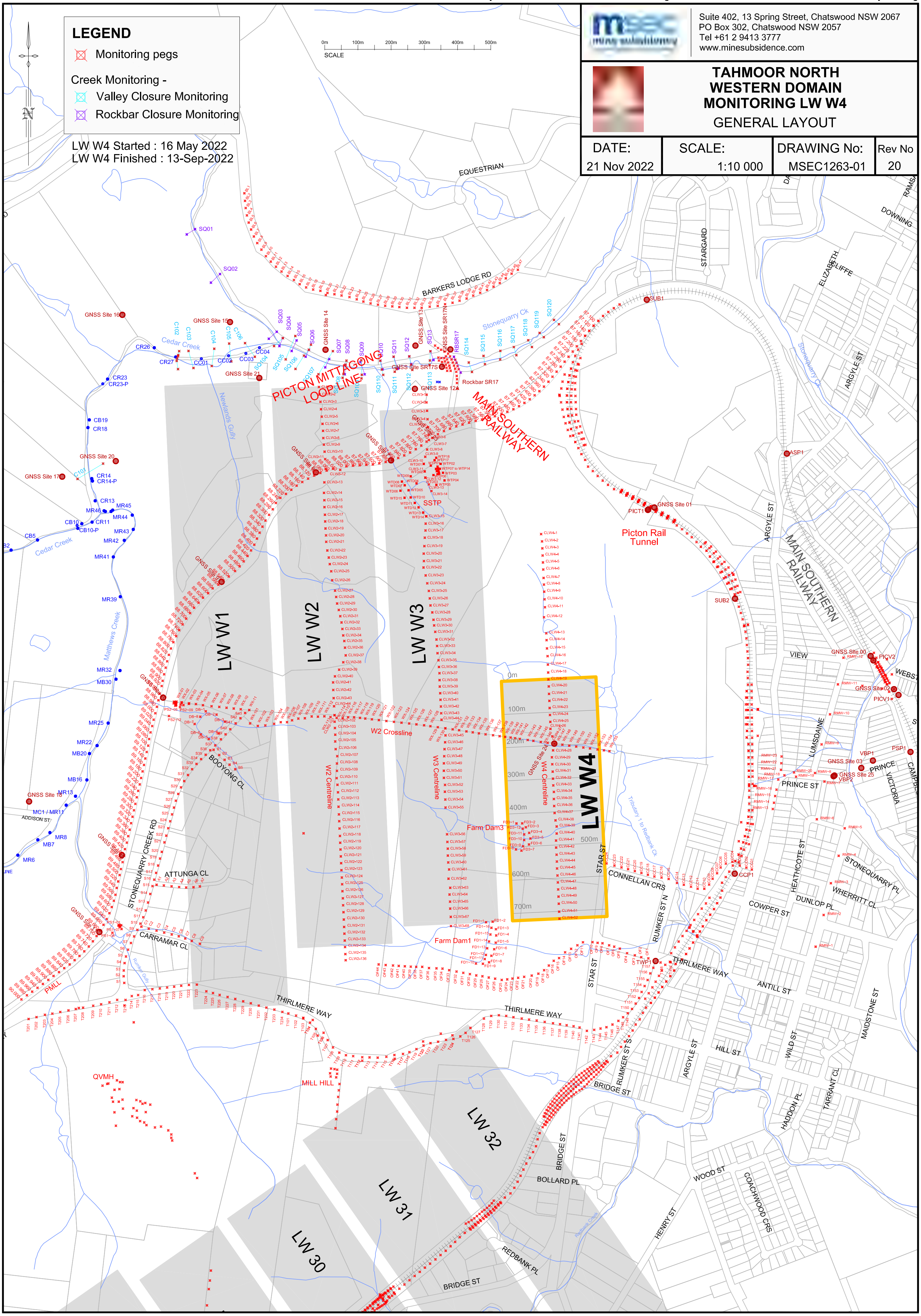


# Tahmoor LW W4
# Incremental subsidence profiles along LW W4 Centreline

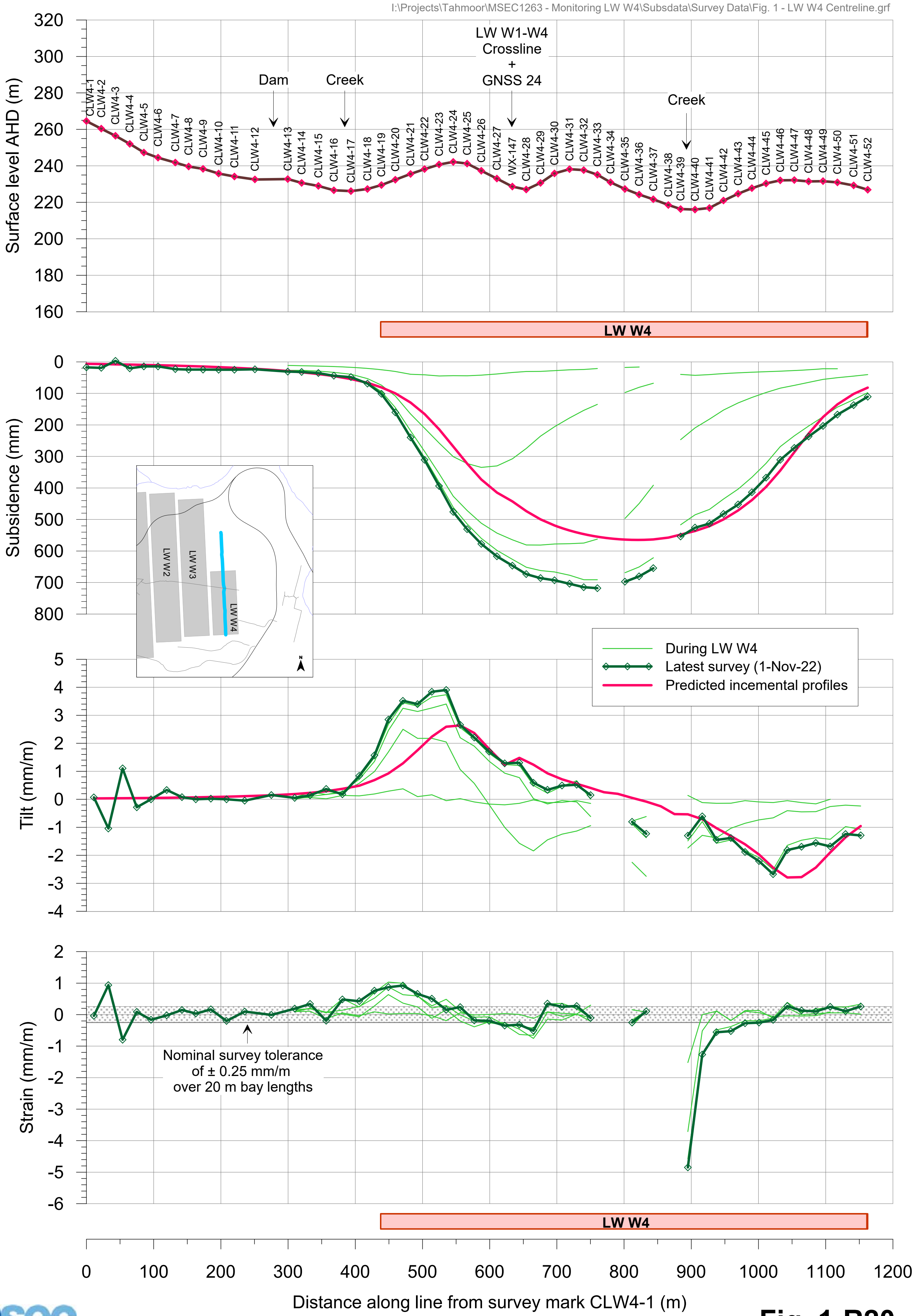
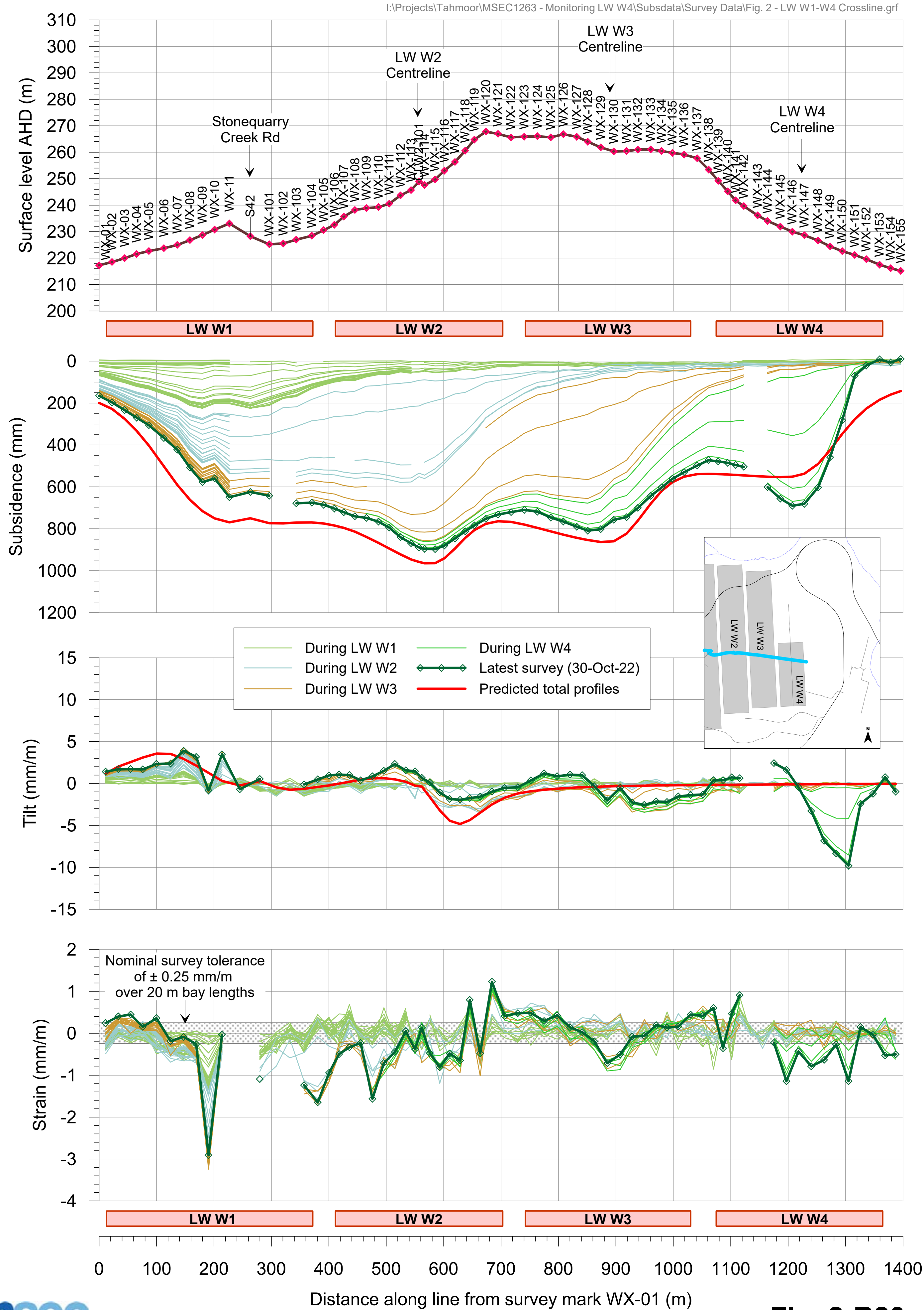



Fig. 1-R20

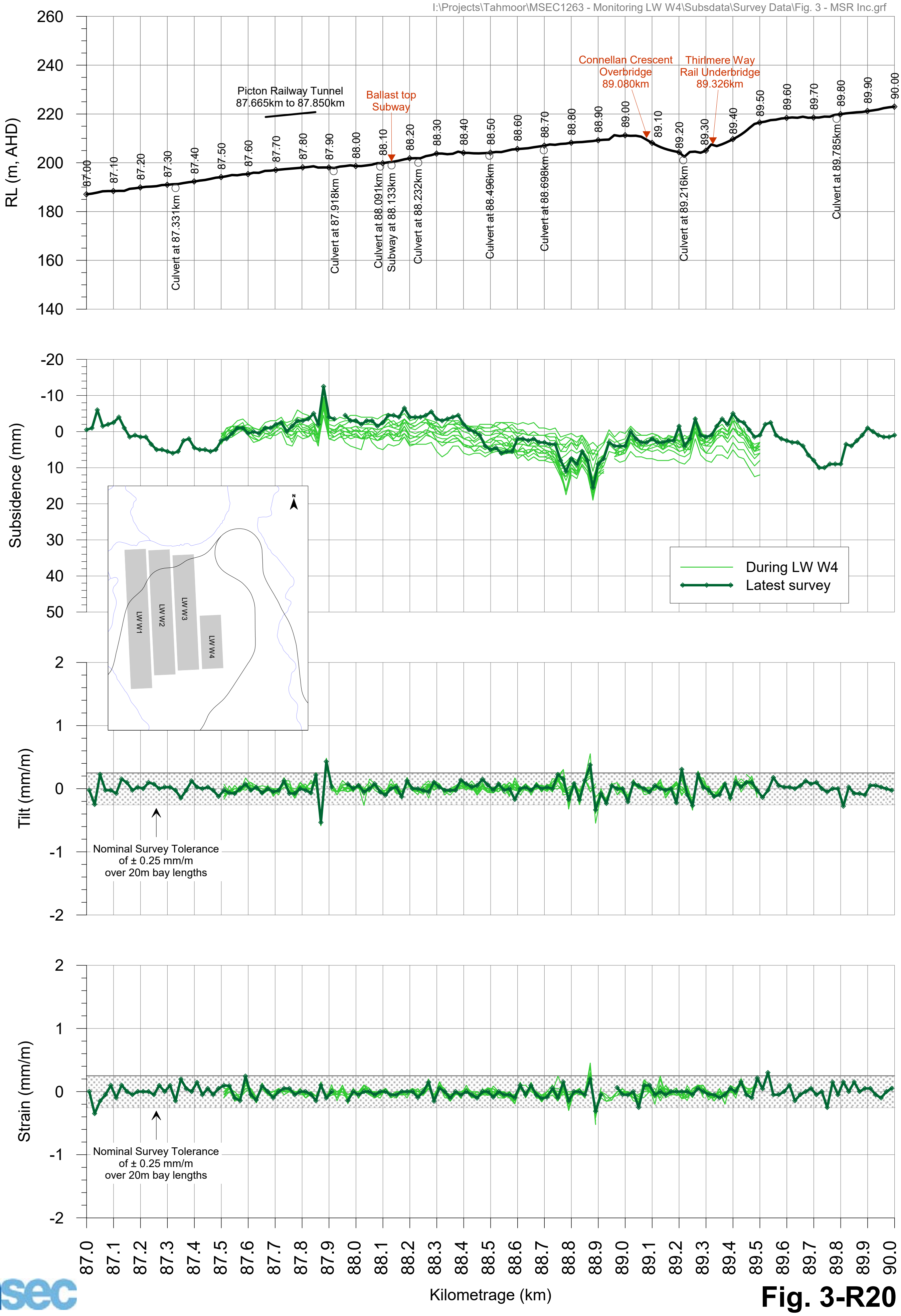
# Tahmoor LW W4
# Total subsidence profiles along LW W1-W4 Crossline




msec

Fig. 2-R20

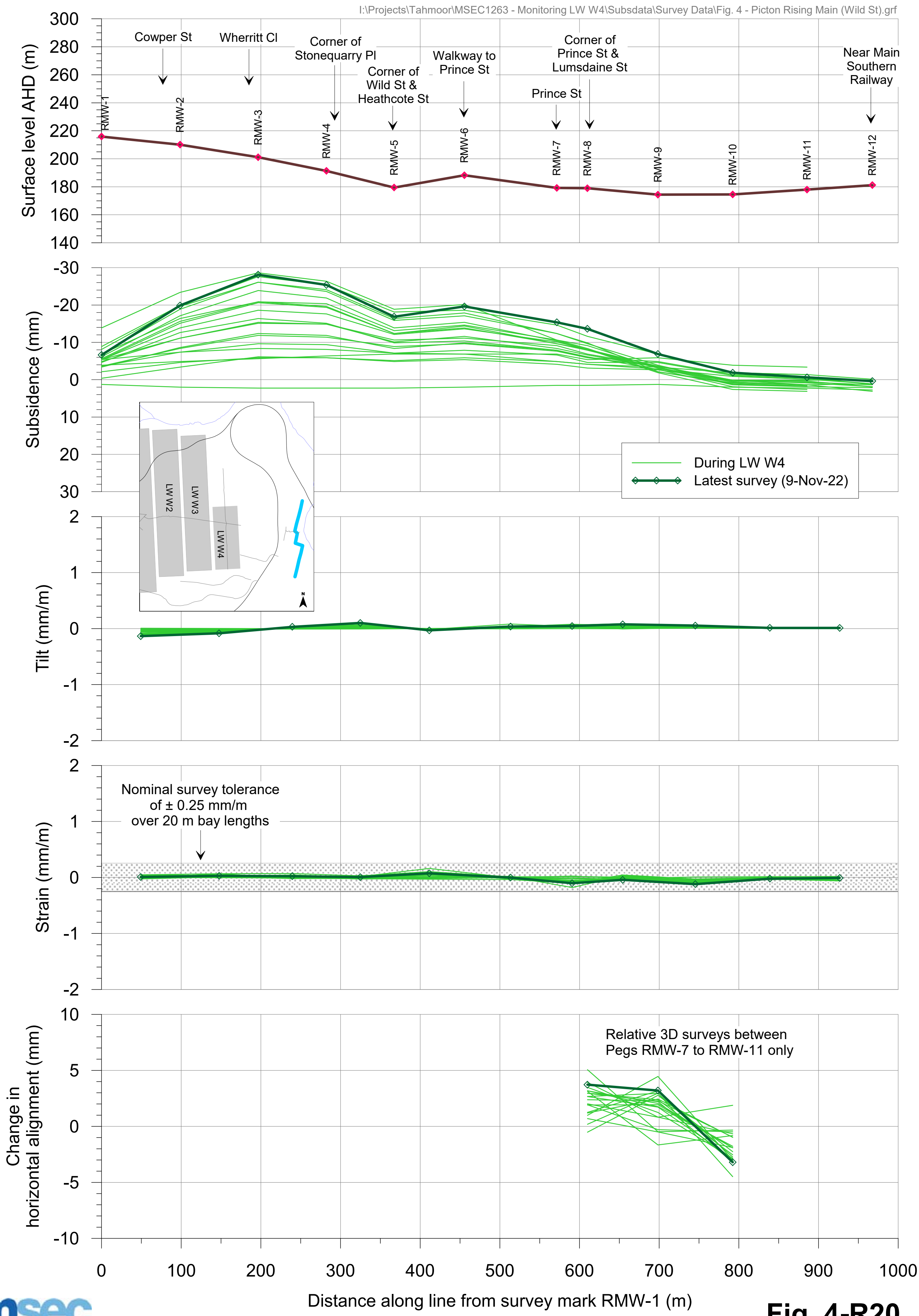
# Tahmoor LW W4 - Main Southern Railway
# Incremental subsidence profiles
# Survey date: 18 October 2022




msec

**Fig. 3-R20**

# Tahmoor LW W4 - Picton Rising Main
# Incremental subsidence profiles along Wild St and Lumsdaine St




msec

**Fig. 4-R20**

# Tahmoor LW W4 - Picton Rising Main
# Incremental subsidence profiles along Argyle St

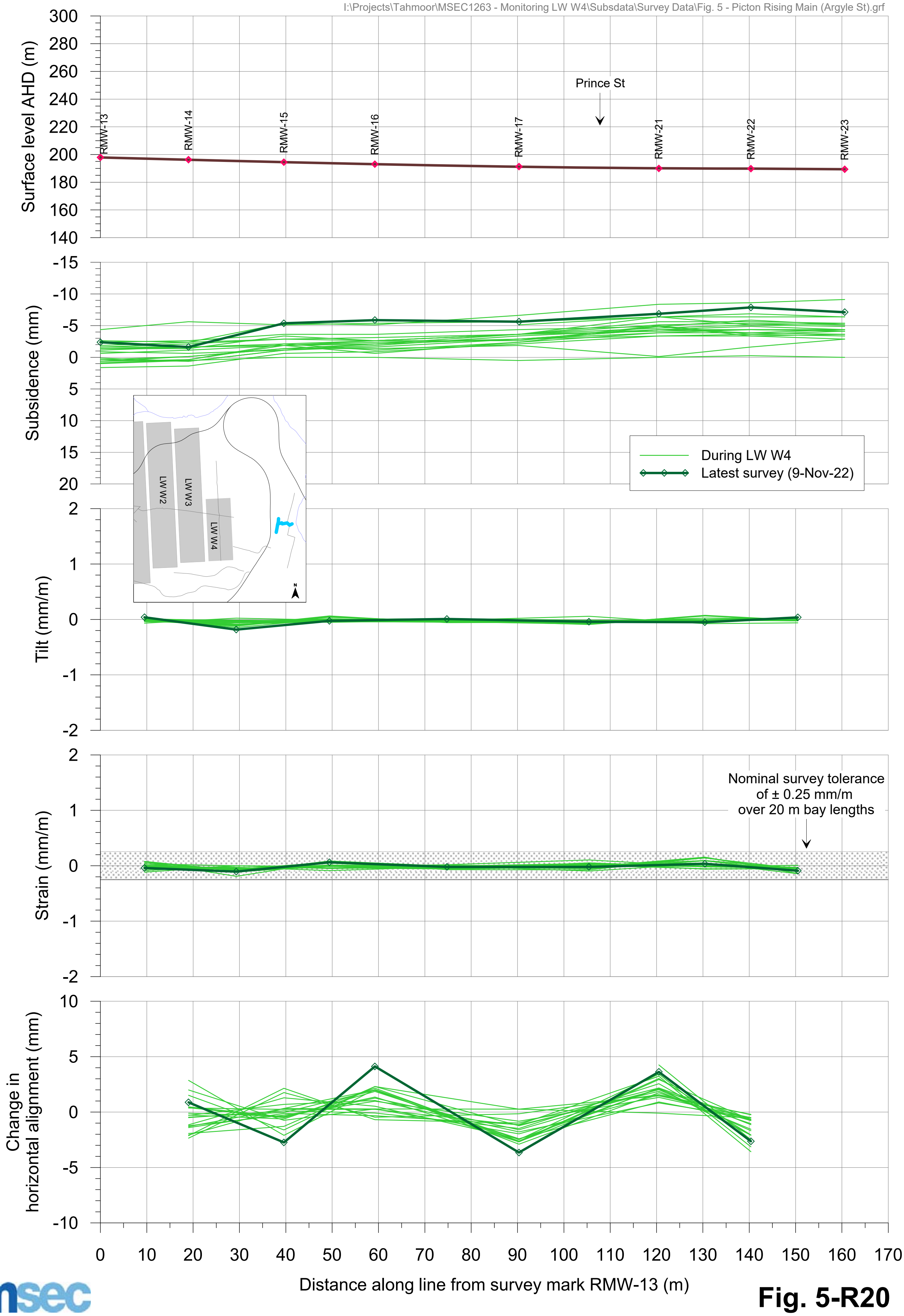
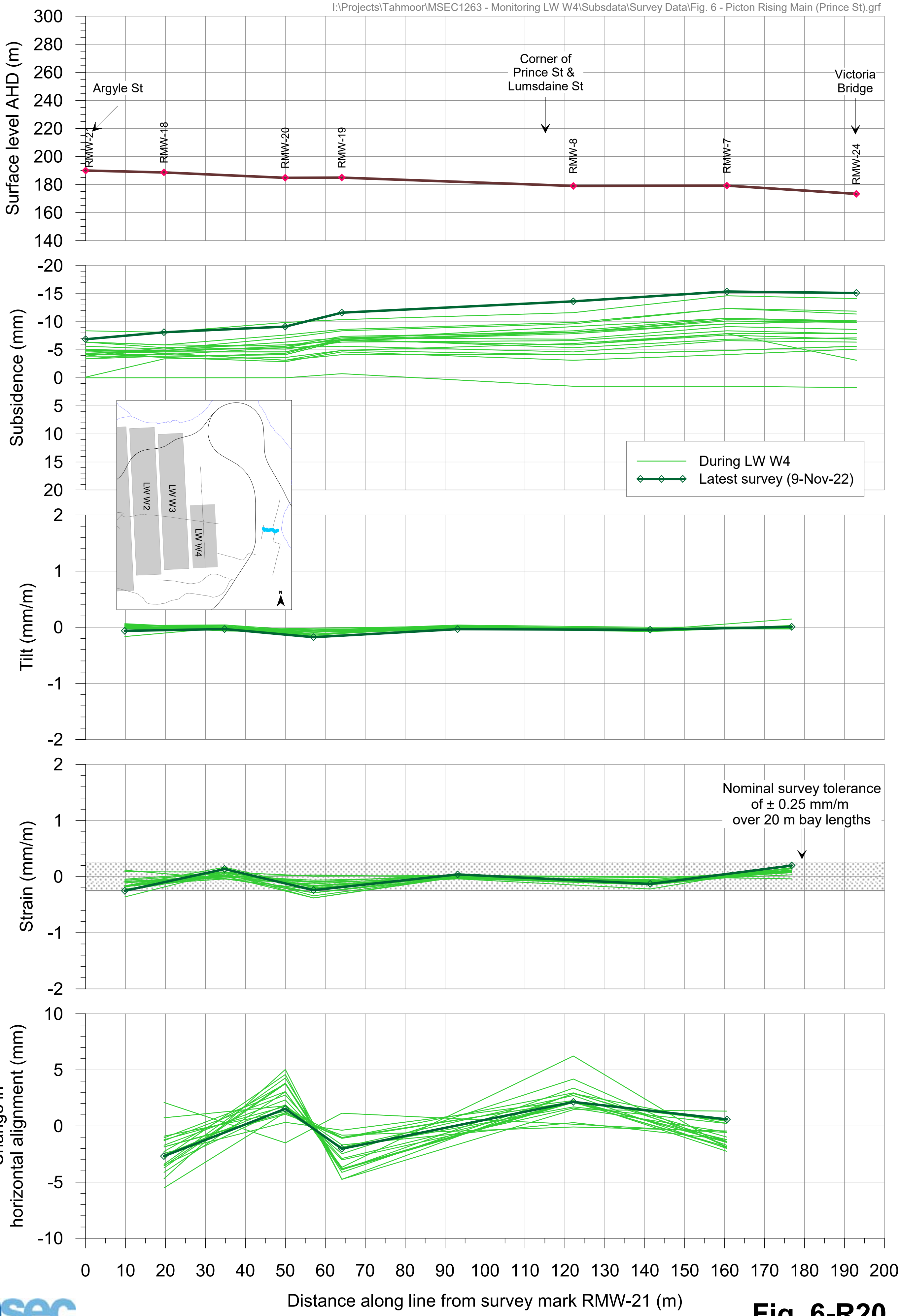



Fig. 5-R20

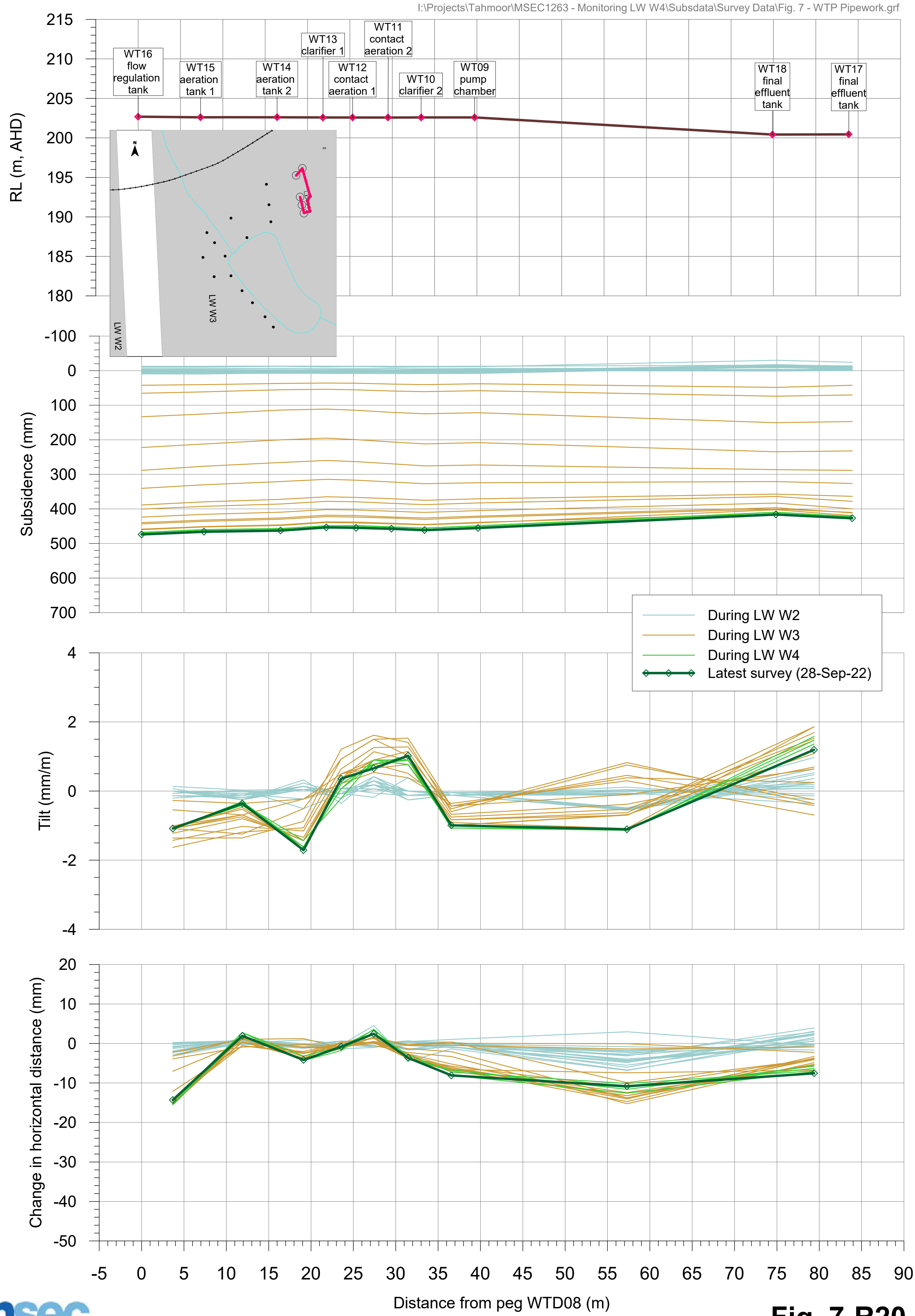
# Tahmoor LW W4 - Picton Rising Main
# Incremental subsidence profiles along Prince St




msec

Fig. 6-R20

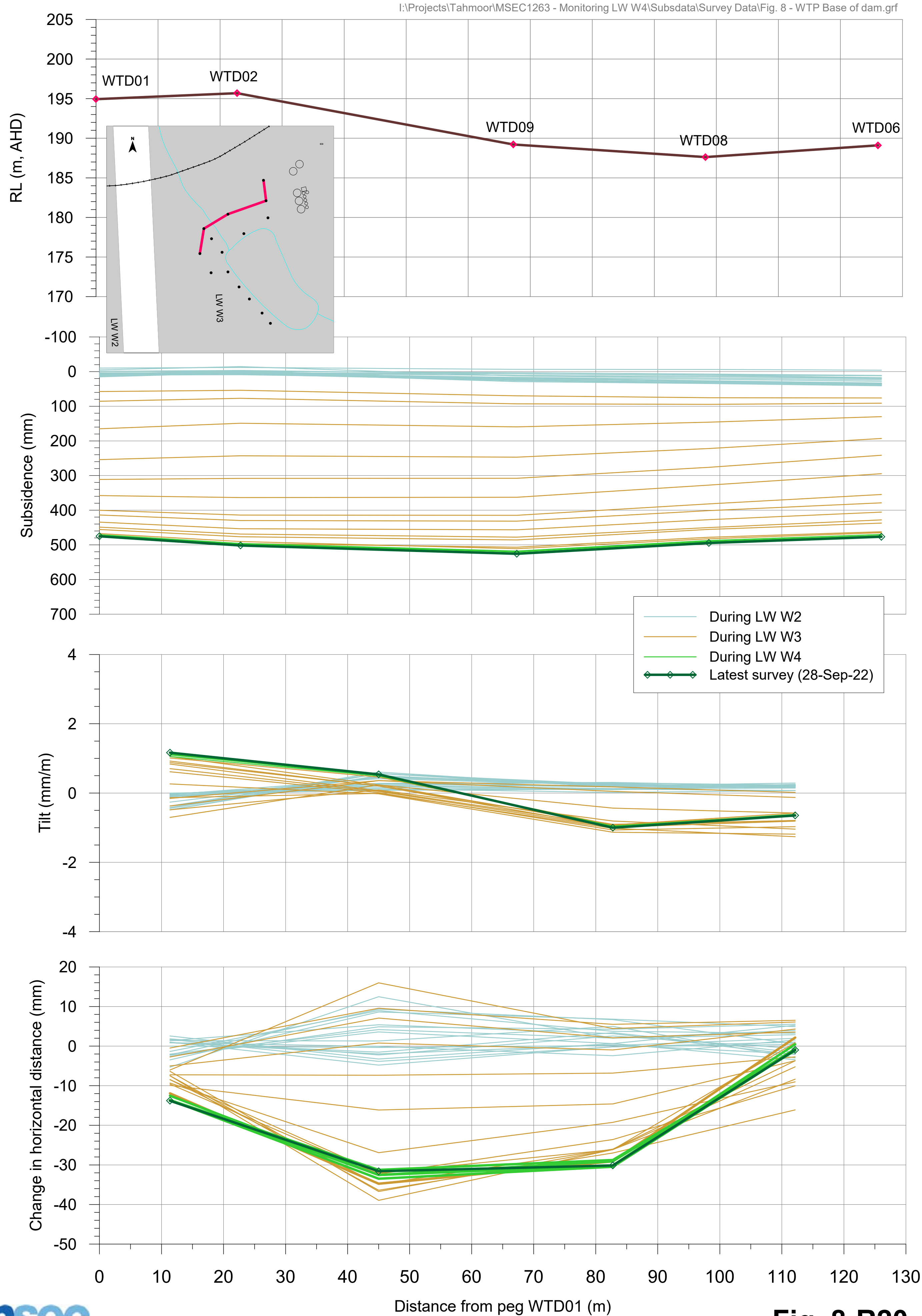
# Tahmoor LW W4 - Stonequarry WTP
# Total subsidence profiles along path of treated effluent




msec

Fig. 7-R20

# Tahmoor LW W4 - Stonequarry WTP
# Total subsidence profiles along base of dam




msec

Fig. 8-R20

# Tahmoor LW W4 - Stonequarry WTP
# Total subsidence profiles along crest of dam

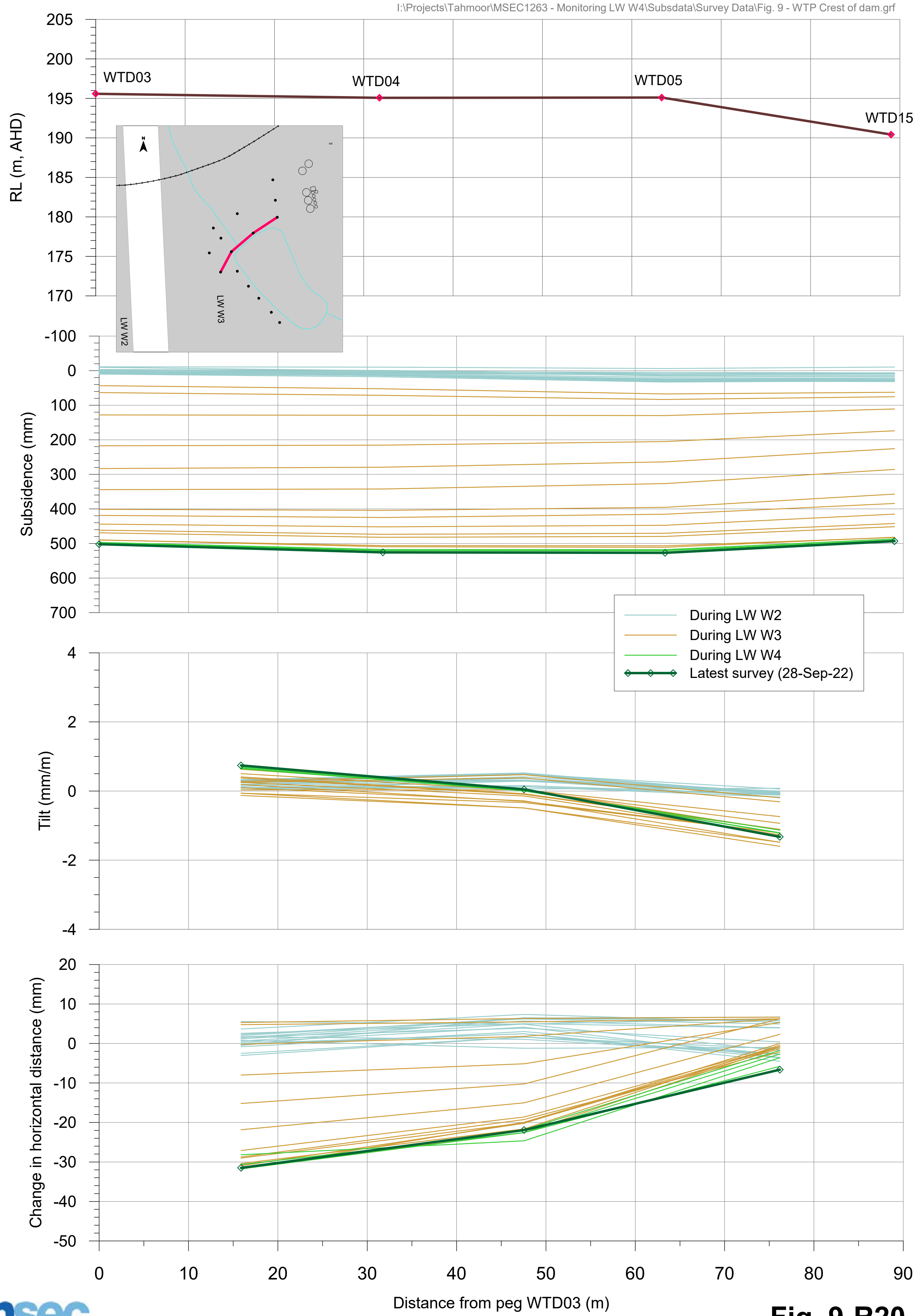



Fig. 9-R20

# Tahmoor LW W3 - Stonequarry WTP
# Total subsidence profiles along western side of dam

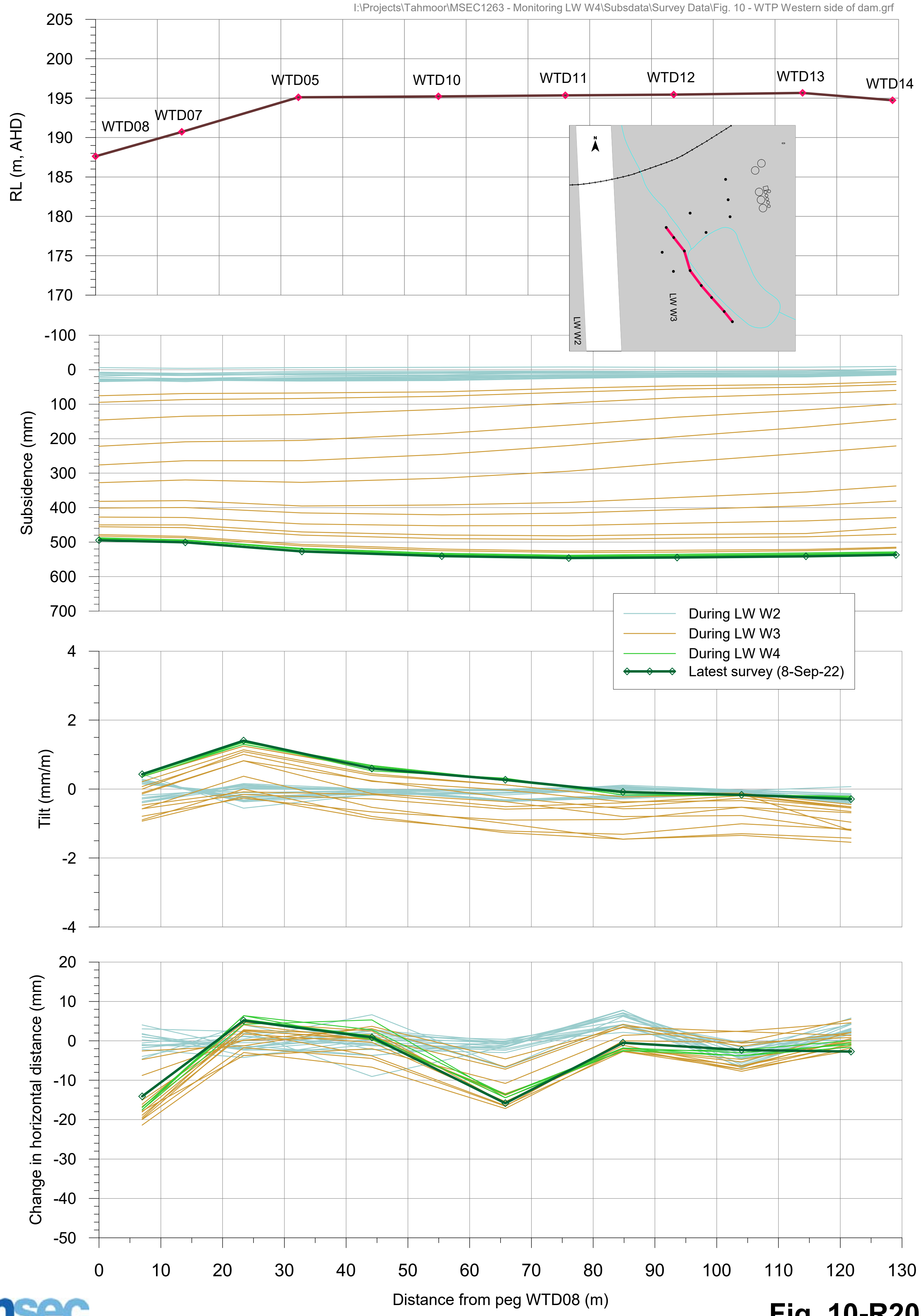
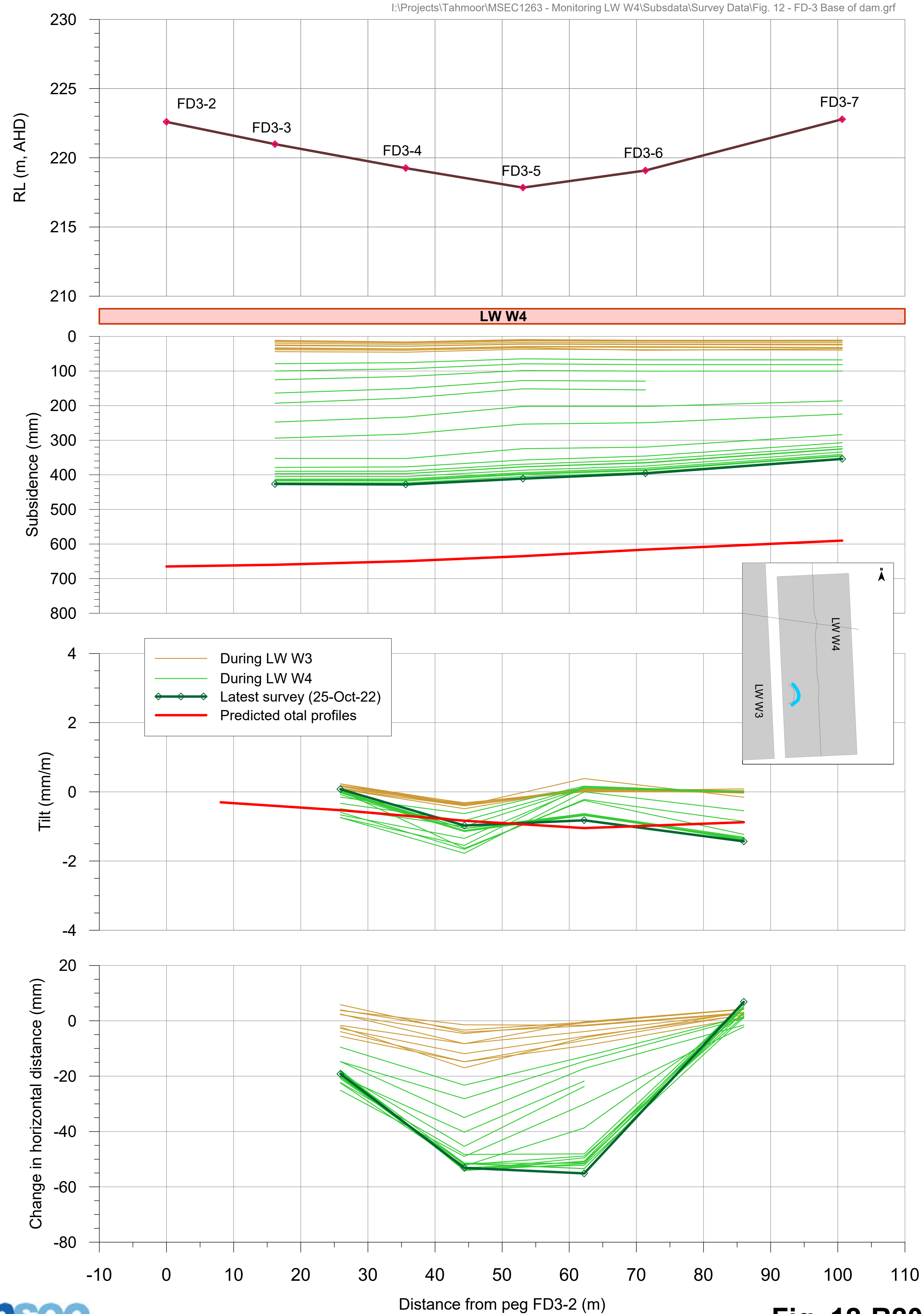



Fig. 10-R20

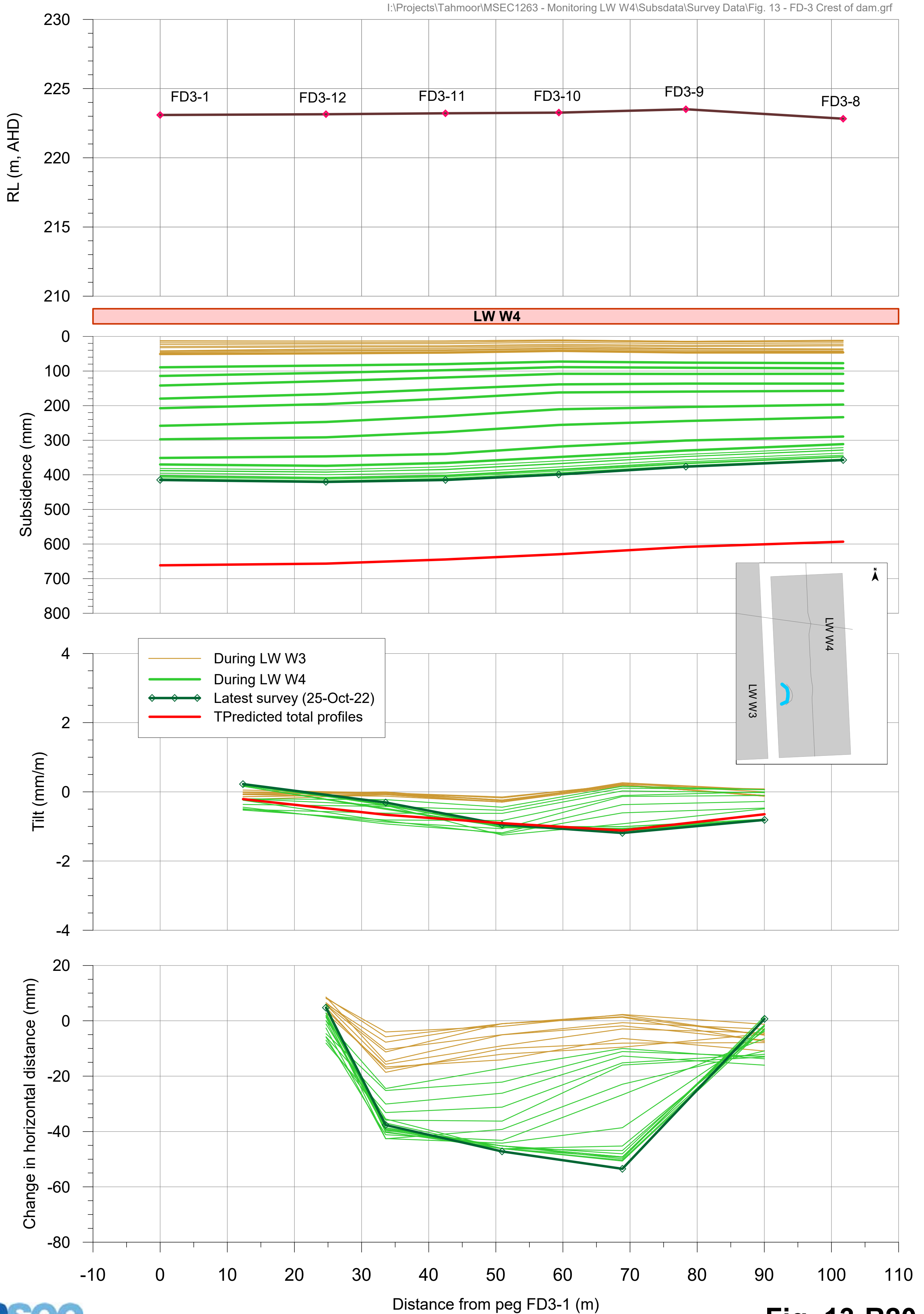
# Tahmoor LW W4
# Total subsidence profiles along base of dam FD-3




msec

Fig. 12-R20

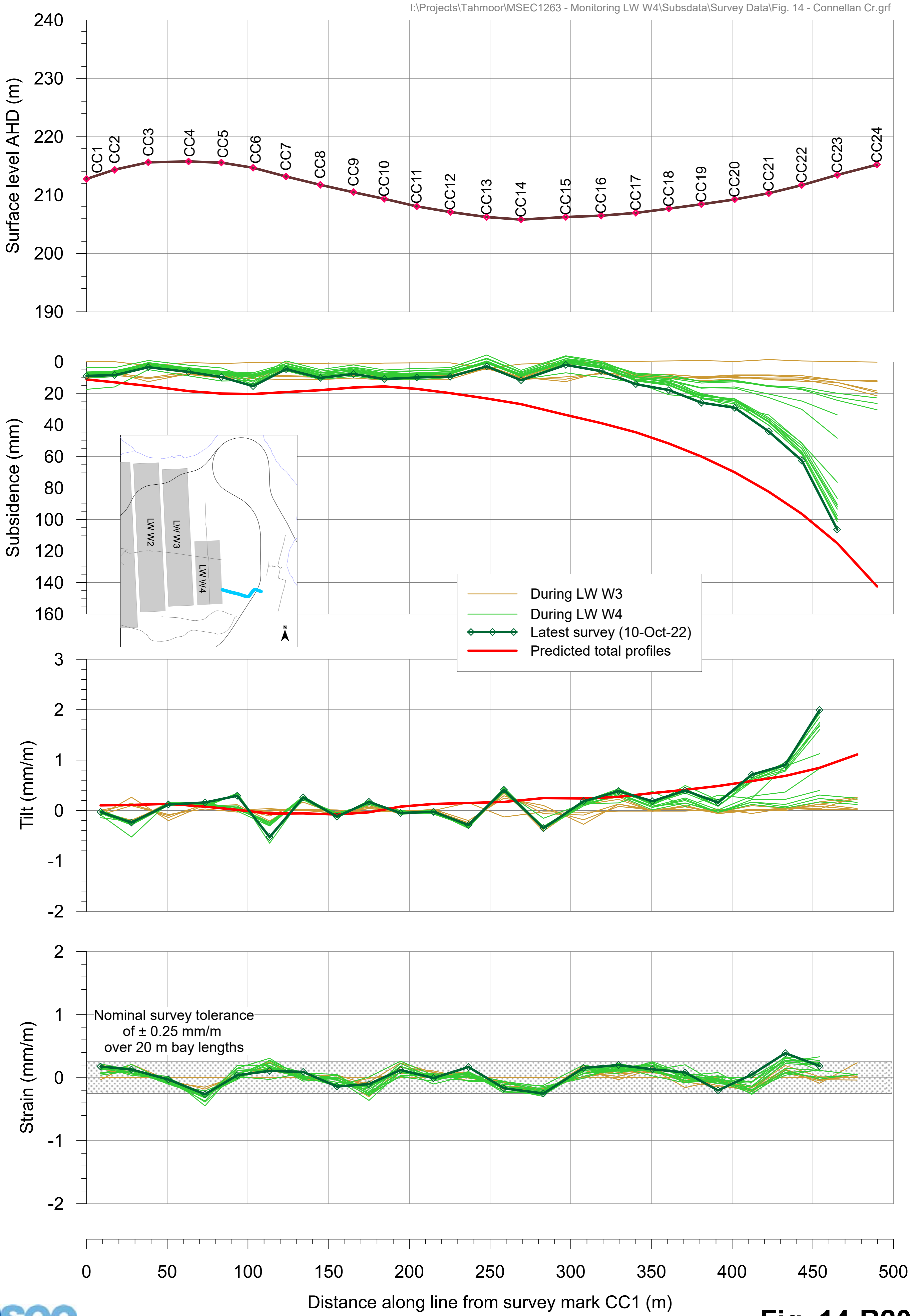
# Tahmoor LW W4
# Total subsidence profiles along crest of dam FD-3




msec

Fig. 13-R20

# Tahmoor LW W4
# Total subsidence profiles along Connellan Crescent




msec

Fig. 14-R20

# Tahmoor LW W4
# Total subsidence profiles along Thirlmere Way

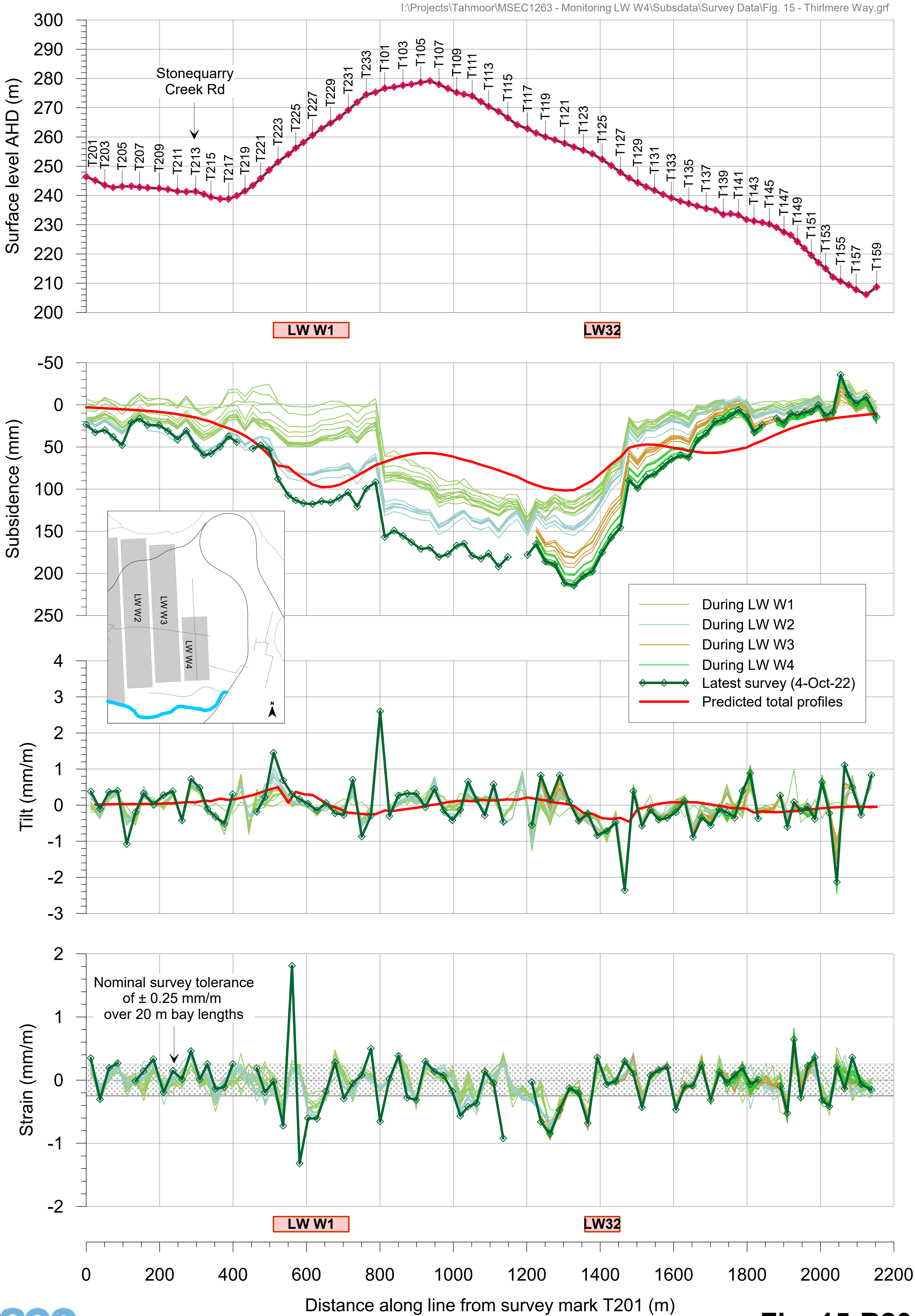



Fig. 15-R20

# Tahmoor LW W4
# Total subsidence profiles along base of dam FD-1

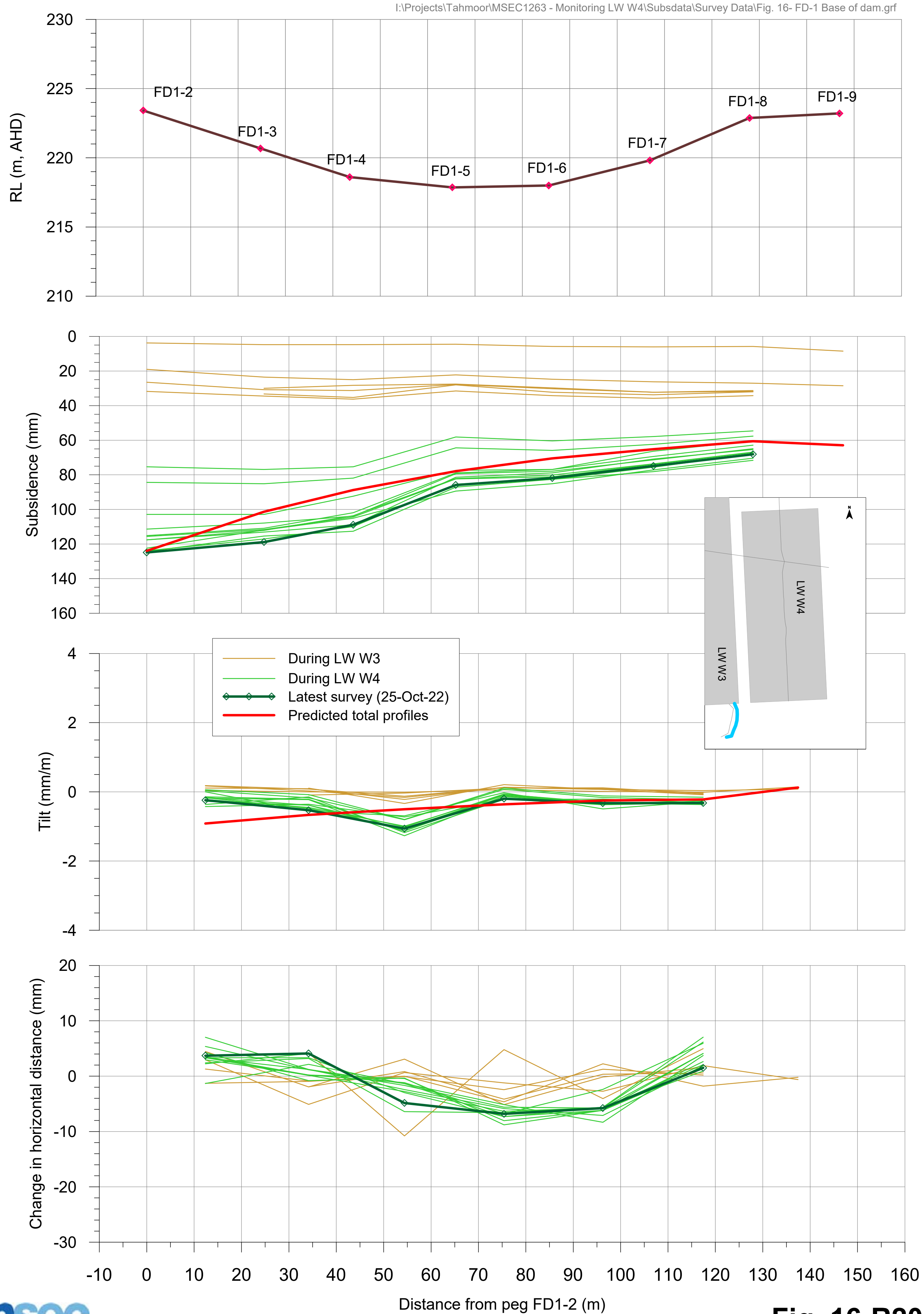



Fig. 16-R20

# Tahmoor LW W4
# Total subsidence profiles along crest of dam FD-1

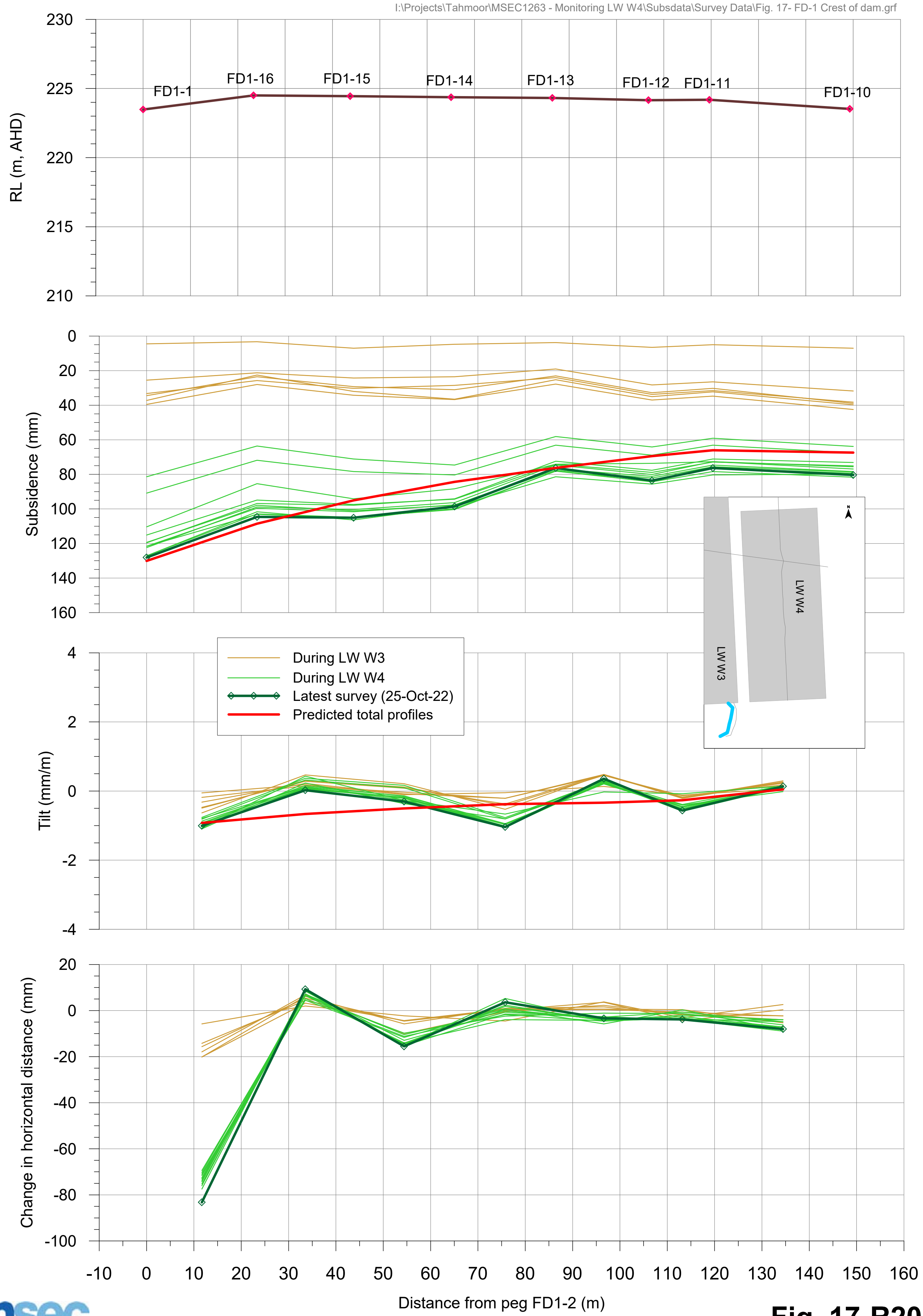





**Fig. 17-R20**

# Tahmoor LW W4
# Total subsidence profiles along Optic Fibre West line

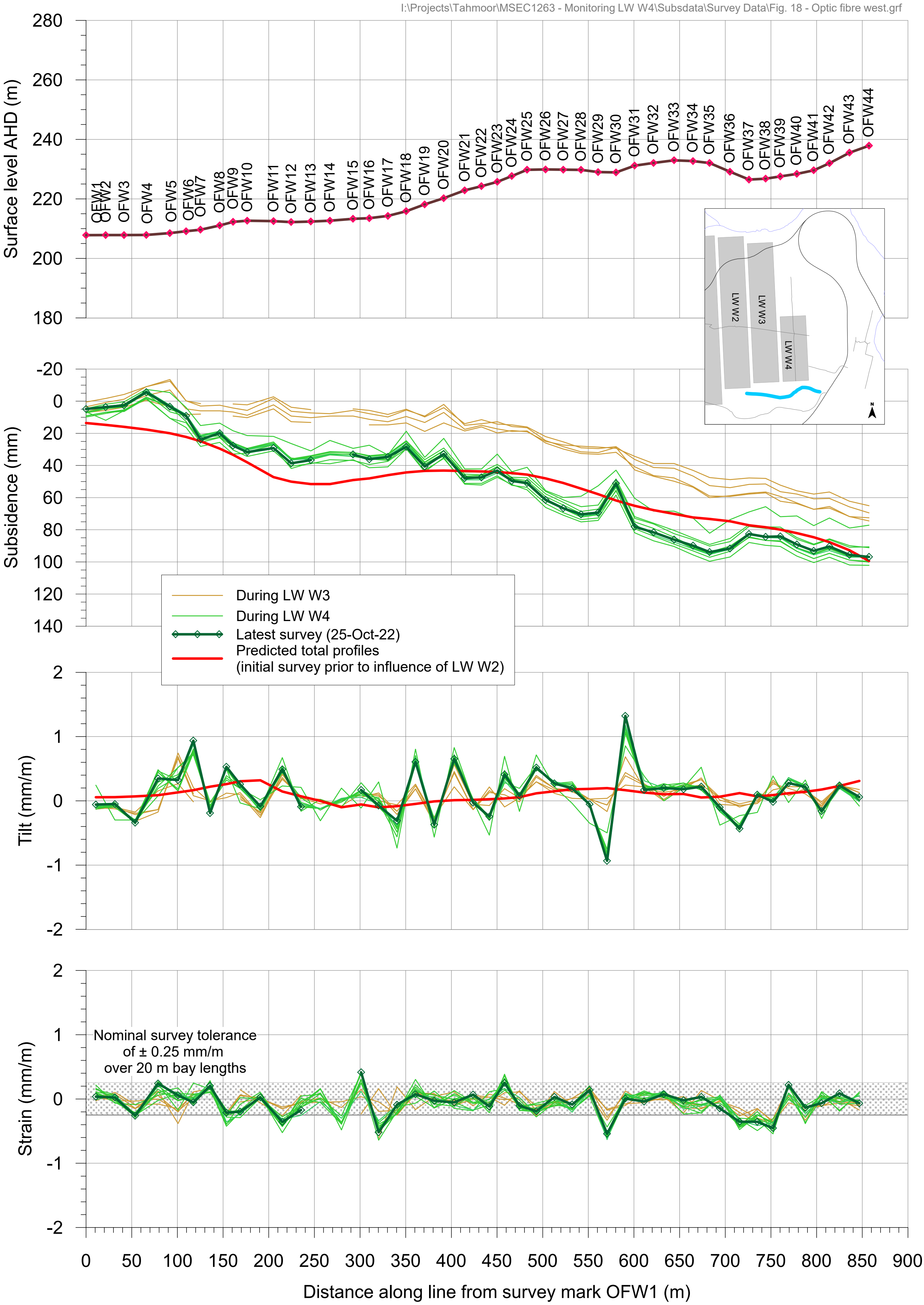
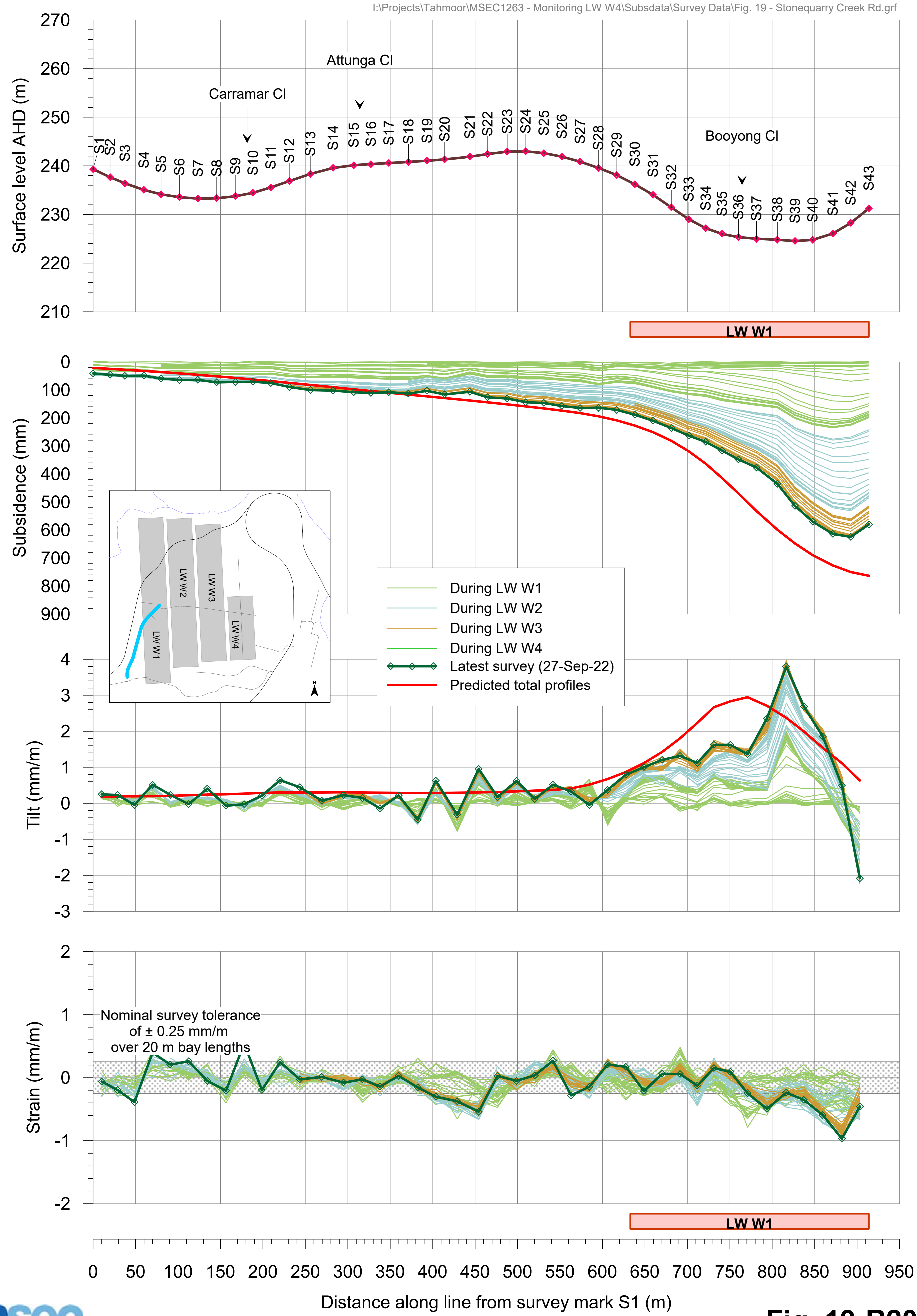



Fig. 18-R20

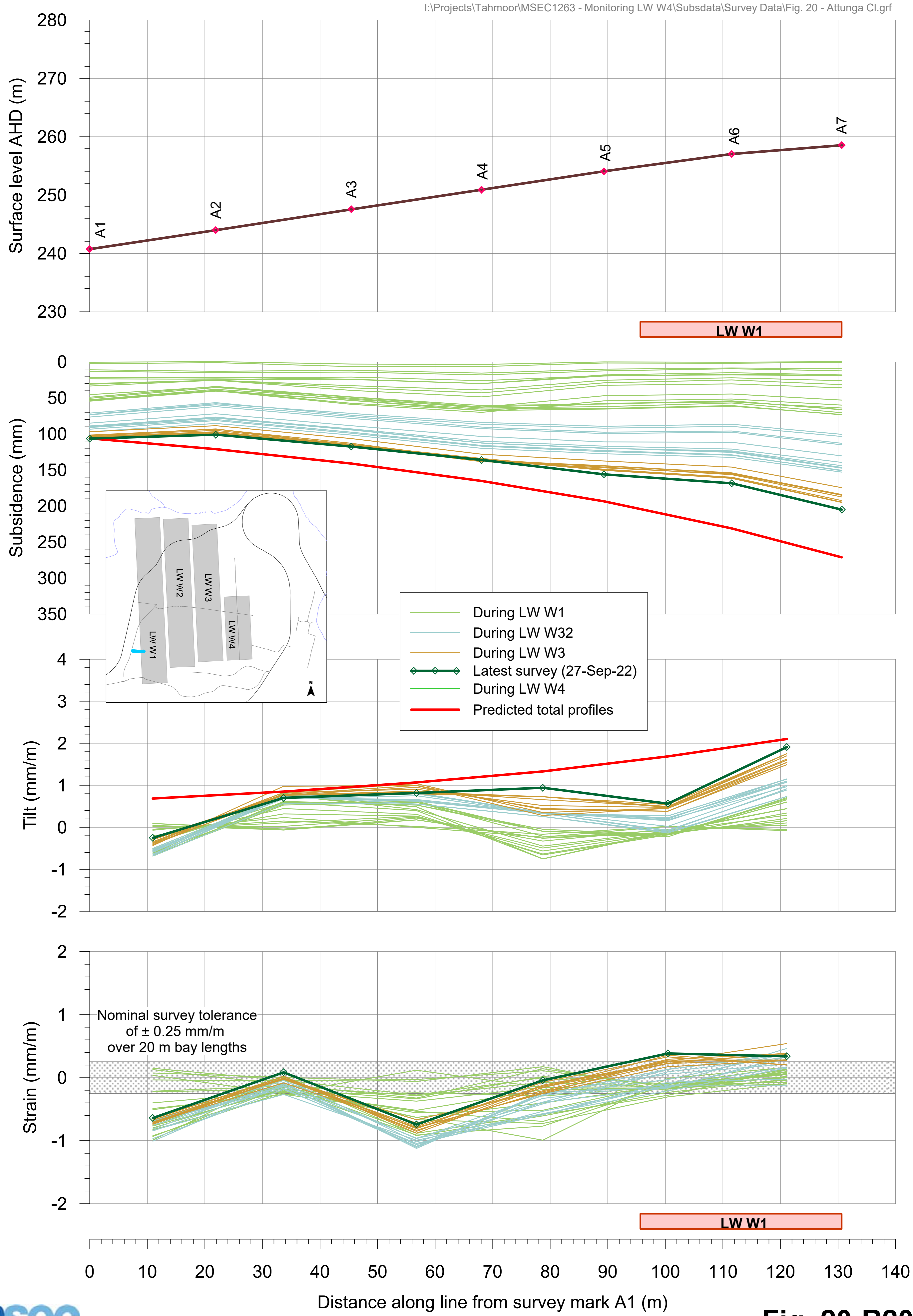
# Tahmoor LW W4
# Total subsidence profiles along Stonequarry Creek Rd




msec

Fig. 19-R20

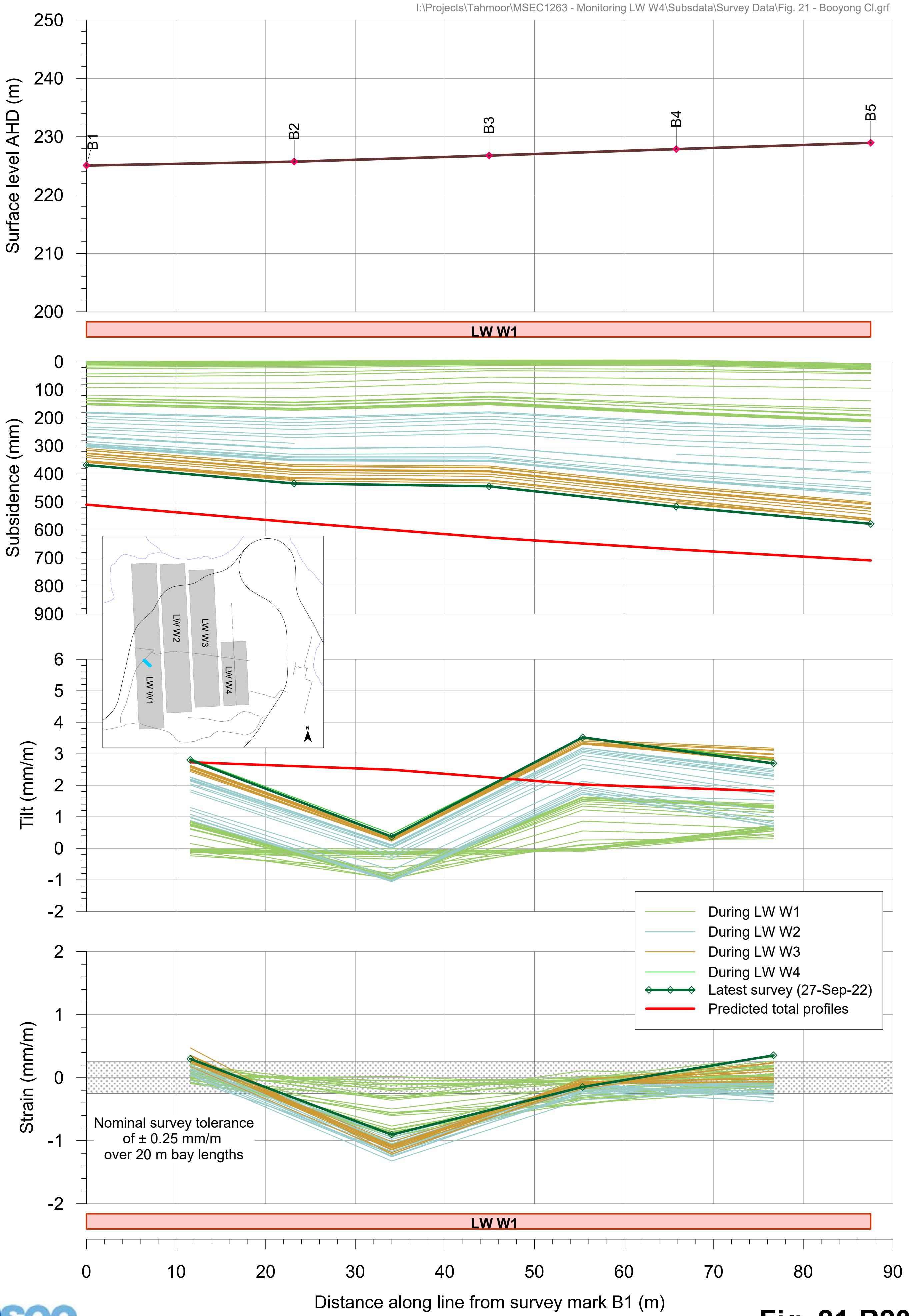
# Tahmoor LW W4
# Total subsidence profiles along Attunga Close




msec

**Fig. 20-R20**

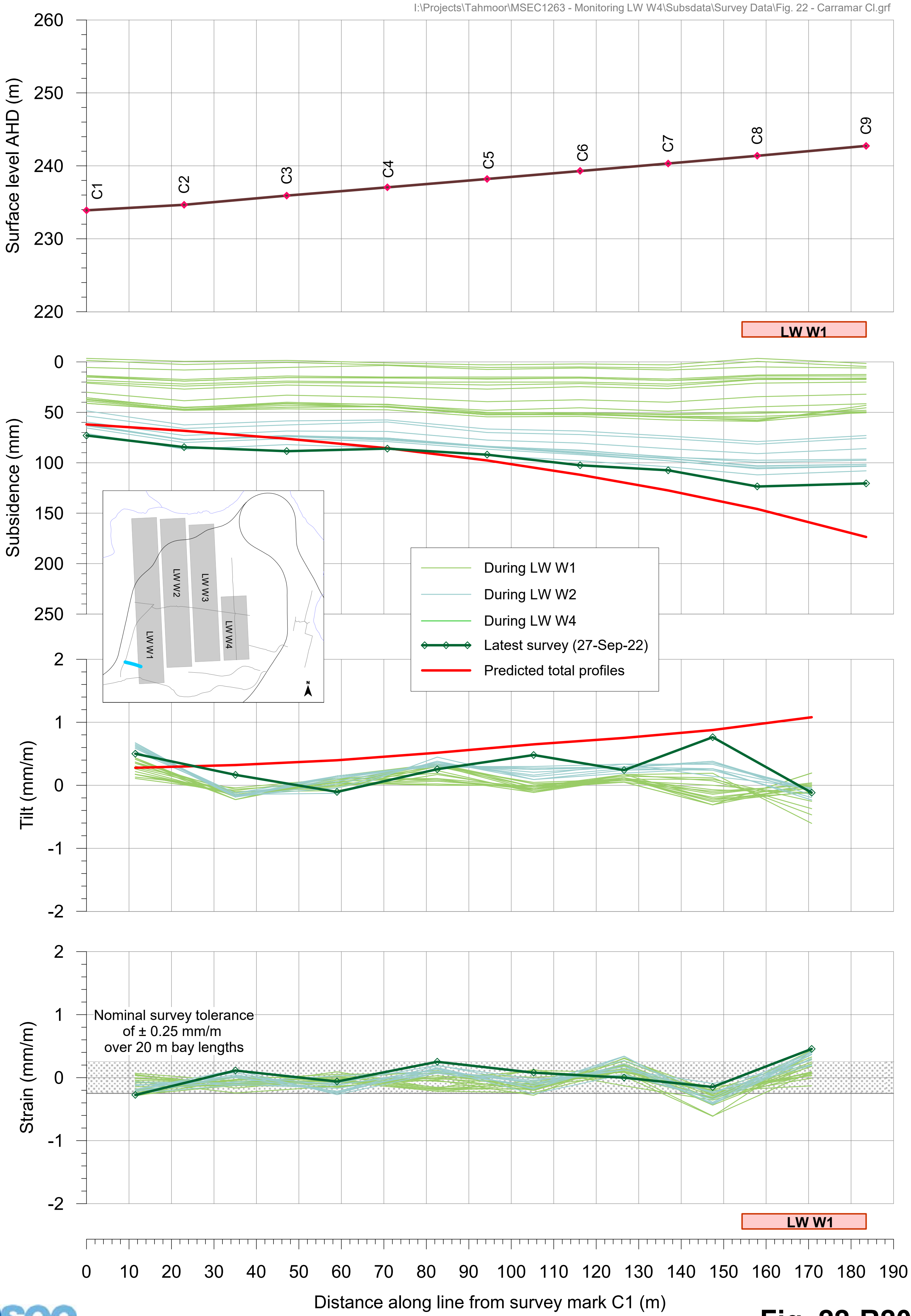
# Tahmoor LW W4
# Total subsidence profiles along Booyong Close




msec

Fig. 21-R20

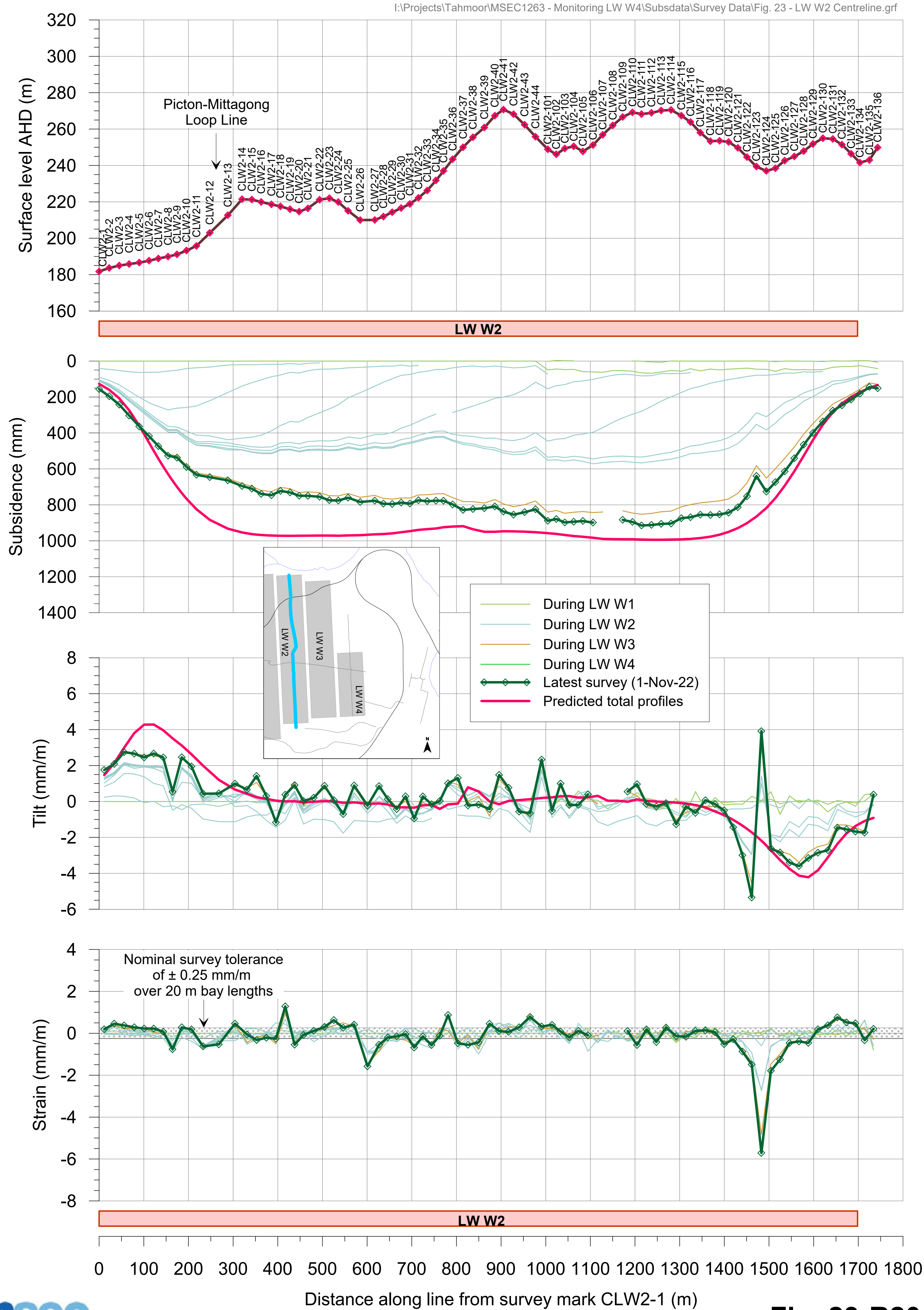
# Tahmoor LW W4
# Total subsidence profiles along Carramar Close




msec

**Fig. 22-R20**

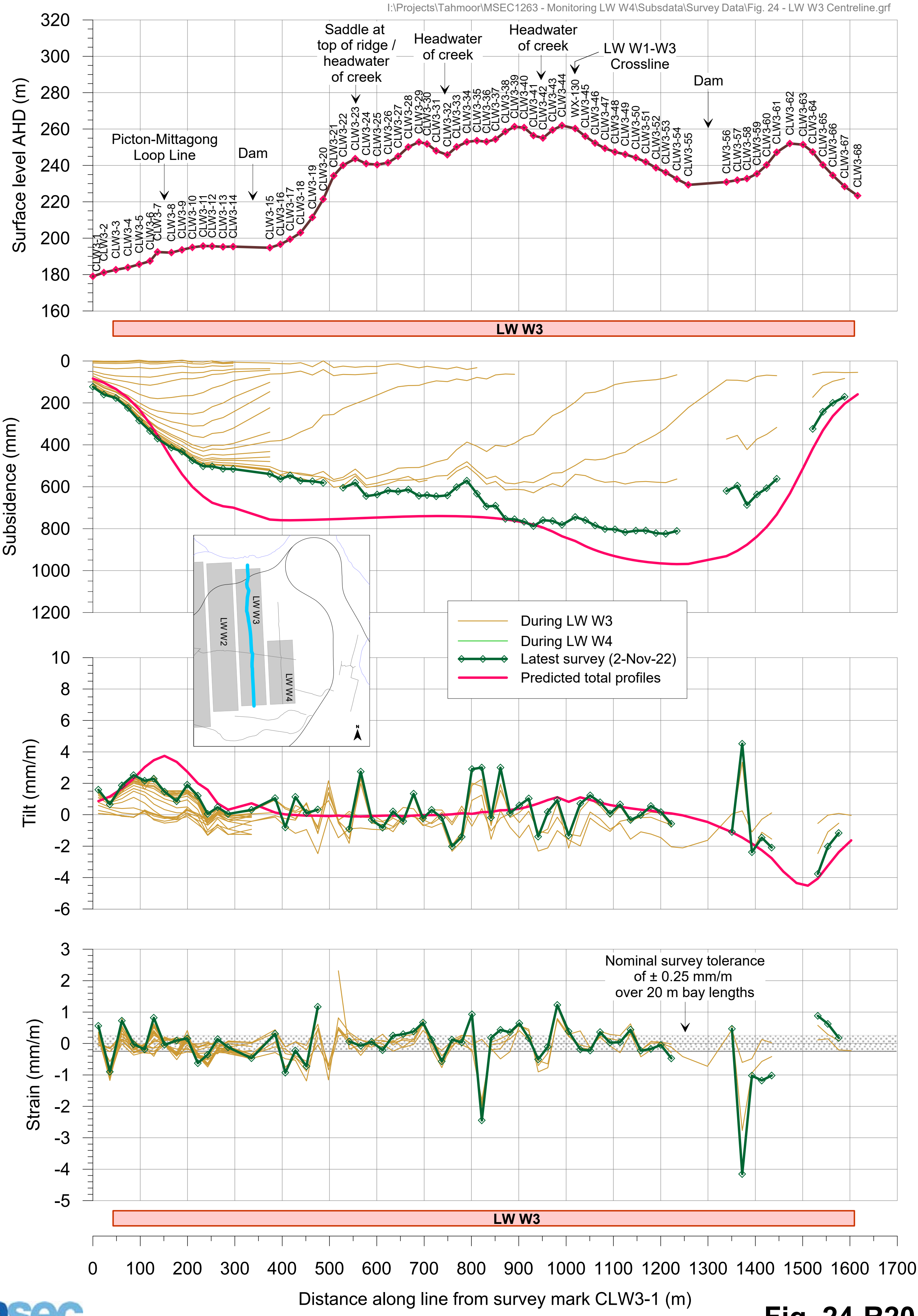
# Tahmoor LW W4
# Total subsidence profiles along LW W2 Centreline




msec

Fig. 23-R20

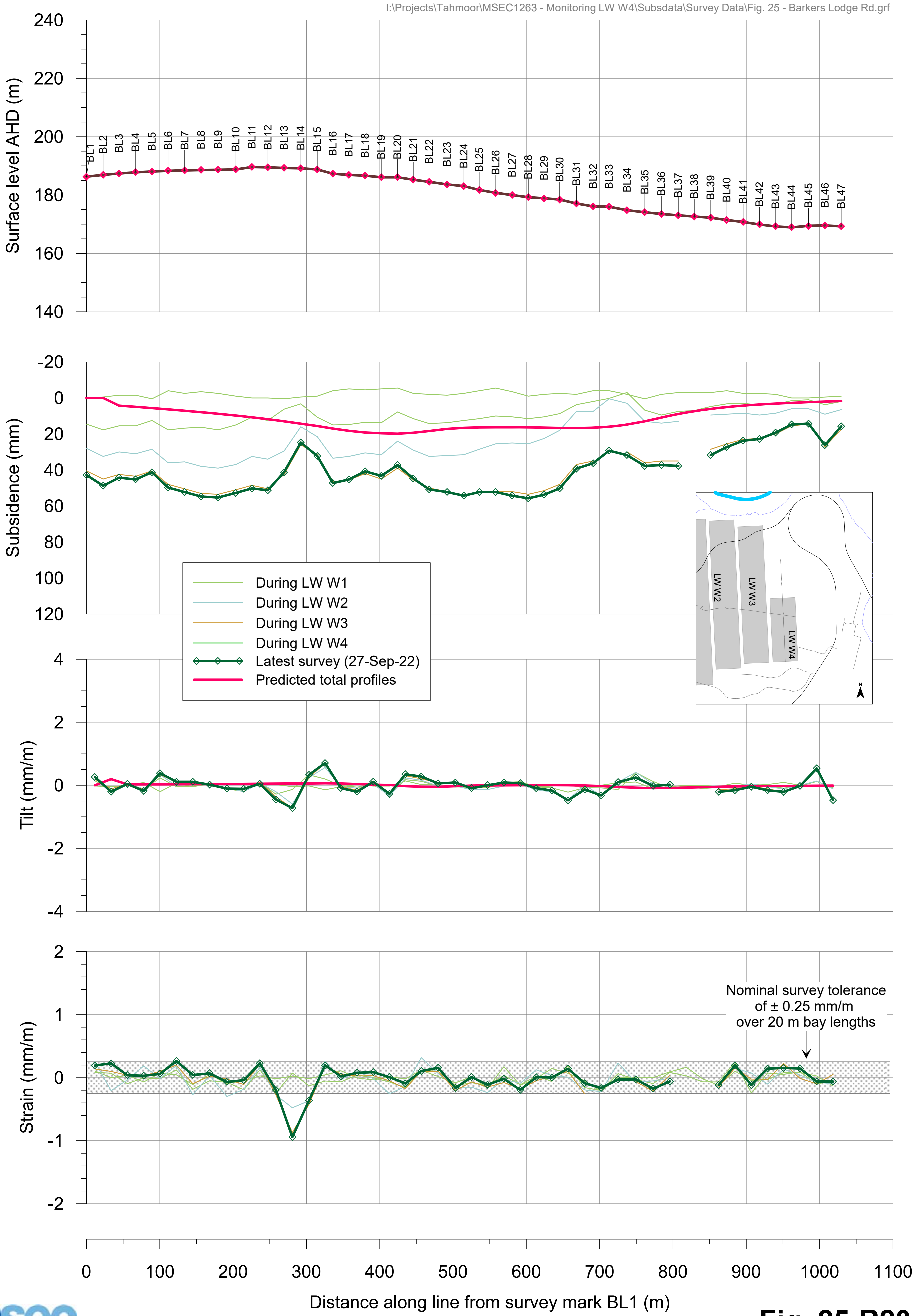
# Tahmoor LW W4
# Total subsidence profiles along LW W3 Centreline




msec

Fig. 24-R20

# Tahmoor LW W4
# Total subsidence profiles along Barkers Lodge Road

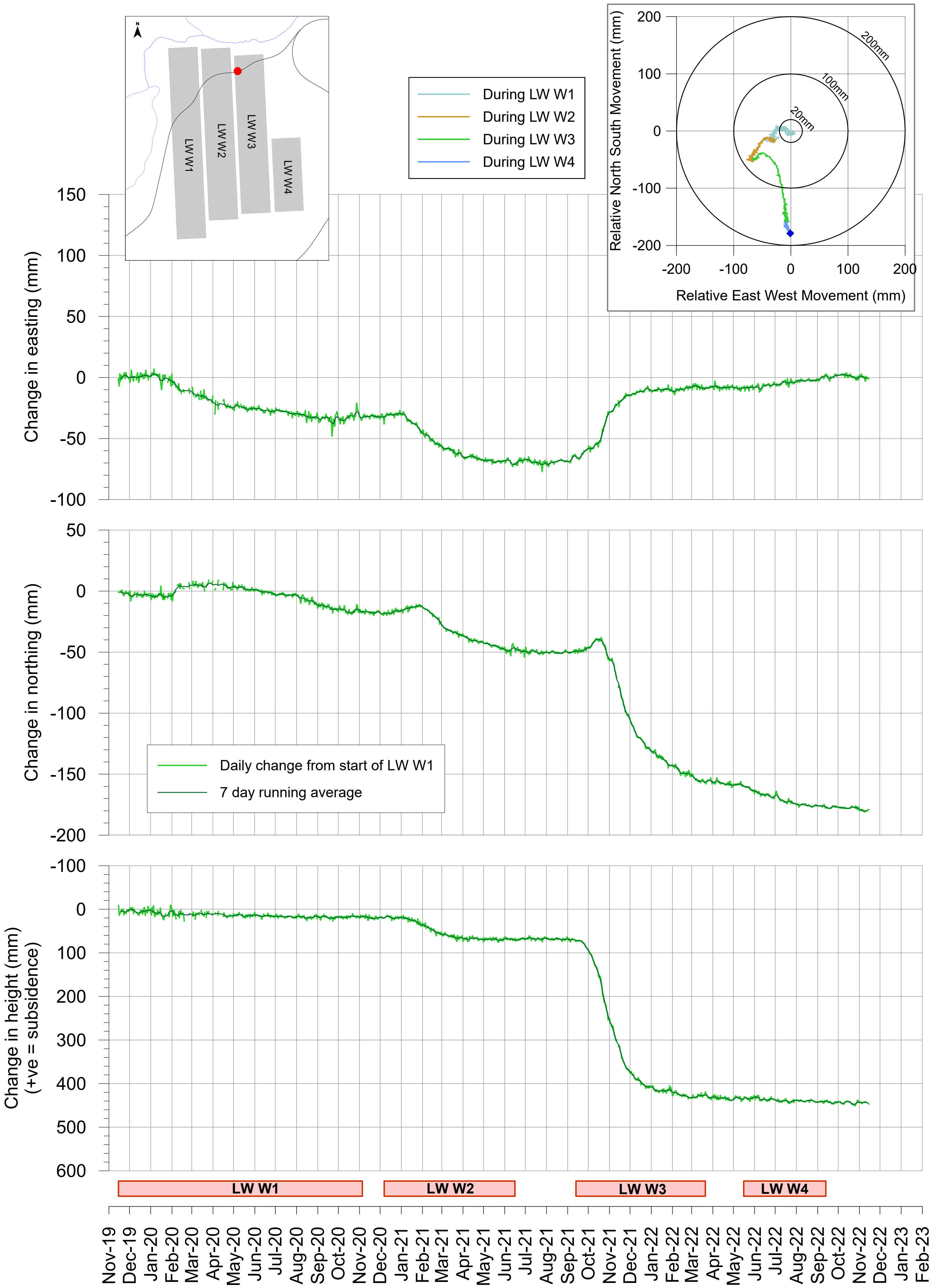



msec

**Fig. 25-R20**

# Tahmoor LW W4 - GNSS Monitoring
## Site 7 - PMLL culvert at 87.850km

I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\Subsdata\Survey Data\Fig. G07 - GNSS.grf



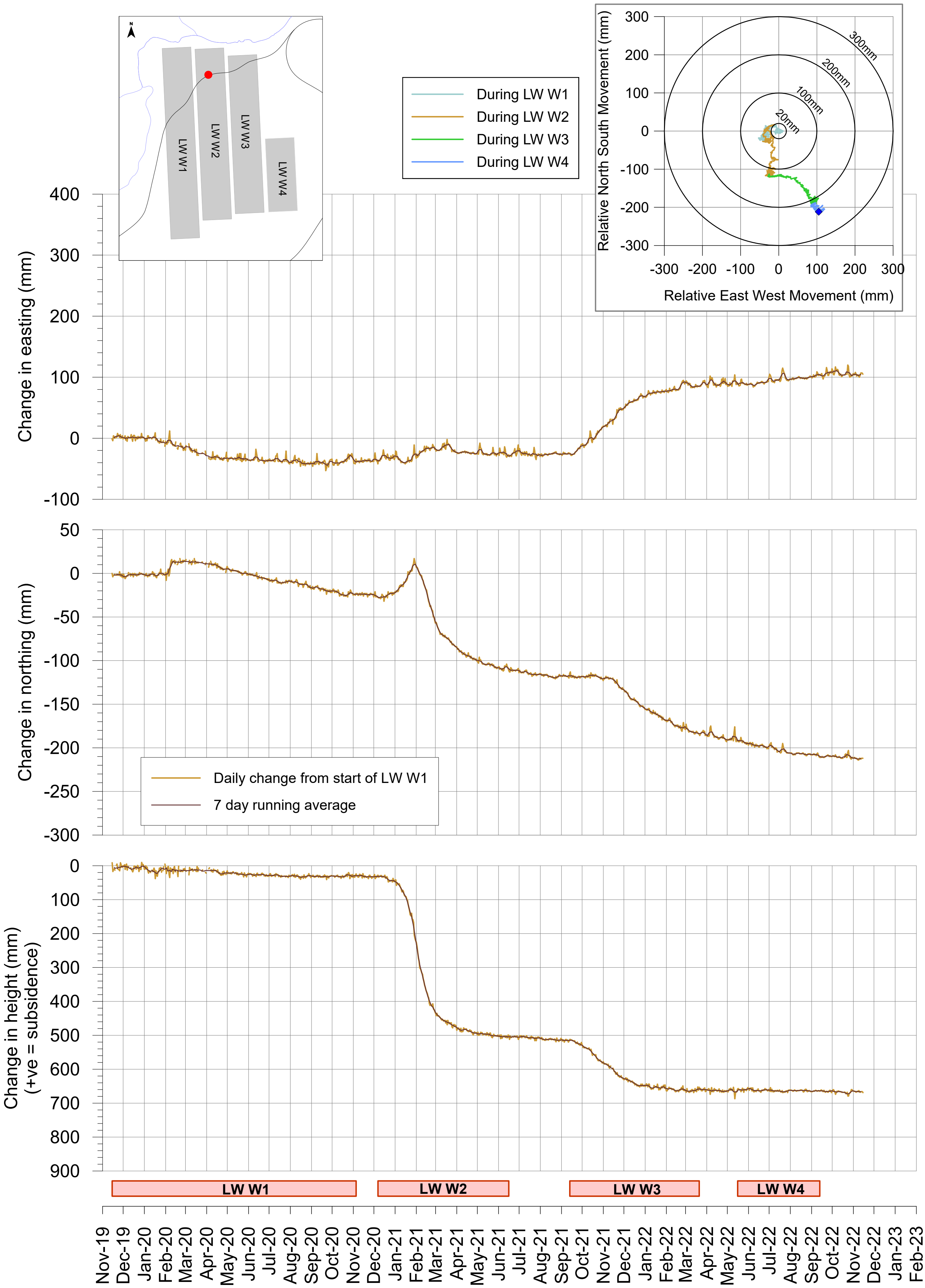

msec

**Fig. G07-R20**

# Tahmoor LW W4 - GNSS Monitoring

Site 8 - LW W2 centreline - PMLL at 88.110km

I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\Subsdata\Survey Data\Fig. G08 - GNSS.grf




msec

Fig. G08-R20

# Tahmoor LW W4 - GNSS Monitoring
## Site 9 - LW W1 centreline - PMLL at 88.550km

I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\Subsdata\Survey Data\Fig. G09 - GNSS.grf

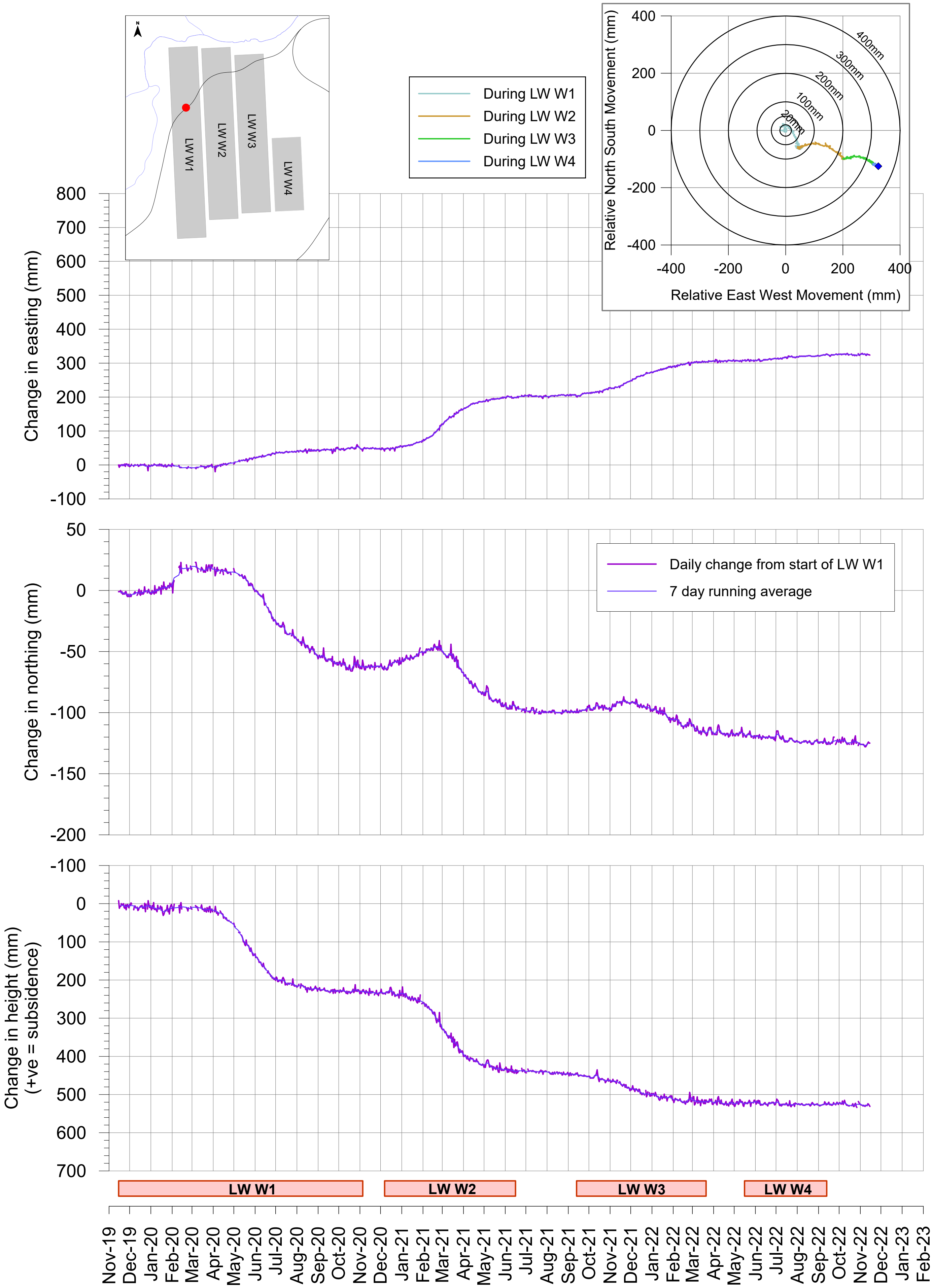



**Fig. G09-R20**

# Tahmoor LW W4 - GNSS Monitoring

Site 10 - PMLL at 89.000km

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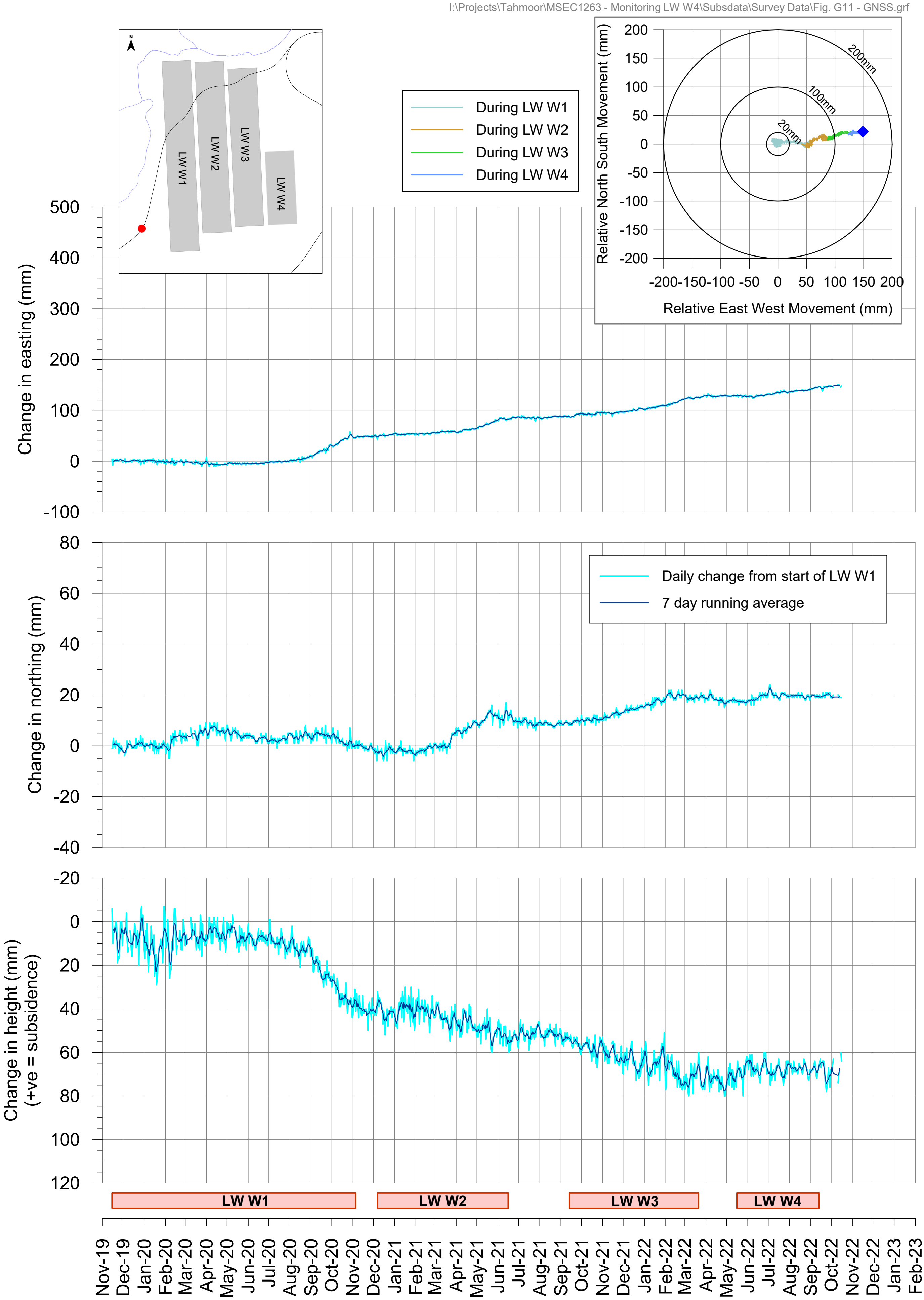
msec

Fig. G10-R20

# Tahmoor LW W4 - GNSS Monitoring
Site 11 - PMLL at 89.629km

I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\Subsdata\Survey Data\Fig. G11 - GNSS.grf

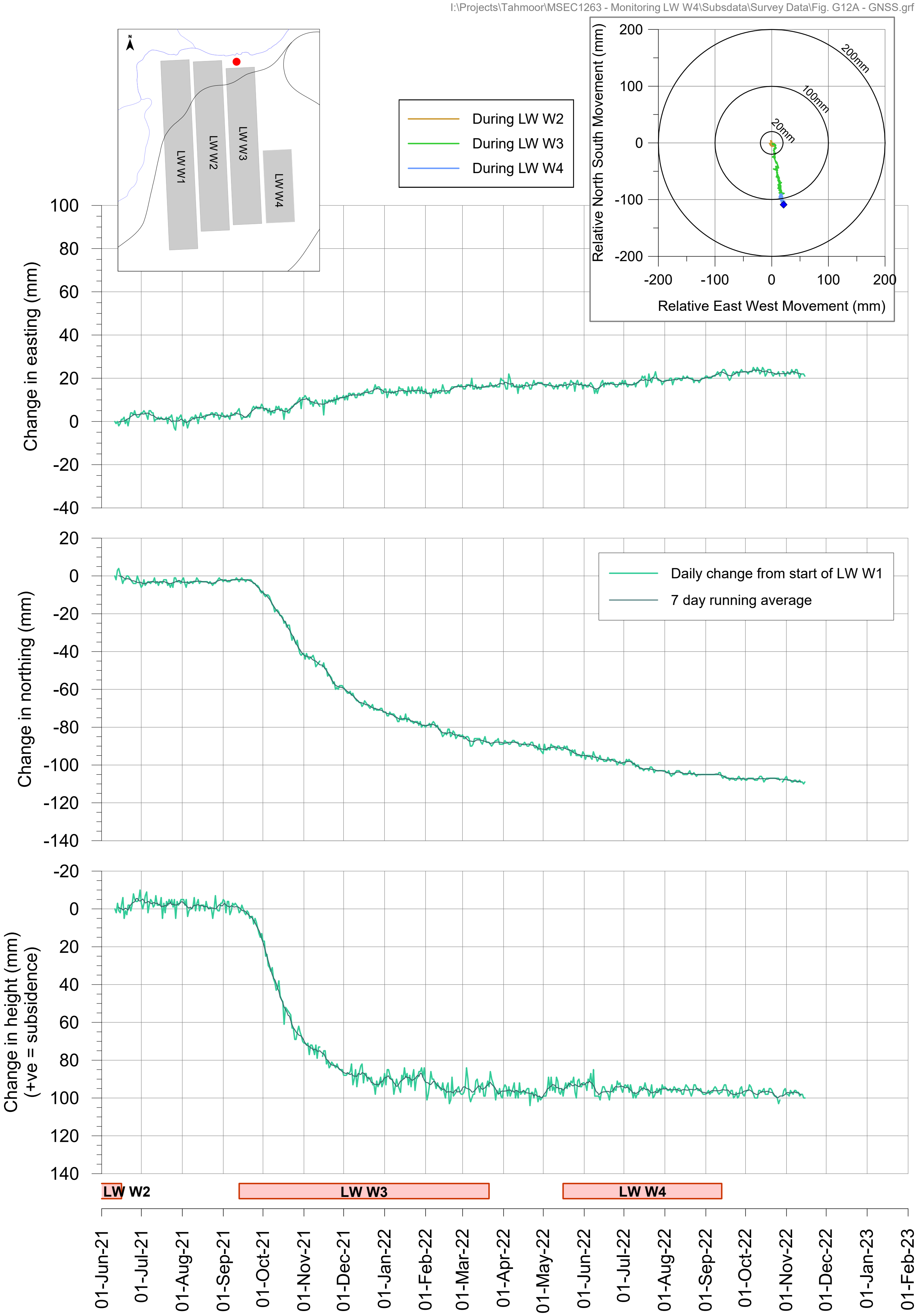



msec

Fig. G11-R20

# Tahmoor LW W4 - GNSS Monitoring
## Site 12A - south of Stonequarry Creek upstream of Rockbar SR17

I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\Subsdata\Survey Data\Fig. G12A - GNSS.grf



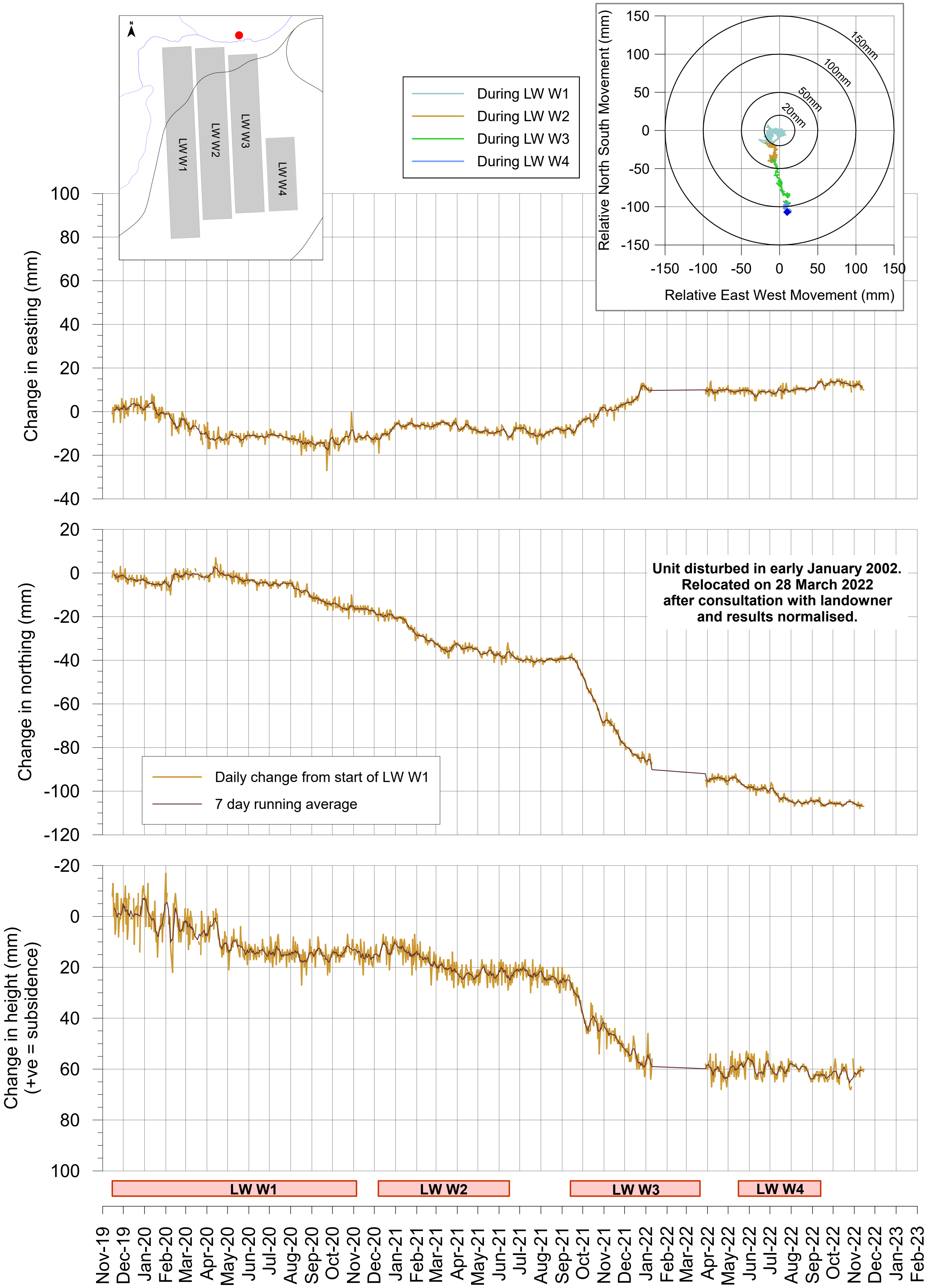

msec

**Fig. G12A-R20**

# Tahmoor LW W4 - GNSS Monitoring

## Site 13 - north of Stonequarry Creek at Rockbar SR17

I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\Subsdata\Survey Data\Fig. G13 - GNSS.grf




msec

**Fig. G13-R20**

# Tahmoor LW W4 - GNSS Monitoring

## Site 15 - Near commencing end of LW W1

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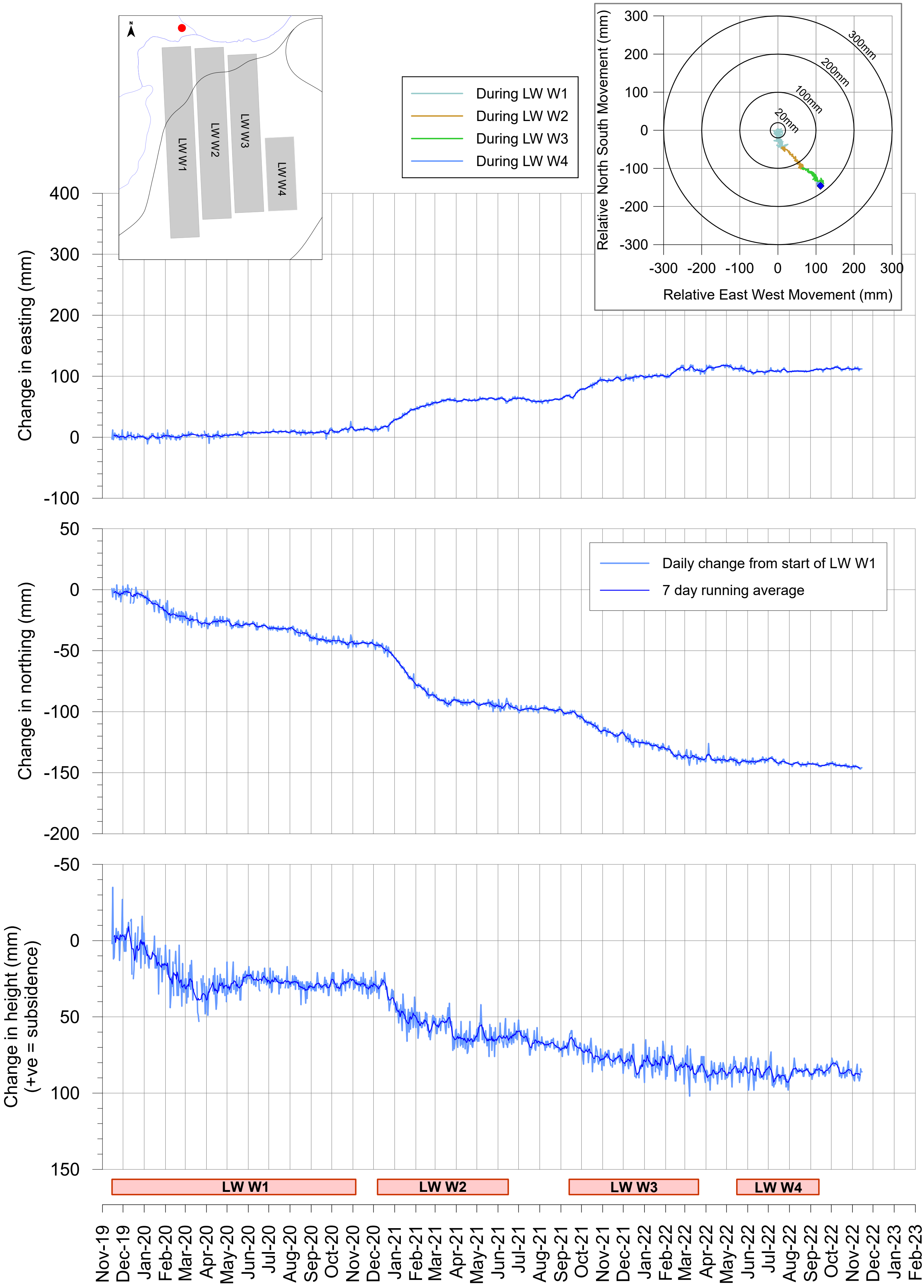


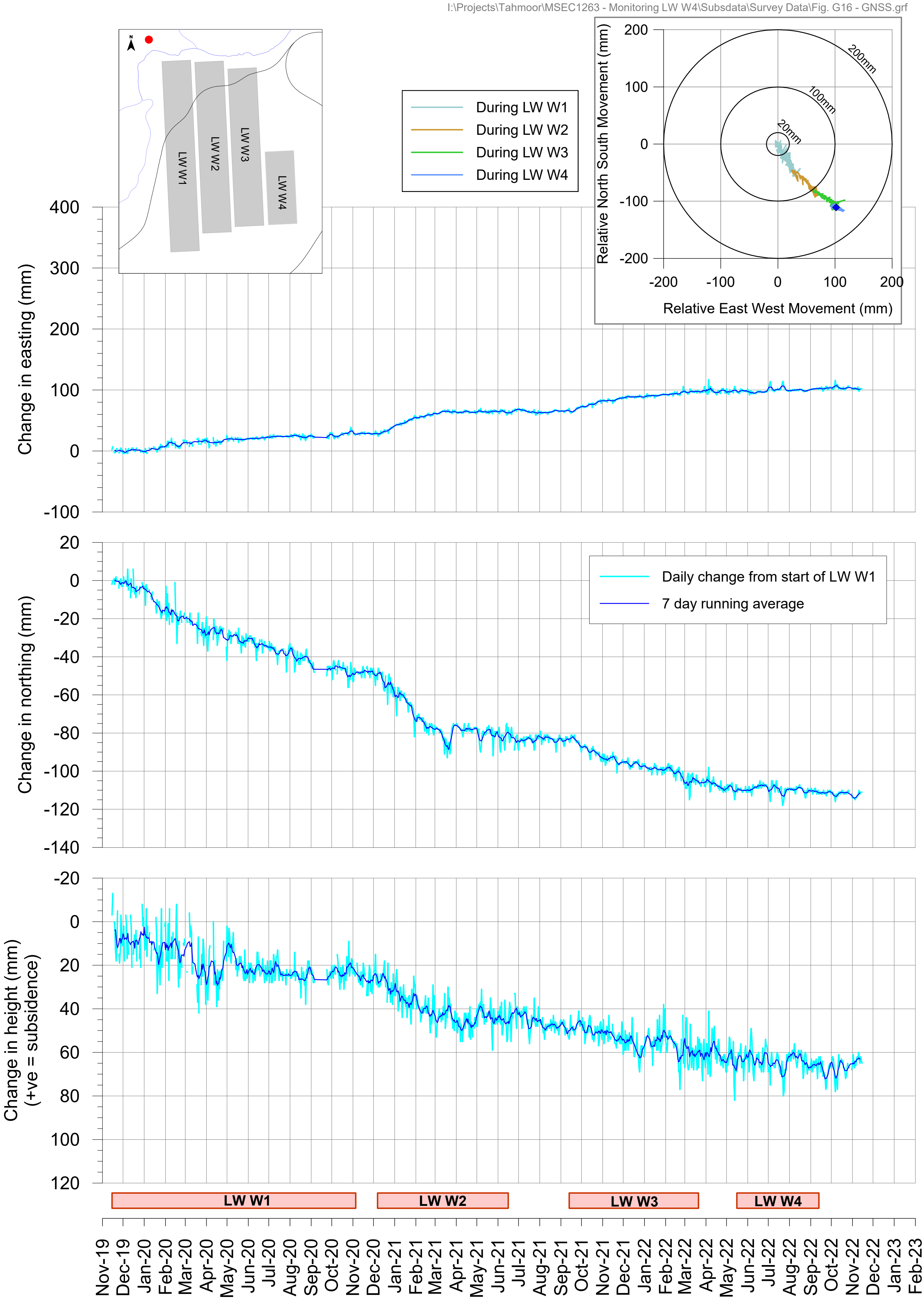

msec

**Fig. G15-R20**

# Tahmoor LW W4 - GNSS Monitoring

## Site 16 - North of Cedar Creek

I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\Subsdata\Survey Data\Fig. G16 - GNSS.grf




msec

**Fig. G16-R20**

# Tahmoor LW W4 - GNSS Monitoring

## Site 17 - Near confluence of Cedar and Matthews Creeks

I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\Subsdata\Survey Data\Fig. G17 - GNSS.grf

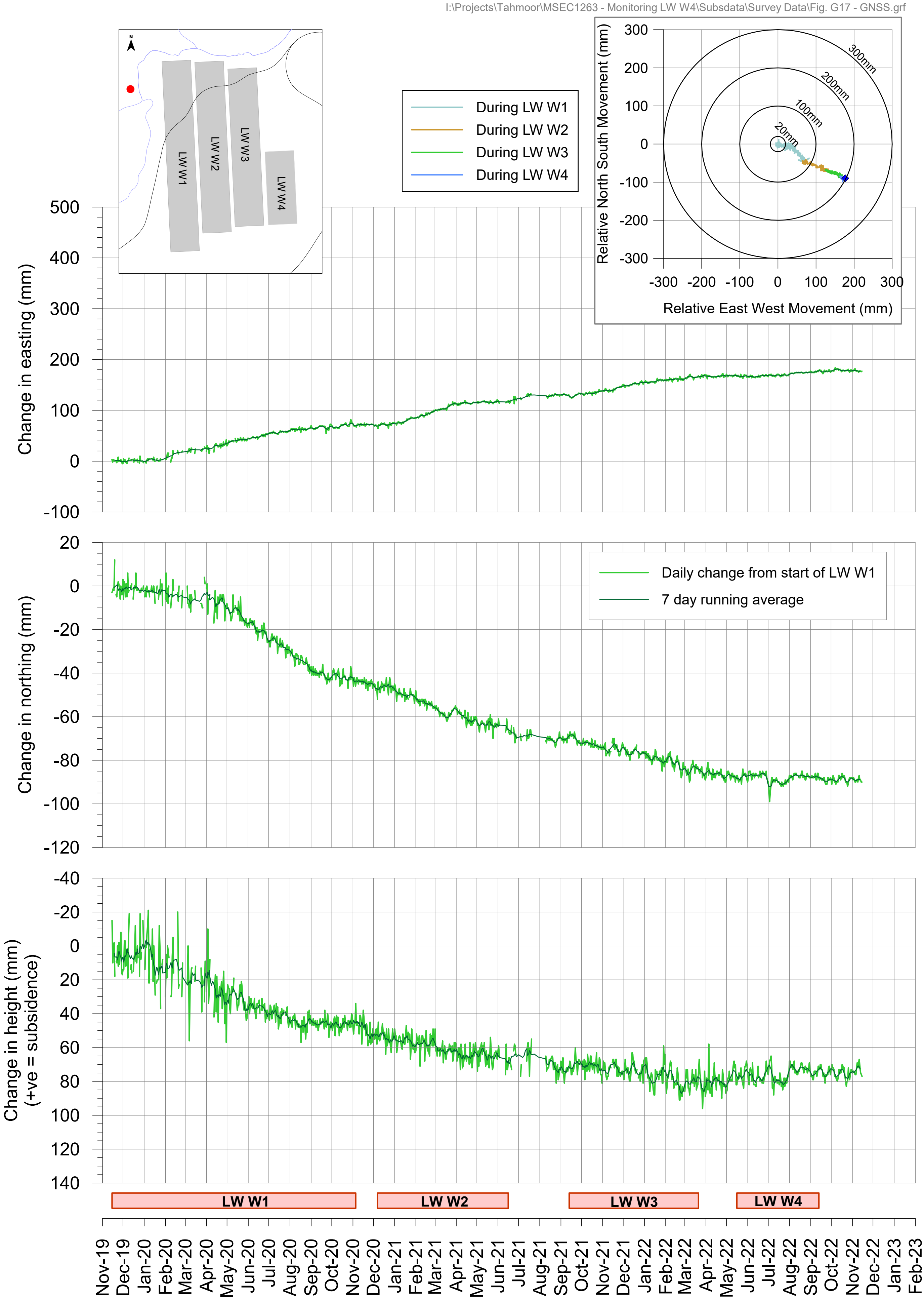
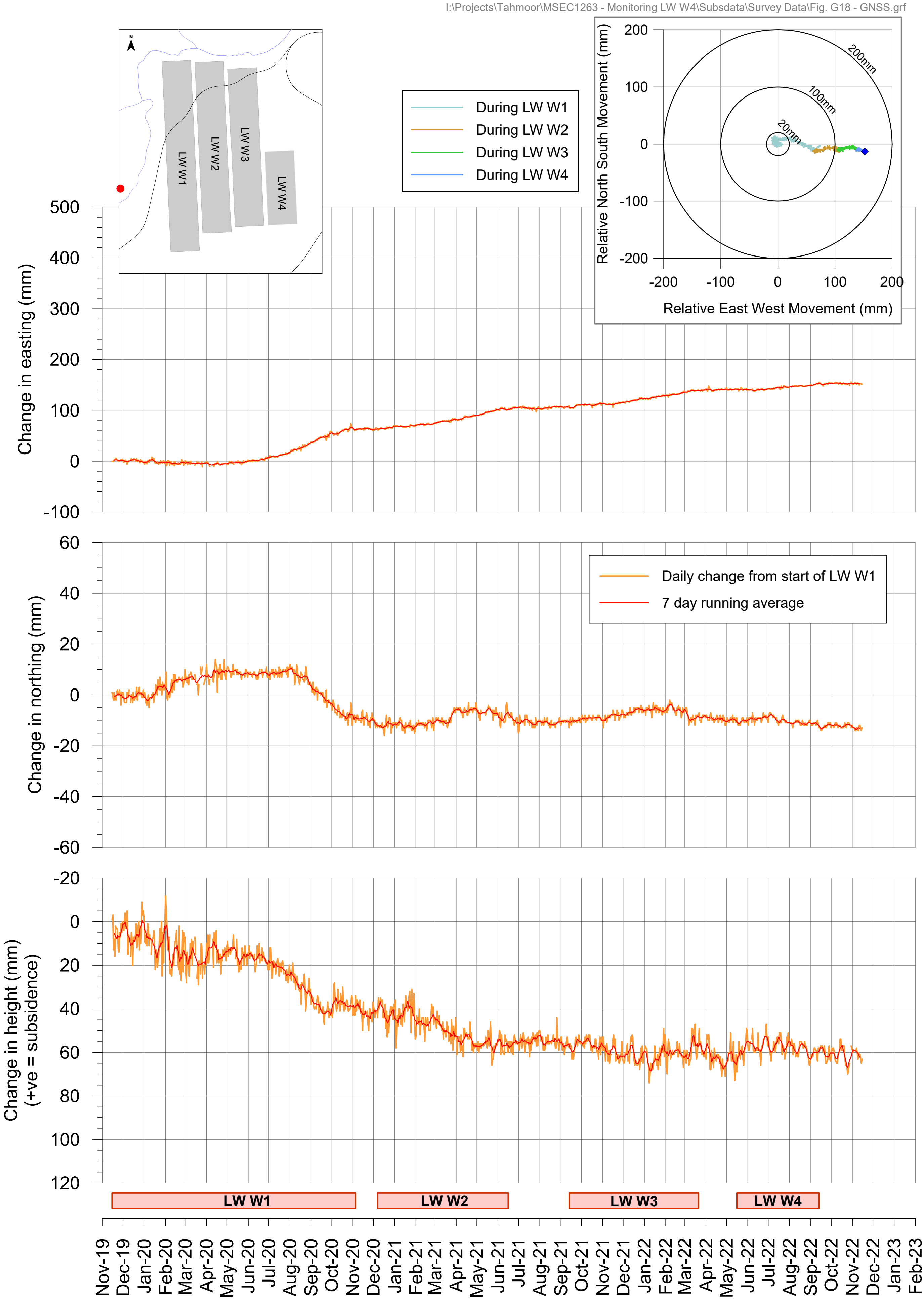



**Fig. G17-R20**

# Tahmoor LW W4 - GNSS Monitoring

Site 18 - Near confluence of Matthews Creek and Rumker Gully

I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\Subsdata\Survey Data\Fig. G18 - GNSS.grf

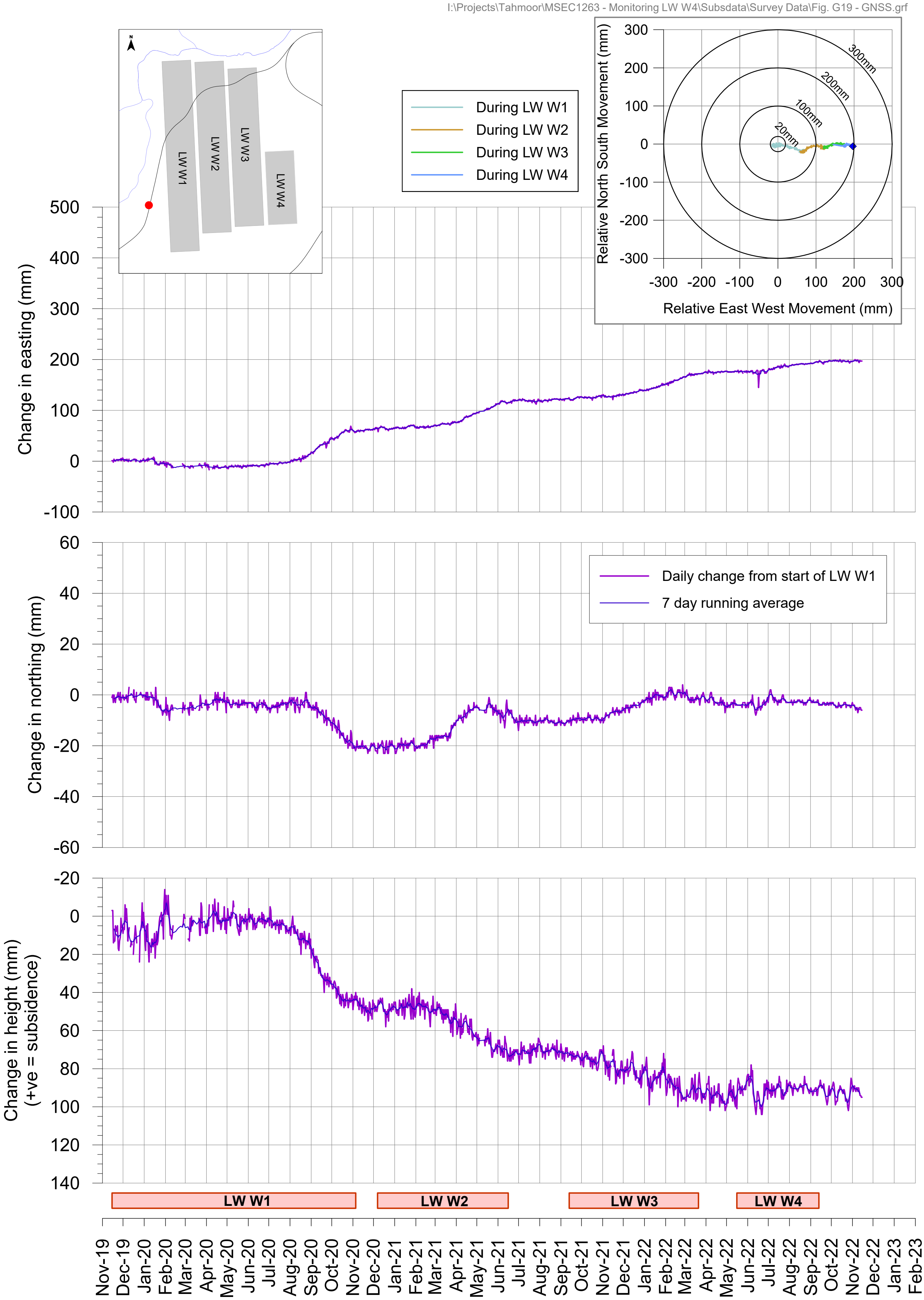



msec

**Fig. G18-R20**

# Tahmoor LW W4 - GNSS Monitoring

Site 19 - PMLL at 89.440km



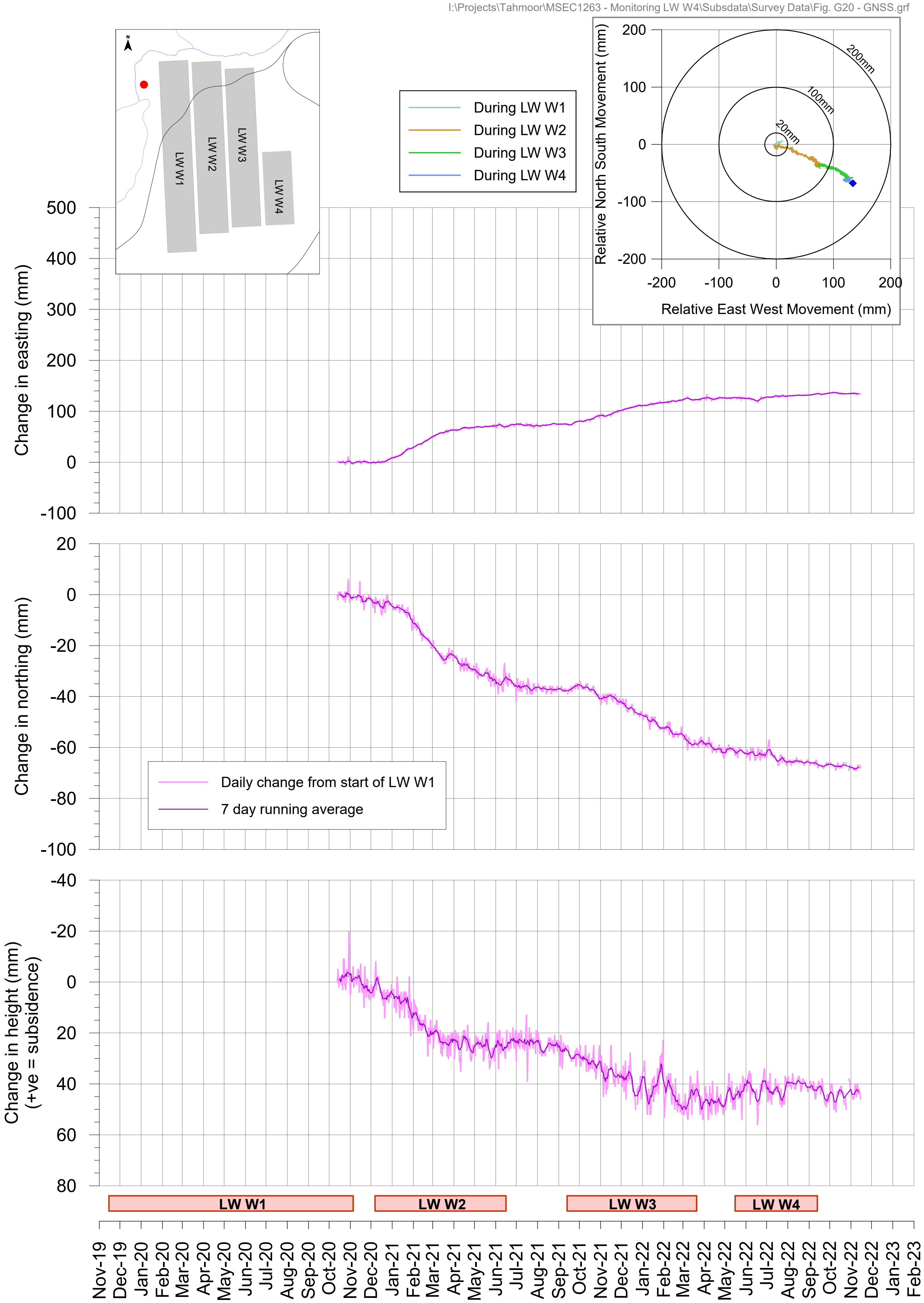

msec

Fig. G19-R20

# Tahmoor LW W4 - GNSS Monitoring

## Site 20 - Near confluence of Cedar and Matthews Creeks

I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\Subsdata\Survey Data\Fig. G20 - GNSS.grf




msec

**Fig. G20-R20**

# Tahmoor LW W4 - GNSS Monitoring

Site 21 - LW W1-2 commencing ends

I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\Subsdata\Survey Data\Fig. G21 - GNSS.grf

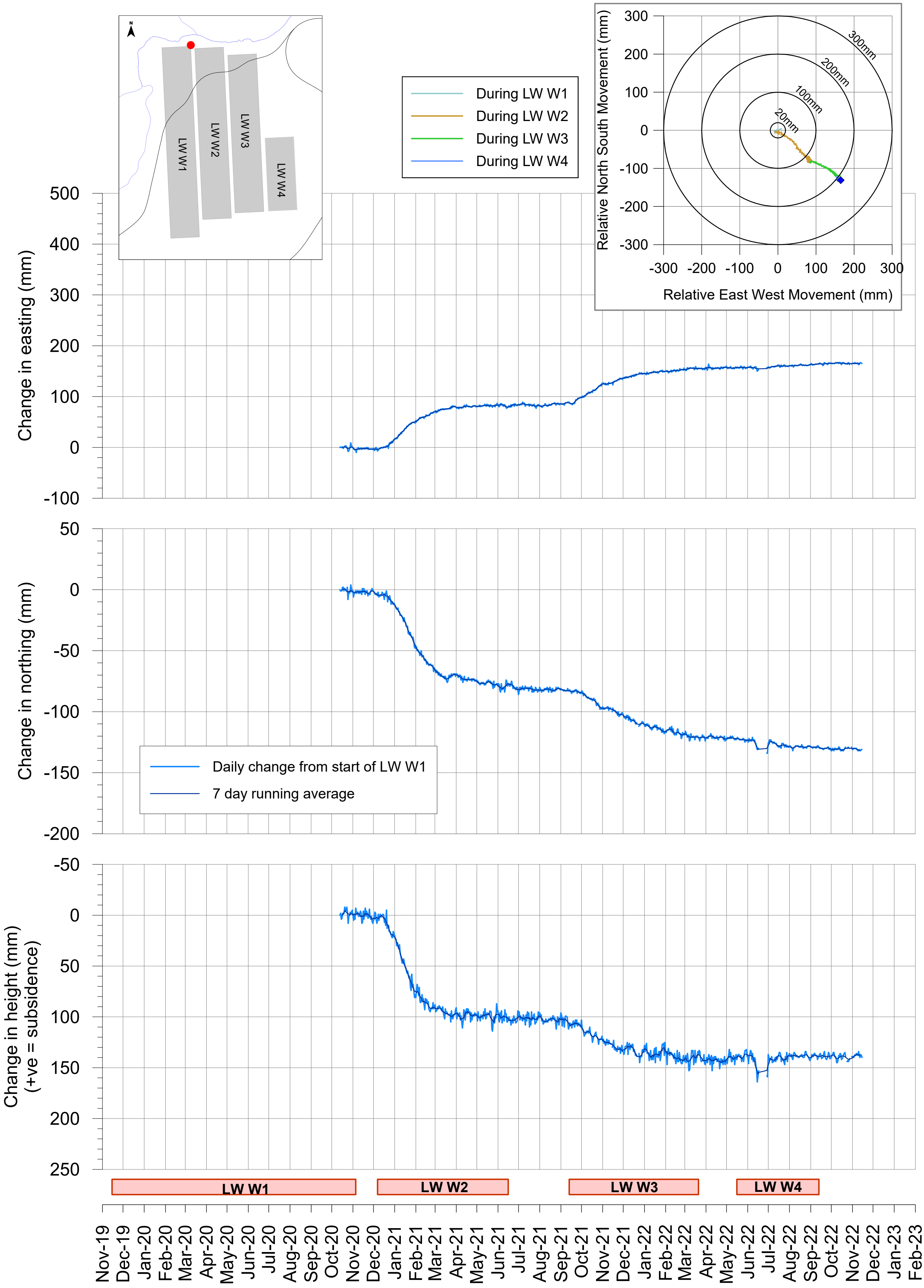



Fig. G21-R20

# Tahmoor LW W4 - GNSS Monitoring

## Site 24 above LW W4

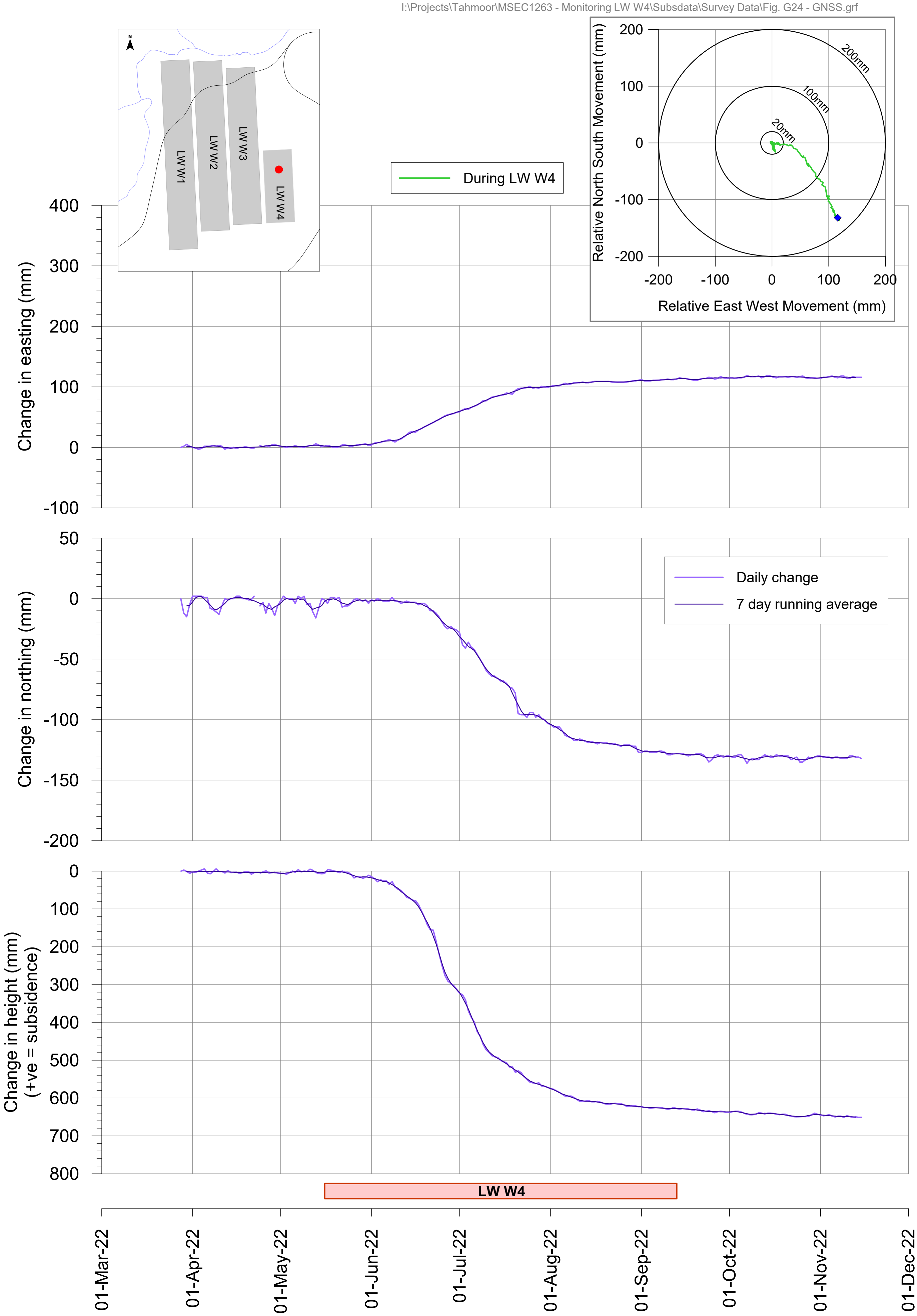
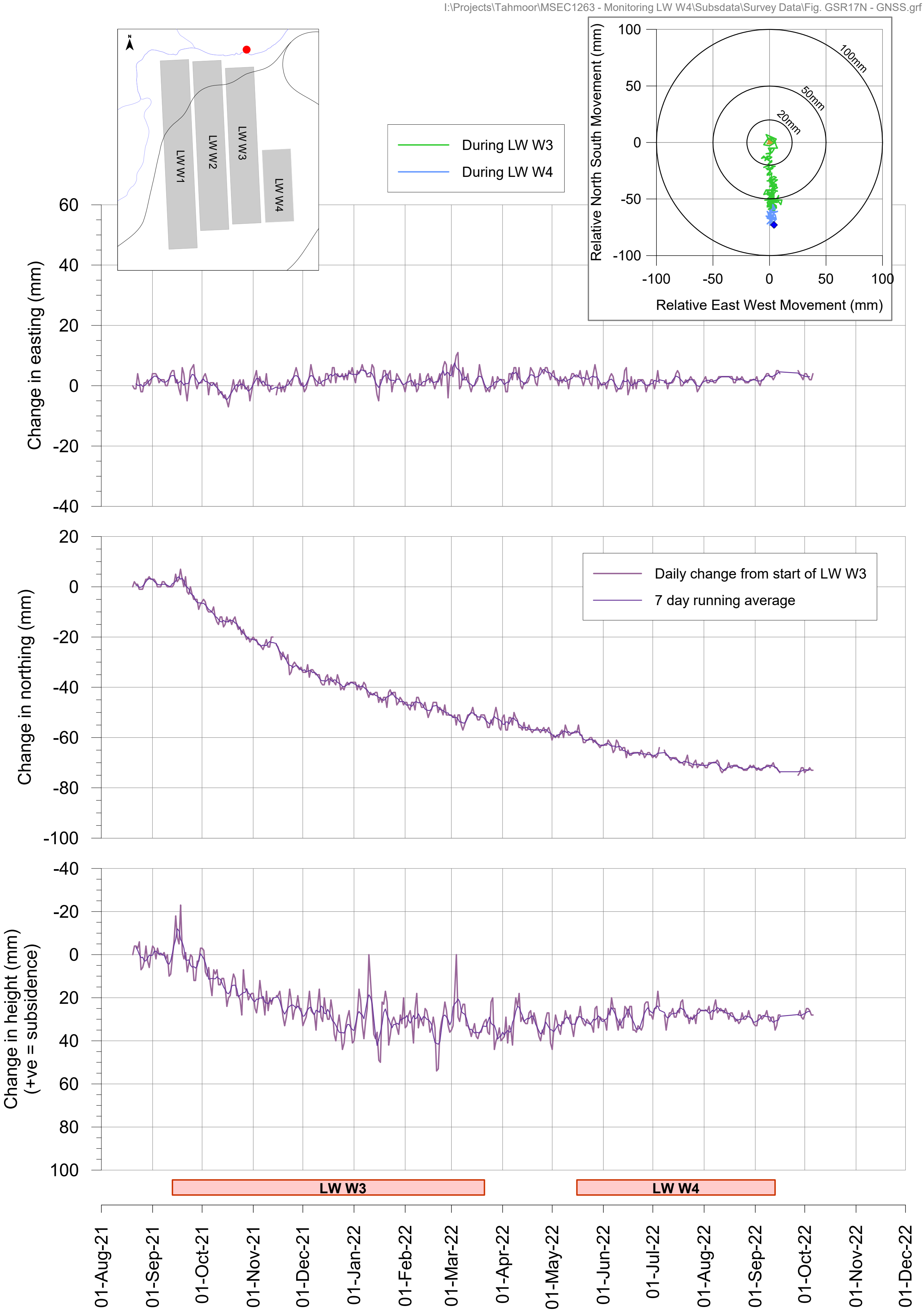



**Fig. G24-R20**

# Tahmoor LW W3 - GNSS Monitoring
## Site SR17N - Northern side of rockbar

I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\Subsdata\Survey Data\Fig. GSR17N - GNSS.grf

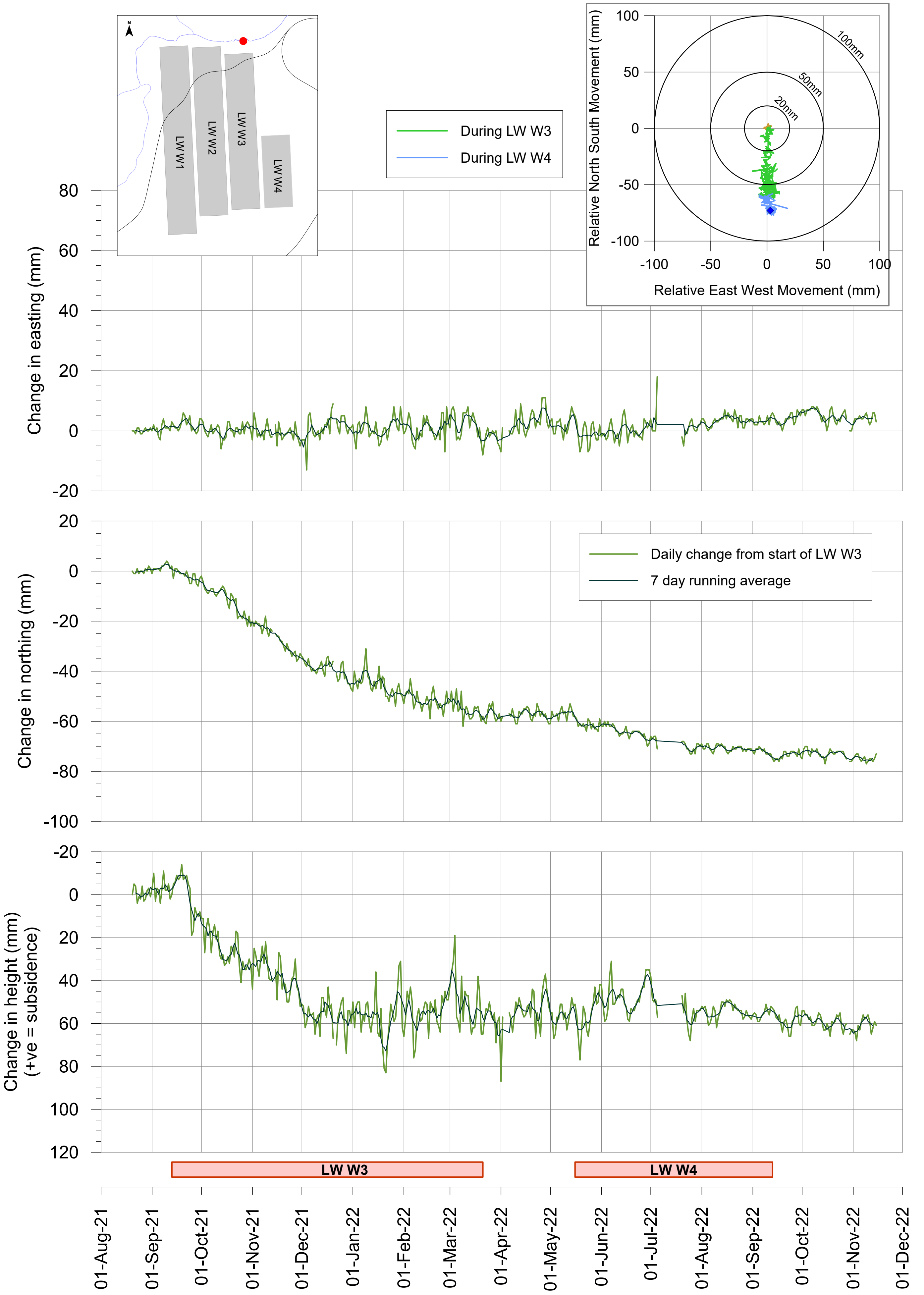



msec

Fig. GSR17N-R20

# Tahmoor LW W3 - GNSS Monitoring
## Site SR17S - Southern side of rockbar

I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\Subsdata\Survey Data\Fig. GSR17S - GNSS.grf




msec

**Fig. GSR17S-R20**

I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\AcadData\MSEC1263-02 Inc Subs.dwg

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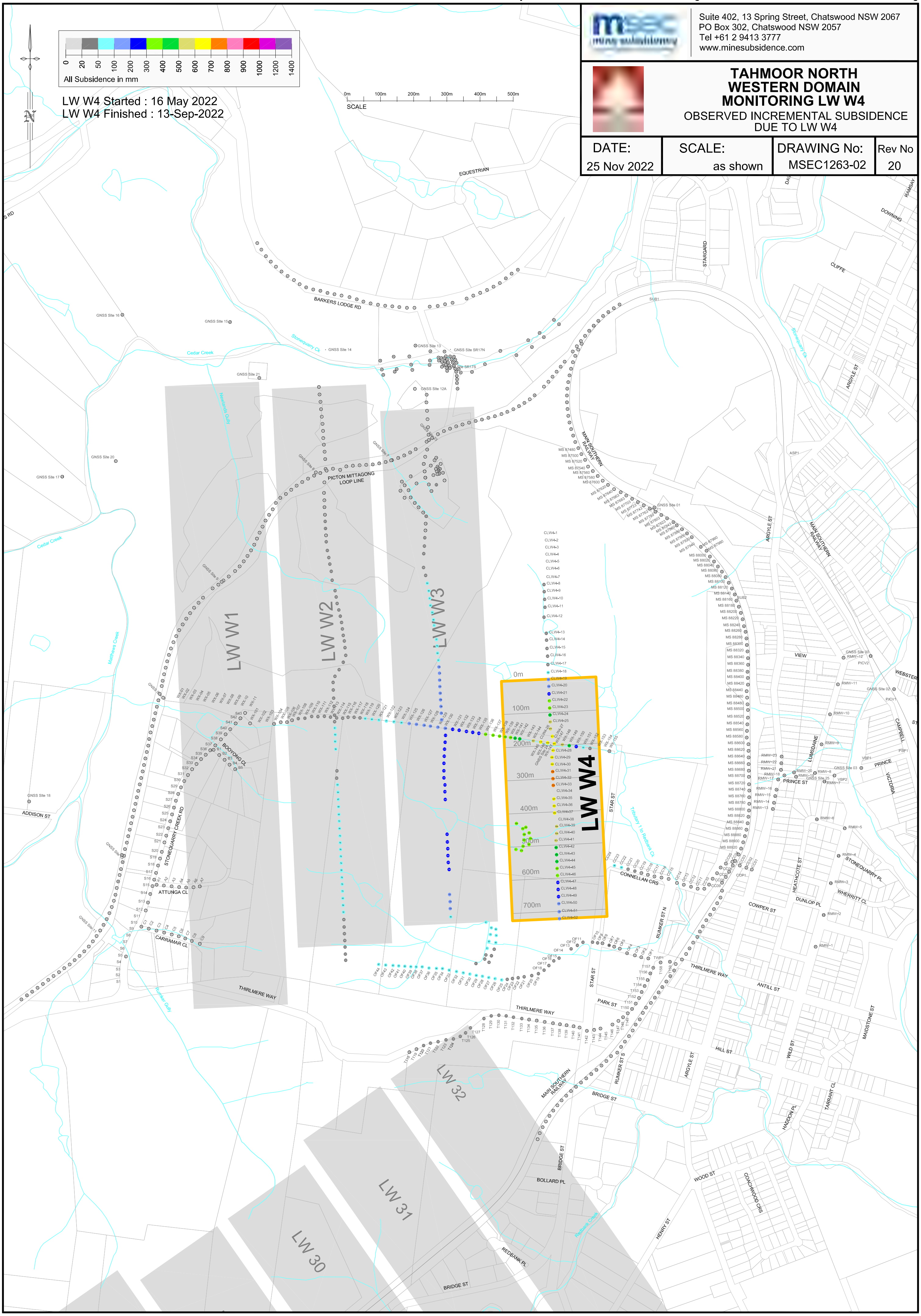
# TAHMOOR NORTH WESTERN DOMAIN MONITORING LW W4

OBSERVED INCREMENTAL SUBSIDENCE DUE TO LW W4

| DATE: | SCALE: | DRAWING No: | Rev No |
|---|---|---|---|
| 25 Nov 2022 | as shown | MSEC1263-02 | 20 |



msec mine subsidence

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# TAHMOOR NORTH WESTERN DOMAIN MONITORING LW W4

## PICTON RISING MAIN

| DATE: | SCALE: | DRAWING No: | Rev No |
|---|---|---|---|
| 21 Nov 2022 | as shown | MSEC1263-04 | 20 |

**Latest Survey 9-Nov-2022**

mm Incremental Subsidence

Horizontal displacement of survey marks since start of LW W4

mm Nominal Survey Accuracy Absolute ± 14mm

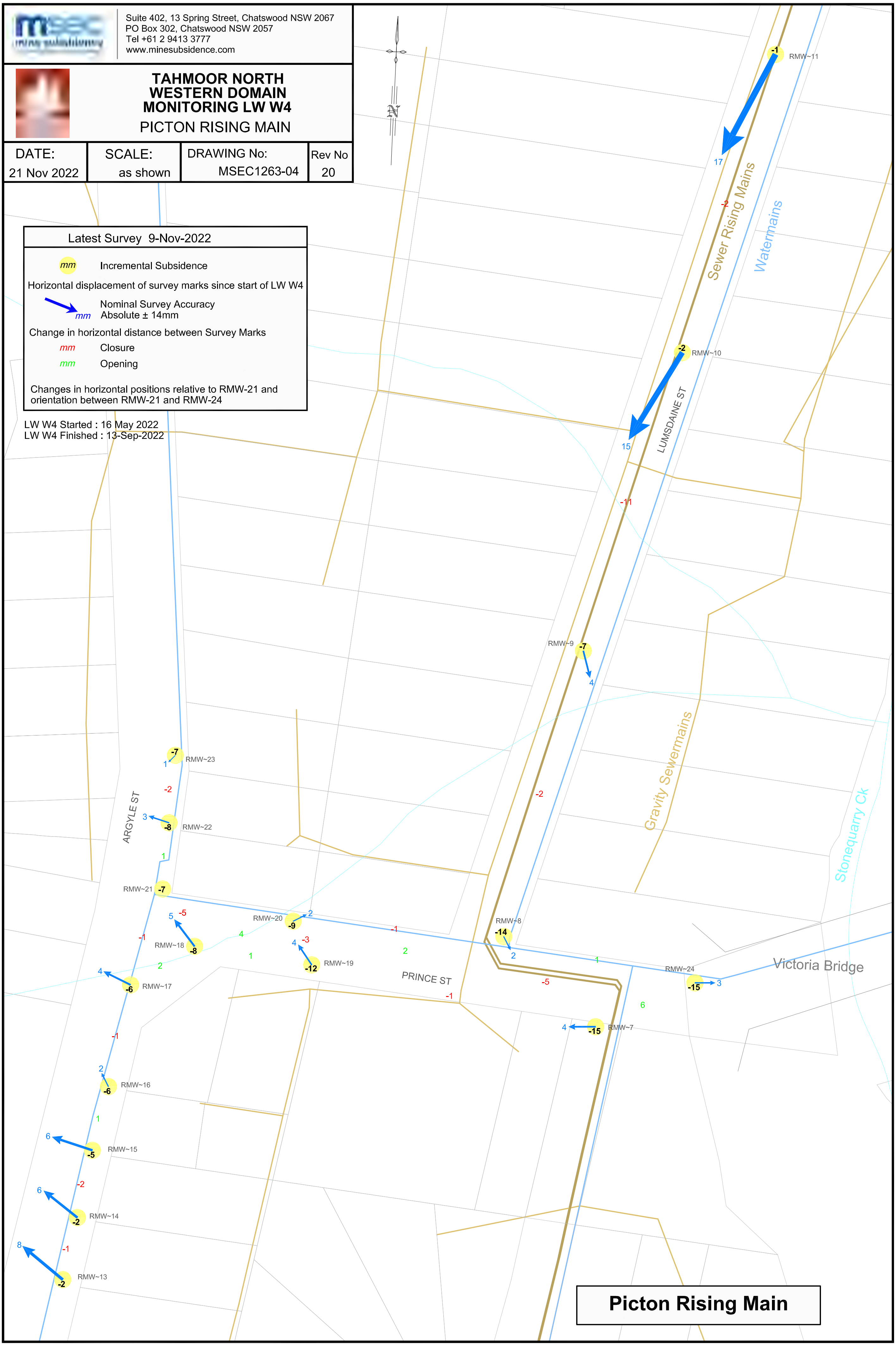
Change in horizontal distance between Survey Marks

mm Closure

mm Opening

Changes in horizontal positions relative to RMW-21 and orientation between RMW-21 and RMW-24

LW W4 Started : 16 May 2022
LW W4 Finished : 13-Sep-2022




**Picton Rising Main**

I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\AcadData\MSEC1263-05 STP Dam.dwg

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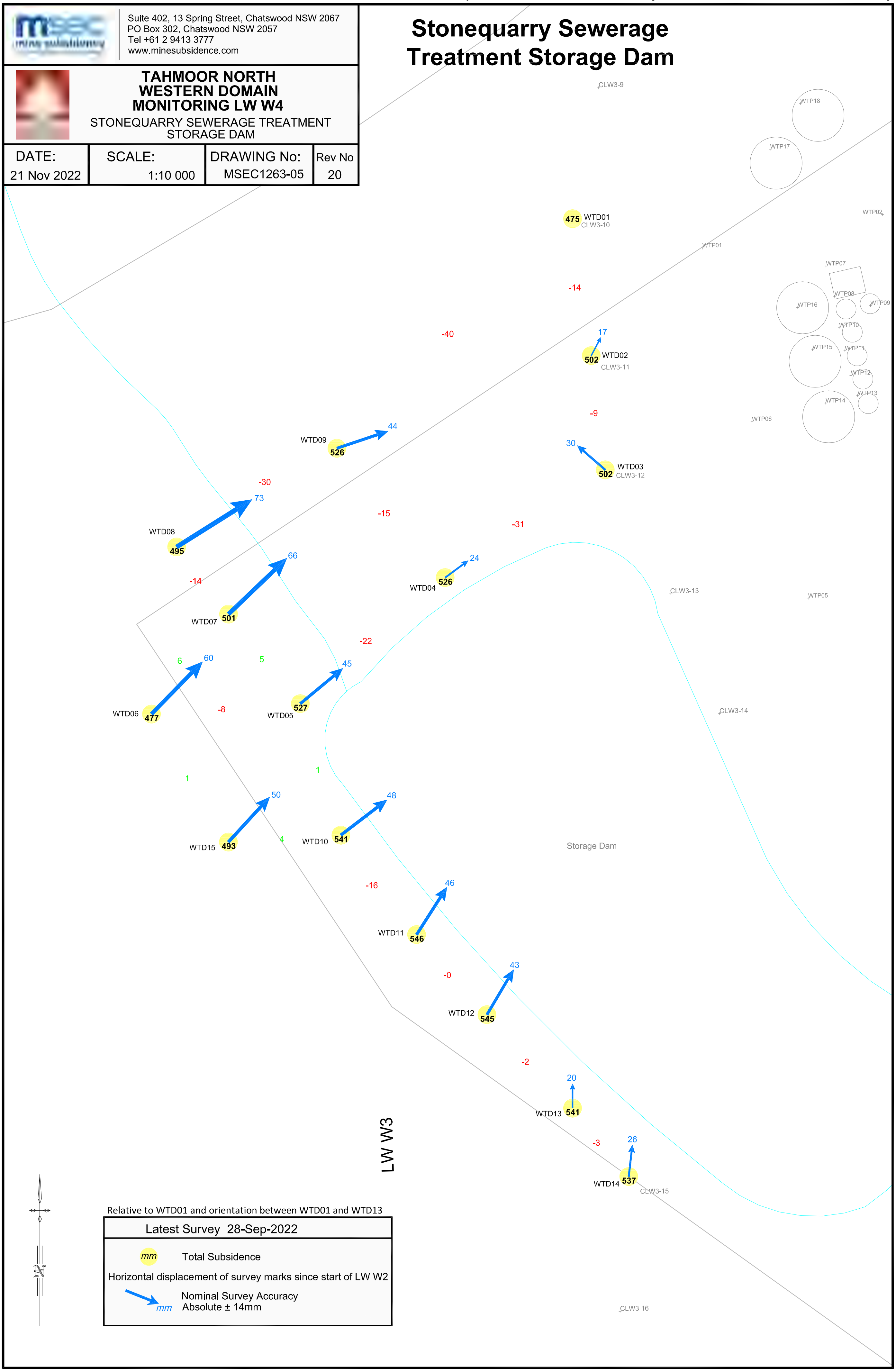
**TAHMOOR NORTH WESTERN DOMAIN MONITORING LW W4**

STONEQUARRY SEWERAGE TREATMENT STORAGE DAM

| DATE: | SCALE: | DRAWING No: | Rev No |
|---|---|---|---|
| 21 Nov 2022 | 1:10 000 | MSEC1263-05 | 20 |

# Stonequarry Sewerage Treatment Storage Dam

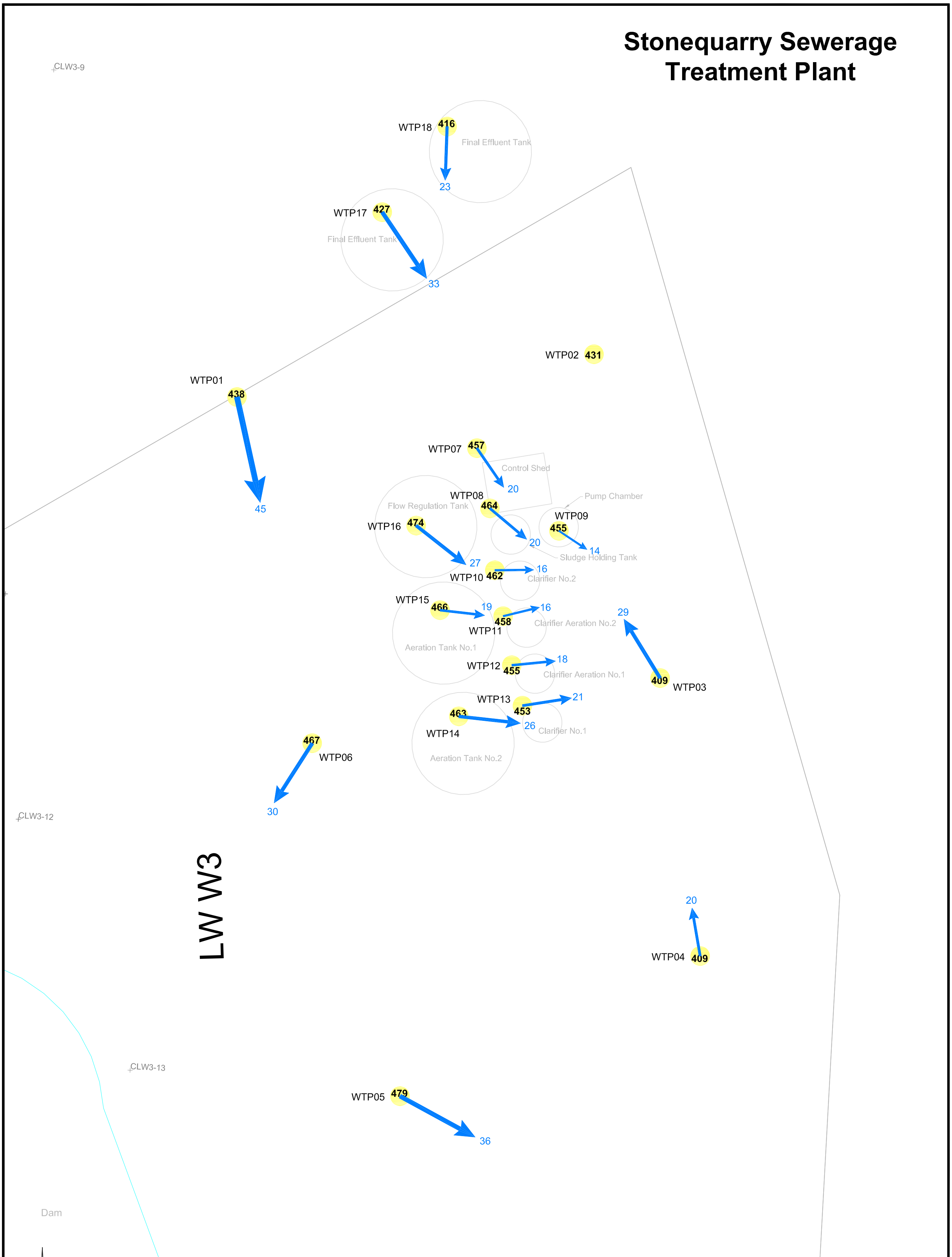



Relative to WTD01 and orientation between WTD01 and WTD13

| Latest Survey 28-Sep-2022 |
|---|
| mm Total Subsidence |
| Horizontal displacement of survey marks since start of LW W2 |
| mm Nominal Survey Accuracy Absolute ± 14mm |

I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\AcadData\MSEC1263-06 STP Plant.dwg

# Stonequarry Sewerage Treatment Plant




Relative to WTP02 and orientation between WTP02 and WTP04

| Latest Survey 28-Sep-2022 |
|---|
| mm Total Subsidence |
| Horizontal displacement of survey marks since start of LW W2 |
| mm Nominal Survey Accuracy Absolute ± 14mm |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**TAHMOOR NORTH WESTERN DOMAIN MONITORING LW W4**

STONEQUARRY SEWERAGE TREATMENT PLANT

| DATE: | SCALE: | DRAWING No: | Rev No |
|---|---|---|---|
| 21 Nov 2022 | 1:10 000 | MSEC1263-06 | 20 |

I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\AcadData\MSEC1263-07 Farm Dam 3.dwg

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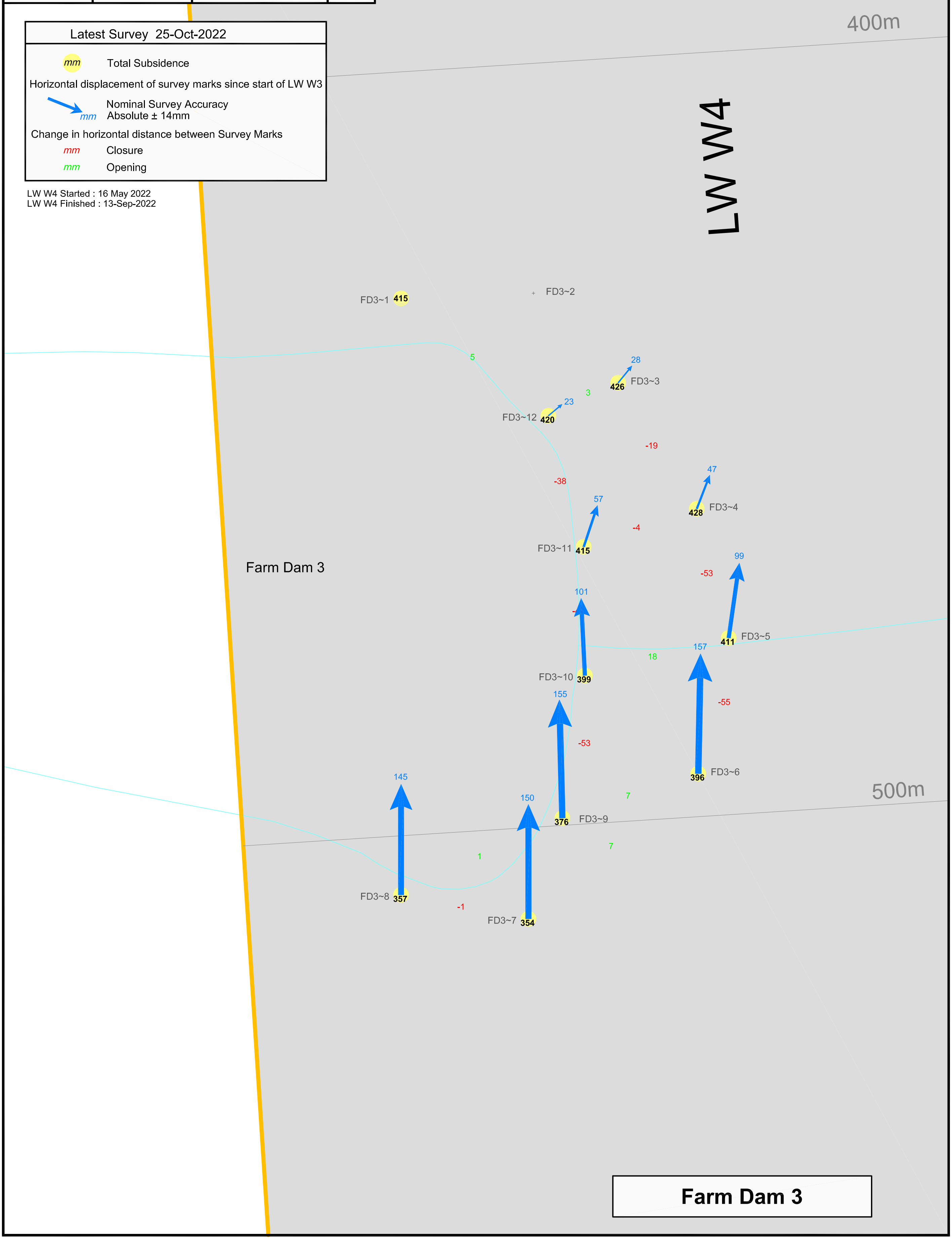
# TAHMOOR NORTH WESTERN DOMAIN MONITORING LW W4

FARM DAM 3

| DATE: | SCALE: | DRAWING No: | Rev No |
|---|---|---|---|
| 25 Nov 2022 | as shown | MSEC1263-07 | 20 |



I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\AcadData\MSEC1263-08 Farm Dam 1.dwg

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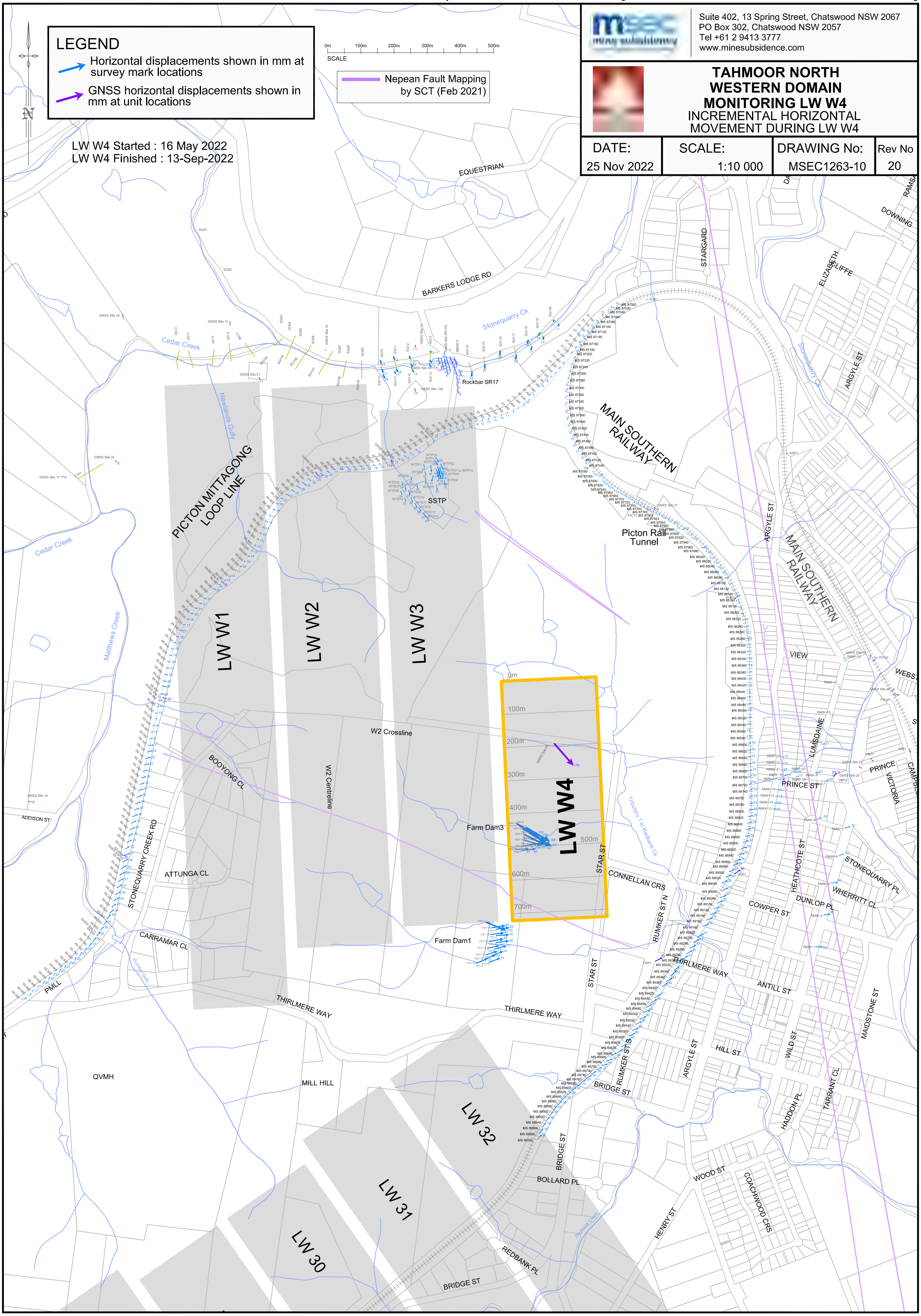
**TAHMOOR NORTH
WESTERN DOMAIN
MONITORING LW W4**

FARM DAM 1

| DATE: | SCALE: | DRAWING No: | Rev No |
|---|---|---|---|
| 25 Nov 2022 | as shown | MSEC1263-08 | 20 |


**Farm Dam 1**

I:\Projects\Tahmoor\MSEC1263 - Monitoring LW W4\AcadData\MSEC1263-10 Inc Horizontal Movement.dwg



# Appendix B – Surface Water Monitoring Reports

ATC WILLIAMS

# DRAFT REPORT

**TAHMOOR COAL PTY LTD**
ABN: 97076663968

**Tahmoor North Western Domain**

**Surface Water Review**
**1 October 2021 to 16 / 24 March 2022**

121171.8, R01, Rev E
June 2022

## Document Control

| | |
|---|---|
| Project Name: | Tahmoor North Western Domain Surface Water Review |
| Document Title: | Six Monthly Review 1 October 2021 to 16 / 24 March 2022 |
| File Location: | N:\Synergy\Projects\121\121171 1809 Tahmoor (SIMEC) Surface Water Assistance\8 LW W1 Monthly SW TARP Review\Documents\6 Monthly Reports\R01\121171.8-R01e.docx |
| Document Number: | 121171.8-R01e.docx |

### Revision History

| Revision | Issue | Issue Date | Prepared by | Reviewed by |
|---|---|---|---|---|
| e | Final | 16/6/2022 | Camilla West | Client |

### ATC Williams Company Details



| | |
|---|---|
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| Approved By: | Tony Marszalek |
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| Email: | camillaw@atcwilliams.com.au |

# CONTENTS



# TABLES



# MAPS



TAILINGS.WATER.WASTE.

# 1 INTRODUCTION

## 1.1 Background

In accordance with the *Tahmoor North Western Domain Longwalls West 3 and West 4 Water Management Plan* (Tahmoor Coal, 2021), Tahmoor Coal Pty Ltd (Tahmoor Coal) have committed to monthly review and analysis of surface water monitoring data recorded at sites within and adjacent to the Tahmoor North Western Domain (the Western Domain). The outcomes of the analysis are assessed against the performance measures, performance indicators and Trigger Action Response Plan (TARP) documented in the *Tahmoor North Western Domain Longwalls West 3 and West 4 Water Management Plan* (WMP).

Tahmoor Coal have developed a comprehensive rainfall, surface water and groundwater monitoring network within and adjacent to the Western Domain. The monitoring network comprises rainfall stations, water level monitoring sites, water quality monitoring sites and visual inspection sites. The locations of the relevant rainfall stations, surface water and groundwater monitoring sites and visual inspection sites are shown in Map 1.

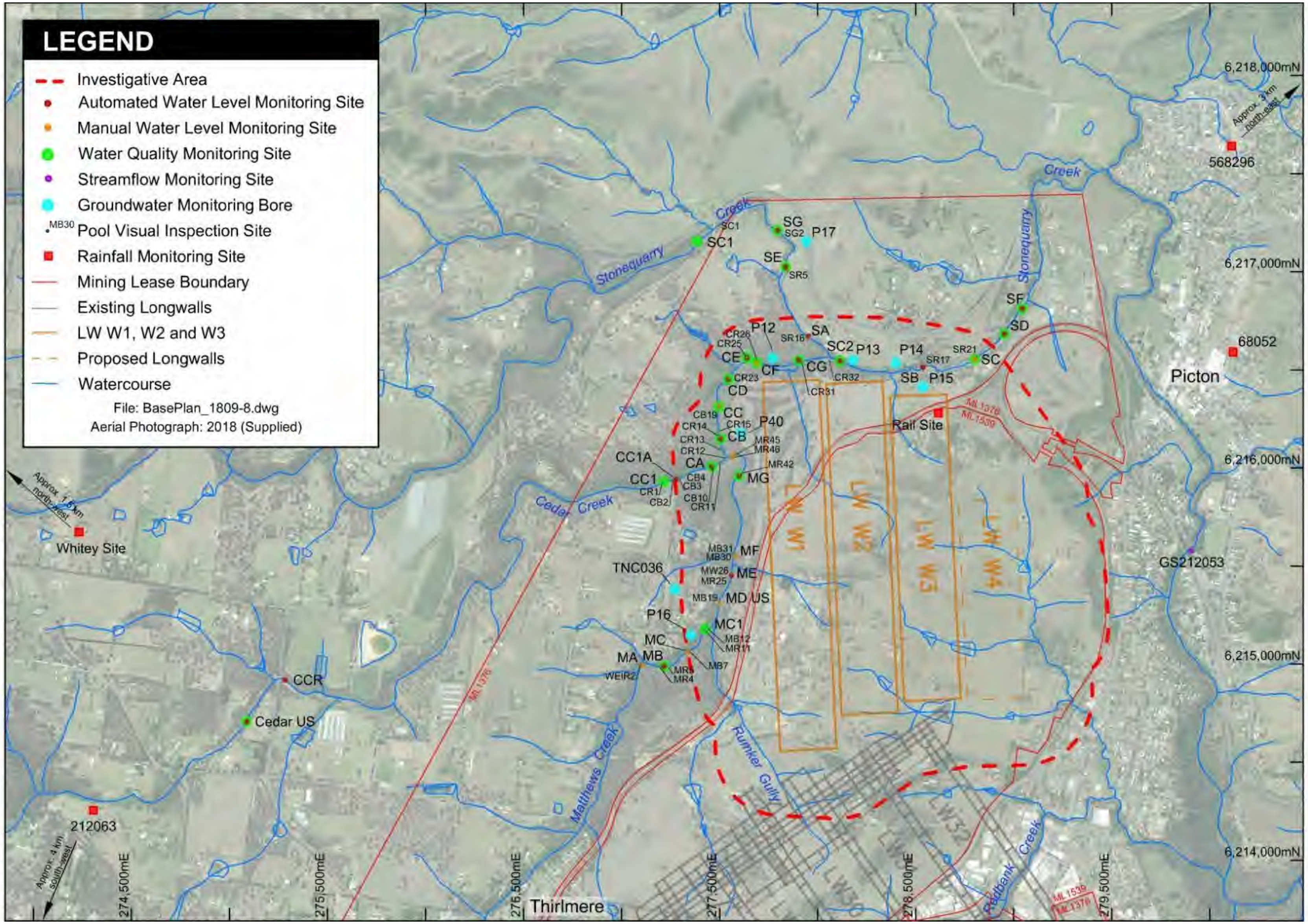
Mining of Longwall West 3 (LW W3) commenced on 13 September 2021 and was completed on 12 March 2022. Mining of Longwall West 4 (LW W4) commenced on 16 May 2022.

## 1.2 Scope of Work

This report documents a review undertaken by ATC Williams Pty Ltd (ATCW) of the environmental performance of the LW W3 mining activities in relation to surface water (water resources and watercourses) within and adjacent to the Western Domain Investigative Area for the review period 1 October 2021 to 16 / 24 March 2022[1]. The Western Domain Investigative Area is shown in Map 1. The report forms a component of the *Subsidence Impact Report* for the Tahmoor North Western Domain and comprises:

- review and interpretation of monitoring data;
- assessment against the performance measures and performance indicators for surface water; and
- recommendations in relation to ongoing monitoring or corrective actions.

[1] Data was collected for a portion of the monitoring sites on 16 March and the remainder on 24 March 2022.




**MAP 1: RELEVANT RAINFALL, SURFACE WATER AND GROUNDWATER MONITORING SITES**

# 2 SURFACE WATER MONITORING DATA REVIEW

The following sections present a summary of the surface water monitoring data recorded for the review period at monitoring sites in Matthews Creek, Cedar Creek and Stonequarry Creek (refer Map 1 for site locations). Further review and interpretation of monitoring data in relation to the relevant TARP is presented in Section 3.2.

## 2.1 Surface Water Level Data

Surface water level data has been collected by Tahmoor Coal at monitoring sites located on Matthews Creek, Cedar Creek and Stonequarry Creek as shown in Map 1. Continuous surface water level data has been recorded at three pool monitoring sites on Matthews Creek, eight monitoring sites on Cedar Creek and seven monitoring sites on Stonequarry Creek. The surface water level data has been recorded hourly using water level sensors. Manual water level measurements have also been collected monthly by Tahmoor Coal at the sites shown in Map 1.

Appendix A provides charts of the automated and manual water level data for the full period of record. Note that the cease to flow (CTF) level shown on the automated water level plots refers to the point at which surface water ceases to flow over the streamflow control i.e. the lowest point on a controlling rockbar or boulder field. In the event that streamflow over the rockbar or boulder field ceases, there may still be streamflow around, through or under the rockbar / boulder field control which reports downstream of the control.

The following is noted in relation to the monitoring data recorded during the current review period:

- Monitoring site CCR - the reference bolt at monitoring site CCR has not been located and as such the raw data recorded from 8 December 2021 was unable to be converted to a water level measurement.
- Monitoring site SA – data for the period between 15 January and 5 February 2022 was lost.
- Monitoring site SC2 - the logger has not been located since 7 December 2021 and therefore no data is available since this date.
- Monitoring site SB - the logger was washed away during a major rainfall event that occurred from late February to early March 2022 and as such no data is available since 5 February 2022.
- Monitoring site SD - the reference bolt at monitoring site SD has not been located and as such the raw data recorded from 7 December 2021 was unable to be converted to a water level measurement.
- The manual water level measurements have not been recorded for some sites due to access restrictions (i.e. high flow conditions) or at sites where the reference bolt has not been located.

The logger at monitoring site SB is to be replaced once the water level has sufficiently receded to enable installation. Additionally, the logger at monitoring site SC2 is to be located once the water level has sufficiently receded.

Table 1 presents a summary of the water level monitoring data for the review period, 1 October 2021 to 16 / 24 March 2022. The summary is presented for each pool in which an automated water level sensor is installed, while Appendix A provides charts of the water level data for all monitoring sites (including manual water level monitoring sites) and daily rainfall. Daily rainfall data is from the 'Rail Site' rainfall gauge (refer Map 1) and, prior to the commissioning of this station, the Lake Nerrigorang rainfall station (WaterNSW Station 212063). The 'baseline minimum' refers to the period of monitoring from commencement to the end of the extended low rainfall period in late 2019 to mid-January 2020.

**TABLE 1: SUMMARY OF AUTOMATED WATER LEVEL MONITORING DATA FOR REVIEW PERIOD**

| Monitoring Site | Natural Control Characteristics | Summary of Recorded Water Level From 1 October 2021 to 16 / 24 March 2022 |
|---|---|---|
| *Matthews Creek* | | |
| MB<br>(Pool MR5)<br><br>Reference Site | Rockbar constrained | The monitoring records indicate that the water level remained above the baseline minimum for the duration of the review period. In late February 2022, the water level declined slightly below the CTF level and then rose in response to a rainfall event and was recorded above the CTF level at the end of the review period (Figure A2, Appendix A). |
| ME<br>(Pool MR25)<br><br>Potential Impact Site | Boulder/rockbar constrained | The water level records indicate that the water level remained above the baseline minimum for the duration of the review period. Consistent with historical behaviour, the water level declined very slightly below the CTF level in mid-October 2021 and late February 2022. For the remainder of the review period, the water level was recorded above the CTF level (Figure A5, Appendix A). |
| MG<br>(Pool MR42)<br><br>Potential Impact Site | Boulder constrained | The water level records indicate that the water level remained above the baseline minimum and CTF level for the duration of the review period (Figure A7, Appendix A). |
| *Cedar Creek* | | |
| CCR<br><br>Reference Site | Weir | The water level at reference site CCR is influenced by backwater effects from a large weir downstream during and following high rainfall periods. As such, the water level records are not necessarily reflective of natural water level conditions during these periods. Notwithstanding, the recorded water level at CCR remained above the CTF level for the duration of the available data for monitoring period – i.e. to 8 December 2021 (Figure A8, Appendix A). |
| Cedar US<br><br>Reference Site | Rockbar constrained | The water level records indicate that the water level remained above the CTF level and the previously recorded minimum for the duration of the review period (Figure A9, Appendix A). |
| CC1A<br>(Pool CB3)<br><br>Reference Site | Boulder/rockbar constrained | The water level records indicate that the water level remained above the baseline minimum and the CTF level for the duration of the review period (Figure A10, Appendix A). |

**TABLE 1 (CONT.): SUMMARY OF AUTOMATED WATER LEVEL MONITORING DATA FOR REVIEW PERIOD**

| Monitoring Site | Natural Control Characteristics | Summary of Recorded Water Level From 1 October 2021 to 16 / 24 March 2022 |
|---|---|---|
| *Cedar Creek* | | |
| CA (Pool CB10)<br><br>Potential Impact Site | Boulder constrained | The monitoring records indicate that the water level remained above the baseline minimum for the duration of the review period. Consistent with historical behaviour, the water level declined very slightly below the CTF level for brief periods on 9 October 2021 and from 1 to 4 November 2021 (Figure A11, Appendix A). |
| CB (Pool CR14)<br><br>Potential Impact Site | Rockbar constrained | The monitoring records indicate that the water level declined below the baseline minimum for parts of October and November 2021, with a maximum decline of 35 mm below the baseline minimum recorded on 3 November 2021. The water level rose in response to subsequent rainfall events and was recorded above the CTF level and baseline minimum for the remainder of the review period (Figure A12, Appendix A). |
| CD (Pool CR23)<br><br>Potential Impact Site | Rockbar/boulder constrained | The monitoring records indicate that the water level declined very slightly below the baseline minimum for brief periods in October and November 2021. The water level rose in response to subsequent rainfall events and remained above the CTF level and baseline minimum for the remainder of the review period (Figure A14, Appendix A). |
| CE (Pool CR25)<br><br>Potential Impact Site | Rockbar/boulder constrained | The monitoring records indicate that the water level declined very slightly below the baseline minimum for brief periods in February 2022, however, remained above the CTF level. The water level rose in response to a major rainfall event in early March 2022 and remained above the baseline minimum for the remainder of the review period (Figure A15, Appendix A). |
| CG (Pool CR31)<br><br>Potential Impact Site | Rock shelf constrained | The water level records indicate that the water level remained above the baseline minimum and the CTF level for the duration of the review period (Figure A17, Appendix A). |

TAILINGS.WATER.WASTE.

## TABLE 1 (CONT.): SUMMARY OF AUTOMATED WATER LEVEL MONITORING DATA FOR REVIEW PERIOD

| Monitoring Site | Natural Control Characteristics | Summary of Recorded Water Level From 1 October 2021 to 16 / 24 March 2022 |
|---|---|---|
| *Stonequarry Creek* | | |
| SG (Pool SG2)<br><br>Reference Site | Rock shelf constrained | The monitoring records for reference site SG indicate that the water level declined to a historically low level for brief periods on 3 November 2021 (noting that there is no baseline data available for this site – i.e. monitoring did not commence until after the start of LW W1). The water level then rose in response to rainfall events and remained above the previously recorded minimum for the remainder of the review period (Figure A18, Appendix A). |
| SE (Pool SR5)<br><br>Reference Site | Rockbar constrained | The monitoring records indicate that the water level remained above the previously recorded minimum for the duration of the review period (Figure A19, Appendix A). |
| SA (Pool SR16)<br><br>Potential Impact Site | Rockbar/boulder constrained | The water level records indicate that the water level remained above the baseline minimum and CTF level for the duration of the available data for the monitoring period (Figure A20, Appendix A). |
| SC2 (Pool SR17)<br><br>Potential Impact Site | Rockbar constrained | The water level records indicate that the water level remained above the historical minimum water level for the duration of the available data for the monitoring period – i.e. to 7 December 2021 (Figure A21, Appendix A). |
| SB (Pool SR17)<br><br>Potential Impact Site | Rockbar constrained | The monitoring records indicate that the water level remained above the baseline minimum for the duration of the available data for the monitoring period – i.e. to 5 February 2022 (Figure A22, Appendix A). |
| SD<br><br>Potential Impact Site | Rockbar constrained | The monitoring records indicate that the water level did not decline below the baseline minimum or the CTF level for the duration of the available data for the monitoring period – i.e. to 7 December 2021 (Figure A24, Appendix A). |
| SF<br><br>Potential Impact Site | Rockbar constrained | The monitoring records indicate that the water level remained above the previously recorded minimum and the CTF level for the duration of the monitoring period (Figure A25, Appendix A). |

## 2.2 Surface Water Quality

Surface water quality monitoring has been conducted at the following sites (refer Map 1 for locations):

Baseline / Impact Site

- Cedar Creek (CA, CB, CC, CD, CE, CF, CG)
- Matthews Creek (MC1, MG)
- Stonequarry Creek (SC2, SC, SD, SF)

Reference / Control Site

- Cedar Creek (Cedar US, CC1)
- Matthews Creek (MB)
- Stonequarry Creek (SC1, SE, SG)

Water quality monitoring commenced at monitoring sites CC1, CB, CG, MC1, MG, MB, SC1, SC2, SD and SC in January 2019; monitoring site CA in June 2019; monitoring site SE in April 2020; monitoring site SF in May 2020; monitoring site SG in September 2020; monitoring site Cedar US in October 2020 and monitoring sites CC, CD, CE and CF in January 2021.

Field analyses are undertaken for pH, electrical conductivity (EC), dissolved oxygen (DO), temperature and oxidation reduction potential (ORP). Laboratory analyses are undertaken for pH, EC, total dissolved solids (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.

Monitoring results for key constituents are shown on a series of plots in Appendix B and summarised in Table 2.

**TABLE 2: SUMMARY OF KEY WATER QUALITY CONSTITUENTS FOR REVIEW PERIOD**

| Constituent | Matthews Creek: MB (reference site), MC1 and MG (potential impact sites) | Cedar Creek: Cedar US, CCR and CC1 (reference sites), CA, CB, CC, CD, CE, CF and CG (potential impact sites) | Stonequarry Creek: SC1, SE, SG (reference sites), SC2, SC, SD and SF (potential impact sites) |
|---|---|---|---|
| **pH** (Figure B1, Appendix B) | The field pH values indicate near neutral pH conditions for the duration of the review period, consistent with baseline values. | The field pH values indicate slightly acidic to near neutral conditions for the duration of the review period. Generally higher pH values were recorded during the review period in comparison to the baseline period. | The field pH values indicate near neutral to slightly alkaline pH conditions for the duration of the review period. Historically high pH values were recorded at monitoring sites SD and SF and at reference site SG in March 2022. The pH values recorded at all other monitoring sites were generally consistent with baseline values. |
| **Electrical Conductivity** (Figure B3, Appendix B) | Field EC values were consistent with baseline values for the duration of the review period (less than 337 µS/cm at all sites). | Field EC values were generally less than baseline values for the duration of the review period (less than 568 µS/cm at all sites). | Field EC values were consistent with or less than baseline values for the duration of the review period (less than 862 µS/cm at all sites). |
| **Dissolved Aluminium** (Figure B5, Appendix B) | Dissolved aluminium concentrations were elevated in January and March 2022 in comparison to the remainder of the review period. The elevated concentrations occurred following a period of above average rainfall. However, the concentrations were consistent with baseline values (equal to or less than 0.13 mg/L at all sites). | Dissolved aluminium concentrations were elevated in January, February and March 2022 in comparison with the remainder of the review period. The elevated concentrations occurred following a period of above average rainfall. Historically high concentrations of dissolved aluminium were recorded in January and February at reference site CCR and in March 2022 at all monitoring sites with the exception of CC1 and CB. | Dissolved aluminium concentrations were elevated in January and March 2022 in comparison with the remainder of the review period. The elevated concentrations occurred following a period of above average rainfall. Historically high concentrations of dissolved aluminium were recorded at all monitoring sites, except SC1, in March 2022 including at reference sites SE and SG. |

**TABLE 2 (CONT.): SUMMARY OF KEY WATER QUALITY CONSTITUENTS FOR REVIEW PERIOD**

| Constituent | **Matthews Creek:** MB (reference site), MC1 and MG (potential impact sites) | **Cedar Creek:** Cedar US, CCR and CC1 (reference sites), CA, CB, CC, CD, CE, CF and CG (potential impact sites) | **Stonequarry Creek:** SC1, SE, SG (reference sites), SC2, SC, SD and SF (potential impact sites) |
|---|---|---|---|
| **Dissolved Barium** (Figure B6, Appendix B) | Dissolved barium concentrations recorded over the duration of the review period were equal to or less than 0.027 mg/L at all sites and generally consistent with baseline values. | Dissolved barium concentrations recorded over the duration of the review period were equal to or less than 0.2 mg/L at all sites and generally less than baseline values. | Dissolved barium concentrations recorded over the duration of the review period were equal to or less than 0.1 mg/L at all sites and consistent with or less than baseline values. |
| **Dissolved Iron** (Figure B7, Appendix B) | Dissolved iron concentrations were slightly elevated from December 2021 to March 2022 in comparison to the remainder of the review period, including at reference site MB, however were generally consistent with baseline values. | An increasing trend in dissolved iron concentrations was recorded at all sites from October 2021 to February 2022, however, concentrations decreased in March 2022 following a major rainfall event. Dissolved iron concentrations recorded at all sites were equal to or less than 2.55 mg/L and generally consistent with baseline values. | An increasing trend in dissolved iron concentrations was recorded at all sites from October 2021 to February 2022, however, concentrations decreased in March 2022 following a major rainfall event. Dissolved iron concentrations recorded at each monitoring site were equal to or less than 1.88 mg/L and generally consistent with baseline values. |
| **Dissolved Manganese** (Figure B8, Appendix B) | Dissolved manganese concentrations recorded over the duration of the review period were less than 0.157 mg/L at all sites and consistent with or less than baseline values. | Dissolved manganese concentrations recorded at all sites for the duration of the review period were less than 0.613 mg/L and less than baseline values. | Dissolved manganese concentrations recorded at all sites for the duration of the review period were less than or equal to 0.461 mg/L and consistent with baseline values. |
| **Dissolved Nickel** (Figure B9, Appendix B) | Dissolved nickel concentrations were less than 0.002 mg/L at all sites during the review period and consistent with baseline values. | Dissolved nickel concentrations were less than 0.004 mg/L at all sites during the review period and generally less than baseline values. | Dissolved nickel concentrations were less than 0.002 mg/L at all sites during the review period and consistent with or less than baseline values. |

TABLE 2 (CONT.): SUMMARY OF KEY WATER QUALITY CONSTITUENTS FOR REVIEW PERIOD

| Constituent | **Matthews Creek:** MB (reference site), MC1 and MG (potential impact sites) | **Cedar Creek:** Cedar US, CCR and CC1 (reference sites), CA, CB, CC, CD, CE, CF and CG (potential impact sites) | **Stonequarry Creek:** SC1, SE, SG (reference sites), SC2, SC, SD and SF (potential impact sites) |
|---|---|---|---|
| **Dissolved Zinc** (Figure B10, Appendix B) | Dissolved zinc concentrations were equal to or less than 0.009 mg/L at all sites during the review period and consistent with baseline values. | Dissolved zinc concentrations were equal to or less than 0.035 mg/L at all sites during the review period and consistent with baseline values. | Dissolved zinc concentrations were less than 0.017 mg/L at all sites during the review period and consistent with baseline values. |
| **Sulphate** (Figure B11, Appendix B) | Sulphate concentrations recorded at all sites during the review period were equal to or less than 8 mg/L and consistent with baseline values. | Sulphate concentrations recorded at all sites during the review period were equal to or less than 8 mg/L and consistent with baseline values. | A decreasing trend in sulphate concentrations was recorded at all sites over the duration of the review period. The sulphate concentrations recorded at all sites were equal to or less than 15 mg/L and consistent with or less than baseline values. |

## 3 ASSESSMENT AGAINST SURFACE WATER TARPS

### 3.1 Subsidence Impact Performance Measures – Natural Features

As detailed in the WMP, TARPs have been developed for the Western Domain to set out response measures for unpredicted subsidence impacts to surface water. The monitoring results, in conjunction with the TARPs, are used to assess the impacts of mining in the Western Domain against the subsidence impact performance measures specified in Table 3. This report addresses the first subsidence impact performance measure listed in Table 3 while the second performance measure is addressed in SLR (2022).

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**TABLE 3: SUBSIDENCE IMPACT PERFORMANCE MEASURES – NATURAL FEATURES**

| Surface Water System | Subsidence Impact Performance Measure | Exceedance of Performance Measure |
|---|---|---|
| Stonequarry Creek, Cedar Creek and Matthews Creek | No subsidence impact or environmental consequence greater than minor* | The performance measure 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:<br>• More than 10% of pools located within the Investigative Area; and/or<br>• Pool SR17. |
| | No connective cracking between the surface, or the base of the alluvium, and the underground workings | The performance measure 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. |

* Minor is defined as *not very large, important or serious.*

## 3.2 Impact to Pool Water Level, Physical Features and Natural Behaviour

### 3.2.1 Significance Triggers for Automated Pool Water Level and Physical Features

The significance levels / triggers, as detailed in the WMP, are summarised in Table 4 for pool water level and in Table 5 for physical features and natural behaviour of pools. In accordance with the WMP, the pool water level data and visual inspection observations have been assessed against the tabulated criteria for each trigger level.

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**TABLE 4: SIGNIFICANCE LEVELS / TRIGGERS FOR POOL WATER LEVEL**

| | Pool Water Level |
|---|---|
| Level 1 | The recorded water level has not declined below the recorded baseline minimum level (in one 24 hour period for automated pool water level) OR the recorded water level has declined below the recorded baseline minimum level (in one 24 hour period for automated pool water level) but the decline is due to a monitoring or sensor error or the magnitude of the decline (below the recorded baseline minimum level) is within the range of sensor accuracy. |
| Level 2 | The recorded water level has declined below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) AND the above has occurred at one of the upstream pools (beyond mining effects). |
| Level 3 | The recorded water level has declined, although not atypically*, below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) AND the above has not occurred at one of the upstream pools (beyond mining effects). |
| Level 4 | The recorded water level has declined atypically* below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) AND similar behaviour has not occurred at one of the upstream pools (beyond mining effects). |

* 'Atypical' surface water characteristics relate to a notable and/or rapid water level decline or change in the slope of the falling limb of the hydrograph or the water level recessionary behaviour below the CTF level which is inconsistent with baseline conditions and cannot be attributed to climatic conditions.

**TABLE 5: SIGNIFICANCE LEVELS / TRIGGERS FOR PHYSICAL FEATURES AND NATURAL BEHAVIOUR OF POOLS**

| Level | Physical Features and Natural Behaviour of Pools |
|---|---|
| Level 1 | No observed impacts to pool level, drainage or overland connected flow. |
| Level 2 | Visually observed reduction in pool level, drainage or overland connected flow AND the above has occurred at one of the upstream pools (beyond mining effects) OR visual monitoring of pools has not noted any mining related impacts*. |
| Level 3 | Rockbar 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 into account climatic conditions and observations during the baseline monitoring period. |
| Level 4 | Visually observed reduction in pool water level, drainage or overland connected flow, taking into account climatic conditions and observations during the baseline monitoring period AND the above change has not occurred at one of the upstream pools (beyond mining effects). |

* Rockbar and/or stream base cracking, gas release or iron precipitation in excess of baseline conditions.

### 3.2.2 Assessment of Automated Pool Water Level Data and Visual Inspection Observations

A summary of the pool water level, physical features and natural behaviour TARP significance levels for potential impact sites over the duration of the review period is presented in Table 6 and discussed in the sections which follow.

**TABLE 6: SURFACE WATER TARP SIGNIFICANCE LEVELS – 1 OCTOBER 2021 TO 16 / 24 MARCH 2022**

| Date | Location(s) | Comment | TARP Significance |
|---|---|---|---|
| *Surface Water Level* | | | |
| 1 October 2021 – 16 March 2022 | All monitoring sites excluding MB, ME, SB, SC2, SD and CB | The recorded water level did not decline below the baseline minimum level (in one 24 hour period) | Level 1 |
| 1 October 2021 – 24 March 2022 | Monitoring sites MB and ME | The recorded water level did not decline below the baseline minimum level (in one 24 hour period) | Level 1 |
| 1 October – 7 December 2021^ | Monitoring sites SC2 and SD | The recorded water level did not decline below the baseline minimum level (in one 24 hour period) | Level 1 |
| 1 October 2021 – 5 February 2022^ | Monitoring site SB | The recorded water level did not decline below the baseline minimum level (in one 24 hour period) | Level 1 |
| 1 – 4 October 2021; 12 – 18 October 20211; 24 – 27 October 2021; 6 November 2021 – 16 March 2022 | Monitoring site CB (pool CR14) in Cedar Creek | The recorded water level did not decline below the baseline minimum level (in one 24 hour period) | Level 1 |
| 5 – 11 October 2021 | | The water level declined by a maximum of 16 mm below the baseline minimum | Level 3 |
| 19 – 23 October 2021 | | The water level declined by a maximum of 20 mm below the baseline minimum | Level 3 |
| 28 October – 5 November 2021 | | The water level declined by a maximum of 35 mm below the baseline minimum | Level 3 |
| *Physical Features and Natural Behaviour of Pools* | | | |
| 1 October 2021 – 17 March 2022 | All monitoring sites excluding SB | No observed impacts to pool level, drainage behaviour or overland connected flow | Level 1* |
| 1 – 27 October 2021 | Monitoring site SB (pool SR17) | No observed impacts to pool level, drainage behaviour or overland connected flow | Level 1* |
| 28 October 2021 – 24 February 2022+ | Monitoring site SB (pool SR17) | Laminar fractures and extension of natural fracture | Level 3* |

* Source: BES (2021a, 2021b, 2021c) and BES (2022a, 2022b, 2022c)

\+ Visual inspection was unable to be conducted in March due to high water flow over the rockbar at pool SR17 (BES, 2022c)

^ Data has not been able to be recorded or corrected for the remainder of the review period

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Matthews Creek and Stonequarry Creek

To date, there has been negligible evidence of an influence of mining of LW W3 on pool surface water level or surface water behaviour in Matthews Creek or Stonequarry Creek. The water level behaviour of monitoring sites in Matthews Creek and Stonequarry Creek following commencement of mining has been consistent with baseline conditions and/or consistent with reference site conditions throughout the review period. As such, this equates to a Level 1 TARP significance in relation to water level for all monitoring sites in Matthews Creek and Stonequarry Creek.

Pool SR17 was initially reported at a Level 3 significance on 28 October 2021 due to surficial fracturing of the controlling rockbar (pers. comm. MSEC). Brienen Environment & Safety (2021b) reported this as laminar fracturing and extension of a natural crack in the rockbar following the inspection on 17 November 2021. Consequently, a Level 3 trigger significance in relation to physical features and natural behaviour of pool SR17 has been derived for the period including and following 17 November 2021.

The water level records for pool SR17 have been assessed with consideration to the surficial fracturing of the controlling rockbar and summarised in Section 3.2.3.

Cedar Creek

The water level behaviour of monitoring sites in Cedar Creek, with the exception of monitoring sites CB was consistent with baseline conditions and / or consistent with reference site conditions for the duration of the review period. As such, this equates to a Level 1 TARP significance in relation to water level for all monitoring sites in Cedar Creek with the exception of monitoring site CB.

The water level records for monitoring site CB (pool CR14) in Cedar Creek indicate that the water level declined below the baseline minimum by a maximum of 16 mm between 5 and 11 October 2021, 20 mm between 19 and 23 October 2021 and 35 mm between 28 October and 5 November 2021 (refer Figure A12, Appendix A). During the periods of water level decline the water level remained above the previously recorded minimum and did not decline atypically.

In accordance with the LW W3-W4 WMP, a Level 3 TARP significance in relation to pool water level decline at monitoring site CB has been derived for the periods 5 to 11 October, 19 to 23 October and 28 October to 5 November 2021. The recorded water level declined, although not atypically, below the recorded baseline minimum level (for more than one 24 hour period) during these periods and the same did not occur at an upstream pool (beyond mining effects).

The actions and responses undertaken for the Level 3 trigger exceedances for pool water level at monitoring site CB (pool CR14), in accordance with LW W3-W4 WMP (Tahmoor Coal, 2021), are summarised in Section 3.2.3.

The water level records for monitoring site CD (pool CR23) in Cedar Creek indicate that the water level declined below the baseline minimum by a maximum of 6 mm for short periods on 22 and 23 October 2021 and 1 and 2 November 2021 (refer Figure A14, Appendix A). The water level did not decline below the baseline minimum for a consecutive 24 hour period and, as such, a Level 1 TARP significance in relation to pool water level decline at monitoring site CD has been derived for the review period.

The water level records for monitoring site CE (pool CR25) in Cedar Creek indicate that the water level declined below the baseline minimum by a maximum of 2 mm for short periods on 20 and 21 February 2022 (refer Figure A15, Appendix A). The water level did not decline below the baseline minimum for a consecutive 24 hour period and, as such, a Level 1 TARP significance in relation to pool water level decline at monitoring site CE has been derived for the review period.

### 3.2.3 Trigger Exceedance Action and Response

Table 7 summarises the actions and responses required to be undertaken in relation to the Level 3 exceedances recorded at monitoring sites CB (pool CR14) and SB (pool SR17).

**TABLE 7: TRIGGER EXCEEDANCE ACTION AND RESPONSE**

| Level | Action | Response |
|---|---|---|
| *Impact to pool water level* | | |
| Level 3 | • Continue monitoring as per monitoring program.<br>• Continue monthly review of data.<br>• Review relevant surface water level, groundwater level and streamflow data to assess comparative trends.<br>• Convene Tahmoor Coal Environmental Response Group to review response. | • As defined by Environmental Response Group.<br>• Consider increasing download and review of data frequency to fortnightly for sites where Level 3 has been reached.<br>• Review manual water level measurements for additional monitoring sites to identify potential spatial trends in water level decline. |
| *Impact to physical features and natural behaviour of pools* | | |
| Level 3 | • Continue monitoring as per monitoring program.<br>• Continue monthly review of data.<br>• 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. | • As defined by Environmental Response Group.<br>• Consider increasing inspection and review of data frequency to fortnightly for sites where Level 3 has been reached. |

Monitoring Site CB (Pool CR14)

In response to the Level 3 trigger exceedances at monitoring site CB (pool CR14), the Environmental Response Group convened and the surface water level data was reviewed in relation to rainfall data and relevant groundwater level monitoring data. As stated in SLR (2022), the groundwater level in the vicinity of monitoring site CB (pool CR14) was inferred at 0.1 m below the surface water level as of early October 2021. The groundwater level was inferred to increase above the surface water level as of mid to late October 2021 and continue to increase notably in response to rainfall events from November 2021. The groundwater level was recorded at a level of approximately 4.2 m above the creek bed elevation at the end of the review period (SLR, 2022). This would suggest that gaining conditions (groundwater contribution to the surface water system) were occurring from mid-October to late March 2022 in the vicinity of monitoring site CB (pool CR14).

However, if fractures were present in the base of pool CR14 or in the subsurface, this would prohibit, to some extent dependent on the nature of the fractures, gaining conditions occurring at pool CR14 (pers. comm. SLR, 16 December 2021). It is noted that fractures have not been observed, however, the base of the pool has not been visible as the pool has continued to retain water. The decline in water level below the baseline minimum recorded at monitoring site CB (pool CR14) in late October and early November 2021 suggests that losing conditions (surface water contribution to the groundwater system), rather than gaining conditions, were prevailing during this period and may potentially indicate the presence of fractures in the base of pool CR14 or in the subsurface.

Nonetheless, the water level records for monitoring site CB (pool CR14) recorded over the duration of the review period indicate that water level impacts were transient, minor (maximum of 35 mm decline below the baseline minimum) and not atypical. In addition, water level impacts were not evident at other monitoring sites in Cedar Creek during the review period; notably monitoring sites CC1A and CA which have previously recorded atypical behaviour (HEC, 2021).

Review of the water level measurements for monitoring sites in Cedar Creek downstream of monitoring site CB, namely monitoring sites CD, CE and CG, indicate that the water level at these sites generally remained above the baseline minimum during the periods 5 to 11 October 2021, 19 to 23 October 2021 and 28 October to 5 November 2021 (refer Appendix A). The water level records for monitoring site CD indicate that water level declined slightly below the baseline minimum for very brief periods on 22 and 23 October and 1 and 2 November 2021, however, the water level did not decline for a full 24 hour period (refer Appendix A). As such, there is no indication that there was a wide spread or prolonged effect on surface water levels in the downstream reach of Cedar Creek during this period.

Accordingly, an increase in the frequency of data download and review is not considered to be required at this stage. Monthly download and review of surface monitoring data will continue to be conducted. Should a Level 4 trigger exceedance occur in the future, further action will be taken in accordance with the LW W3-W4 WMP.

Monitoring Site SB (Pool SR17)

In accordance with the Stonequarry Creek Rockbar Management Plan (Tahmoor Coal, 2021), mining of LW W3 was temporarily suspended on 28 October 2021 following initial identification of surficial fracturing of the rockbar at pool SR17. Subsequently, the Subsidence Technical Committee convened to review the required actions and responses in accordance with the Stonequarry Creek Rockbar Management Plan TARP. The Subsidence Technical Committee confirmed that the fracturing was identified approximately 40 metres (m) downstream of the nearest grinding grove site on the north-eastern side of the access track. No evidence of fracturing was evident at any of the grinding groove sites.

Additional monitoring, inspection and reporting was then implemented in accordance with the TARP. Subsequent visual inspections identified an increase in the extent of fracturing. On 1 November 2021, approval was granted to recommence mining of LW W3 subject to the continuation of monitoring at an increased frequency.

Geotechnical reviews by PSM Consulting (2021a, b and c) 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.
- The fracturing provided a release for mining induced stress and was confined to the sheeted sandstone above the competent sandstone.

In response to the Level 3 trigger exceedances in relation to physical features at monitoring site SB (pool SR17), the Environmental Response Group convened and the surface water level data was reviewed. The water level records for monitoring site SB (pool SR17) shown in Chart A22, Appendix A, indicate 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 5 February 2022 (extent of available monitoring data). As such, there is no requirement to increase the frequency of visual inspections and review of data in relation to pool physical features, natural drainage behaviour and pool water level. The physical features and water level records for this site will continue to be monitored in accordance with the WMP.

## 3.3 Surface Water Quality

### 3.3.1 Significance Triggers for Surface Water Quality

Water quality data has been analysed for key water quality parameters of relevance to surface water systems and the effects of subsidence, namely pH, EC, dissolved (field filtered) aluminium, iron, manganese, nickel and zinc at monitoring sites on Matthews Creek, Cedar Creek and Stonequarry Creek. The monitoring results have been assessed against the criteria for each significance level/trigger listed in Table 8.

**TABLE 8: SIGNIFICANCE LEVELS / TRIGGERS FOR WATER QUALITY**

| | Surface Water Quality |
|---|---|
| Level 1 | The triggers for pH, EC and dissolved metals do not occur and there is no visual evidence of increased iron staining that was not observed in the baseline period. |
| Level 2 | The trigger for pH, EC or dissolved metals occurs in one month and there is no visual evidence of increased iron staining that was not observed in the baseline period. |
| Level 3 | The trigger for pH, EC or dissolved metals occurs in one month and there is visual evidence of increased iron staining that was not observed in the baseline period. |
| Level 4 | Any of the following:<br>• pH: the value falls below a corresponding control (upstream) site(s) mean*, or at the site itself, minus two standard deviations (i.e. the sample becomes more acidic) for more than two consecutive months OR the value rises above corresponding control (upstream) site(s) mean, or at the site itself, plus two standard deviations (i.e. the sample becomes more alkaline) for more than two consecutive months.<br>• EC: the value rises above corresponding control (upstream) site(s) mean*, or at the site itself, plus two standard deviations for more than two consecutive months.<br>• Dissolved metals: a specific metal or metals laboratory value/s rise above corresponding control (upstream) site(s) mean*, or at the site itself, plus two standard deviations for more than two consecutive months. |

* The value is compared with the corresponding control (upstream) site(s) mean to date plus two standard deviations and with the baseline mean plus two standard deviations for the site itself.

### 3.3.2 Assessment of Surface Water Quality

A summary of the water quality TARP significance levels for the review period is presented in Table 9 and discussed in the sections which follow.

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**TABLE 9: WATER QUALITY TARP SIGNIFICANCE LEVELS – 1 OCTOBER 2021 TO 16 / 24 MARCH 2022**

| Date | Location(s) | Comment | TARP Significance |
|---|---|---|---|
| October 2021 to March 2022 | All monitoring sites in Matthews Creek | The triggers for pH, EC and dissolved metals do not occur and there is no visual evidence of increased iron staining that was not observed in the baseline period. | Level 1 |
| October to December 2021 and February 2022 | All monitoring sites in Cedar Creek | | Level 1 |
| October to December 2021 and February 2022 | All monitoring sites in Stonequarry Creek | | Level 1 |
| January 2022 | Monitoring site CB in Cedar Creek | The trigger for dissolved aluminium occurs in one month and there is no visual evidence of increased iron staining that was not observed in the baseline period. | Level 2 |
| February and March 2022 | Monitoring site CG in Cedar Creek | | Level 2 |
| March 2022 | Monitoring site CA | | Level 2 |
| January and March 2022 | Monitoring sites SC2, SC and SD in Stonequarry Creek | | Level 2 |

Matthews Creek

A water quality TARP significance above Level 1 was not reported for any sites in Matthews Creek during the period 1 October 2021 to 16 / 24 March 2022.

Cedar Creek

As stated in Table 2 and illustrated in Figure B5 of Appendix B, historically high concentrations of dissolved aluminium were recorded in March 2022 at monitoring sites CA, CC, CD, CE, CF and CG in Cedar Creek. Elevated concentrations of dissolved aluminium were also recorded at monitoring sites CB, CD, CC, CA and CC1 in Cedar Creek in January 2022 and at monitoring site CG in February 2022. Historically high concentrations of dissolved aluminium were recorded at reference site CCR in January, February and March 2022 and at reference site Cedar US in March 2022.

The dissolved aluminium concentrations recorded at monitoring sites CB, CA and CC1 in January 2022 did not exceed baseline concentrations. It is noted that monitoring of sites CC, CD and CE only commenced in January 2021 and, as such, baseline data is not available for these sites. Additionally, Cedar US was unable to be accessed for monitoring in January and February 2022.

The elevated concentrations of dissolved aluminium recorded at monitoring site CB in January 2022, at monitoring site CG in February 2022 and at monitoring sites CA and CG in March 2022 resulted in an exceedance of the mean plus two standard deviations, equating to a Level 2 TARP significance at these sites. The elevated concentrations of dissolved aluminium did not result in an exceedance of the reference site mean plus two standard deviations during these periods. Additionally, the elevated concentration of dissolved aluminium recorded at monitoring site CB in January 2022 did not exceed the baseline maximum concentration of dissolved aluminium recorded at monitoring site CB.

Stonequarry Creek

As stated in Table 2 and illustrated in Figure B5 of Appendix B, historically high concentrations of dissolved aluminium were recorded in March 2022 at reference sites SE and SG and at monitoring sites SC2, SC, SD and SF in Stonequarry Creek. Elevated concentrations of dissolved aluminium were also recorded at reference site SC1 and at monitoring sites SC and SD in January 2022. The dissolved aluminium concentration recorded at monitoring site SC2 in January 2022 did not exceed the maximum baseline concentration or reference site concentrations and the dissolved aluminium concentrations recorded at SC, SD and SF in March 2022 did not exceed reference site concentrations. It is noted that monitoring at site SF did not commence until May 2020 and, as such, baseline data is not available for this site.

The elevated concentrations of dissolved aluminium recorded at monitoring sites SC2, SC and SD in January 2022 and March 2022 resulted in an exceedance of the mean plus two standard deviations, equating to a Level 2 TARP significance at these sites. The elevated concentrations of dissolved aluminium did not result in an exceedance of the reference site mean plus two standard deviations during these periods.

### 3.3.3 Trigger Exceedance Action and Response

Table 10 summarises the actions and responses required to be undertaken in relation to the Level 2 exceedances recorded at monitoring site CB in January 2022, monitoring site CG in February and March 2022, monitoring site CA in March 2022 and monitoring sites SC2, SC and SD in January 2022 and March 2022.

**TABLE 10: TRIGGER EXCEEDANCE ACTION AND RESPONSE**

| Level | Action | Response |
|---|---|---|
| *Impact to stream water quality* | | |
| Level 2 | • Continue monitoring as per monitoring program.<br>• Continue monthly review of data including analysis of water quality trend along creek (upstream to downstream) to identify spatial changes.<br>• Convene Tahmoor Coal Environmental Response Group to review response. | As defined by Environmental Response Group. |

In response to the Level 2 trigger exceedances, the Environmental Response Group convened and the surface water quality data was reviewed in relation to the prevailing climate and catchment wide water quality trends.

The elevated concentrations of dissolved aluminium recorded in January, February and March 2022 occurred during and following above average rainfall. As stated in Section 3.3.2, concentrations were also elevated and, in some cases, historically high at reference sites (upstream of mining influences) in January, February and March 2022. Accordingly, the elevated dissolved aluminium concentrations were considered to be catchment wide and related to the prevailing climatic conditions.

In accordance with the WMP, monthly monitoring and review of water quality data recorded at sites in Cedar Creek, Stonequarry Creek and Matthews Creek will continue to be undertaken and assessed in relation to the water quality TARP.

## 4 SUMMARY AND CONCLUSIONS

Review and assessment of surface water monitoring data recorded prior to and during the review period of 1 October 2021 to 16 / 24 March 2022 has indicated the following:

- A water quality TARP significance above Level 1 was not reported for any sites in Matthews Creek during the period 1 October 2021 to 16 / 24 March 2022.
- A water quality TARP significance of Level 2 was reported for dissolved aluminium recorded at Cedar Creek monitoring site CB in January 2022 and monitoring sites CA and CG in March 2022.
- A water quality TARP significance of Level 2 was reported for dissolved aluminium recorded at Stonequarry Creek monitoring sites SC2, SC and SD in January and March 2022.
- The TARP Level 2 significance for water quality at these sites appeared to be catchment wide and related to the prevailing (high rainfall) climatic conditions.
- There is no evidence from the monitoring data of an influence of mining LW W3 on surface water quality in Matthews Creek, Cedar Creek or Stonequarry Creek.
- With the exception of monitoring site CB in Cedar Creek, a water level TARP significance above Level 1 was not reported for sites in Matthews Creek, Cedar Creek or Stonequarry Creek during the period 1 October 2021 to 16 / 24 March 2022.
- A Level 3 TARP significance in relation to pool water level decline at monitoring site CB in Cedar Creek was reported for the periods 5 to 11 October, 19 to 23 October and 28 October to 5 November 2021.

- The water level at monitoring site CB did not decline atypically or below the previously recorded minimum during these periods.
- The inferences of groundwater-surface water connectivity indicated that the surface water system was gaining from the groundwater system in the vicinity of monitoring site CB (pool CR14) during these periods. However, the presence of fractures in the base of pool CR14 or in the subsurface would prohibit, to some extent dependent on the nature of the fractures, gaining conditions occurring at pool CR14.
- A Level 3 TARP significance was reported for pool SR17 in Stonequarry Creek due to surficial fracturing of the rockbar.
- 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.
- There has been no evidence of fracturing at the grinding groove sites at rockbar SR17.
- The water level records for monitoring site SB (pool SR17) indicate that the surficial fracturing of the rockbar has not resulted in an apparent impact to the pool water holding capacity. As such, an increase in the frequency of monitoring from monthly to fortnightly is not required at this stage.

Less than 10% of the pools within the Investigative Area have been impacted and the surficial fracturing of the rockbar at pool SR17 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[2] associated with mining in the Western Domain.

It is recommended that monthly review of surface monitoring data is continued to be undertaken in accordance with the WMP.

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[2] Minor is defined as *not very large, important or serious.*

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## CONDITIONS OF REPORT

This report must be read in its entirety.

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## APPENDIX A – WATER LEVEL PLOTS

## MATTHEWS CREEK SURFACE WATER MONITORING SITES

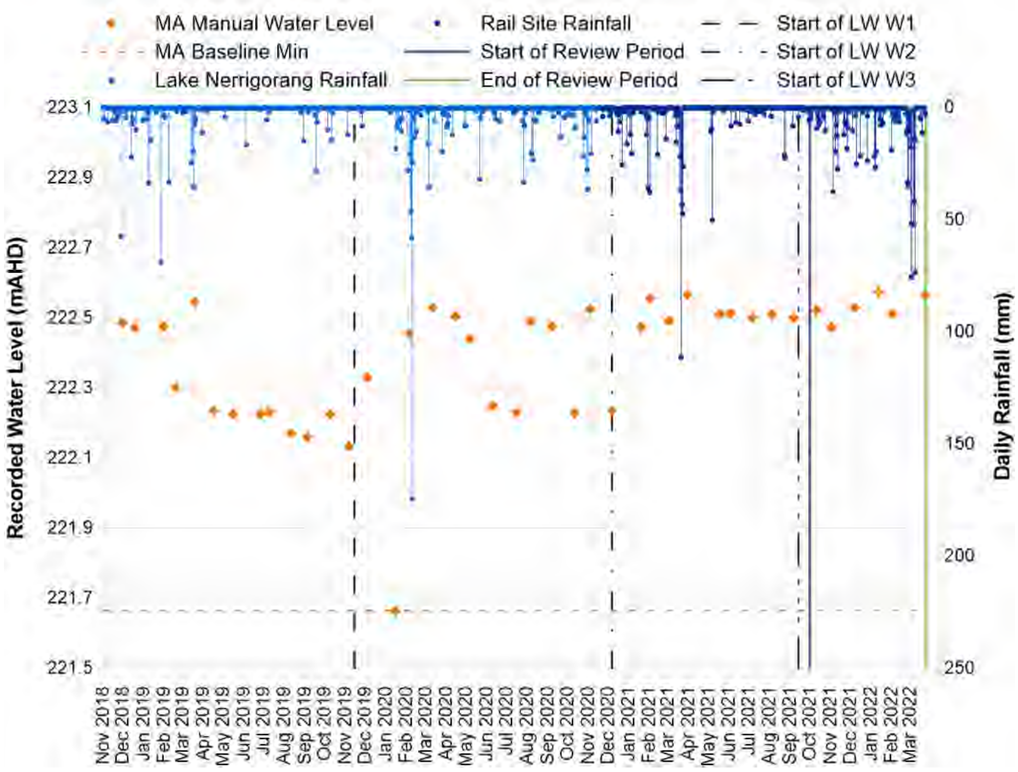


**FIGURE A1: MONITORING SITE MA WATER LEVEL RECORDS**

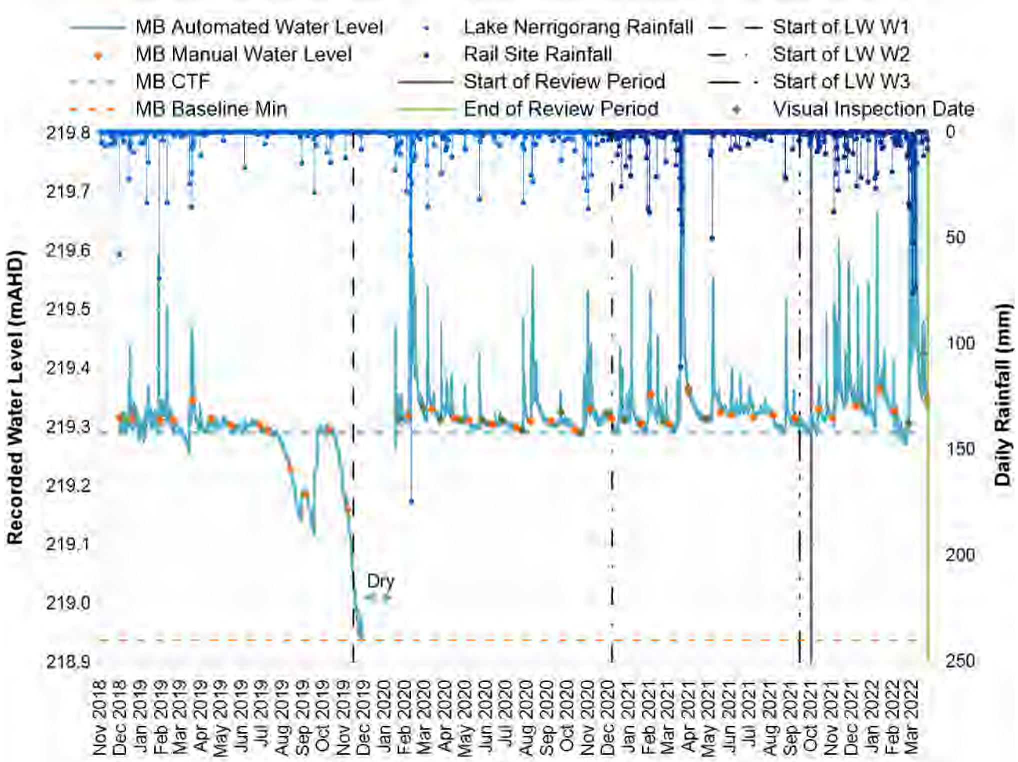


**FIGURE A2: MONITORING SITE MB WATER LEVEL RECORDS**

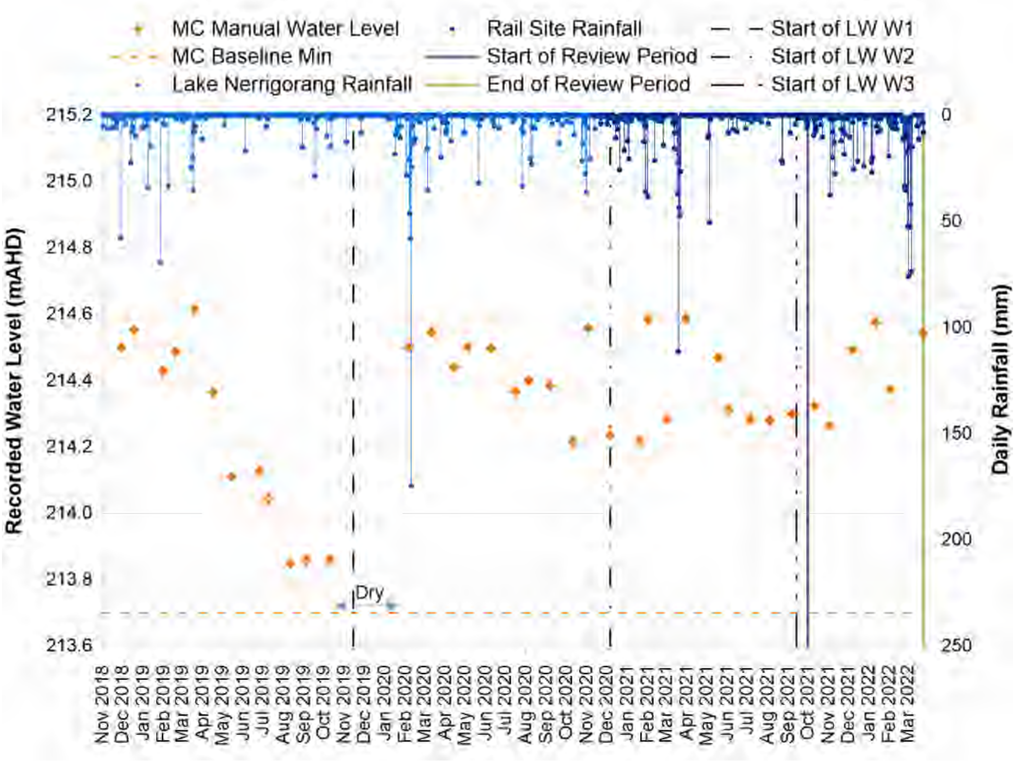


**FIGURE A3: MONITORING SITE MC WATER LEVEL RECORDS**

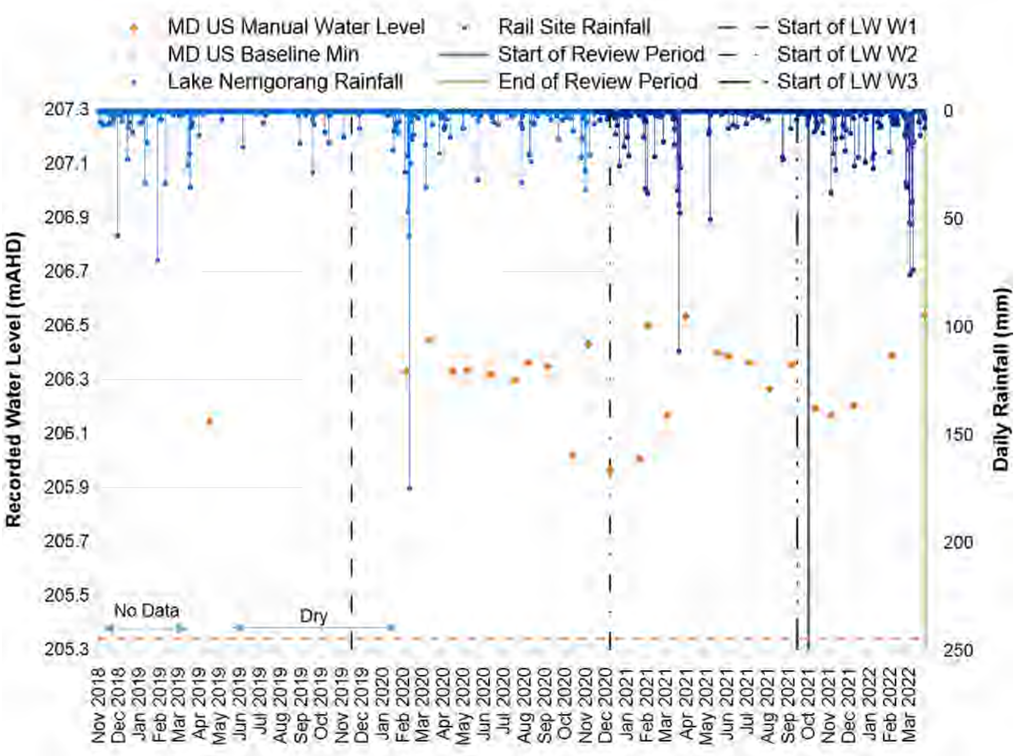


**FIGURE A4: MONITORING SITE MD US WATER LEVEL RECORDS**

TAILINGS.WATER.WASTE.

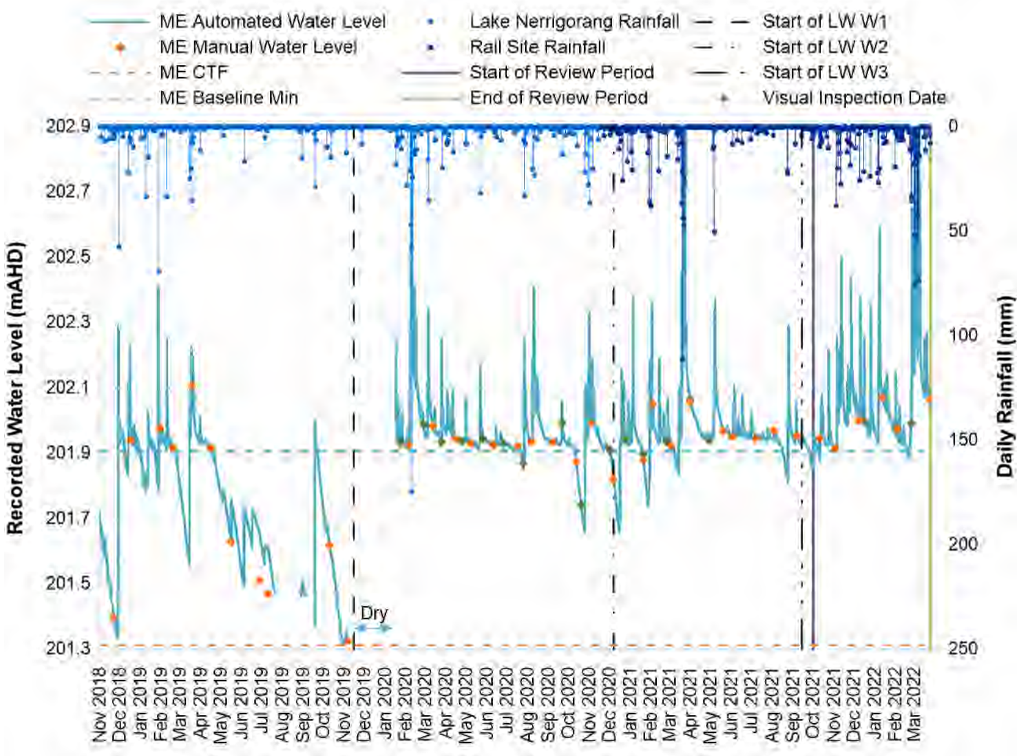


**FIGURE A5: MONITORING SITE ME WATER LEVEL RECORDS**

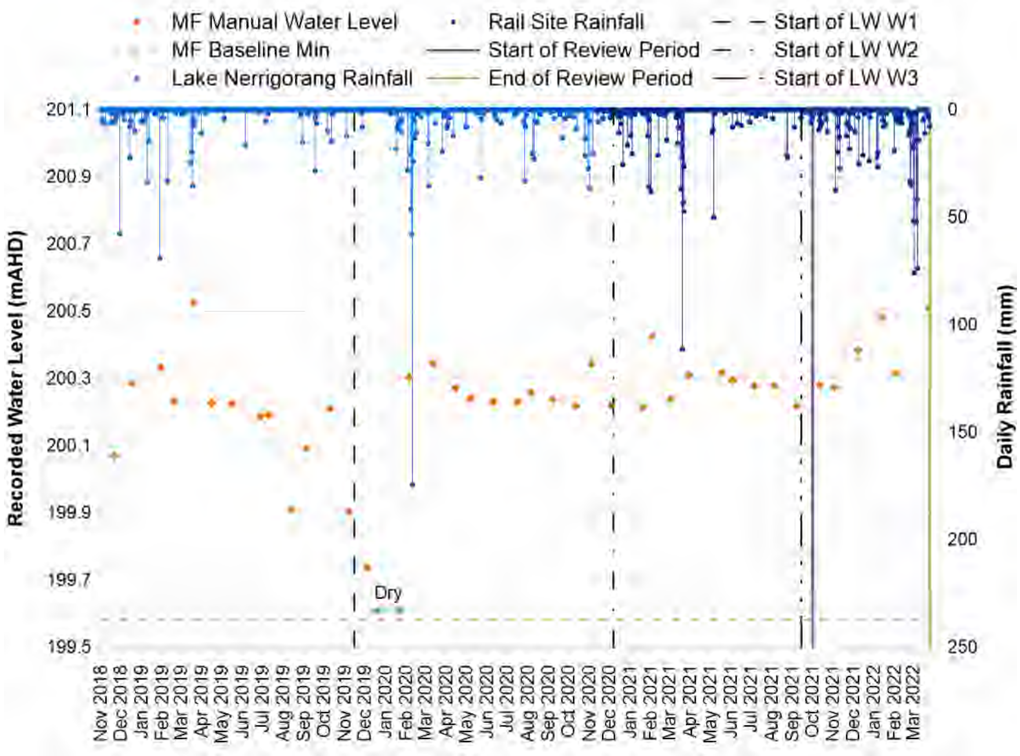


**FIGURE A6: MONITORING SITE MF WATER LEVEL RECORDS**

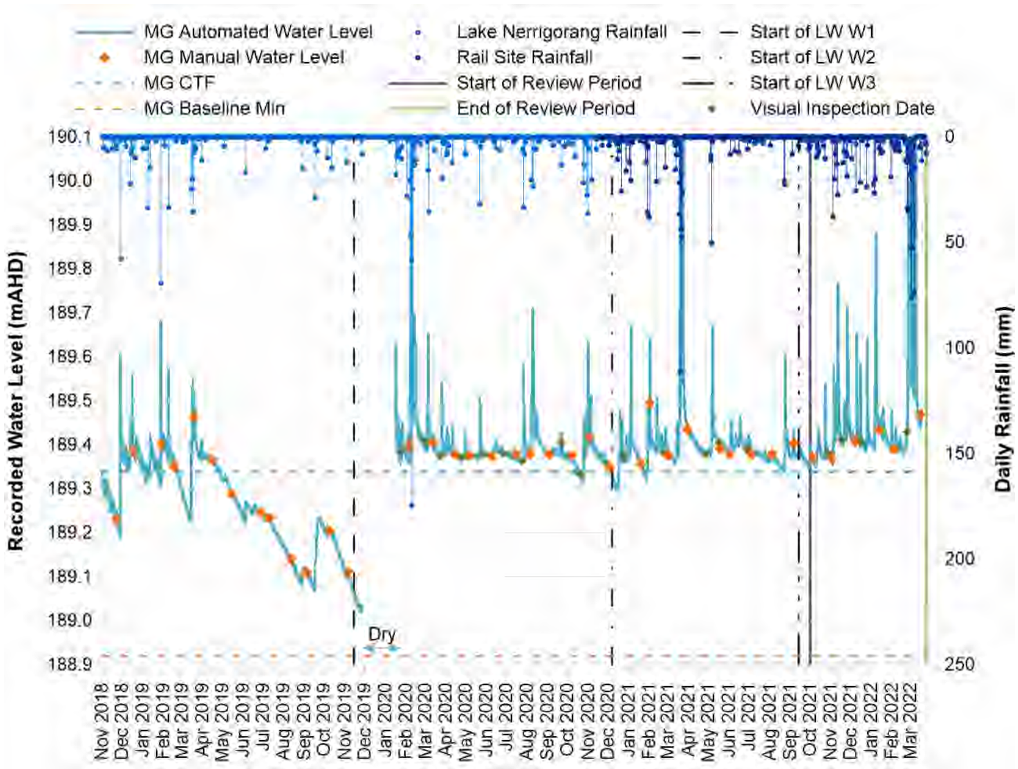


**FIGURE A7: MONITORING SITE MG WATER LEVEL RECORDS**

## CEDAR CREEK SURFACE WATER MONITORING SITES

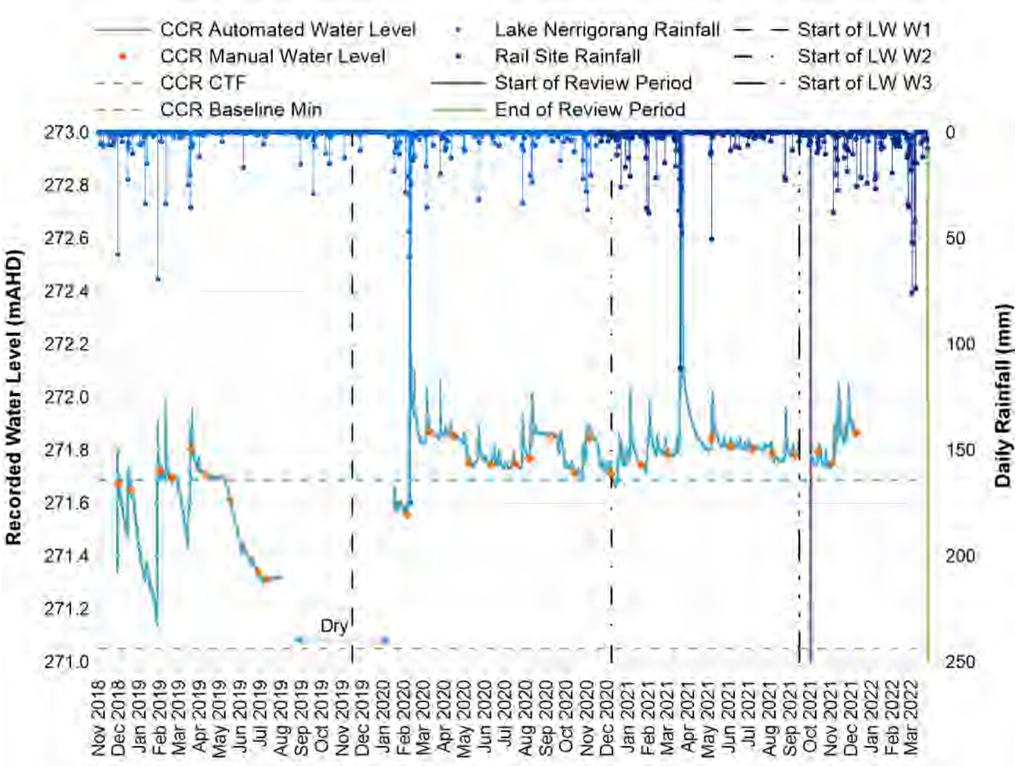


**FIGURE A8: MONITORING SITE CCR WATER LEVEL RECORDS[3]**

[3] The reference bolts at monitoring sites CCR and SF have not been found and as such the raw data recorded from 7 / 8 December 2021 was unable to be converted to a water level measurement.

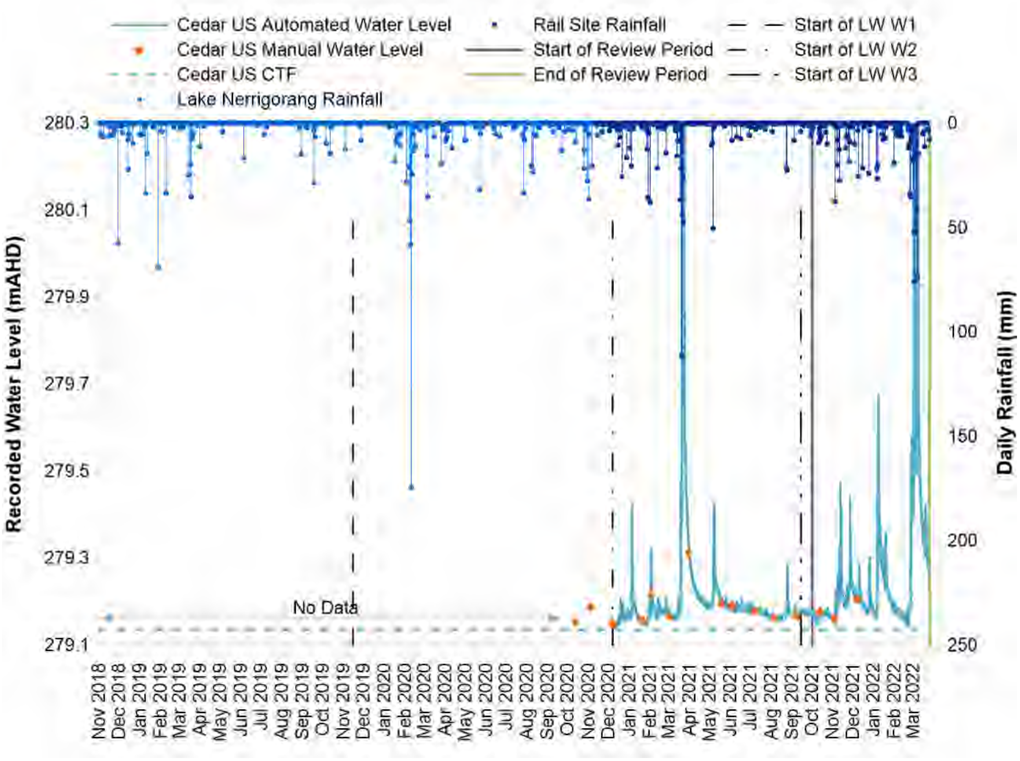


FIGURE A9: MONITORING SITE CEDAR US WATER LEVEL RECORDS

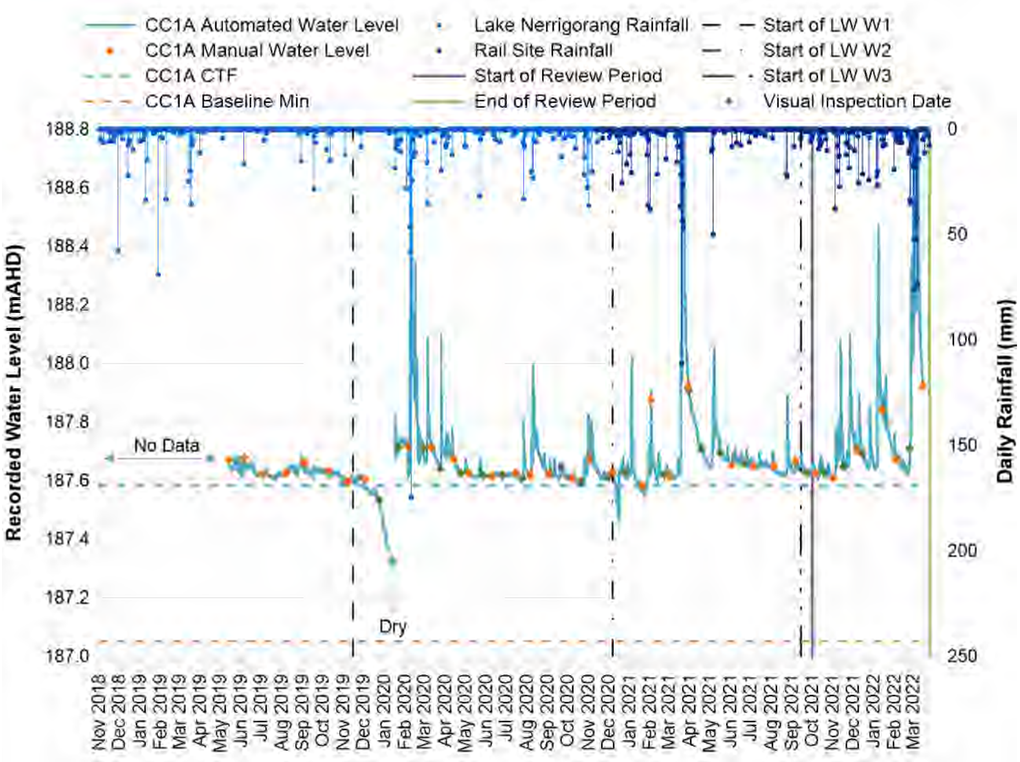


FIGURE A10: MONITORING SITE CC1A WATER LEVEL RECORDS

TAILINGS.WATER.WASTE.

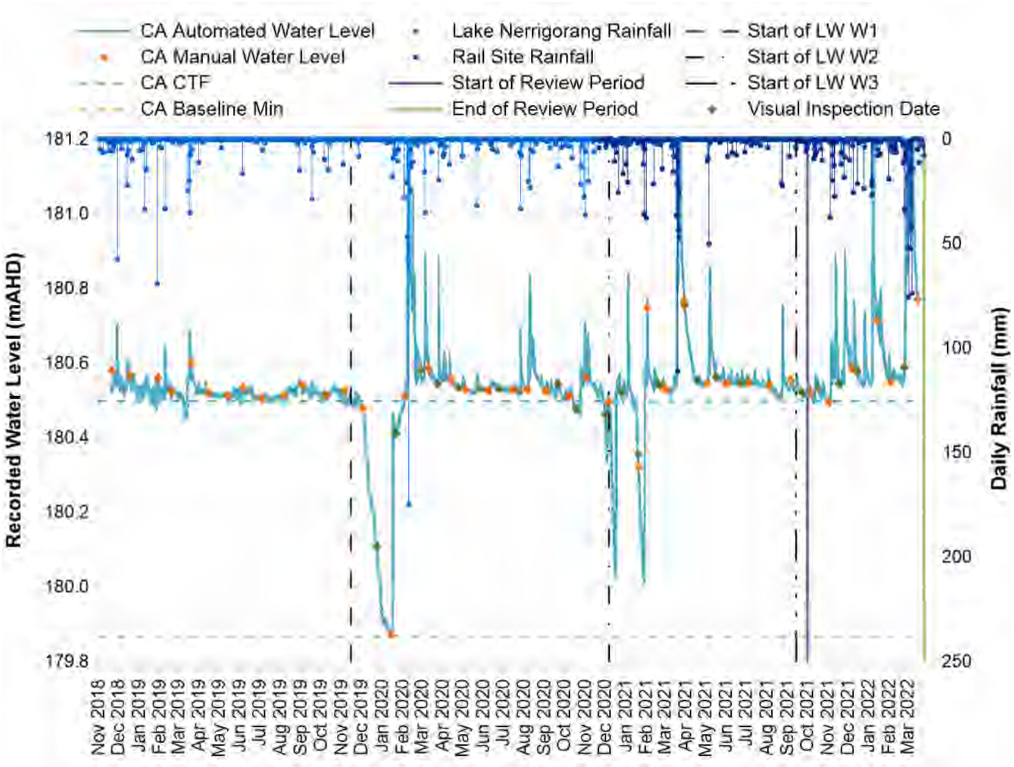


**FIGURE A11: MONITORING SITE CA WATER LEVEL RECORDS**

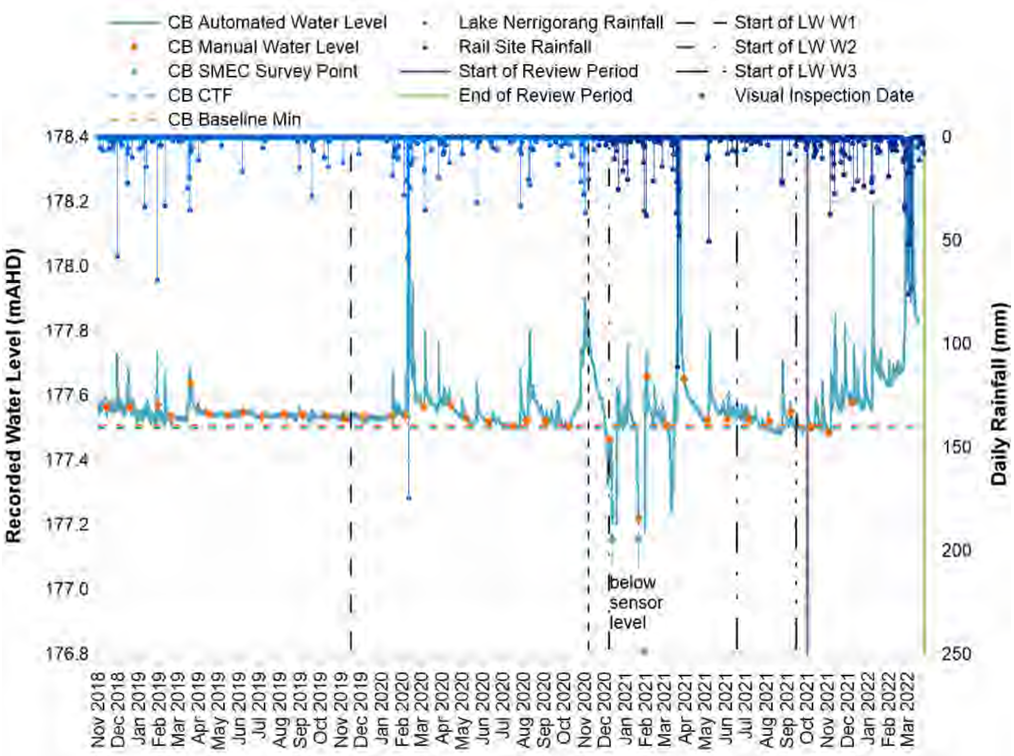


**FIGURE A12: MONITORING SITE CB WATER LEVEL RECORDS**

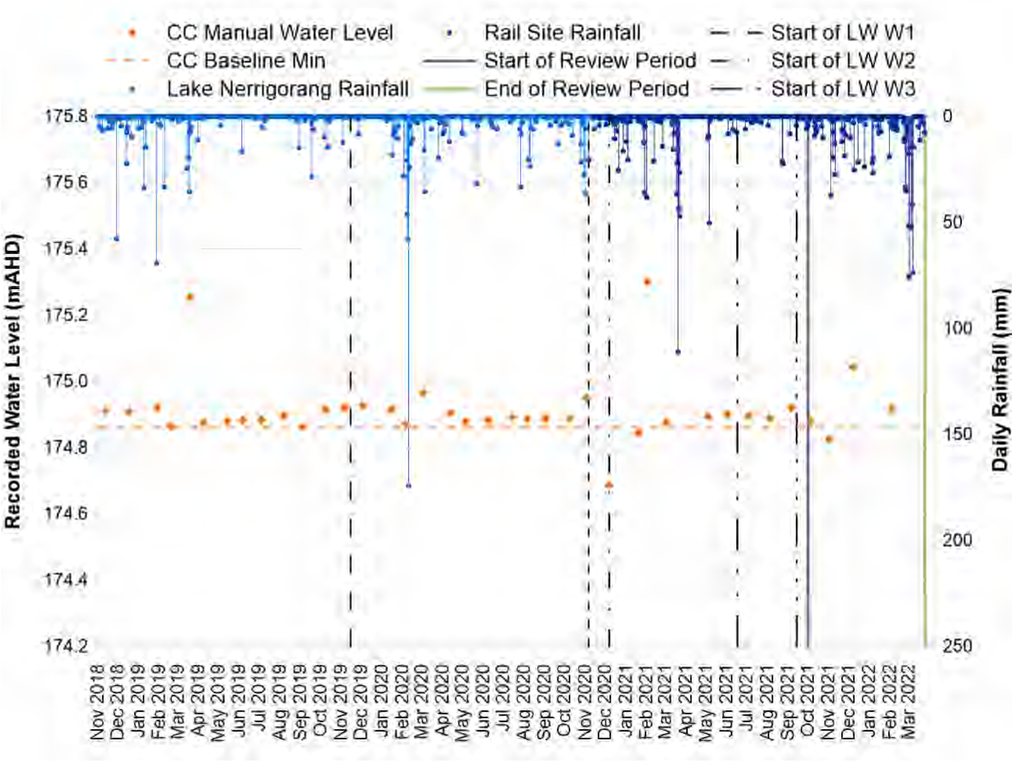


**FIGURE A13: MONITORING SITE CC WATER LEVEL RECORDS**

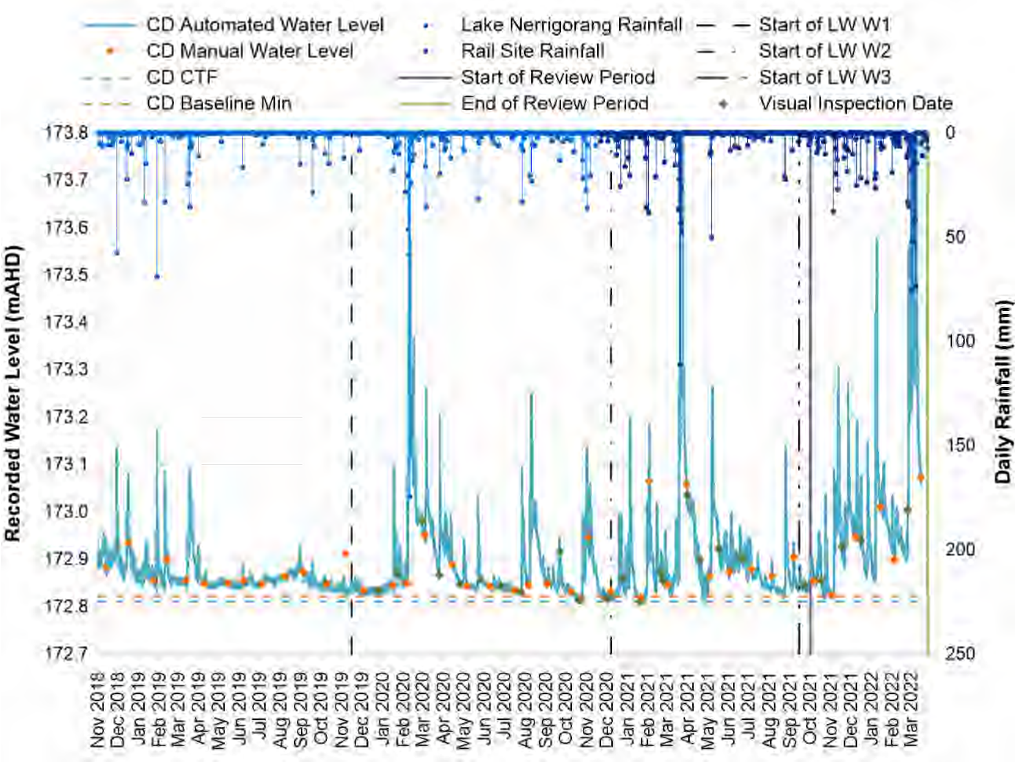


**FIGURE A14: MONITORING SITE CD WATER LEVEL RECORDS**

TAILINGS.WATER.WASTE.

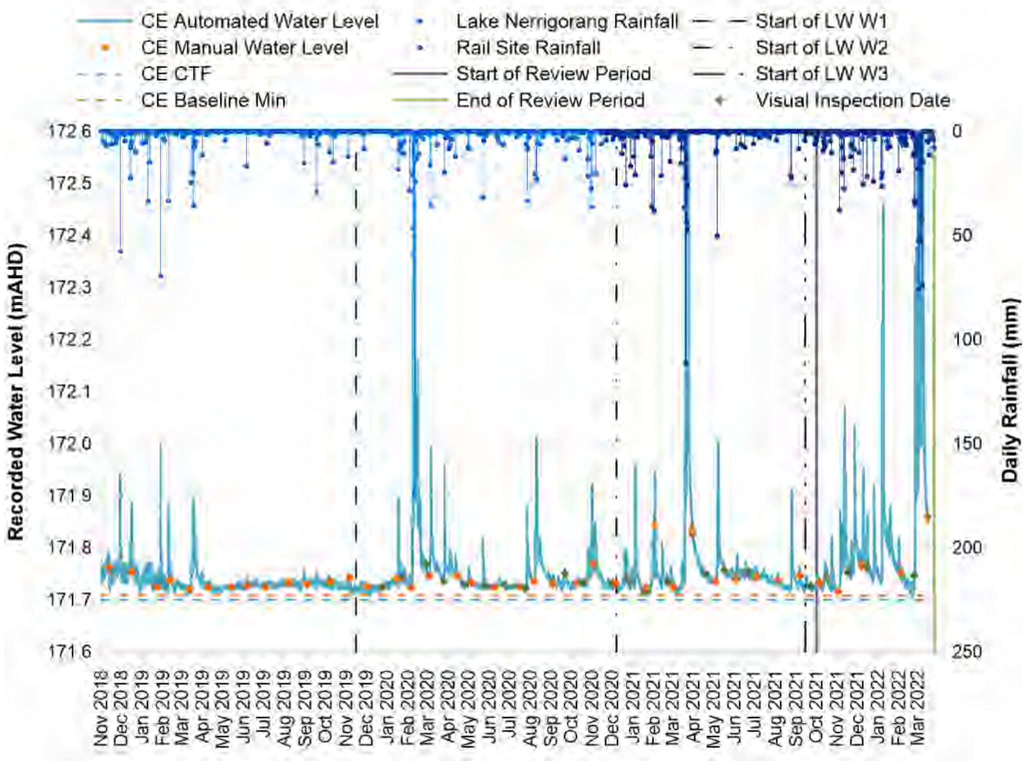


**FIGURE A15: MONITORING SITE CE WATER LEVEL RECORDS**

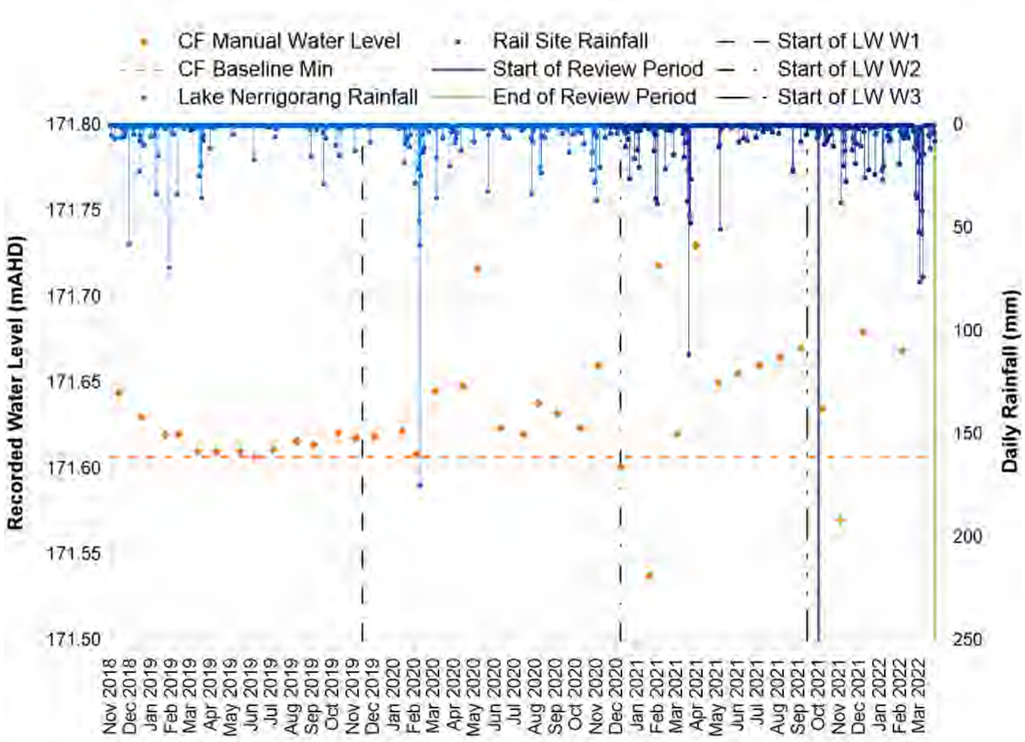


**FIGURE A16: MONITORING SITE CF WATER LEVEL RECORDS**

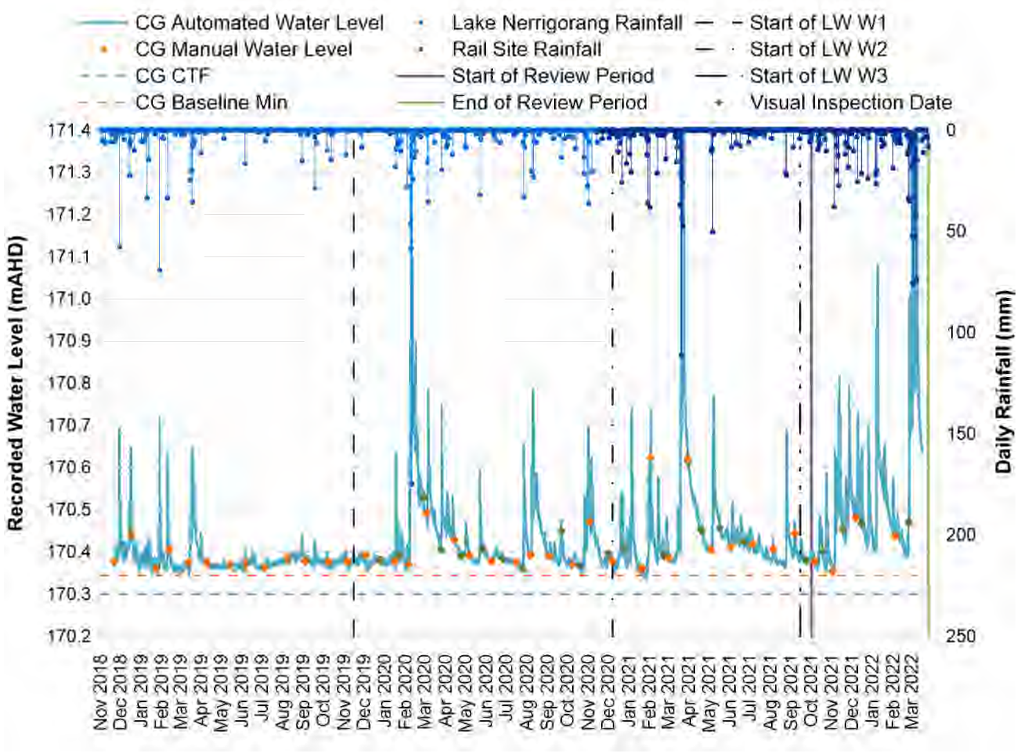


**FIGURE A17: MONITORING SITE CG WATER LEVEL RECORDS**

## STONEQUARRY CREEK SURFACE WATER MONITORING SITES

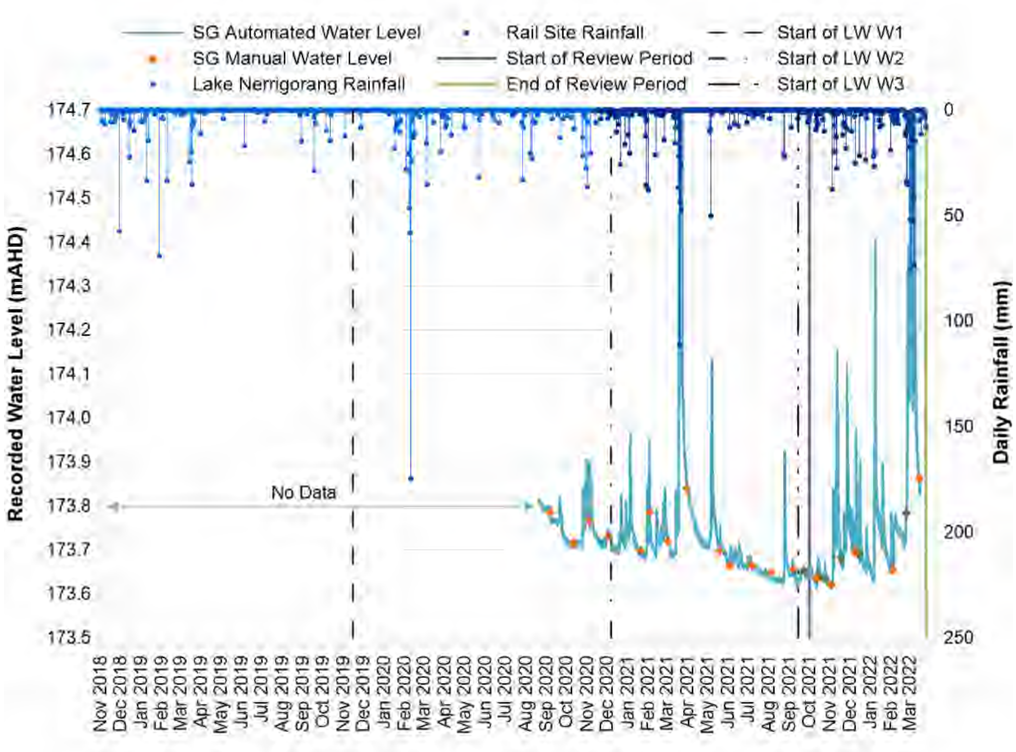


**FIGURE A18: MONITORING SITE SG WATER LEVEL RECORDS**

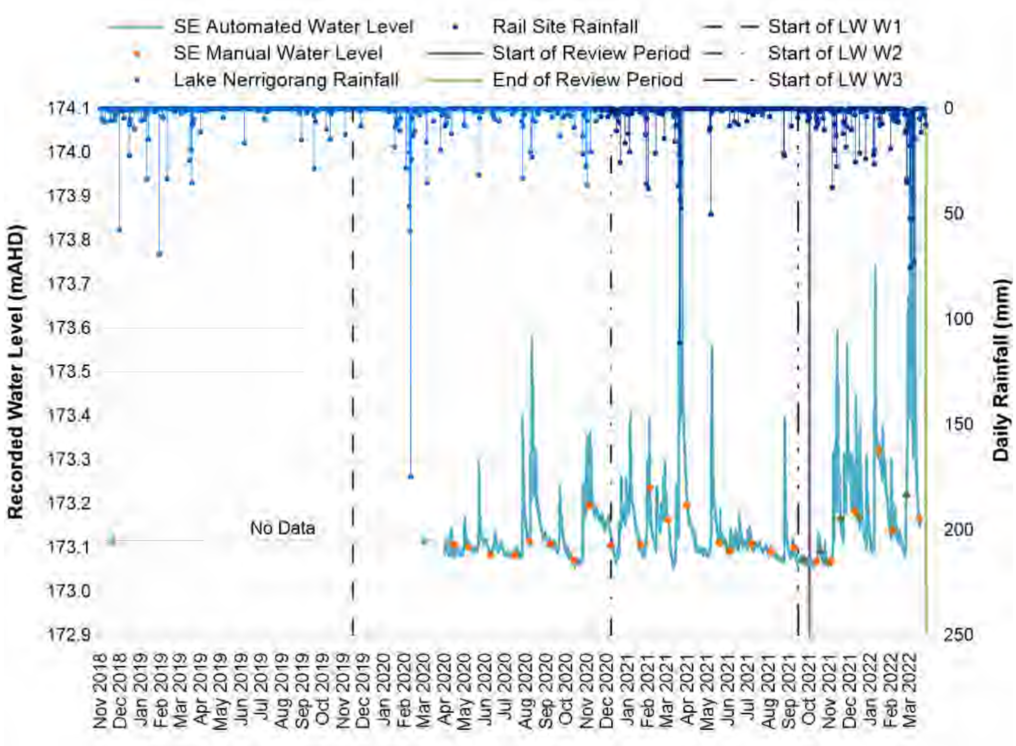


**FIGURE A19: MONITORING SITE SE WATER LEVEL RECORDS**

TAILINGS.WATER.WASTE.

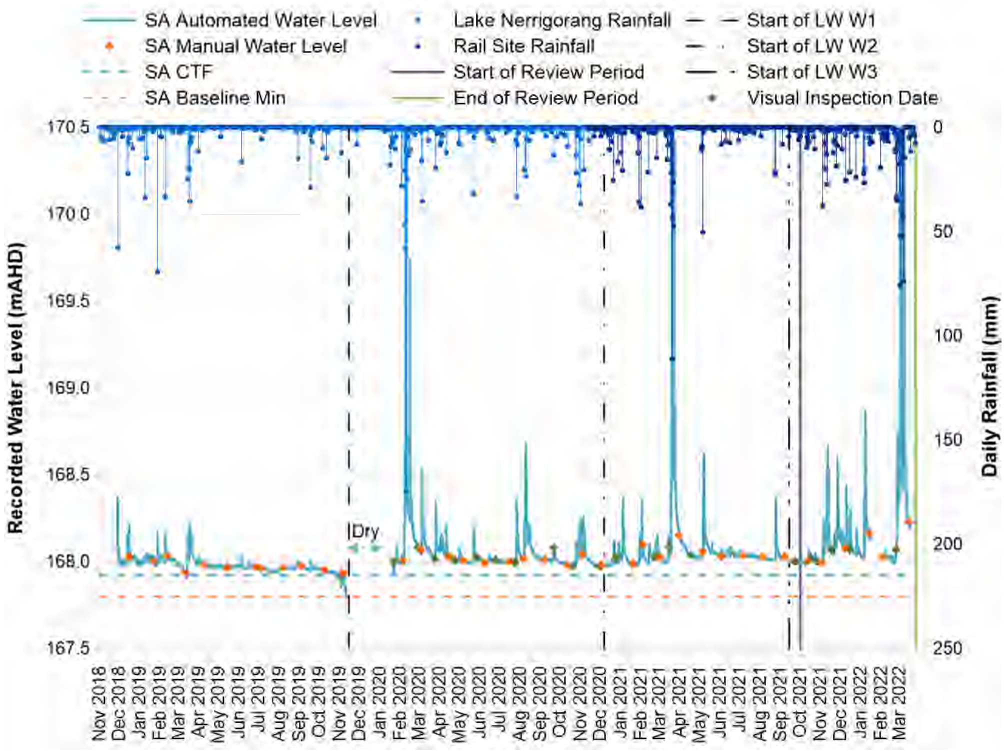


**FIGURE A20: MONITORING SITE SA WATER LEVEL RECORDS[4]**

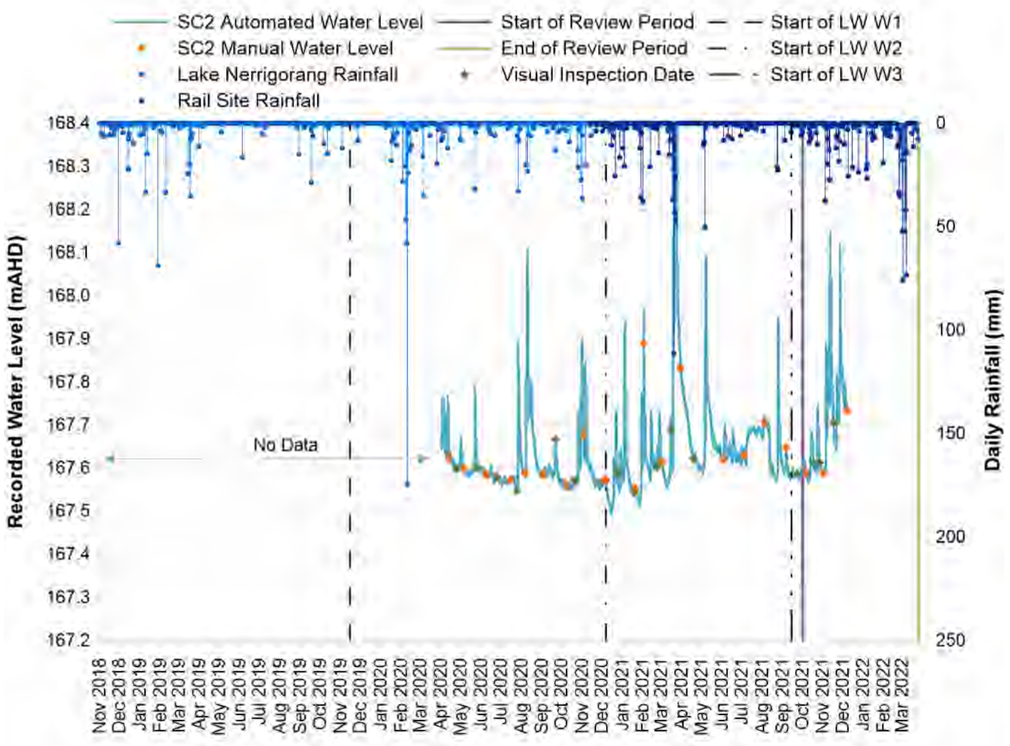


**FIGURE A21: MONITORING SITE SC2 WATER LEVEL RECORDS[5]**

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[4] Between 15 January and 5 February 2022, an incomplete data download occurred at monitoring site SA, or the logger was not correctly restarted, and as such no data is available for this period.

[5] The water level sensor has not been located and therefore records are not available from 7 December 2021.

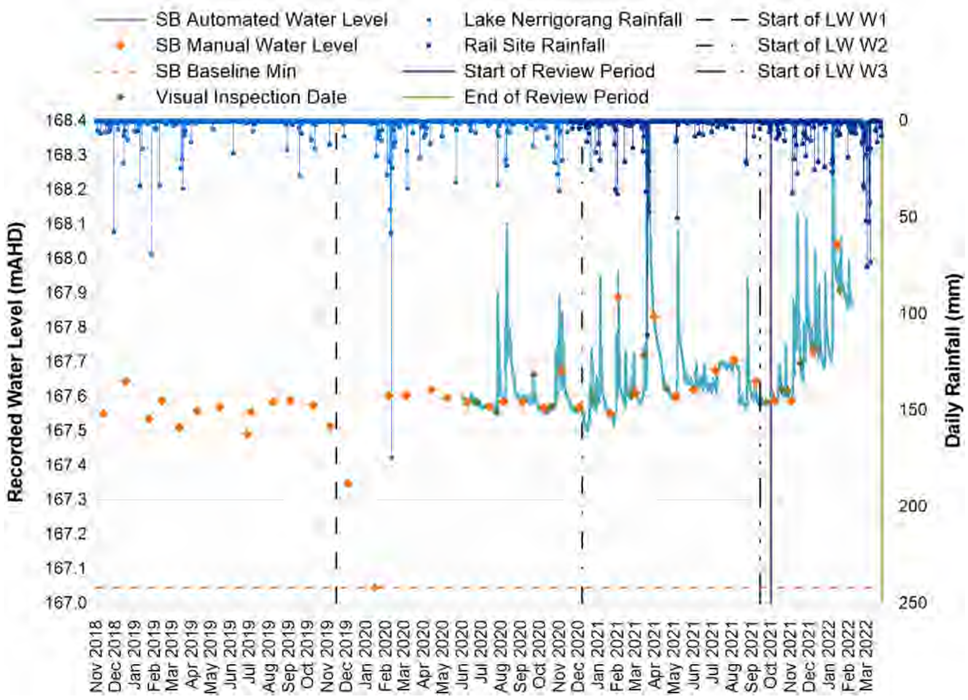


**FIGURE A22: MONITORING SITE SB WATER LEVEL RECORDS[6]**

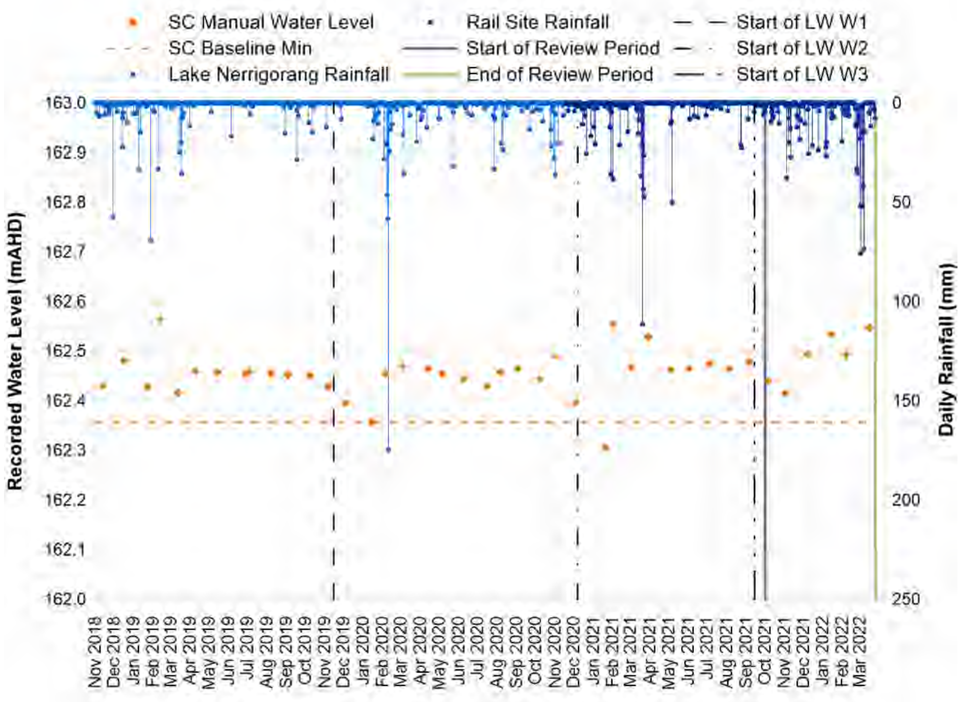


**FIGURE A23: MONITORING SITE SC WATER LEVEL RECORDS**

6 The logger at monitoring site SB was washed away during a major rainfall event from late February to early March 2022 and as such data has not been collected since 5 February 2022.

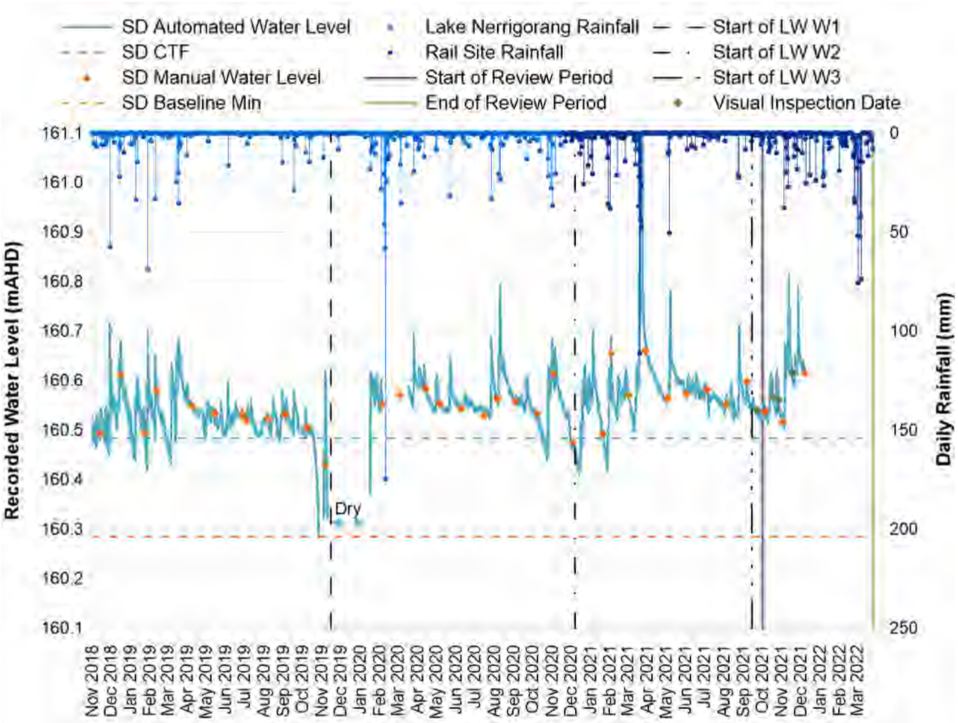


**FIGURE A24: MONITORING SITE SD WATER LEVEL RECORDS**[7]

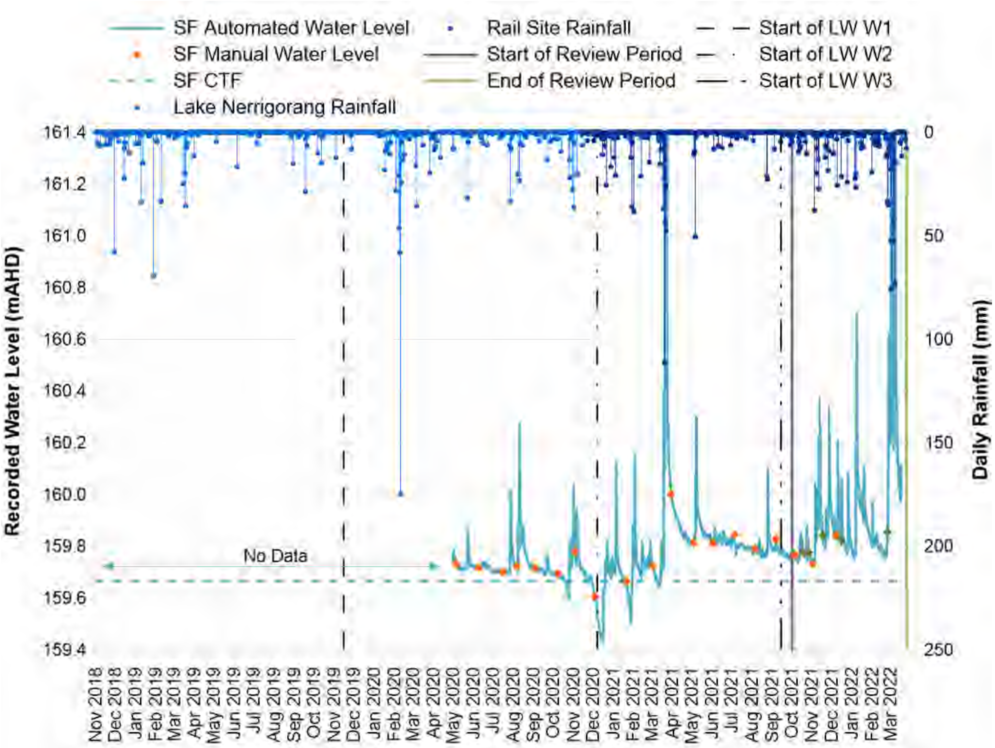


**FIGURE A25: MONITORING SITE SF WATER LEVEL RECORDS**

[7] The water level sensor has not been located and therefore records are not available from 7 December 2021.



TAILINGS.WATER.WASTE.

# APPENDIX B – WATER QUALITY PLOTS[8]

[8] When the recorded value was below the limit of reporting, the value has been plotted at the limit of reporting in the following plots.

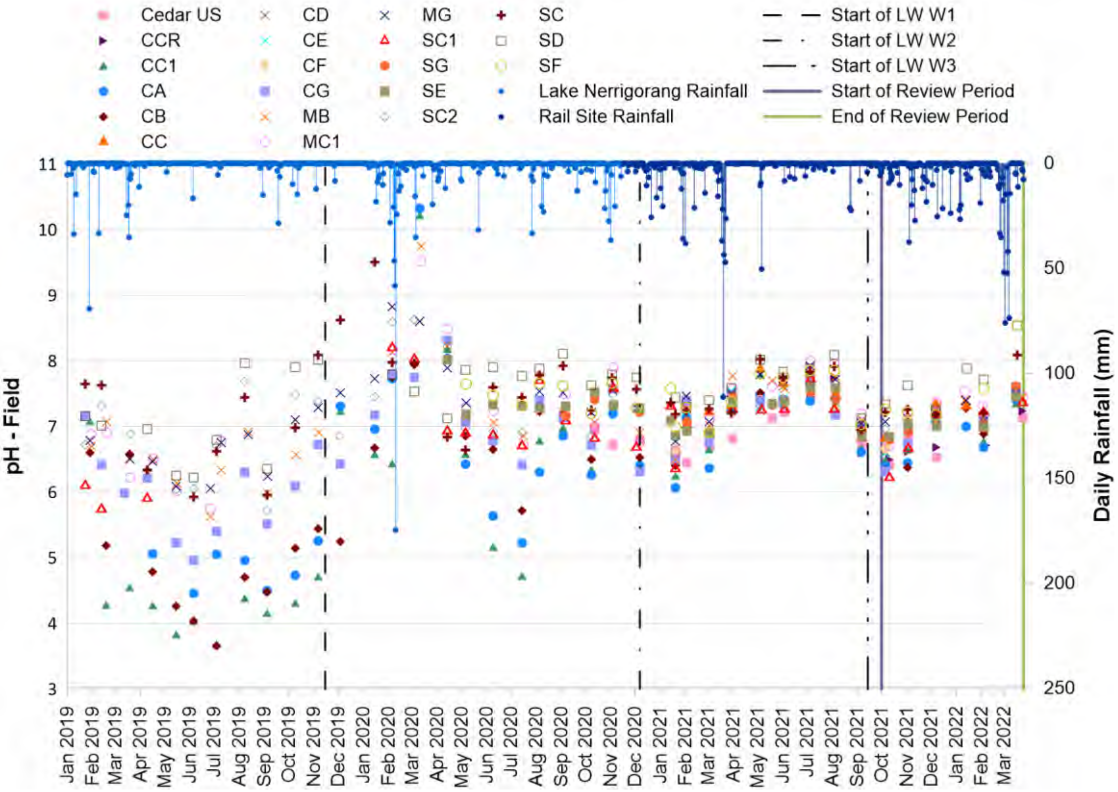


**FIGURE B1: FIELD PH RECORDS**

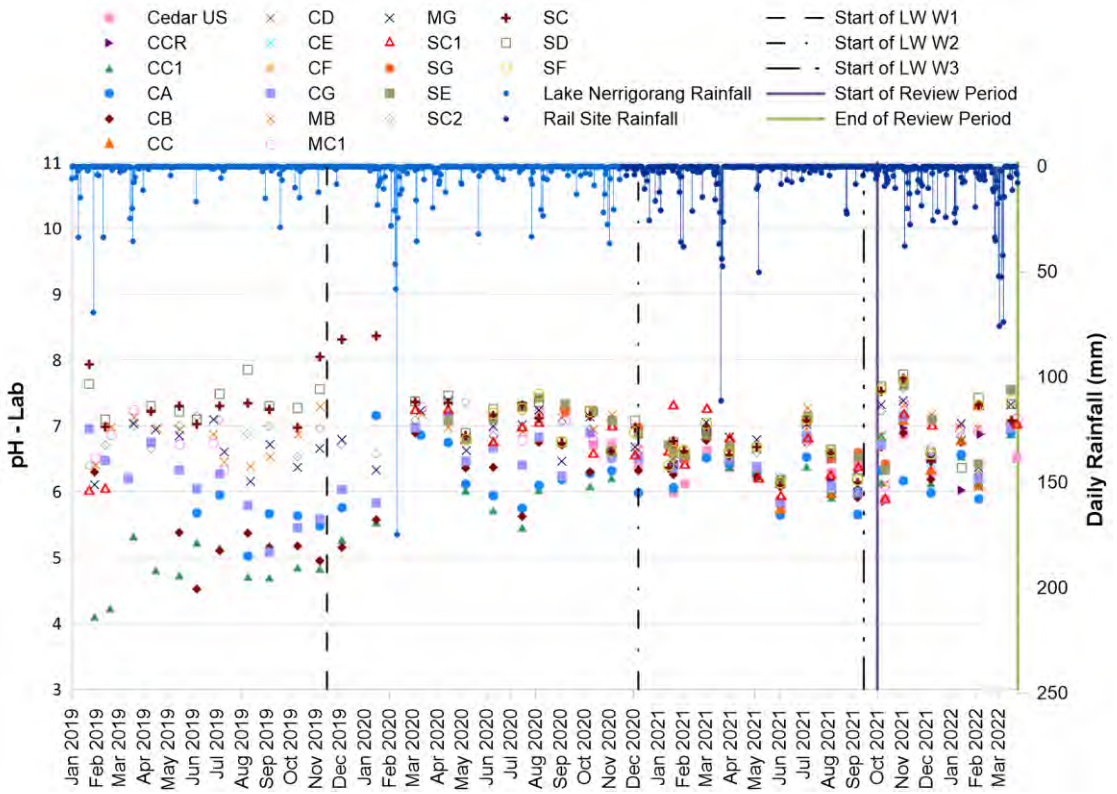


**FIGURE B2: LABORATORY PH RECORDS**

TAILINGS.WATER.WASTE.

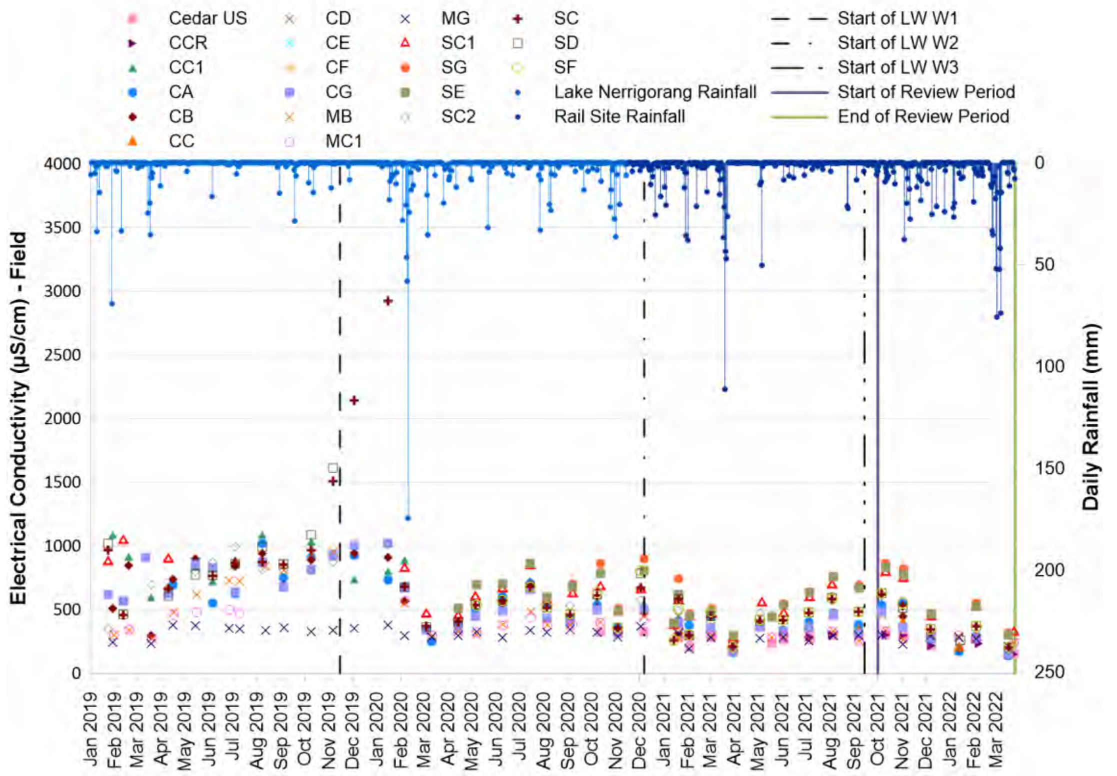


**FIGURE B3: FIELD ELECTRICAL CONDUCTIVITY RECORDS**

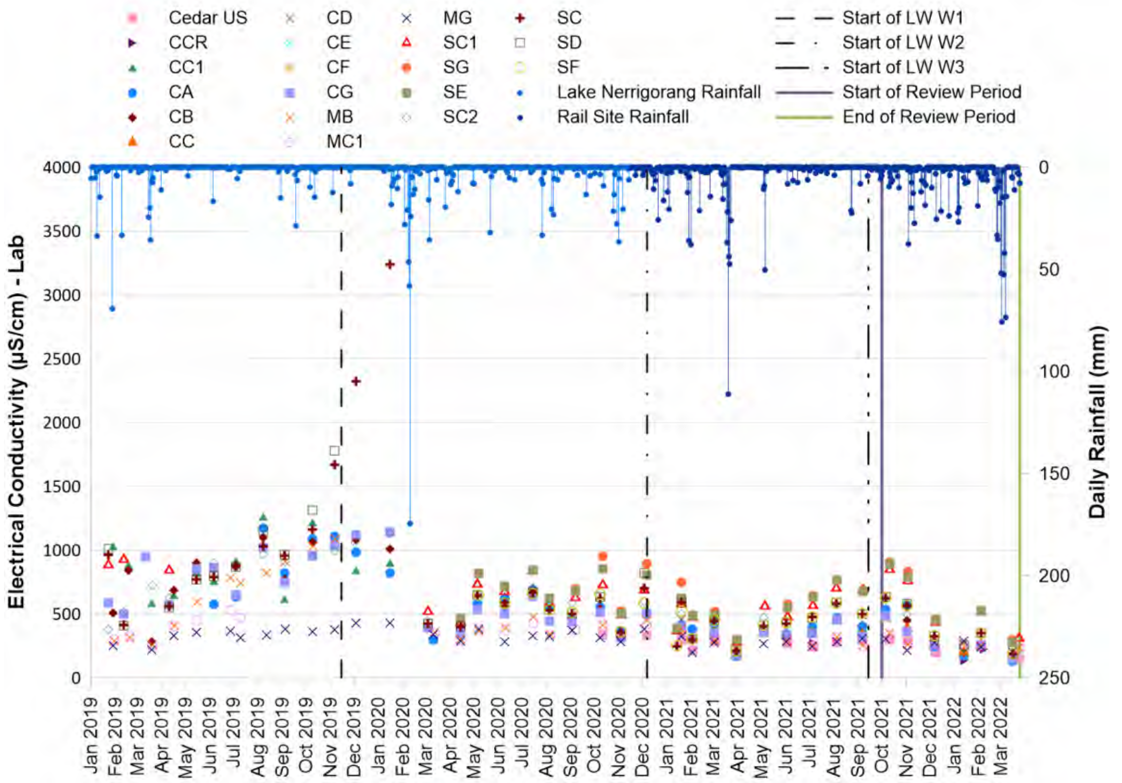


**FIGURE B4: LABORATORY ELECTRICAL CONDUCTIVITY RECORDS**

TAILINGS.WATER.WASTE.

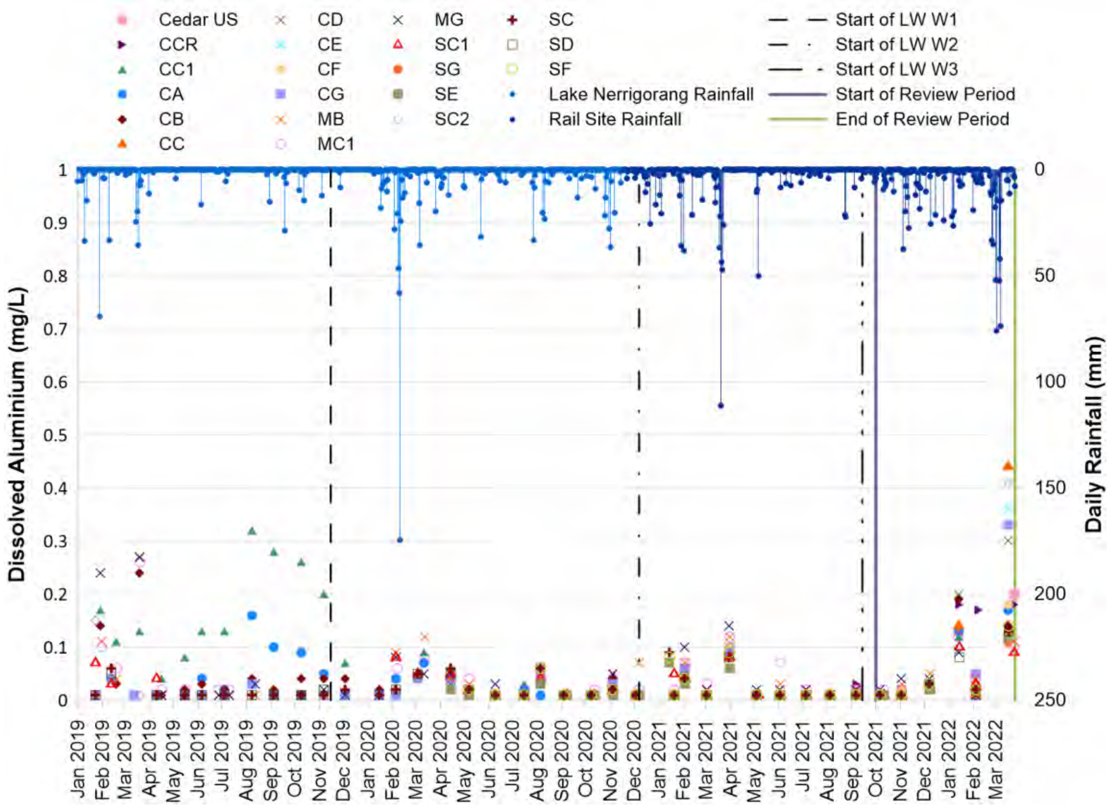


**FIGURE B5: DISSOLVED ALUMINIUM RECORDS**

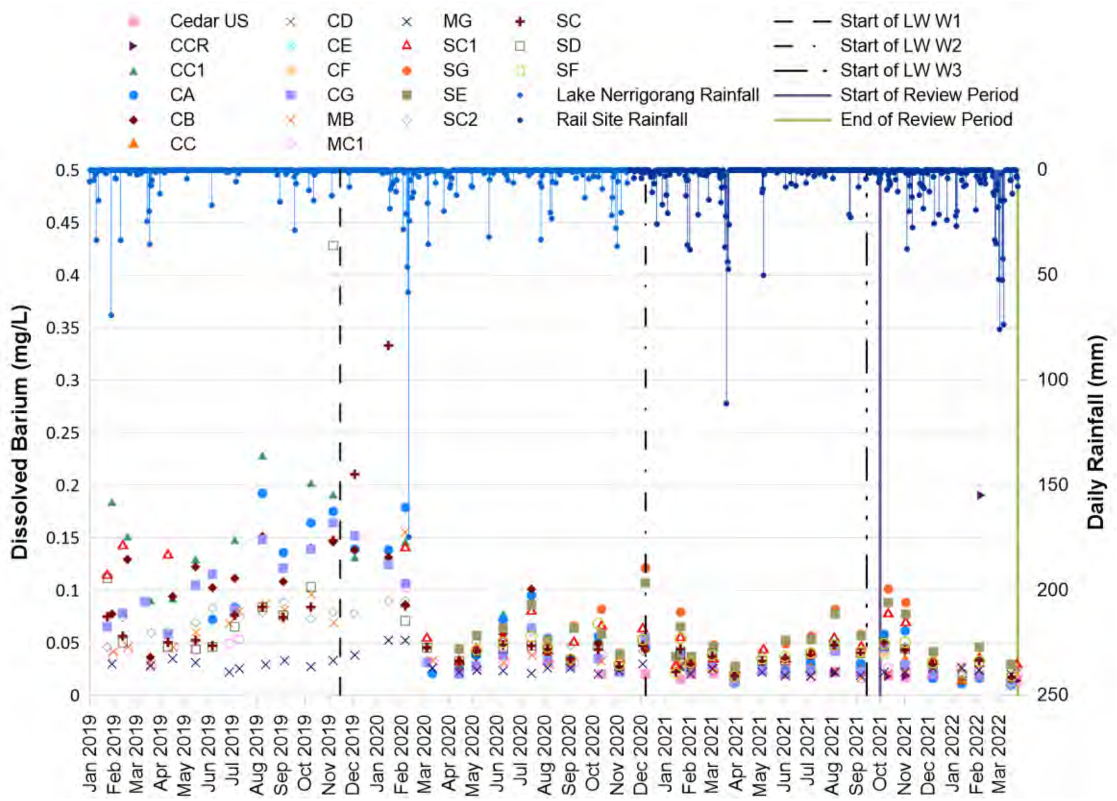


**FIGURE B6: DISSOLVED BARIUM RECORDS**

TAILINGS.WATER.WASTE.

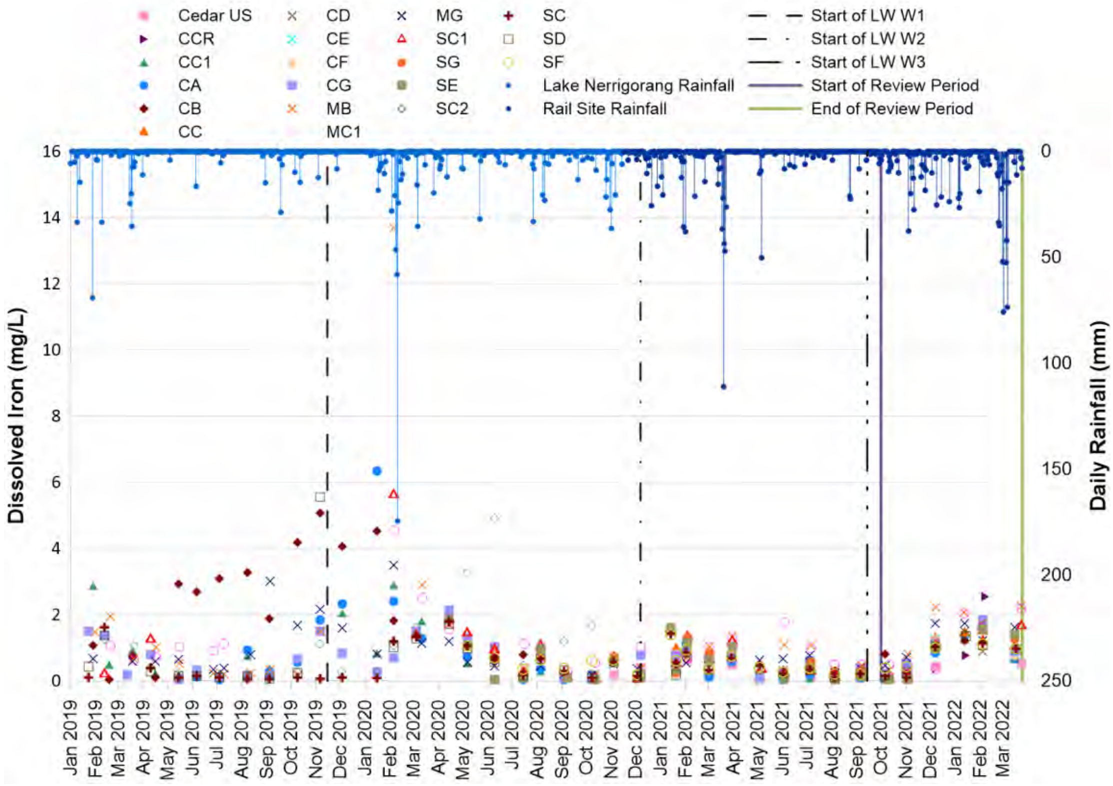


**FIGURE B7: DISSOLVED IRON RECORDS**

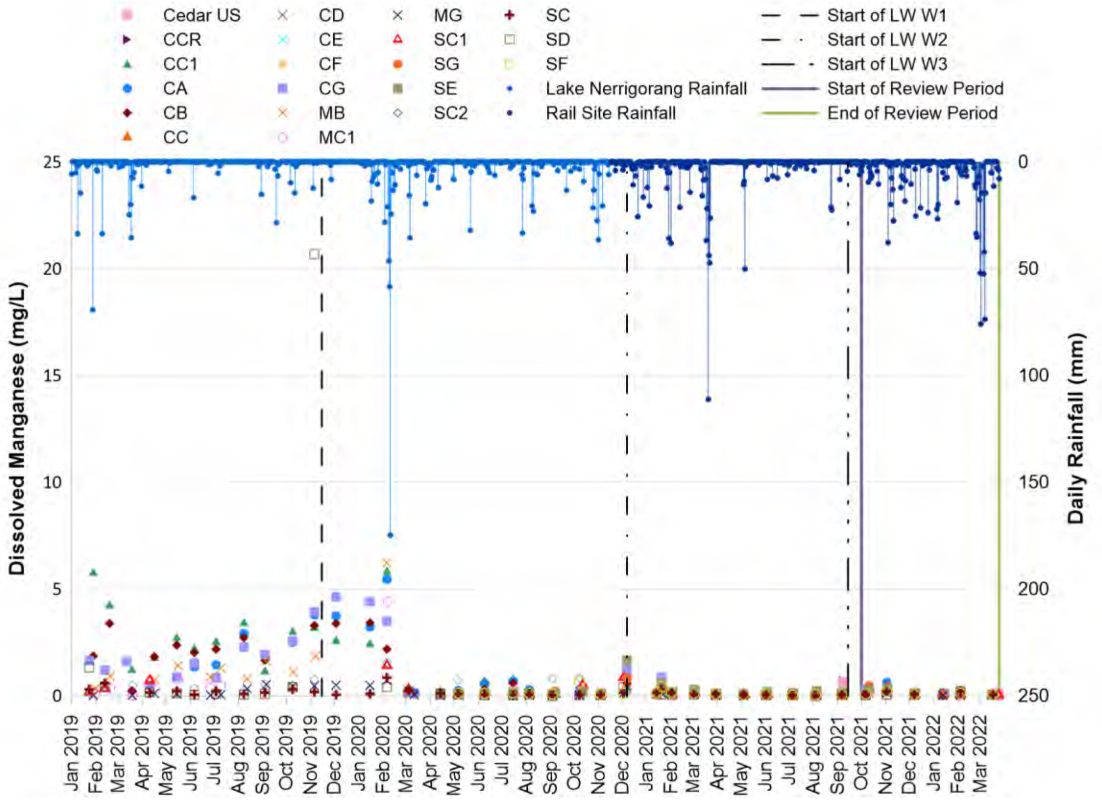


**FIGURE B8: DISSOLVED MANGANESE RECORDS**



TAILINGS.WATER.WASTE.

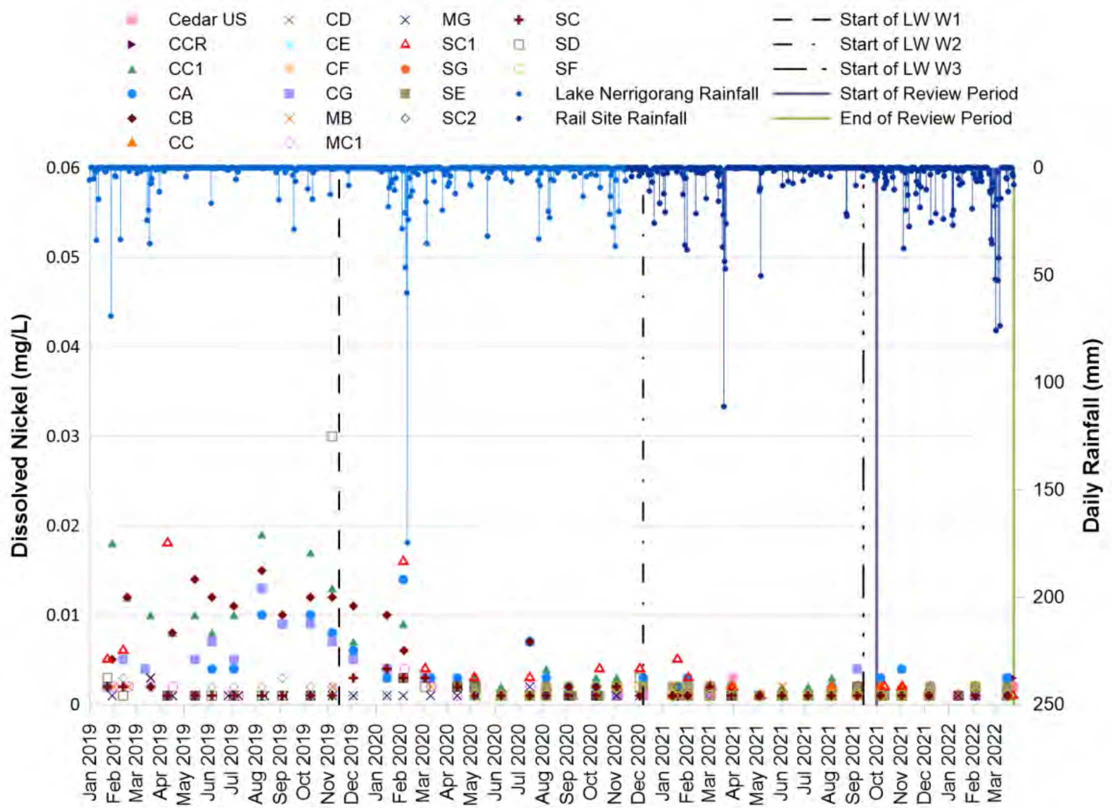


FIGURE B9: DISSOLVED NICKEL RECORDS

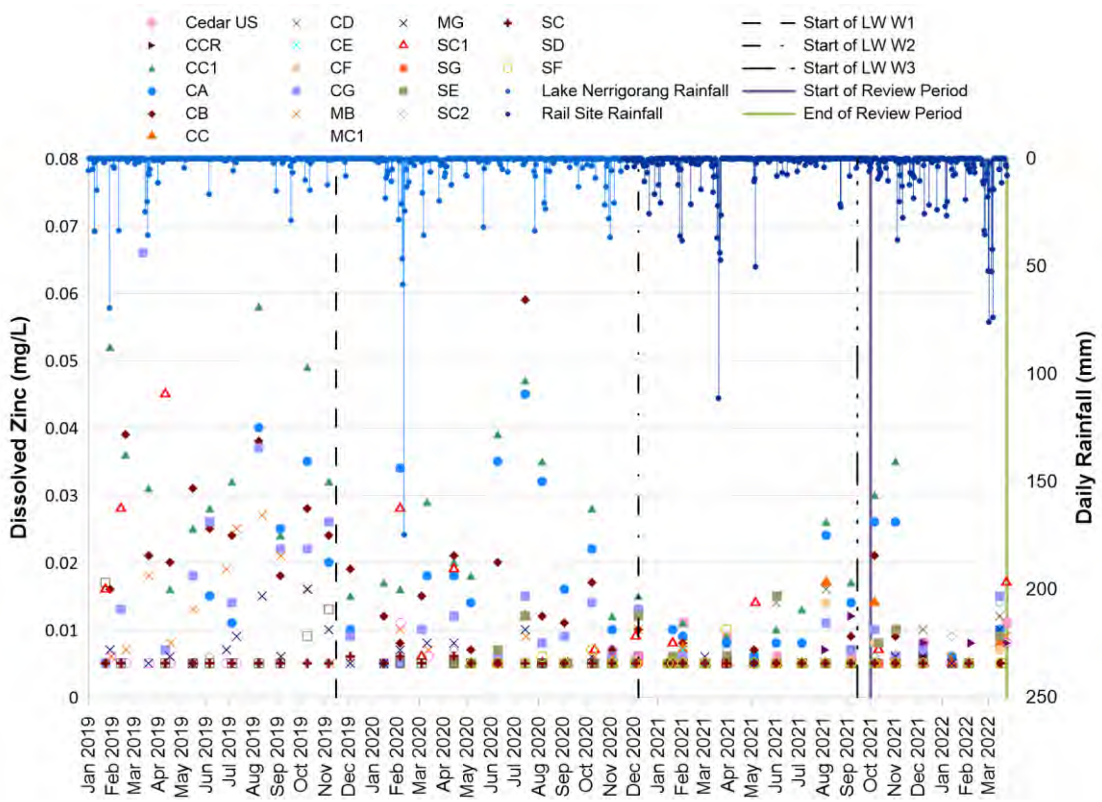


FIGURE B10: DISSOLVED ZINC RECORDS

TAILINGS.WATER.WASTE.

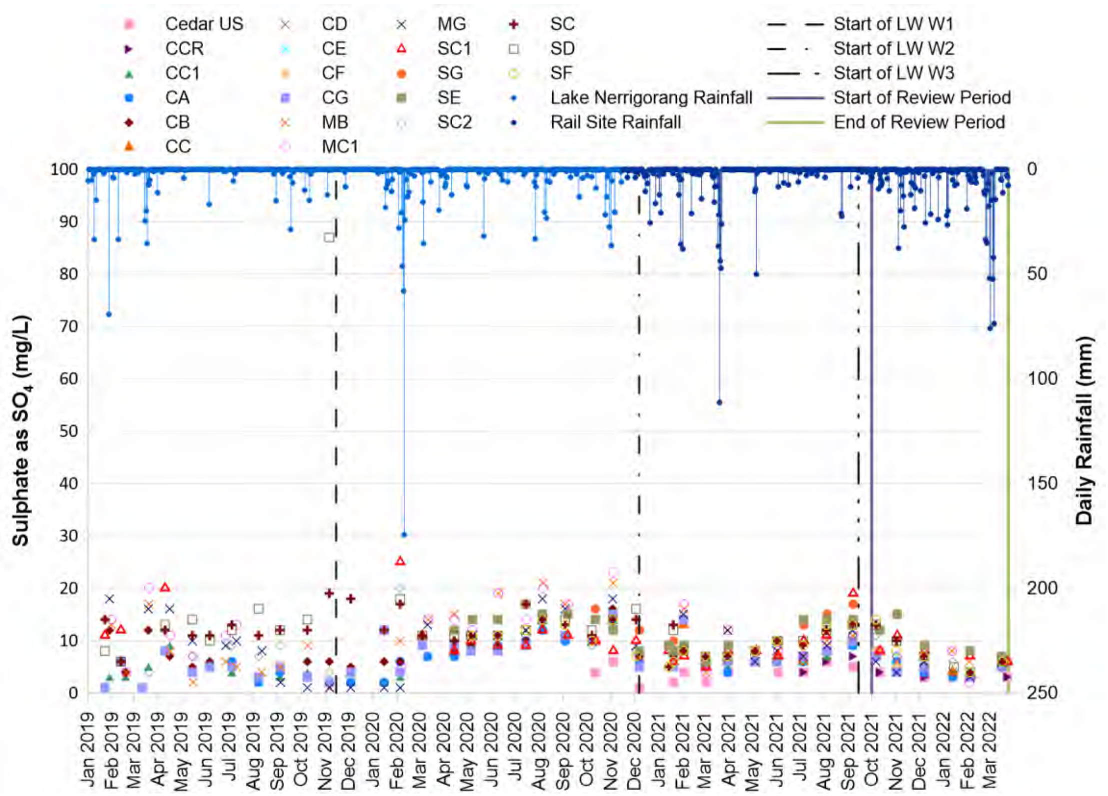


**FIGURE B11: DISSOLVED SULPHATE RECORDS**

# REPORT

**TAHMOOR COAL PTY LTD**
ABN: 97076663968

**Tahmoor North Western Domain**

**Surface Water Review**
**25 March to 7 September 2022**

121171-08R001-rev0
November 2022

TAILINGS.WATER.WASTE.

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|---|---|---|---|---|
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## APPENDICES

# 1 INTRODUCTION

## 1.1 Background

Tahmoor Coal Pty Ltd (Tahmoor Coal) owns and operates Tahmoor Mine, an underground coal mine extracting coking coal which is an ingredient in the production of steel. The mine surface operations are located south of Tahmoor NSW (within the Greater Sydney Basin) approximately 80 km southwest of Sydney. Tahmoor Mine is within the Wollondilly Shire Council (WSC) Local Government Area (LGA). Underground workings extend north under the town of Tahmoor and Picton with two ventilation shafts being located on the outskirts of Tahmoor. The location of Tahmoor Mine in the regional context is shown in **Map 1**.

Mining of Longwall West 3 (LW W3) commenced on 13 September 2021 and was completed on 12 March 2022. Mining of Longwall West 4 (LW W4) commenced on 16 May 2022 and was completed on 13 September 2022.

In accordance with the *Tahmoor North Western Domain Longwalls West 3 and West 4 Water Management Plan* (Tahmoor Coal, 2021; WMP), Tahmoor Coal Pty Ltd (Tahmoor Coal) are required to implement a monitoring program that includes groundwater, surface water and subsidence.

To support the monitoring program, Tahmoor Coal have developed a comprehensive rainfall, surface water and groundwater monitoring network within and adjacent to the Western Domain. The monitoring network comprises rainfall stations, water level monitoring sites, water quality monitoring sites and visual inspection sites. The locations of the relevant rainfall stations, surface water and groundwater monitoring sites and visual inspection sites are shown in **Map 1**.

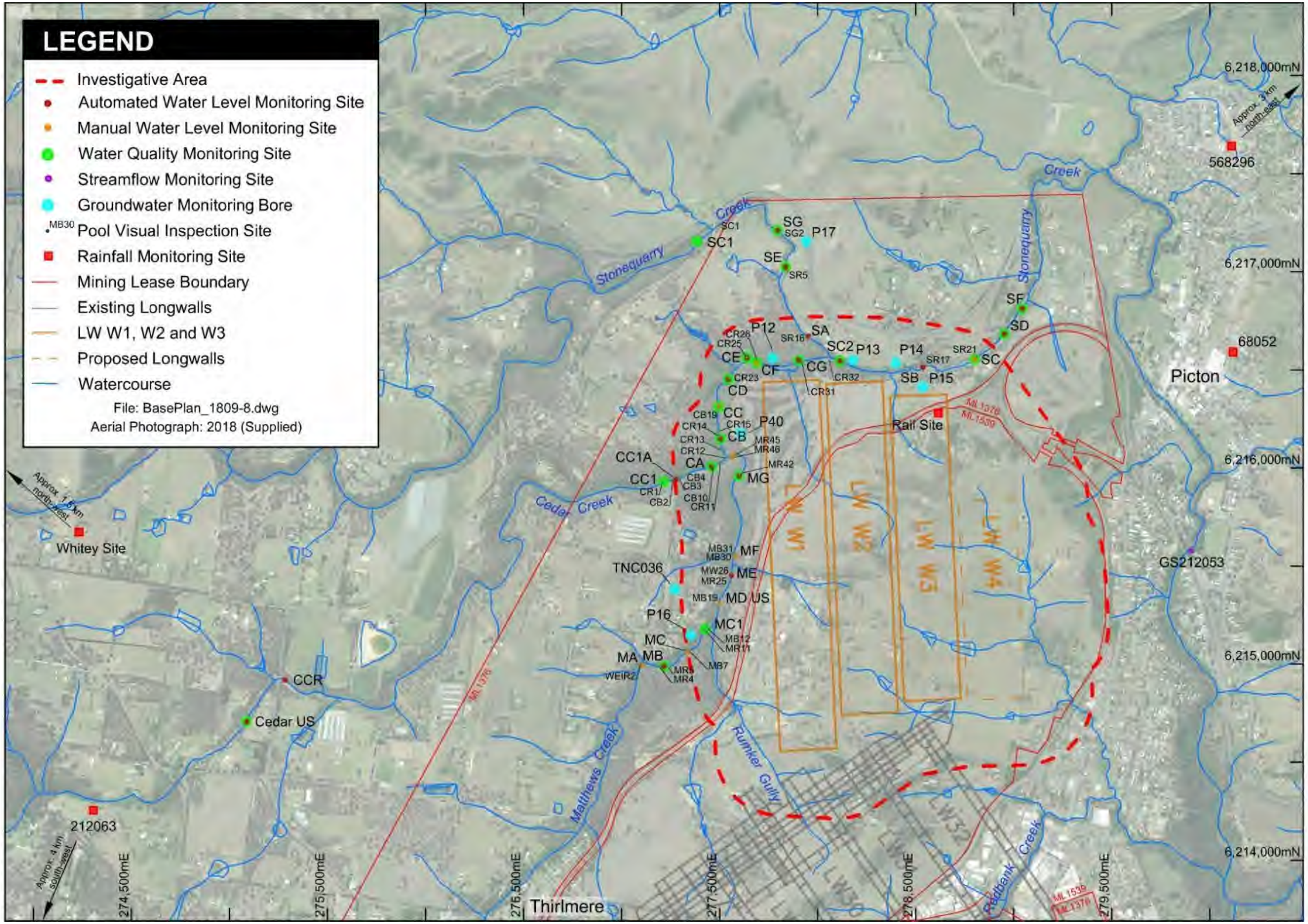
Tahmoor Coal have engaged ATC Williams Pty Ltd (ATCW) to undertake a review and analysis of surface water monitoring data recorded at sites within and adjacent to the Tahmoor North Western Domain (the Western Domain). The groundwater and subsidence review and analysis are undertaken by independent specialists.

## 1.2 Scope of Work

This report documents a review undertaken by ATCW of the environmental performance of the LW W3 and LW W4 mining activities in relation to surface water (water resources and watercourses) within and adjacent to the Western Domain Investigative Area for the review period 25 March to 7 September 2022[1] (the review period). The Western Domain Investigative Area is shown in **Map 1**. This report forms a component of the *Subsidence Impact Report* for the Tahmoor North Western Domain and comprises:

- Review and interpretation of monitoring data recorded over the reporting period;
- Assessment of water level and quality results against the performance measures and performance indicators for surface water in accordance with the *Tahmoor North Western Domain Longwalls West 3 and West 4 Water Management Plan*; and
- Recommendations in relation to ongoing monitoring or corrective actions, where required.

[1] Data was collected for a portion of the monitoring sites between 25 March to 7 September 2022.




MAP 1: RELEVANT RAINFALL, SURFACE WATER AND GROUNDWATER MONITORING SITES

# 2 MONITORING PROGRAM

## 2.1 Overview

The surface water monitoring program is described in the WMP. The purpose of the surface water monitoring program is to ensure compliance with regulatory requirements and to enable identification of potential mining related impacts to:

- physical features and natural drainage behaviour (assessed by independent specialists and summarised herein);
- surface water level; and
- surface water quality.

The surface water level and quality data are assessed against the performance measures, performance indicators and Trigger Action Response Plan (TARP) documented in the WMP.

Surface water monitoring locations have been located to facilitate this assessment, with the following definitions for baseline, reference and potential impact sites applying:

| | |
|---|---|
| Baseline Site: | Surface water monitoring site that has been monitored for water level and quality prior to the commencement of mining in the Western Domain. Baseline surface water monitoring sites were used to derive Site Specific Guideline Values (SSGVs) which inform the TARPS. |
| Reference Site: | Surface water monitoring site that is located upstream of the subsidence impact zone and is considered unlikely to be affected by mining activity. These sites are utilised as benchmarks for observations from potential impact sites. |
| Potential Impact Site: | Surface water monitoring site located within the potential subsidence impact zone (as defined based on mining induced subsidence predictions), from which a potential effect on surface water level or quality from the site activity may be detected. |

Based on these definitions, surface water monitoring sites have been classified and are summarised in **Appendix A**.

## 2.2 Methodology

In accordance with the WMP, automated and manual water level monitoring is undertaken. The automated water level monitoring is collected via a water pressure sensor that continuously records pressure measurements. Water level measurements are also recorded manually on a monthly basis at sites with and without automated water level monitoring.

Water quality monitoring is undertaken monthly. The monitored water quality constituents are defined in **Table 1**:

**TABLE 1: SUMMARY OF WATER QUALITY MONITORING**

| Field Monitoring | Laboratory Analysis |
|---|---|
| pH<br>Electrical Conductivity (EC)<br>Temperature<br>Dissolved Oxygen (DO)<br>Oxidation Reduction Potential (ORP) | pH,<br>EC,<br>major cations, including; calcium, magnesium, sodium and potassium, sulphate, alkalinity, chloride,<br>dissolved and total metals, including; aluminium, arsenic, barium, copper, iron, lead, lithium, manganese, nickel, selenium, strontium and zinc,<br>total kjeldahl nitrogen,<br>total nitrogen,<br>nitrite + nitrate,<br>total phosphorus,<br>total cations and total anions. |

Field work and quality control/quality assurance associated with this monitoring program are undertaken by others.

Surface water level and quality data has been collected by Tahmoor Coal at monitoring sites located on Matthews Creek, Cedar Creek and Stonequarry Creek as shown in **Map 1** and **Appendix A**. A summary of the monitoring sites and associated classifications are provided in **Appendix A**.

# 3 SURFACE WATER MONITORING DATA REVIEW

The following sections present a summary of the surface water monitoring data recorded over the review period at monitoring sites in Matthews Creek, Cedar Creek and Stonequarry Creek (refer **Map 1** for site locations). Further review and interpretation of monitoring data in relation to the relevant TARPs as per the WMP, is presented in **Section 4**.

## 3.1 Surface Water Level Data

### 3.1.1 Data Constraints

**Appendix B** provides charts of the automated and manual water level data for the full period of record. Note that the cease to flow (CTF) level shown on the automated water level plots refers to the point at which surface water ceases to flow over the streamflow control (i.e., the lowest point on a controlling rockbar or boulder field). In the event that streamflow over the rockbar or boulder field ceases, there may still be streamflow around, through or under the rockbar / boulder field control which reports downstream of the control.

The following is noted in relation to the monitoring data recorded during the current review period (25 March to 7 September 2022):

- Monitoring site CCR - the reference bolt at monitoring site CCR has not been located and as such the raw data recorded from 8 December 2021 was unable to be converted to a water level measurement. This site is recommended for decommissioning due to the challenges in data correction and as CCR is influenced by backwater effects from a downstream weir. A reliable reference site for Cedar Creek is located at Cedar US .
- Monitoring site SC2 - the logger and housing were washed away during flood events in late 2021 with no data subsequently available from December 2021.
- Monitoring site SB - the logger was washed away during a major rainfall event that occurred from late February to early March 2022. A new logger and housing were installed on 14 July 2022. Subsequently, data is unavailable for the period 5 February to 13 July 2022.
- Monitoring site SF - the control at monitoring site SF has been impacted by flood events and, as such, the water level records are not necessarily comparative to pre-flood conditions.
- Monitoring site SG – the flow control at monitoring site SG, comprised predominantly of sand and rubble, was washed away in recent flood events and therefore SG is no longer a suitable monitoring site for water level measurements. Monitoring site SG has been recommended for decommissioning, as two alternative representative reference sites are located on Stonequarry Creek (SC1 and SE).
- The manual water level measurements have not been recorded for some sites due to access restrictions (i.e. high flow conditions) or at sites where the reference bolt has not been located.

### 3.1.2 Summary of Observations

**Table 2** presents a summary of the water level monitoring data for the review period. The summary is presented for each pool in which an automated water level sensor is installed. **Appendix B** provides charts of the water level data for all monitoring sites (including manual water level monitoring sites) and daily rainfall. Daily rainfall data was recorded at the 'Rail Site' rainfall gauge (refer **Map 1**) and, prior to the commissioning of this station, the Lake Nerrigorang rainfall station (WaterNSW Station 212063). The 'baseline minimum' refers to the minimum water level recorded prior to the commencement of mining.

**TABLE 2: SUMMARY OF AUTOMATED WATER LEVEL MONITORING DATA FOR REVIEW PERIOD 25 MARCH TO 7 SEPTEMBER 2022**

| Monitoring Site | Classification | Summary of Recorded Water Level During Review Period | Appendix B - Figure Number |
|---|---|---|---|
| *Matthews Creek* | | | |
| MB (Pool MR5) | Reference Site | • Water level remained above the baseline minimum and CTF level | Figure B2 |
| ME (Pool MR25) | Potential Impact Site | • Water level remained above the baseline minimum and CTF level | Figure B5 |
| MG (Pool MR42) | Potential Impact Site | • Water level remained above the baseline minimum and CTF level | Figure B7 |
| *Cedar Creek* | | | |
| Cedar US | Reference Site | • Water level remained above the CTF level | Figure A9 |
| CC1A (Pool CB3) | Reference Site | • Water level remained above the baseline minimum and CTF level | Figure A10 |
| CA (Pool CB10) | Potential Impact Site | • Water level remained above the baseline minimum and CTF level | Figure A11 |
| CB (Pool CR14) | Potential Impact Site | • Water level remained above the baseline minimum and CTF level for the majority of the period.<br>• On 7 September 2022 (end of review period), water level declines slightly below the baseline minimum, however, the decline occurs for less than 24 hrs. | Figure A12 |
| CD (Pool CR23) | Potential Impact Site | • Water level remained above the baseline minimum and CTF level | Figure A14 |
| CE (Pool CR25 | Potential Impact Site | • Water level remained above the baseline minimum and CTF level | Figure A15 |
| CG (Pool CR31) | Potential Impact Site | • Water level remained above the baseline minimum and CTF level | Figure A17 |

**TABLE 2 (CONT.): SUMMARY OF AUTOMATED WATER LEVEL MONITORING DATA FOR REVIEW PERIOD 25 MARCH TO 7 SEPTEMBER 2022**

| Monitoring Site | Classification | Summary of Recorded Water Level for the Period | Appendix B - Figure Number |
|---|---|---|---|
| *Stonequarry Creek* | | | |
| SE (Pool SR5) | Reference Site | • Water level remained above the previously recorded minimum | Figure A19 |
| SA (Pool SR16) | Potential Impact Site | • Water level remained above the baseline minimum and CTF level | Figure A20 |
| SB (Pool SR17) | Potential Impact Site | • Water level remained above the baseline minimum and CTF level | Figure A22 |
| SD | Potential Impact Site | • Water level remained above the baseline minimum and CTF level | Figure A24 |
| SF | Potential Impact Site | • The water level records indicate a decline in water level from early August 2022, however, this represents an impact to the flow control due to consecutive flood events. | Figure A25 |

## 3.2 Surface Water Quality

The water quality data for the following constituents, which are considered to be primary indicators of mining influence, are summarised in **Table 3**:

- pH;
- Electrical conductivity (EC);
- Dissolved metals, including: aluminium, barium, iron, manganese, nickel and zinc; and
- Sulphate.

Monitoring results for key constituents are also shown on a series of plots in **Appendix C**.

**TABLE 3: SUMMARY OF KEY WATER QUALITY CONSTITUENTS FOR REVIEW PERIOD 25 MARCH TO 7 SEPTEMBER 2022**

| Constituent | Matthews Creek: MB (reference site), MC1 and MG (potential impact sites) | Cedar Creek: Cedar US, CCR and CC1 (reference sites), CA, CB, CC, CD, CE, CF and CG (potential impact sites) | Stonequarry Creek: SC1, SE, SG (reference sites), SC2, SC, SD and SF (potential impact sites) |
|---|---|---|---|
| **pH** (Figure C1, Appendix C) | • Near neutral pH conditions.<br>• Consistent with baseline values. | • Near neutral to slightly acidic pH conditions.<br>• Generally higher pH values were recorded during the review period in comparison to the baseline period. | • The field pH values indicate near neutral to slightly alkaline pH conditions for most sites.<br>• Historically high pH values were recorded at SD and SF in August 2022.<br>• Historically low pH recorded at SD in September 2022.<br>• The pH values recorded at all other monitoring sites were generally consistent with baseline values. |
| **Electrical Conductivity** (Figure C3, Appendix C) | • Field EC values were consistent with baseline values. | • Field EC values are slightly below the historical range. | • Field EC values were slightly less than recorded historically. |

**TABLE 3 (CONT.): SUMMARY OF KEY WATER QUALITY CONSTITUENTS FOR REVIEW PERIOD 25 MARCH TO 7 SEPTEMBER 2022**

| Constituent | Matthews Creek: MB (reference site), MC1 and MG (potential impact sites) | Cedar Creek: Cedar US, CCR and CC1 (reference sites), CA, CB, CC, CD, CE, CF and CG (potential impact sites) | Stonequarry Creek: SC1, SE, SG (reference sites), SC2, SC, SD and SF (potential impact sites) |
|---|---|---|---|
| **Dissolved Aluminium** (Figure C5, Appendix C) | • 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.<br>• Concentrations were consistent with baseline values (≤0.15 mg/L at all sites). | • 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.<br>• A historically high concentration of dissolved aluminium was recorded at Cedar US in April and CCR, Cedar US and CF in July. | • 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.<br>• 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** (Figure C6, Appendix C) | • Concentrations generally stable over the review period and consistent with baseline values. | • Concentrations recorded over the duration of the review period were ≤0.2 mg/L at all sites and generally less than baseline values. | • 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** (Figure C7, Appendix C) | • Concentrations were slightly elevated for the review period, however were generally consistent with baseline values. | • Concentrations generally consistent over the review period and with baseline values. | • 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** (Figure C8, Appendix C) | • Concentrations recorded at all sites were consistent with or less than baseline values. | • Concentrations recorded at all sites were consistent with or less than baseline values. | • Concentrations recorded at all sites were consistent with or less than baseline values. |

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**TABLE 3 (CONT.): SUMMARY OF KEY WATER QUALITY CONSTITUENTS FOR REVIEW PERIOD 25 MARCH TO 7 SEPTEMBER 2022**

| Constituent | Matthews Creek: MB (reference site), MC1 and MG (potential impact sites) | Cedar Creek: Cedar US, CCR and CC1 (reference sites), CA, CB, CC, CD, CE, CF and CG (potential impact sites) | Stonequarry Creek: SC1, SE, SG (reference sites), SC2, SC, SD and SF (potential impact sites) |
|---|---|---|---|
| **Dissolved Nickel** (Figure C9, Appendix C) | • Concentrations recorded at all sites were consistent with or less than baseline values. | • 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. | • Concentrations recorded at all sites were consistent with or less than baseline values. |
| **Dissolved Zinc** (Figure C10, Appendix C) | • Concentrations recorded at all sites were consistent with or less than baseline values. | • 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. | • Concentrations recorded at all sites were consistent with or less than baseline values. |
| **Sulphate** (Figure C11, Appendix C) | • Concentrations recorded at all sites were generally consistent with baseline values. | • Concentrations recorded at all sites were generally consistent with baseline values. | • Concentrations recorded at all sites were generally consistent with baseline values. |

## 4 ASSESSMENT AGAINST SURFACE WATER TARPS

### 4.1 Subsidence Impact Performance Measures – Natural Features

As detailed in the WMP, TARPs have been developed for the Western Domain to define actions and response measures for unpredicted subsidence impacts to surface water resources. The monitoring results, in conjunction with the TARPs, are used to assess the impacts of mining in the Western Domain against the subsidence impact performance measures specified in **Table 4**. This report addresses the first subsidence impact performance measure listed in **Table 4** while the second performance measure is addressed by the hydrogeological specialist.

**TABLE 4: SUBSIDENCE IMPACT PERFORMANCE MEASURES – NATURAL FEATURES**

| Surface Water System | Subsidence Impact Performance Measure | Exceedance of Performance Measure |
|---|---|---|
| Stonequarry Creek, Cedar Creek and Matthews Creek | No subsidence impact or environmental consequence greater than minor* | The performance measure 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:<br>• More than 10% of pools located within the Investigative Area; and/or<br>• Pool SR17. |
| | No connective cracking between the surface, or the base of the alluvium, and the underground workings | The performance measure 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. |

* Minor is defined as *not very large, important or serious.*

### 4.2 Impact to Pool Water Level, Physical Features and Natural Behaviour

#### 4.2.1 Significance Triggers for Automated Pool Water Level and Physical Features

The significance levels / triggers, as detailed in the WMP, are summarised in **Table 5** for pool water level and in **Table 6** for physical features and natural behaviour of pools. In accordance with the WMP, the pool water level data and visual inspection observations have been assessed against the tabulated criteria for each trigger level.

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**TABLE 5: SIGNIFICANCE LEVELS / TRIGGERS FOR POOL WATER LEVEL**

| TARP Level | Pool Water Level |
|---|---|
| Level 1 | The recorded water level has not declined below the recorded baseline minimum level (in one 24 hour period for automated pool water level) OR the recorded water level has declined below the recorded baseline minimum level (in one 24 hour period for automated pool water level) but the decline is due to a monitoring or sensor error or the magnitude of the decline (below the recorded baseline minimum level) is within the range of sensor accuracy. |
| Level 2 | The recorded water level has declined below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) AND the above has occurred at one of the upstream pools (beyond mining effects). |
| Level 3 | The recorded water level has declined, although not atypically*, below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) AND the above has not occurred at one of the upstream pools (beyond mining effects). |
| Level 4 | The recorded water level has declined atypically* below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) AND similar behaviour has not occurred at one of the upstream pools (beyond mining effects). |

* 'Atypical' surface water characteristics relate to a notable and/or rapid water level decline or change in the slope of the falling limb of the hydrograph or the water level recessionary behaviour below the CTF level which is inconsistent with baseline conditions and cannot be attributed to climatic conditions.

**TABLE 6: SIGNIFICANCE LEVELS / TRIGGERS FOR PHYSICAL FEATURES AND NATURAL BEHAVIOUR OF POOLS**

| TARP Level | Physical Features and Natural Behaviour of Pools |
|---|---|
| Level 1 | No observed impacts to pool level, drainage or overland connected flow. |
| Level 2 | Visually observed reduction in pool level, drainage or overland connected flow AND the above has occurred at one of the upstream pools (beyond mining effects) OR visual monitoring of pools has not noted any mining related impacts*. |
| Level 3 | Rockbar 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 into account climatic conditions and observations during the baseline monitoring period. |
| Level 4 | Visually observed reduction in pool water level, drainage or overland connected flow, taking into account climatic conditions and observations during the baseline monitoring period AND the above change has not occurred at one of the upstream pools (beyond mining effects). |

* Rockbar and/or stream base cracking, gas release or iron precipitation in excess of baseline conditions.

## 4.3 Assessment of Automated Pool Water Level Data and Visual Inspection Observations

A summary of the pool water level, physical features and natural behaviour TARP significance levels for potential impact sites over the duration of the review period is presented in **Table 7** and discussed in the sections which follow.

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## TABLE 7: SURFACE WATER TARP SIGNIFICANCE LEVELS – 25 MARCH TO 7 SEPTEMBER 2022

| Date | Location(s) | Comment | TARP Significance |
|---|---|---|---|
| *Surface Water Level* | | | |
| 25 March to 7 September | All monitoring sites in Cedar Creek, Matthews Creek and Stonequarry Creek | The recorded water level did not decline below the baseline minimum level (in one 24 hour period) | Level 1 |
| *Physical Features and Natural Behaviour of Pools* | | | |
| 22 June, 18 August 2022, | All monitoring sites in Cedar Creek | No observed impacts to pool level, drainage or overland connected flow. | Level 1 |
| 22 June, 21 July, 18 August 2022 | All monitoring sites Matthews Creek | No observed impacts to pool level, drainage or overland connected flow. | Level 1 |
| 22 June, 18 August 2022, | All monitoring sites in Stonequarry Creek (excluding SR17 and SR20) | No observed impacts to pool level, drainage or overland connected flow. | Level 1 |
| 13 April, 22 June, 18 August 2022 | SR17 Rockbar, Stonequarry Creek | Rockbar fracturing noted during visual inspection (in excess of baseline conditions) AND no reduction in pool water level, drainage or overland connected flow, taking into account climatic conditions and observations during the baseline monitoring period. | Level 3 |
| 18 August 2022 | SR20 Rockbar, Stonequarry Creek | Rockbar fracturing noted during visual inspection (in excess of baseline conditions) AND no reduction in pool water level, drainage or overland connected flow, taking into account climatic conditions and observations during the baseline monitoring period. | Level 3 |

* Source: BES (2022a, 2022b, 2022c)

+ Visual inspection was unable to be conducted in March, May and July 2022 due to high water flow over the rockbar at pool SR17 (BES, 2022b)

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#### 4.3.1 Trigger Exceedance Action and Response

**Table 8** summarises the actions and responses required to be undertaken in relation to the Level 3 exceedances recorded at monitoring sites SB/pool SR17 and pool SR20.

**TABLE 8: TRIGGER EXCEEDANCE ACTION AND RESPONSE**

| Level | Action | Response |
|---|---|---|
| *Impact to physical features and natural behaviour of pools* | | |
| Level 3 | • Continue monitoring as per monitoring program.<br>• Continue monthly review of data.<br>• 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 climatic conditions | • As defined by Environmental Response Group.<br>• Consider increasing inspection and review of data frequency to fortnightly for sites where Level 3 has been reached. |

<u>Pool SR17</u>

Pool SR17 was initially reported at a Level 3 significance on 28 October 2021 due to surficial fracturing of the controlling rockbar (pers. comm. MSEC). Brienen Environment & Safety (2021b) reported this as laminar fracturing and extension of a natural crack in the rockbar following the inspection on 17 November 2021. Since the initial observation of the fracturing, no gas release or iron precipitation has been noted during visual inspections. Consequently, a Level 3 trigger significance in relation to physical features and natural behaviour of pool SR17 has been derived for the review period.

The continuous water level records and manual water levels indicate that the fracturing of the rockbar had not resulted in an impact to the pool water holding capacity, shown in Figure B21 of **Appendix B**.

In response to the Level 3 trigger exceedances in relation to physical features at monitoring site SB (pool SR17), the Environmental Response Group convened and the surface water level data was reviewed. The water level records for monitoring site SB (pool SR17) shown in Figure B22, **Appendix B**, indicate that the 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). As such, there is no requirement to increase the frequency of visual inspections and review of data in relation to pool physical features, natural drainage behaviour and pool water level. The physical features and water level records for this site will continue to be monitored in accordance with the WMP.

<u>Pool SR20</u>

Pool SR20 was reported by Brienen Environment & Safety (BES 2022c) as a Level 3 significance due to surface fracturing observed on 18 August 2022. There are two fractures present, the first was initially observed in July 2019 during the pre-mining survey and the second during the August 2022 visual inspection. No gas release or iron precipitation was observed during the visual inspection.

In response to the Level 3 trigger exceedances in relation to physical features at pool SR20, the Environmental Response Group convened, and the surface water level data was reviewed. The water level records for the monitoring site upstream of SR20 (SB) and downstream of SR20 (SC and SD) indicate that:

- The surface fracturing of the rockbar has not resulted in an impact to the 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 fracturing was initially observed and 7 September 2022 (extent of available monitoring data). This is supported by the water level and Level 1 TARPs triggers for these sites, refer **Table 8.**

Additionally, MSEC indicated during the Environmental Response Group (held 20 September) that there was no measurable change in closure associated with the fracturing based on the latest survey.

As such, there is no requirement to increase the frequency of visual inspections and review of data in relation to pool physical features, natural drainage behaviour and pool water level. The physical features and water level records for this site will continue to be monitored in accordance with the WMP.

## 4.4 Surface Water Quality

### 4.4.1 Significance Triggers for Surface Water Quality

Water quality data has been analysed for key water quality parameters of relevance to surface water systems and the effects of subsidence, namely pH, EC, dissolved (field filtered) aluminium, iron, manganese, nickel and zinc at monitoring sites on Matthews Creek, Cedar Creek and Stonequarry Creek. The monitoring results have been assessed against the criteria for each significance level/trigger listed in **Table 9**.

**TABLE 9: SIGNIFICANCE LEVELS / TRIGGERS FOR WATER QUALITY**

| TARP Level | Surface Water Quality |
|---|---|
| Level 1 | The triggers for pH, EC and dissolved metals do not occur and there is no visual evidence of increased iron staining that was not observed in the baseline period. |
| Level 2 | The trigger for pH, EC or dissolved metals occurs in one month and there is no visual evidence of increased iron staining that was not observed in the baseline period. |
| Level 3 | The trigger for pH, EC or dissolved metals occurs in one month and there is visual evidence of increased iron staining that was not observed in the baseline period. |
| Level 4 | Any of the following:<br>• pH: the value falls below a corresponding control (upstream) site(s) mean*, or at the site itself, minus two standard deviations (i.e. the sample becomes more acidic) for more than two consecutive months OR the value rises above corresponding control (upstream) site(s) mean, or at the site itself, plus two standard deviations (i.e. the sample becomes more alkaline) for more than two consecutive months.<br>• EC: the value rises above corresponding control (upstream) site(s) mean*, or at the site itself, plus two standard deviations for more than two consecutive months.<br>• Dissolved metals: a specific metal or metals laboratory value/s rise above corresponding control (upstream) site(s) mean*, or at the site itself, plus two standard deviations for more than two consecutive months. |

* The value is compared with the corresponding control (upstream) site(s) mean to date plus two standard deviations and with the baseline mean plus two standard deviations for the site itself.

### 4.4.2 Assessment of Surface Water Quality

A summary of the water quality TARP significance levels for the review period is presented in **Table 10** and discussed in the sections which follow.

**TABLE 10: WATER QUALITY TARP SIGNIFICANCE LEVELS – 25 MARCH TO 7 SEPTEMBER 2022**

| Date | Location(s) | Comment | TARP Significance |
|---|---|---|---|
| March to September 2022 | All monitoring sites in Matthews Creek | The triggers for pH, EC and dissolved metals do not occur and there is no visual evidence of increased iron staining that was not observed in the baseline period. | Level 1 |
| March, May to June and September 2022 | All monitoring sites in Cedar Creek | | Level 1 |
| March, June and August 2022 | All monitoring sites in Stonequarry Creek | | Level 1 |
| August to September 2022 | Monitoring site SD | The trigger for pH occurs in one month and there is no visual evidence of increased iron staining that was not observed in the baseline period. | Level 2 |
| April to July 2022 | Monitoring site CG in Cedar Creek | The trigger for dissolved aluminum occurs in one month and there is no visual evidence of increased iron staining that was not observed in the baseline period. | Level 2 |
| April to May and July 2022 | Monitoring site SC2 | | Level 2 |
| April to May and July2022 | Monitoring site SC | | Level 2 |

### 4.4.3 Trigger Exceedance Action and Response

**Table 11** summarises the actions and responses required to be undertaken in relation to the Level 2 exceedances recorded at the following monitoring sites for the review period:

- Cedar Creek: CG
- Stonequarry Creek: SC2, SC and SD

**TABLE 11: TRIGGER EXCEEDANCE ACTION AND RESPONSE**

| Level | Action | Response |
|---|---|---|
| *Impact to stream water quality* | | |
| Level 2 | • Continue monitoring as per monitoring program.<br>• Continue monthly review of data including analysis of water quality trend along creek (upstream to downstream) to identify spatial changes.<br>• Convene Tahmoor Coal Environmental Response Group to review response. | As defined by Environmental Response Group. |

pH Trigger Exceedance

As stated in **Table 3** and illustrated in Figure C1 of **Appendix C:**

- Historically high concentrations of pH were recorded in August 2022 at potential impact site SD. This resulted in a trigger level 2 for the upper pH trigger.
- A historically low concentration for pH was recorded in September. This resulted in a trigger level 2 for the lower pH trigger.

The pH results for SD compared to the Stonequarry Creek reference sites is shown below on **Diagram 1.**

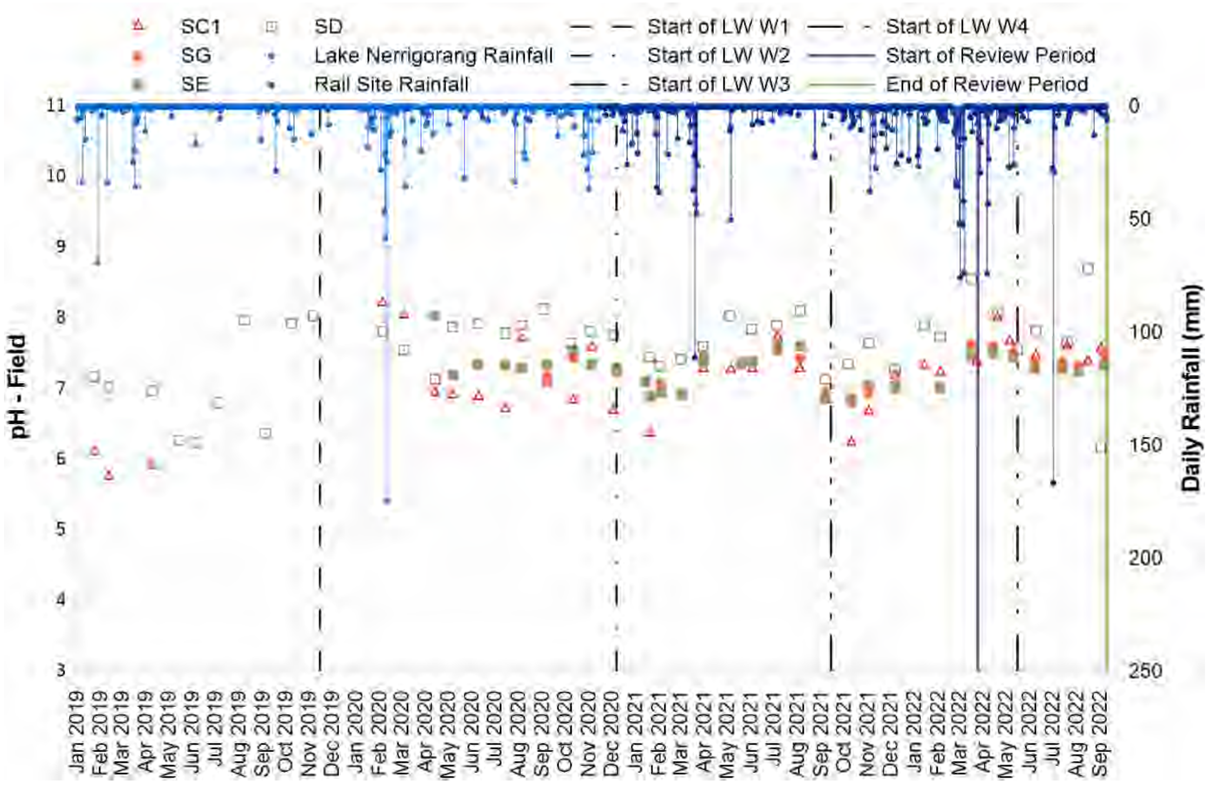


**DIAGRAM 1: STONEQUARRY CREEK SITE SD AND REFERENCE SITES - PH RESULTS**

In response to the pH Level 2 trigger exceedances for Stonequarry Creek, the Environmental Response Group convened, and the surface water quality data was reviewed in relation to the prevailing climate and catchment wide water quality trends. Whilst both the upper and low pH trigger levels were exceeded in consecutive months, the recorded values were 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. Accordingly, re-calibration of field instrumentation has been recommended. Monitoring will continue to be undertaken in accordance with the WMP.

Aluminium Trigger Exceedance

The dissolved aluminium concentrations recorded at monitoring site CG in April and July 2022 were slightly elevated above baseline concentrations, resulting in an exceedance of the mean plus two standard deviations. As such, a Level 2 TARP significance has been equated. The elevated concentrations of dissolved aluminium did not result in an exceedance of the reference site mean plus two standard deviations during these periods. The aluminium results for monitoring site CG compared to the Cedar Creek reference sites is shown below on **Diagram 2.**

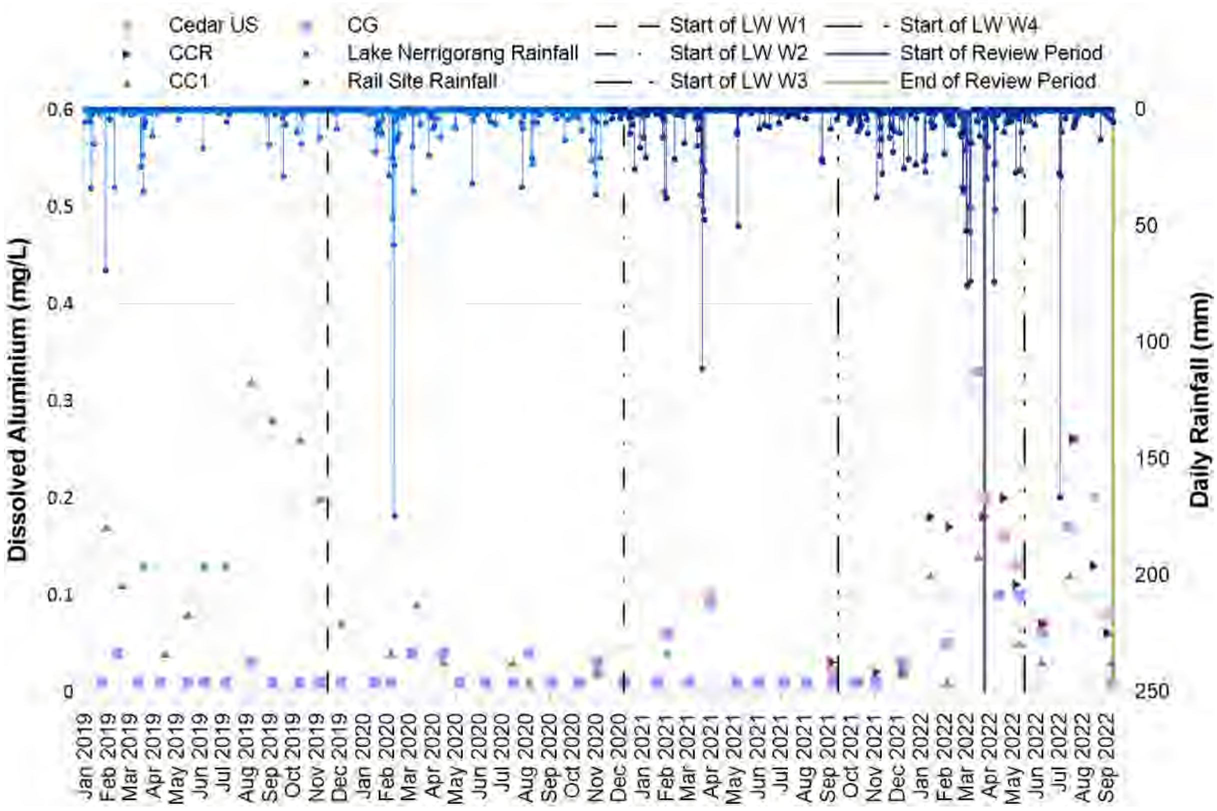


**DIAGRAM 2: CEDAR CREEK SITE CG AND REFERENCE SITES – ALUMINIMUM RESULTS**

As shown in **Diagram 2**, the dissolved aluminium concentrations recorded at reference sites CCR and Cedar US, which are located at a notable distance upstream of the Western Domain, were higher than that recorded at monitoring site CG for the duration of the review period. As such, this indicates a catchment wide (non-mining related) influence on dissolved aluminium concentrations in Cedar Creek.

Monitoring sites SC2 and SC dissolved aluminium concentrations recorded in April to May and July 2022, resulted in an exceedance of the mean plus two standard deviations, equating to a Level 2 TARP significance at these sites. The elevated concentrations of dissolved aluminium did not result in an exceedance of the reference site mean plus two standard deviations during these periods. The dissolved aluminium results for SC2 and SC compared to the Stonequarry Creek reference sites is shown below on **Diagram 3.**

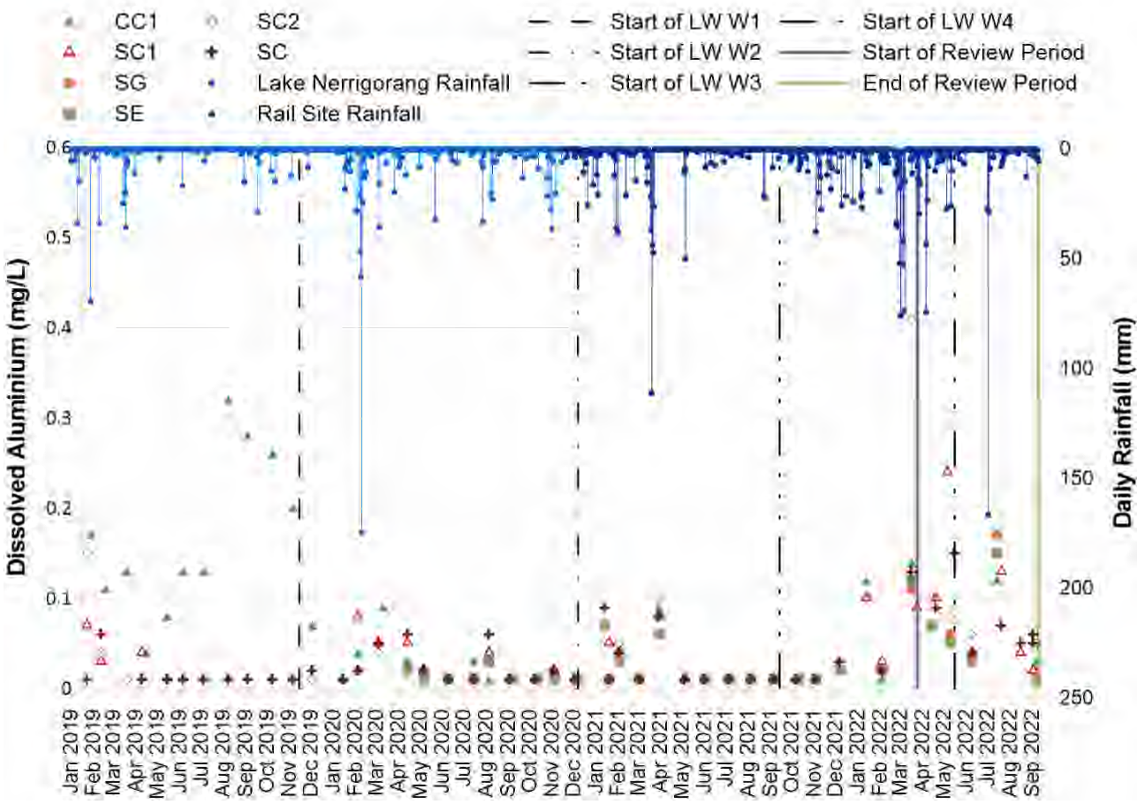


**DIAGRAM 3: STONEQUARRY CREEK SITES SC1, SC AND REFERENCE SITES – ALUMINIMUM RESULTS**

As shown in **Diagram 3**, the dissolved aluminium concentrations recorded at reference sites SC1, SG and SE, located upstream of potential mining relation influences, were consistent with or higher than that recorded at monitoring sites SC2 and SC for the duration of the review period. As such, this indicates a catchment wide (non-mining related) influence on dissolved aluminium concentrations in Stonequarry Creek.

In response to the aluminium Level 2 trigger exceedances for Cedar and Stonequarry Creek, the Environmental Response Group convened, and the surface water quality data was reviewed in relation to the prevailing climate and catchment wide water quality trends.

The elevated concentrations of dissolved aluminium recorded during the review period occurred during and following above average rainfall. Accordingly, the elevated dissolved aluminium concentrations were considered to be catchment wide and related to the prevailing climatic conditions.

In accordance with the WMP, monthly monitoring and review of water quality data recorded at sites in Cedar Creek, Stonequarry Creek and Matthews Creek will continue to be undertaken and assessed in relation to the water quality TARP.

# 5 SUMMARY AND CONCLUSIONS

Review and assessment of surface water monitoring data recorded prior to and during the review period of 25 March to 7 September 2022 has indicated the following:

- Surface Water Level:
  - TARP significance above Level 1 was not reported for any sites in Cedar Creek, Matthews Creek and Stonequarry Creek during the review period.
- Physical Features and Natural Behaviour of Pools:
  - TARP significance level 3 was reported for two pools located in Stonequarry Creek as follows:
    - SR17, initially reported at a Level 3 significance on 28 October 2021 due to surficial cracking of the controlling rockbar. No gas release or iron precipitation has been noted during visual inspection.
    - SR20, reported at a Level 3 significance as of 18 August 2022 due to cracking of the controlling rockbar. No gas release or iron precipitation was observed during visual inspection.
- Surface Water Quality:
  - TARP significance above Level 1 was not reported for any sites in Matthews Creek during the review period.
  - TARP significance of Level 2 was reported for pH, recorded at Stonequarry Creek monitoring site SD in August and September. The Level 2 trigger exceedance is considered to be an anomalous result or due to a field meter calibration issue.
  - TARP significance of Level 2 was reported for dissolved aluminium recorded at the following sites, however, is considered to be catchment wide (i.e. non mining related):
    - Cedar Creek: monitoring sites CB in July 2022 and CG in April and July 2022.
    - Stonequarry Creek: monitoring sites SC in April, May, July and September 2022 and SC2 in April, May and July 2022.

Less than 10% of the pools within the Investigative Area have been impacted and the surficial cracking 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[2] associated with mining in the Western Domain.

It is recommended that ongoing review of surface monitoring data is continued to be undertaken in accordance with the WMP.

[2] Minor is defined as *not very large, important or serious.*

# 6 RECOMMENDATIONS FOR MONITORING PROGRAM

Based on the outcomes of the surface water review for the Western Domain, the following is recommended:

- Monitoring site CCR - this site is recommended for decommissioning as:
  - The reference bolt at monitoring site CCR 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 measurement.
  - CCR is influenced by backwater effects from the downstream weir. Cedar US is considered a more representative reference site for Cedar Creek.
- Monitoring site SG – the flow control at monitoring site SG, comprised predominantly of sand and rubble, was washed away in recent flood events and therefore SG is no longer a suitable monitoring site for water level measurements. Monitoring site SG has been recommended for decommissioning, as two alternative representative reference sites are located on Stonequarry Creek (SC1 and SE).
- Re-calibration of field water quality instrumentation has been recommended.

## REFERENCES


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This report must be read in its entirety.

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## APPENDIX A – SUMMARY OF SURFACE WATER MONITORING SITES RELEVANT TO WESTERN DOMAIN

| Location | Monitoring Site(s) | Monitoring Component | Classification | Natural Control Characteristics | Water Quality Monitoring Commencement |
|---|---|---|---|---|---|
| Cedar Creek | CCR | Water level and quality | Reference Site | Weir | July 2021 |
| | Cedar US | Water level and quality | Reference Site | Rockbar constrained | October 2020 |
| | CC1A (Pool CB3) | Water level | Reference Site | Boulder/rockbar constrained | - |
| | CC1 | Water quality | Reference Site | Boulder/rockbar constrained | January 2019 |
| | CA (Pool CB10) | Water level and quality | Potential Impact Site | Boulder constrained | June 2019 |
| | CB (Pool CR14) | Water level and quality | Potential Impact Site | Rockbar constrained | January 2019 |
| | CD (Pool CR23) | Water level and quality | Potential Impact Site | Rockbar/boulder constrained | January 2021 |
| | CE (Pool CR25) | Water level and quality | Potential Impact Site | Rockbar/boulder constrained | January 2021 |
| | CF | Water level and quality | Potential Impact Site | Rockshelf constrained | January 2021 |
| | CG (Pool CR31) | Water level and quality | Potential Impact Site | Rockshelf constrained | January 2019 |
| Matthews Creek | MB (Pool MR5) | Water level and quality | Reference Site | Rockbar constrained | January 2019 |
| | MC1 | Water level and quality | Baseline / Potential Impact Site | Rockshelf/boulder constrained | January 2019 |
| | ME (Pool MR25) | Water level | Potential Impact Site | Boulder/rockbar constrained | - |
| | MG (Pool MR42) | Water level and quality | Potential Impact Site | Boulder constrained | January 2019 |
| Stonequarry Creek | SA (Pool SR16) | Water level | Potential Impact Site | Rockbar/boulder constrained | - |
| | SB (Pool SR17) | Water level | Potential Impact Site | Rockbar constrained | - |

| Location | Monitoring Site(s) | Monitoring Component | Classification | Natural Control Characteristics | Water Quality Monitoring Commencement |
|---|---|---|---|---|---|
| | SC | Water level and quality | Baseline / Potential Impact Site | Rockbar constrained | January 2019 |
| | SC1 | Water quality | Reference Site | Rockshelf constrained | January 2019 |
| | SC2 / Pool SR17 | Water level and quality | Potential Impact Site | Rockbar constrained | January 2019 |
| | Pool SR20 | Water level and quality | Potential Impact Site | Rockbar constrained | - |
| | SD | Water level and quality | Baseline / Potential Impact Site | Rockbar constrained | January 2019 |
| | SE (Pool SR5) | Water level and quality | Reference Site | Rockbar constrained | April 2020 |
| | SF | Water level and quality | Potential Impact Site | Rockbar constrained | May 2020 |
| | SG (Pool SG2) | Water level and quality | Reference Site | Rockshelf constrained | September 2020 |

# APPENDIX B – WATER LEVEL PLOTS

## MATTHEWS CREEK SURFACE WATER MONITORING SITES

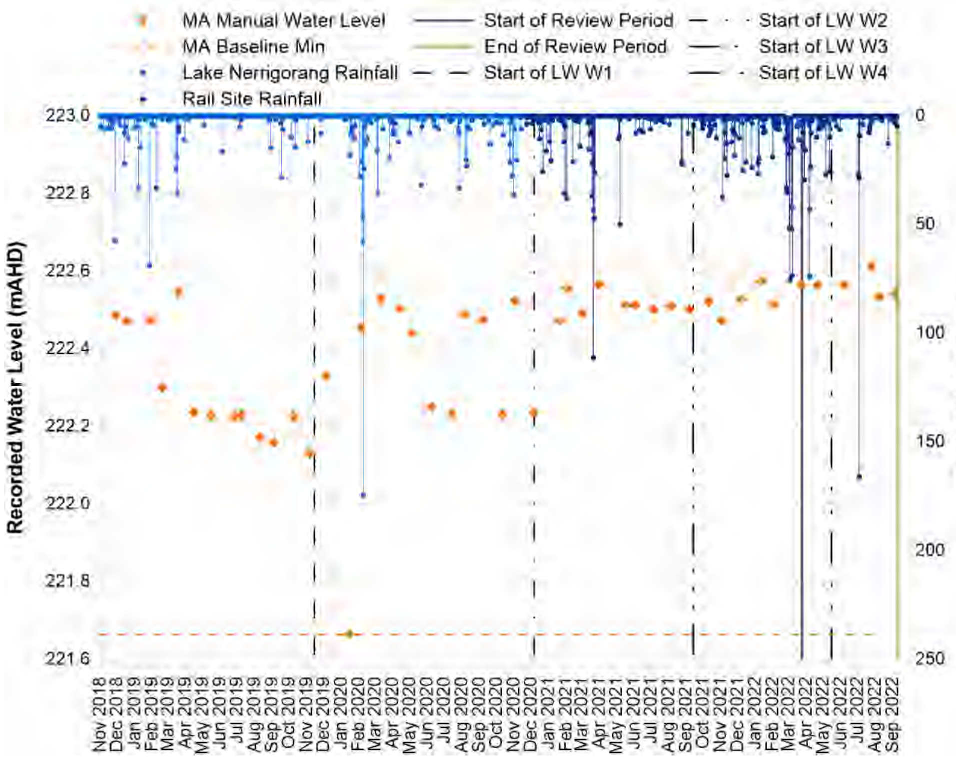


**FIGURE B1: MONITORING SITE MA WATER LEVEL RECORDS**

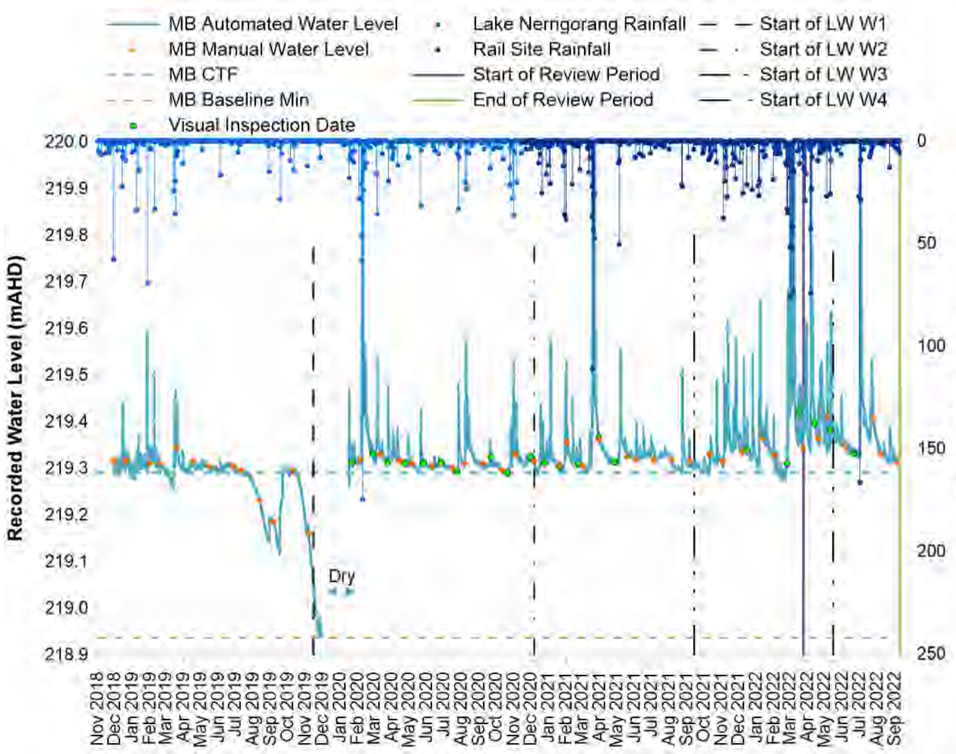


**FIGURE B2: MONITORING SITE MB WATER LEVEL RECORDS**

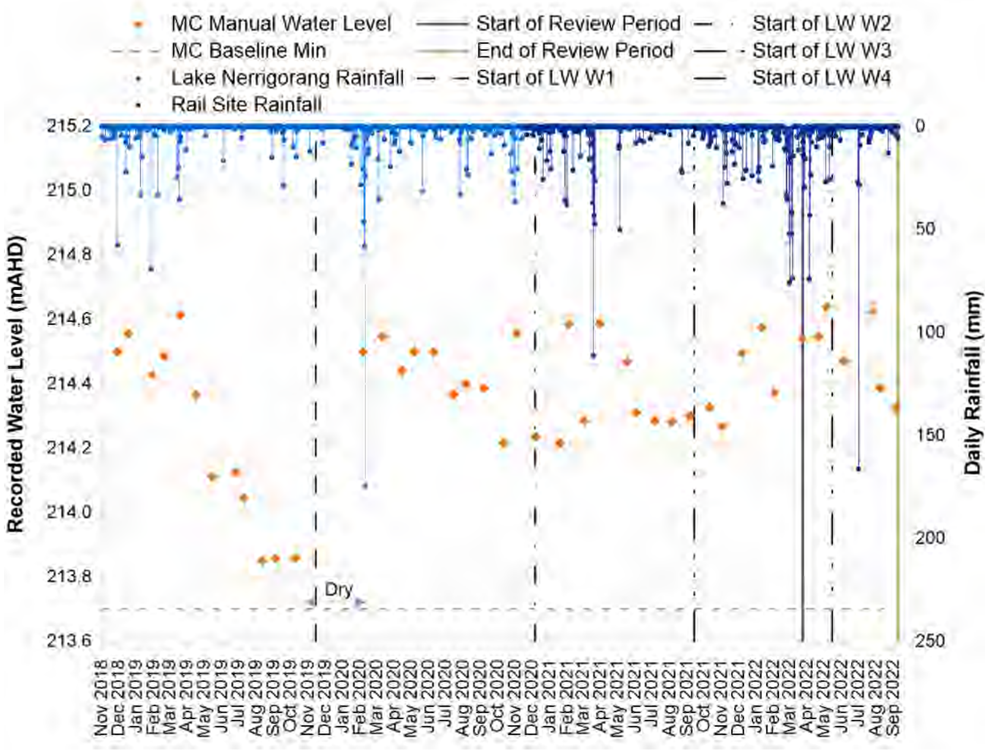


**FIGURE B3: MONITORING SITE MC WATER LEVEL RECORDS**

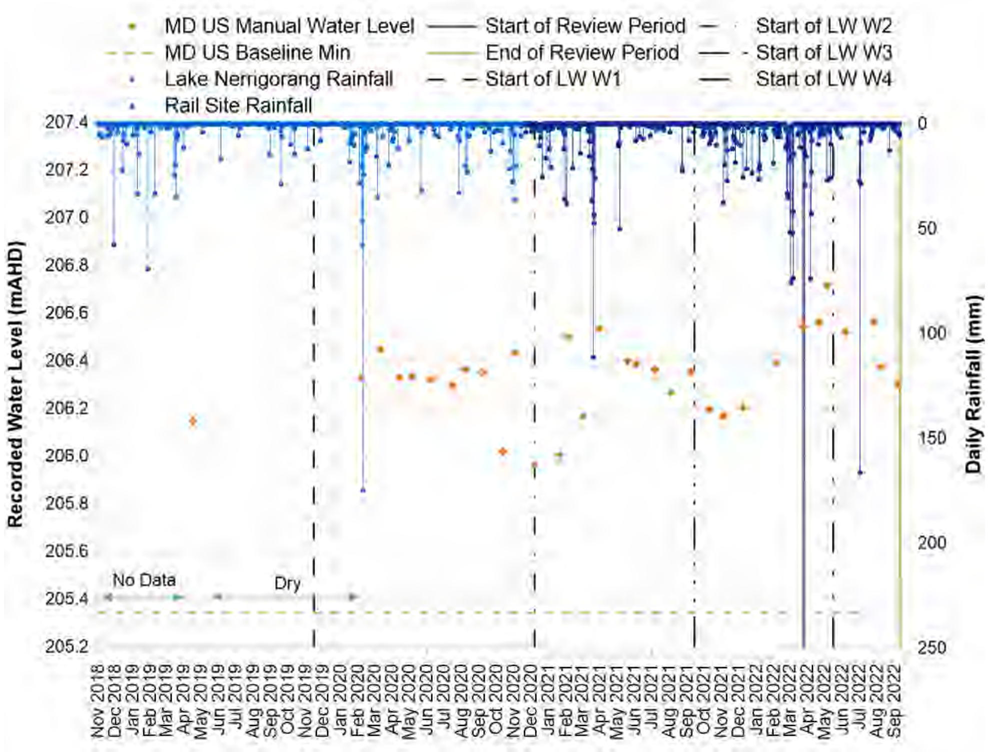


**FIGURE B4: MONITORING SITE MD US WATER LEVEL RECORDS**

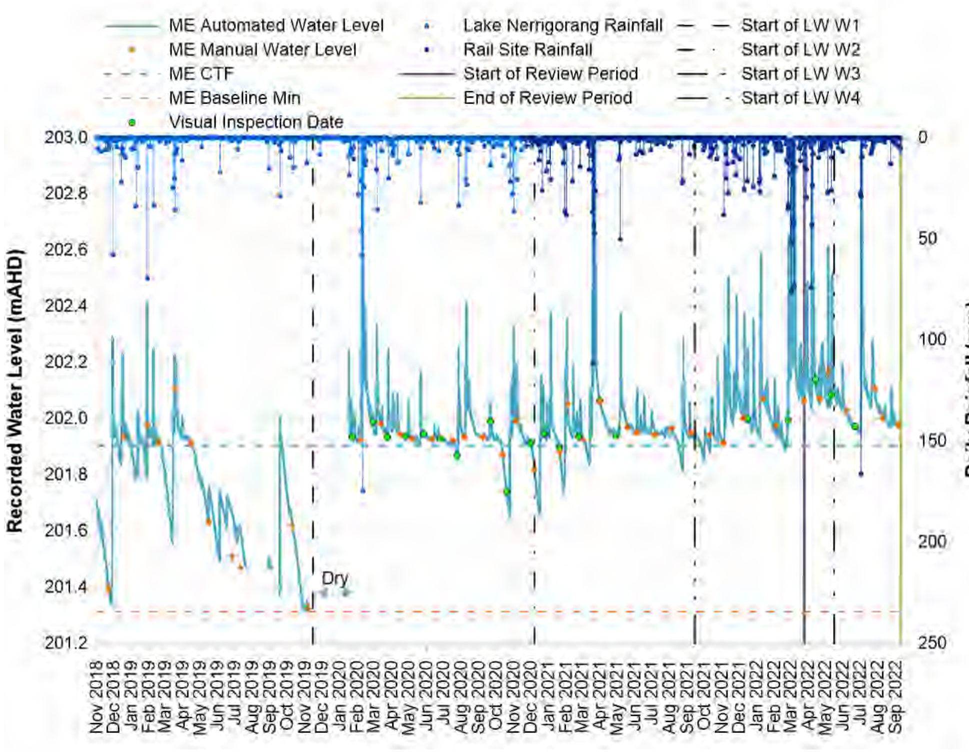


**FIGURE B5: MONITORING SITE ME WATER LEVEL RECORDS**

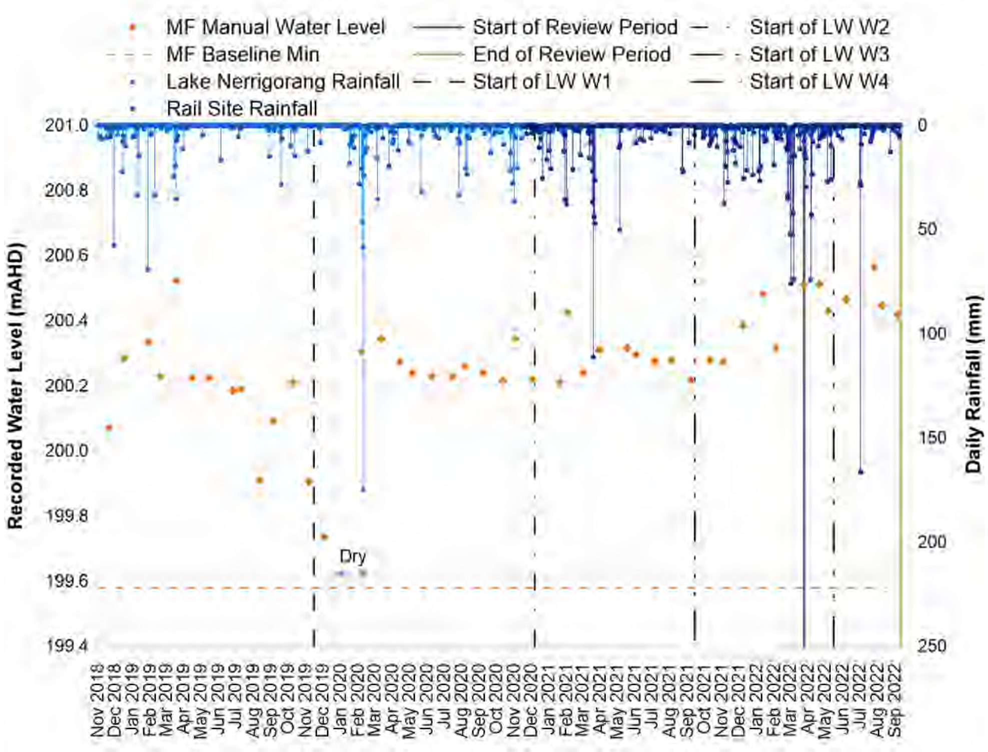


**FIGURE B6: MONITORING SITE MF WATER LEVEL RECORDS**

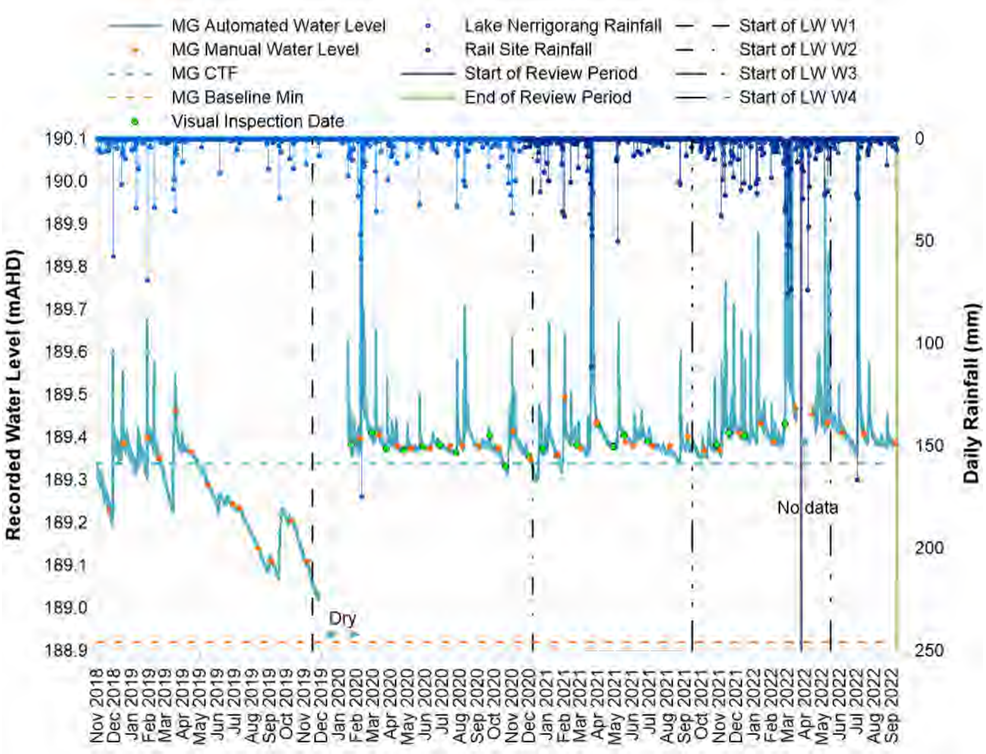


**FIGURE B7: MONITORING SITE MG WATER LEVEL RECORDS**

## CEDAR CREEK SURFACE WATER MONITORING SITES

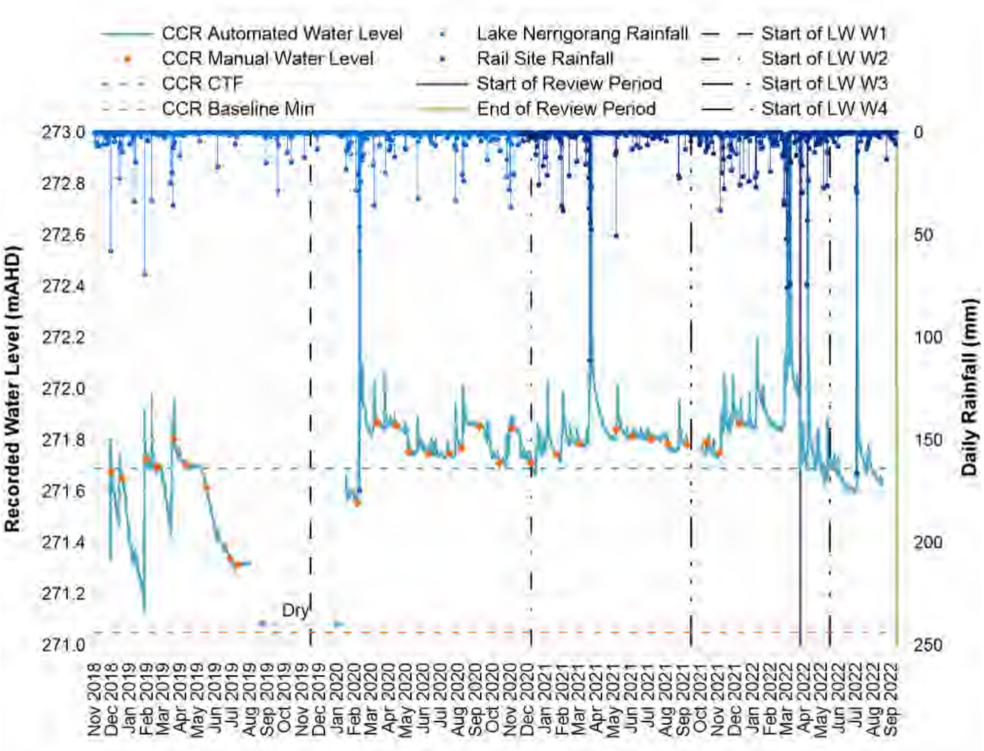


**FIGURE B8: MONITORING SITE CCR WATER LEVEL RECORDS[3]**

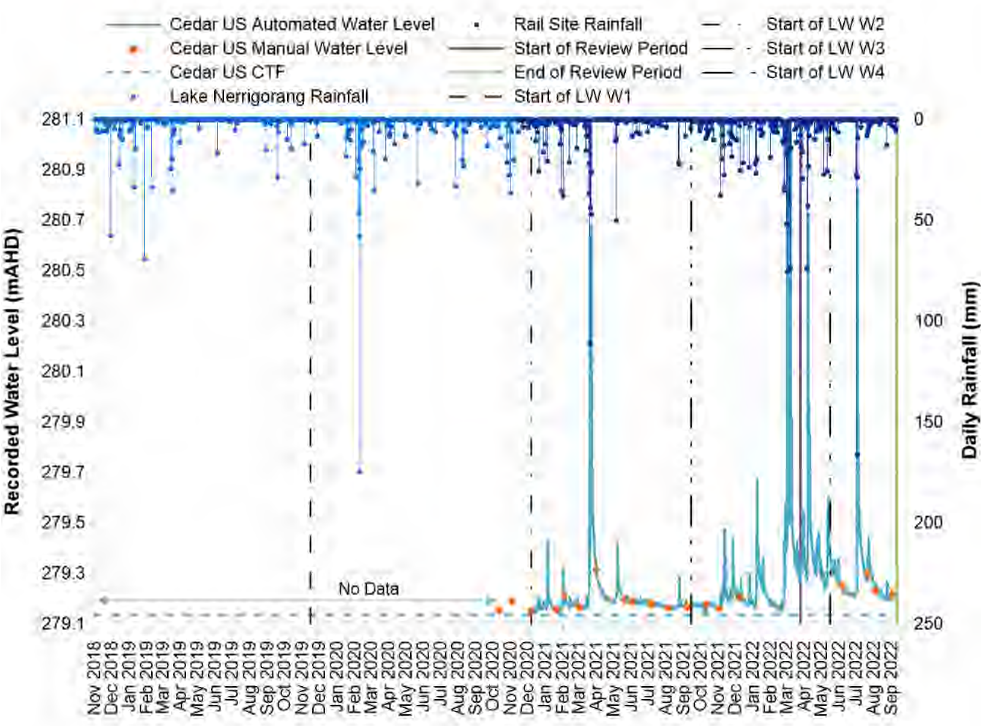


**FIGURE B9: MONITORING SITE CEDAR US WATER LEVEL RECORDS**

[3] The reference bolts at monitoring sites CCR and SF have not been found and as such the raw data recorded from 7 / 8 December 2021 was unable to be converted to a water level measurement.

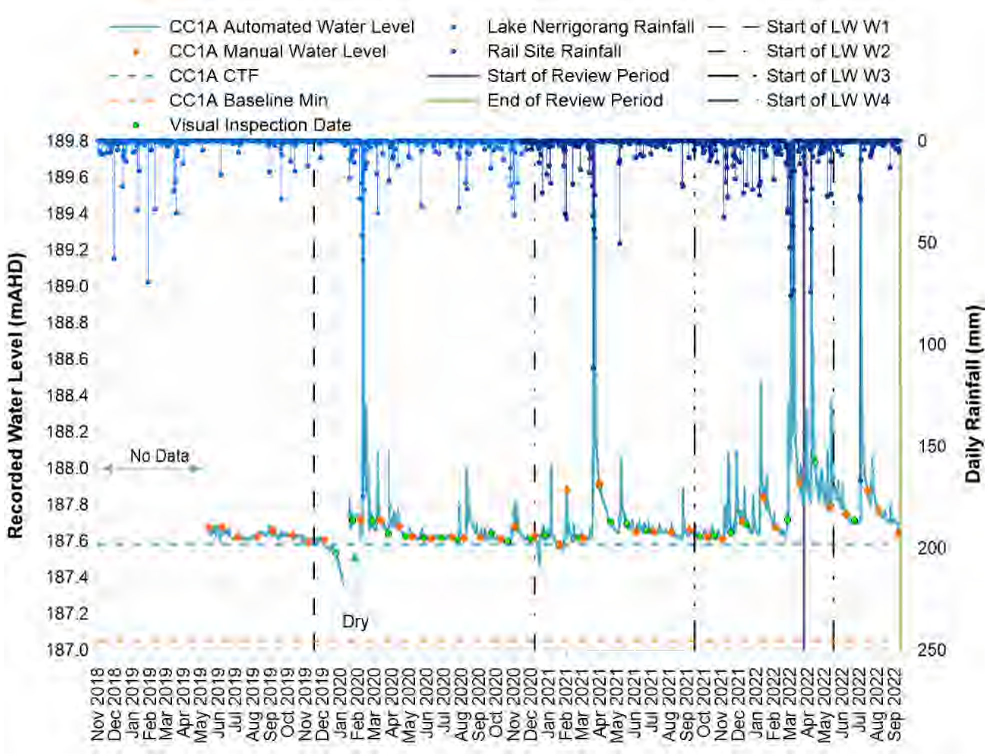


FIGURE B10: MONITORING SITE CC1A WATER LEVEL RECORDS

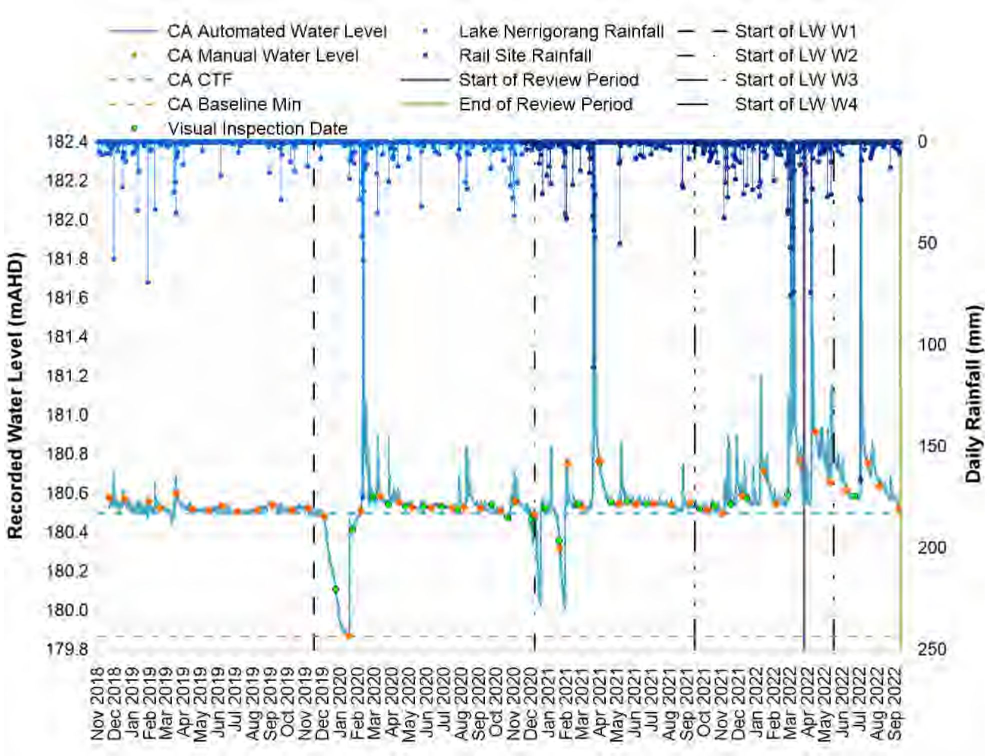


FIGURE B11: MONITORING SITE CA WATER LEVEL RECORDS

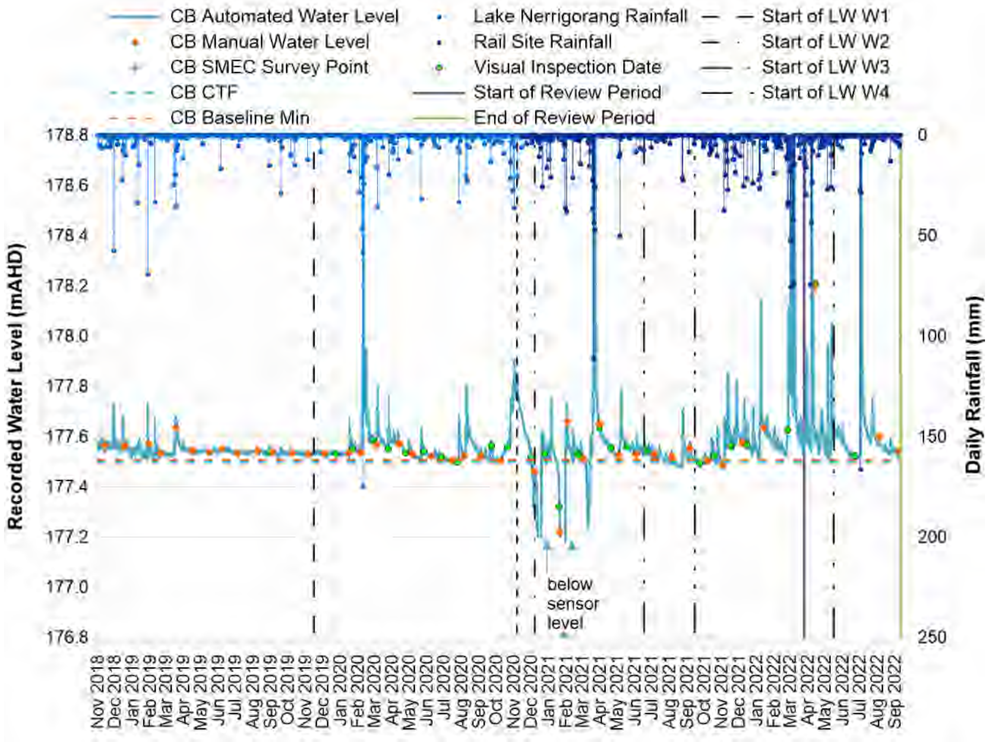


**FIGURE B12: MONITORING SITE CB WATER LEVEL RECORDS**

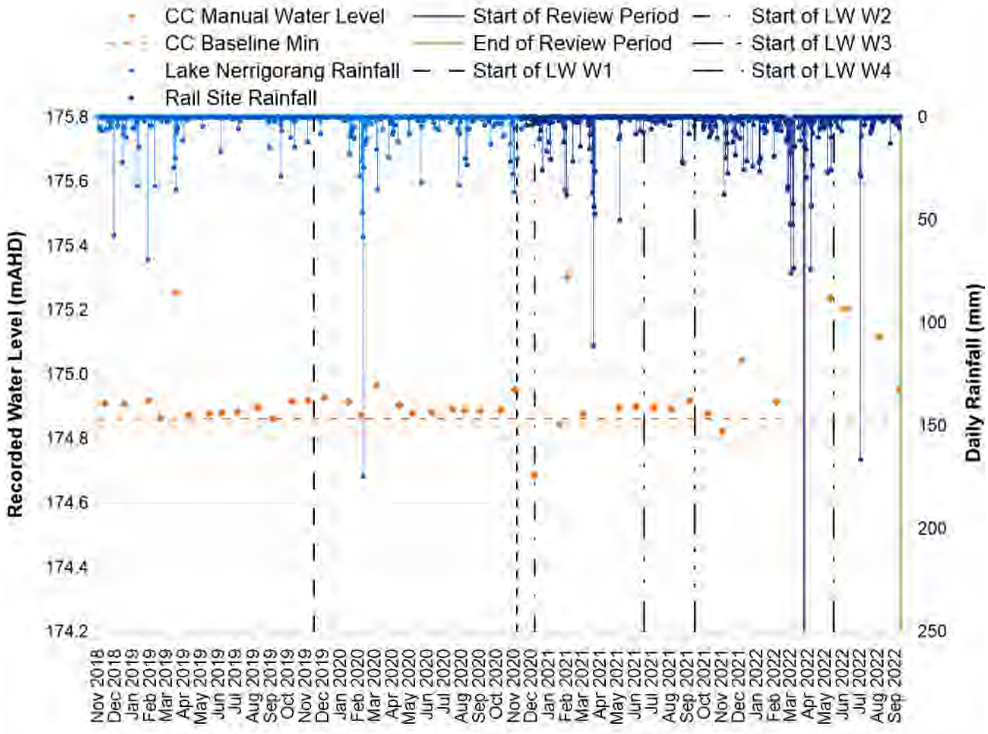


**FIGURE B13: MONITORING SITE CC WATER LEVEL RECORDS**

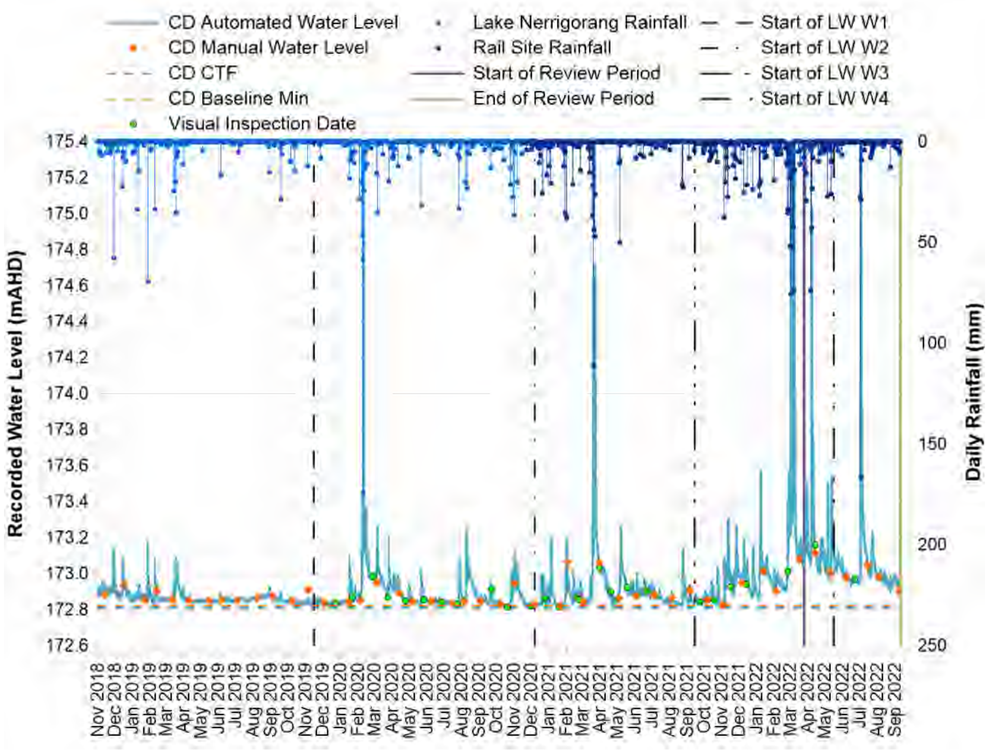


**FIGURE B14: MONITORING SITE CD WATER LEVEL RECORDS**

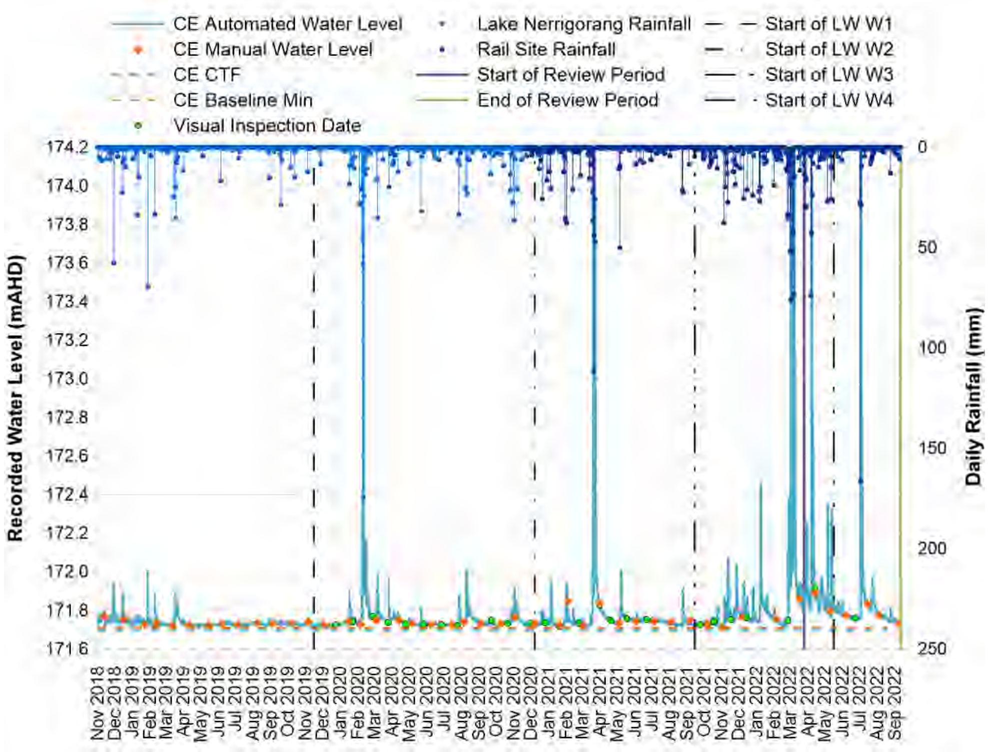


**FIGURE B15: MONITORING SITE CE WATER LEVEL RECORDS**

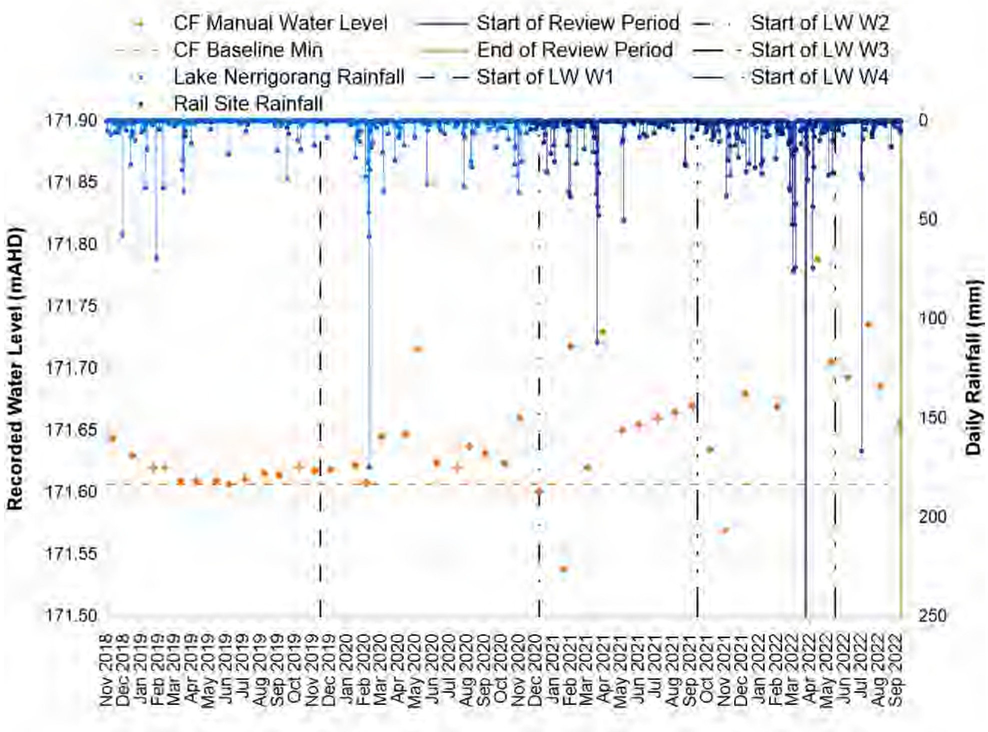


FIGURE B16: MONITORING SITE CF WATER LEVEL RECORDS

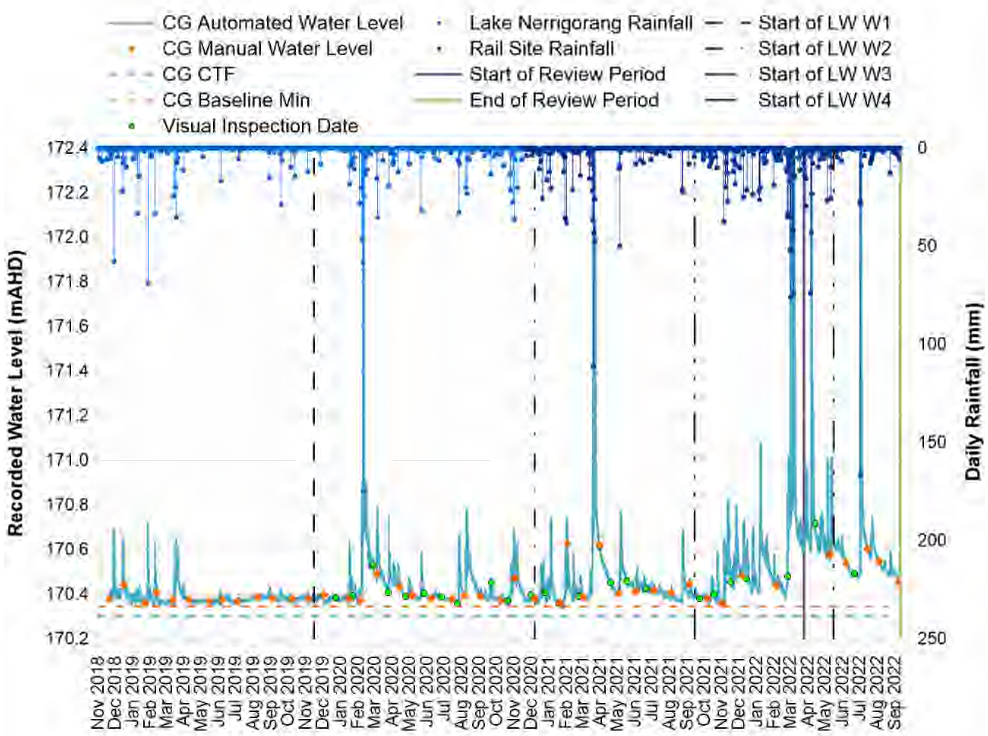


FIGURE B17: MONITORING SITE CG WATER LEVEL RECORDS

## STONEQUARRY CREEK SURFACE WATER MONITORING SITES

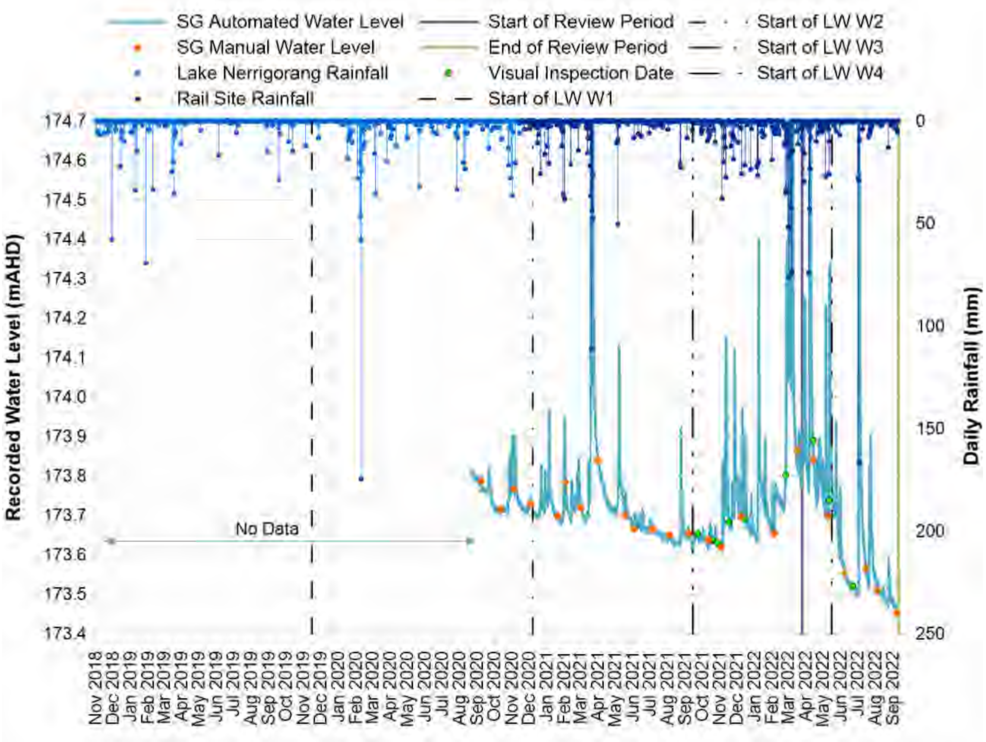


**FIGURE B18: MONITORING SITE SG WATER LEVEL RECORDS**

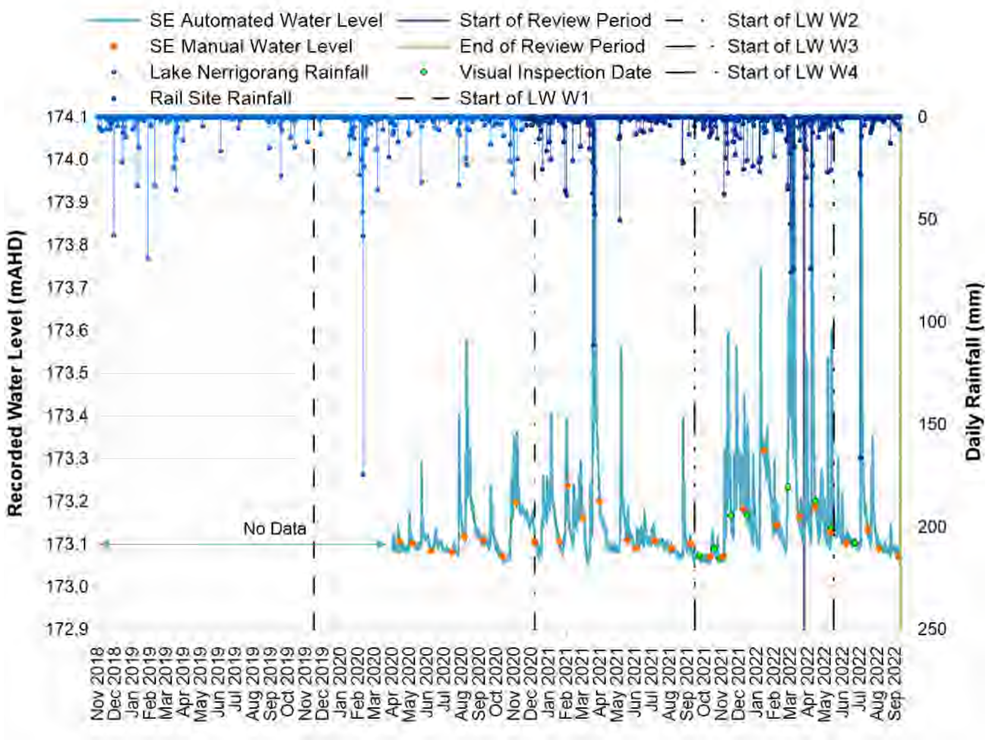


**FIGURE B19: MONITORING SITE SE WATER LEVEL RECORDS**

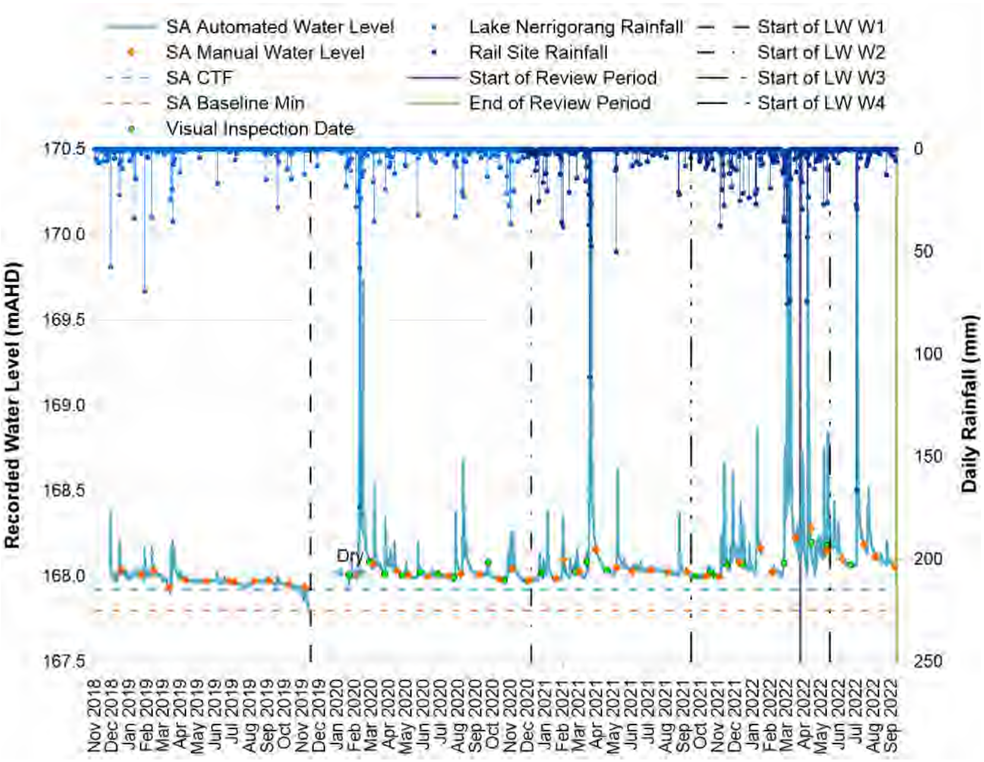


**FIGURE B20: MONITORING SITE SA WATER LEVEL RECORDS[4]**

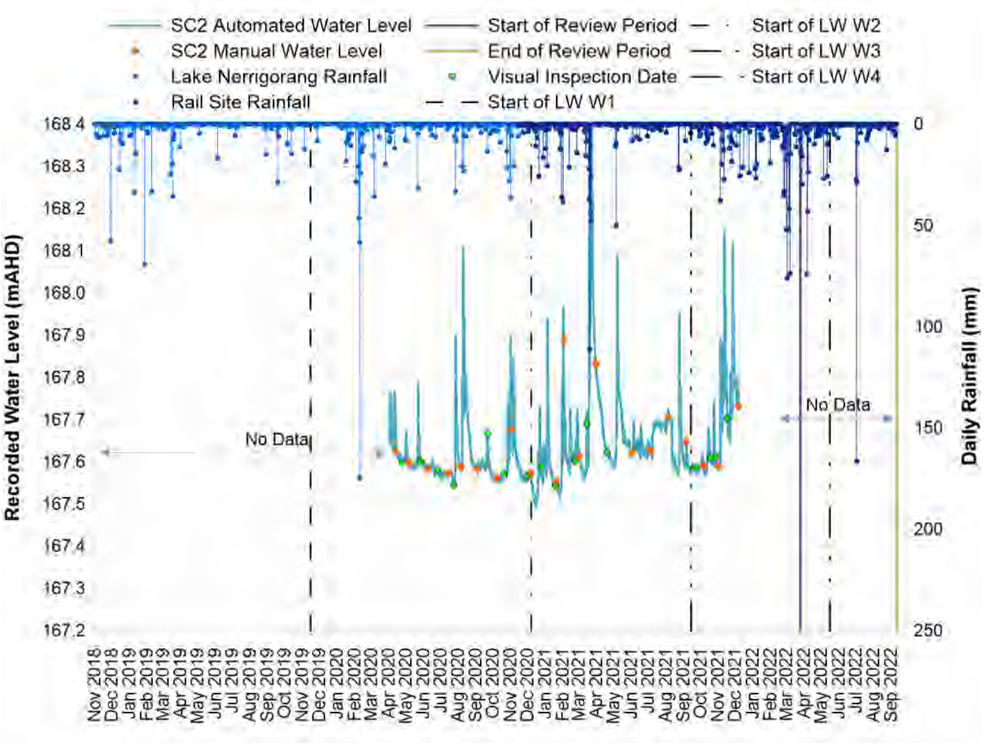


**FIGURE B21: MONITORING SITE SC2 WATER LEVEL RECORDS[5]**

[4] Between 15 January and 5 February 2022, an incomplete data download occurred at monitoring site SA, or the logger was not correctly restarted, and as such no data is available for this period.

[5] The water level sensor has not been located and therefore records are not available from 7 December 2021.

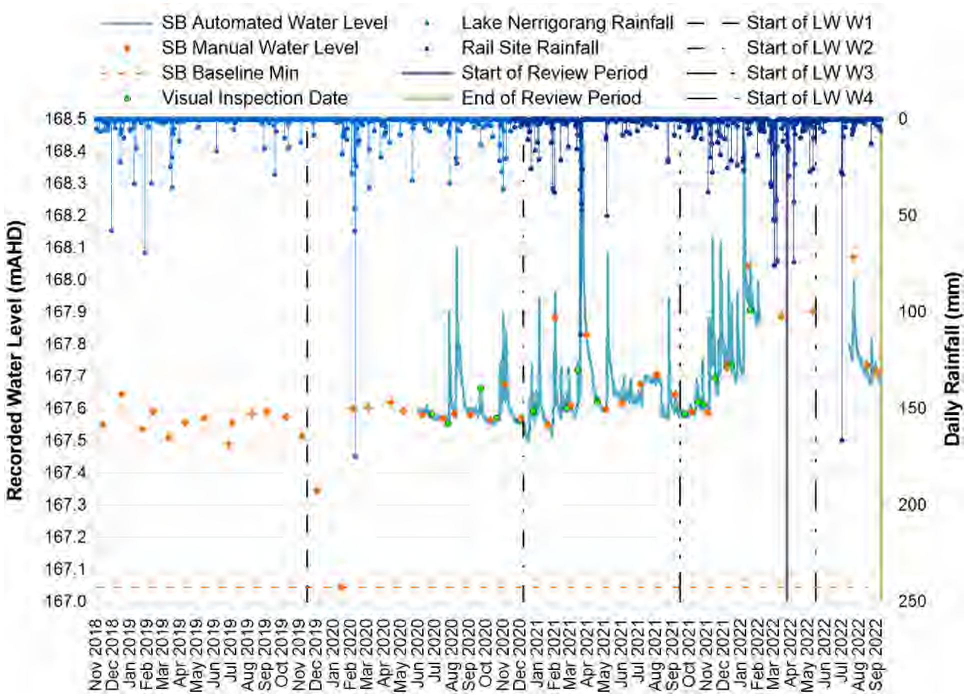


**FIGURE B22: MONITORING SITE SB WATER LEVEL RECORDS[6]**

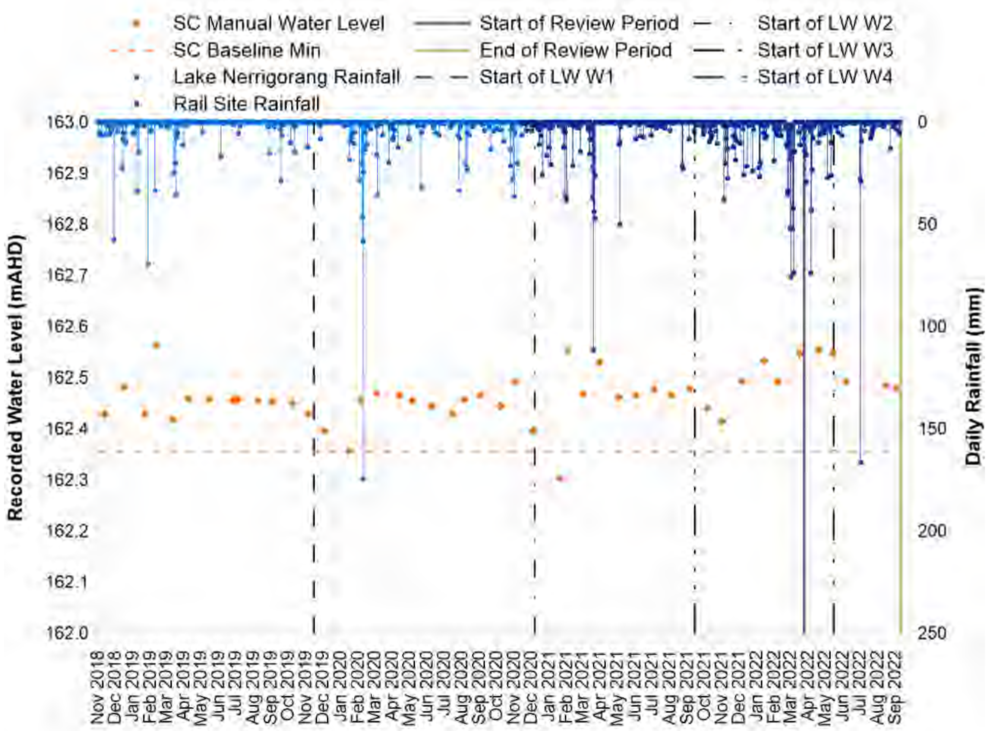


**FIGURE B23: MONITORING SITE SC WATER LEVEL RECORDS**

[6] The logger at monitoring site SB was washed away during a major rainfall event from late February to early March 2022 and as such data has not been collected since 5 February 2022.

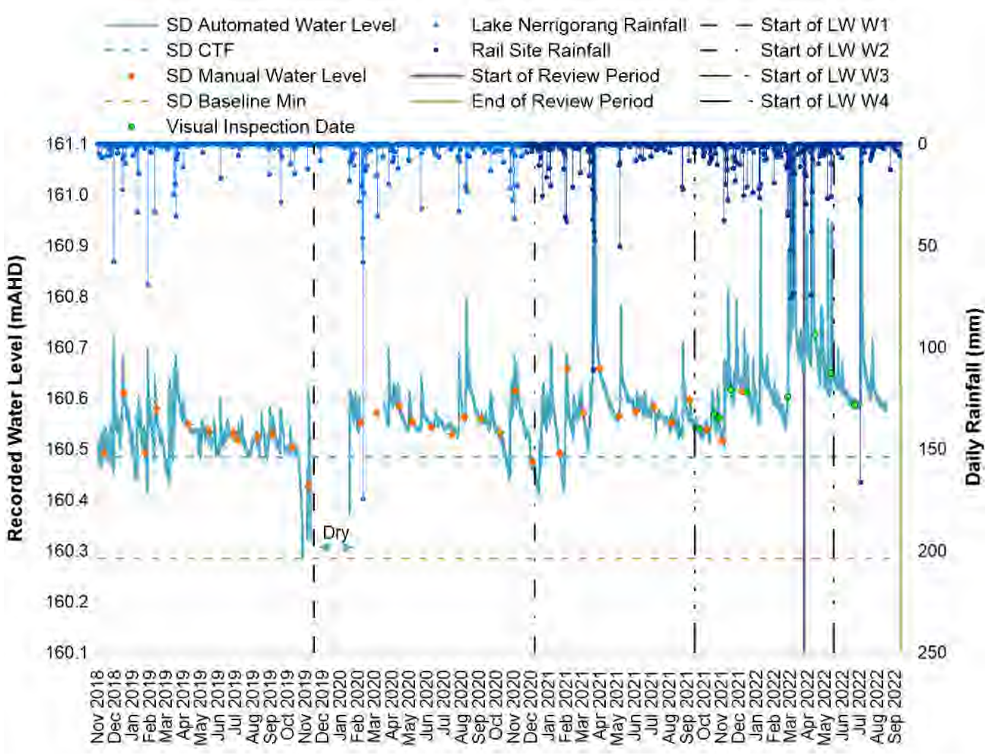


**FIGURE B24: MONITORING SITE SD WATER LEVEL RECORDS**[7]

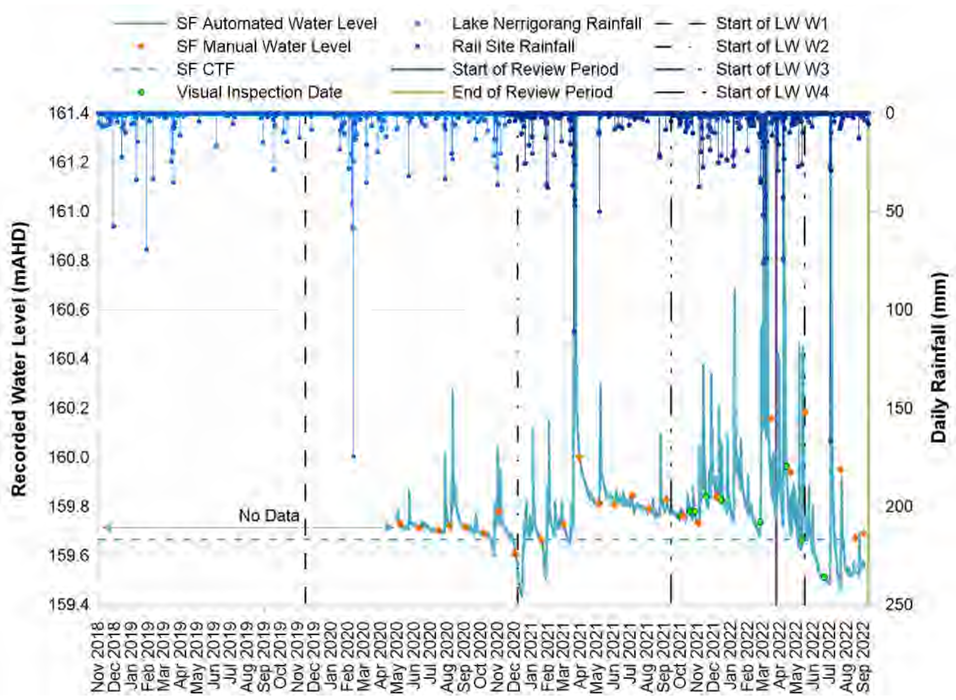


**FIGURE B25: MONITORING SITE SF WATER LEVEL RECORDS**

[7] The water level sensor has not been located and therefore records are not available from 7 December 2021.

## APPENDIX C – WATER QUALITY PLOTS[8]

[8] When the recorded value was below the limit of reporting, the value has been plotted at the limit of reporting in the following plots.

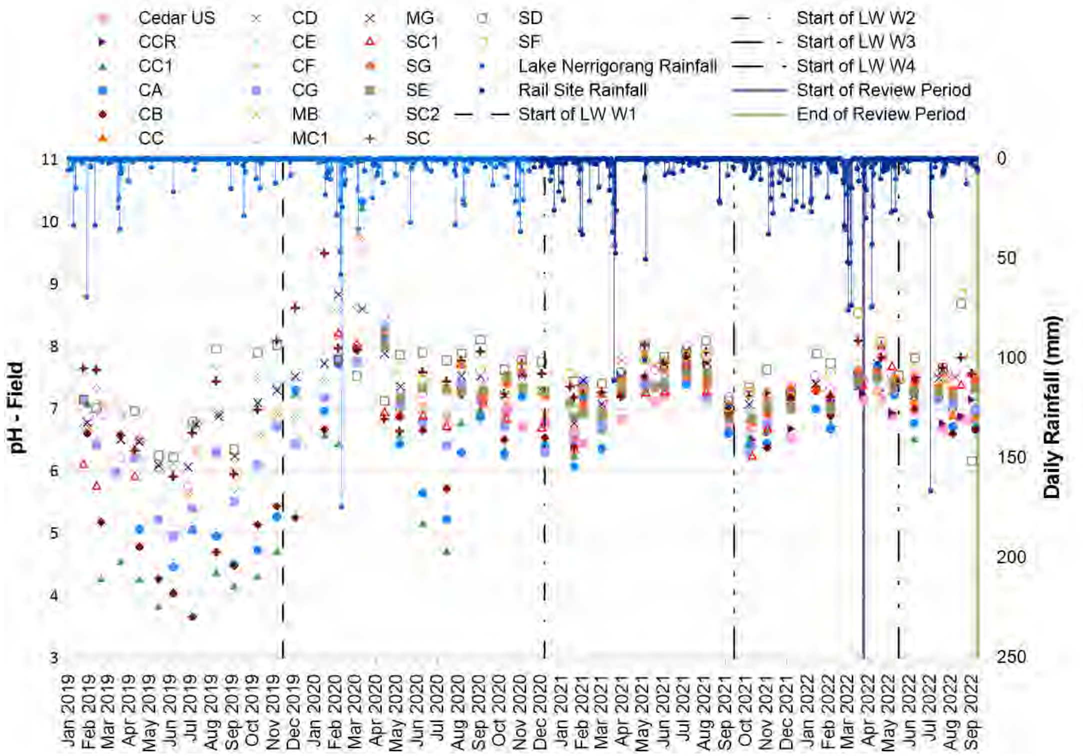


**FIGURE C1: FIELD PH RECORDS**

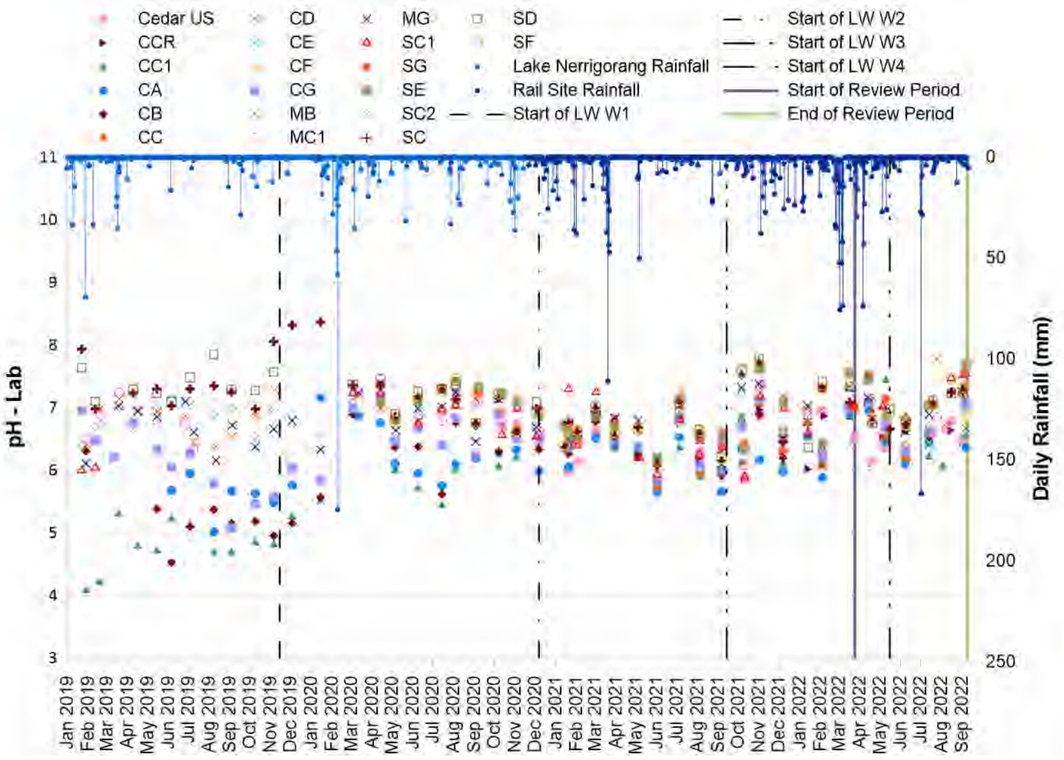


**FIGURE C2: LABORATORY PH RECORDS**

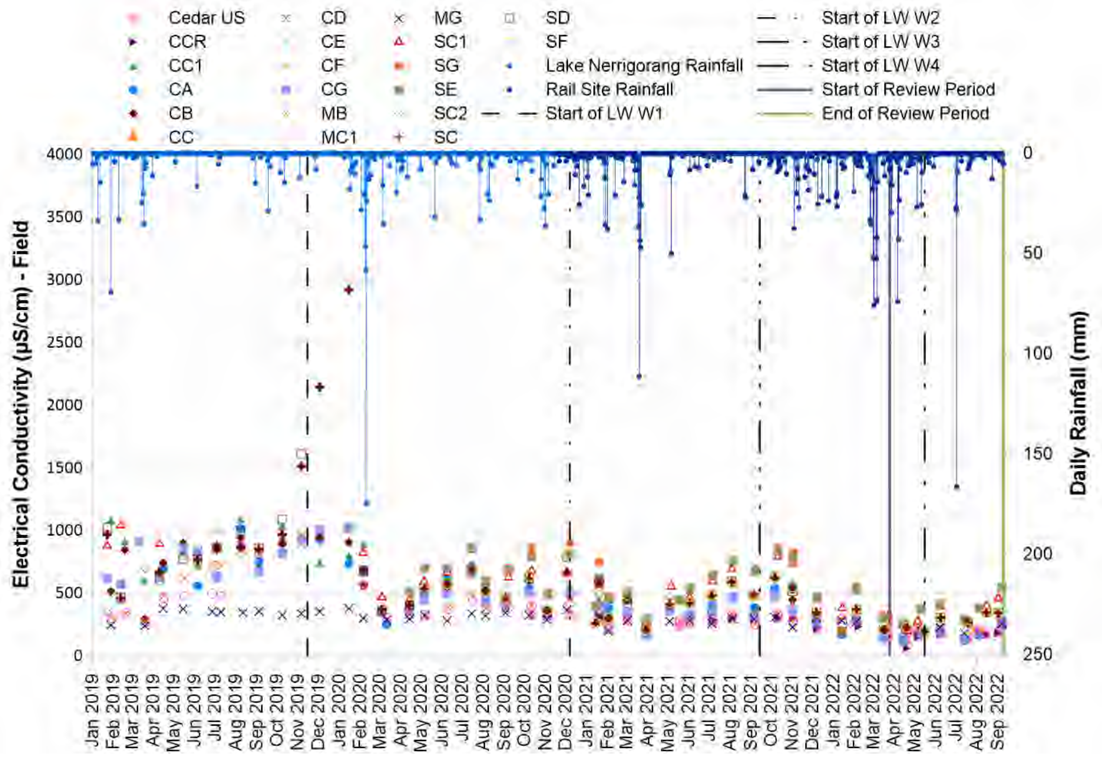


**FIGURE C3: FIELD ELECTRICAL CONDUCTIVITY RECORDS**

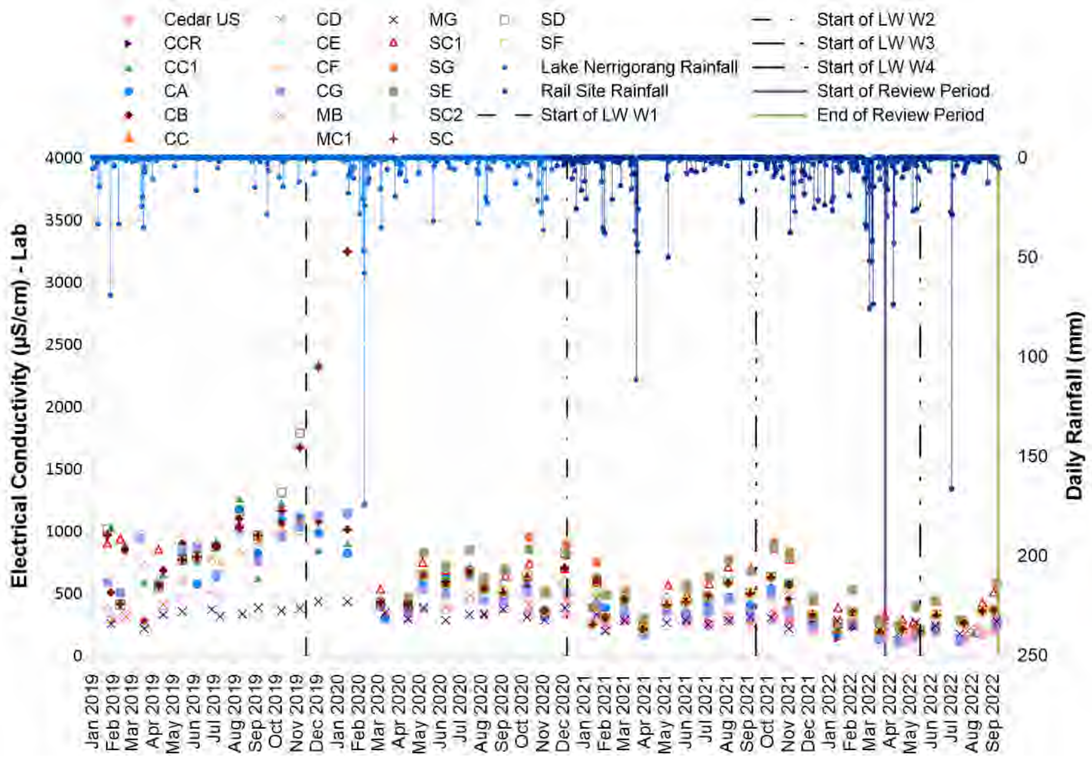


**FIGURE C4: LABORATORY ELECTRICAL CONDUCTIVITY RECORDS**

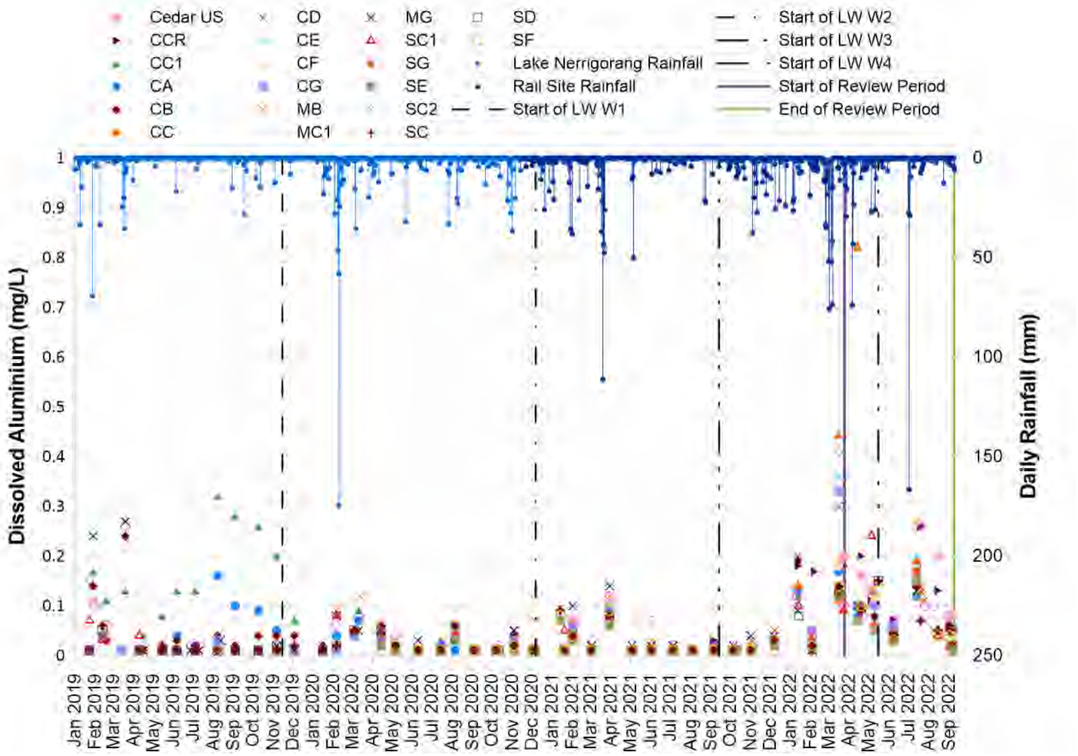


**FIGURE C5: DISSOLVED ALUMINIUM RECORDS**

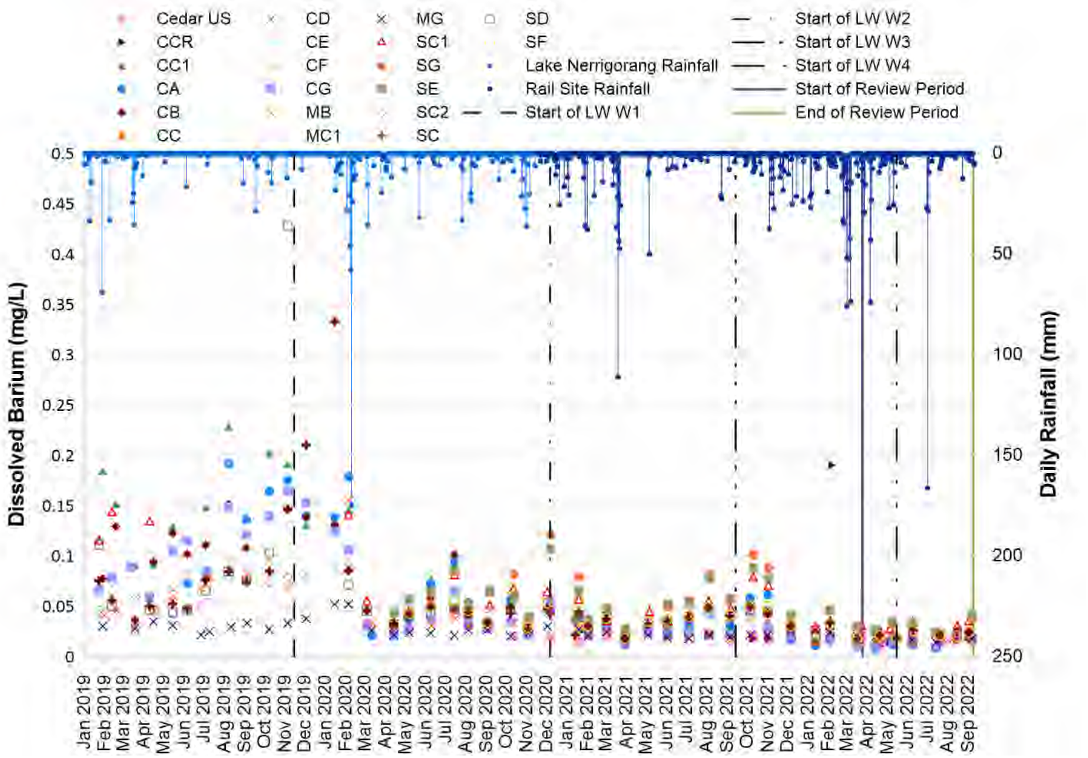


**FIGURE C6: DISSOLVED BARIUM RECORDS**

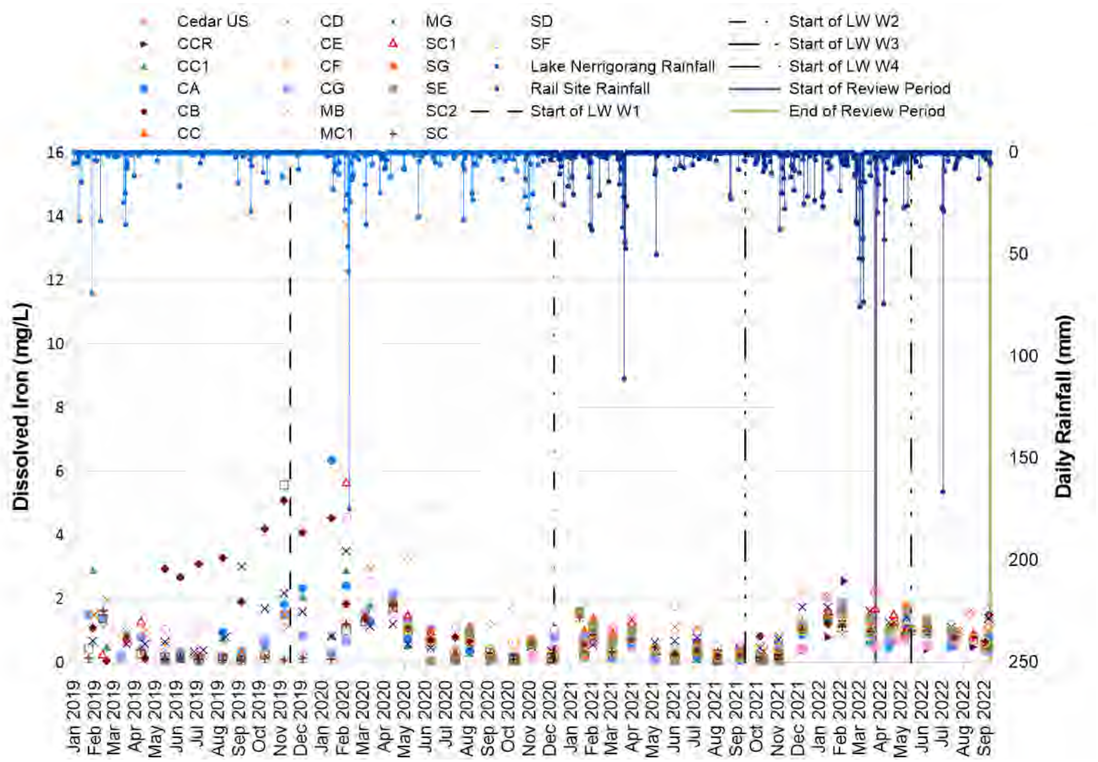


FIGURE C7: DISSOLVED IRON RECORDS

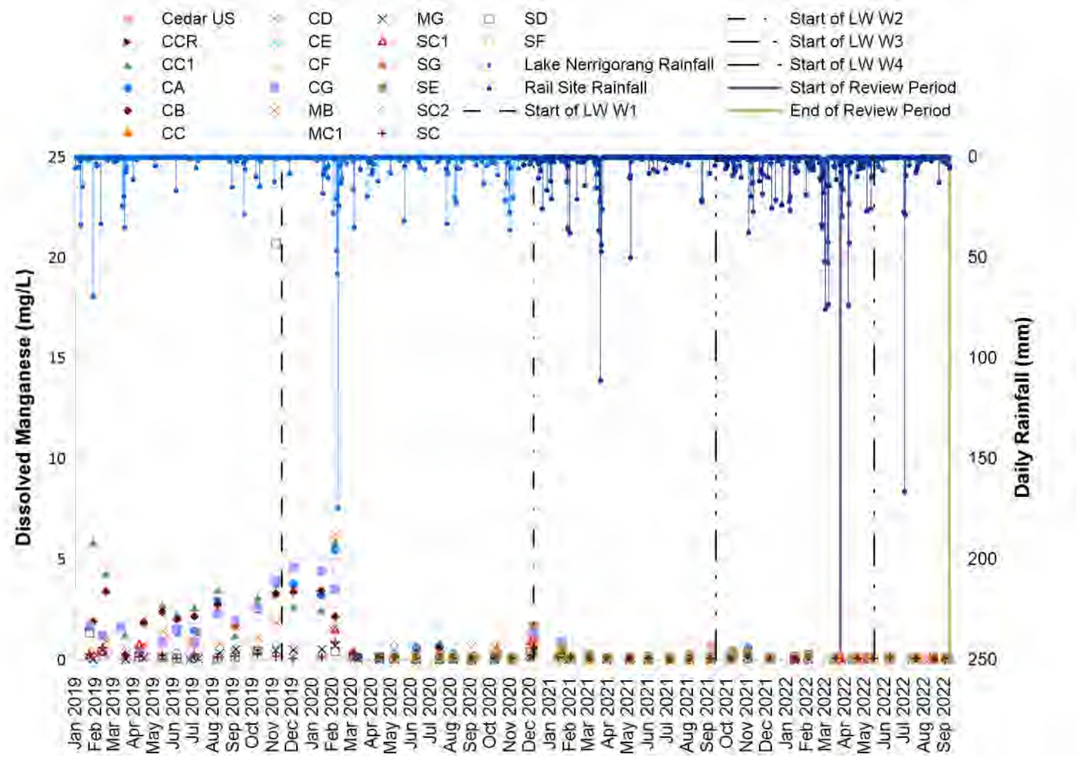


FIGURE C8: DISSOLVED MANGANESE RECORDS

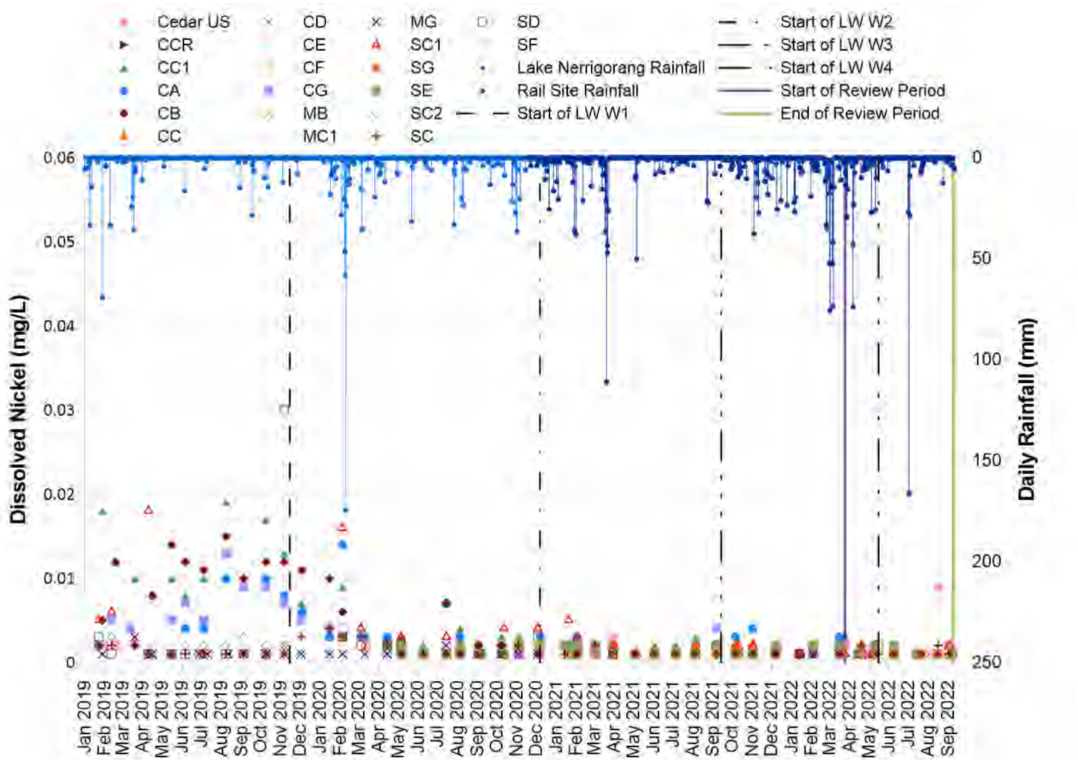


**FIGURE C9: DISSOLVED NICKEL RECORDS**

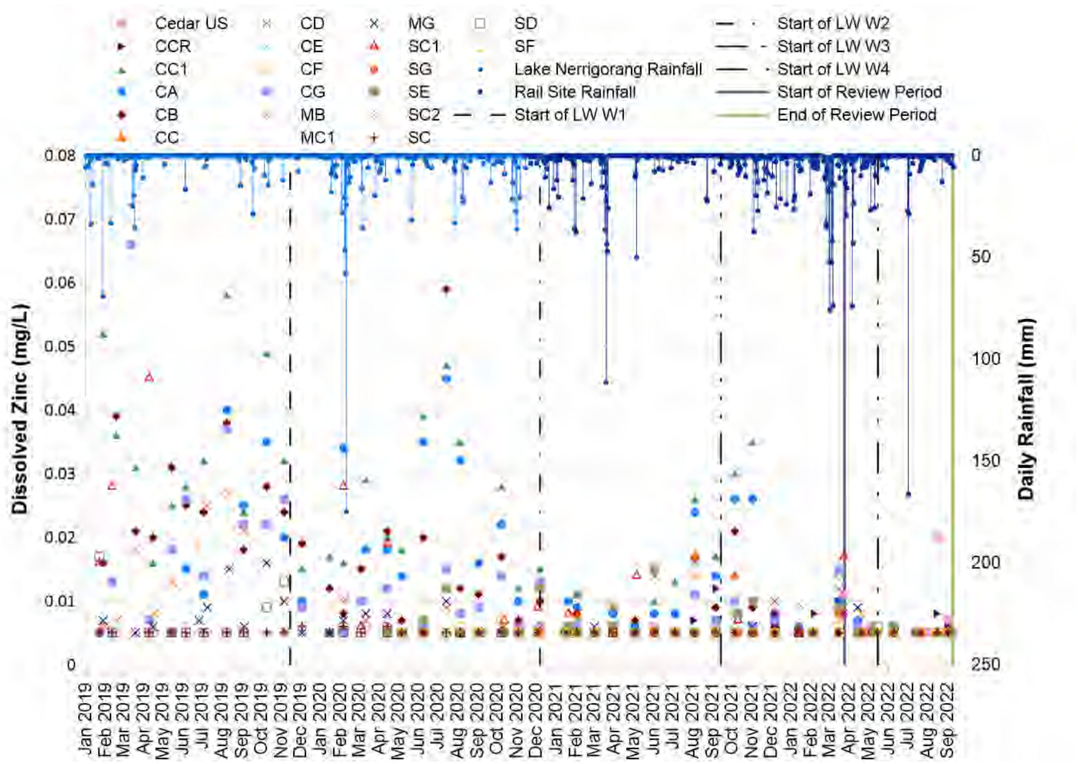


**FIGURE C10: DISSOLVED ZINC RECORDS**

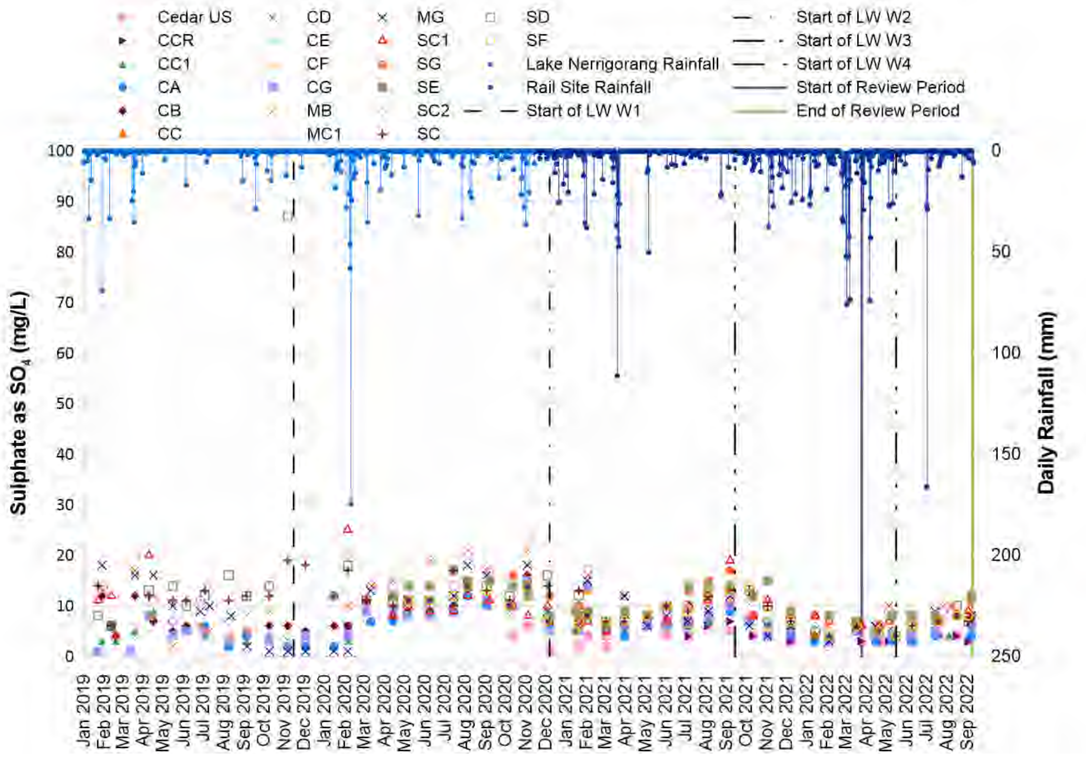


**FIGURE C11: DISSOLVED SULPHATE RECORDS**

ATC WILLIAMS

# REPORT

**TAHMOOR COAL PTY LTD**
ABN: 97076663968

**Tahmoor North Western Domain**

**Surface Water Review**
**1 September to 31 December 2022**

121171-16R003-rev0
March 2023

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|---|---|---|---|---|
| Rev 0 | Final | 1 March 2023 | Makaela McGrath | Camilla West |
| | | | | |
| | | | | |

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CONTENTS



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## TABLES



## DIAGRAMS



## MAPS

# 1 INTRODUCTION

## 1.1 Background

The Tahmoor North Western Domain (Western Domain) Investigative Area, which encompasses longwall (LW) West 1 (W1) to West 4 (W4), is shown in **MAP 1**. Mining of LW W1 to LW W4 was conducted from 15 November 2019 to 13 September 2022.

In accordance with the *Tahmoor North Western Domain Longwalls West 3 and West 4 Water Management Plan* (Tahmoor Coal, 2021; WMP), Tahmoor Coal Pty Ltd (Tahmoor Coal) are required to implement monitoring of groundwater, surface water and subsidence.

Accordingly, Tahmoor Coal have developed a comprehensive rainfall, surface water and groundwater monitoring network within and adjacent to the Western Domain. The surface water monitoring network comprises water level monitoring sites, water quality monitoring sites and visual inspection sites. The locations of the relevant rainfall stations, surface water and groundwater monitoring sites and visual inspection sites are shown in **MAP 1**.

Tahmoor Coal have engaged ATC Williams Pty Ltd (ATCW) to undertake a review and analysis of surface water monitoring data recorded at sites within and adjacent to the Tahmoor North Western Domain (the Western Domain) for the period 1 September to 31 December 2022. The groundwater and subsidence review and analysis are undertaken by independent specialists.

The review period of 1 September to 31 December 2022 comprises the latter period of mining of LW W4 and the period immediately following cessation of all mining in the Western Domain.

## 1.2 Scope

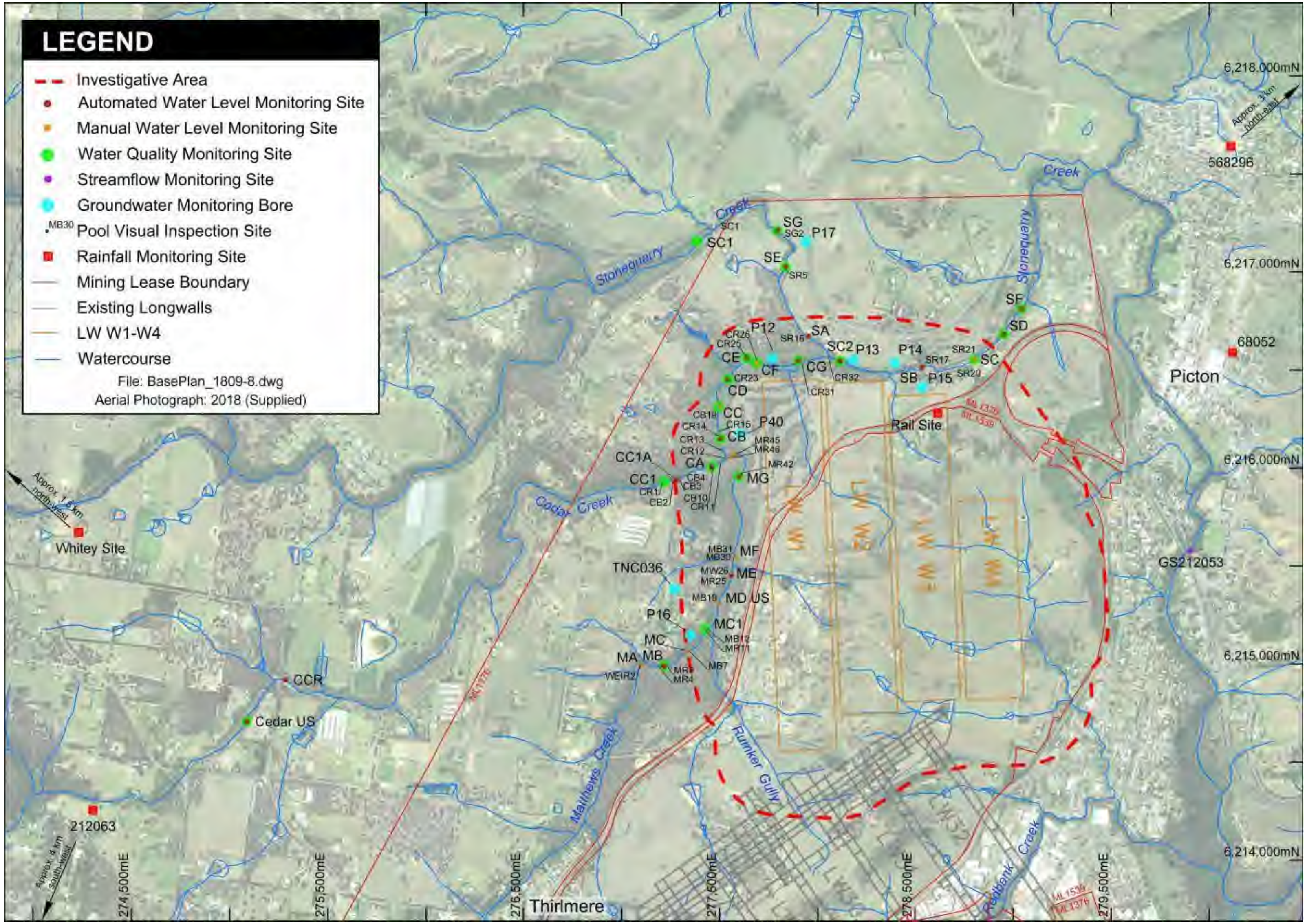
In January 2021, a Level 4 TARP significance was triggered in relation to surface water level decline at monitoring site CB (pool CR14) in Cedar Creek (refer **MAP 1** for site location). Following the Level 4 TARP exceedance, the Department of Planning and Environment (DPE) requested that Tahmoor Coal report on a three-monthly basis until such time as the DPE agrees that impacts have stabilised and the extent and longevity of impacts are confirmed.

In addition to the requested DPE reporting, this report comprises:

- Review and interpretation of monitoring data for the period 1 September to 31 December 2022, where available data permits - referred to as the review period herein;
- Assessment against the performance measures (listed in DA67/98) and performance indicators (Tahmoor Coal, 2021) for surface water; and
- Recommendations in relation to ongoing monitoring and/or corrective actions.

This report predominantly presents and interprets surface water monitoring data recorded in the vicinity of the Western Domain Investigative Area. The report addresses the extent and longevity of water level impacts at monitoring site CB in addition to surface water trigger exceedances that have been recorded at all other monitoring sites during the period of review. Assessment of groundwater is detailed in SLR (2023).

**MAP 1: RELEVANT RAINFALL, SURFACE WATER AND GROUNDWATER MONITORING SITES**



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# 2 SURFACE WATER MONITORING PROGRAM

## 2.1 Overview

Surface water level and quality data has been collected by Tahmoor Coal at monitoring sites located on Matthews Creek, Cedar Creek and Stonequarry Creek as shown in **MAP 1** and detailed in **Appendix A**. The surface water monitoring program is described in the WMP. The purpose of the surface water monitoring program is to ensure compliance with regulatory requirements and to enable identification of potential mining related impacts to:

- physical features and natural drainage behaviour (assessed by independent specialists and summarised herein);
- surface water level; and
- surface water quality.

The surface water level data, water quality data and visual inspection records are assessed against the performance measures, performance indicators and Trigger Action Response Plan (TARP) documented in the WMP.

To facilitate the assessment, surface water monitoring sites have been implemented as follows:

| | |
|---|---|
| Baseline Site: | Surface water monitoring site that has been monitored for water level and quality prior to the commencement of mining in the Western Domain. Baseline surface water monitoring sites were used to derive Site Specific Guideline Values (SSGVs) which inform the TARPS. |
| Reference Site: | Surface water monitoring site that is located upstream of the subsidence impact zone and is considered unlikely to be affected by mining activity. These sites are utilised as benchmarks for observations from potential impact sites. |
| Potential Impact Site: | Surface water monitoring site located within the potential subsidence impact zone (as defined based on mining induced subsidence predictions), from which a potential effect on surface water level or quality from the site activity may be detected. |

Based on these definitions, surface water monitoring sites have been classified as follows:

Baseline / Impact Site

- Cedar Creek (CA, CB, CC, CD, CE, CF, CG)
- Matthews Creek (MC1, MG)
- Stonequarry Creek (SC2, SC, SD, SF)

Reference / Control Site

- Cedar Creek (CCR, Cedar US, CC1)
- Matthews Creek (MB)
- Stonequarry Creek (SC1, SE, SG)

Further detail on each monitoring site is provided in **Appendix A.**

## 2.2 Methodology

In accordance with the WMP, automated and manual water level monitoring is undertaken. The automated water level monitoring is collected via a water pressure sensor that continuously records pressure measurements. Water level measurements are also recorded manually on a monthly basis at sites with and without automated water level monitoring.

Water quality monitoring is undertaken monthly. The monitored water quality constituents are defined in **TABLE 1**:

**TABLE 1: SUMMARY OF WATER QUALITY MONITORING**

| Field Monitoring | Laboratory Analysis |
|---|---|
| pH<br>Electrical Conductivity (EC)<br>Temperature<br>Dissolved Oxygen (DO)<br>Oxidation Reduction Potential (ORP) | pH<br>EC<br>major cations including; calcium, magnesium, sodium and potassium, sulphate, alkalinity, chloride<br>dissolved and total metals including; aluminium, arsenic, barium, copper, iron, lead, lithium, manganese, nickel, selenium, strontium and zinc<br>total kjeldahl nitrogen<br>total nitrogen<br>nitrite + nitrate<br>total phosphorus<br>total cations and total anions |

Field work and quality control/quality assurance associated with this monitoring program are undertaken by others.

## 3 SUMMARY OF MONITORED SUBSIDENCE MOVEMENTS

### 3.1 LW W4 Subsidence Impact Performance Measures

The subsidence impact performance measures and performance indicators for natural features defined in the WMP are summarised in **TABLE 2** . The monitoring results, in conjunction with the TARPs, are used to assess the impacts of mining in the Western Domain against the subsidence impact performance measures specified in **TABLE 2**. This report addresses the first subsidence performance measure listed in **TABLE 2**.

**TABLE 2: SUBSIDENCE PERFORMANCE MEASURES AND PERFORMANCE INDICATORS FOR SURFACE WATER AND GROUNDWATER RESOURCES**

| Feature | Subsidence Performance Measures | Subsidence Performance Indicators |
|---|---|---|
| Stonequarry Creek, Cedar Creek and Matthews Creek | No subsidence impact or environmental consequence greater than minor* | This performance measure 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:<br>• More than 10% of pools located within the Study Area for Natural Features; and/or<br>• Pool SR17. |
| | 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 groundwater model predictions. This would be supported by analysis of pre- and post-mining goaf centreline bore data. |

* Minor is defined as *not very large, important or serious*

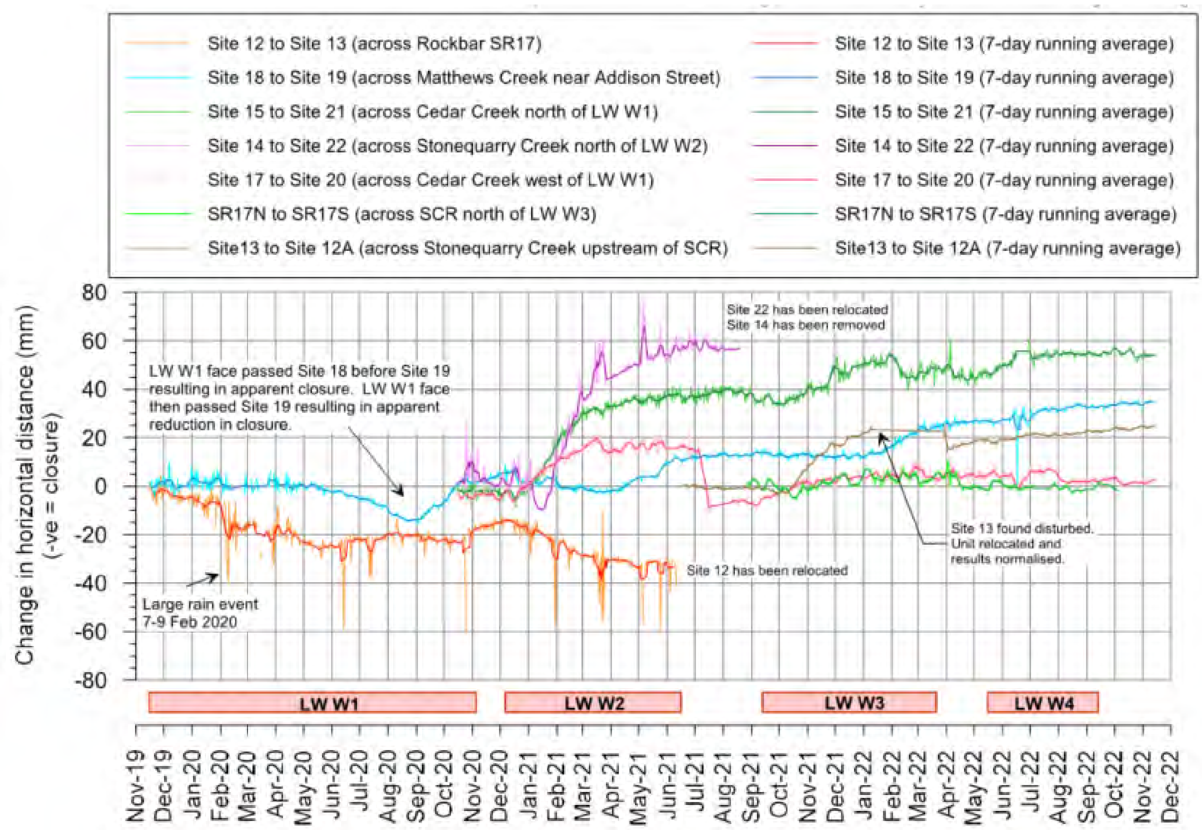
### 3.2 Summary of Results

Tahmoor Coal has installed many ground survey marks above and adjacent to LW W1 – W4 with monitoring of subsidence movements undertaken at key locations across Stonequarry Creek, Matthews Creek and Cedar Creek.

Changes in horizontal distances calculated between GNSS[1] units that are stationed close together are presented in **DIAGRAM 1**.

[1] Global Navigation Satellite System (GNSS) units are fixed survey stations that continuously measure absolute horizontal and vertical positions at a location in real time.

**DIAGRAM 1: OBSERVED CHANGES IN HORIZONTAL DISTANCES BETWEEN GNSS UNITS (SOURCE: MSEC, 2022)**




Since the completion of LW W4 to 18 November 2022[2], the following was recorded (MSEC, 2022):

- Small changes in horizontal distance at Site SR17N to Site SR17S across rockbar SR17 (SCR).
- Measurements at Marks RBE11, RBF05 and RBF06 located across rockbar SR17 indicate that minor ground shortening has occurred in the south-east corner of the rockbar (MSEC, 2022).
- Less than 10 mm horizontal distance at Site 13 to Site 12A, located across Stonequarry Creek upstream of rockbar SR17 (SCR).
- Negligible opening at Site 15 to Site 21, located across Cedar Creek upstream of the confluence with Stonequarry Creek.
- Little change in horizontal distance at Site 18 to Site 19, located across Matthews Creek near Addison Street.
- Negligible change in horizontal distance at Site 17 to Site 20, located across Cedar Creek to the west of LW W1.

[2] The latest subsidence monitoring review period was to 18 November 2022; subsidence monitoring is reported on a six monthly basis for the Western Domain.

# 4 SURFACE WATER MONITORING REVIEW

The following sections present a summary of the pool visual inspections outcomes and the surface water level and water quality monitoring data recorded at monitoring sites in Matthews Creek, Cedar Creek and Stonequarry Creek (refer **MAP 1** for site locations). **Section 5** presents further interpretation of monitoring data for sites which reported a TARP significance level in excess of Level 1 during the review period.

## 4.1 Surface Water Level Data

### 4.1.1 Data Constraints

The following is noted in relation to the monitoring data recorded during the current review period (1 September to 31 December 2022):

- Monitoring site MG – safety issues have prevented access to monitoring site MG and as such data was unable to be collected from 7 December onwards.
- Monitoring site CCR - the reference bolt at monitoring site CCR has not been located and as such the raw data recorded from 8 December 2021 was unable to be converted to a water level measurement. This site has been decommissioned due to the challenges in data correction and as CCR is influenced by backwater effects from a downstream weir. A reliable reference site for Cedar Creek is located at Cedar US.
- Monitoring site SC2 - the logger and housing were washed away during flood events in late 2021. The site has subsequently been decommissioned for water level monitoring, with water level monitoring undertaken at monitoring site SB (SC2 and SB are both located in pool SR17).
- Monitoring site SF - the control at monitoring site SF has been impacted by flood events and, as such, the water level records are not necessarily comparative to pre-flood conditions.
- Monitoring site SG – the flow control at monitoring site SG, comprised predominantly of sand and rubble, was washed away in recent flood events and the site subsequently decommissioned.
- The manual water level measurements have not been recorded for some sites due to access restrictions (i.e. high flow conditions) or at sites where the reference bolt has not been located.

### 4.1.2 Surface Water Levels

**Appendix A** provides charts of the automated and manual water level data for the full period of record. Note that the cease to flow (CTF) level shown on the automated water level plots refers to the point at which surface water ceases to flow over the streamflow control i.e. the lowest point on a controlling rockbar or boulder field. In the event that streamflow over the rockbar or boulder field ceases, there may still be streamflow around or under the rockbar/boulder field control which reports downstream of the control. **TABLE 3** presents a summary of the water level monitoring data for the review period. Exceedances of trigger levels are discussed in **Section 5**.

### TABLE 3: SUMMARY OF AUTOMATED WATER LEVEL MONITORING DATA FOR THE REVIEW PERIOD

| Monitoring Site | Classification | Summary of Recorded Water Level During Review Period | Appendix B - Figure Number |
|---|---|---|---|
| ***Matthews Creek*** | | | |
| MB (Pool MR5) | Reference Site | The water level remained above the baseline minimum for the duration of the review period. In December 2022, the water level declined below the CTF level, consistent with below average rainfall conditions. The water level was recorded above the CTF level at the end of December 2022. | Figure B2 |
| ME (Pool MR25) | Potential Impact Site | The water level remained above the baseline minimum for the duration of the review period. In December 2022, the water level declined slightly below the CTF level, consistent with below average rainfall conditions. The water level was recorded above the CTF level at the end of December 2022. | Figure B5 |
| MG (Pool MR42) | Potential Impact Site | The water level remained above the baseline minimum and CTF level for the period of data availability. | Figure B7 |
| ***Cedar Creek*** | | | |
| Cedar US | Reference Site | The water level characteristics were consistent with historical characteristics for the duration of the review period. | Figure B9 |
| CC1A (Pool CB3) | Reference Site | The water level remained above the baseline minimum and CTF level for the duration of the review period. | Figure B10 |
| CA (Pool CB10) | Potential Impact Site | The water level remained above the baseline minimum for the duration of the review period. The water level declined very slightly below the CTF level in late December 2022 however was recorded above the CTF level at the end of December. | Figure B11 |
| CB (Pool CR14) | Potential Impact Site | The water level remained above the baseline minimum until 9 December 2022. From 9 to 30 December 2022, the water level declined below the baseline minimum by a maximum of 0.46 m. | Figure B12 |
| CD (Pool CR23) | Potential Impact Site | The water level remained above the baseline minimum and CTF level for the duration of the review period. | Figure B14 |
| CE (Pool CR25 | Potential Impact Site | The water level remained above the baseline minimum and CTF level for the duration of the review period. | Figure B15 |
| CG (Pool CR31) | Potential Impact Site | The water level remained above the baseline minimum and CTF level for the duration of the review period. | Figure B17 |

| Monitoring Site | Classification | Summary of Recorded Water Level for the Period | Appendix B - Figure Number |
|---|---|---|---|
| ***Stonequarry Creek*** | | | |
| SE (Pool SR5) | Reference Site | The water level remained above the previously recorded minimum except for brief periods (less than 24 hours consecutively) in December 2022. | Figure B19 |
| SA (Pool SR16) | Potential Impact Site | The water level remained above the baseline minimum and CTF level for the duration of the review period. | Figure B20 |
| SB (Pool SR17) | Potential Impact Site | The water level remained above the baseline minimum and CTF level for the duration of the review period. | Figure B22 |
| SD | Potential Impact Site | The water level remained above the baseline minimum for the duration of the review period. The water level declined below the CTF level for a brief period in late December 2022. | Figure B24 |

## 4.2 Surface Water Quality

The water quality data for the following constituents, which are considered to be primary indicators of a mining related influence, are summarised in **TABLE 4**:

- pH;
- Electrical conductivity (EC);
- Dissolved metals, including: aluminium, barium, iron, manganese, nickel and zinc; and
- Sulphate.

Monitoring results for key constituents are also shown on a series of plots in **Appendix C**. Exceedances of trigger levels are discussed in **Section 5**.

### TABLE 4: SUMMARY OF KEY WATER QUALITY CONSTITUENTS – 1 SEPTEMBER TO 31 DECEMBER 2022

| Constituent | Matthews Creek: MB (reference site), MC1 and MG (potential impact sites) | Cedar Creek: Cedar US, CCR and CC1 (reference sites), CA, CB, CC, CD, CE, CF and CG (potential impact sites) | Stonequarry Creek: SC1, SE, SG (reference sites), SC2, SC, SD and SF (potential impact sites) |
|---|---|---|---|
| **pH** (Figure C1, Appendix C) | • Near neutral pH conditions.<br>• pH was consistent with baseline values. | • Slightly acidic to near neutral pH conditions.<br>• pH recorded during the review period was in range with baseline values. | • The field pH values indicate slightly acidic to slightly alkaline pH conditions.<br>• A historical minimum pH value was recorded at SD in September 2022. This was an isolated event and pH values returned to baseline conditions from October 2022.<br>• pH recorded at all other monitoring sites was generally consistent with baseline values. |
| **Electrical Conductivity** (Figure C3, Appendix C) | • Field EC values were consistent with baseline values (equal to or less than 350 µS/cm). | • Field EC values were within the range of baseline values (equal to or less than 350 µS/cm). | • Field EC values were consistent with baseline values (equal to or less than 350 µS/cm). |
| **Dissolved Aluminium** (Figure B5, Appendix B) | • An elevated concentration of dissolved aluminium was recorded at MC1 in October 2022 following a period of above average rainfall.<br>• For the remainder of the review period and for all other sites, the concentrations of dissolved aluminium were generally consistent with baseline conditions. | • Elevated concentrations of dissolved aluminium were recorded in October 2022 at all sites, including at reference site CC1.<br>• The elevated concentrations were recorded following above average rainfall, returning to baseline conditions for the remainder of the review period. | • Elevated concentrations of dissolved aluminium were recorded in October and November 2022 at SC2, SC and SD.<br>• A historically high concentration of dissolved aluminium was recorded at reference site SC1 in October 2022.<br>• The elevated concentrations were recorded following above average rainfall, returning to baseline conditions in December 2022. |

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| Constituent | **Matthews Creek:** MB (reference site), MC1 and MG (potential impact sites) | **Cedar Creek:** Cedar US, CCR and CC1 (reference sites), CA, CB, CC, CD, CE, CF and CG (potential impact sites) | **Stonequarry Creek:** SC1, SE, SG (reference sites), SC2, SC, SD and SF (potential impact sites) |
|---|---|---|---|
| **Dissolved Barium** (Figure B6, Appendix B) | • The concentrations of dissolved barium were consistent with baseline conditions for the duration of the review period (less than 0.03 mg/L recorded at all sites). | • The concentrations of dissolved barium were consistent with baseline conditions for the duration of the review period (less than 0.02 mg/L recorded at all sites). | • The concentrations of dissolved barium were consistent with baseline conditions for the duration of the review period (less than 1mg/L recorded at all sites). |
| **Dissolved Iron** (Figure B7, Appendix B) | • The concentrations of dissolved iron were consistent with baseline conditions for the duration of the review period (less than 2 mg/L recorded at all sites). | • The concentrations of dissolved iron were consistent with baseline conditions for the duration of the review period (less than 2 mg/L recorded at all sites). | • The concentrations of dissolved iron were consistent with baseline conditions for the duration of the review period (less than 2 mg/L recorded at all sites). |
| **Dissolved Manganese** (Figure C8, Appendix C) | • Concentrations recorded at all sites were consistent with or less than baseline values. | • Concentrations recorded at all sites were consistent with or less than baseline values. | • Concentrations recorded at all sites were consistent with or less than baseline values. |
| **Dissolved Nickel** (Figure C9, Appendix C) | • Concentrations recorded at all sites were consistent with baseline values. | • Concentrations recorded at all sites were consistent with baseline values. | • Concentrations recorded at all sites were consistent with baseline values. |
| **Dissolved Zinc** (Figure C10, Appendix C) | • The concentrations of dissolved zinc recorded at all sites were consistent with or less than baseline values. | • The concentrations of dissolved zinc recorded at all sites were consistent with or less than baseline values. | • The concentrations of dissolved zinc recorded at all sites were consistent with or less than baseline values. |
| **Sulphate** (Figure C11, Appendix C) | • Concentrations recorded at all sites were generally consistent with baseline values. | • Concentrations recorded at all sites were generally consistent with baseline values. | • Concentrations recorded at all sites were generally consistent with baseline values. |

## 4.3 Pool Visual Inspections

The visual inspections conducted between 1 September to 31 December 2022 identified that all sites inspected at Stonequarry Creek, Cedar Creek and Matthews Creek were reported at a Level 1 trigger significance[3] in relation to physical features and natural behaviour of pools, with the exception of pool SR17 and pool SR20 in Stonequarry Creek which were reported at a Level 3 trigger significance (BES, 2022a-c).

Pool SR17 was initially reported at a Level 3 significance on 28 October 2021 due to surficial fracturing of the controlling rockbar (pers. comm. MSEC). Brienen Environment & Safety (BES, 2021b) reported this as laminar fracturing and extension of a natural crack in the rockbar following the inspection on 17 November 2021. Since the initial observation of the fracturing, no gas release or iron precipitation has been noted during visual inspections. Consequently, a Level 3 trigger significance in relation to physical features and natural behaviour of pool SR17 has been derived for the period including and following 17 November 2021 (BES, 2022a-c).

Pool SR20 was reported by BES (2022b-c) as a Level 3 significance due to surface fracturing of the controlling rockbar observed on 18 August 2022. Two fractures were identified at pool SR20, the first was initially observed in July 2019 during the pre-mining survey and the second during the August 2022 visual inspection. Between August and November 2022, it was reported that the fractures had widened (BES, 2022c). Since the initial observation of the fracturing, no gas release or iron precipitation has been noted during visual inspections. Consequently, a Level 3 trigger significance in relation to physical features and natural behaviour of pool SR20 has been derived for the period including and following 18 August 2022 (BES, 2022b-c).

[3] No observed impact to pool level, drainage or overland connected flow.

# 5 ASSESSMENT AGAINST SURFACE WATER TARPS

## 5.1 Subsidence Impact Performance Measures – Natural Features

As detailed in the WMP, TARPs have been developed for the Western Domain to define actions and response measures for unpredicted subsidence impacts to surface water resources. The monitoring results, in conjunction with the TARPs, are used to assess the impacts of mining in the Western Domain against the subsidence impact performance measures specified in **TABLE 5**. This report addresses the first subsidence impact performance measure listed in **TABLE 5** while the second performance measure is addressed by the hydrogeological specialist.

**TABLE 5: SUBSIDENCE IMPACT PERFORMANCE MEASURES – NATURAL FEATURES**

| Surface Water System | Subsidence Impact Performance Measure | Exceedance of Performance Measure |
|---|---|---|
| Stonequarry Creek, Cedar Creek and Matthews Creek | No subsidence impact or environmental consequence greater than minor* | The performance measure 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:<br>• More than 10% of pools located within the Investigative Area; and/or<br>• Pool SR17. |
| | No connective cracking between the surface, or the base of the alluvium, and the underground workings | The performance measure 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. |

* Minor is defined as *not very large, important or serious.*

## 5.2 Impact to Pool Water Level, Physical Features and Natural Behaviour

### 5.2.1 Significance Triggers for Automated Pool Water Level and Physical Features

The significance levels / triggers, as detailed in the WMP, are summarised in **TABLE 6** for pool water level and in **TABLE 7** for physical features and natural behaviour of pools. In accordance with the WMP, the pool water level data and visual inspection observations have been assessed against the tabulated criteria for each trigger level.

**TABLE 6: SIGNIFICANCE LEVELS / TRIGGERS FOR POOL WATER LEVEL**

| TARP Level | Pool Water Level |
|---|---|
| Level 1 | The recorded water level has not declined below the recorded baseline minimum level (in one 24 hour period for automated pool water level) OR the recorded water level has declined below the recorded baseline minimum level (in one 24 hour period for automated pool water level) but the decline is due to a monitoring or sensor error or the magnitude of the decline (below the recorded baseline minimum level) is within the range of sensor accuracy. |
| Level 2 | The recorded water level has declined below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) AND the above has occurred at one of the upstream pools (beyond mining effects). |
| Level 3 | The recorded water level has declined, although not atypically*, below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) AND the above has not occurred at one of the upstream pools (beyond mining effects). |
| Level 4 | The recorded water level has declined atypically* below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) AND similar behaviour has not occurred at one of the upstream pools (beyond mining effects). |

* 'Atypical' surface water characteristics relate to a notable and/or rapid water level decline or change in the slope of the falling limb of the hydrograph or the water level recessionary behaviour below the CTF level which is inconsistent with baseline conditions and cannot be attributed to climatic conditions.

**TABLE 7: SIGNIFICANCE LEVELS / TRIGGERS FOR PHYSICAL FEATURES AND NATURAL BEHAVIOUR OF POOLS**

| TARP Level | Physical Features and Natural Behaviour of Pools |
|---|---|
| Level 1 | No observed impacts to pool level, drainage or overland connected flow. |
| Level 2 | Visually observed reduction in pool level, drainage or overland connected flow AND the above has occurred at one of the upstream pools (beyond mining effects) OR visual monitoring of pools has not noted any mining related impacts*. |
| Level 3 | Rockbar 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 into account climatic conditions and observations during the baseline monitoring period. |
| Level 4 | Visually observed reduction in pool water level, drainage or overland connected flow, taking into account climatic conditions and observations during the baseline monitoring period AND the above change has not occurred at one of the upstream pools (beyond mining effects). |

* Rockbar and/or stream base cracking, gas release or iron precipitation in excess of baseline conditions.

## 5.3 Assessment of Automated Pool Water Level Data and Visual Inspection Observations

A summary of the pool water level, physical features and natural behaviour TARP significance levels for potential impact sites over the duration of the review period is presented in **TABLE 8** and discussed in the sections which follow.

### TABLE 8: SURFACE WATER TARP SIGNIFICANCE LEVELS

| Date | Location(s) | Comment | TARP Significance |
|---|---|---|---|
| ***Surface Water Level*** | | | |
| 1 September to 31 December 2022 | All monitoring sites in Cedar Creek (excluding CB), Matthews Creek and Stonequarry Creek | The recorded water level did not decline below the baseline minimum level (in one 24 hour period). | Level 1 |
| 1 September to 8 December 2022 | Site CB in Cedar Creek | The recorded water level did not decline below the baseline minimum level (in one 24 hour period). | Level 1 |
| 9 to 30 December 2022 | Site CB in Cedar Creek | The recorded water level has declined, although not atypically*, below the recorded baseline minimum level (for more than one 24 hour period for automated pool water level) AND the above has not occurred at one of the upstream pools (beyond mining effects). | Level 3 |
| 31 December 2022 | Site CB in Cedar Creek | The recorded water level did not decline below the baseline minimum level (in one 24 hour period). | Level 1 |
| ***Physical Features and Natural Pool Behaviour*** | | | |
| 15 November 2022 | All monitoring sites in Cedar Creek | No observed impacts to pool level, drainage or overland connected flow. | Level 1* |
| 13 September 2022, 27 October 2022, 15 November 2022 | All monitoring sites Matthews Creek | No observed impacts to pool level, drainage or overland connected flow. | Level 1* |
| 27 October 2022, 15 November 2022 | SR17 rockbar in Stonequarry Creek | Rockbar fracturing noted during visual inspection (in excess of baseline conditions) AND no reduction in pool water level, drainage or overland connected flow, taking into account climatic conditions and observations during the baseline monitoring period. | Level 3* |
| 27 October 2022, 15 November 2022 | SR20 rockbar in Stonequarry Creek | Rockbar fracturing noted during visual inspection (in excess of baseline conditions) AND no reduction in pool water level, drainage or overland connected flow, taking into account climatic conditions and observations during the baseline monitoring period. | Level 3* |

* Source: BES (2022a, 2022b, 2022c)

### 5.3.1 Trigger Exceedance Action and Response

**TABLE 9** summarises the actions and responses required to be undertaken in relation to the Level 3 exceedances recorded at monitoring site CB, pool SR17 and pool SR20.

**TABLE 9: TRIGGER EXCEEDANCE ACTION AND RESPONSE**

| Level | Action | Response |
|---|---|---|
| *Pool water level* | | |
| Level 3 | • Continue monitoring as per monitoring program<br>• Continue monthly review of data<br>• Convene Tahmoor Coal Environmental Response Group to review response | • As defined by Environmental Response Group<br>• Consider increasing download and review of data frequency to fortnightly for sites where Level 3 has been reached<br>• Review manual water level measurements for additional monitoring sites to identify potential spatial trends in water level decline |
| *Impact to physical features and natural behaviour of pools* | | |
| Level 3 | • Continue monitoring as per monitoring program<br>• Continue monthly review of data<br>• 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 climatic conditions | • As defined by Environmental Response Group<br>• Consider increasing inspection and review of data frequency to fortnightly for sites where Level 3 has been reached |

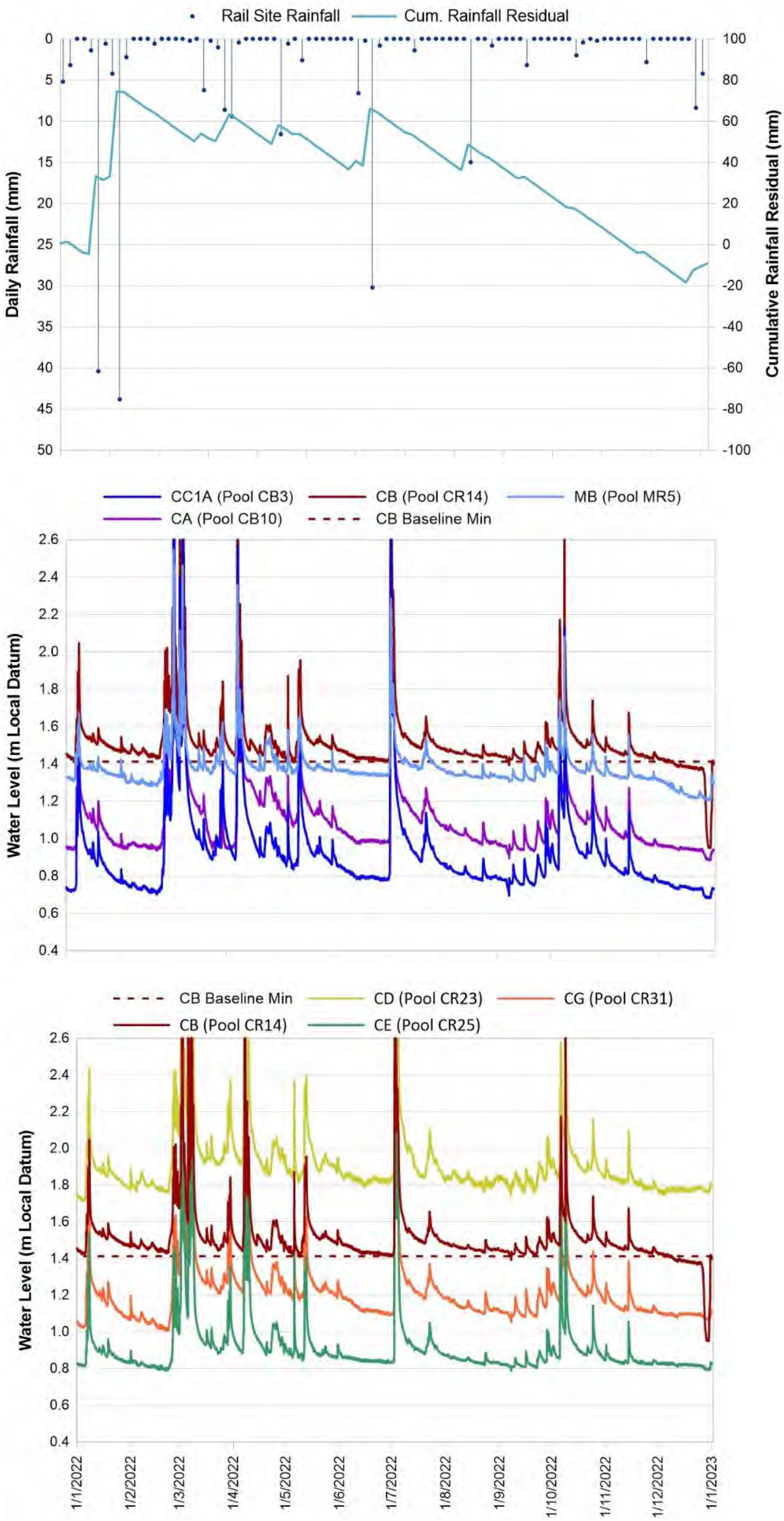
Monitoring Site CB (Pool CR14)

A Level 4 TARP significance was originally triggered in relation to surface water level decline for the period 19 to 29 January 2021 at monitoring site CB (pool CR14) in Cedar Creek. As stated in HEC (2021), whilst not visible on the surface, it was likely that mining induced subsidence had mobilised existing fractures resulting in changes in the water level recession rate of pool CR14 (monitoring site CB). In addition, it was likely that mining induced groundwater drawdown had resulted in the surface water system in the vicinity of pool CR14 transitioning from a gaining stream (baseflow discharge from the groundwater system to the stream) to a weakly gaining or losing stream (surface water recharge to the groundwater system) (HEC, 2021).

From 9 to 30 December 2022, the water level recorded at monitoring site CB (pool CR14) declined below the baseline minimum by a maximum of 0.46 m. This equated to a Level 3 water level trigger exceedance in accordance with the WMP for the period 9 to 30 December 2022. Consequently, the Environmental Response Group was convened and the surface water level data was reviewed in relation to climatic conditions and groundwater level trends.

**CHART 1** presents the cumulative rainfall residual and Cedar Creek water level records for the period 1 January to 31 December 2022.

## CHART 1: CEDAR CREEK WATER LEVEL AND RAINFALL



The data presented in Chart 1 shows that:

- The level 3 trigger exceedance at monitoring site CB occurred during a period of below average rainfall, with the cumulative rainfall residual declining near consistently from September to December 2022.
- Water level decline was recorded at a number of monitoring sites during the period 9 to 30 December 2022, including at reference site MB on Matthews Creek and CC1A on Cedar Creek, although the water level did not decline below the baseline minimum at these sites.
- The water level decline recorded at monitoring site CB from 9 to 30 December 2022 had negligible influence on the water level of downstream monitoring sites during the corresponding period.

As stated in **Section 3.2**, negligible change in horizontal distance has been recorded at Site 17 to Site 20, located across Cedar Creek to the west of LW W1.

As stated in SLR (2023), groundwater levels recorded at groundwater monitoring site P40 (A, B, C and D) were recorded above the creek bed elevation from 9 to 30 December 2022. An upward vertical head hydraulic gradient between P40A and P40B persisted in December 2022 suggesting that groundwater flow was from the mid-Hawkesbury Sandstone to the upper Hawkesbury Sandstone. This is likely to have resulted in baseflow contribution to Cedar Creek in the vicinity of monitoring site CB.

As noted in HEC (2022), the presence of fractures in the base of pool CR14 or in the subsurface would prohibit, to some extent dependent on the nature of the fractures, gaining conditions occurring at pool CR14 (pers. comm. SLR, 16 December 2021). The decline in water level at monitoring site CB (pool CR14) from 9 to 30 December 2022 suggests that, although gaining conditions were prevailing in the vicinity of monitoring site CB, it is likely that fractures in the base of pool CR14 or in the subsurface, resulted in losing conditions occurring at monitoring site CB during this period.

Given the decline in water level at monitoring site CB has occurred intermittently since late 2020 and there has been negligible indication of an associated impact to downstream monitoring sites, increased frequency of monitoring is not deemed to be required. The water level records for this site will continue to be monitored in accordance with the WMP.

<u>Pool SR17</u>

As mentioned in **Section 4.3**, Pool SR17 was initially reported at a level 3 significance on 28 October 2021 due to surficial fracturing of the controlling rockbar (pers. comm. MSEC). Since the initial observation of the fracturing, no gas release or iron precipitation has been noted during visual inspections.

In response to the Level 3 trigger exceedances in relation to physical features at monitoring site SB (pool SR17), the Environmental Response Group convened and the surface water level data was reviewed. The water level records for monitoring site SB (pool SR17) shown in Figure B22, **Appendix B**, indicate that the fracturing of the rockbar has not resulted in an impact to the pool water holding capacity. The water level recorded at monitoring site SB (pool SR17) has not declined below the baseline minimum water level and no atypical water level behaviour has been recorded at this site to date. As such, there is no requirement to increase the frequency of visual inspections and review of data in relation to pool physical features, natural drainage behaviour and pool water level. The physical features and water level records for this site will continue to be monitored in accordance with the WMP.

<u>Pool SR20</u>

In response to the level 3 trigger exceedances in relation to physical features at pool SR20, the Environmental Response Group convened, and the surface water level data was reviewed for the monitoring sites upstream of pool SR20 (monitoring site SB) and downstream of pool SR20 (monitoring sites SC and SD). The monitoring data for these sites indicates that the water level has not declined below the baseline minimum water level from 18 August 2022 (date that fracturing was initially observed) and 31 December 2022 (end of review period).

Additionally, MSEC 2022 as indicated in **Section 3.2**, only minor movements have been recorded generally in the western domain since the completion of mining (13 September 2022), as such, further mining related widening of the observed fractures is considered unlikely to occur.

As such, there is no requirement to increase the frequency of visual inspections and review of data in relation to pool physical features, natural drainage behaviour and pool water level. The physical features and water level records for this site will continue to be monitored in accordance with the WMP.

## 5.4 Surface Water Quality

### 5.4.1 Significance Triggers for Surface Water Quality

Water quality data has been analysed for key water quality parameters of relevance to surface water systems and the effects of subsidence, namely pH, EC, dissolved (field filtered) aluminium, iron, manganese, nickel and zinc at monitoring sites on Matthews Creek, Cedar Creek and Stonequarry Creek. The monitoring results have been assessed against the criteria for each significance level/trigger listed in **TABLE 10**.

**TABLE 10: SIGNIFICANCE LEVELS / TRIGGERS FOR WATER QUALITY**

| TARP Level | Surface Water Quality |
|---|---|
| Level 1 | The triggers for pH, EC and dissolved metals do not occur and there is no visual evidence of increased iron staining that was not observed in the baseline period. |
| Level 2 | The trigger for pH, EC or dissolved metals occurs in one month and there is no visual evidence of increased iron staining that was not observed in the baseline period. |
| Level 3 | The trigger for pH, EC or dissolved metals occurs in one month and there is visual evidence of increased iron staining that was not observed in the baseline period. |
| Level 4 | Any of the following:<br>• pH: the value falls below a corresponding control (upstream) site(s) mean*, or at the site itself, minus two standard deviations (i.e. the sample becomes more acidic) for more than two consecutive months OR the value rises above corresponding control (upstream) site(s) mean, or at the site itself, plus two standard deviations (i.e. the sample becomes more alkaline) for more than two consecutive months.<br>• EC: the value rises above corresponding control (upstream) site(s) mean*, or at the site itself, plus two standard deviations for more than two consecutive months.<br>• Dissolved metals: a specific metal or metals laboratory value/s rise above corresponding control (upstream) site(s) mean*, or at the site itself, plus two standard deviations for more than two consecutive months. |

* The value is compared with the corresponding control (upstream) site(s) mean to date plus two standard deviations and with the baseline mean plus two standard deviations for the site itself.

### 5.4.2 Assessment of Surface Water Quality

A summary of the water quality TARP significance levels for the review period is presented in **TABLE 11** and discussed in the sections which follow.

**TABLE 11: WATER QUALITY TARP SIGNIFICANCE LEVELS – 1 SEPTEMBER TO 31 DECEMBER 2022**

<table>
<tr><th>Date</th><th>Location(s)</th><th>Comment</th><th>TARP Significance</th></tr>
<tr><td colspan="4">Surface Water Quality</td></tr>
<tr><td>September, November and December</td><td>All monitoring sites in Matthews Creek</td><td>The triggers for pH, EC and dissolved metals did not occur.</td><td>Level 1</td></tr>
<tr><td>September and December</td><td>All monitoring sites in Cedar Creek</td><td>The triggers for pH, EC and dissolved metals did not occur.</td><td>Level 1</td></tr>
<tr><td>December</td><td>All monitoring sites in Stonequarry Creek</td><td>The triggers for pH, EC and dissolved metals did not occur.</td><td>Level 1</td></tr>
<tr><td>September</td><td>Site SD in Stonequarry Creek</td><td>The trigger for pH occurred in one month and there was no visual evidence of increased iron staining that was not observed in the baseline period.</td><td>Level 2</td></tr>
<tr><td>October</td><td>Site MC1 in Matthews Creek</td><td rowspan="4">The trigger for dissolved aluminum occurred in one month and there was no visual evidence of increased iron staining that was not observed in the baseline period.</td><td rowspan="4">Level 2</td></tr>
<tr><td>October</td><td>Sites CA, CB and CG in Cedar Creek</td></tr>
<tr><td>November</td><td>Site CG in Cedar Creek</td></tr>
<tr><td>October and November</td><td>Sites SC2, SC and SD in Stonequarry Creek</td></tr>
</table>

### 5.4.3 Trigger Exceedance Action and Response

**TABLE 12** summarises the actions and responses required to be undertaken in relation to the level 2 trigger exceedances recorded at the following monitoring sites for the review period:

- Matthews Creek: MC1 (October)
- Cedar Creek: CA, CB, CG (October) and CG (November)
- Stonequarry Creek: SD (September) and SC2, SC, SD (October and November)

**TABLE 12: TRIGGER EXCEEDANCE ACTION AND RESPONSE**

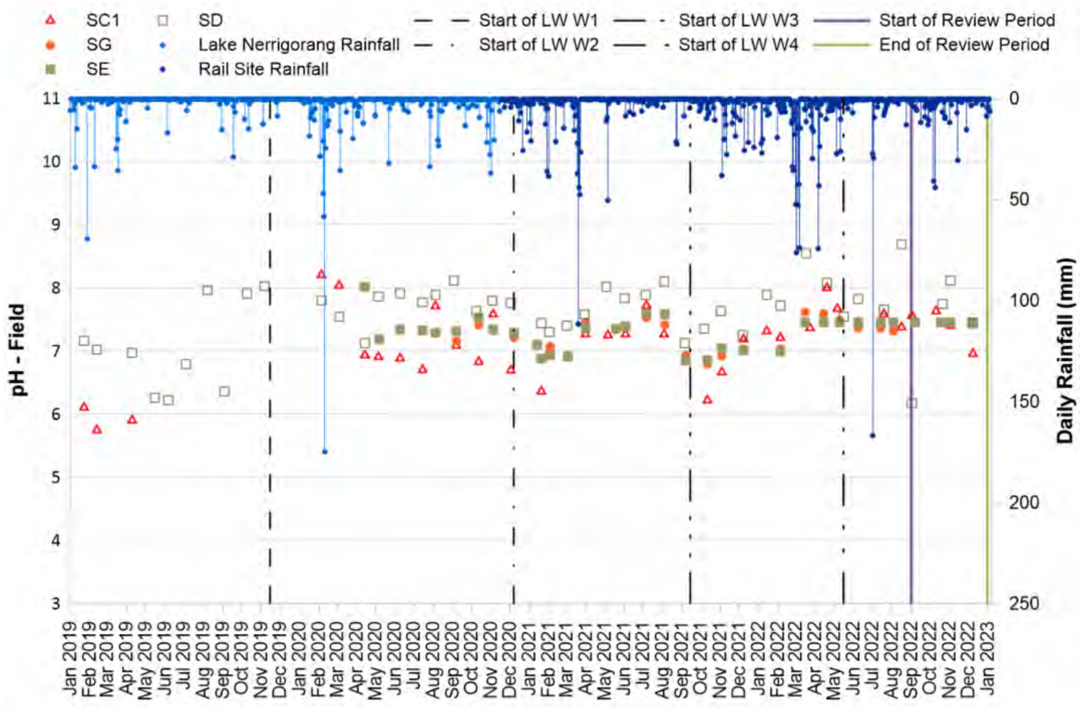
| Level | Action | Response |
|---|---|---|
| *Impact to stream water quality* | | |
| Level 2 | • Continue monitoring as per monitoring program.<br>• Continue monthly review of data including analysis of water quality trend along creek (upstream to downstream) to identify spatial changes.<br>• Convene Tahmoor Coal Environmental Response Group to review response. | As defined by Environmental Response Group. |

For each trigger exceedance, the Environmental Response Group was convened and the surface water quality data reviewed in relation to climatic conditions and water quality trends for the reach of each surface water system monitored.

<u>Field pH Trigger Exceedance</u>

The field pH records for monitoring site SD compared to the Stonequarry Creek reference sites (SC1, SG and SE) are shown below on **DIAGRAM 2**.

**DIAGRAM 2: STONEQUARRY CREEK SITE SD AND REFERENCE SITES – FIELD PH RECORDS**




In September 2022, a level 2 trigger exceedance occurred in relation to the field pH measurement recorded at monitoring site SD in Stonequarry Creek (pH 6.2). In response to the trigger exceedance, the Environmental Response Group convened, and the surface water quality data was reviewed in relation to the prevailing climate and catchment wide water quality trends.

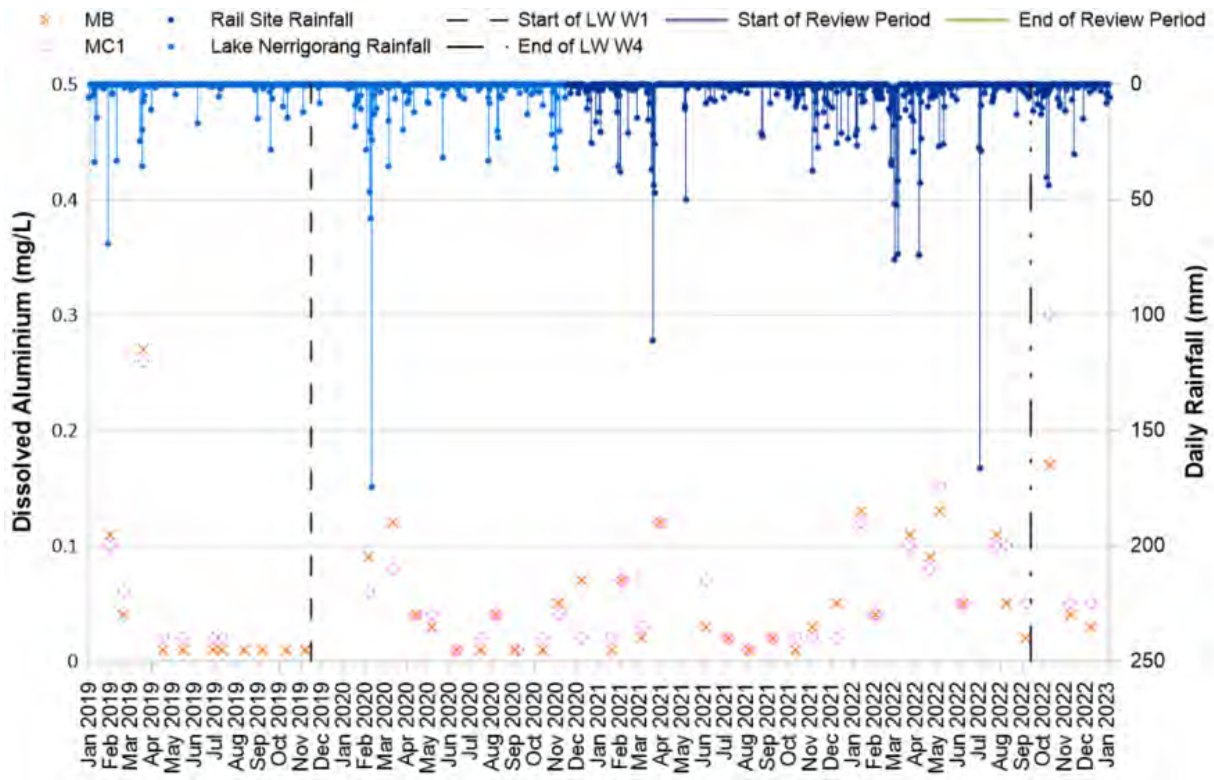
The pH value recorded at SD in September 2022 (pH 6.2) was within the range of historical pH values recorded at this site, however, a pH value lower than pH 7 has not been recorded since 2019. It is noted that the pH recorded in October 2022 at monitoring site SD had returned to near neutral (pH 7.7). It is likely that the September record was an anomaly and may be related to instrumentation or field measurement issues. Accordingly, re-calibration of the field instrumentation has been recommended. Monitoring will continue to be undertaken in accordance with the WMP.

<u>Dissolved Aluminium Trigger Exceedance</u>

*Matthews Creek*

The dissolved aluminium records for monitoring site MC1 compared to the Matthews Creek reference site (MB) are shown below on **DIAGRAM 3**.

**DIAGRAM 3: MATTHEWS CREEK SITE MC1 AND REFERENCE SITES – DISSOLVED ALUMINIMUM RECORDS**

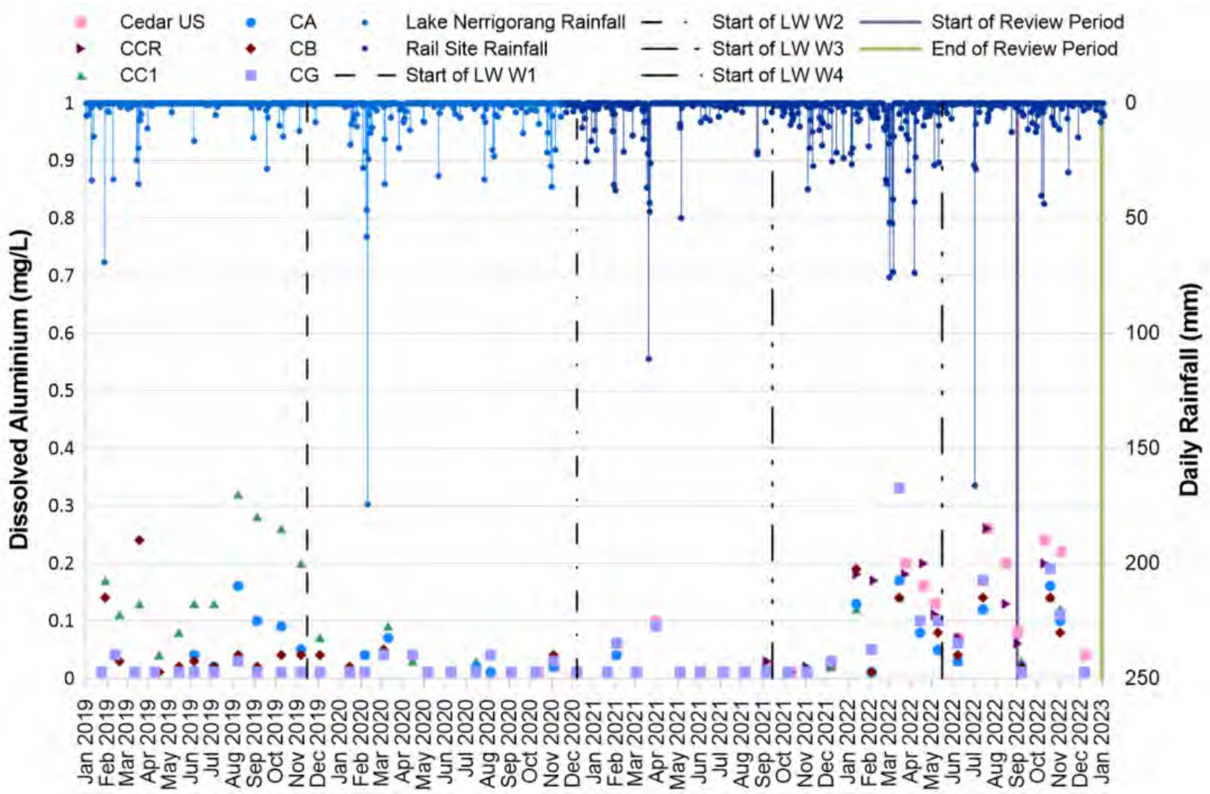



In October 2022, a level 2 trigger exceedance occurred in relation to dissolved aluminium recorded at monitoring site MC1 in Matthews Creek (0.3 mg/L). The elevated dissolved aluminium concentration resulted in an exceedance of the site specific trigger value however did not exceed the reference site trigger level. As shown in **DIAGRAM 3**, the dissolved aluminium concentrations recorded at both MC1 and MB were elevated in October, and may be related to the rainfall event which occurred prior to sampling. The dissolved aluminium concentrations declined in November and December and were within the range of baseline concentrations.

*Cedar Creek*

The dissolved aluminium records for CA, CB and CG compared to the Cedar Creek reference sites (CCR, Cedar US and CC1) are shown below on **DIAGRAM 4**.

**DIAGRAM 4: CEDAR CREEK SITE CG AND REFERENCE SITES – DISSOLVED ALUMINIMUM RECORDS**

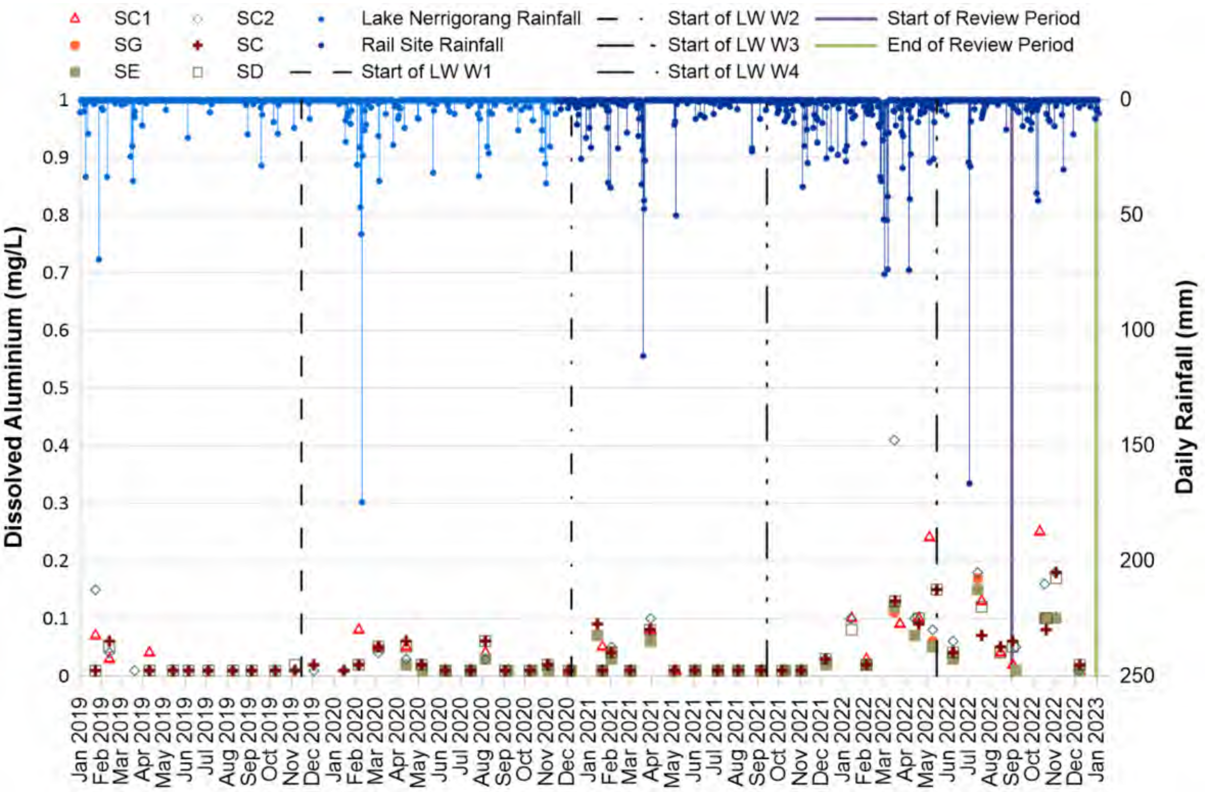



As shown in **DIAGRAM 4**, the dissolved aluminium concentrations recorded at reference sites CCR and Cedar US, which are located at a notable distance upstream of the Western Domain, were higher than that recorded at monitoring sites CA, CB and CG for the duration of the review period. As such, this indicates a catchment wide (non-mining related) influence on dissolved aluminium concentrations in Cedar Creek.

*Stonequarry Creek*

The dissolved aluminium records for monitoring sites SC2, SC and SD compared to the Stonequarry Creek reference sites (SC1, SG and SE) are shown on **DIAGRAM 5.**

**DIAGRAM 5: STONEQUARRY CREEK SITES SC1, SC AND REFERENCE SITES – DISSOLVED ALUMINIMUM RECORDS**




As shown in **DIAGRAM 5**, the dissolved aluminium concentrations recorded at reference sites SC1 and SE, located upstream of potential mining relation influences, followed a similar trend to that recorded at SC2, SC and SD from September to December 2022. In October 2022, a higher concentration of dissolved aluminium was recorded at reference site SC1 than at other monitoring sites in Stonequarry Creek. As such, this suggests a catchment wide (non-mining related) influence on dissolved aluminium concentrations in Stonequarry Creek.

### *5.4.3.1 Summary*

In response to the aluminium Level 2 trigger exceedances for Matthews, Cedar and Stonequarry Creek, the Environmental Response Group convened, and the surface water quality data was reviewed in relation to the prevailing climate and catchment wide water quality trends.

The elevated concentrations of dissolved aluminium recorded during the review period occurred during and following above average rainfall. Additionally, the elevated concentrations of dissolved aluminium were also recorded at several reference sites (located upstream of potential mining influences). Accordingly, the elevated dissolved aluminium concentrations were considered to be catchment wide and related to the prevailing climatic conditions.

The field value of pH 6.2 recorded at monitoring site SD in Stonequarry Creek is considered to be anomalous.

In accordance with the WMP, monthly monitoring and review of water quality data recorded at sites in Cedar Creek, Stonequarry Creek and Matthews Creek will continue to be undertaken and assessed in relation to the water quality TARP.

# 6 SUMMARY AND CONCLUSIONS

Review and assessment of surface water monitoring data recorded prior to and during the review period of 1 September to 31 December 2022 has indicated the following:

- Surface Water Level:
  - A TARP significance above Level 1 was not reported for any sites in Cedar Creek, Matthews Creek and Stonequarry Creek during the review period, with the exception of monitoring site CB in Cedar Creek.
  - A level 3 trigger exceedance in relation to pool water level was recorded at monitoring site CB (pool CR14) in Cedar Creek from 9 to 30 December 2022. The water level declined by a maximum of 0.46 m below the baseline minimum during this period.
  - The level 3 trigger exceedance at monitoring site CB occurred during a period of below average rainfall, with the cumulative rainfall residual declining near consistently from September to December 2022.
  - The water level decline recorded at monitoring site CB from 9 to 30 December 2022 had negligible influence on the water level of downstream monitoring sites during the corresponding period.
  - Given the decline in water level at monitoring site CB has occurred intermittently since late 2020 and there has been negligible indication of an associated impact to downstream monitoring sites, increased frequency of monitoring is not deemed to be required. The water level records for this site will continue to be monitored in accordance with the WMP.
- Physical Features and Natural Behaviour of Pools:
  - A TARP significance level 3 was reported for rockbar SR17 and SR20 located in Stonequarry Creek.
  - The water level records for monitoring site SB (pool SR17) indicate that the surficial fracturing of the rockbar has not resulted in an apparent impact to the pool water holding capacity. As such, an increase in the frequency of monitoring from monthly to fortnightly is not required at this stage.
  - The water level records for upstream monitoring site SB (pool SR17) and downstream monitoring sites SC and SD indicate that the surficial fracturing of the rockbar at pool SR20 has not resulted in an apparent impact to the pool water holding capacity at monitoring sites upstream or downstream on Stonequarry Creek. As such, an increase in the frequency of monitoring from monthly to fortnightly is not required at this stage.
- Surface Water Quality:
  - A TARP significance of level 2 was reported for field pH, recorded at Stonequarry Creek monitoring site SD in September. The level 2 trigger exceedance is considered to be an anomalous record, potentially due to instrumentation or field measurement error.
  - A TARP significance of level 2 was reported for dissolved aluminium at sites in Matthews Creek, Cedar Creek and Stonequarry between September and November. Elevated concentrations of dissolved aluminium were also recorded at associated reference sites and, as such, the elevated concentrations are considered to be catchment wide and related to above average rainfall conditions.

The monitoring data for 1 September to 31 December 2022 indicates that less than 10% of pools within the Investigative Area have been impacted. Consequently, there is negligible evidence to date of subsidence impacts with environmental consequences greater than minor[4] associated with mining in the Western Domain.

It is recommended that ongoing review of surface monitoring data is continued to be undertaken in accordance with the WMP.

[4] Minor is defined as *not very large, important or serious.*

# 7 RECOMMENDATIONS FOR MONITORING PROGRAM

## 7.1 Current Surface Water Monitoring Recommendations

As discussed in **Section 5.4.3**, it is recommended that re-calibration of field instrumentation is undertaken due to intermittent records of potentially erroneous field pH values. Progress in relation to this recommendation will be provided in the next quarterly surface water review report for the Western Domain.

## 7.2 Previous Surface Water Monitoring Recommendations

Recommendations from the review period of 25 March to 7 September 2022 (ATCW, 2022b) and the subsequent status/actions are summarised in **TABLE 13**.

**TABLE 13: STATUS OF RECOMMENDATIONS TO SURFACE WATER MONITORING PROGRAM**

| Item | Previous Recommendation | Progress of Recommendation |
|---|---|---|
| 1 | 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 was decommissioned in October 2022. |
| 2 | Monitoring site SG: 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). | Monitoring site SG was decommissioned in October 2022. |
| 3 | Re-calibration of field instrumentation has been recommended due to intermittent records of potentially erroneous field pH values. | Re-calibration of field instrumentation has been requested of the relevant field personnel. |

## REFERENCES


**[1]** ATCW (2022a). "Surface Water Review 1 October 2021 to 16 / 24 March 2022". Prepared for Tahmoor Coal Pty Ltd by ATC Williams (ATCW), June 2022.

**[2]** ATCW (2022b). "Surface Water Review 25 March to 7 September 2022". Prepared for Tahmoor Coal Pty Ltd by ATC Williams (ATCW), November 2022.

**[3]** BES (2022a). "Longwall West 3 Creek Monitoring". Prepared for Tahmoor Coking Coal by Brienen Environment & Safety (BES), September.

**[4]** BES (2022b). "Longwall West 3 Creek Monitoring". Prepared for Tahmoor Coking Coal by Brienen Environment & Safety (BES), October.

**[5]** BES (2022c). "Longwall West 3 Creek Monitoring". Prepared for Tahmoor Coking Coal by Brienen Environment & Safety (BES), November.

**[6]** MSEC (2022) Tahmoor LW W4 Subsidence Monitoring Report, Monitoring Period 16$^{th}$ May to 18 November 2022. Report Number: MSEC1263-R20, December 2022.

**[7]** Tahmoor Coal (2021a). "Tahmoor North Western Domain Longwalls West 3 and West 4 Water Management Plan". September.

**[8]** Tahmoor Coal (2021b). "Tahmoor North – Western Domain, LW W3-W4 Stonequarry Creek Rockbar Management Plan". September.

## CONDITIONS OF REPORT

This report must be read in its entirety.

This report has been prepared by ATCW for the purposes stated herein and ATCW's experience, having regard to assumptions that can reasonably be expected to make in accordance with sound professional principles. ATCW does not accept responsibility for the consequences of extrapolation, extension or transference of the findings and recommendations of this report to different sites, cases, or conditions.

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# APPENDIX A – SUMMARY OF SURFACE WATER MONITORING SITES RELEVANT TO WESTERN DOMAIN

| Location | Monitoring Site(s) | Monitoring Component | Classification | Natural Control Characteristics | Water Quality Monitoring Commencement |
|---|---|---|---|---|---|
| Cedar Creek | CCR | Water level and quality | Reference Site | Weir | July 2021 |
| | Cedar US | Water level and quality | Reference Site | Rockbar constrained | October 2020 |
| | CC1A (Pool CB3) | Water level | Reference Site | Boulder/rockbar constrained | - |
| | CC1 | Water quality | Reference Site | Boulder/rockbar constrained | January 2019 |
| | CA (Pool CB10) | Water level and quality | Potential Impact Site | Boulder constrained | June 2019 |
| | CB (Pool CR14) | Water level and quality | Potential Impact Site | Rockbar constrained | January 2019 |
| | CD (Pool CR23) | Water level and quality | Potential Impact Site | Rockbar/boulder constrained | January 2021 |
| | CE (Pool CR25) | Water level and quality | Potential Impact Site | Rockbar/boulder constrained | January 2021 |
| | CF | Water level and quality | Potential Impact Site | Rockshelf constrained | January 2021 |
| | CG (Pool CR31) | Water level and quality | Potential Impact Site | Rockshelf constrained | January 2019 |
| Matthews Creek | MB (Pool MR5) | Water level and quality | Reference Site | Rockbar constrained | January 2019 |
| | MC1 | Water level and quality | Baseline / Potential Impact Site | Rockshelf/boulder constrained | January 2019 |
| | ME (Pool MR25) | Water level | Potential Impact Site | Boulder/rockbar constrained | - |
| | MG (Pool MR42) | Water level and quality | Potential Impact Site | Boulder constrained | January 2019 |
| Stonequarry Creek | SA (Pool SR16) | Water level | Potential Impact Site | Rockbar/boulder constrained | - |

| Location | Monitoring Site(s) | Monitoring Component | Classification | Natural Control Characteristics | Water Quality Monitoring Commencement |
|---|---|---|---|---|---|
| | SB<br>(Pool SR17) | Water level | Potential Impact Site | Rockbar constrained | - |
| | SC | Water level and quality | Baseline / Potential Impact Site | Rockbar constrained | January 2019 |
| | SC1 | Water quality | Reference Site | Rockshelf constrained | January 2019 |
| | SC2 / Pool SR17 | Water level and quality | Potential Impact Site | Rockbar constrained | January 2019 |
| | Pool SR20 | Water level and quality | Potential Impact Site | Rockbar constrained | - |
| | SD | Water level and quality | Baseline / Potential Impact Site | Rockbar constrained | January 2019 |
| | SE<br>(Pool SR5) | Water level and quality | Reference Site | Rockbar constrained | April 2020 |
| | SF | Water level and quality | Potential Impact Site | Rockbar constrained | May 2020 |
| | SG<br>(Pool SG2) | Water level and quality | Reference Site | Rockshelf constrained | September 2020 |

# APPENDIX B – WATER LEVEL PLOTS

## MATTHEWS CREEK SURFACE WATER MONITORING SITES

### DIAGRAM B1: MONITORING SITE MA WATER LEVEL RECORDS

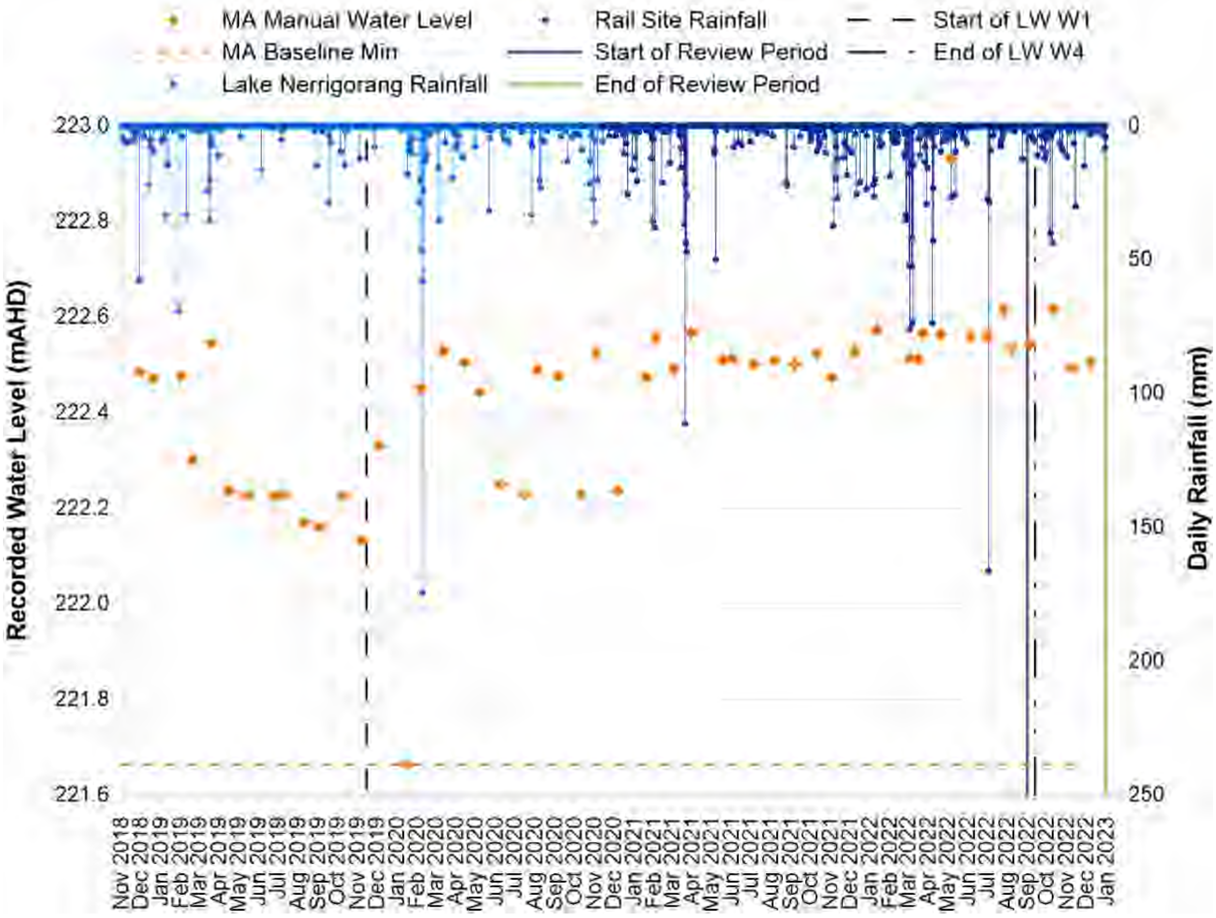


**DIAGRAM B2: MONITORING SITE MB WATER LEVEL RECORDS**

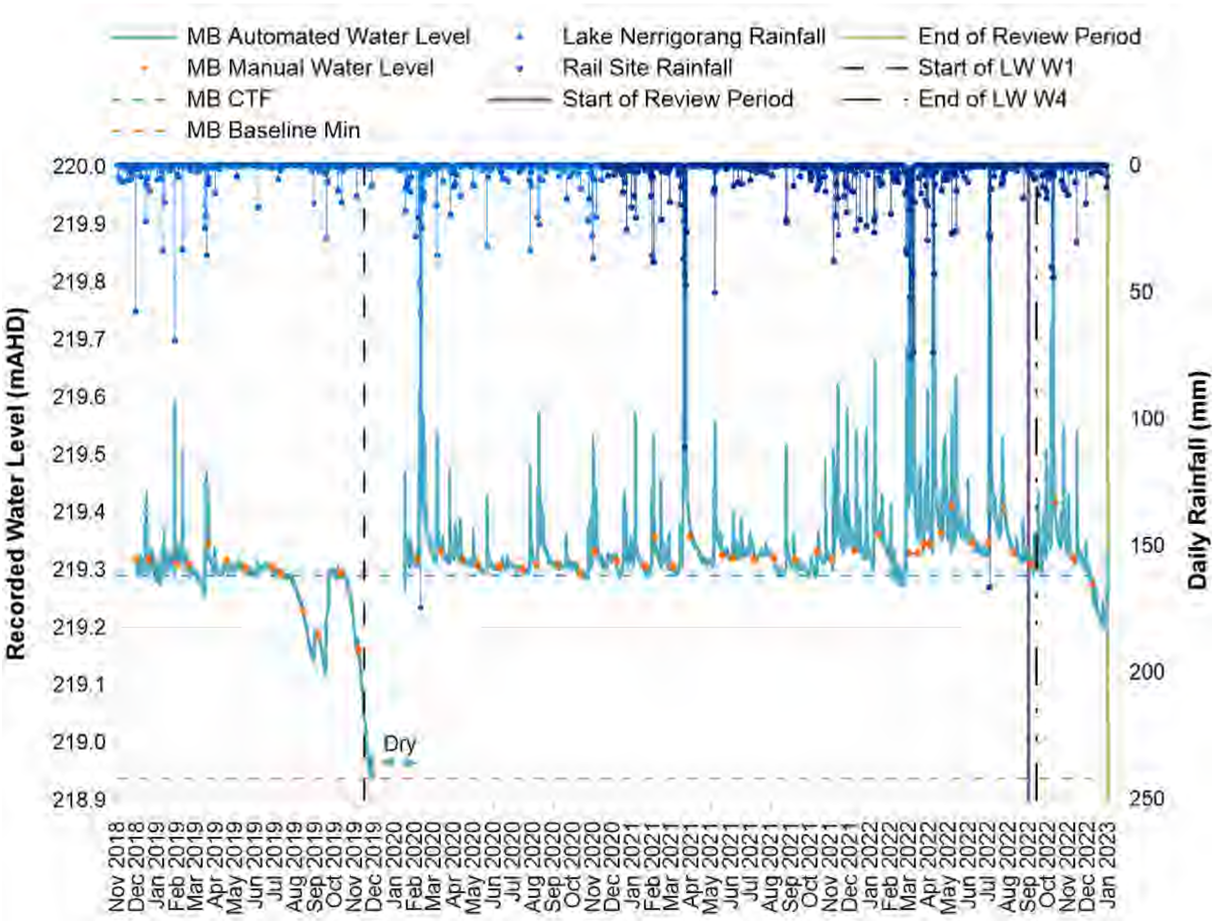
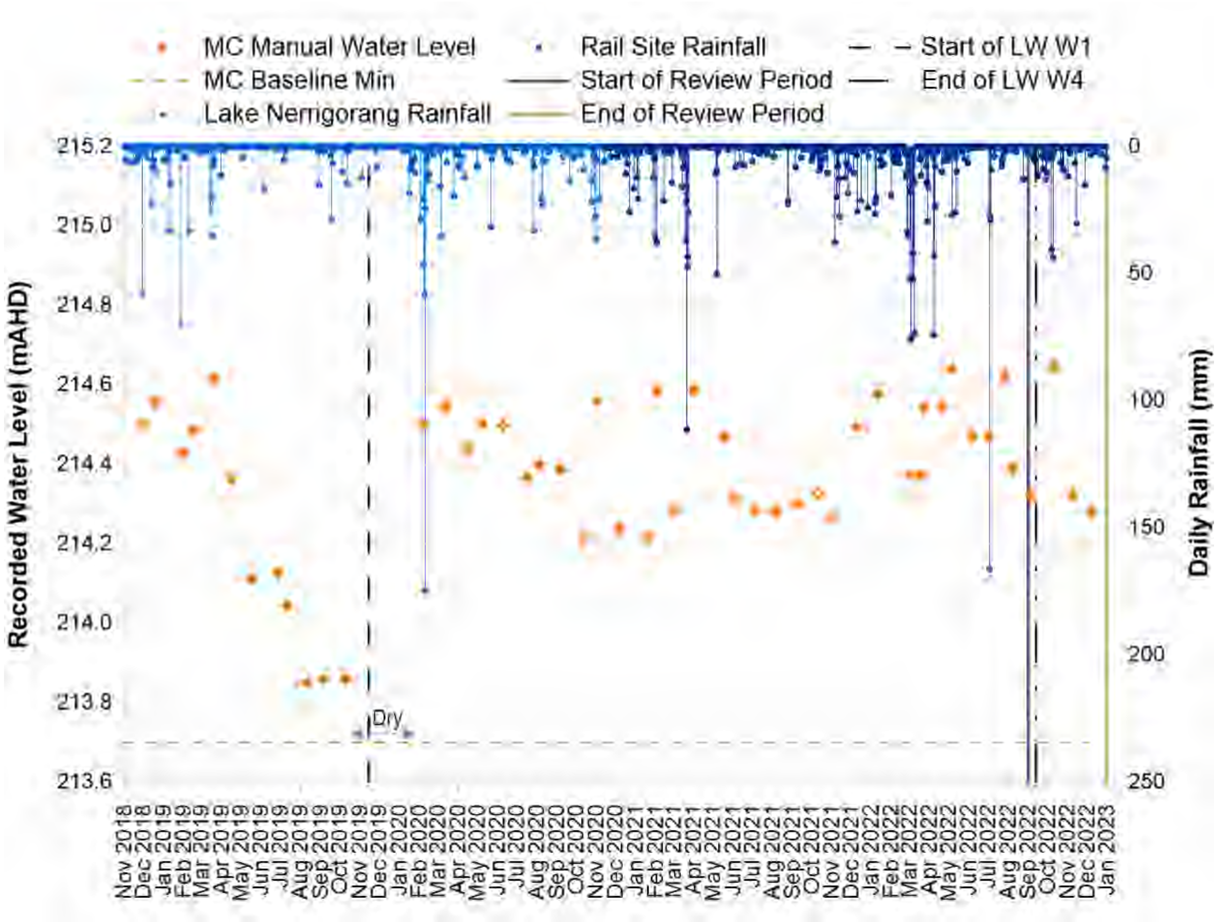


**DIAGRAM B3: MONITORING SITE MC WATER LEVEL RECORDS**



## DIAGRAM B4: MONITORING SITE MD US WATER LEVEL RECORDS

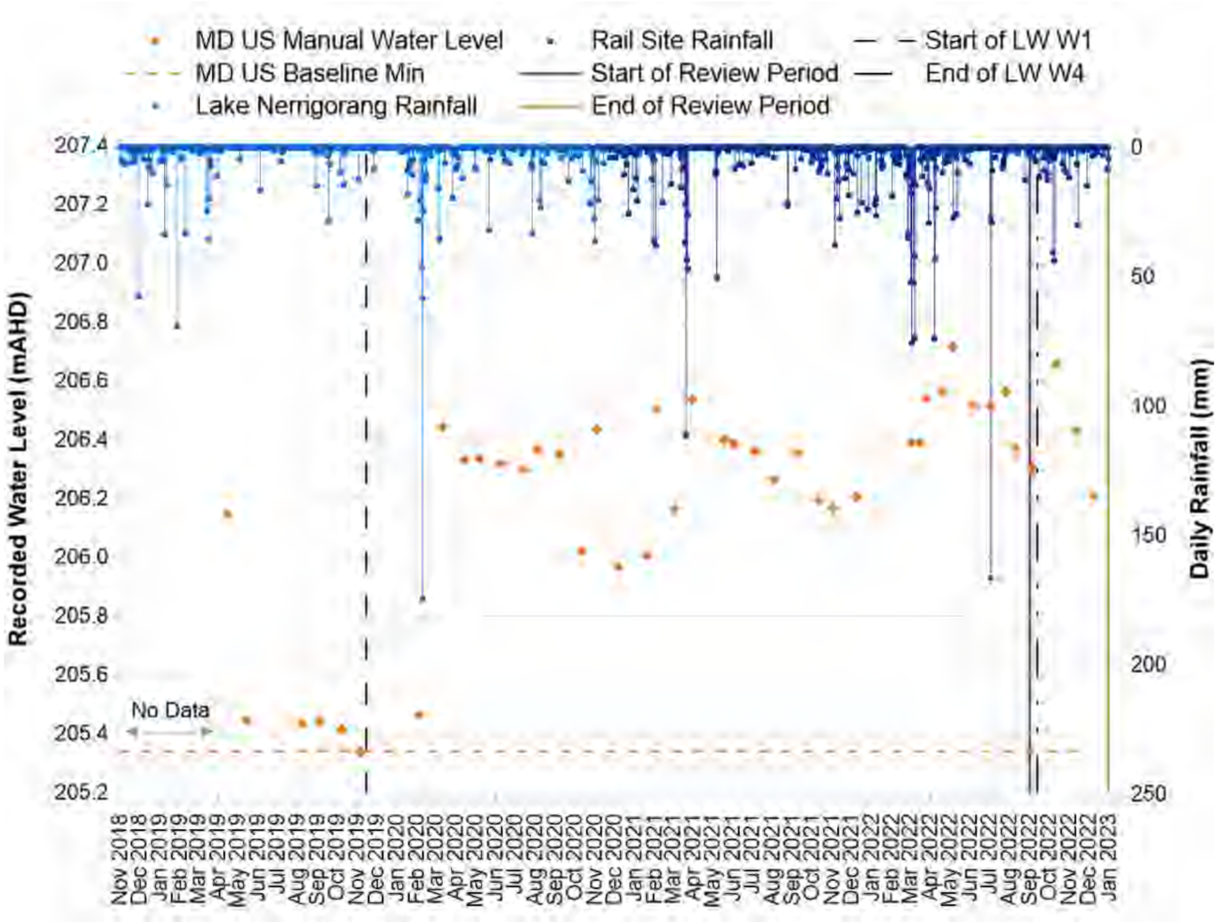
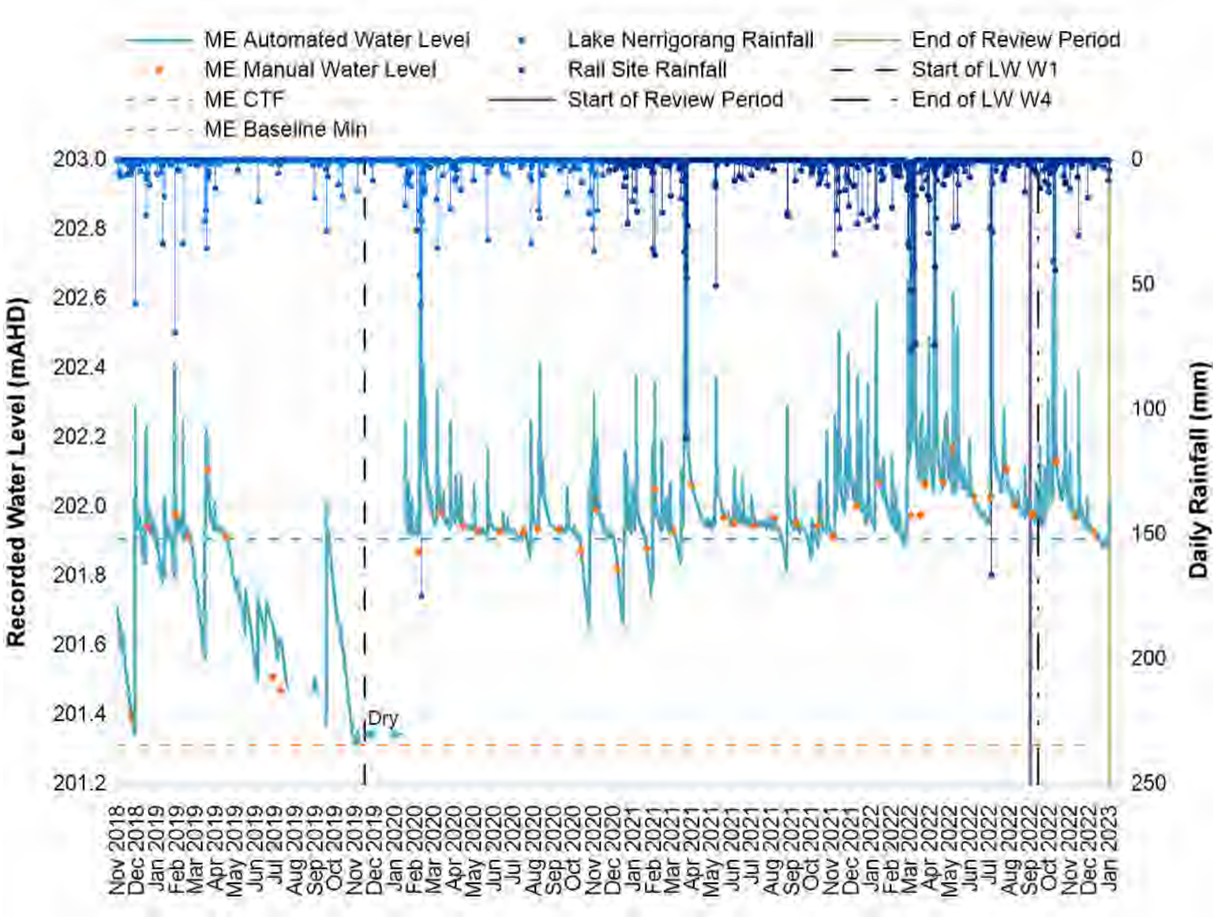


**DIAGRAM B5: MONITORING SITE ME WATER LEVEL RECORDS**



## DIAGRAM B6: MONITORING SITE MF WATER LEVEL RECORDS

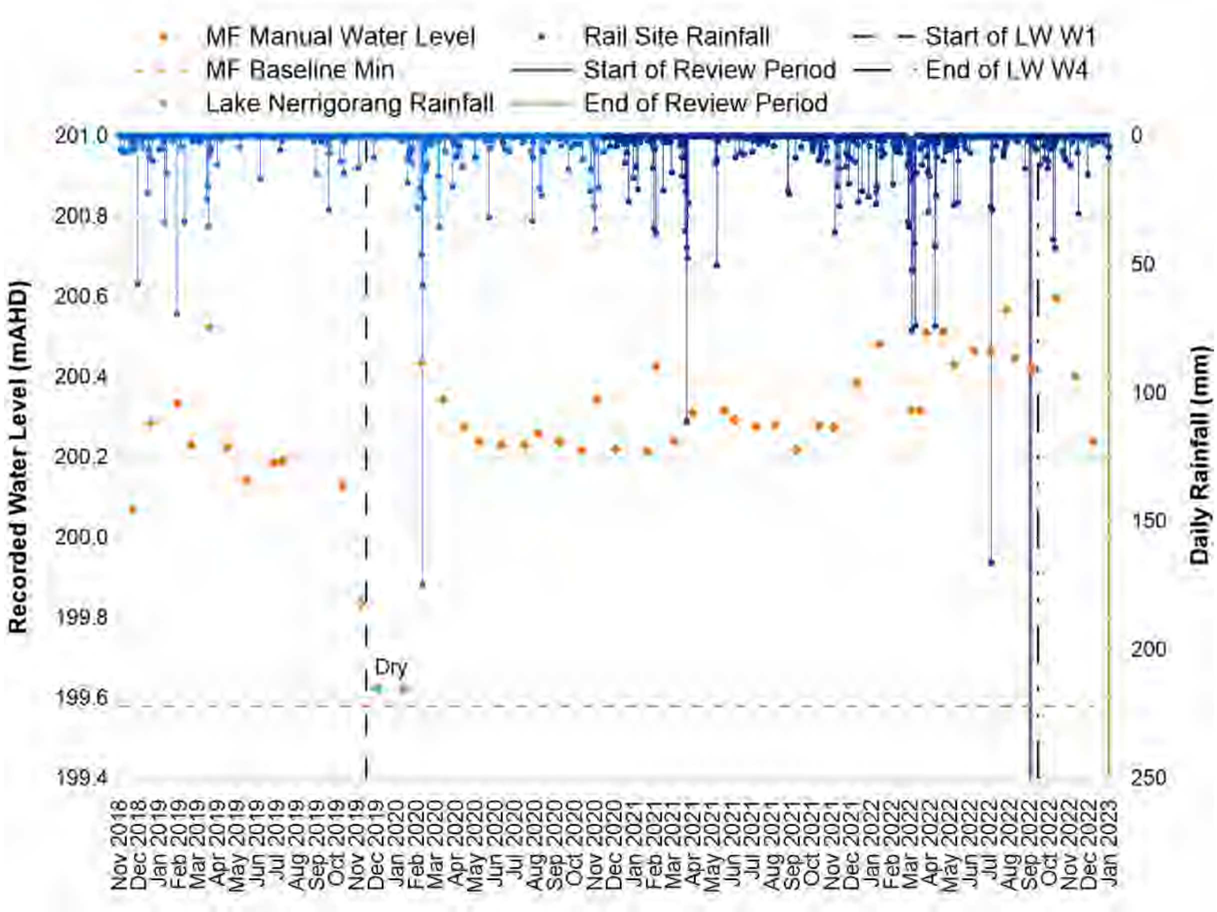
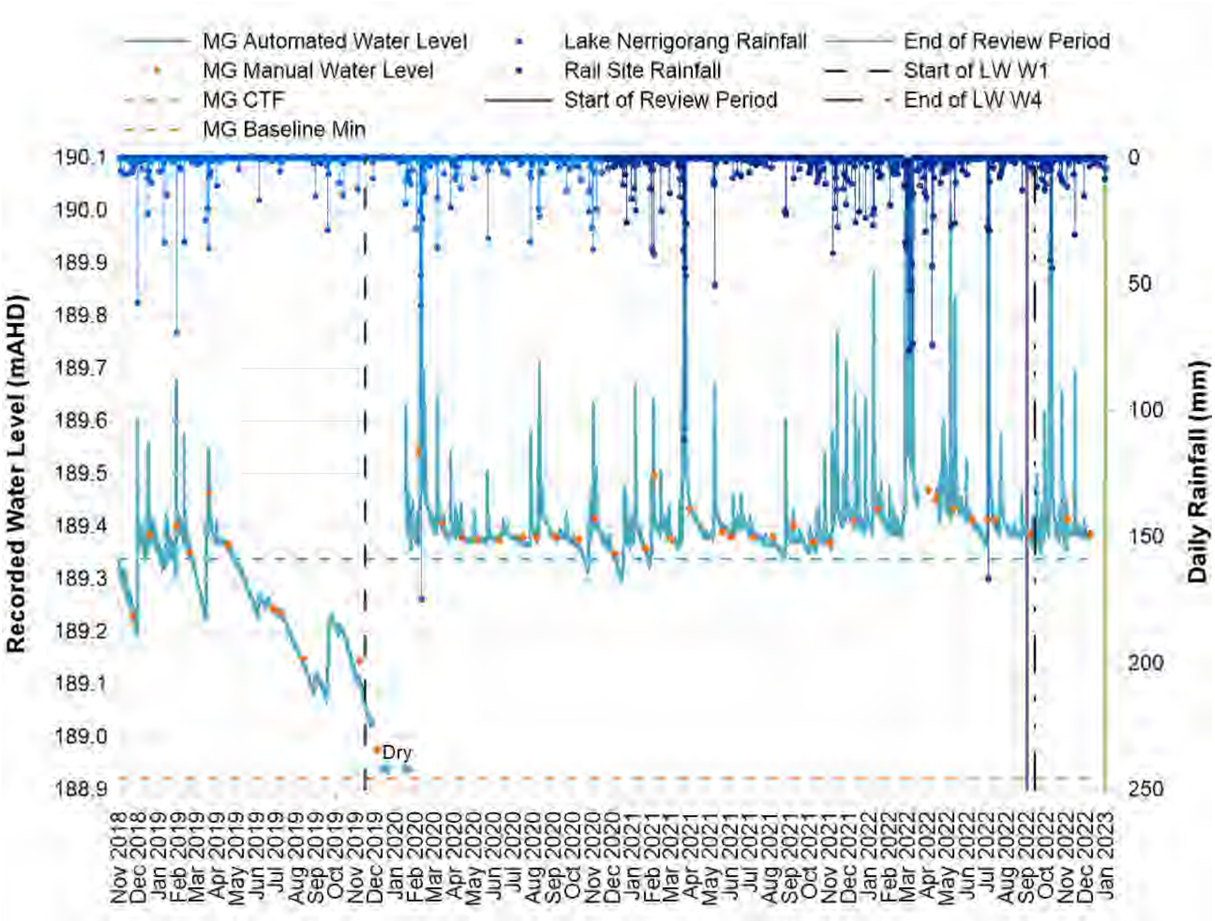


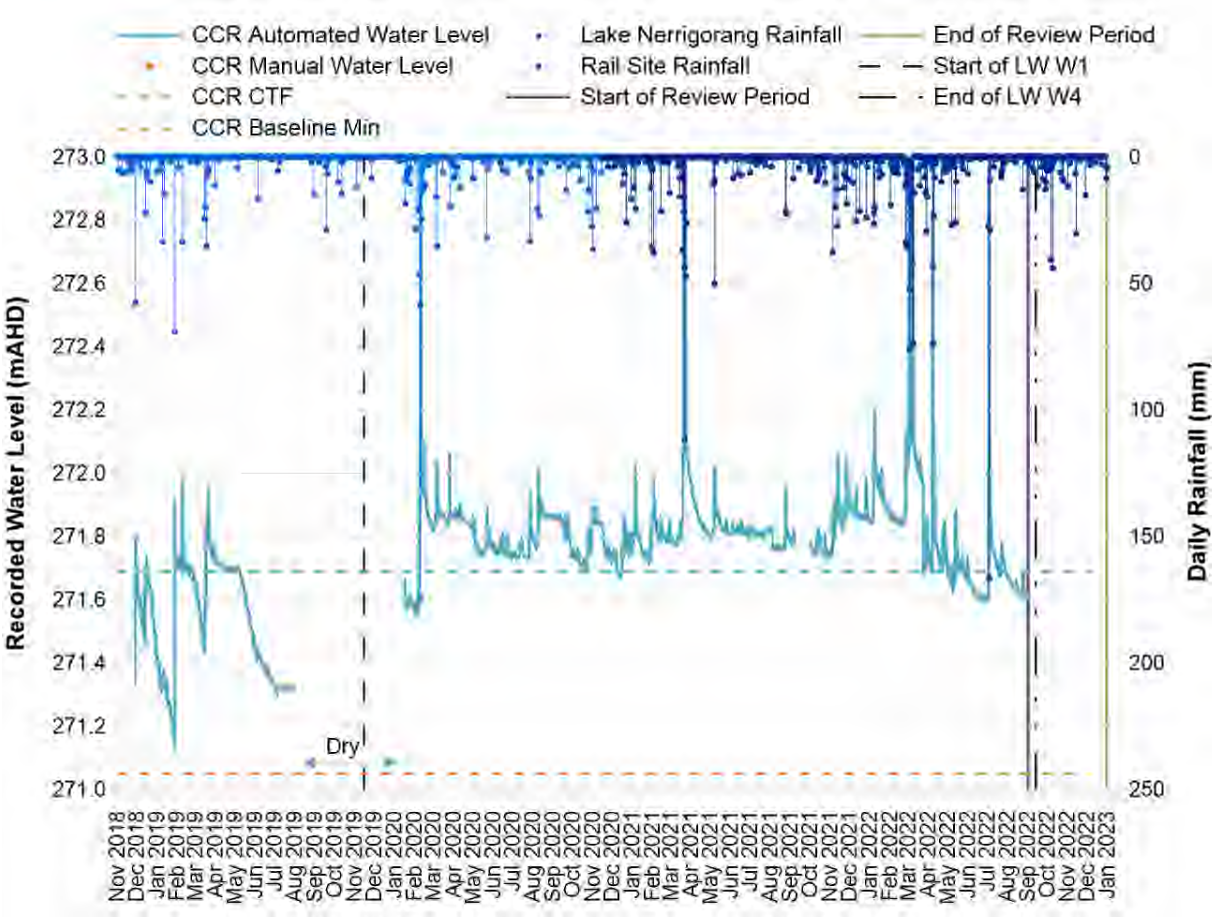
**DIAGRAM B7: MONITORING SITE MG WATER LEVEL RECORDS[5]**




[5] No data was recorded between 17 March and 14 April 2022 due to a logger re-start issue.

## CEDAR CREEK SURFACE WATER MONITORING SITES

### DIAGRAM B8: MONITORING SITE CCR WATER LEVEL RECORDS[6]




[6] The reference bolts at monitoring sites CCR and SF have not been found and as such the raw data recorded from 7 / 8 December 2021 was unable to be converted to a water level measurement.

## DIAGRAM B9: MONITORING SITE CEDAR US WATER LEVEL RECORDS

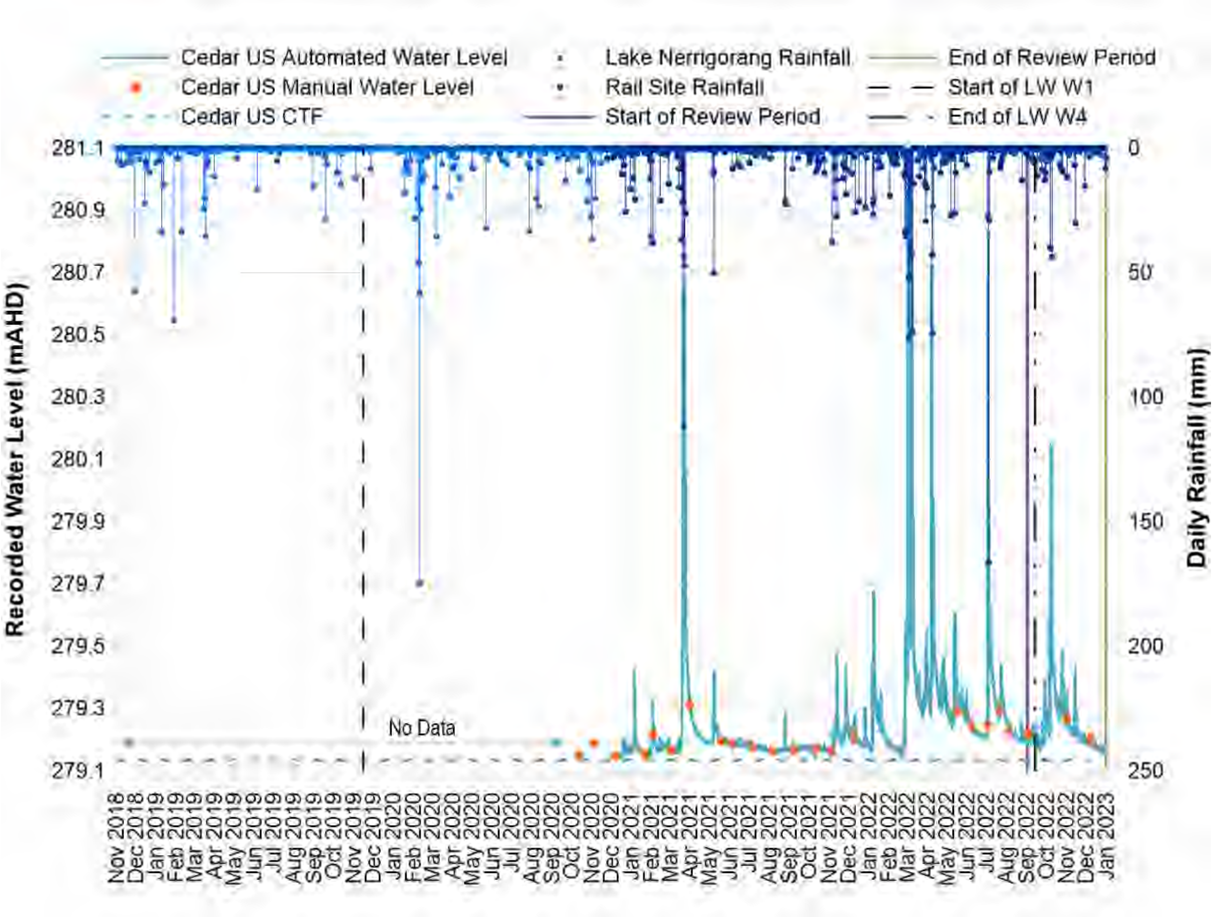


**DIAGRAM B10: MONITORING SITE CC1A WATER LEVEL RECORDS**

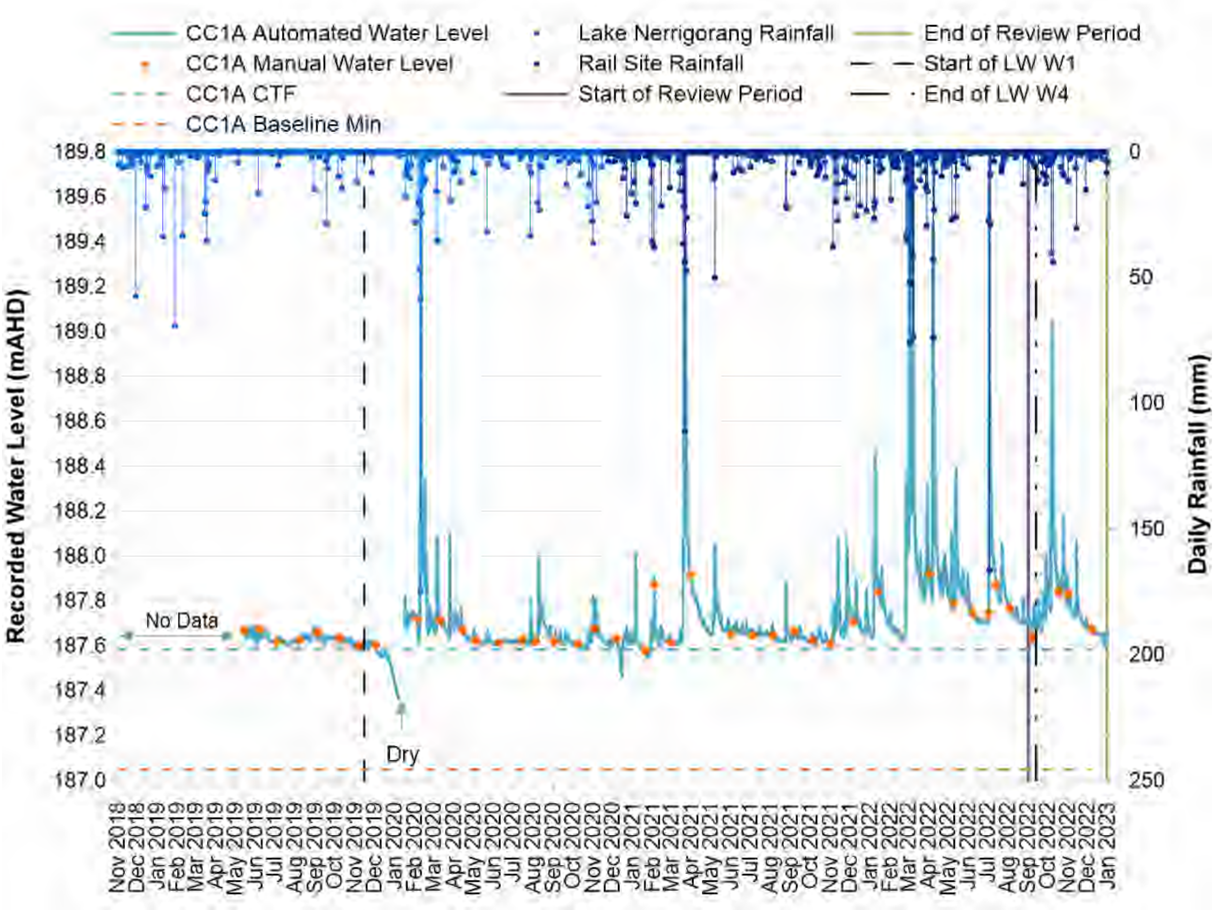
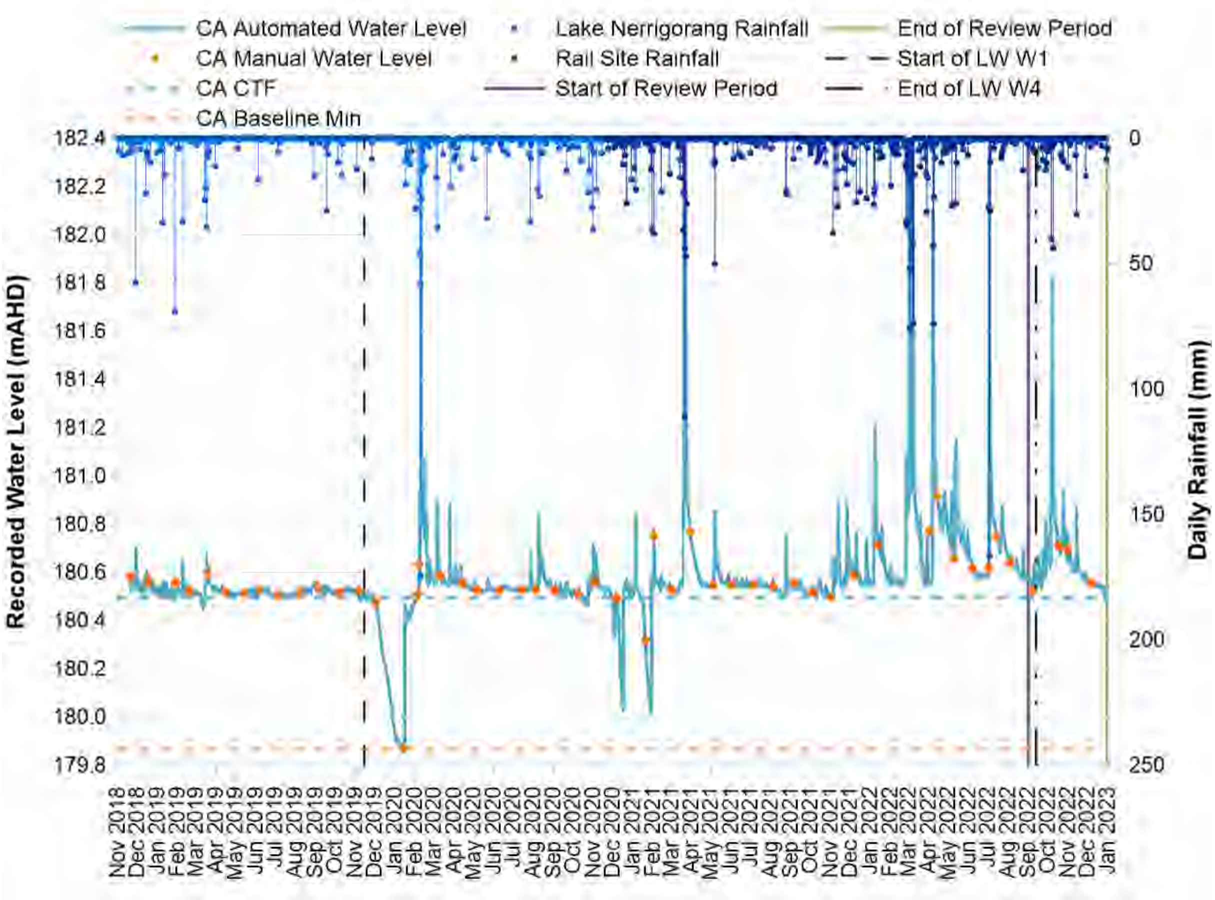
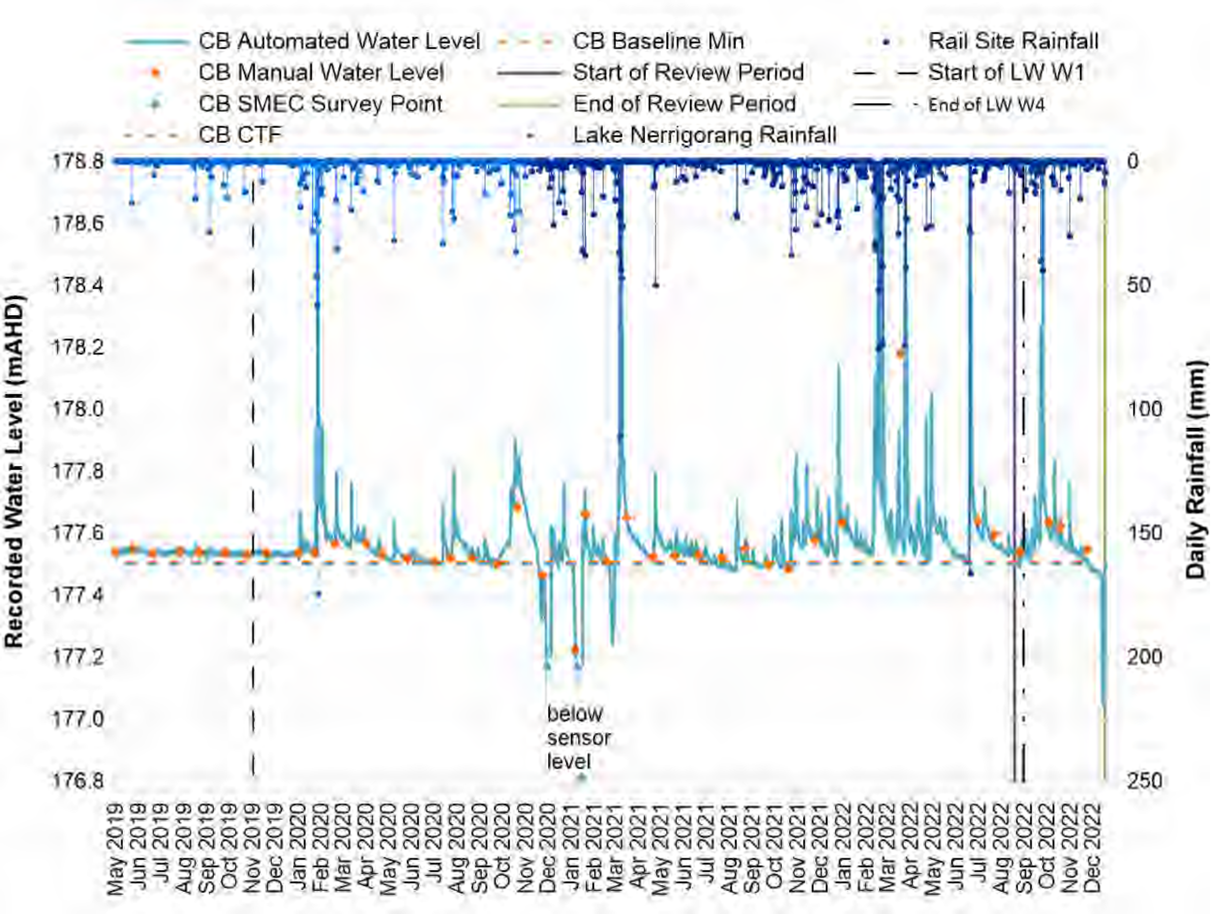


**DIAGRAM B11: MONITORING SITE CA WATER LEVEL RECORDS**



## DIAGRAM B12: MONITORING SITE CB WATER LEVEL RECORDS



## DIAGRAM B13: MONITORING SITE CC WATER LEVEL RECORDS

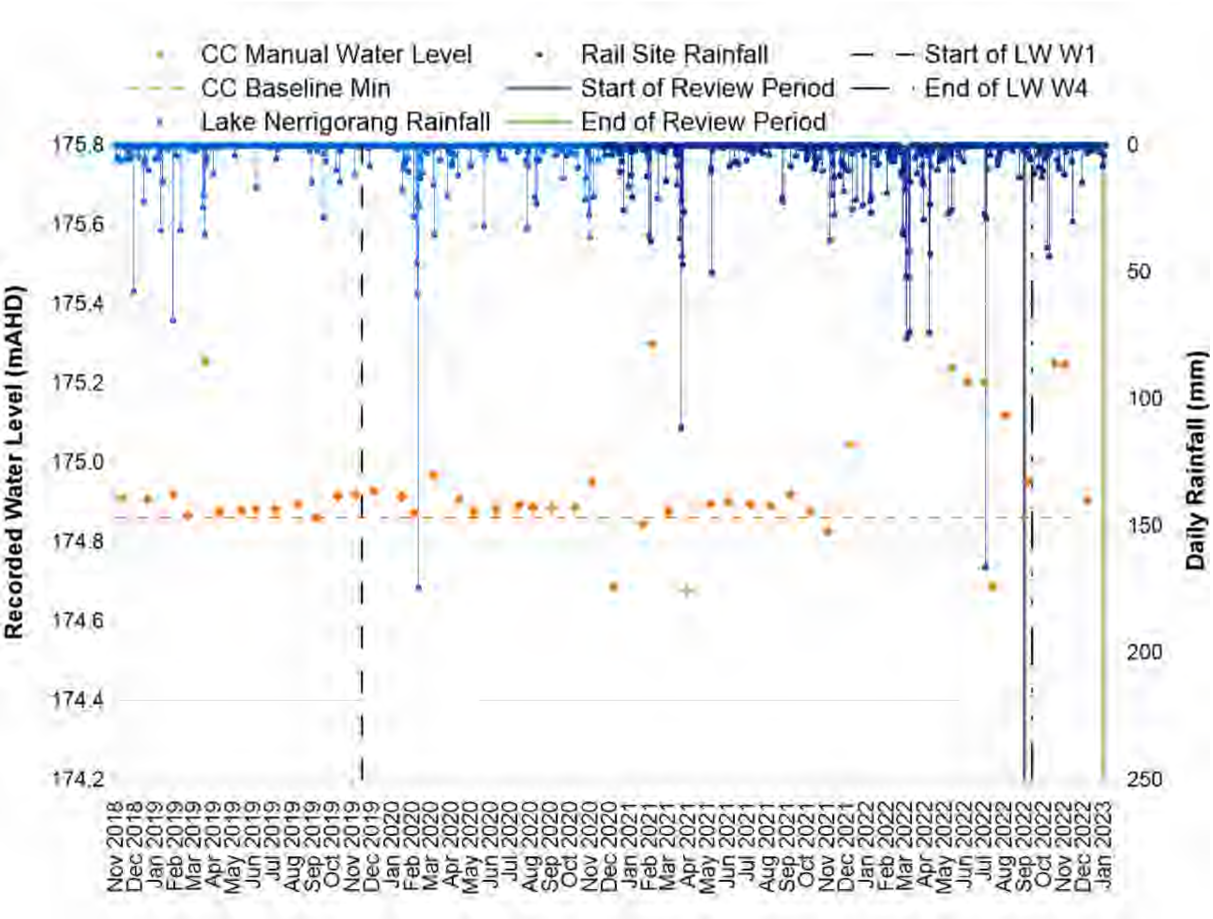


**DIAGRAM B14: MONITORING SITE CD WATER LEVEL RECORDS**

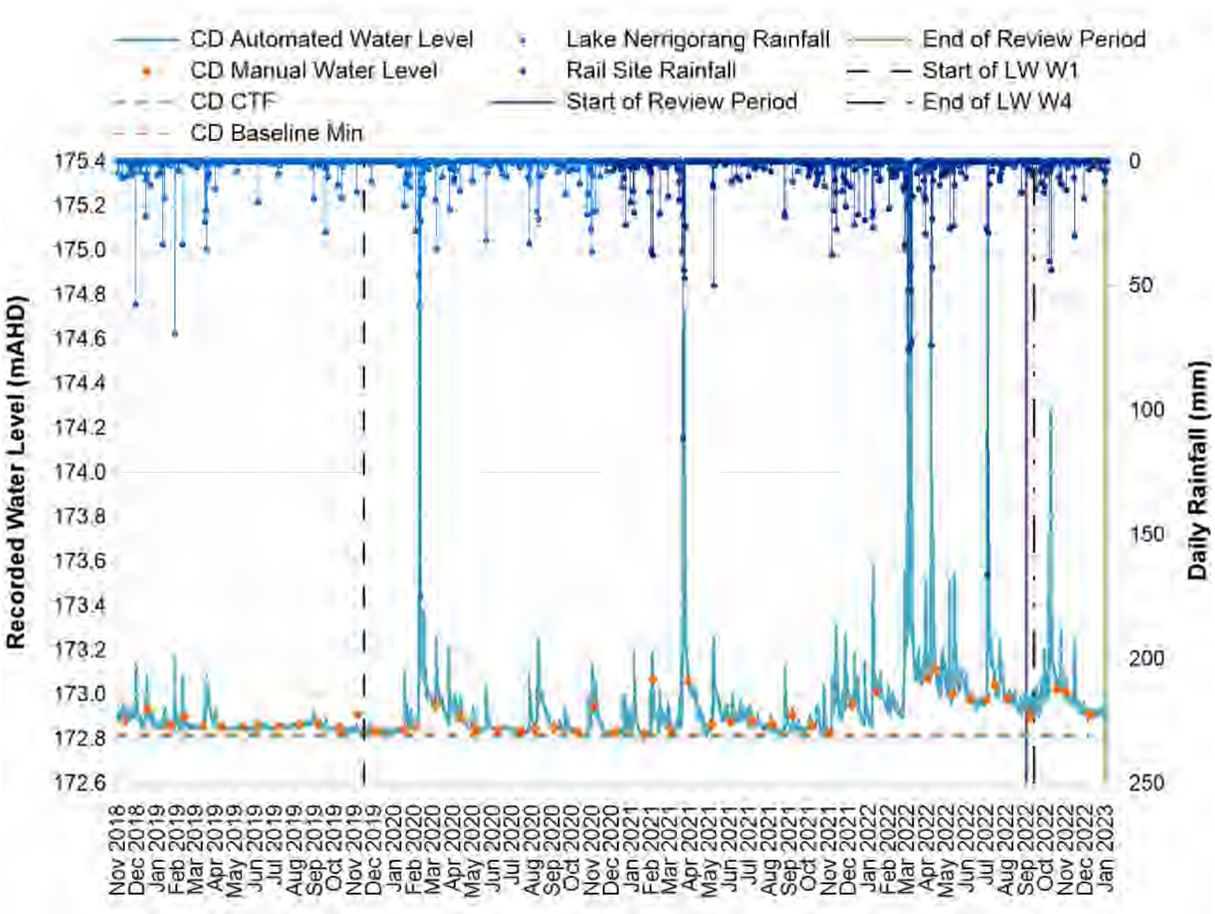
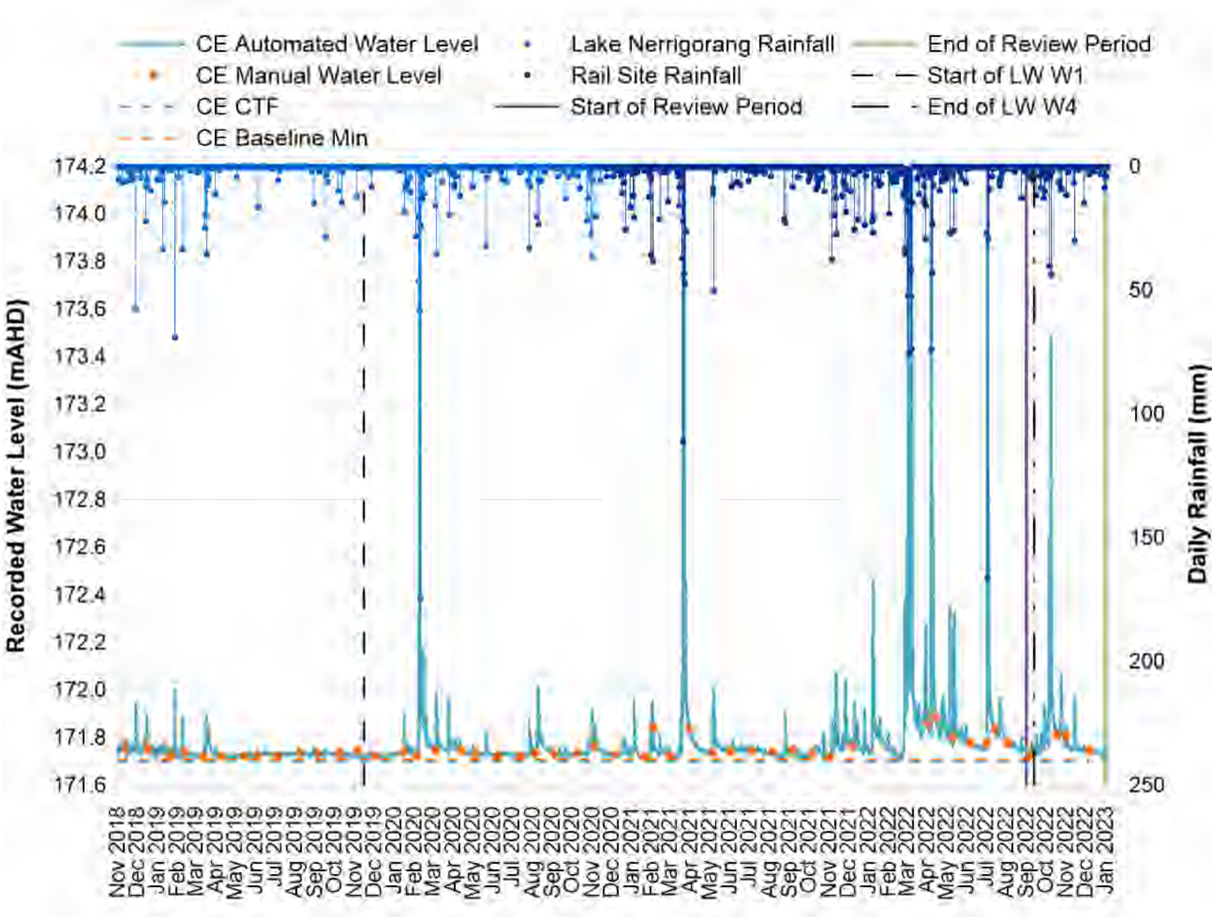


**DIAGRAM B15: MONITORING SITE CE WATER LEVEL RECORDS**



## DIAGRAM B16: MONITORING SITE CF WATER LEVEL RECORDS

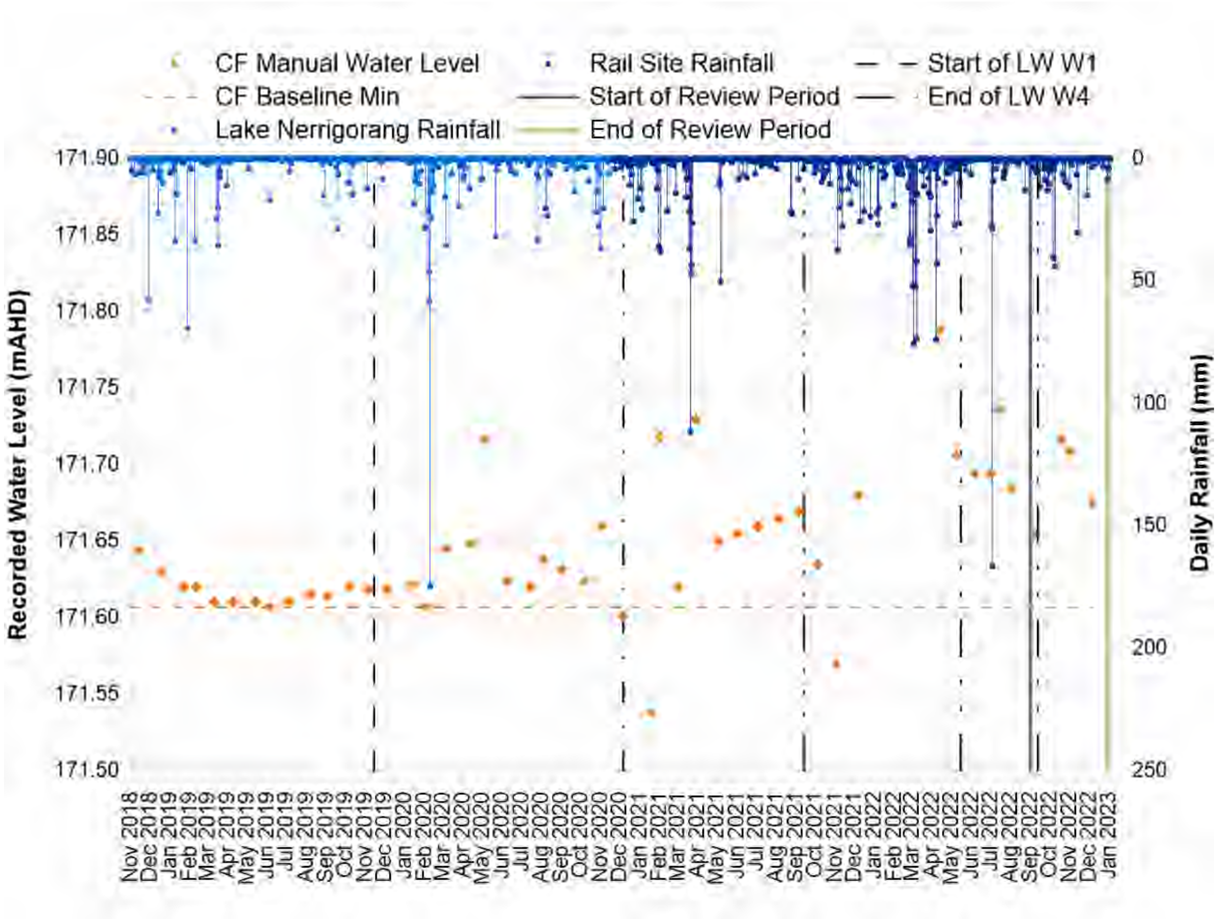
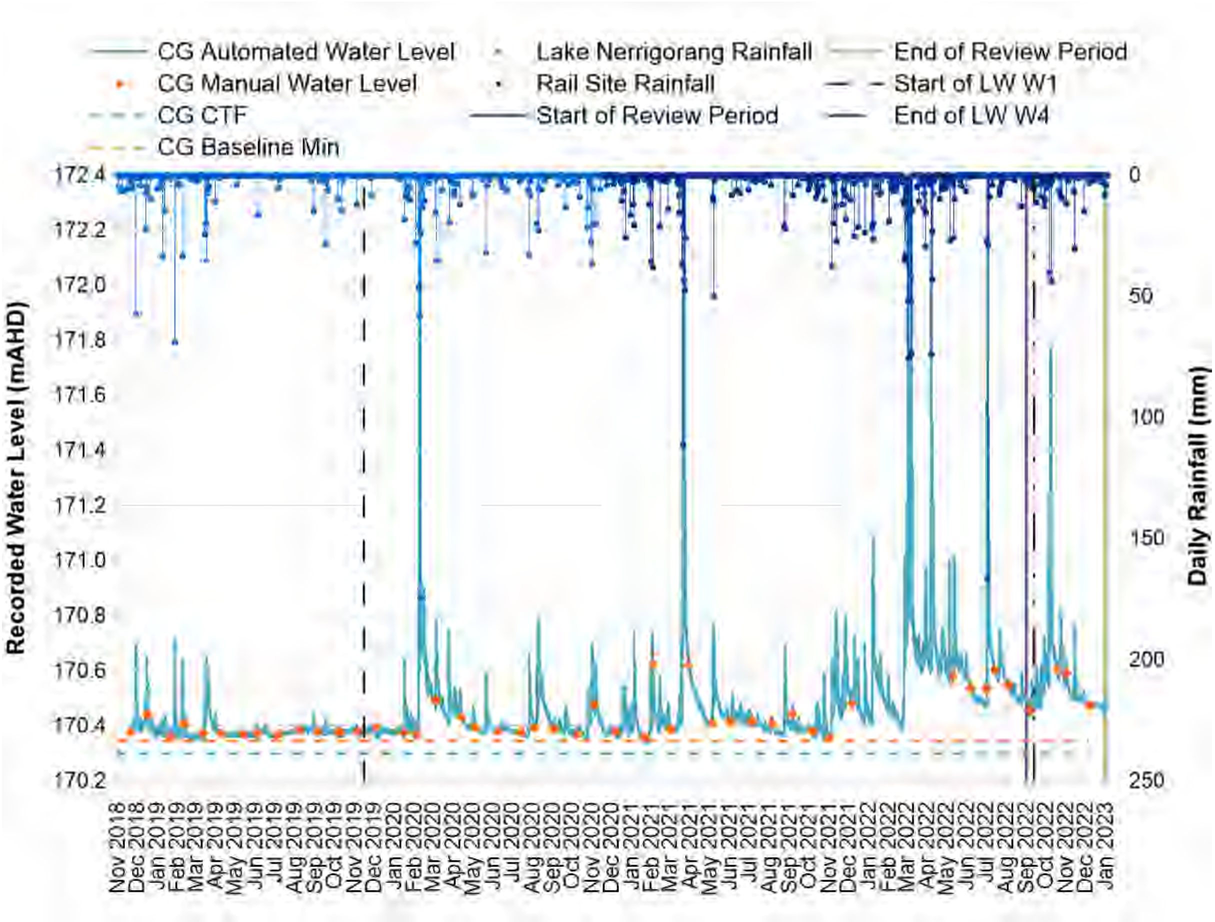
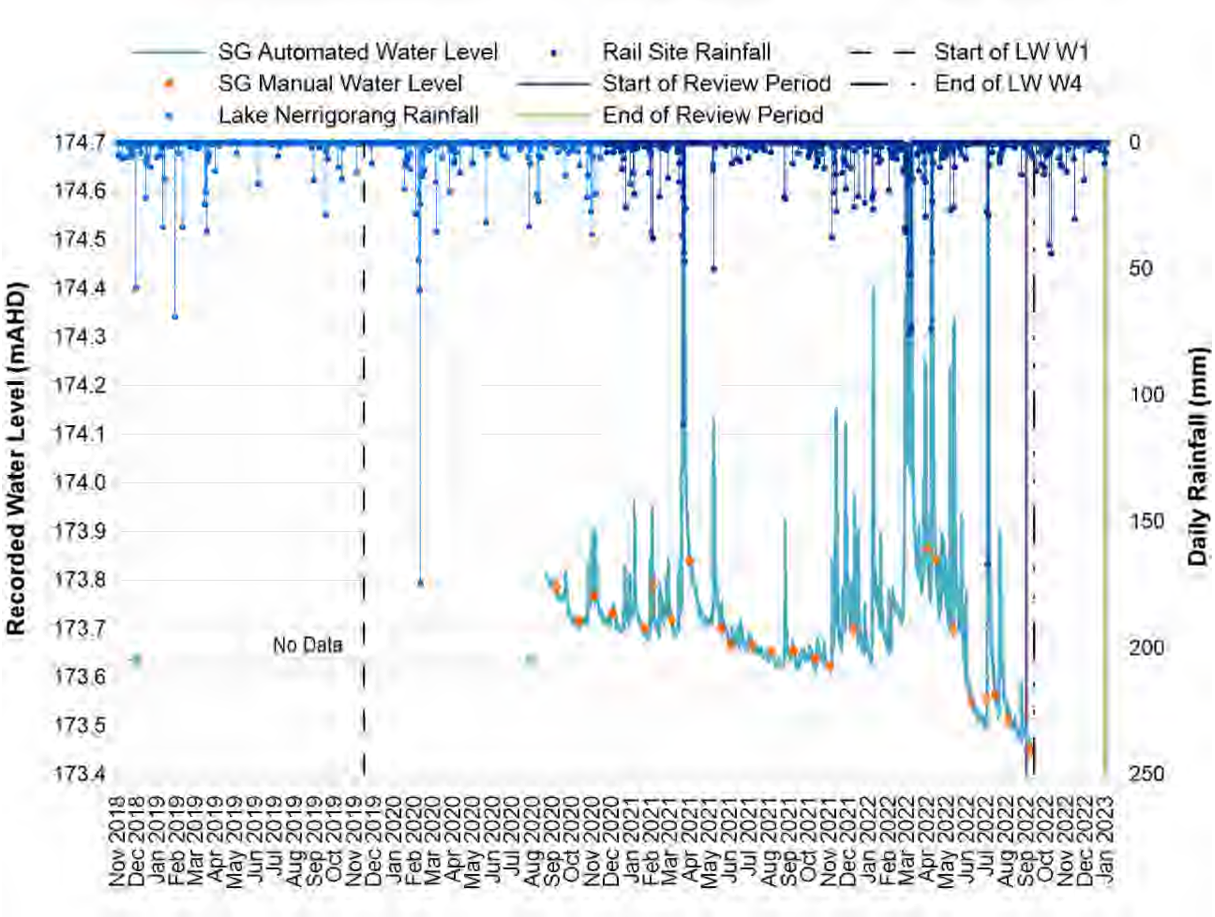


DIAGRAM B17: MONITORING SITE CG WATER LEVEL RECORDS



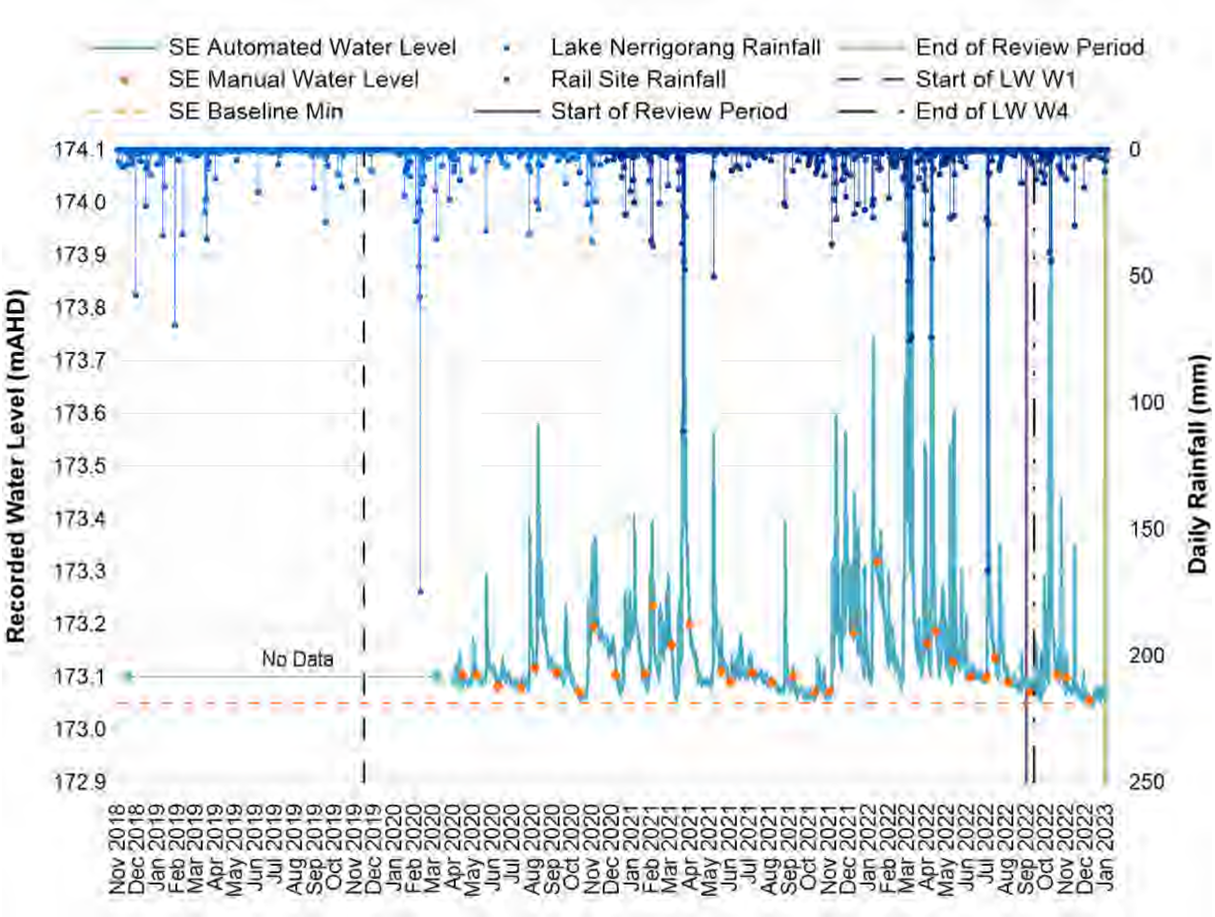
## STONEQUARRY CREEK SURFACE WATER MONITORING SITES

### DIAGRAM B18: MONITORING SITE SG WATER LEVEL RECORDS[7]

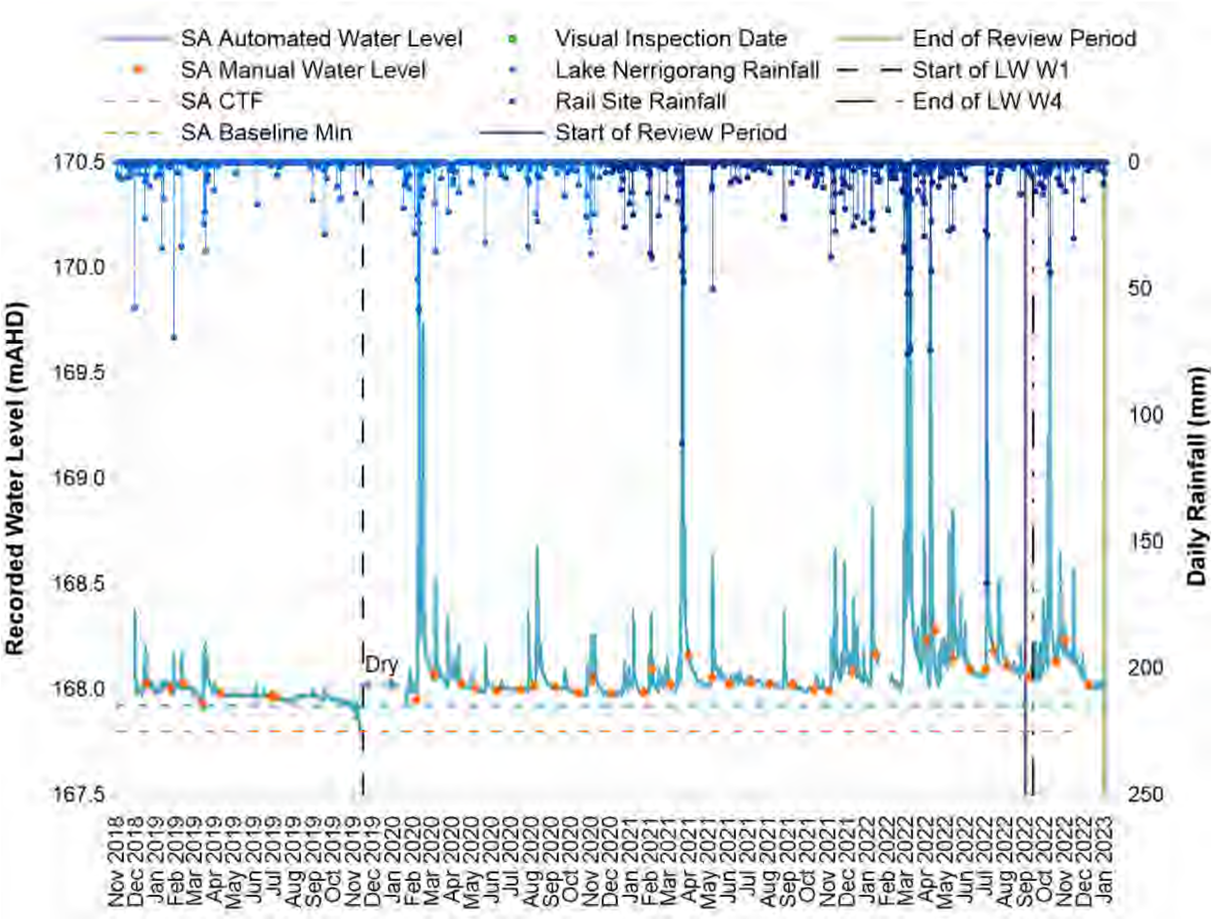



[7] The control at monitoring site SG was predominantly comprised of sand and stones and was impacted by high flow events during the review period. Subsequently, the control is no longer functional and the water level recorded from May 2022 is not comparable to previous records.

## DIAGRAM B19: MONITORING SITE SE WATER LEVEL RECORDS

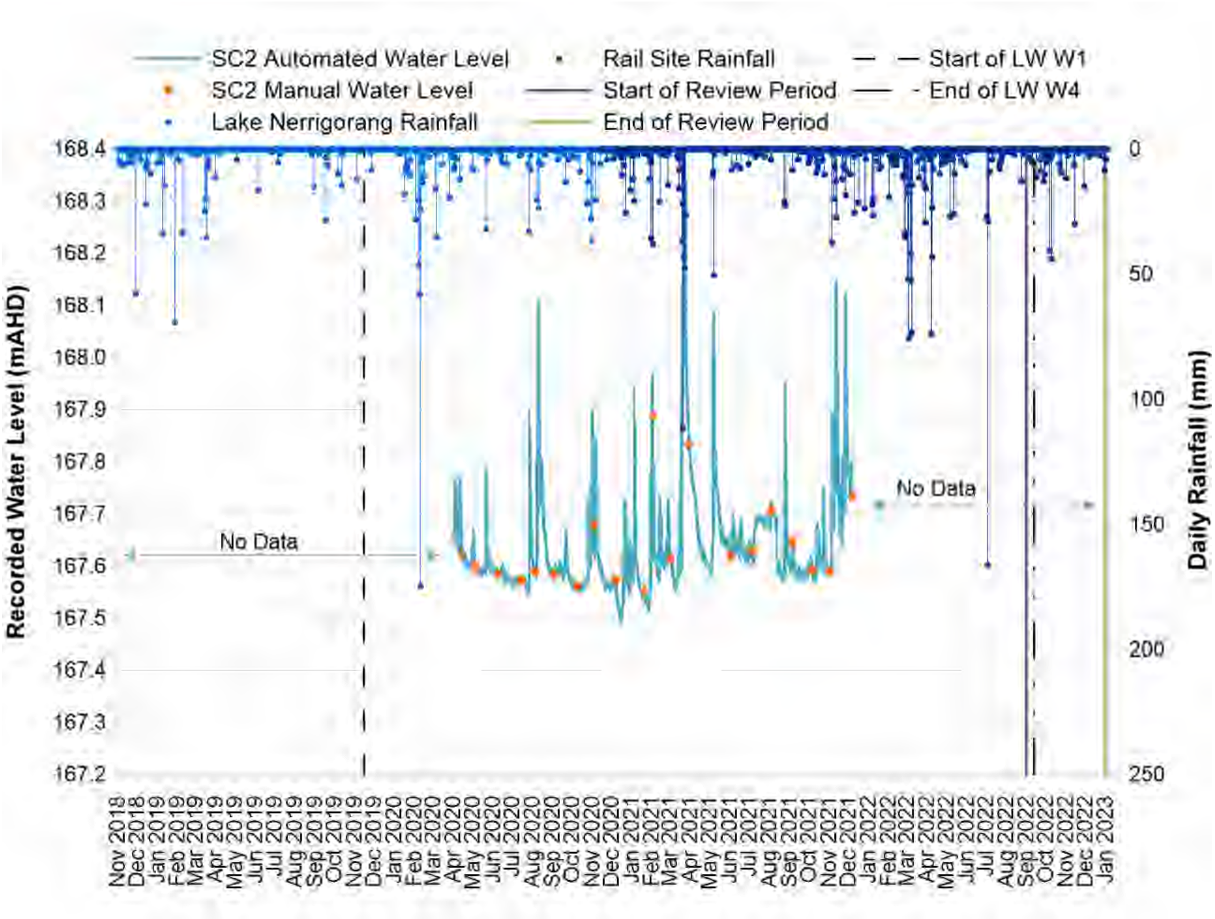


## DIAGRAM B20: MONITORING SITE SA WATER LEVEL RECORDS[8]



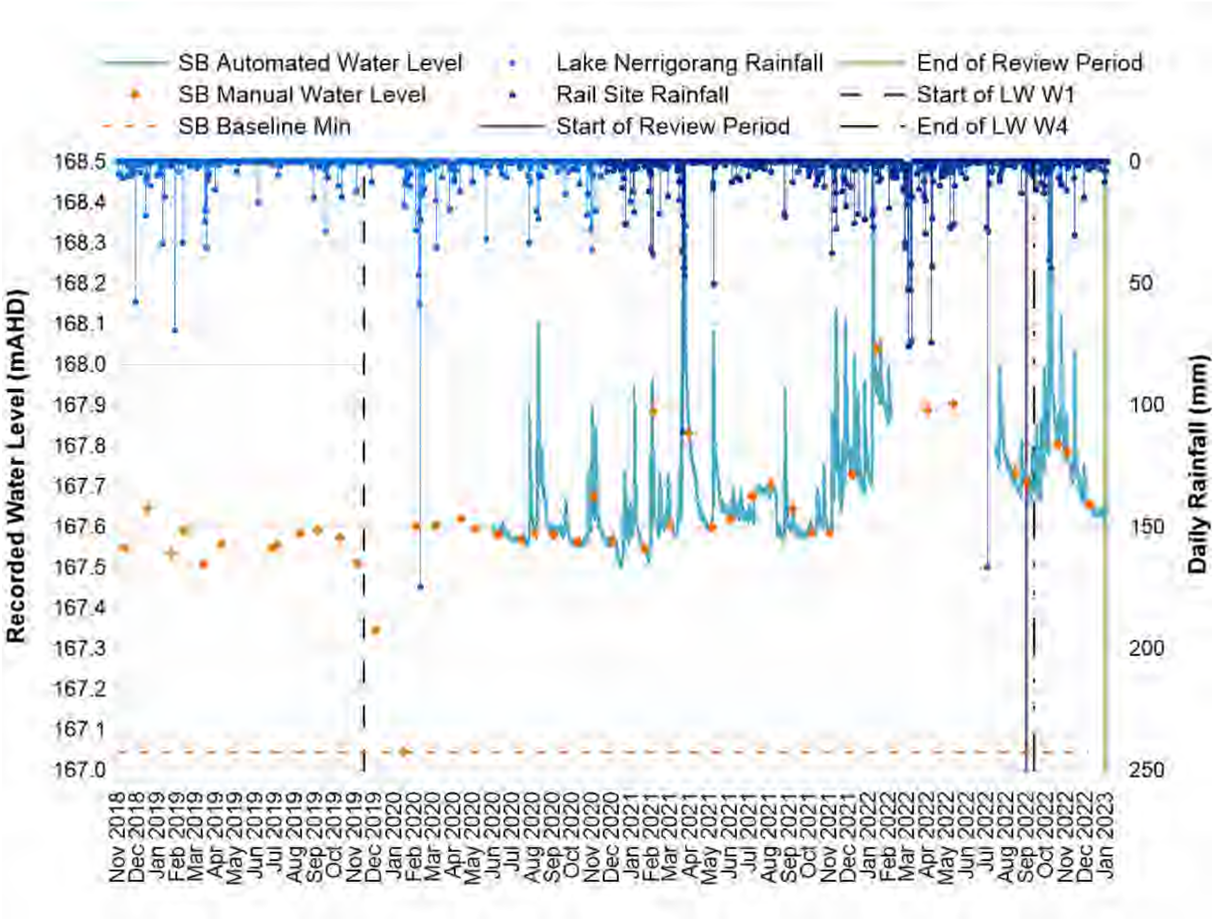

[8] Between 15 January and 5 February 2022, an incomplete data download occurred at monitoring site SA, or the logger was not correctly restarted, and as such no data is available for this period.

**DIAGRAM B21: MONITORING SITE SC2 WATER LEVEL RECORDS**[9]




[9] The water level sensor has not been located and therefore records are not available from 7 December 2021.

**DIAGRAM B22: MONITORING SITE SB WATER LEVEL RECORDS**[10]

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[10] The logger at monitoring site SB was washed away during a major rainfall event from late February to early March 2022 and as such data has not been collected since 5 February 2022. A manual water level measurement was unable to be recorded in April and June 2022 due to high flow.

**DIAGRAM B23: MONITORING SITE SC WATER LEVEL RECORDS**

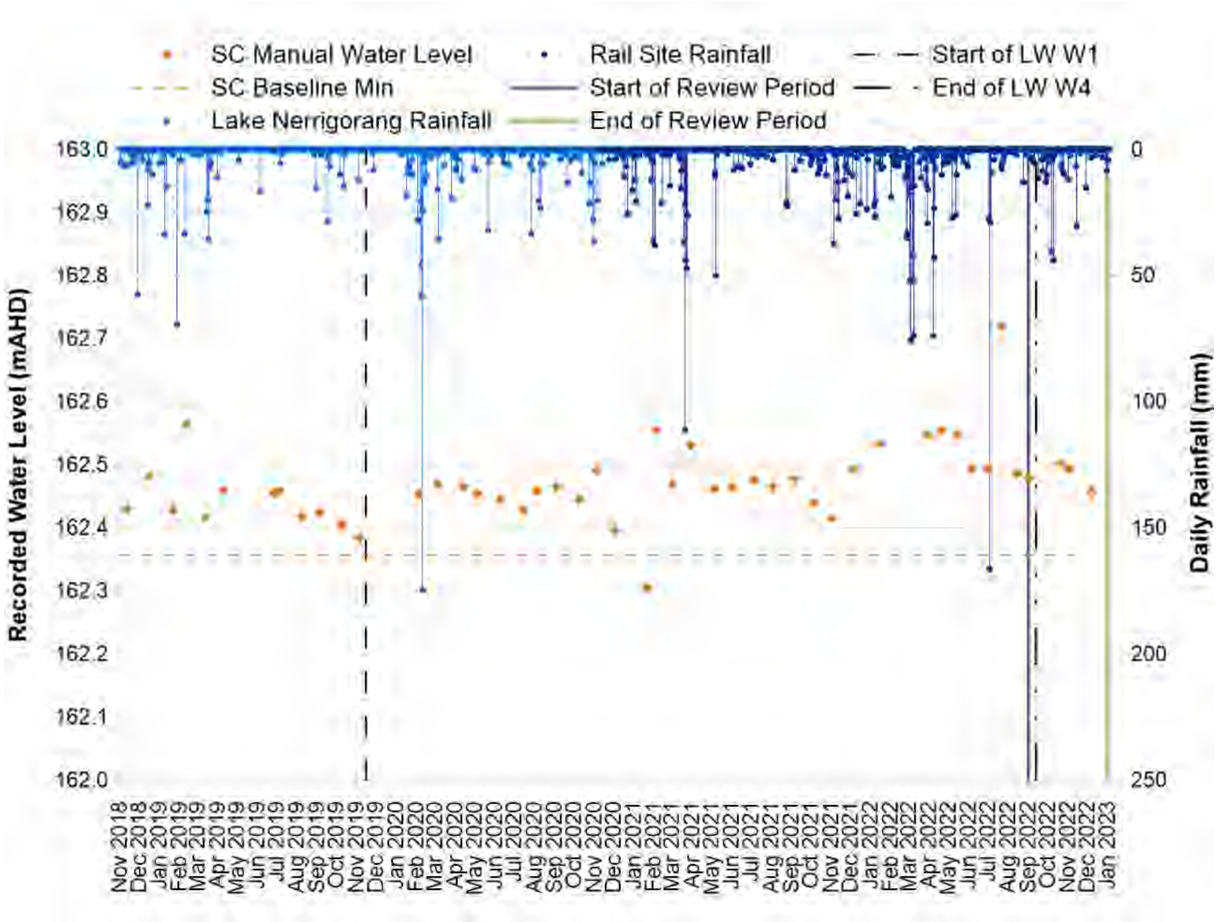
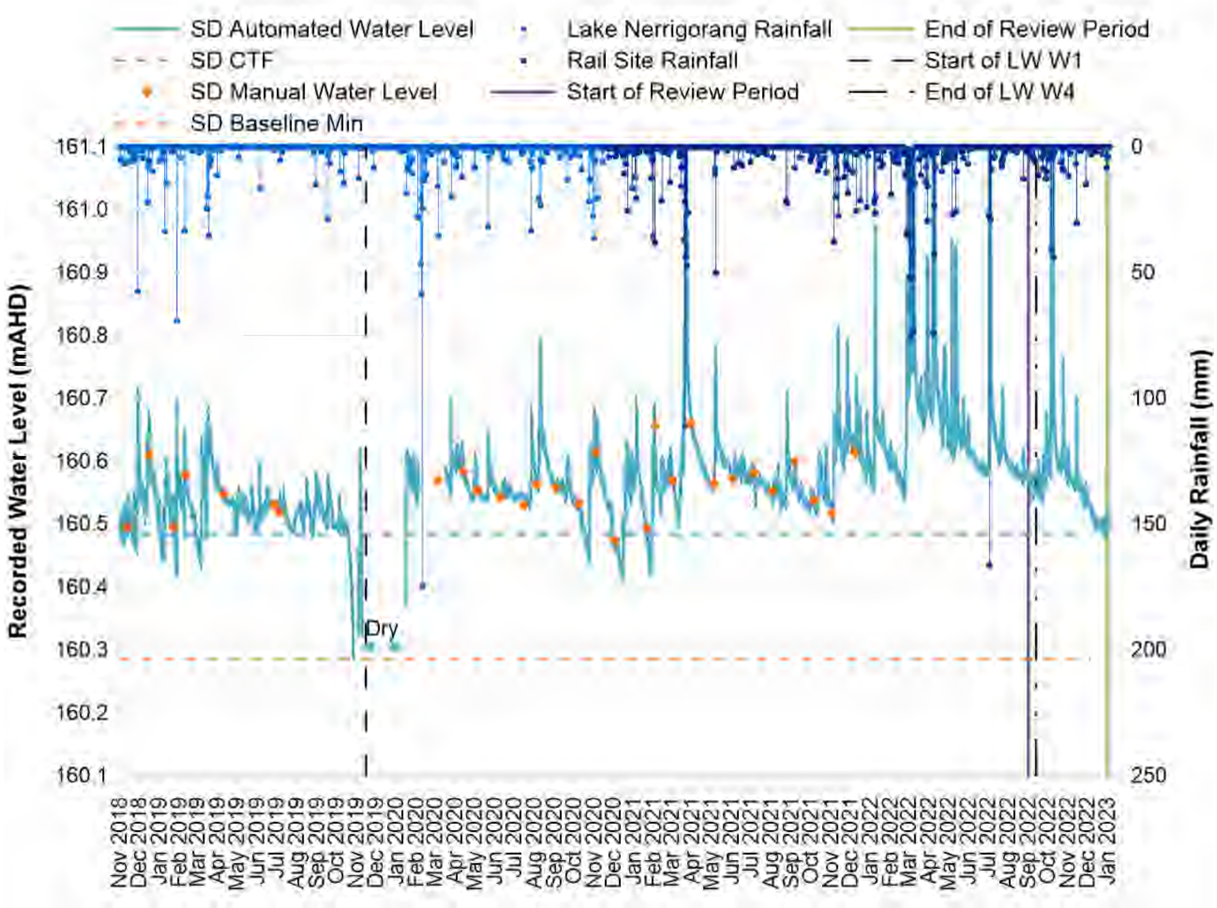


**DIAGRAM B24: MONITORING SITE SD WATER LEVEL RECORDS[11]**

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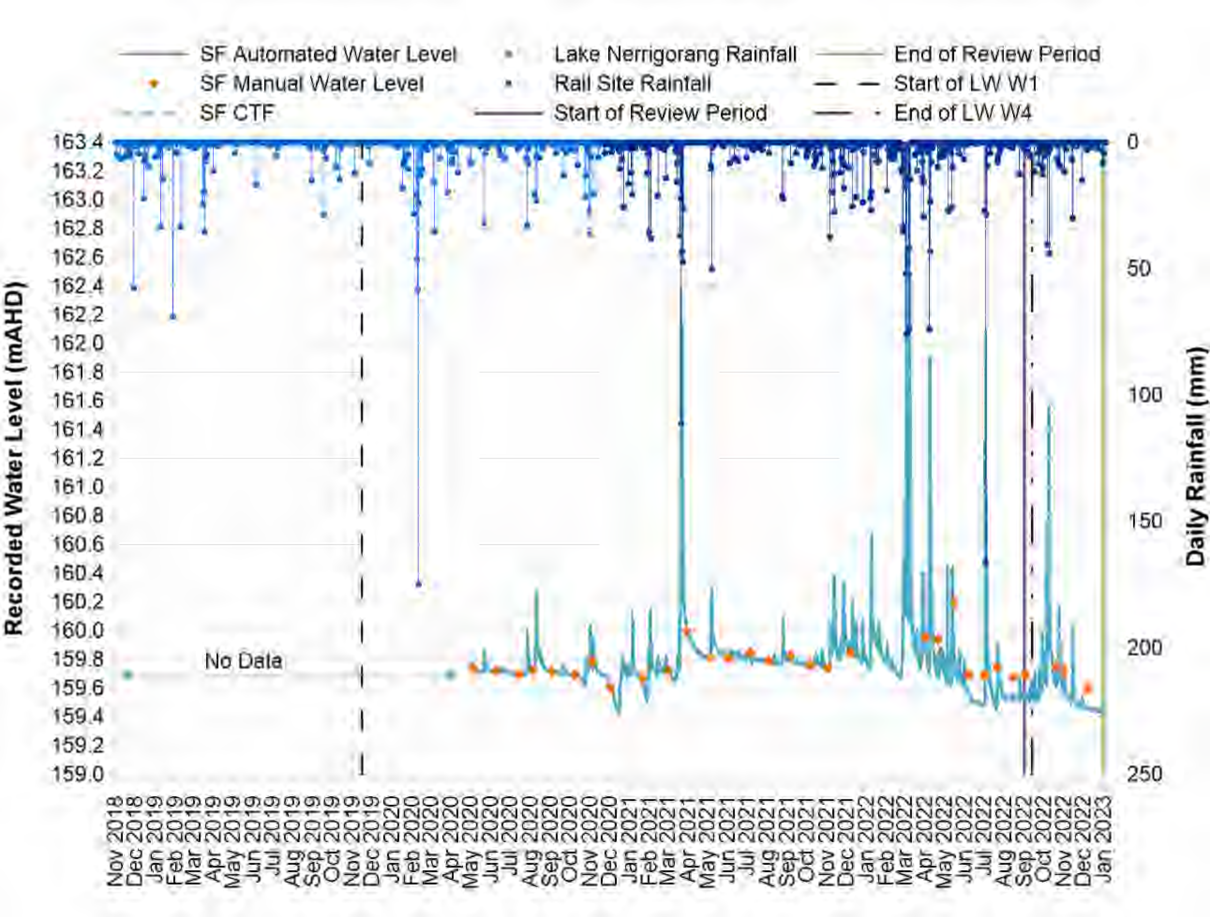
[11] The water level sensor has not been located and therefore records are not available from 7 December 2021.

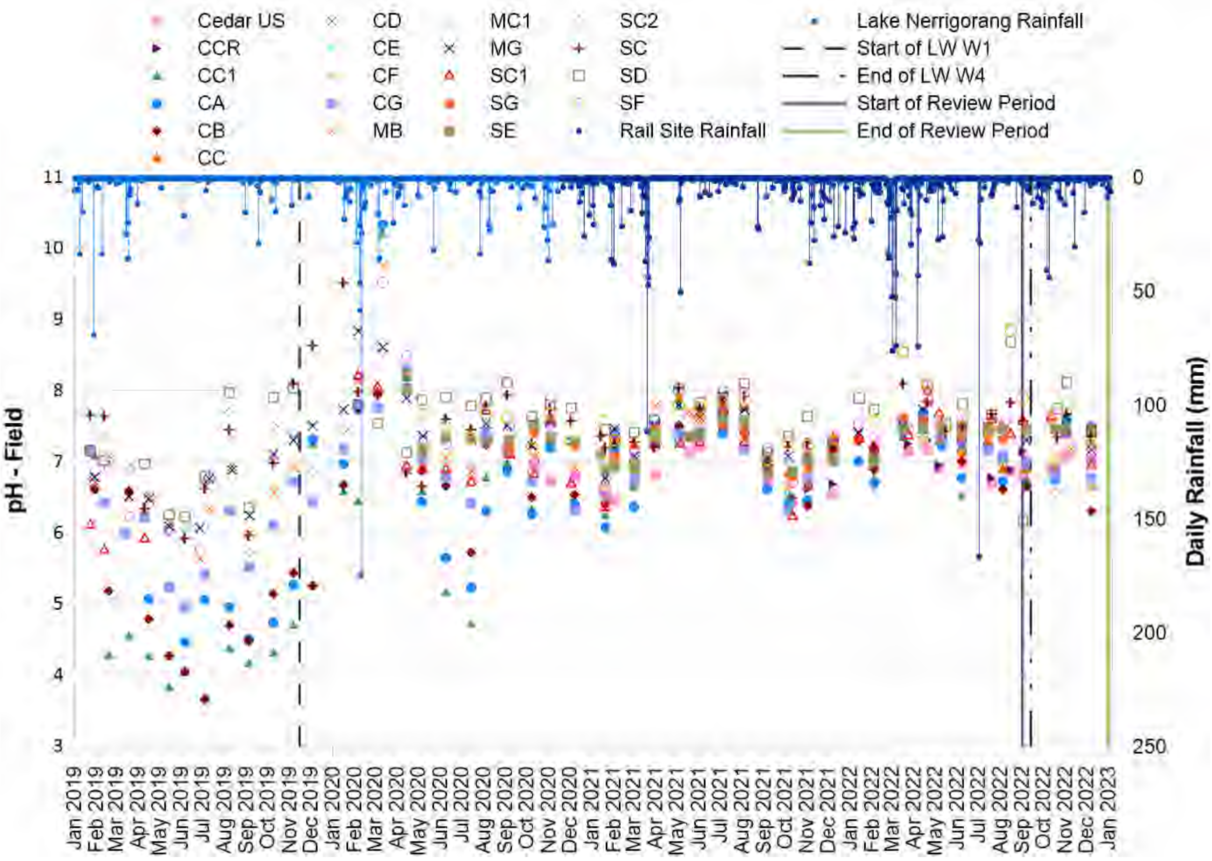
## DIAGRAM B25: MONITORING SITE SF WATER LEVEL RECORDS



## APPENDIX C – WATER QUALITY PLOTS[12]

[12] When the recorded value was below the limit of reporting, the value has been plotted at the limit of reporting in the following plots.

**DIAGRAM C1: FIELD PH RECORDS**



## DIAGRAM C2: LABORATORY PH RECORDS

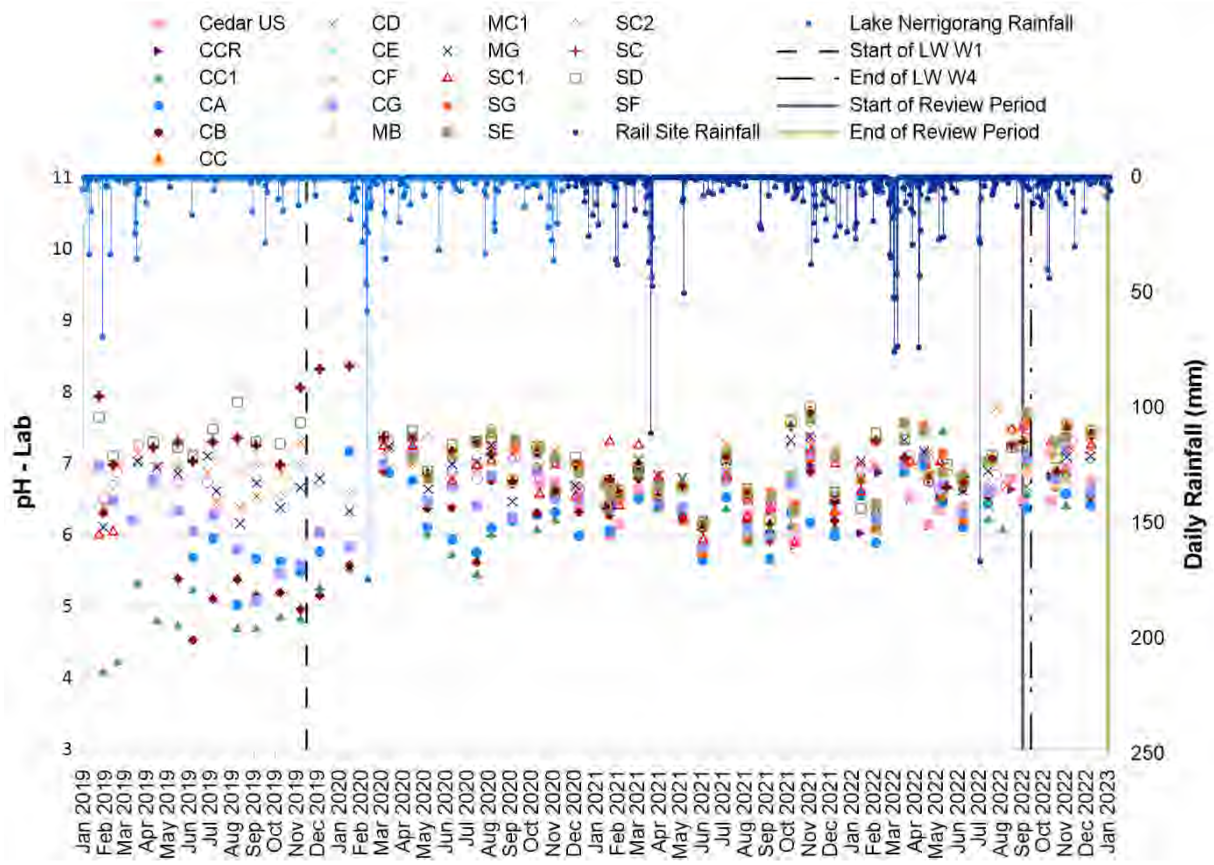
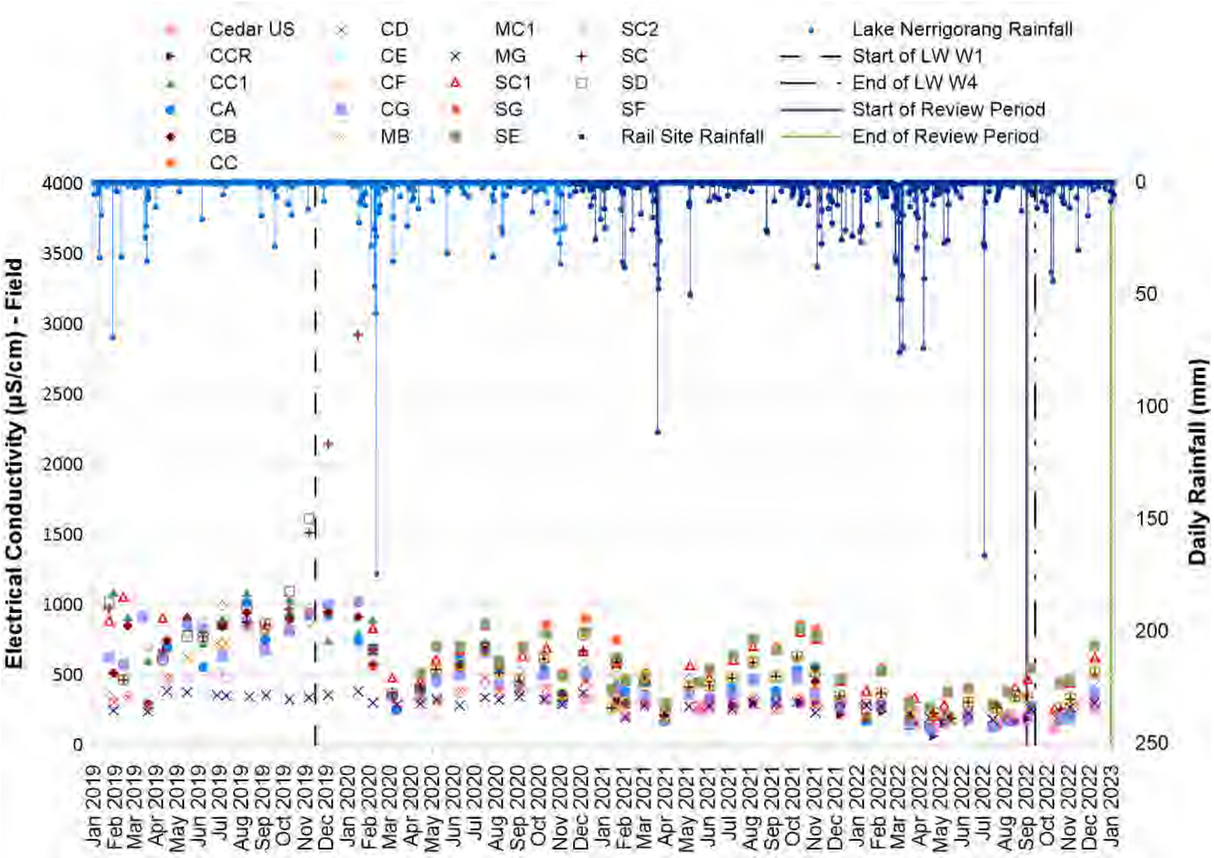


**DIAGRAM C3: FIELD ELECTRICAL CONDUCTIVITY RECORDS**



## DIAGRAM C4: LABORATORY ELECTRICAL CONDUCTIVITY RECORDS

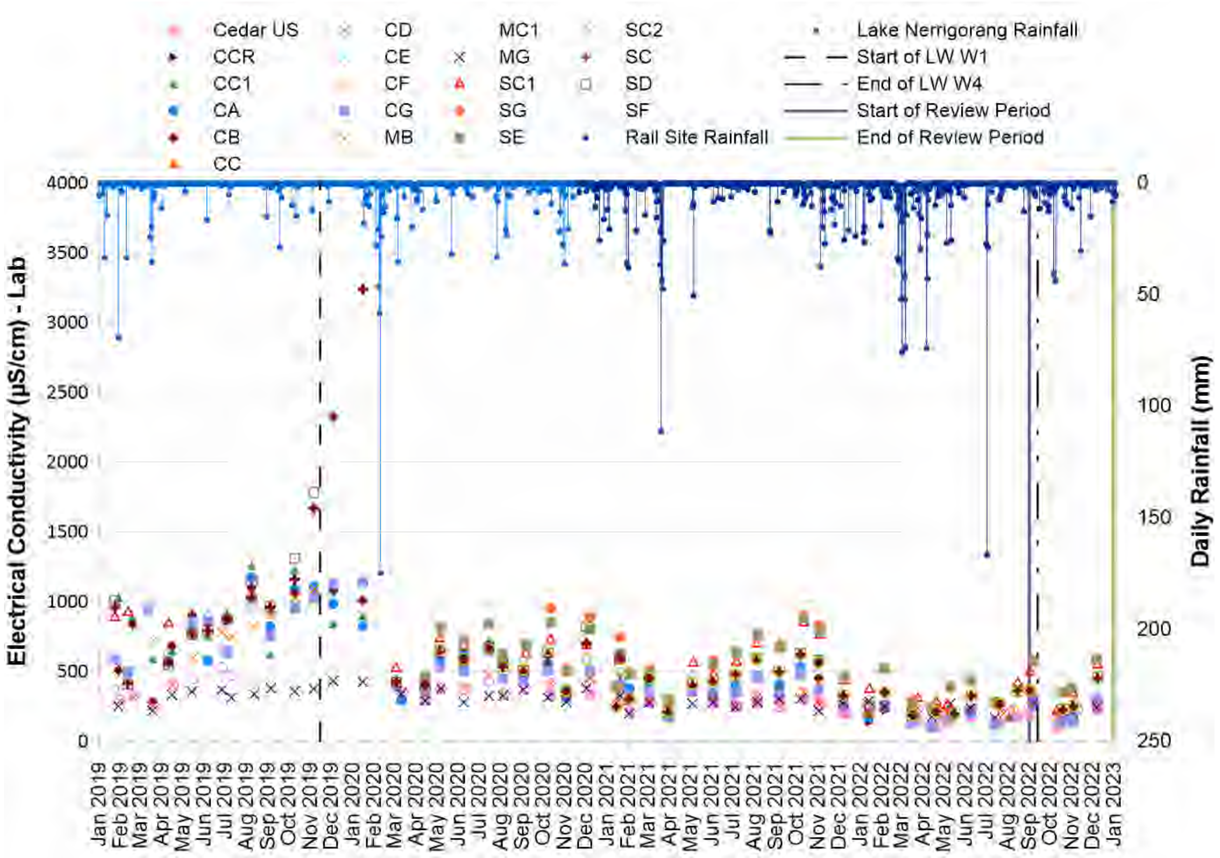


**DIAGRAM C5: DISSOLVED ALUMINIUM RECORDS**

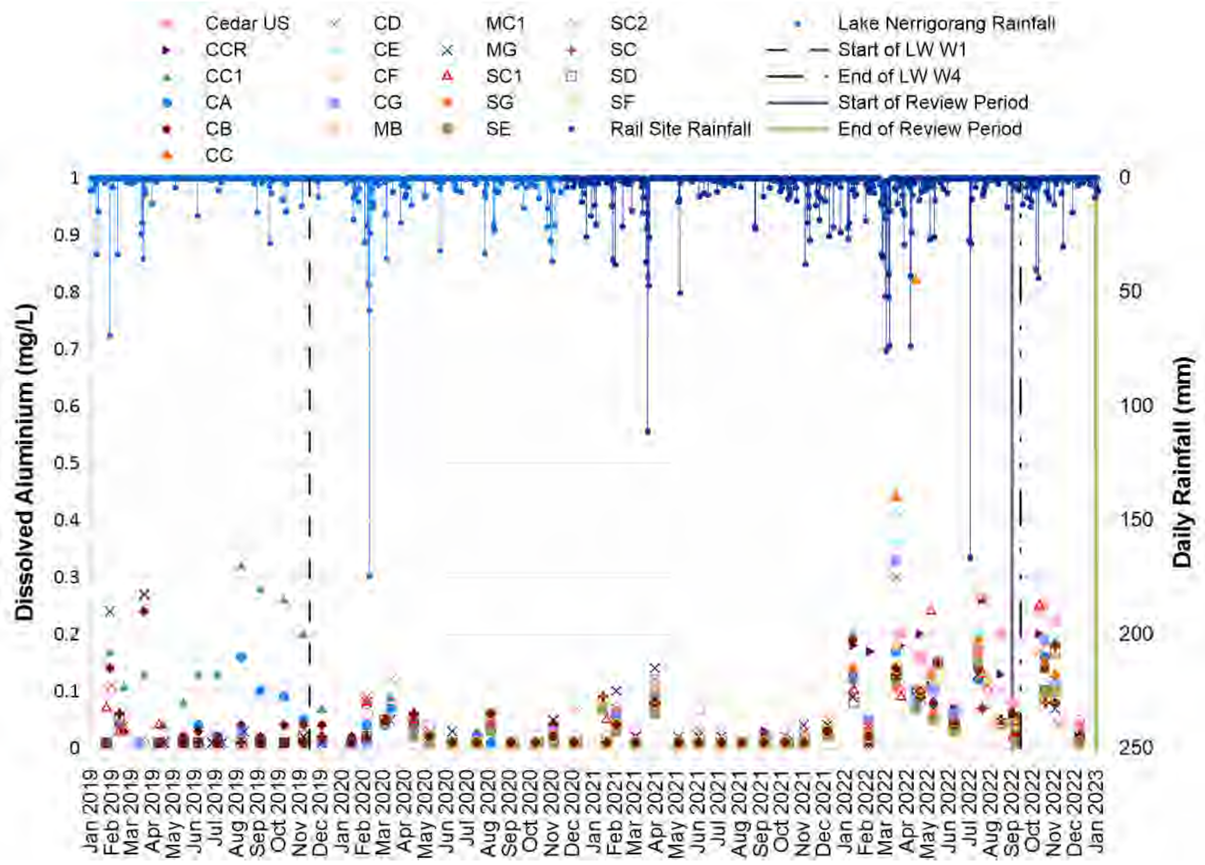


**DIAGRAM C6: DISSOLVED BARIUM RECORDS**

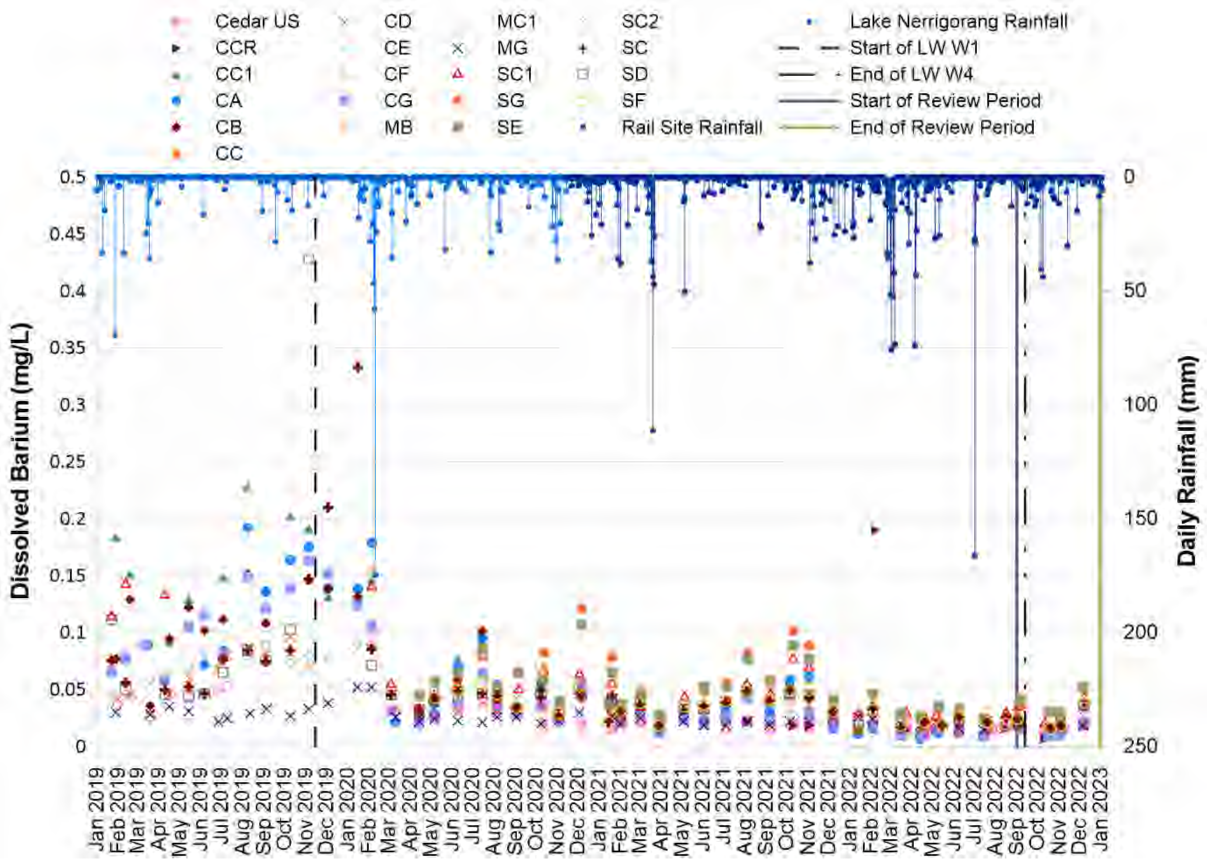


**DIAGRAM C7: DISSOLVED IRON RECORDS**

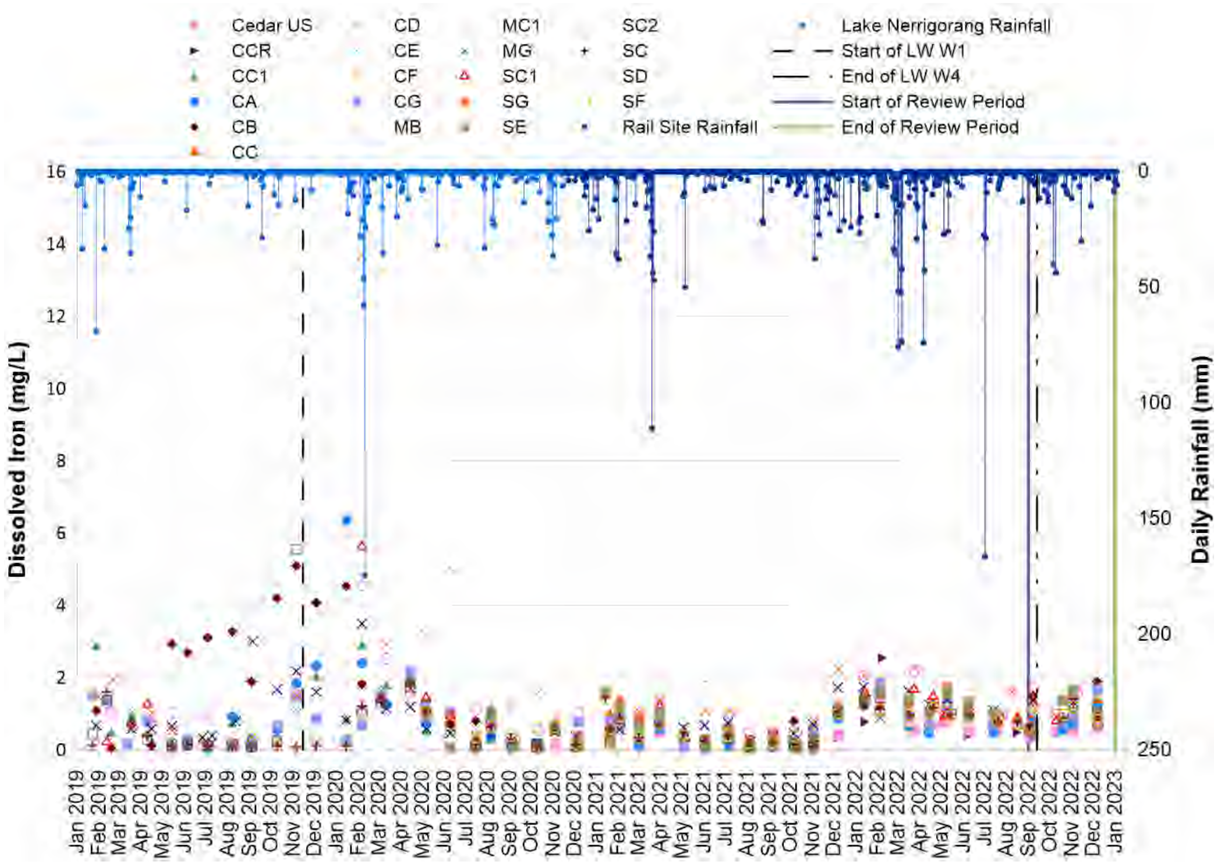
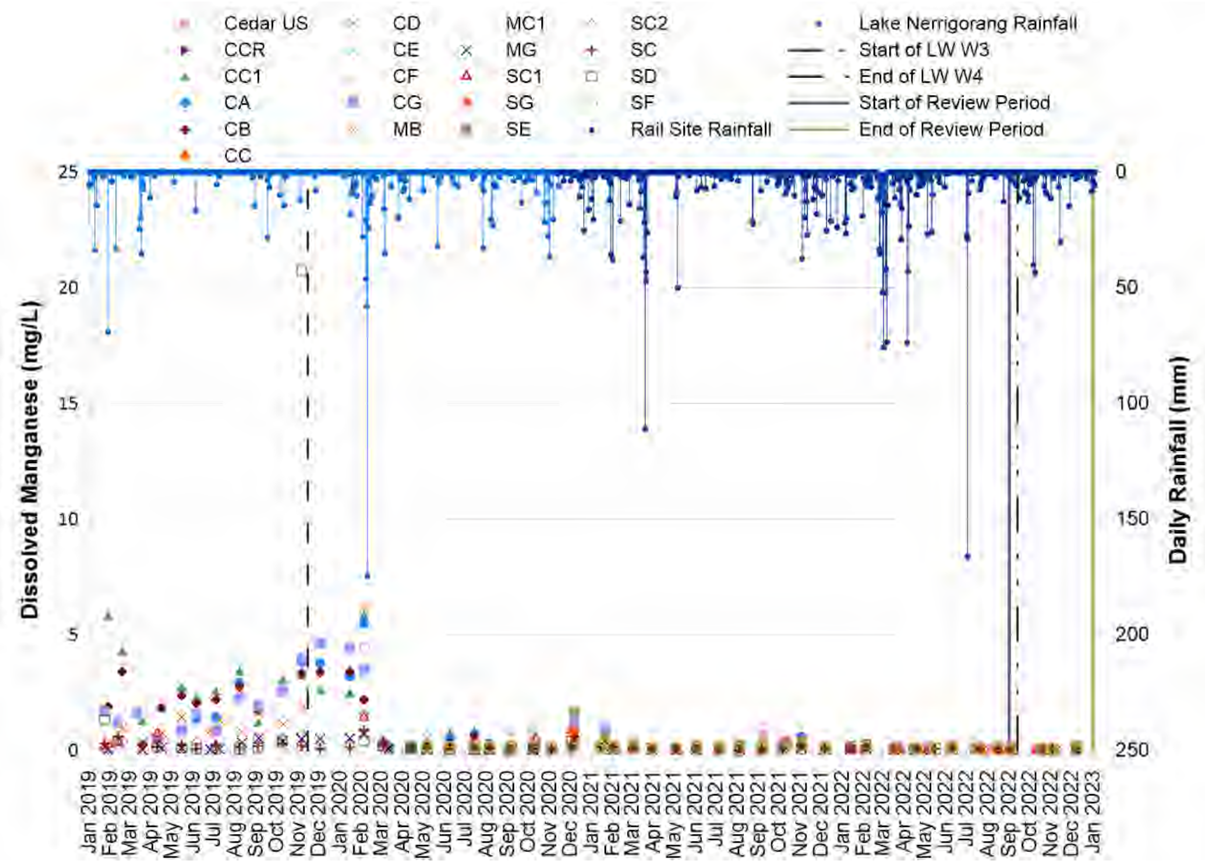
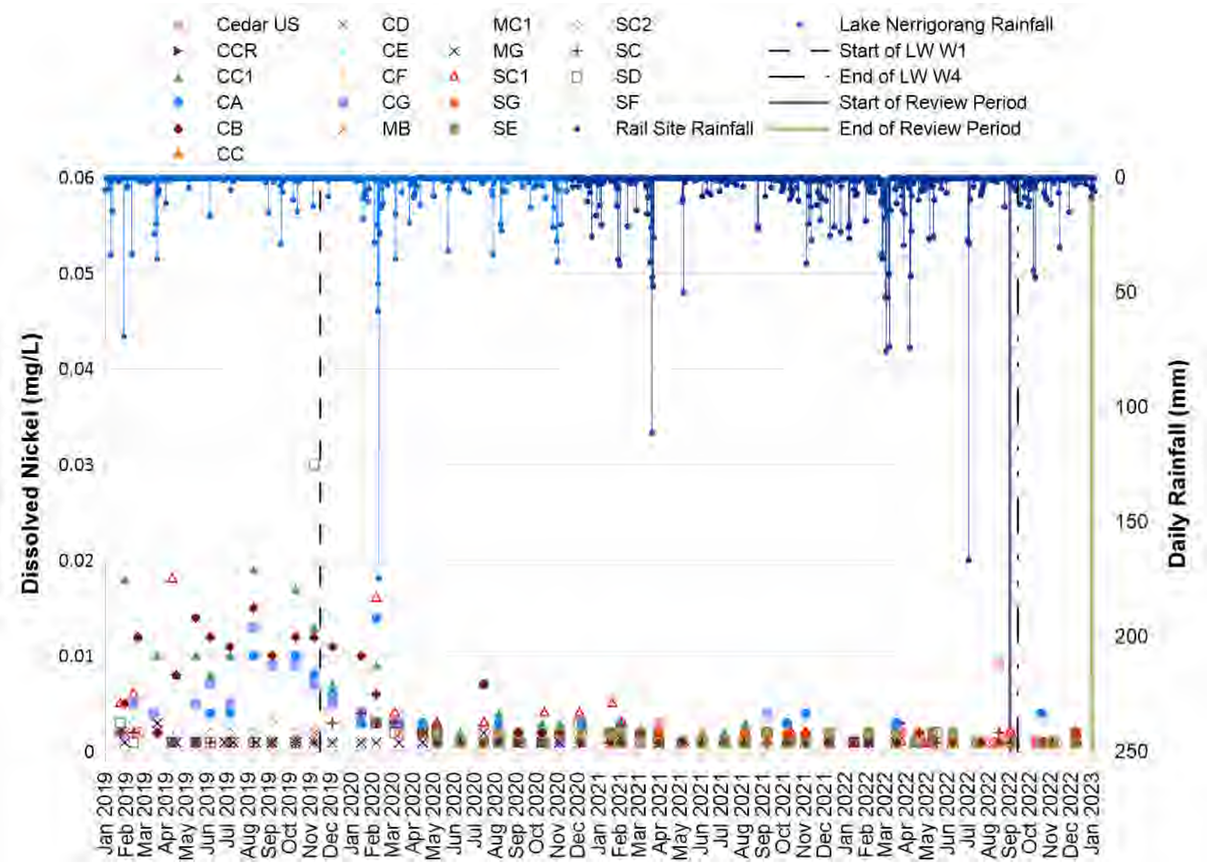


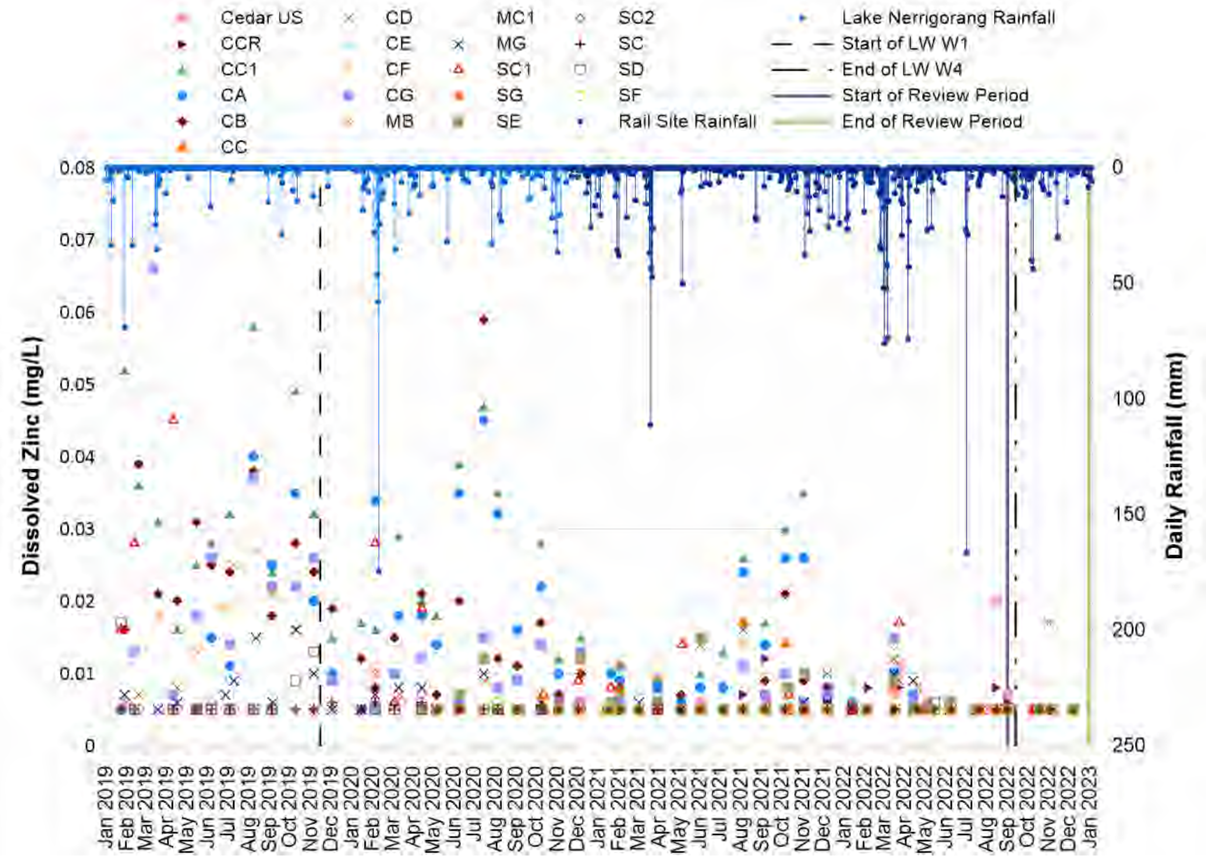
**DIAGRAM C8: DISSOLVED MANGANESE RECORDS**



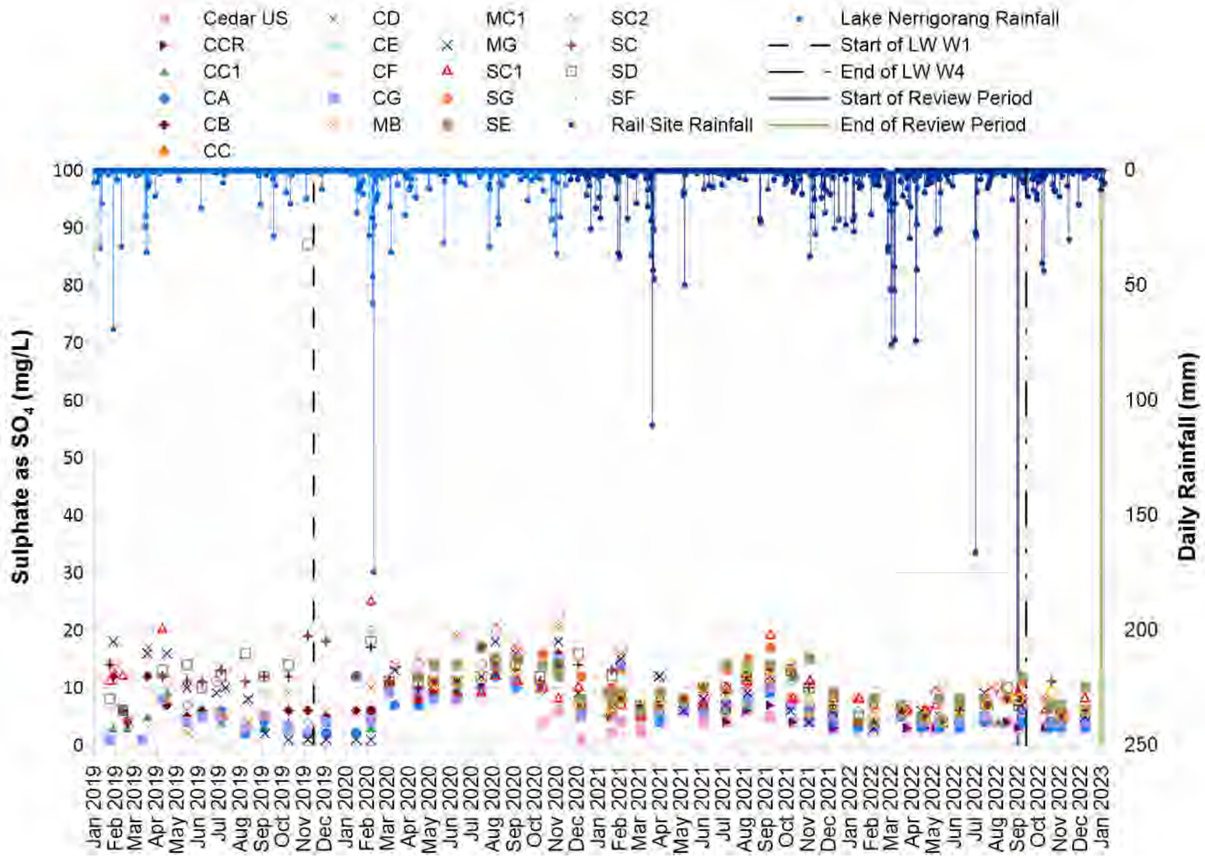
## DIAGRAM C9: DISSOLVED NICKEL RECORDS



## DIAGRAM C10: DISSOLVED ZINC RECORDS



## DIAGRAM C11: DISSOLVED SULPHATE RECORDS



# Appendix C – Creek Monitoring Reports

Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

SIMEC Mining – Tahmoor Coking Coal
Remembrance Driveway
TAHMOOR NSW 2573

Attention: April Hudson

**RE:** Longwall West 4 Creek Monitoring:

3 November 2022 Matthews Creek and Stonequarry Creek

April,

Please find discussed below observations in Mathews and Stonequarry creeks from surveys conducted on the 27 October 2022.

**Matthews Creek**

Inspections within the Longwall West 4 reach of Matthews Creek between sites MB1 and MB20 on 13 September 2022 as shown in **Figure 1**, identified the reduction of the presence of iron oxy-hydroxide precipitates in all the pools due to the flushing of the creek from the recent rains except for MB1.

No gas discharge was observed in Matthews Creek pool MR45 on 27 October 2022.

All observed Matthew Creek sites were therefore within TARP Level 1 for the observations of individual pool water level and flow, iron oxyhydroxide precipitation and gas releases as compared to previous surveys or the baseline survey conducted in August 2019.

**Stonequarry Creek**

Visual inspections of Stonequarry Creek's pools and associated rock bars at sites SR17 and SR20 were conducted on 27 October 2022.

The inspection at sites shown in **Figure 2**, indicated that potential mine-induced surface fracturing was observed at SR17 Rockbar. Most of this laminar cracking has now sheared away.

It was also noted that there are tyre tracks near the grinding grooves and some type of plastic residue is also marking the area.

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15/17 Cemetery Rd
Helensburgh NSW 2508

The surveyors noted a fluctuation of the pool associated with quarried stone removed from the west side of Stonequarry at SR17. The pool appeared to recover from the surveyors' photos in June 2022. No pool level reduction or reduction in overland flow was noted in the SR17 pool.

Surface fracturing was also noted at SR20 with one crack approximately 5.8 metres long and 6.2 mm wide at its widest point. This was first noted in the September 2022 inspection.

- MSEC indicated during the Environmental Response Group (held 20 September) and email dated 12 September (attached) that there was no measurable change associated with the fracturing based on the latest survey.

- ATC Williams indicated during the Environmental Response Group (held 20 September) that there is no indication of water level impact (except for SF, which is unlikely to be related).

- Please also note that there is no need to increase monitoring as extraction has been completed, just continue monitoring according to the LW W3-W4 Water Management Plan.

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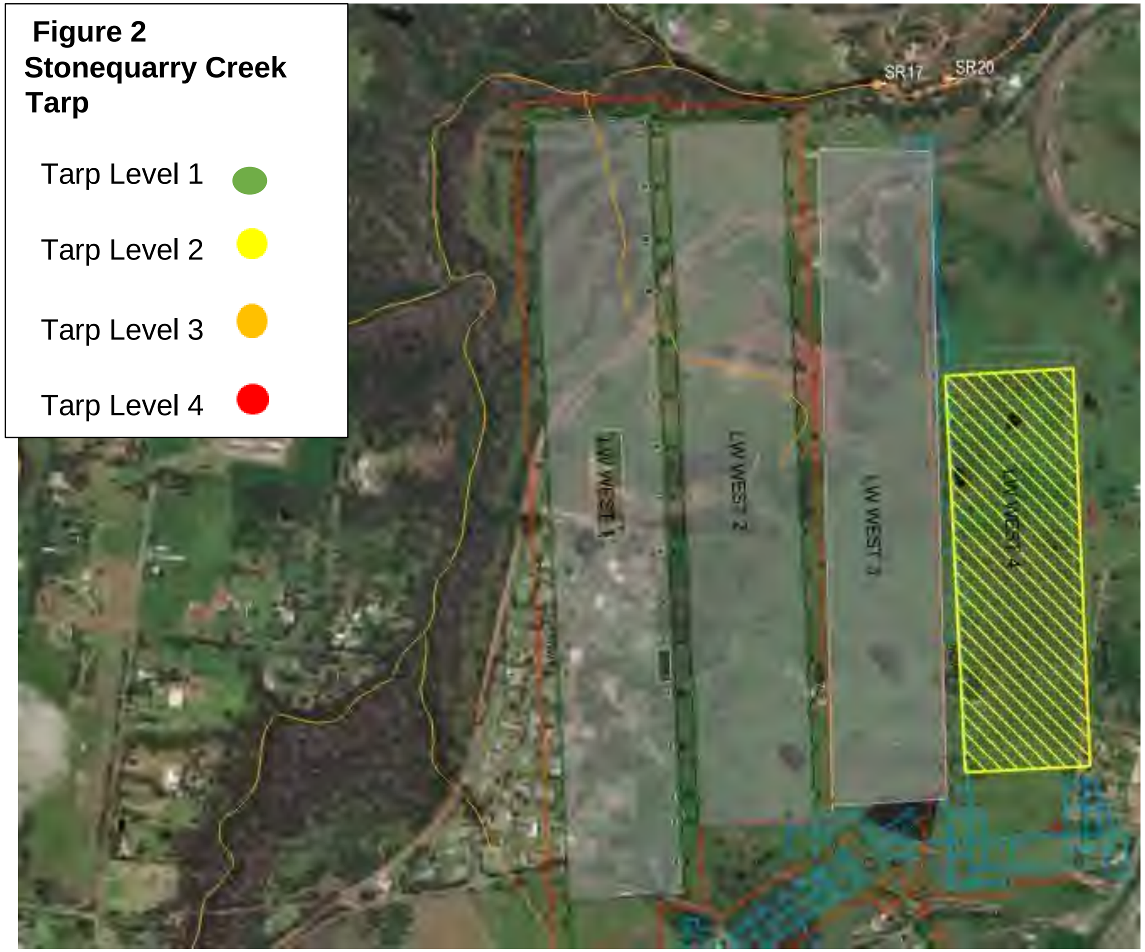
15/17 Cemetery Rd
Helensburgh NSW 2508

Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

**Figure 2**
**Stonequarry Creek Tarp**



Brienen Environment & Safety
15/17 Cemetery Rd
Helensburgh NSW 2508

SIMEC Mining – Tahmoor Coking Coal
Remembrance Driveway
TAHMOOR NSW 2573

Attention: April Hudson

**RE:** Longwall West 3 Creek Monitoring:

17 November 2021 (Matthews, Cedar and Stonequarry Creeks)

April,

Please find discussed below observations in Cedar, Mathews and Stonequarry Creeks from surveys conducted on the 17 November 2021.

**Stonequarry Creek**

Visual inspections of Stonequarry Creek's pools and associated rock bars within the Longwall West 3 active subsidence reach were conducted on 17 November 2021. The inspections at the sites shown in **Figure 1,** indicated that potential mine-induced surface cracking was observed at SR17 Rockbar. The cracking was observed in an area that vehicles use to access the property on the south side of Stonequarry Creek. No surface cracking, gas release, reduction in pool flow or connective overland flow was observed at any other observed site along Stonequarry Creek. Iron-oxy hydroxide precipitation at site SF was observed however, this had been identified in previous surveys.

Due to the development of laminar cracking and an extension of a natural crack, site SR17 would be at TARP Level 3. All other observed Stonequarry Creek sites were within TARP Level 1 for the observations of individual pool water level and flow, iron oxyhydroxide precipitation and gas releases as compared to previous surveys or the baseline survey conducted in August 2019.

**Cedar Creek**

Visual inspections of Cedar Creek's pools and associated rock bars within the Longwall West 3 active subsidence reach were conducted on 17 November 2021. The inspections at the sites shown in **Figure 2,** indicated that no mine-induced surface cracking, gas release, reduction in pool flow or connective overland flow was observed. Iron-oxy hydroxide precipitation at sites CB7, CR11/12, CR14, CR29 and CB30 was observed however, the precipitation was within the degree observed in the pre–Longwall West 1 baseline period.

All observed Cedar Creek sites were therefore within TARP Level 1 for the observations of individual pool water level and flow, iron oxyhydroxide precipitation and gas releases as compared to previous surveys or the baseline survey conducted in August 2019.

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**Matthews Creek**

Inspections within the Longwall West 3 reach of Matthews Creek between sites MR35 and MR46 on 27 Oct 2021 as shown in **Figure 3**, identified the presence of minor iron oxy-hydroxide precipitates at site MR35. It should be noted that the iron-oxy hydroxide precipitation was within the degree of precipitates observed in the pre–Longwall West 1 baseline period.

All observed Matthew Creek sites were therefore within TARP Level 1 for the observations of individual pool water level and flow, iron oxyhydroxide precipitation and gas releases as compared to previous surveys or the baseline survey conducted in August 2019.

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**Figure 1 Stonequarry Creek Tarp**

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15/17 Cemetery Rd
Helensburgh NSW 2508

# Appendix D – Groundwater Monitoring Reports

# TAHMOOR COAL

## Groundwater Six-Month Review November 2021 - March 2022

Prepared for:

Tahmoor Coal Pty Ltd

SLR Ref: 610.30831.00000-R03
Version No: -v3.0
June 2022

# PREPARED BY

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# BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Tahmoor Coal Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

# DOCUMENT CONTROL

| Reference | Date | Prepared | Checked | Authorised |
|---|---|---|---|---|
| 610.30831.00000-R03-v3.0-20220616.docx | 16 June 2022 | Maxime Philibert | Corinna De Castro | Corinna De Castro |
| 610.30831.00000-R03-v2.0-20220513.docx | 30 May 2022 | Maxime Philibert | Corinna De Castro | Corinna De Castro |
| 610.30831.00000-R03-v1.0-20220513.docx | 27 May 2022 | Maxime Philibert | Will Minchin | Corinna De Castro |

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## APPENDICES

# 1 Introduction

## 1.1 Overview

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Tahmoor Coal Pty Ltd (Tahmoor Coal) to undertake a groundwater six-monthly review for the Tahmoor Coal Mine (Tahmoor Mine), located between the towns of Tahmoor and Bargo, New South Wales (NSW). A five-month reporting period was chosen to match with the review period presented in the surface water review completed in ATC Williams (2022a).

This review focuses on the five-month reporting period from 1st November 2021 to 31st March 2022, and includes:

- A review of groundwater levels in monitoring bores in the context of the water level triggers specified in the Longwall W1-W2 Water Management Plan (WMP) and Longwall W3-W4 Water Management Plan (Tahmoor Coal, 2021), with a subsequent evaluation and analysis of any groundwater level trends that exceed this assessment to determine possible causes for these trends;
- A review of water quality triggers and analysis of any bores that exceed these water quality trigger limits as specified in the WMP (i.e. LW W1-W2 and LW W3-W4 WMP); and
- A review of groundwater inflow to the underground mine and compliance with the water access licence held by Tahmoor Coal.

## 1.2 Site Background

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

Tahmoor Mine has been operated by Tahmoor Coal since Tahmoor Mine commenced in 1979 using board 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 previously mined 35 longwalls to the north and west of Tahmoor Mine's current pit top mine infrastructure location. The current mining area, the 'Western Domain', is located north-west of the Main Southern Rail between the townships of Thirlmere and Picton. The Western Domain is within Mining Lease (ML) 1376 and ML 1539.

The mine plan for the Western Domain includes four longwalls - Longwalls West 1 to West 4. An Extraction Plan for the first two longwalls in the Western Domain, Longwalls West 1 and West 2 (LW W1-W2), was approved by the NSW Department of Planning, Industry and Environment (DPIE[1]) on 8 November 2019. LW W1 extraction commenced on 15 November 2019 and was completed on 6 November 2020. The extraction of LW W2 commenced on 7 December 2020 and was completed on 17 June 2021. The extraction of LW W3-W4 was approved in September 2021 under the WMP (Tahmoor Coal, 2021). Extraction of LW W3 started on 13 September 2021 and was completed on 21 March 2022. LW W4 started on 16th May 2022.

[1] Currently the Department of Planning and Environment (DPE) since 21 December 2021

## 1.3 Recent Mining Activity

Over the reporting period from 1 November 2021 to 31 March 2022 the following mining (new and continued mining) activities have taken place at the Tahmoor Mine:

- LW W3 extraction started on 13 September 2021 and was completed on 21 March 2022.

## 1.4 Methodology

This report details the analysis of groundwater levels and quality to comply with the conditions of the WMP, outlined in Section 2, focusing on groundwater levels and water quality parameters that have exceeded the trigger levels. To fulfil these requirements this report has carried out the following:

- An analysis of groundwater levels in the relevant monitoring bores to determine groundwater level changes over the reporting period in the vicinity of the Western Domain of Tahmoor Mine to demonstrate the correlation between climatic conditions and groundwater levels. Where any unexpected groundwater level changes and exceedances of defined trigger levels are observed, an analysis is carried out to determine the main reasons for this groundwater change (Section 4);
- A review of groundwater quality monitoring, including both field and laboratory data, undertaken during the monitoring period, and identification of any parameters that fall outside those specified in the WMP and the possible causes for these exceedances (Section 5);
- A summary of comparison between the modelled and observed groundwater levels using the latest model results presented in the Groundwater Technical Report: Extraction Plan for LW W3-W4 (SLR, 2021) and latest available observed groundwater data (Section 6); and
- An analysis of groundwater mine inflow to determine compliance with groundwater licences and the causes of any significant increases or decreases in groundwater take at Tahmoor Mine (Section 7).

# 2 Statutory Requirements

The relevant statutory requirements for the Tahmoor Mine six-month groundwater review (presented here as a five-month groundwater review, refer to Section 1.1) are outlined in the following sections. These requirements outline the licensed take from groundwater and highlight trigger levels for the approved impacts to groundwater levels and quality.

## 2.1 Development Application

The activities at the Tahmoor North Coal Mine were initially approved under the conditions of Development Application (DA 67/98) in 1999. Since this approval five modifications to the DA have been made to maintain the relevance of the approval conditions to changes in legislation and policy, industry practice, as well as environmental and community values.

In September 2018 (Modification 4) additional conditions (13A to 13J) were added to the DA to make provision to report on and measure the impacts of subsidence on natural, built and heritage features in the landscape. Under condition 13H of this modified section, is the request to prepare an Extraction Plan for all longwalls after and including Longwall 33 (now known as LW W1). Condition 13H section (vii) c) required the inclusion of a WMP to accompany the Extraction Plan for LW W3-W4. It is noted that a Modification 5 of DA 67/98 was issued by DPIE in October 2020 and includes only minor alterations to condition 13H. In September 2021, the extraction of LW W3-W4 was approved under the Tahmoor North – Western Domain Longwalls West 3 and West 4 Water Management Plan (Tahmoor Coal, 2021).

## 2.2 Water Licensing

Water Access Licences (WAL) held by Tahmoor Coal under the authority of the *Water Management Act 2000* are listed in Table 1.

Table 1 Tahmoor Coal Water Access Licences

| Work approval | WAL title | Issued | Purpose | Share |
|---|---|---|---|---|
| 10WAI18745 | WAL 36442 | 06/12/2013 | Mining dewatering (groundwater) (Nepean Sandstone Groundwater MZ2) | 1,642 ML |
| 10AL103025 | WAL 25777 | 27/10/2014 | Surface Water Take (Maldon Weir MZ) | 5 ML |
| 10MW119329 | WAL 43572 | 13/04/2021 | Incidental Surface Water Take (Stonequarry Creek MZ) | 16 ML |

## 2.3 Water Management Plan

The approval of LW W1-W2 was conducted under the WMP for LW W1-W2 and the approval of LW W3-W4 is currently conducted under the WMP for LW W3-W4 recently submitted and approved in September 2021.

As part of the Project Approval the WMP outlines the relevant approval conditions and monitoring requirements that the Tahmoor Mine is subject to. As part of the WMP, a Groundwater Technical Report was prepared to determine monitoring and acceptable impacts to groundwater. The Groundwater Technical Report (Appendix D of the WMP, prepared by SLR (2021)) outlines both the groundwater relevant triggers and Trigger Action Response Plan (TARP). Subsequent modifications to the TARP were undertaken to address comments made by DPIE and the Independent Advisory Panel for Underground Mining (IAPUM) prior to the submission of the WMP in September 2021 (Tahmoor Coal, 2021).

A summary of the requirements of the WMP that are relevant to this groundwater assessment and where they are addressed in this document are presented in Table 2.

### Table 2 Groundwater Technical Report requirements of the WMP for Water Monitoring

| WMP Parameter | Groundwater Requirements Summary |
|---|---|
| Springs | There are no springs identified in the vicinity of LW W1-W4 or the surrounding watercourses. Therefore, monitoring and management of such features is currently not required. |
| Groundwater level | Detection of a lowering of groundwater (drawdown) that exceeds beyond the trigger (trigger levels detailed further in Section 4.2), the Trigger Action Response Plan must be implemented (Appendix B). |
| Groundwater quality<br>Field: pH, EC, temperature<br>Lab: pH, EC, Total dissolved solids, sodium, calcium, potassium, magnesium, chloride, fluor, sulphate, total phosphorous, total nitrogen, organic carbon, total alkalinity as calcium carbonate, bicarbonate and carbonate, arsenic, cadmium, copper, iron, lead, manganese, nickel, selenium, zinc, aluminium | Assessment of whether concentrations are within the minimum and maximum background values (detailed further in Section 5.1).<br>If the trigger values for selected groundwater quality parameters are exceeded, or are found to be out of the acceptable range, the Trigger Action Response Plan must be implemented (Appendix B). |
| Groundwater interception (mine inflow) | Determination of groundwater interception as part of the Annual Review process to identify that the annual inflow to underground workings is covered by the water licence of 1,642 ML (WAL36442). |
| Subsidence performance measures | Subsidence performance measures for natural and heritage features are listed under Condition 13A of DA 67/98. There are no performance measures specific to groundwater. |

# 3 Existing Network and Monitoring Program

There are six existing boreholes with vibrating wire piezometers (VWPs) (TNC036, TNC040, TNC043, WD01, P40 and P41) that are routinely monitored by Tahmoor Coal to monitor groundwater levels in the aquifers surrounding Tahmoor Western Domain. In addition, there is a set of standpipe monitoring bores (at sites P12, P13, P14, P15, P16 and P17) as shown on Figure 1. P13 and P17 were decommissioned in September 2021.

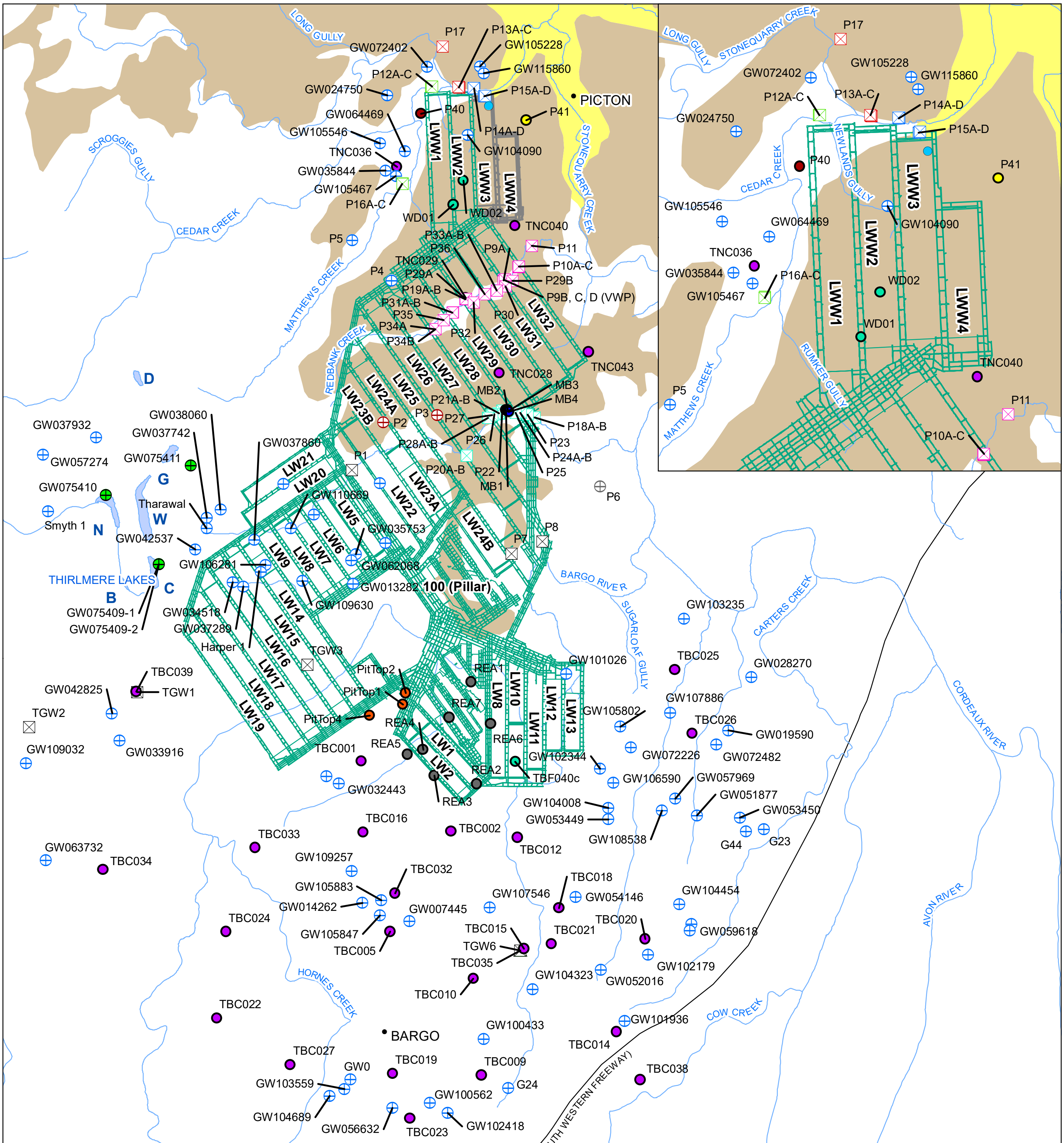
P40, located near the surface water monitoring site CB along Cedar Creek (approximately 115 m east of the creek), was drilled to a depth of 97.8 m (Figure 1). Four VWP instruments (P40A-D) were installed at different depths within the Hawkesbury Sandstone (39, 44, 49 and 85 m below ground level (bgl)) at P40 with groundwater levels recorded since late August 2021.

The Nepean Fault Complex VWPs at P41 were installed in early 2021 approximately 230 m north-east of LW W4 and 600 m south of Stonequarry Creek within the Nepean Fault Complex. P41 is an angled borehole equipped with six VWPs instruments at different depths (P41A-F) within the Wianamatta Formation and Hawkesbury Sandstone recording groundwater levels since late August 2021.

P40 and P41 provide data on groundwater level throughout the current extraction of LW W3 and future extraction of LW W4. Other monitoring locations that may be added to the network in future would be included in an updated monitoring program. In addition, bores WD01 (existing) and WD02 (proposed) are designed to monitor groundwater level response directly above Western Domain workings.

To fulfill the requirements of the WMP, groundwater level monitoring at Tahmoor Mine is carried out in accordance with the WMP conditions. All groundwater level monitoring bores and VWPs in the vicinity of Tahmoor, and their available monitoring details, are listed in Table 3 below. Some piezometers or bores have failed due to ground movement (subsidence effects) or had equipment fail or logger equipment stolen, which affects the ability to collect data or affects the frequency of data measurement. The status of each instrument is listed in Table 3.

In addition to groundwater level monitoring, all shallow standpipe bores are sampled to fulfill the requirements of the WMP groundwater quality monitoring at Tahmoor Mine.




- Rainfall Monitoring Site - Rail Site Tipping Bucket

**Groundwater Monitoring Locations**

- Pointe Engineering
- Deep GWL
- HOF investigation bore
- Nepean Fault Complex piezometer
- Cedar Creek piezometer
- Shallow OSP
- Shallow OSP - Cedar Creek
- Shallow OSP - Redbank
- Shallow OSP - Myrtle Creek
- Shallow OSP - Stonequarry Creek
- Shallow OSP - Stonquarry (decommissioned bore)
- Shallow OSP - Matthews Creek
- Shallow OSP - pit-top
- Shallow OSP - REA
- Groundwater quality
- NSW govt monitoring
- Regional GW Bore
- Regional old exploration bore
- Regional GW Bore (destroyed)
- Pool 23 rehab

0 1 2 km

| | |
|---|---|
| Coordinate System: | GDA 1994 MGA Zone 56 |
| Scale: | 1:80,000 at A4 |
| Project Number: | 665.10010 |
| Date: | 16-May-2022 |
| Drawn by: | JG |

- Town
- Tahmoor North and Western Domain
- Proposed Areas of Future Mining
- Major Roads
- Watercourses
- Lakes
- Alluvium
- Wianamatta Formation

Lakes:
D = Dry Lake
G = Gandangarra
W = Werri Berri
C = Couridjah
B = Baraba
N = Nerrigorang

**TAHMOOR COAL**

**Groundwater Monitoring Network**

**FIGURE 1**

H:\Projects-SLR\620-BNE\665-WOL\665.TAH05 Tahmoor GWMP\GIS\66510010 Fig1 Groundwater monitoring locations May 2021- October 2021.mxd

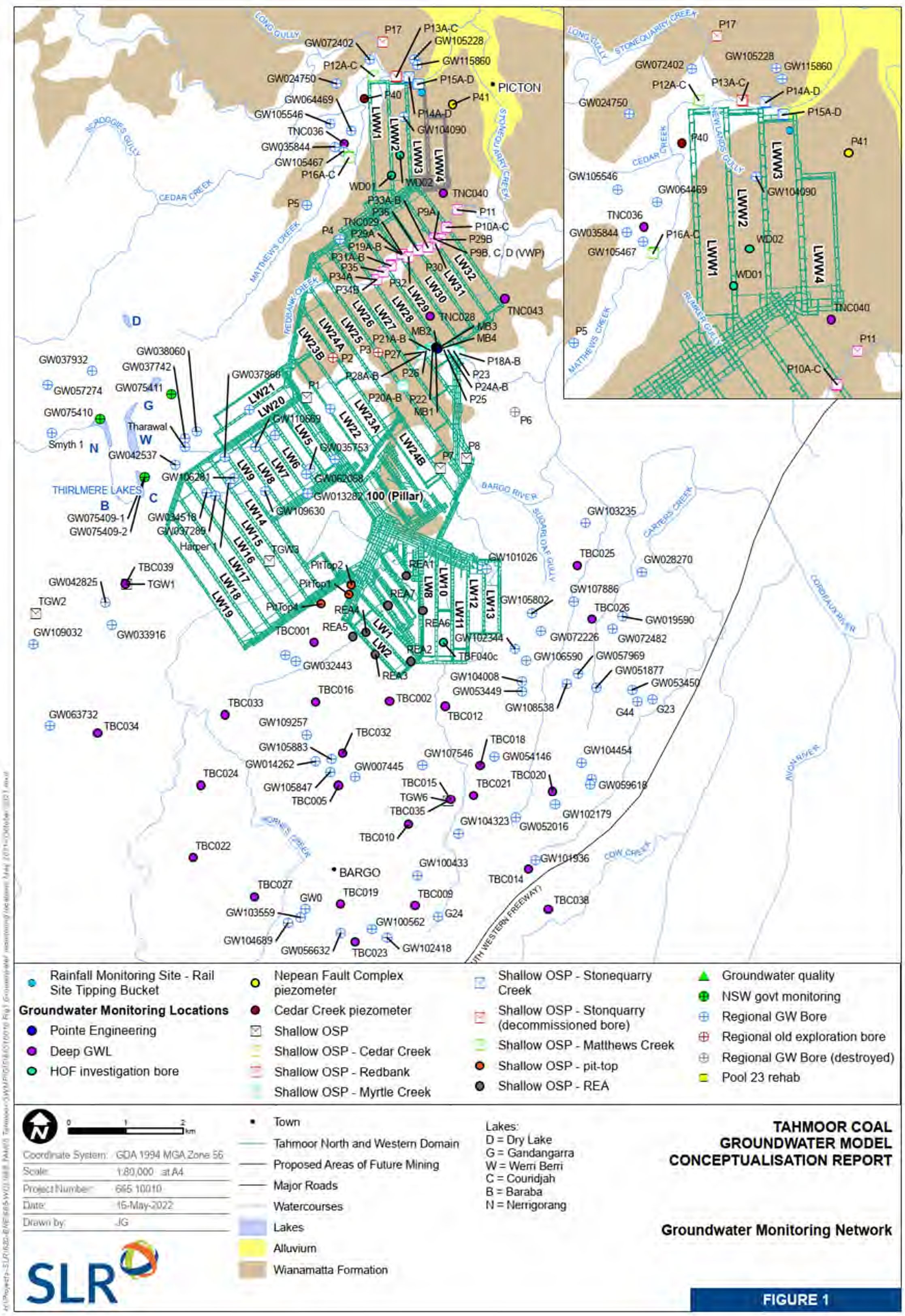



Figure 1 Groundwater Monitoring Network

## Table 3 Groundwater Monitoring Network

| Monitoring Bore or VWP ID | Owner | Easting[1] (MGA94) | Northing[1] (MGA94) | Bore screen or VWP sensor depth (mBGL) | Status | Groundwater Level Monitoring Frequency | Groundwater Quality Monitoring Frequency | Impact or Control Bore |
|---|---|---|---|---|---|---|---|---|
| Shallow Groundwater Levels (Monitoring bores/standpipe piezometers) | | | | | | | | |
| P12A | Tahmoor Coal (TC) | 277771 | 6216561 | 14.6 - 19.6 | EX | PRE-MINING - Minimum continuous 24-hourly readings with monthly logger download and dip meter.<br><br>DURING MINING - Minimum continuous 24-hourly readings with monthly logger download and dip meter. | PRE-MINING - Field water quality and laboratory analysis monthly.<br><br>DURING MINING - Field water quality and laboratory analysis monthly.<br><br>POST MINING - Field water quality and laboratory analysis monthly for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group. | Impact |
| P12B | TC | 277776 | 6216560 | 31.6 - 34.6 | EX | | | Impact |
| P12C | TC | 277781 | 6216559 | 61.6 - 64.6 | EX | | | Impact |
| P13A | TC | 278180 | 6216550 | 19.5 - 22.5 | D | | | Impact |
| P13B | TC | 278175 | 6216554 | 33.5 - 37.5 | D | | | Impact |
| P13C | TC | 278170 | 6216558 | 64.5 - 67.5 | D | | | Impact |
| P14A | TC | 278398 | 6216536 | 4.5 - 6.0 | EX | | | Impact |
| P14B | TC | 278393 | 6216534 | 13.6 - 16.6 | EX | | | Impact |
| P14C | TC | 278397 | 6216542 | 28.6 - 31.6 | EX | | | Impact |
| P14D | TC | 278391 | 6216540 | 58.6 - 61.6 | EX | | | Impact |
| P15A | TC | 278550 | 6216426 | 16.1-17.6 | EX | | | Impact |
| P15B | TC | 278545 | 6216423 | 18.6-20.1 | EX | | | Impact |
| P15C | TC | 278556 | 6216427 | 30.5-32.0 | EX | | | Impact |
| P15D | TC | 278561 | 6216431 | 66 (bore depth) | EX | | | Impact |
| P16A | TC | 277351 | 6215147 | 24.5 - 27.5 | EX | | | Impact |
| P16B | TC | 277350 | 6215140 | 42.5 - 45.5 | EX | | | Impact |
| P16C | TC | 277347 | 6215135 | 72.5 - 75.5 | EX | | | Impact |

| Monitoring Bore or VWP ID | Owner | Easting[1] (MGA94) | Northing[1] (MGA94) | Bore screen or VWP sensor depth (mBGL) | Status | Groundwater Level Monitoring Frequency | Groundwater Quality Monitoring Frequency | Impact or Control Bore |
|---|---|---|---|---|---|---|---|---|
| P17 | TC | 277941 | 6217153 | 19.6 - 22.6 | D | POST MINING - Minimum continuous 24-hourly readings with monthly logger download and dip meter for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group. | | Control |
| GW072402 | Private | 277708 | 6216852 | 8.2 - 72.0 | EX | | | Impact |
| GW105228 | Private | 278490 | 6216858 | 23.0 - 63.0 | EX | | | Impact |
| GW105467 | Private | 277253 | 6215247 | 73.0 - 79.0 | EX | | | Impact |
| GW105546 | Private | 277018 | 6215732 | 48.0 - 56.0 | EX | | | Impact |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| GW115860 | Private | 278543 | 6216760 | 20, 48 and 55 | EX | PRE-MINING – Standing water level (where available) and yield data. Pre-mining testing completed in bore census (GeoTerra, 2019, 2021b).<br>DURING MINING - Manual monitoring (flow rate and, where available, groundwater level) on a 3-monthly basis.<br>POST MINING - Manual monitoring (flow rate and, where available, groundwater level) on a 3-monthly basis for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group. | PRE-MINING - Field water quality (EC, pH) and iron staining. Pre-mining testing completed during bore census (GeoTerra, 2019, 2021b).<br>DURING MINING - Field water quality and laboratory analysis on a 3-monthly basis.<br>POST MINING - Field water quality and laboratory analysis on a 3-monthly basis for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group. | Impact |
| Shallow Groundwater Pressures (VWPs < 200 mBGL) | | | | | | | | |

| Monitoring Bore or VWP ID | Owner | Easting[1] (MGA94) | Northing[1] (MGA94) | Bore screen or VWP sensor depth (mBGL) | Status | Groundwater Level Monitoring Frequency | Groundwater Quality Monitoring Frequency | Impact or Control Bore |
|---|---|---|---|---|---|---|---|---|
| P40(A-D) | TC | 277620.6 | 6216160.1 | HBSS-39 | EX | PRE-MINING - Minimum continuous 24-hourly readings with monthly logger download.<br><br>DURING MINING - Minimum continuous 24-hourly readings with monthly logger download.<br><br>POST MINING - Minimum continuous 24-hourly readings with monthly logger download for 12 months following the completion of LW W4. The period may be extended as per the decision by the Environmental Response Group. | Not monitored for water quality | Impact |
| | | | | HBSS-44 | EX | | | Impact |
| | | | | HBSS-49 | EX | | | Impact |
| | | | | HBSS-85 | EX | | | Impact |
| P41(A-F) | TC | 279167 | 6216068 | WNFM-53 (vertical) | EX | | | Impact |
| | | | | HBSS-71 (vertical) | EX | | | Impact |
| | | | | HBSS-88 (vertical) | EX | | | Impact |
| | | | | HBSS-106 (vertical) | EX | | | Impact |
| | | | | HBSS-123 (vertical) | EX | | | Impact |
| | | | | 140 (vertical) | EX | | | Impact |
| TNC036 | TC | 277269 | 6215382 | HBSS-65 | EX | | | Impact |
| | | | | HBSS-97 | EX | | | |
| | | | | BGSS-169 | EX | | | |
| TNC040 | TC | 279004 | 6214521 | WNFM-27 | EX | | | Control |
| | | | | HBSS-65 | EX | | | |
| | | | | HBSS-111 | F | | | |
| TNC043 | TC | 280077 | 6212671 | HBSS-65 | L | | | Control |
| | | | | HBSS-111.5 | L | | | |
| WD01 | TC | 278099 | 6214828 | HBSS-70 | EX | | | Impact |

| Monitoring Bore or VWP ID | Owner | Easting[1] (MGA94) | Northing[1] (MGA94) | Bore screen or VWP sensor depth (mBGL) | Status | Groundwater Level Monitoring Frequency | Groundwater Quality Monitoring Frequency | Impact or Control Bore |
|---|---|---|---|---|---|---|---|---|
| | | | | HBSS-90 | EX | | | |
| | | | | HBSS-190 | F | | | |
| WD02 | TC | 278246 | 6215178 | Not drilled yet | P | | | Impact |
| Deep Groundwater Pressures (VWPs > 200 mBGL) | | | | | | | | |
| TNC036 | TC | 277269 | 6215382 | BGSS-214 | EX | PRE-MINING - Minimum continuous 24-hourly readings with monthly logger download.<br><br>DURING MINING - Minimum continuous 24-hourly readings with monthly logger download. | Not monitored for water quality | Impact |
| | | | | BGSS-298.5 | F | | | |
| | | | | BGSS-412.5 | EX | | | |
| | | | | BUSM-463.5 | F | | | |
| TNC040 | TC | 279004 | 6214521 | HBSS-225 | F | | | Control (for LW W1-W4) |
| | | | | BHCS-252 | F | | | |
| | | | | BGSS-352 | F | | | |
| | | | | SCSS-482 | F | | | |
| | | | | BUCO-501.9 | F | | | |
| TNC043 | TC | 280077 | 6212671 | HBSS-213 | F | | | Impact |
| | | | | BGSS-240 | F | | | |
| | | | | BGSS-332.6 | F | | | |
| | | | | BGSS-405.2 | F | | | |
| | | | | BUCO-476.3 | F | | | |
| WD01 | TC | 278099 | 6214828 | 210-HBSS | EX | | | Impact |
| | | | | 230-Newport Fm | F | | | |

| Monitoring Bore or VWP ID | Owner | Easting[1] (MGA94) | Northing[1] (MGA94) | Bore screen or VWP sensor depth (mBGL) | Status | Groundwater Level Monitoring Frequency | Groundwater Quality Monitoring Frequency | Impact or Control Bore |
|---|---|---|---|---|---|---|---|---|
| | | | | 300-BGSS | F | POST MINING - Minimum continuous 24-hourly readings with monthly logger download for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group. | | |
| | | | | 330-BGSS | F | | | |
| | | | | 350-BGSS | F | | | |
| WD02 | TC | 278246 | 6215178 | Not yet drilled | P | | | Impact |

*1 Coordinates in metres (GDA94 Zone 56).*

*WNFM – Wianamatta Group*
*SCSS – Scarborough Sandstone*
*EX – Existing*
*"-" - Not drilled yet*
*BGSS – Bulgo Sandstone*
*mBGL – metres below ground level*
*F - Failed*
*D – Decommissioned*
*VWP – vibrating wire piezometer*
*BHCS – Bald Hill Claystone*
*P – Proposed monitoring bore*
*vert. = vertical depth below ground in angled hole*
*HBSS – Hawkesbury Sandstone*
*BUCO – Bulli Coal Seam*
*L – Loss of logger (stolen), manual readings still taken.*

# 4 Groundwater Level Trigger Review

The following section addresses the compliance of groundwater levels at Tahmoor Coal during the reporting period in relation to both a rainfall cause-and-effect and trigger analysis.

## 4.1 Cause and Effect Analysis

An analysis of rainfall at Tahmoor Mine has been carried out to provide context for observed changes and trends in groundwater levels and quality. This cause-and-effect analysis has then been used to determine if the observed changes in groundwater levels could be attributed to weather conditions, a mining effect, or a combination of both. Groundwater levels may also be affected by local groundwater pumping (at bores unrelated to Tahmoor Mine), however pumping records are not available, and this cause/effect is difficult to identify with confidence.

In accordance with the current TARP in place, any exceedances in groundwater levels or quality identified across the Western Domain are flagged below. A more detailed summary of performance against the associated response plan for each monitoring location is discussed in Section 4.3.

### 4.1.1 Rainfall Analysis

Rainfall data in the area is available from several sources. Bureau of Meteorology (BoM) operate two rainfall stations, Picton Council Depot (68052) and Buxton (68166) which are located approximately 1.3 km east and 2.2 km west respectively to Tahmoor Mine. The locations, range of data and comment about quality of the rainfall data are presented in Table 4. Tahmoor Coal operates three rainfall stations (Mine gauge, Rail Site and Whiteys Site), and the SILO climate data source provides interpolated and infilled records for 0.05°x0.05° latitude and longitude tiles. Due to the occasional gaps in the data for the BoM sites, and the relatively short record of data held by Tahmoor (the Mine gauge record has no gaps, but only started in July 2006), the SILO record for the 0.05°x0.05° tile centred on the location 274250E, 6212950N has been adopted for this report to understand long-term trends.

Table 4 Rainfall Data Sources

| Data Source | Owner | Location | Range of Data | Comment |
|---|---|---|---|---|
| Picton Council Depot (68052) | BOM | Picton | 1880-2020 | Good quality, occasional gaps |
| Buxton (68166) | BOM | Buxton | 1966-2021 | Good quality, occasional gaps |
| Mine gauge | Tahmoor Coal | Western Domain | 2006-2021 | Data quality can be suspect. |
| Rail Site | Tahmoor Coal | Western Domain | Nov-2020 to present | Good quality, short record |
| Whiteys Site | Tahmoor Coal | Upper Stonequarry Creek catchment | Feb-2021 to present | Good quality, short record |
| SILO 0.05x0.05 tiles | SILO | 274250E, 6212950N | Jan-1900 to present | Interpolated infilled record |

Monthly average rainfall is presented on Figure 2, alongside potential evaporation and estimated actual evapotranspiration. Rainfall is generally consistent all year with average monthly totals of 41 to 88 mm. The highest monthly rainfall is typically in February and March, (88 and 84 mm respectively), while September is typically the driest month (averaging 41 mm) for the period of record. The average annual rainfall at Tahmoor is approximately 765 mm. Evaporation and evapotranspiration show similar trends with higher rates during the summer months and lower rates in winter. The average monthly potential evaporation is highest in December (200 mm). The average annual potential evaporation is 1463 mm.

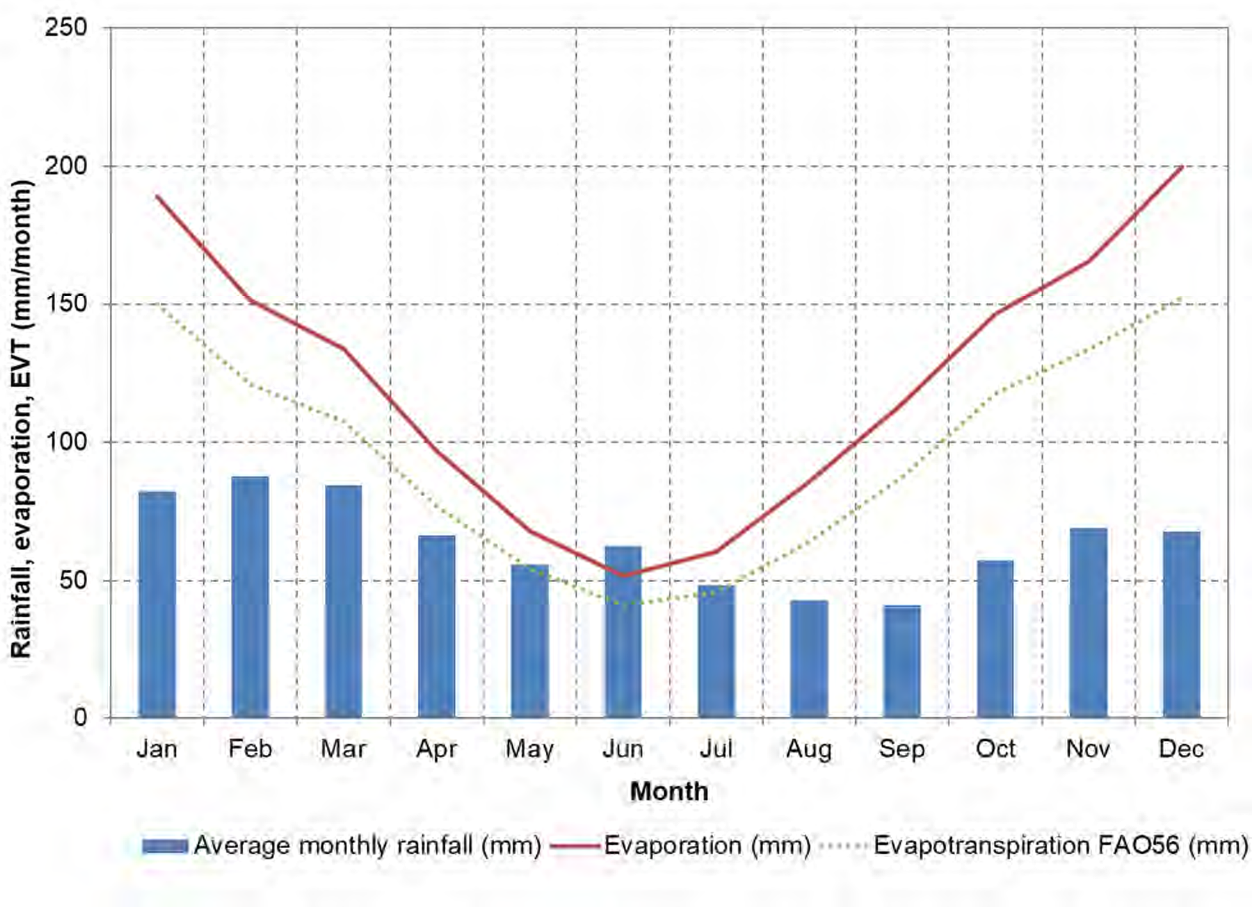



Figure 2 Monthly Average Rainfall and Potential Evaporation and Rainfall Trends

Figure 3 shows the historical record of monthly rainfall and potential evaporation, and the calculated trend in rainfall (using "cumulative residual departure" from mean method). This trend (dark green line) shows wet periods as upward gradients, droughts as downward gradients, and average conditions as horizontal. Of note in recent times, there was a significant drought period from mid-2017 until January 2020, with extreme conditions in November 2019 to January 2020, notable for bushfire conditions around Tahmoor Mine and more widely across eastern NSW. Since then, conditions have been wetter than average, including high rainfall totals in February and August 2020, in March 2021 and again in March 2022. Wetter than average conditions were observed during the entire reporting period. Total rainfall in March 2022 was 476.4 mm resulting in major floods across much of NSW including around Picton and well above the long-term average of 84 mm. The cumulative rainfall departure (CRD) gradient in Figure 3 is based on SILO records dating back to 1900.

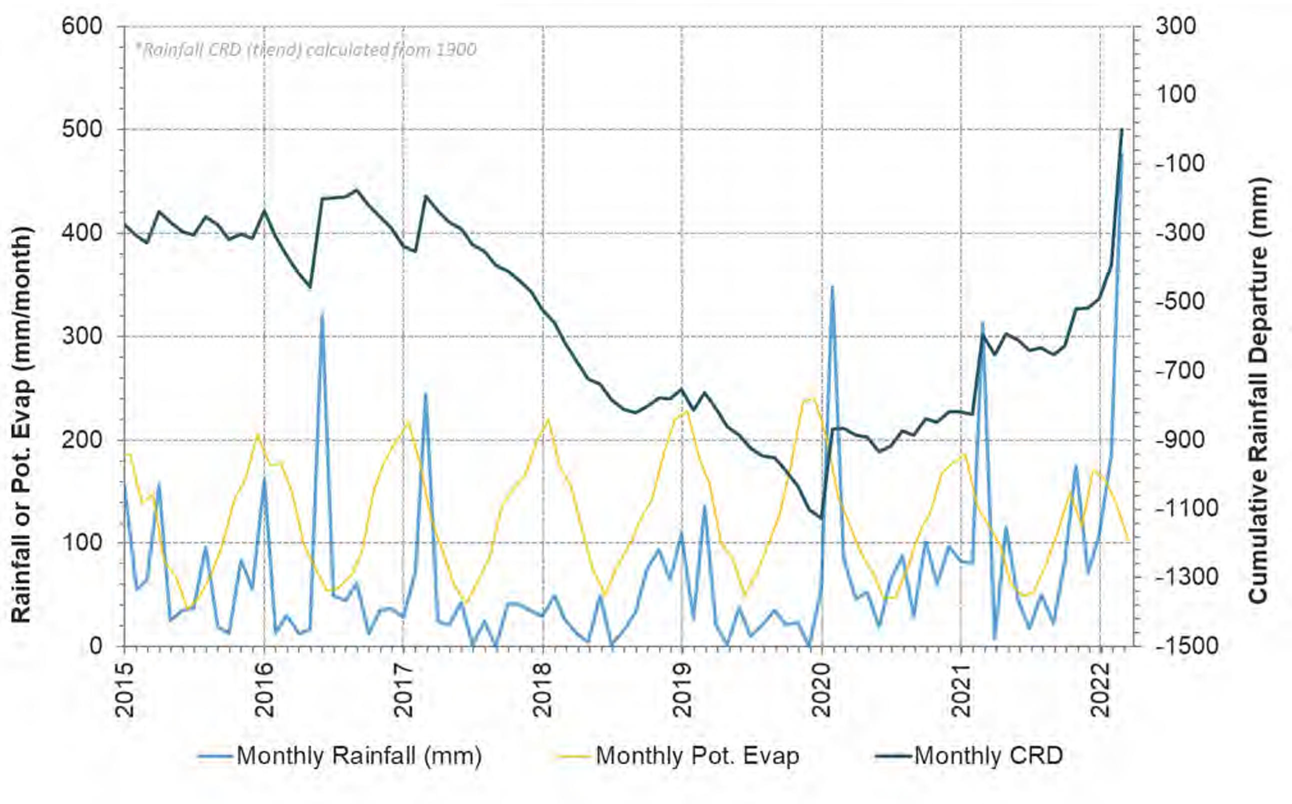



Figure 3 Long-term Rainfall Record and Trends

### 4.1.2 Western Domain

Hydrographs for the existing shallow standpipe bores (P12-P16) and VWP sites P40 and P41 drilled in 2019 and 2021 around the Western Domain are presented in Appendix A (A1-A6) with the rainfall trend (CRD). Monitoring bores P12-P14, P15 and P17 are located north of the Western Domain longwalls, outside the mine footprint and adjacent to Stonequarry Creek (P13, P14, P15 and P17) and Cedar Creek (P12). P16 is situated along Matthew Creek, 300 m west of LW W1 and upstream from the confluence of Matthews Creek and Rumker Gully. P40 is located 115 m east from the surface water site CB and P41, the Nepean Fault Complex site, is located 230 m north-east of LW W4. A brief analysis of the groundwater trends in relation to weather and mining activity is presented below except for sites P13 and P17 which were decommissioned in September 2021. Previous analysis conducted at P13 and P17 are presented in SLR (2021, 2021a). Locations for the monitoring sites are shown on Figure 1.

#### 4.1.2.1 Site P12

P12 bores are the closest monitoring bores to LW W1 (50 m north) which was completed in November 2020. The lowest groundwater level recorded at P12C was between June and November 2019 (prior to LW W1 commencement) at 176.3 m AHD. There is evidence of groundwater pumping by nearby users, causing drawdown over short periods (less than two months) in the range of 1 m to 3 m (SLR, 2021).

At P12 (Figure A-1), groundwater levels in the upper Hawkesbury Sandstone (P12A and P12B) stabilised in February 2021 following a progressive reduction of approximately 0.5 m during LW W1 and a further 0.5 m drop during the early part of LW W2. In March 2021, groundwater levels at P12A and P12B responded to rainfall recharge, with increases in the range of 1 m. After the March 2021 rainfall event, more consistent rainfall response in the range of 0.5 m to 0.8 m has been observed. A minor decline of approximately 0.4 m was observed in P12B following the commencement of LW W3 but remain stable in P12A. Between November 2021 and early February 2022, groundwater levels in P12A and P12B were stable with minor fluctuation around approximately 170.4 mAHD. The response to rainfall recharge during November 2021 (a period of above average rainfall) was very limited, suggesting that extraction of LW W3 could have affected (flattened) the groundwater level response to rainfall in the shallow Hawkesbury Sandstone or the rainfall amount was insufficient for a groundwater level recharge response. From late February 2022 groundwater levels have responded to rainfall recharge in the range from 0.5 m to 0.8 m and up to 2.5 m in P12A in early March 2022, likely attributed to the exceptional rainfall. At the end of the reporting period, groundwater levels in P12A and P12B are 0.9 m and 0.3 m above baseline levels respectively, at approximately 171 mAHD.

There was a difference in groundwater levels at P12A and P12B during the baseline period of approximately 0.6 m which suggested an upward vertical gradient. This gradient has weakened following mining at LW W1, LW W2 and early part of LW W3, with groundwater levels at P12A and P12B observed at similar elevations. This suggests that there is more drawdown at P12B, and that the connectivity between the upper (P12A) and mid-Hawkesbury Sandstone (P12B) may have locally increased following mining.

Groundwater levels at P12C declined by approximately 14 m during LW W1, and a further 0.5 m during the early stage of LW W2. Groundwater levels started to recover from February 2021, albeit at a slightly slower rate between July and August 2021. From July 2021, groundwater levels at P12C increased to 1 m above the groundwater levels observed at P12A/P12B suggesting the re-establishment of an upward hydraulic gradient from P12C to P12B observed prior to mining.

In November 2021, groundwater levels at P12C appeared stable at approximately 171.2 mAHD, following a decline in groundwater levels in the range of 0.8 m after the commencement of LW W3 in September 2021. The stabilisation in groundwater levels is likely attributed to above average rainfall in November 2021. From mid-December 2021, groundwater started to recover at a similar rate as observed in 2021 with an acceleration in the rate observed in late February 2022 due to intense rainfall. During the reporting period groundwater levels at P12C increased by approximately 2.8 m, currently at an elevation of 174 mAHD, which is approximately 2.2 m below baseline levels.

The groundwater recovery in P12C results in the strengthening of the upward hydraulic gradient from P12C and P12B (which was the pre-mining condition) and could strengthen inferred gaining condition groundwater to Cedar Creek.

#### 4.1.2.2 Site P14

P14 bores are located 350 m east of LW W1. Since the start of monitoring in June 2019 each of the open standpipes except P14A show a continual and relatively linear decline in groundwater levels which correlate with a reduction in rainfall until February 2020 (Figure A-2). Groundwater levels respond to the wetter conditions from early 2020 to present.

From March 2020 onwards, groundwater levels within P14B, C and D exhibited a progressive reduction in groundwater levels (up to 2 m at P14D) due to LW W1 and a further 1 m reduction following the extraction of LW W2. Groundwater levels started to stabilise in February 2021 as LW W2 progressed to the south. From February to July 2021, groundwater levels at P14B, C and D recovered by approximately 1.5 m. Groundwater levels in P14B and P14C stabilised throughout July and August 2021 at similar levels (166.5 mAHD) while groundwater levels in the lower Hawkesbury continued to recover until the end of August 2021. In early September 2021, a minor and rapid decline in groundwater level of 0.7 m is observed in P14D, which is prior to the commencement of LW W3. Groundwater levels in P14D increased back to levels similar to those in August 2021 during the first 250m LW W3 extraction in September 2021. A consistent and sudden decline ranging from 0.25 m to 0.45 m was observed in P14A, B, C and D between the 15$^{th}$ and 16$^{th}$ October 2021, 32 days following the start of LW W3 (after 250 m extraction of LW W3). This groundwater decline has been investigated in SLR (2021b) and assessed as a minor mining-related effect on groundwater levels at site P14. During the reporting period, groundwater levels at P14B, C and D show a consistent trend. Groundwater levels were stable in November 2021 with minor responses to above average rainfall. In December 2021, a consistent and minor decline in groundwater levels of approximately 0.3 m to 0.4 m is observed in P14B, C and D which is possibly a mining effect related to LW W3 extraction. From January 2022, a consistent recovery in groundwater levels is observed at P14B, C and D with the rate in recovery accelerating following the exceptional rainfall in early March 2022. During the reporting period, groundwater levels in P14D increased by 2 m and are approximately 1.7 m above baseline levels. In P14B and P14C, groundwater levels increased by 1.8 m, are 0.4 m above the approximate creek bed elevation and 1.2 m and 1.3 m respectively above baseline levels.

P14A is screened in surficial sediments (colluvium/alluvium) above the HBSS. The groundwater level in this monitoring bore is very responsive to rainfall conditions. Recent groundwater levels are approximately 2.7 m higher than the pre-mining groundwater levels, due to a shift from drought (occurring 2017 to January 2020) to above-average rainfall from February 2020 through to April 2022. Significant peaks in groundwater level are related to rainfall events (including February 2020, March 2021 and March 2022), with recessions related to the following drier periods. The hydrograph for this site does not show any clear sign of mining-related effects.

#### 4.1.2.3 Site P15

P15 bores are located 540 m and 220 m northeast of LW W1 and LW W2 respectively, and 60 m north of LW W3. P15A, B and C have been installed to depths of 17.6, 20 and 32 m bgl and equipped with loggers recording at 12-hourly readings (Figure A-3). Groundwater level records commenced at P15A, B, C (Figure A-3) in March 2021. Groundwater levels increased by approximately 1 m from that time until early June 2021, likely due to heavy rainfall in March 2021. P15D was drilled in early June 2021 to a depth of 66 m bgl and packer tested on 11 June 2021 which locally affected the connectivity of fractures and influenced groundwater levels at P15 (see annotation on Figure A-3). The drilling of P15D resulted in an overall reduction of 1 m in the water column at P15B, and while it is not clear why this bore is affected and not P15A or C, the data from mid-June is consistent with the other two shallower piezometers. Prior to the commencement of LW W3, groundwater levels in P15A, B and C have showed similar groundwater trends, with response to rainfall in the range of 0.1 m to 0.2 m. At P15D, consistent groundwater levels were observed, similar to those at P14D (drilled at a similar depth).

From September 2021, a short-term increase in groundwater levels is observed at P15D, similar as in P14D for the same period. No mining related effects on groundwater levels is observed at monitoring sites P15 during September 2021 following the commencement of LW W3. Little change in groundwater levels was observed in shallow groundwater in this area adjacent to the commencing end of LW W3 extraction until October 2021 (i.e. groundwater decline ranging from 0.2-0.5 m at site P15, up to 0.8 m in mid-October 2021 in P15D) (SLR, 2021a). This resulted in the trigger exceedances in the shallow groundwater levels at P15A and P14B in October 2021 (SLR, 2021c) and as per the Trigger Action Response Plan for Stonequarry Creek (not presented in this study) (Tahmoor North – Western Domain, September 2021).

SLR (2021c) found no impact on baseflow at site SB (at or near rockbar SR17) in October 2021 (i.e. no loss of surface water to the underlying aquifer) despite trigger exceedances for the rate of shallow groundwater level decline at P15A and P14B (SLR, 2021c). The minor groundwater decline at P15A and P14B was investigated in SLR (2021c) and assessed as a minor mining related effect on groundwater levels at site P15A and P14B (i.e. following the early part of LW W3 extraction).

Between November 2021 and December 2021, groundwater levels in P15D

suddenly declined for short periods of time (between 4-6 days) by approximately 0.5 m (on 20th November 2021, 10th December and 25th December 2021) but responded immediately to rainfall within 1-2 days after the groundwater level decline. These short-term declines could be a combination of reduced rainfall in this period and minor mining related effects due to LW W3.

Figure 4 (a) presents water levels at site P15 for the length of the review period, with the daily CRD plotted and daily rainfall shown on Figure 4 (b).

A similar trend in groundwater levels to that at P15D is observed in the upper and mid Hawkesbury Sandstone aquifer (bores P15A, B and C), including similar short-term fluctuations, but these short-term fluctuations are in the range of 0.2 m (i.e. smaller than those in P15D). This suggests that if a mining related effect due to LW W3 occurred at P15 (as seems likely), it would have been to a greater magnitude in the deeper strata (P15D) than the shallow strata (e.g. P15A-C) as previously observed in October 2021 (SLR, 2021b)).

From late December 2022, a gradual increase in groundwater levels is observed in all piezometers at P15. The rate of groundwater recovery accelerates in late February 2022 following intense rainfall and flooding in the area. Over the reporting period, groundwater levels in P15D increased by approximately 3 m while groundwater levels in P15A, B and C increased by 2.2 m. At the end of the reporting period, groundwater levels in all piezometers at site P15 are at approximately 168 mAHD which is 0.4 m above the creek bed elevation at P15, suggesting that baseflow conditions (i.e. gaining conditions) to Stonequarry Creek have strengthened.

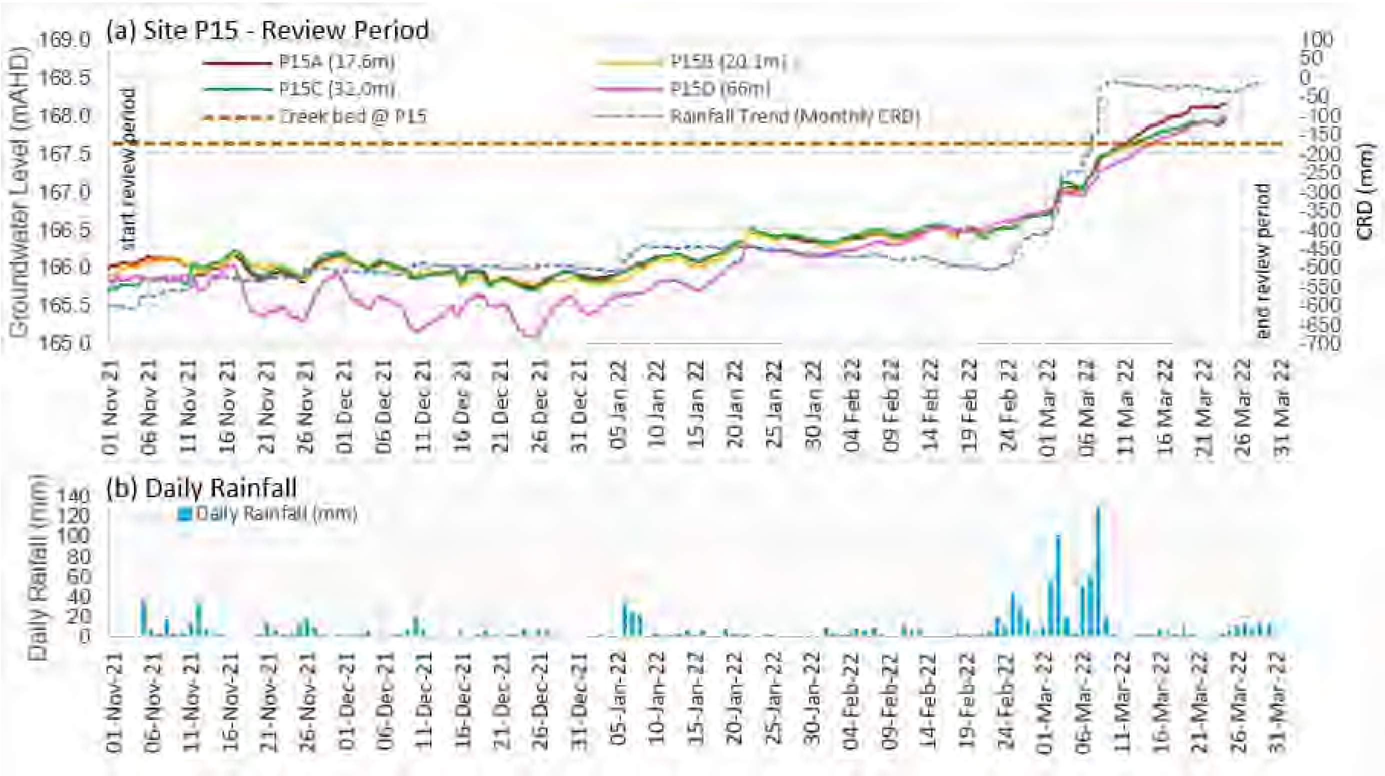



Figure 4 Groundwater levels at P15 during the review period (a); Daily rainfall over the reporting period (b)

#### 4.1.2.4 Site P16

At P16 (Figure A4), situated 430 m west of LW W1, groundwater depressurisation stabilised in late October 2020 (coinciding with the end of LW W1 extraction) which was four months earlier than at P12 and P13. As LW W2 progressed to the south, a slight reduction in groundwater levels of approximately 0.5 m was observed at P16B and P16C five months following the commencement of LW W2. The effects of LW W2 are less here than at the other sites due to the greater distance from the second longwall.

Groundwater levels at P16A declined gradually by approximately 0.8 m during mining at LW W1 and LW W2. Following mining at LW W2 and above average rainfall in June 2021, water levels increased by 0.4 m and stabilised until September 2021. Following the commencement of LW W3, groundwater levels gradually declined by 0.2 m (primarily between November 2021 and early February 2022) despite above average rainfall. From mid to late February 2022, groundwater levels increased by 2 m, rising to 1.2 m above the baseline level as of March 2022. It is possible that this consistent increase is caused by the ingress of surface runoff and not representative of groundwater conditions. Hence, the previously identified long-term impact from LW W1-W2 mining at this site and the progression of LW W3 to the south appears reduced, whereas this might not actually be the case due to potential surface water run-off ingress into the bore. Following this observation, some improvements regarding the diversion of surface water runoff were conducted by GeoTerra to minimise water ingress following rainfall. Further monitoring will confirm groundwater trends and whether P16A is still affected by surface run-off ingress.

From April to June 2021, groundwater levels at P16B and P16C started to recover. At P16B they stabilised in September throughout late December 2021 at 204 mAHD, approximately 4 m above the minima in April 2021, and approximately 2.5-3.5 m below baseline. In January 2022, there was a clear decline of around 1.8 m to 202.8 m AHD at P16B, which followed approximately six months of stable groundwater levels. An additional drop in water levels (approximately 1 m) is observed in late January 2022 before increasing again by 1 m following rainfall in early February 2022. At P16B, GeoTerra noted significant spikes in the raw groundwater level dataset following rainfall which, as with P16A, suggest that surface run-off could likely flow into the piezometer P16B or that P16B is possibly damaged to the surface allowing water ingress. The spikes in groundwater levels observed in the raw datasets have been removed or filtered from Figure A4 (as per the annotation on the graph).

SLR conducted a site visit in March 2022 to identify the potential issue with surface run-off ingress at P16B. The flush head was inspected, with the well cap re-sealed to prevent or minimize any surface water entry into the bore. The presence of iron-staining was observed on the logger and on the rope above the groundwater level suggesting P16 could be damage close to the surface allowing water ingress. While groundwater levels in P16B in March 2022 may not be representative of groundwater condition due to the potential water ingress, groundwater levels are at approximately 204 mAHD, similar level to those at the start of the reporting period or those at the start of LW W2, and 2.4 m below baseline levels.

Groundwater levels at P16C continued to recover until September 2021, having risen 3.6 m since June, but remained 7.8 m below baseline. Water levels in P16C stabilised at 191.7 mAHD in September and October 2021 before gradually declining by 1.3 m throughout November until mid-February 2022. At P16C, a minor response in groundwater levels (i.e. approximately 0.6 m) is observed following the intense rainfall in late February – early March 2022. Groundwater levels have stabilised at 191 mAHD toward the end of the reporting period (8.2 m below baseline levels).

SLR (2022a) investigated the groundwater level decline at P16B and P16C observed during the reporting period.

The recent (January 2022) decline in groundwater levels could be due to a delayed mining effect from LW W2 and active mining at LW W3 (longwall timing displayed as lines on Figure A-4). The sudden decline in groundwater levels at P16B could potentially be due to the sudden movement (subsidence) of strata from mining. As seen in Section 4.1.2.3, similar sudden declines were observed during mining at LW W3 at the P15 bores located adjacent to the northern end of LW W3.

#### 4.1.2.5 Site P40

P40 is situated between LW W1 and the surface water monitoring site CB, approximately 120 m west of the edge of the longwall and 115 m east of CB (Figure A-5). Groundwater levels started to be recorded in late August 2021. P40 is equipped with four VWPs at different depth intervals within the Hawkesbury Sandstone (at 39, 44, 49 and 85 mbgl respectively, reported below as P40A, B, C and D).

Groundwater levels in P40A started to increase from October 2021 and has shown a consistent rise throughout the reporting period with groundwater levels increasing by approximately 4 m to 181.2 mAHD. In P40B, groundwater levels were stable at 176.9 mAHD in November 2021 and started to increase in early December 2021 at a similar rate as observed in P40A. At the end of the reporting period, water levels in P40B increased by 4.4 m and sit approximately at the same elevation as water levels in P40A (181.2 mAHD). The rainfall recharge has reduced the downward vertical gradient identified at the start of monitoring between P40A and P40B. Also, groundwater levels recorded in the two upper sensors at P40 are 3.7 m above the Cedar Creek bed elevation, suggesting a possible strengthening of gaining conditions in the vicinity of the surface water monitoring site CB.

A similar trend in groundwater levels in the two lower sensors P40C and P40D is observed during the reporting period. In November 2021, a minor decline in groundwater levels in the range of 0.1-0.2 m is observed in P40C and P40D before starting to rise at a similar rate in early December 2021. The records in groundwater levels in P40C and P40D indicate a consistent increase of approximately 3 m and 3.4 m respectively throughout the reporting period.

In summary, groundwater levels at P40 indicate that the shallow Hawkesbury Sandstone has been recharged significantly following the exceptional rainfall over the reporting period. A reduction in the downward vertical gradient between P40A and P40B (to near neutral conditions) suggests a potential increase in baseflow along Cedar Creek with both water levels well above the creek bed elevation.

A vertical downward gradient is still recorded between the upper and lower Hawkesbury Sandstone aquifer at P40. This condition is expected at this location, as P40 monitors groundwater levels near LW W1 and although there is no monitoring data to confirm groundwater trends prior to August 2021, it is suggested that the deepest groundwater (P40D) underwent greater depressurisation than the upper strata. The significant rainfall has also recharged the mid and lower Hawkesbury Sandstone aquifer (P40C and P40D) suggesting a potential re-pressurisation of the deeper strata at P40.

#### 4.1.2.6 Site P41

In addition to the hydrogeological investigations near the creeks, SCT conducted an investigation to quantify the hydraulic properties of the Nepean Fault Complex. A borehole ("Nepean Fault Hole C") was drilled to 202 m at 45 degrees from vertical, angled to intersect the fault splay. This bore intersects two zones of increased jointing inferred to be a secondary splay of the Nepean Fault (SCT, 2021a). The upper zone is within the Wianamatta Formation, and the lower is within the HBSS.

Figure A-6 presents the hydrographs for P41 located 230 m from the north-east corner of LW W4, within the Nepean Fault Complex.

P41 is instrumented with VWPs at multiple depths within the Wianamatta Formation and Hawkesbury Sandstone and has been recording groundwater pressures/heads since August 2021. VWPs are installed respectively at 53 m bgl, 71 m bgl, 88 m bgl, 106 m bgl, 124 m bgl and 140 m bgl and reported as P41A-F. The vertical depth rather than the horizontal depth was used to convert depth-to-water (m bgl) to water level elevation (mAHD), as noted in Table 3. No groundwater records are available in January 2022 due to downloading issues.

The records at P41 indicates a strong downward gradient from P41A to P41C with almost 30 m head difference (Figure A-6). This could be explained by the fact that P41A sits within the Wianamatta Formation and P41B sits just at the interface between the Wianamatta Formation and Hawkesbury Sandstone suggesting the presence of perched groundwater likely to be disconnected from the upper Hawkesbury Sandstone aquifer (P41C).

Groundwater levels in P41A were stable during the reporting period at 190.8 mAHD with no discernible responses to rainfall recharge in February – late March 2022. In P41B, water levels seemed to have stabilised at 172.8 mAHD in early January 2022 following a gradual decline of 2.8 m likely attributed to a period of equilibration following the VWP installation.

At P41C, in November 2021 groundwater levels in the Hawkesbury Sandstone are stable at 160.9 mAHD. From February 2022, water levels in P40C are approximately 0.5 m below water levels observed in December 2021 at 160.4 mAHD, which could suggest a very minor effect due to the progression of LW W3. Since then, water level in P41C slightly responded to the above average rainfall in March 2022 to increase to 161.1 mAHD, which is 0.6 m above the pre-LW W3 water levels. The P41C piezometer is located at a similar elevation to the surveyed elevation of Stonequarry Creek (SC surface water monitoring site) with groundwater levels at approximately 1.3 m below the Stonequarry Creek bed elevation (labelled "creek bed" on Figure A-6).

P41D is located in the lower Fault Zone, as inferred by SCT (2021). Groundwater levels at P41D were stable following the VWP installation in August 2021. In early October 2021, a decline in groundwater level of approximately 1.3 m was observed before rising to pre LWW3 water level late November 2021. The minor depressurisation could be due to an unstable VWP sensor, but more likely suggests a minor effect following the commencement of LW W3.

Following the rainfall in mid-February 2022, groundwater levels in P41D rose by approximately 2.3 m to 162.3 mAHD and 1 m above P41C groundwater levels in March 2022 which suggest some degree of upward vertical gradient between those two sensors. The data from these two piezometers are considered the best means of assessing mining impacts including groundwater depressurisation, if any, in the upper Hawkesbury Sandstone between LW W4 and Stonequarry Creek following the extraction of that longwall and possible activation of the fault zone that could cause an increase in hydraulic conductivity (permeability).

The groundwater levels at P41E and P41F were recently assessed in SLR (2022a). Any correlation between groundwater levels to the daily CRD could not be established (SLR, 2022a). The quality of the data (i.e. rising trend observed from September 2021) is questionable, and it is considered that the VWP sensors at P41E and P41F could be unstable. However, the site will continue to be monitored and reviewed. Further monitoring data is required to confirm groundwater trends.

#### 4.1.2.7 TNC036

TNC036 is located almost 500 m to the west of the middle of LW W1 and west of Matthews Creek. It has a number of sensors placed in the Hawkesbury and Bulgo Sandstones at various depths, as well as one in the Bulli Coal seam (Table 3). The hydrographs for the VWPs are presented in Figure 5. Groundwater pressures at TNC036 have recently been re-assessed and resulted in the removal of the transducer records at 298 m and 463 m (Groundwater Exploration Services [GES], 2020). Data collected from 2010 to 2011 at TNC036 appears erroneous, likely due to influence from construction. Consistent data that appears representative of local groundwater conditions has been collected from 2016. Further details on reliability of TNC036 data is presented in the Groundwater Technical Report LW W3-W4 (SLR, 2021).

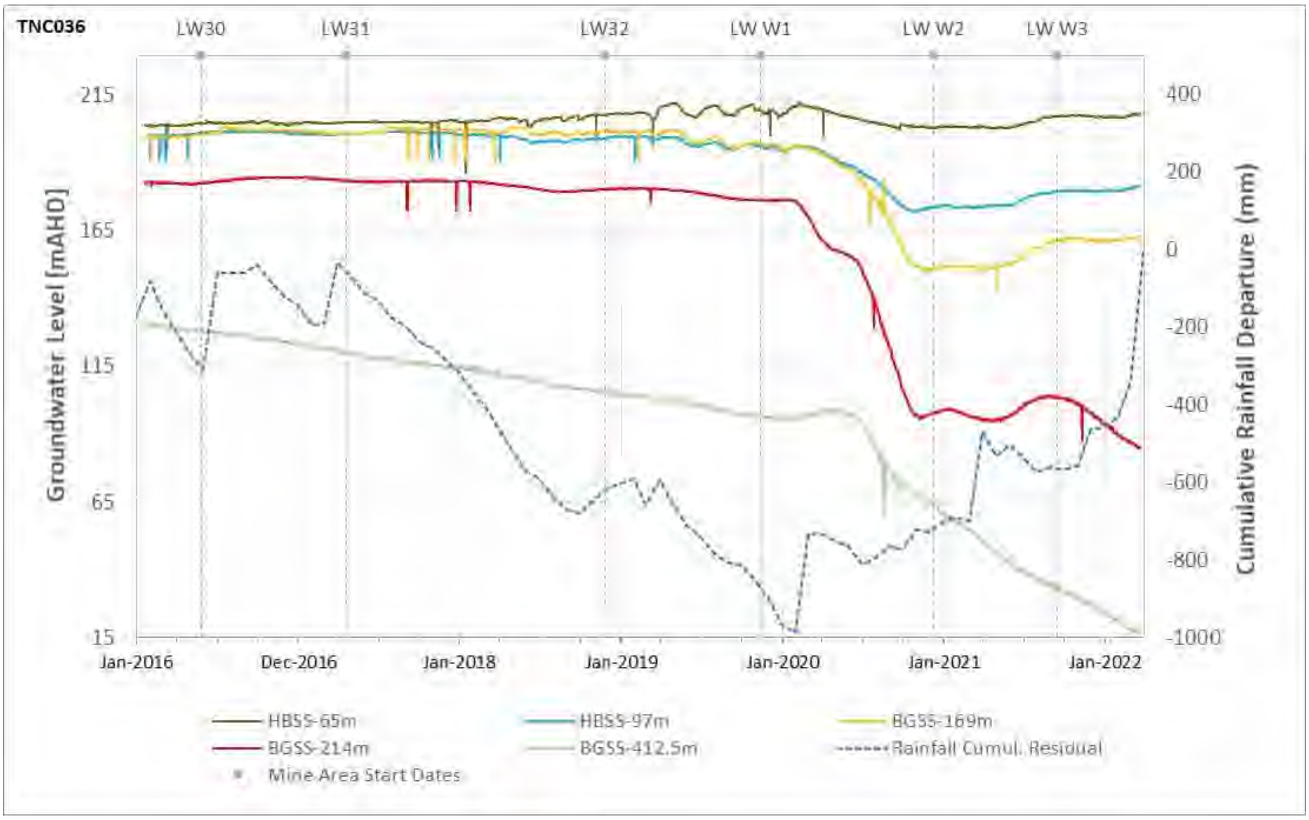



Figure 5 Hydrograph for TNC036

Approximately 60 m of depressurisation is apparent in the lower Bulgo Sandstone (piezometer BGSS-412.5m) for the period from February 2016 to August 2019, with the rate of drawdown increasing in mid-2020 and reducing in late-early 2021. The decline in water levels in the lower Bulgo Sandstone from 2016 (or before) is likely related to regional drawdown of deeper aquifers due to the cumulative effect of Longwalls 29-32 at Tahmoor.

From November 2020, water levels in HBSS-65m, HBSS-97m and BGSS-169m have recovered slightly in all three instruments following depressurisation throughout 2020. In early 2021, groundwater levels in HBSS-97m are stable with minimal responses to the significant rainfall events in March 2021. Water levels in HBSS-65m and BGSS-169m showed slight fluctuations in groundwater levels in the range of 0.5 m to 1 m. Groundwater levels in BGSS-214m stabilised from November 2020 following completion of LW W1, recovered to 99.5 mAHD in mid-January 2021 and declined to 95 mAHD in April 2021 due to the progression of LW W2.

In May 2021, water levels in HBSS-65m, HBSS-97m and BGSS-169m are stable and show minor responses to rainfall. From June 2021, as LW W2 is near completion, the rate in groundwater recovery increased rapidly in the three instruments. Between June and August 2021, water levels in HBSS-65m, HBSS-97m and BGSS-169m increased by 4 m, 4.4 m and 7 m respectively. Both the timing and rate in groundwater recovery match with that observed at P16 (located 245 m south of TNC036). From mid-August 2021, water levels continued to recover but at a slower rate until October 2021 with water level increasing by 0.8 m, 1 m and 3 m respectively in HBSS-65m, HBSS-97m and BGSS-169m.

In November 2021, water levels in HBSS-65m, HBSS-97m and BGSS-169m are stable and show responses to rainfall in the range of 0.5 m. From mid-February 2022, water levels started to increase by approximately 1.5m in the Hawkesbury Sandstone aquifer and by 1m in the upper Bulgo Sandstone aquifer (BGSS-169m) following the intense rainfall in mid-February 2022 to early March 2022.

An additional depressurisation of 13 m in BGSS-412.5m is observed during the reporting period and is likely attributed to mining of LW W2 and LW W3 extraction.

As of November, 2021, the depressurisation (drawdown) observed in the following monitored horizons is primarily a result of LW W1 and LW W2 extraction, with:

- 2.1 m in HBSS-65m.
- 16.5 m in HBSS-97m.
- 35 m in BGSS-169m.
- 75 m in BGSS-214m.
- 67m in BGSS-412m.

As of March 2022, compared against pressures measured in November 2019, the observed depressurisation in the following monitoring horizons are:

- 0.9 m in HBSS-65m.
- 14 m in HBSS-97m.
- 34 m in BGSS-169m.
- 90 m in BGSS-214m.

#### 4.1.2.8 WD01

Figure 6 presents a hydrograph of the pre-mining borehole (WD01) located above a chain pillar between the Western Domain LW W1-W2. The bore is 570 m north of the closest Tahmoor North (not Western Domain) goaf (LW 32) and was completed while LW W1 was 400 m to the north (Section 3). WD01 is instrumented with VWPs at multiple depths and has been recording groundwater pressures/heads since June 2020. The latest available groundwater pressure dataset is dated to January 2022. In late April 2021 the sensors HBSS-190m and NPFM-230m both failed due to ground movement therefore no comment on groundwater elevations can be made past this date. The remaining active sensors HBSS-70m and HBSS-90m continue to show stable groundwater levels with no signs of depressurisation as of January 2022. The HBSS-210m sensor failed in late June 2021 due to ground movements caused by the retreating longwall panels. No groundwater level data past January 2022 is available as yet.

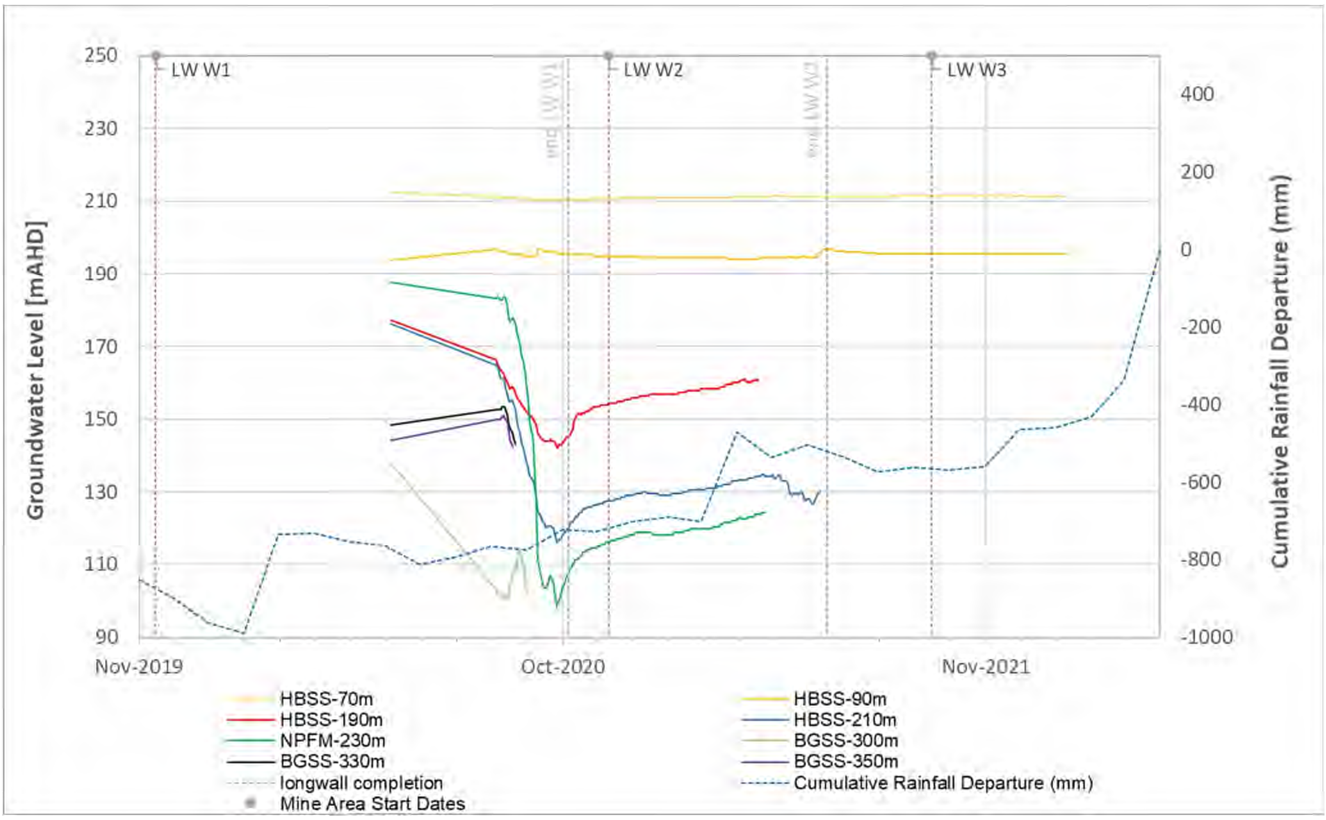



Figure 6 Groundwater Level Trends at WD01

The instrument HBSS-70m shows stable groundwater levels at about 211 mAHD. In HBSS-70m, no mining effect is evident as of January 2022, consistent with previous reporting. A small drawdown (1 m) was observed in HBSS-90m late April 2021 caused by the approach of LW W2. In June 2021, water levels in HBSS-90m recovered by approximately 2 m and has since then been stable at 196 mAHD and does not appear to show any discernible effect from mining.

A sharp decline in groundwater levels was observed in HBSS-190m and HBSS-210m with a respective drawdown of 23 m and 48 m in October 2020 due to the passing of LW W1. Approximately 80 m of depressurisation is apparent in the Newport Formation (piezometer NPFM-230 m) between September 2020 and October 2020 with the rate of drawdown increasing in October 2020.

Groundwater levels in the Newport Formation started to recover at a similar rate to the lower HBSS late October 2020, as or after LW W1 was completed. From October 2020 to April 2021, groundwater levels recovered by 26 m (NPFM-230m) and approximately 18 m (HBSS-190m and HBSS-210m). The rate of recovery slowed in January 2021, possibly due to the commencement of LW W2, but accelerated again from March 2021 following significant rainfall. The instrument HBSS-210m showed a decline in water levels of approximately 6 m in June 2021, probably caused by the progression of LW W2 extraction, and pressures appeared to stabilise before the instrument failed in June 2021.

Prior to November 2020, an apparent downward vertical gradient developed between the instruments HBSS-190m and HBSS-210m due to the passage of LW W1 and has remained stable while recovering with a head separation of 30 m for the remainder of the reporting period. Groundwater levels in the Newport Formation stayed below the groundwater levels of the Hawkesbury Sandstone, with a stable downward vertical head gradient for the remainder of the reporting period.

Groundwater drawdown of shallow groundwater levels in the lower HBSS and NPFM is attributed to strata dilation leading to increased aquifer storage. The pressure recovery since October 2020 points to the filling of this enhanced storage and appears to confirm that this zone is not connected and constantly draining to the goaf/workings. The latest pressure readings from July 2021 confirms this observation.

In the Bulgo Sandstone, the two deeper sensors (BGSS-330 m and BGSS-350 m) show higher groundwater pressures than the upper sensor BGSS-300 m (45 m difference), suggestive of some aquifer confinement. During September 2020, water levels at these two lower sensors declined progressively by 10 m and 7 m respectively before sensor failure in both sensors occurs during mid-September 2020 (significant drawdown after that time is assumed). The BGSS-300 m sensor shows a 3 m decline in early September 2020 with a subsequent increase of 10 m in groundwater level, attributed to strata compression as the longwall approaches, before declining again and then failing due to ground movement in late September 2020. Again, further significant drawdown is assumed after that time, as these Bulgo Sandstone piezometers are very likely to be within the zone of vertically connected fracturing.

#### 4.1.2.9 Private Bores

Several privately-operated and licensed groundwater bores are present to the north and west of LW W3-W4 (Figure 1), as identified in the most recent bore census for the Western Domain and surrounding area (GeoTerra, 2019 and 2021b). The primary usage of these bores is for farming and irrigation. Initial monitoring of licensed groundwater user bores was undertaken in the bore census conducted by GeoTerra (2019) prior to the commencement of LW W1 extraction, and by GeoTerra (2021b) prior to the commencement of LW W3 extraction. Monitoring of water levels and field sampling of water quality parameters is undertaken on a three-monthly basis during the extraction of LW W1-W2 and LW W3-W4, and on an annual basis following mining.

Continuous water level data has been collected at private bores GW072402 and GW104090 since January and March 2021 respectively by automatic dataloggers. LiDAR data has been used to estimate ground elevation at the bores and convert depth-to-water (mbgl) to water level elevation (mAHD). Private bores GW105228 and GW115860 are located 500 m and 400 m north of LW W3 respectively and have been equipped with data loggers recording groundwater level data every 15 minutes, with the latest available data dated to 18 October 2021.

The standing water level at other private bores is not available due to pumps and headworks restricting bore access.

GW072402 is located 430 m north of LW W1. Prior to LW W1, groundwater level at GW072402 was observed at 173.1 mAHD with no significant changes in water levels during mining of LW W1. Following a period of above average rainfall in March-April 2021, water levels slightly increased from 172.5 mAHD to 173.7 mAHD in late August 2021. In mid-September 2021, groundwater records show a decline in water levels of approximately 0.7 m followed by a sharp decline of approximately 0.4 m in late October 2021. The gradual decline of 0.7 m throughout September and early October 2021 is not attributed to groundwater pumping (i.e. private usage) as no pump installed/used in GW72402 (pers. comment Andrew Dawkins, GeoTerra). While the decline start date matches with the commencement of LW W3 (to within 3 days), it is unlikely this reduction in groundwater level could be attributed to mining as there would have been no significant subsidence as the goaf would only have started developing. The sharp water level decline (i.e. 0.4 m) occurring late October 2021 matches with the timing of declines seen at P15 bores and could be attributed to LW W3.

From November 2021, groundwater levels start to rise in response to rainfall recharge. By January 2022, groundwater level increased by 0.7 m to 173.4 mAHD, similar to baseline conditions (Figure 7). No yield information is available at this location due to pump malfunction.

Since October 2021, this bore is used as a control site in place of monitoring site P17 (now inaccessible) due to their distance to LW W3 being similar; 880-900 m.

GW104090 is located above the northern half of LW W2, and north of Newlands Gully. The bore census conducted by GeoTerra (2019) before mining of LW W1 indicated water level in GW104090 at approximately 176.2 mAHD. It is evident from the next available data (March 2021) that the combined effect of mining (LW W1 and W2) and possibly some effect of drought (although that is likely to have been minor in comparison) caused groundwater levels to decline by at least 12 m.

Since March 2021 an improved groundwater level dataset has been available. Following the significant rainfall events in February-March 2021, water levels increased by 4.5 m to 167.5 mAHD in April 2021, which is 8.2 m below baseline level (Figure 7). As noted above, groundwater levels at GW104090 experienced some degree of drawdown (>12 m) due to the passage of LW W1 and W2 but still show good responses to rainfall recharge. No groundwater levels were available between late April 2021 and July 2021 due to loss of the datalogger.

A manual measurement of the groundwater level at 169.2 mAHD was made available while replacing the logger in late July 2021 which suggest that water levels continued to recover during the period of missing data. From August 2021, water levels have responded to rainfall and fluctuates by 0.5 m but appear 2m below the water level taken manually in July 2021 which suggest that either the short periods of drier conditions throughout June-July 2021 and/or the completion of LW W2 influenced water levels during this period (or the manual reading in July 2021 was incorrect). In September 2021, an increasing trend in groundwater levels is observed with no mining effect due to the early part of LW W3 extraction identified. In October 2021, groundwater levels decreased by approximately 1.7 m likely due to the progression of LW W3. From November 2021, groundwater levels appeared stable at 165 mAHD. During the month of January 2022, there was a blockage at the private bore GW104090 at a depth of 48.3 m and thus it should be noted the data from January 2021 to the end of the reporting period at this location is not representative of groundwater conditions. A field inspection is planned in the coming months to identify the cause of the blockage and assess if the bore can be unblocked.

No yield information is available at this location due to pump malfunction at these bore locations.

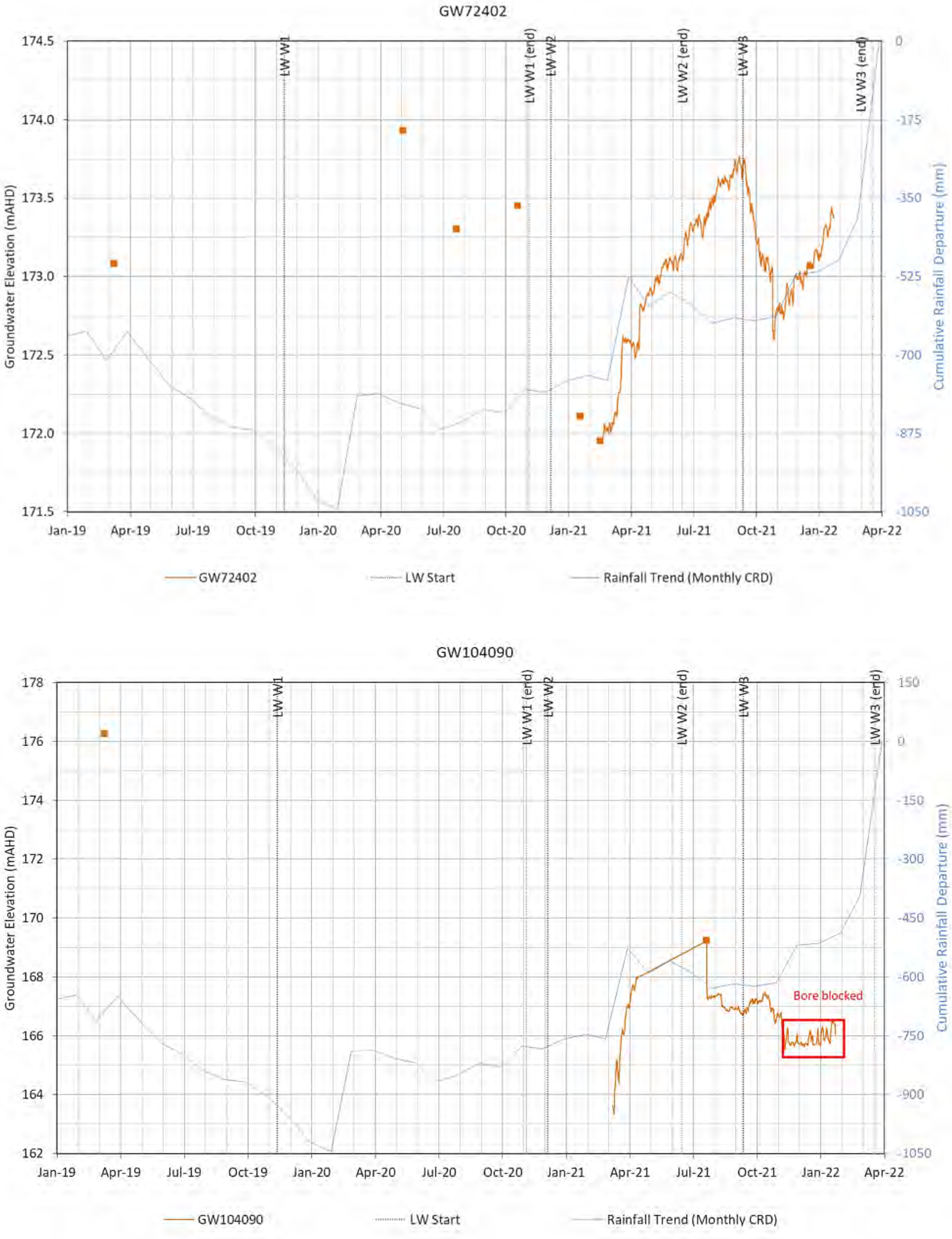



Figure 7 Groundwater level hydrographs for GW72402 and GW10409

Groundwater level data at private bores GW105228 and GW115860 are recorded every 15 minutes and presented on Figure 8, with the latest available data to 24 January 2022. Groundwater levels for the two private bores show no response in water levels following the commencement of LW W3 compared to GW72402 (Figure 7). As discussed in SLR (2021b) any mining effect on groundwater levels due to the early part of LW W3 extraction is difficult to assess due to alternation between pumping and not pumping at one or both bores for private usage. The timing in groundwater level decline and recovery match between GW105228 and GW115860 (only 110 m apart), suggesting that the drawdown in one bore (i.e. due to pumping) influences water levels in the other bore. On Figure 8, the drawdown observed at GW115860 is consistently greater than the drawdown at GW105228, which suggests that GW115860 is more frequently pumping groundwater and influences water levels in GW105228. During mid-October 2021, at GW115860, pumping seems to have reduced as water level increased by 1.8 m, a period also associated with fewer pumping cycles compared to September 2021. This could be explained by the fact that reliability on groundwater has reduced during a period of above average rainfall conditions throughout October and November 2021 and during the exceptional rainfall in early 2022. However, water levels provided before 19th October 2021 seem suspect and any conclusions on pumping effect is difficult to understand prior to this period. No drawdown due to mining of LW W3 is identified during the reporting period at either GW105228 or GW115860.

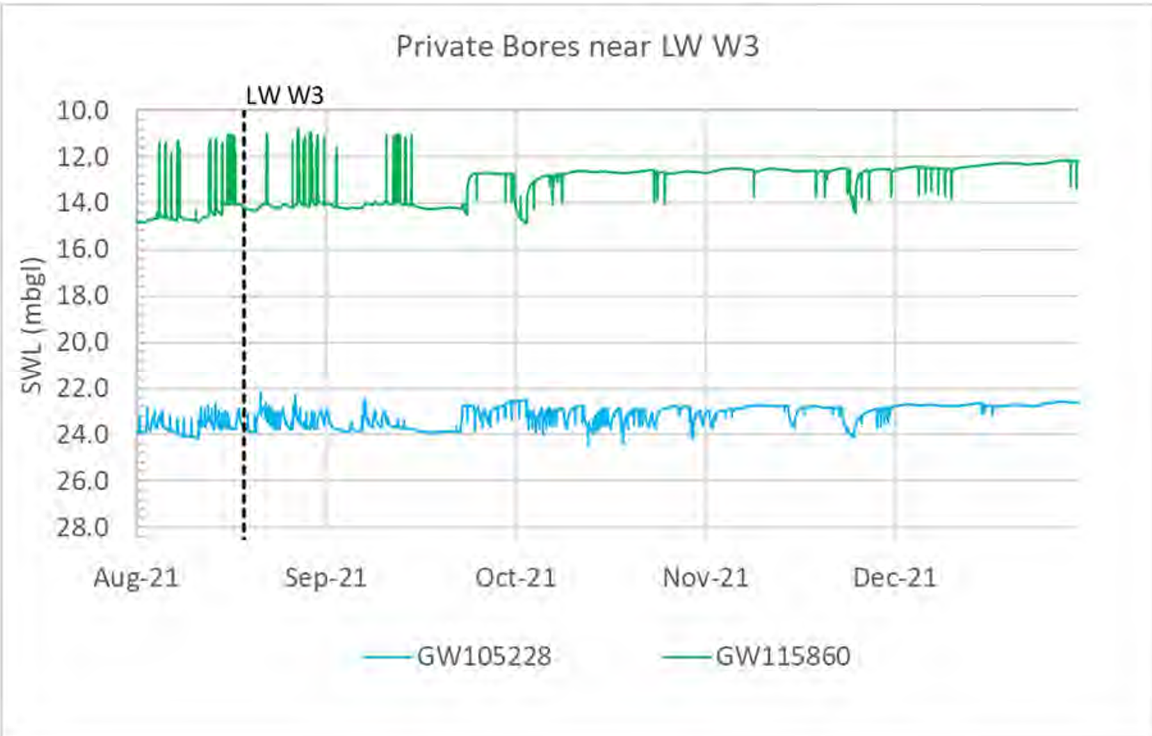



Figure 8 Hydrographs for GW105228 and GW115860

### 4.1.3 Tahmoor North

#### 4.1.3.1 Site P9

P9 monitoring sites are located on the northern bank of Redbank Creek and overlie the pillar between LW31 and LW32, where extraction commenced in November 2018. These bores are not directly relevant to the Western Domain but show behaviours that would be expected above or near to Western Domain longwalls. Groundwater data has been recorded at P9 since October 2017. The open standpipe bores are screened at 22-24 m (P9A), 37-40 m (P9C) and 65-68 m (P9D), all within the Hawkesbury Sandstone. There were also three VWPs installed in a single P9 bore at 28 m, 40 m and 68 m depths, corresponding to some of the open standpipe intervals (Table 3).

One of the standpipe bores P9D (65-68m) and all three VWP sensors at P9 have failed; failures in P9_V1 in May 2018, P9_V2 in May 2019 and P9_V3 in October 2018. This is not surprising given the position between longwall panels and susceptibility to subsidence effects, however measurements of groundwater level are still recorded at P9A (22-24m) and P9C (37-40m) (Figure 9).

Figure 9 presents hydrographs of groundwater levels at P9 VWPs and open standpipes bores. At the commencement of monitoring the water levels in P9_V1 and P9_V2 were closely related. Greater head separation exists (approximately 5 m) between the water levels in the two shallower VWPs and the deeper instrument (P9_V3), however, groundwater levels at all depths show similar peaks and declines in response to rainfall.

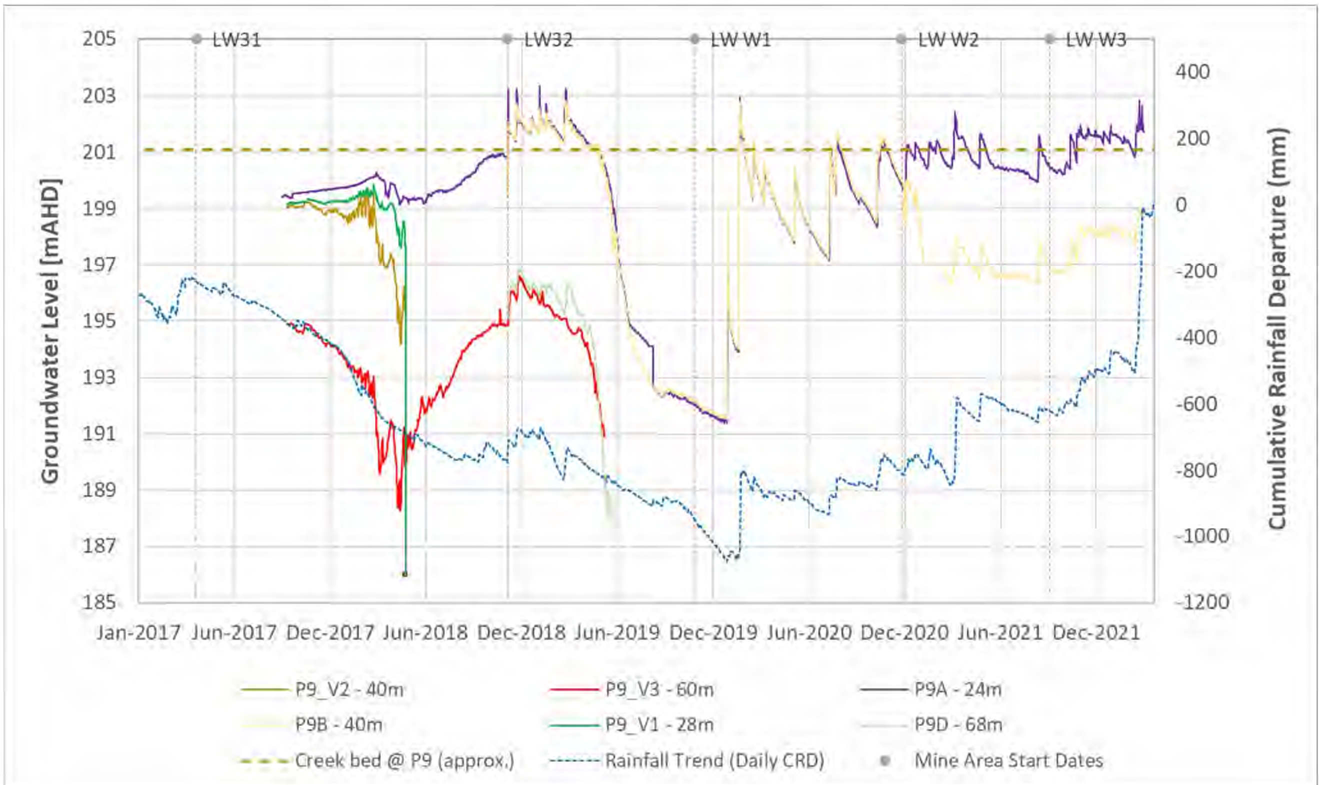



Figure 9 Groundwater Level Hydrographs at P9

Water levels in most of the P9 instruments declined gradually throughout the first half of 2018, following a trend similar to of the rainfall cumulative residual curve. During this period water levels decline by approximately 5 m in each of the VWPs. Following this, groundwater levels decreased to below the groundwater levels at VWPs P9_V1 and P9_V2 and these instruments fail at this point, while pressures at V3 begin to recover. By December 2018, water levels in P9_V3 have fully recovered and are approximately 2 m higher than those first recorded in October 2017. The higher head in P9_V3 at this time may be related to surface fracturing along Redbank Creek. An investigation of shallow groundwater in boreholes (including P9) around Redbank Creek was conducted by SCT in late 2018 (SCT, 2018b). This report identified increases in hydraulic conductivity at bore P9 in the presence of subsidence-induced “surface cracking”. This hydrograph indicates that water drains from shallower horizons and recharges deeper horizons.

From December 2018 to April 2019, as LW32 advanced toward the P9 bores, water levels in P9_V2 and in standpipe bore P9D-68m declined by 2 m, followed by a sharp drawdown of 6 m in May 2019 due to the extraction of LW32, noting that this monitoring site lies above the chain pillar of LW32.

Following significant rainfall in March 2020, water levels in P9A-24m and P9B-40m recovered by approximately 11 m and are observed at similar levels as the pre-LW32 groundwater levels. Throughout 2020, water levels in P9A-24m and P9B-40m responded to rainfall events in the range of 2-3 m, which suggests that fluctuations could have been exacerbated by the progression of LW W1. Between December 2020 and April 2021, water levels in P9A-24m stabilised between 200-201 mAHD and approximately 1.5 m above the first recorded water level in 2017 but declined by 2.5 m in P9B-40m in early January 2021 (i.e. before failing of sensor/logger). The logger was repaired and replaced in March 2021, with water levels recorded at 196 mAHD in P9B-40m and since then have continued to show responses to rainfall but remain 5 m below the first water levels recorded in November 2018. This suggests that extraction of LW W1 (or W2, although that is considered much less likely) has had an effect on recent water levels in P9B-40m, with further drawdown just after LW W1 was completed.

During the early extraction of LW W3, responses to rainfall are observed in both P9A-24m and P9B-40m with water levels in December 2021 being 1.5 m and 1.8 m respectively above pre-LW W3 water levels. In early February 2022, a decline of 0.4 m is observed in P9A-24m and P9B-40m during a period of low rainfall (Figure 9). Following the major rainfall in early March 2022, groundwater levels increase by approximately 1 m. We note that water levels at P9A-24m were observed above the creek bed elevation for most of the reporting period which suggests gaining conditions along Redbank Creek in the vicinity of P9, except during the short period of water level decline in February 2022, which would be associated with groundwater in the shallow Hawkesbury Sandstone (P9A-24m) leaking to the underlying aquifer (P9B-40m). No recent mining effect is discernible over the reporting period in the P9A-24m and P9B-40m piezometers.

#### 4.1.3.2 Site P11

Bore P11, located along Redbank Creek and 300 m east of (downstream of) LW 32 shows a mining induced drawdown of approximately 3 m between July 2019 and January 2020 (Figure 10). The groundwater levels along Redbank Creek are correlated to weather patterns or rainfall events. There is a clear response in groundwater levels to the significant rainfall commencing in January 2020. Since March 2020 water levels have recovered above the baseline level (period prior LW W32) and show small responses to rainfall events. Water levels have gradually declined by approximately 0.4 m between March 2021 and August 2021 and have shown a response to rainfall in late August 2021. During the reporting period, groundwater levels at P11 have increased by 0.7 m in response to the above average rainfall conditions. As of March 2022, water levels at P11 are around 2.7 m above the first recorded level in February 2019. No discernible effects on water levels due to LW W3 are identified during the reporting period.

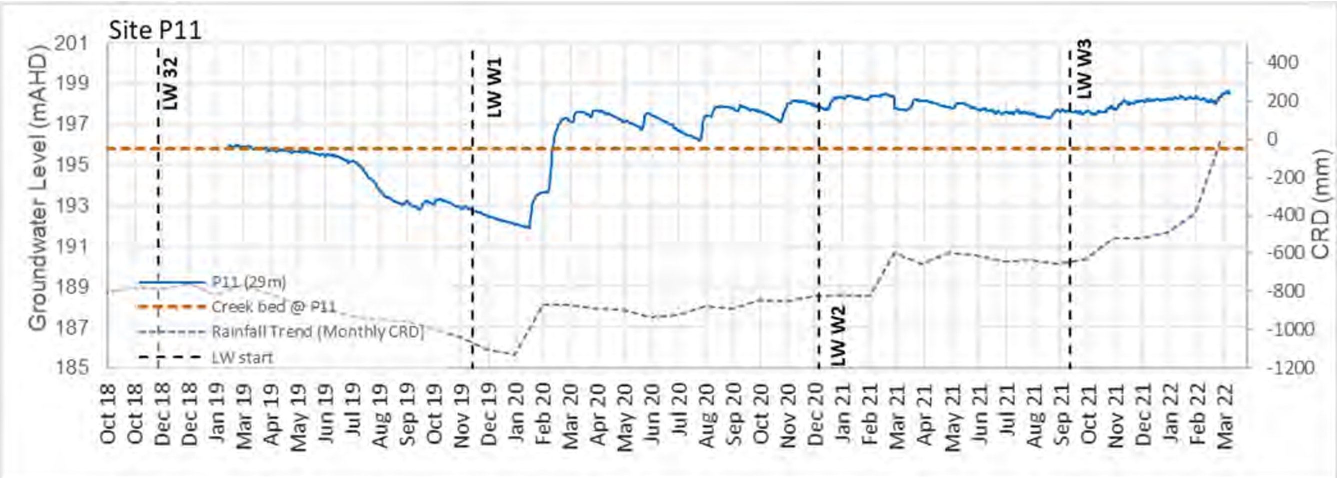



Figure 10 Groundwater Level Hydrograph at P11

#### 4.1.3.3 TNC040

TNC040 is situated 300 m north of LW32, 650 m south-east of LW W2, and will be 430 m south of LW W4. Eight data sensors installed in TNC040 are positioned within the Wianamatta Group, Hawkesbury Sandstone, Bald Hill Claystone, Bulgo Sandstone, Scarborough Sandstone and Bulli Coal seam (Table 3). As of February 2019, the lower four VWP sensors were no longer active due to subsidence effects (GES, 2019). The decline in water level shown in late 2018 in the lowest sensor in the Bulli Coal seam (BUCO-501.9m) is a result of a nearby road advancement that has caused depressurisation of this seam.

As of March 2022, the upper two sensors (WMFM-27m, HBSS-65m) remain active, with monthly manual measurements taken between June 2021 and December 2021 and do not appear to show an influence from mining (Figure 11). In January 2022 the two loggers WMFM-27m and HBSS-65m were repaired, and continuous data was available from that time. In early February 2022, groundwater levels in HBSS-65m gradually declined by 1 m before stabilising at 187.3 mAHD. Minor fluctuations are observed in WMFM-27m (i.e. 0.2 m water level fluctuations). This water level decline in HBSS-65m could be associated with the progression of LW W3 to the south in the direction of TNC040 (i.e. 450 m from LW W3). No mining effect is discernible in the WMFM-27m piezometer.


Figure 11 Groundwater Level Trends at TNC040

#### 4.1.3.4 TNC043

TNC043 is also located 140 m east of the southern end of LW32, at the opposite end to TNC040. Monitoring began at this VWP-instrumented borehole in July 2010, and as with TNC036 and TNC040, there are some gaps in the record. However, data has been consistently collected since mid-2015. Until October 2019, the HBSS-65m and HBSS-111.5m piezometers were the only active instruments at this bore, with the remainder failing in 2018 due to subsidence from nearby LW32. The two upper sensors HBSS-65m and HBSS-111.5m at TNC043 remained active until September 2020 before being stolen at the end of 2020 (Table 3). Despite the loss of the loggers, manual readings are taken for the upper two sensors approximately monthly.

The water levels at HBSS-65m and HBSS-111.5m present similar trends to one another and both have responded to rainfall since monitoring started (Figure 12).

A gradual decline in water levels is observed throughout 2020 which is likely attributed to mining at LW W1. Water levels at HBSS-65m and HBSS-111.5m stabilised in November 2020 and started to recover respectively at 158.7 mAHD and 154.2 mAHD in April 2021. Since this period, water levels in HBSS-65m and HBSS-111.5m fluctuated by 0.5m and have responded to the early 2022 rainfall in the range 0.7m to 1m.

As of March 2022, water levels in HBSS-65m and HBSS-111.5m are respectively 2.5 m and 1 m above water levels observed during the baseline period (i.e. prior to LW 32).


Figure 12 Groundwater Level Hydrographs at TNC043

## 4.2 Trigger Criteria

TARPs have been developed based on the groundwater management program outlined in the Groundwater Technical Report LW W3-W4 (SLR, 2021) and the WMP (Tahmoor Coal, 2021), and describe necessary responses for exceedances in groundwater quality and groundwater level triggers at open standpipe 'P' bores, as well as exceedance of groundwater pressure triggers developed for VWPs. The approved trigger criteria for shallow and deep groundwater levels are summarised and presented in Table 5. Appendix B1 details the latest approved impact assessment trigger criteria from the LW W3-W4 Extraction Plan presented in the WMP (Tahmoor Coal, 2021) and the appropriate action plan to be enacted should a trigger exceedance occur during mining of LW W1-W2 and LW W3-W4. Figure 13 to Figure 17 present groundwater hydrographs at each site with the associated groundwater level triggers.

Prior to the approval of LW W3 in September 2021, groundwater levels and quality observations were assessed against the TARPs developed for and outlined in the Groundwater Technical Report LW W1-W2 (HS/SLR, 2019). From September 2021, as stated above, groundwater levels and quality observation across the Western Domain are now assessed against latest approved impact assessment trigger criteria (Tahmoor Coal, 2021). The following sections present the groundwater exceedances identified and highlight the change in TARPs that occurred from September 2021.

Further details regarding the development of the TARPs are provided in SLR (2021).

Table 5 Groundwater TARP Level Criteria for Open Standpipes, Shallow VWPs and Deep VWPs (Tahmoor Coal, 2021).

| Significance Level | Criteria | | |
|---|---|---|---|
| | Open standpipes | Shallow VWPs (<200m bgl) | Deep VWPS (>200m bgl) |
| Level 1 | Groundwater level remains consistent within baseline variability and/or pre-mining trends, with reductions in groundwater level less than two metres and does not trigger Level 2 to Level 4 Significance Levels (refer to Appendix C). | No observable mining induced change at VWP intakes located at or above (i.e. shallower than) 200 m depth. | Observed data does not exceed predicted (modelled) impacts (excluding those monitoring the Bulli Coal Seam). |
| Level 2 | Greater than 2 m water level reduction following the commencement of extraction at LW W1 (and LW W2, W3, W4) (refer to Appendix C for TARP Significance Level 2).<br>AND<br>The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors. | 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) (refer to Appendix C for TARP Significance Level 2).<br>AND The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors. | Calculated or observed drawdown (based on 2009-2015 baseline data and excluding VWPs within the Bulli Coal Seam) is within 30 m of predicted (modelled) drawdown. |
| Level 3 | Water level declines below the water level of TARP Significance Level 3 (refer Appendix C, 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).<br>AND<br>The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors. | Water level declines below the water level of TARP Significance Level 3 (refer Appendix C, 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. | Calculated or observed drawdown (based on 2009-2015 baseline data and excluding VWPs within the Bulli Coal Seam) exceeds predicted (modelled) drawdown by 30 m for a period of 6 months or more. |
| Level 4 | Water level reduction greater than the maximum modelled drawdown (refer to Appendix C for TARP Significance Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4).<br>AND<br>The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors. | Water level reduction greater than the maximum modelled drawdown (refer to Appendix C for TARP Significance Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4). AND<br>The reduction in water level is determined not to be controlled by climatic or anthropogenic factors. | Calculated or observed drawdown (based on 2009-2015 baseline data and excluding VWPs within the Bulli Coal Seam) exceeds predicted (modelled) drawdown by 30 m for a period of 12 months or more. |

## 4.3 Trigger Exceedances

Table 6 presents the occurrence of trigger level exceedances in groundwater levels since the start of mining at Western Domain as per the trigger values (HS/SLR, 2019; SLR, 2021) and the TARP trigger criteria presented in Table 5 and Appendix B1.

Table 6 Groundwater Level Trigger Exceedances over January 2021 – March 2022 for the Shallow Open Standpipes, Shallow and Deep VWPs.

| Bore | Groundwater Level prior to LW W1 (m AHD) | Trigger Level Exceedances Jan 21 | Feb 21 | Mar 21 | Apr 21 | May 21 | Jun 21 | Jul 21 | Aug 21 | Sep 21 | Oct 21 | Nov 21 | Dec 21 | Jan 22 | Feb 22 | Mar 22 | Maximum drawdown Nov 2020 - Aug 2021 | GWL Prior to LW W3 (10-SEP-21) (m AHD) | Drawdown since Nov 21 as of March 2022 (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Shallow OSP | | TARP (HS/SLR, 2019) | | | | | | | | TARP (Tahmoor Coal, 2021) | | | | | | | | | |
| P12A | 170.1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | 0.5 | 170.5 | - |
| P12B | 170.7 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | 0.8 | 170.7 | - |
| P12C | 176.3 | L4 | L4 | L4 | L4 | L4 | L4 | L4 | L4 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | 11.0 | 172.1 | 2.1 |
| P13A | 167.2 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | # | # | # | # | # | # | 0.7 | 167.5 | # |
| P13B | 166.4 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | # | # | # | # | # | # | 1.5 | 166.5 | # |
| P13C | 169.8 | L4 | L4 | L4 | L4 | L4 | L4 | L2 | L1 | L2 | # | # | # | # | # | # | 5.0 | 168.3 | # |
| P14A | 168.6 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | - | 170.3 | - |
| P14B | 166.7 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | 1.4 | 166.4 | - |
| P14C | 166.6 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | 1.7 | 166.2 | - |
| P14D | 164.8 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | 1.8 | 164.8 | - |
| P15A | 164.7^ | L1 | L1 | L1 | L1 | L1 | * | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | - | 165.7 | - |
| P15B | 165.2^ | L1 | L1 | L1 | L1 | L1 | * | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | - | 165.6 | - |
| P15C | 164.9^ | L1 | L1 | L1 | L1 | L1 | * | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | - | 165.6 | - |
| P15D | 165.4^ | # | # | # | # | # | # | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | # | 164.4 | - |
| P16A | 211.3 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | 1.1 | 210.7 | - |
| P16B | 206.4 | L4 | L4 | L4 | L4 | L4 | L4 | L4 | L4 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | 5.7 | 203.9 | 2.4 |

| Bore | Groundwater Level prior to LW W1 (m AHD) | Trigger Level Exceedances | | | | | | | | | | | | | | | Maximum drawdown Nov 2020 - Aug 2021 | GWL Prior to LW W3 (10-SEP-21) (m AHD) | Drawdown since Nov 21 as of March 2022 (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Jan 21 | Feb 21 | Mar 21 | Apr 21 | May 21 | Jun 21 | Jul 21 | Aug 21 | Sep 21 | Oct 21 | Nov 21 | Dec 21 | Jan 22 | Feb 22 | Mar 22 | | | |
| P16C | 199.6 | L4 | L4 | L4 | L4 | L4 | L4 | L4 | L4 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | 13.8 | 191.4 | 8.3 |
| P17 | 171.3 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | # | # | # | # | # | # | 0.2 | 171.5 | # |
| | | Shallow VWPs (<200m) | | | | | | | | | | | | | | | | | |
| TNC036 - HBSS-65 | 209.5 | L4 | L4 | L4 | L4 | L4 | L4 | L2 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | 6.7 | 207.3 | 0.9 |
| TNC036 - HBSS-97 | 196.3 | L4 | L4 | L4 | L4 | L4 | L4 | L4 | L4 | L4 | L4 | L4 | L4 | L4 | L4 | L3 | 24.0 | 179.5 | 14.2 |
| TNC036 - BGSS-169 | 197.5 | L4 | L4 | L4 | L4 | L4 | L4 | L4 | L4 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | 47.6 | 161.5 | 34 |
| TNC040 - WNFM-27 | 208.3 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | # | L1 | L1 | L1 | L1 | L1 | - | 210.3 | - |
| TNC040 - HBSS-65 | 187.1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | # | L1 | L1 | L1 | L1 | L1 | - | 187.5 | - |
| TNC043 - HBSS-65 | 158.7 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | 0.3 | 158.2 | - |
| TNC043 - HBSS-111.5 | 155.6 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | 1.8 | 153.9 | 0.9 |

| Bore | Groundwater Level prior to LW W1 (m AHD) | Trigger Level Exceedances | | | | | | | | | | | | | | | Maximum drawdown Nov 2020 - Aug 2021 | GWL Prior to LW W3 (10-SEP-21) (m AHD) | Drawdown since Nov 21 as of March 2022 (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Jan 21 | Feb 21 | Mar 21 | Apr 21 | May 21 | Jun 21 | Jul 21 | Aug 21 | Sep 21 | Oct 21 | Nov 21 | Dec 21 | Jan 22 | Feb 22 | Mar 22 | | | |
| | | Deep VWPs (>200m) | | | | | | | | | | | | | | | | | |
| TNC036 - BGSS-214 | 176.5 | L3 | L3 | L3 | L3 | L3 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | 81.4 | 103.4 | 85.5 |
| TNC036 - BGSS-412.5 | 96.8 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | 49.7 | 33.5 | 73.5 |

TARP Level 1 TARP Level 2 TARP Level 3 TARP Level 4

*LX: maximum trigger level exceedances recorded (including P13 and P17 decommissioned in October 2021)* *"-": no observed drawdown* *^ baseline groundwater level at P15 (A,B,C,D) is the groundwater level recorded in June 2021.* *#: not applicable*

*"*" not assessed due to disruption in groundwater levels during drilling and packer testing at P15D (see (SLR, 2021c) section 2.3)*

## Table 7 Groundwater Level Trigger Exceedances over the Reporting Period (January 2021 – January 2022) for Private Bores

| Bore | Baseline Maximum Ground water Depth (m bgl) | Baseline Groundwater Yield (L/s) | Trigger Level Exceedances | | | | | | | | | | | | | Groundwater Depths as of January 2022 (m bgl) | Ground water Yield as of January 2022 (L/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Jan 2021 | Feb 2021 | Mar 2021 | Apr 2021 | May 2021 | June 2021 | July 2021 | Aug 2021 | Sep 2021 | Oct 2021 | Nov 2021 | Dec 2021 | Jan 2022 | | |
| Private Bores | | | | | | | | | | | | | | | | | |
| GW104090 | 39.0 | # | L1 | L1 | L1 | L1 | # | # | # | L1 | L1 | L1 | L1 | L1 | # | # (49.2^) | # |
| GW105467 | 32.0 | 0.5 | L1 | L1 | L1 | L1 | L1 | L1 | L2 | # | # | * | * | * | * | # | # |
| GW105228 | 23.0 | 1.8 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | 22.4 | 2.0-2.1 |
| GW072402 | 11.76 | # | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | 11.5 | # |
| GW115860 | 5.0 | # | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | 12.6 | 2.0 |
| GW105546 | 31.9 | 1.6 | L1 | L1 | L1 | L1 | # | # | * | # | # | * | * | * | * | # | # |

*LX: maximum trigger level exceedances recorded* *#: not applicable* ** no site access* *"-"standing water level not available (access is not available inside the bore)*

TARP Level 1 TARP Level 2 TARP Level 3 TARP Level 4

## 4.4 Discussion of Groundwater Level Exceedances

This section discusses any exceedances observed over the reporting period from November 2021 to March 2022. TARP level exceedances were observed in bores as follows:

- TARP Level 4 at the shallow VWP sensors at TNC036 (HBSS-97m) from October 2021 to February 2022, with a reduction in TARP to Level 3 in March 2022;
- TARP Level 3 at the shallow open standpipes P12C and P16C during the reporting period;
- TARP Level 2 at the shallow open standpipe P16B during the reporting period;
- 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.

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

In terms of yield and groundwater level at the private bores, the following observations are noted over the reporting period (to January 2022):

- GW105228: There was no significant change in groundwater yield at GW105228 that could impede groundwater use in January 2022. In January 2022, groundwater yield was recorded between 2.0-2.1 L/sec compared to 1.82 L/sec during the baseline period (GeoTerra, 2019). As of January 2022, groundwater levels are 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 January 2022. In January 2022, groundwater yield at this location is recorded between 2.0-2.05 L/sec compared to 2.3 L/sec during the baseline period. As of January 2022, groundwater levels are observed within baseline level. TARP Level 1 applies.
- GW105467: In January 2021 the bore yield at GW105467 has declined from 0.67 L/s to 0.38 L/s in July 2021. A TARP Level 2 was applied at GW105467 as the lowest groundwater yield during the baseline period was 0.47 L/s in March 2019 and during the severe NSW drought. This bore is not actively used for groundwater extraction and no site access was possible in October 2021 and January 2022. Further monitoring is planned at this location.
- There was no site access at GW105546 throughout the reporting period, hence the assessment of trigger assessment exceedances at this location was not possible.

### 4.4.1 Shallow Open Standpipes

#### 4.4.1.1 P12C

During the reporting period, groundwater levels at P12C have increased to a maximum of 174.2 mAHD in March 2022 and are 2.1 m below baseline levels (Table 6). Groundwater levels at P12C have increased by 2.8 m in March 2022 and are approximately 3.1 m above groundwater level observed in the upper piezometer P12A and P12B (Figure A-1). A TARP Level 3 still applies at P12C as the recovered groundwater levels as of March 2022 are below the trigger level 3.

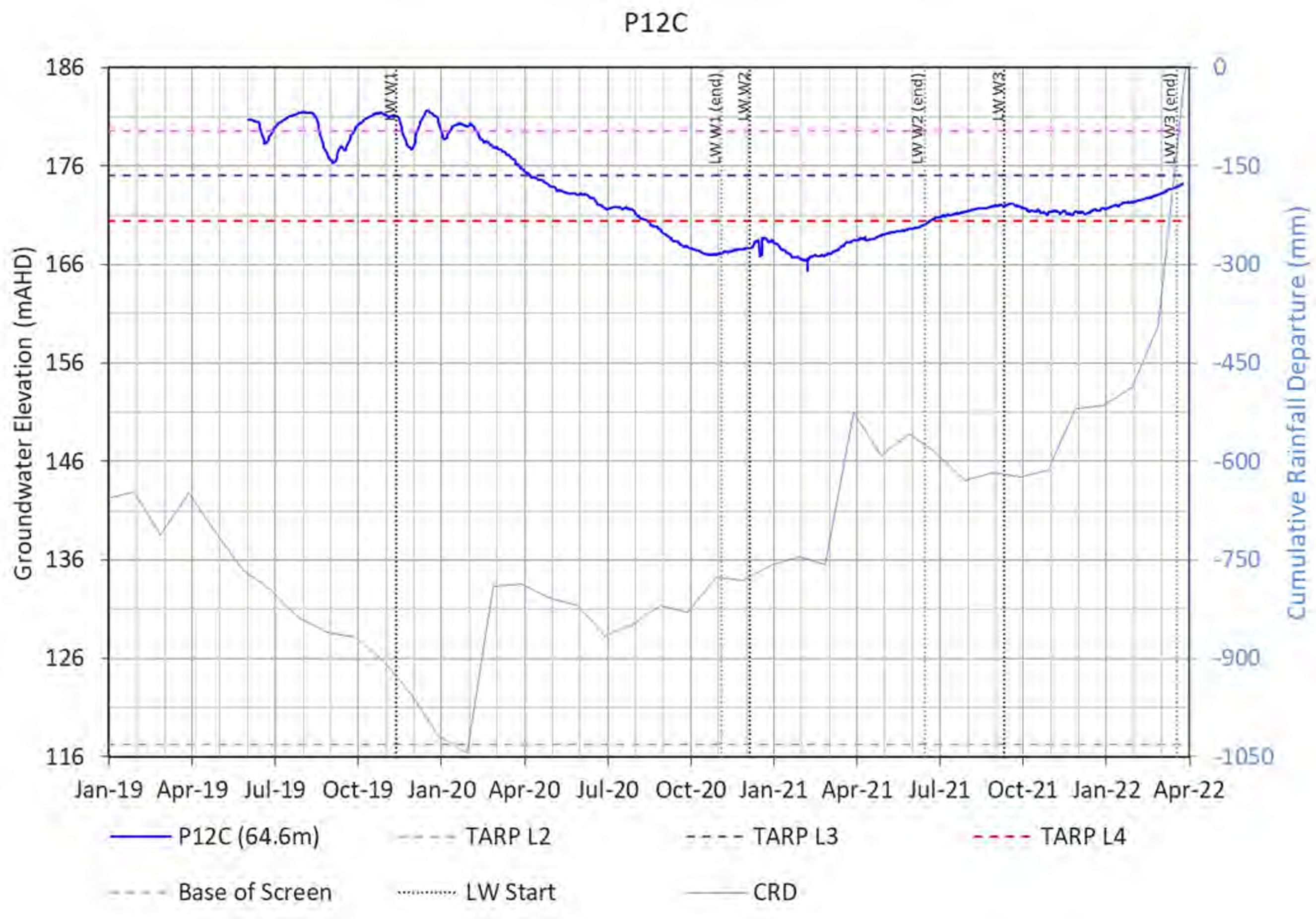



Figure 13 Groundwater Level Exceedance at P12C

#### 4.4.1.2 P16B and P16C

Both P16B and P16C have shown a TARP Level 4 exceedance from December 2020 to August 2021 and reduced respectively to Level 2 and Level 3 from September 2021. During the reporting period a TARP Level 2 and Level 3 still apply at P16B and P16C respectively.

At P16B, groundwater levels were observed at 202.8 mAHD in mid-January 2022, below the trigger TARP Level 2 (205.9 mAHD) following a decline of approximately 1.8m (Figure 14). SLR investigated the nature of the sharp decline (SLR, 2022a). The recent decline in groundwater levels could be due to a delayed mining effect from LW W2 and active mining at LW W3. The sudden decline in groundwater levels at P16B could potentially be due to the sudden movement of strata from mining. Similar sudden declines were observed at P15 located adjacent to the northern end of LW W3 after the commencement of that panel (Appendix A, Figure A-3).

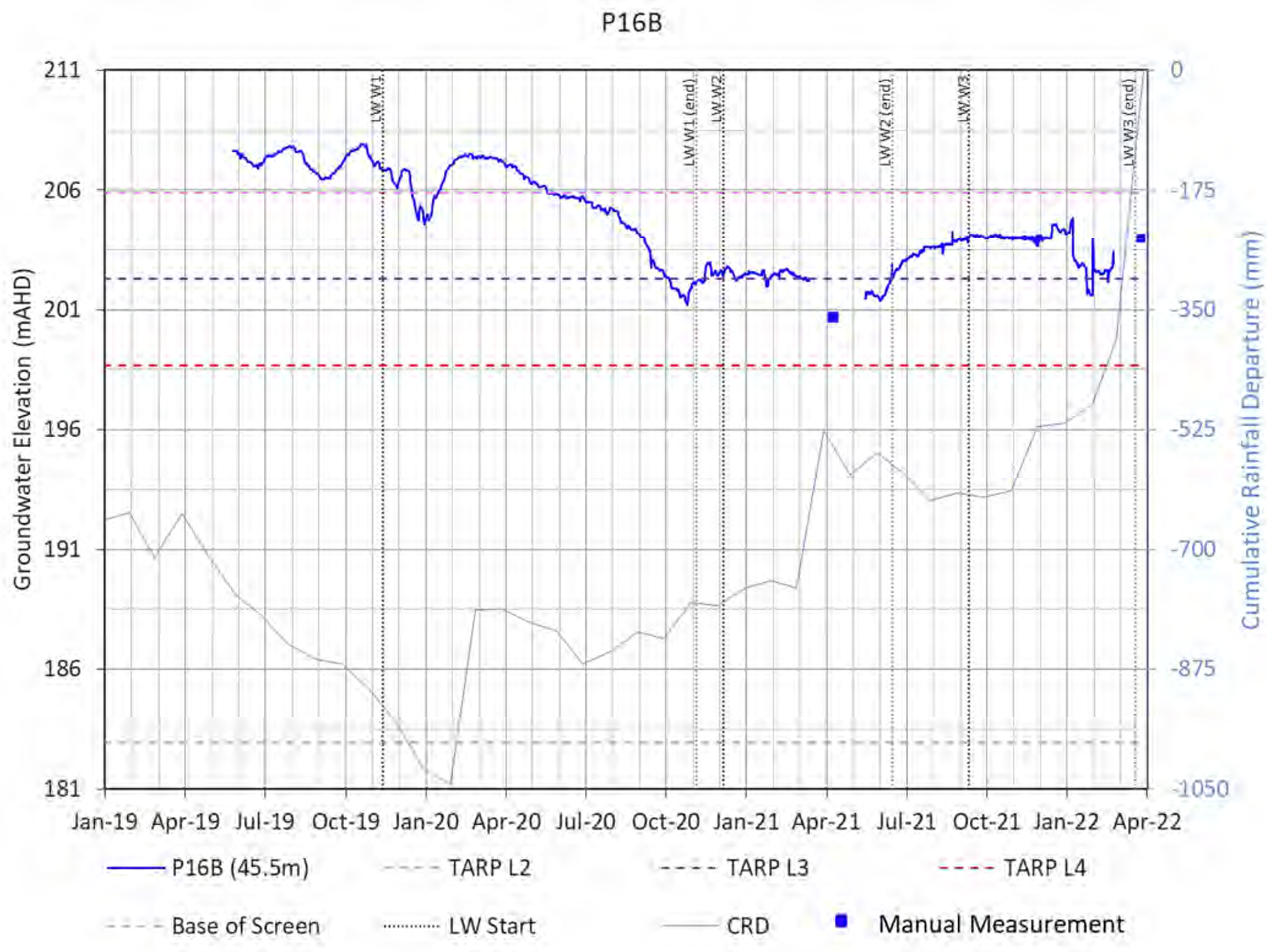



Figure 14 Groundwater Level Exceedance at P16B

During the second half of January 2022, water levels at P16B declined by 1.4 m, dropping below the TARP Level 3 for a short-period of time between 25$^{th}$- 31$^{st}$ January 2022 before rising back to approximately 203.4 mAHD from March 2022. As of March 2022, groundwater levels at P16B are within a TARP Level 2 (Figure 14).

During the reporting period, recovery in groundwater at P16C has reduced with water levels at 191.7 mAHD and 7.6 m below baseline levels (Table 6 and Figure 15).

Groundwater levels at P16C gradually declined by approximately 0.4 m throughout the reporting period to 190.2 mAHD and are observed at 191.3 mAHD in March 2022. As of March 2022, groundwater levels remain below the trigger TARP Level 3 (193.9 mAHD), hence a TARP Level 3 still applies (Figure 15).

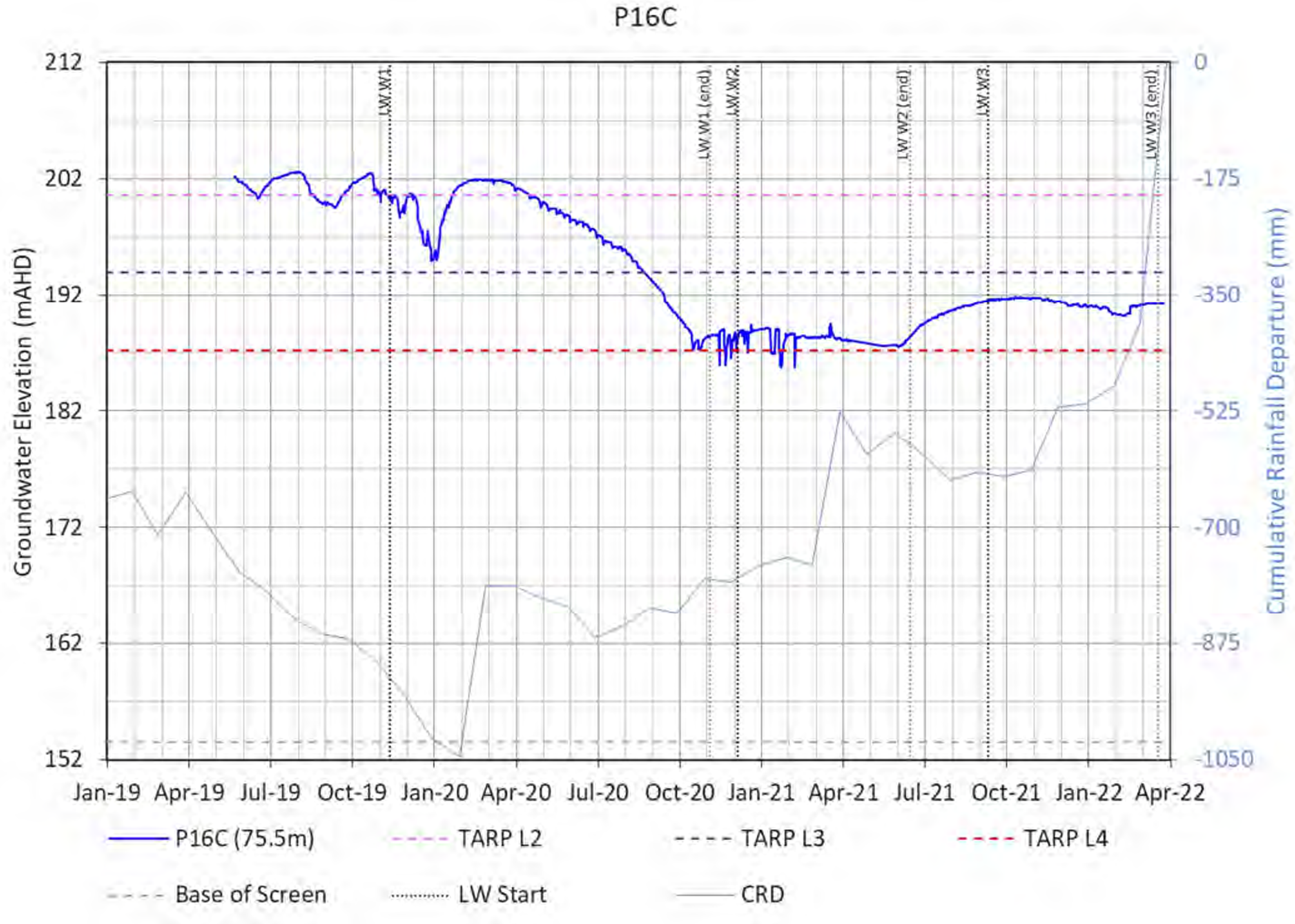



Figure 15 Groundwater Level Exceedance at P16C

### 4.4.2 Shallow VWPs – TNC036

Groundwater trends at monitoring sites equipped with shallow VWPs (less than 200m depth) were within the TARP Level 1 except at TNC036 (HBSS-65m, HBSS-97m and BGSS-169m) triggering the TARP Level 3 throughout 2020 and TARP Level 4 from December 2020 to April 2021 (Table 6).

The triggering of TARP Level 3 at TNC036 was attributed to mining induced depressurisation of deeper aquifer throughout the passage of LW W1 and exacerbated by a reduction in rainfall recharge events in late 2020.

Following the completion of LW W1 in November 2020, groundwater levels started to stabilise in all shallow TNC036 sensors and in WD01-HBSS-190m. In November 2020, a TARP Level 4 was attributed to TNC036 (HBSS-65m, HBSS-97m and BGSS-169m) due to a greater than 5 m depressurisation over a period of six months. Above LW W1 and following the completion of that longwall, groundwater levels in WD01-190m started to recover.

At TNC036, the progression of mining at LW W2 induced a minor drawdown in HBSS-65m and HBSS-169m while water levels at HBSS-97m are stable. Between December 2020 and June 2021, water levels in HBSS-65m recorded a reduction greater than 5m due to the passage of both LW W1 and LW W2, being within the Level 4 TARP criteria. Groundwater levels started to recover in June 2021 and by the end of July 2021, water levels in HBSS-65m increased above the TARP level 2 (i.e. 4.2 m below baseline level) and since August 2021 a TARP Level 1 applies (Table 6).

At HBSS-97m groundwater levels are observed between 180.7 and 179.6 mAHD between November 2021 and February 2022. Over this period groundwater levels seem to have stabilised with fluctuations up to 1 m. This follows a period of recovery since June 2021 (Figure 16). In February 2022, groundwater levels declined marginally below the trigger TARP Level 4 (180 mAHD) for short periods of time (five days in February 2022). As of March 2022, groundwater levels increased above the trigger TARP Level 4, hence a TARP Level 3 applies.

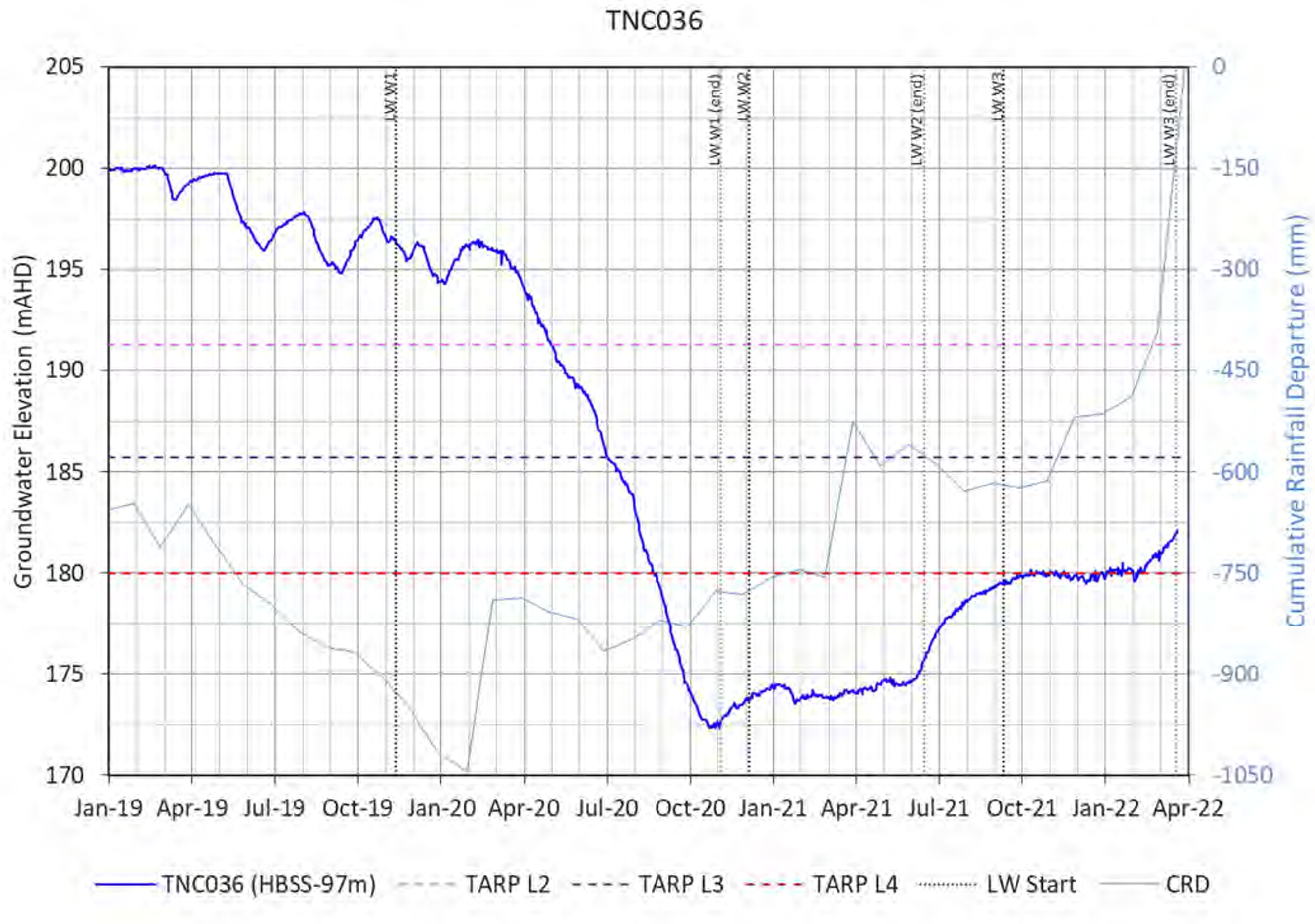



Figure 16 Groundwater Level Exceedance at TNC036-HBSS-97m

In HBSS-169m, the reduction to a TARP Level 2 occurred in September 2021 while groundwater levels continued to recover within the revised TARP Level 2. Groundwater levels are observed between 161.5 and 163.5 mAHD and increase by approximately 2 m during the reporting period (Figure 17). The groundwater trend at TNC36-169m in March 2022 remains consistent with the observations made in the six-monthly review (SLR, 2021a) and previous monthly reporting (SLR, 2022b). As of March 2022, groundwater levels remain below the trigger for TARP Level 2 (192.5 mAHD), hence a TARP Level 2 still applies.

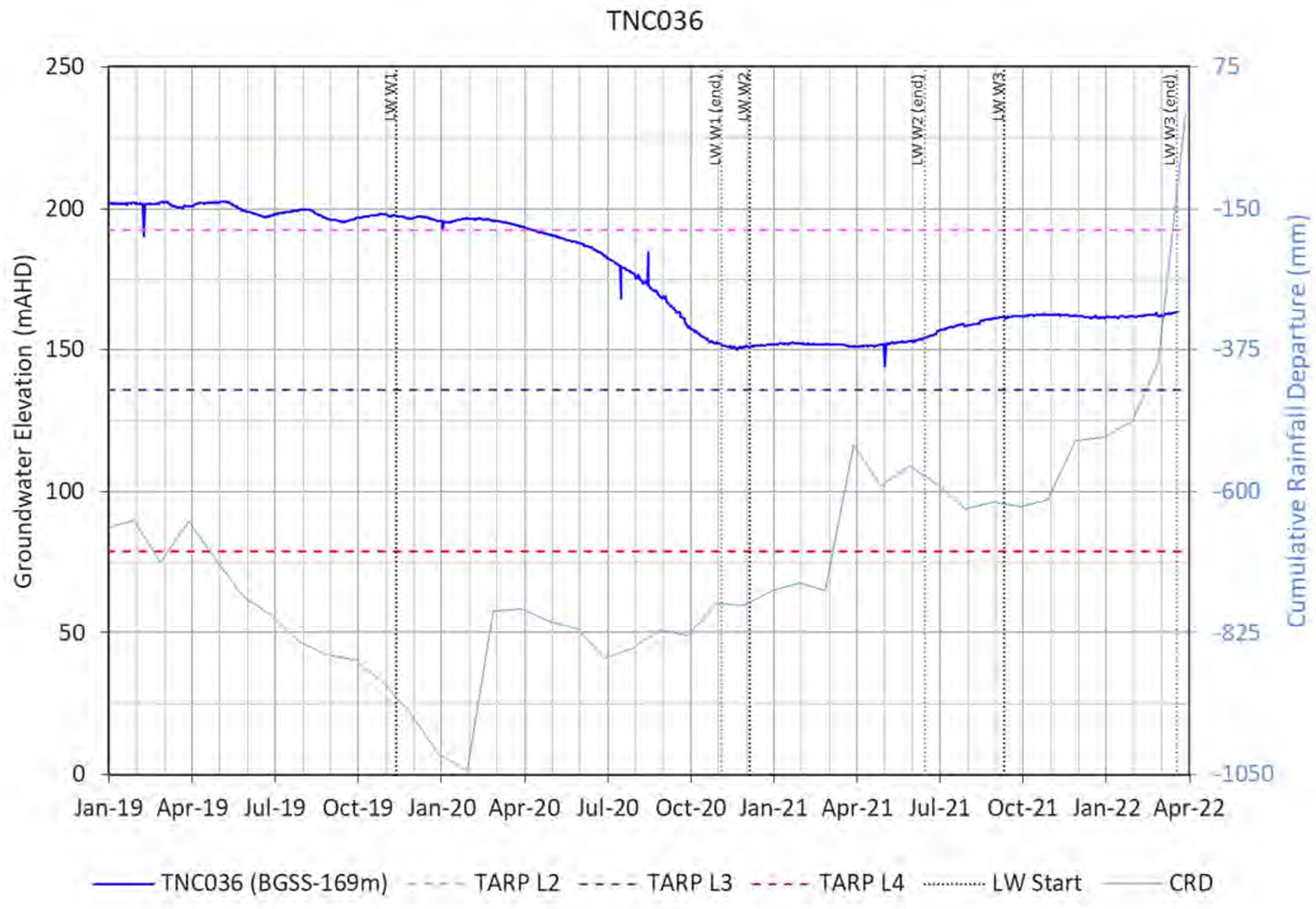



Figure 17 Groundwater Level Exceedance at TNC036-BGSS-169m

### 4.4.3 Deep VWPs – TNC036

Figure 18 and Figure 19 present the modelled (blueline) and observed (orange marker) drawdown at TNC036 sensors (BGSS-214m, BGSS-412.5m) since the start of LW LW1 extraction. The blue dashed line represents a threshold established as per the TARP for deep VWP sensors which is the modelled drawdown plus 30 m (Table 5).

Figure 18 shows that the observed drawdown at TNC036-BGSS-214m exceeds the modelled drawdown from March 2020 and the 30 m predicted drawdown between September 2020 and April 2021. Since May 2021, a TARP Level 2 applies with observed water levels within the predicted drawdown (+30m) (Table 5).

Figure 19 shows that the observed drawdown at TNC036-BGSS-412.5m exceeds the modelled drawdown from August 2020 but remains within the predicted drawdown (+30m) as of March 2022. A Level 2 TARP criteria applies at TNC036-BGSS-412.5m over the reporting period (Table 5).

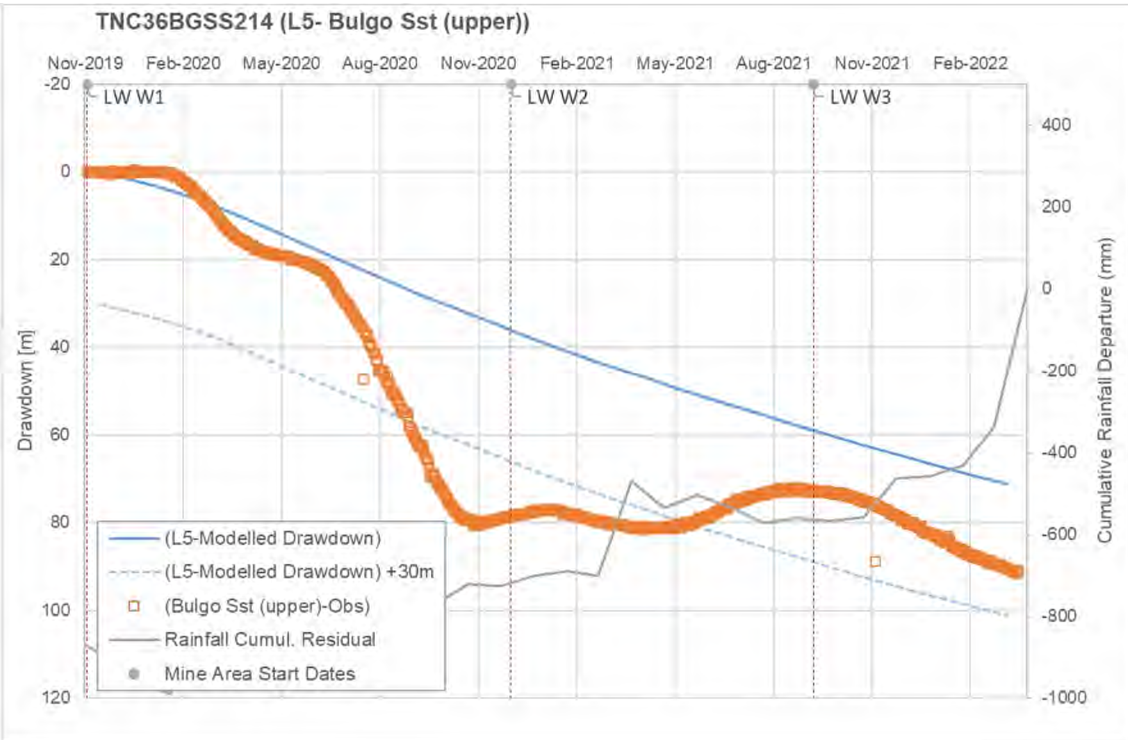



Figure 18 Comparison of Modelled and Observed Drawdown at TNC036 (BGSS-214m) with the +30m Threshold Modelled Drawdown

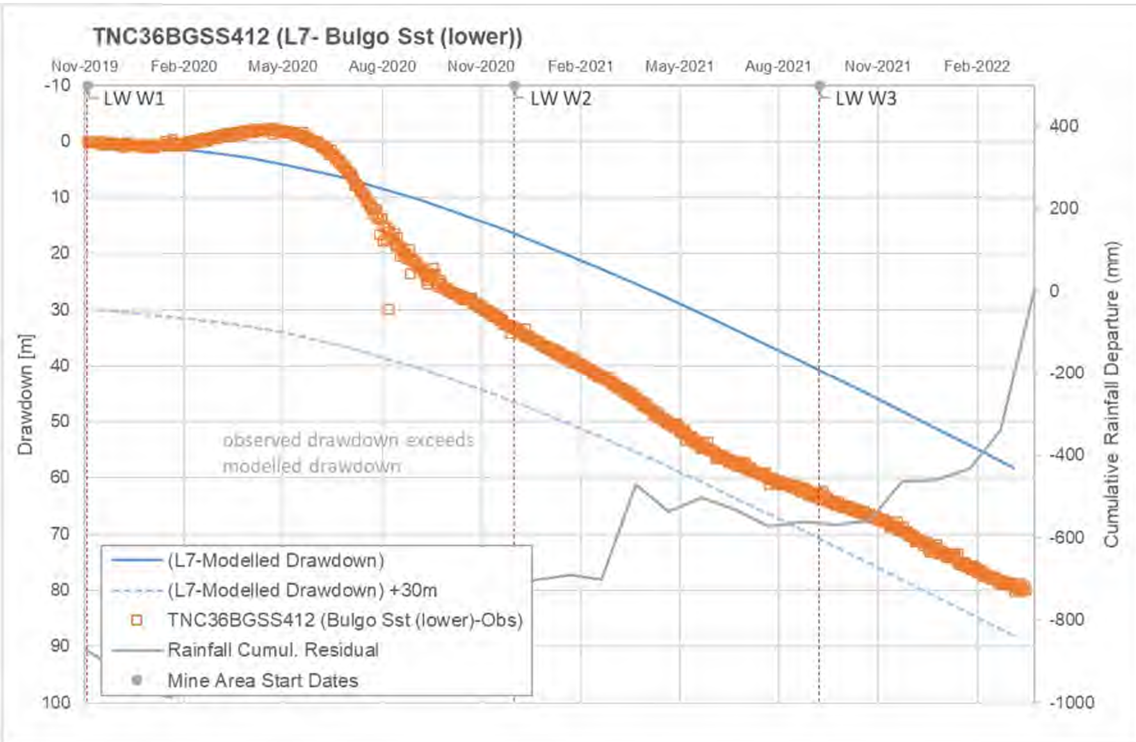



Figure 19 Comparison of Modelled and Observed Drawdown at TNC036 (BGSS-412.5m) with the +30m Threshold Modelled Drawdown

# 5 Groundwater Quality Trigger Review

## 5.1 Trigger Criteria

The approved trigger criteria for groundwater quality are summarised in Table 8. Appendix B2 details the water quality impact assessment trigger criteria from the LW W3-W4 Extraction Plan (Tahmoor Coal, 2021) and the appropriate action plan to be enacted should a trigger exceedance in groundwater quality occur during mining of LW W1-W2.

The groundwater triggers for water quality parameters are detailed in the Groundwater Technical Report (SLR, 2021) and reproduced in Table 9 below. These values were set for each bore. The water quality triggers were assigned as follows:

- pH - each bore was assigned a lower and upper pH trigger level based on the minimum and maximum pH value recorded in the available dataset minus/plus a pH unit;
- electrical conductivity (EC) - this trigger was established for each bore as the maximum observed EC during the pre-mining baseline and early mining period, plus ten percent of this maximum value; and
- for metals, either:
    - when the maximum metal concentration was recorded during the mining period, the trigger was set at the 95$^{th}$ percentile of the full historical data record (pre-mining and mining period); or
    - when the maximum metal concentration was recorded during the baseline period, the trigger level was defined as the maximum concentration plus ten percent of that value.

Further details on the methodology to develop the proposed groundwater quality trigger levels are provided in the Section 6.2.2 of the Groundwater Technical Report LWW3-W4 (SLR, 2021).

## Table 8 Groundwater Quality TARP Criteria for Open Standpipes and Private Bores (Tahmoor Coal, 2021)

| Significance Level | Criteria |
|---|---|
| | Open Standpipes |
| Level 1 | No observable change in salinity, pH or metals outside of the baseline variability*. |
| Level 2 | 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.<br>AND/OR A similar trend or response has been noted at other monitored bores or private groundwater bores. |
| Level 3 | Short term increase (< 3 months) in salinity and/or metals or change in pH outside of baseline variability*. The effect persists after a significant rainfall recharge event.<br>AND/OR the change in water quality is determined not to be controlled by climatic or anthropogenic factors. |
| Level 4 | 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.<br>AND The reduction in water quality is determined not to be controlled by climatic or anthropogenic factors. |

*the baseline variability was estimated using available data and refers to the proposed trigger levels (refer the section 6.2.2 and Table 6.2 of Groundwater Technical Report (SLR,2021)

## Table 9 Triggers for Groundwater Quality TARPs

| Bore | Trigger Level | | | Trigger Level Concentrations (mg/L) for Metals | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | EC (µS/cm) | pH lower | pH upper | Fe | Mn | Cu | Pb | Zn | Ni | Al | As | Li | Ba | Sr | Se |
| P12A | 942 | 5.4 | 8.1 | 26.4 | 1.7 | 0.0110 | 0.0044 | 75.90 | 0.011 | 0.06 | 0.011 | 0.06 | 0.3 | 0.1 | 0.011 |
| P12B | 729 | 5.0 | 8.2 | 15.2 | 1.3 | 0.0044 | 0.0076 | 50.6 | 0.011 | 0.04 | 0.011 | 0.04 | 0.4 | 0.2 | 0.011 |
| P12C | 528 | 5.9 | 9.2 | 23.1 | 0.8 | 0.0034 | 0.0011 | 0.90 | 0.011 | 0.04 | 0.011 | 0.1 | 0.2 | 0.1 | 0.011 |
| P13A | 1232 | 5.2 | 9.4 | 69.3 | 1.5 | 0.0036 | 0.0014 | 0.91 | 0.011 | 0.04 | 0.011 | 0.03 | 0.4 | 0.3 | 0.011 |
| P13B | 1269 | 5.4 | 9.6 | 16.6 | 1.2 | 0.0020 | 0.0011 | 0.22 | 0.011 | 0.06 | 0.011 | 0.04 | 0.2 | 0.3 | 0.011 |
| P13C | 376 | 6.3 | 10.2 | 46.2 | 1.4 | 0.0011 | 0.0011 | 0.1 | 0.011 | 0.1 | 0.011 | 0.02 | 0.1 | 0.3 | 0.011 |
| P14A | 396 | 4.1 | 9.1 | 15.4 | 2.0 | 0.0022 | 0.0011 | 0.21 | 0.011 | 0.05 | 0.011 | 0.01 | 0.1 | 0.1 | 0.011 |
| P14B | 915 | 4.6 | 8.8 | 46.2 | 0.9 | 0.0022 | 0.0011 | 0.22 | 0.011 | 0.04 | 0.011 | 0.07 | 0.1 | 0.2 | 0.011 |
| P14C | 1881 | 5.3 | 9.4 | 19.8 | 1.5 | 0.0011 | 0.0011 | 0.04 | 0.011 | 0.1 | 0.011 | 0.11 | 0.2 | 0.4 | 0.011 |
| P14D | 1198 | 5.5 | 9.6 | 11.0 | 1.9 | 0.0011 | 0.0011 | 0.04 | 0.011 | 0.04 | 0.011 | 0.35 | 0.1 | 0.2 | 0.011 |
| P15A | 4620 | 4.63 | 8.22 | 5.7 | 1.0 | 0.0011 | 0.0011 | 0.28 | 0.0011 | 0.055 | 0.011 | 0.13 | 2.9 | 2.3 | 0.011 |
| P15B | 3575 | 4.11 | 12.1 | 4.8 | 0.9 | 0.0011 | 0.0011 | 0.09 | 0.0011 | 0.055 | 0.011 | 0.14 | 1.3 | 1.2 | 0.011 |
| P15C | 2090 | 5.04 | 8.66 | 6.2 | 0.5 | 0.0011 | 0.0011 | 0.19 | 0.0011 | 0.033 | 0.011 | 0.20 | 0.5 | 0.5 | 0.011 |
| P15D | 1430 | 5.48 | 7.72 | 3.5 | 0.9 | 0.0011 | 0.0011 | 0.13 | 0.0011 | 0.055 | 0.011 | 0.19 | 0.2 | 0.4 | 0.011 |
| P16A | 1539 | 4.9 | 7.8 | 116.0 | 3.9 | 0.0011 | 0.0011 | 0.1 | 0.011 | 0.04 | 0.011 | 0.06 | 0.3 | 0.5 | 0.011 |
| P16B | 1180 | 5.9 | 9.6 | 41.8 | 1.8 | 0.0011 | 0.0011 | 0.03 | 0.011 | 0.05 | 0.011 | 0.04 | 0.2 | 0.1 | 0.011 |
| P16C | 1212 | 6.2 | 9.5 | 46.6 | 1.6 | 0.0011 | 0.0011 | 0.02 | 0.011 | 0.05 | 0.011 | 0.1 | 0.1 | 0.1 | 0.011 |
| P17 | 2019 | 4.8 | 8.3 | 10.6 | 0.6 | 0.0011 | 0.0011 | 0.2 | 0.011 | 0.04 | 0.011 | 0.11 | 0.2 | 0.7 | 0.011 |
| GW105546 | 448 | 3.5 | 7.2 | 37.4 | 1.6 | 0.0011 | 0.0011 | 0.1 | 0.011 | 0.03 | 0.011 | 0.011 | 0.05 | 0.04 | 0.011 |
| GW105467 | 1041 | 3.7 | 6.8 | 77.0 | 3.9 | 0.094 | 0.0019 | 0.2 | 0.039 | 0.04 | 0.011 | 0.072 | 0.1 | 0.04 | 0.011 |

| Bore | Trigger Level | | | Trigger Level Concentrations (mg/L) for Metals | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | EC (µS/cm) | pH lower | pH upper | Fe | Mn | Cu | Pb | Zn | Ni | Al | As | Li | Ba | Sr | Se |
| GW105228 | 1793 | 4.6 | 7.1 | 31.4 | 2.7 | 0.0011 | 0.0011 | 0.2 | 0.0181 | 0.04 | 0.011 | 0.026 | 0.23 | 0.15 | 0.011 |
| GW072402 | 8151 | 4.7 | 7.5 | 63.8 | 0.9 | 0.0019 | 0.0011 | 0.2 | 0.011 | 0.03 | 0.011 | 0.157 | 0.3 | 0.5 | 0.011 |
| GW115860* | 948.2 | 4.9 | 7.25 | 16.5 | 0.9 | 0.0011 | 0.0011 | 0.02 | 0.011 | 0.022 | 0.011 | 0.253 | 0.51 | 0.3 | 0.011 |
| GW104090 | 3861 | 5.3 | 7.5 | 50.6 | 1.4 | 0.0011 | 0.0011 | 0.05 | 0.022 | 0.033 | 0.011 | 1.650 | 0.1 | 1.2 | 0.011 |

'*" Revised trigger level for Ba at bore GW115860 following the groundwater trigger investigation presented in SLR (2022a)

## 5.2 Discussion of Groundwater Quality Exceedances

The following section details the groundwater quality compliance at Tahmoor Coal in relation to the groundwater quality triggers. Table 10 presents the occurrence of trigger level exceedances in groundwater quality (EC, pH and metals) over the reporting period as per the proposed trigger values (Table 9) and the TARP trigger criteria found respectively in Appendix B.

A brief analysis of the EC, pH and metal concentrations in relation to climate and mining activity during the reporting period is presented in Sections 5.2.1 to 5.2.3 alongside trigger exceedances. Time series plots with the approved trigger values (EC, pH, metals) with exceedances only are shown in Appendix D, Figures D1-D25.

Table 10 Trigger Exceedances for pH, EC and Metal Concentrations over the Reporting Period (November 2021 – March 2022)

| Bore | Month | Trigger Level Exceedance | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EC (µS/cm) | pH lower | pH upper | Fe | Mn | Cu | Pb | Zn | Ni | Al | As | Li | Ba | Sr | Se |
| Shallow OSP | | | | | | | | | | | | | | | | |
| P12A | Nov | | | | | | | | | | | | | | | |
| | Dec | | | | | | | | | | | | | | | |
| | Jan | | | | | | | | | | | | | | | |
| | Feb | | | | | | L2 | L2 | | | | | | | | |
| | Mar | | | | | | | | | | | | | | | |
| P12B | Nov | | | | | | | | | | | | | | | |
| | Dec | | | L2 | | | | | | | L2 | | | | | |
| | Jan | | | L2 | | | | | | | | | | | | |
| | Feb | | | L2 | | | | | | | | | | | | |
| | Mar | | | *L4 | | | | | | | | | L2 | | | |
| P12C | Nov | | | | | | | | | | L2 | | | | | |
| | Dec | | | | | | | | | | | | | | | |
| | Jan | | | | | | | | | | | | | | | |
| | Feb | | | | | | | | | | | | | | | |
| | Mar | | | | | | | | | | | | | | | |
| P14A | Nov | | | | | | L2 | | | | | | L2 | | L2 | |
| | Dec | | | | | | | | | | | | | | | |
| | Jan | | | | | | | | | | | | | | | |
| | Feb | | | | | | | | | | | | L2 | | | |
| | Mar | | | | | | | | | | | | | | | |
| P14B | Nov | | | | | | | | | | | | | | | |
| | Dec | | | | | | | | | | L2 | | | | | |

| Bore | Month | Trigger Level Exceedance | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EC (µS/cm ) | pH lower | pH upper | Fe | Mn | Cu | Pb | Zn | Ni | Al | As | Li | Ba | Sr | Se |
| | Jan | | | | | | | | | | L2 | | | | | |
| | Feb | | | | | | | | | | | | | | | |
| | Mar | | | | | | | | | | | | | | | |
| P14C | Nov | | | | | | | | | | L2 | | | | | |
| | Dec | | | | | | | | | | | | | | | |
| | Jan | | | | | | | | | | | | | | | |
| | Feb | | | | | | | | | | L2 | | | | | |
| | Mar | | | | | | | | | | | | | | | |
| P14D | Nov | | | | | | | | | | | | | | | |
| | Dec | | | | | | | | | | | | | | | |
| | Jan | | | | | | | | | | | | | | | |
| | Feb | | | | | | | | | | | | | | | |
| | Mar | | | | | | | | | | | | | | | |
| P15A | Nov | | | | | | | | | | | | | | L2 | |
| | Dec | | | | | | | | | | | | | | L2 | |
| | Jan | | | | | | | | | | | | | | *L4 | |
| | Feb | L2 | | | | | | | | | | | | | *L4 | |
| | Mar | L2 | | | | | | | | | | | | | *L4 | |
| P15B | Nov | | | | | | | | | | | | | | L2 | |
| | Dec | L2 | | | | | | | | | | | | | | |
| | Jan | | | | | | | | | | | | | | | |
| | Feb | | | | | | | | | | | | | | L2 | |
| | Mar | L2 | | | | | | | | | | | | | | |
| P15C | Nov | | | | | L2 | | | | | | | | | L2 | |
| | Dec | | | | | | | | | | | | | | | |
| | Jan | | | | | | | | | | | | | | | |
| | Feb | | | | | | | | | | L2 | | | | L2 | |
| | Mar | | | | | L2 | | | | | | | | | L2 | |
| P15D | Nov | | | | | | | | | | | | | | | |
| | Dec | | | | | | | | | | | | | | | |
| | Jan | | | | | | | | | | | | | | | |
| | Feb | | | | L2 | | | | | | | | | L2 | | |
| | Mar | | | | | | | | | | | | | | | |
| P16A | Nov | | | | | | | | | | | | | L2 | | |

| Bore | Month | Trigger Level Exceedance | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EC (µS/cm) | pH lower | pH upper | Fe | Mn | Cu | Pb | Zn | Ni | Al | As | Li | Ba | Sr | Se |
| | Dec | | | | | | | | | | | | | | | |
| | Jan | | | | | | | | | | | | | | | |
| | Feb | | | | | | | | | | | | | | | |
| | Mar | | | | | | | | | | | | | | | |
| P16B | Nov | | | | | | | | | | | | | | L2 | |
| | Dec | | | | L2 | | | | | | | | | | L2 | |
| | Jan | | | | | | | | | | | | | | | |
| | Feb | | | | | | | | | | | | | | L2 | |
| | Mar | | | | L2 | | | | | | | | | | | |
| P16C | Nov | | | | | | | | | | | | | | | |
| | Dec | | | L2 | | | | | | | | | | | | |
| | Jan | | | | | | | | | | | | | | | |
| | Feb | | | | | | | | | | | | | | | |
| | Mar | | | | | | | | | | | | | | | |
| Private Bores | | | | | | | | | | | | | | | | |
| GW104090 | Jan | | | | | | | | | | | | | L2 | L2 | |
| GW105467 | Jan | | | | | | | | | | | | | | | |
| GW105228 | Jan | | | | | | | | | | | | | L2 | | |
| GW072402 | Jan | | | | | | | | | | | | | L2 | | |
| GW115860 | Jan | *L4 | | | | | | | | | | | | *L4 ^ | | |
| GW105546 | Jan | | | | | | | | | | | | | | | |

TARP Level 1 TARP Level 2 TARP Level 3 Potential TARP Level 4 no site access

site decommissioned (P13 and P17)

*LX: maximum trigger level exceedances recorded*

"*" remains a potential Level 4 TARP trigger

"^" A potential TARP Level 4 was identified at GW115860 for Ba. Following the groundwater trigger investigation (SLR,2022a), a revision of the trigger levels was recommended with a reduction to a TARP Level 1 (see Section 5.2.3.8)

### 5.2.1 Electrical Conductivity (EC)

Prior to this reporting period, there had been no trigger exceedances for EC at any of the standpipes (P12-P14, P16, and P17). Private bores GW104090 and GW115860 showed a TARP Level 2 EC trigger exceedance in the July monitoring round, with GW115860 also showing an exceedance in October 2021.

During this reporting period, three monitoring sites have triggered EC trigger levels within this six-monthly monitoring period:

- P15A;

- P15B; and
- GW115860.

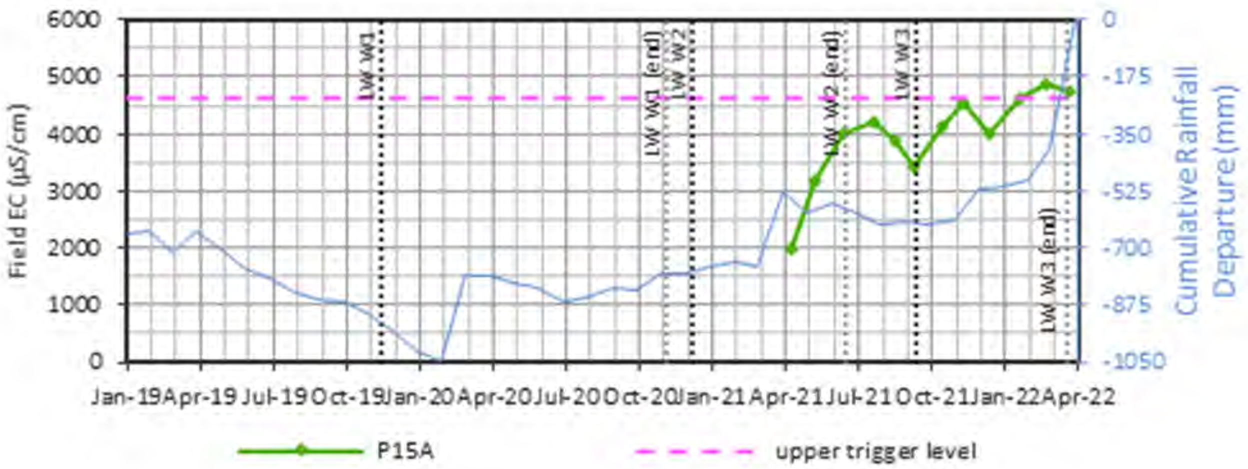
All others EC measurements from the Tahmoor standpipes and private bores are within the Level 1 TARP.

#### 5.2.1.1 P15A

EC in P15A shows fluctuating behaviour since monitoring started in April 2021. The salinity at P15A has been increasing from 4,010 in December 2021 to 4,860 µS/cm in February 2022 before reducing to 4,760 µS/cm in March 2022. Since February 2022, EC has been marginally above the TARP Level 2 of 4,620 µS/cm (Figure 20).

#### 5.2.1.2 P15B

EC in P15B also shows fluctuating behaviour. At P15B, EC triggered a TARP Level 2 of 3,575 µS/cm in December 2021 before returning within TARP Level 1 in January 2022. In February 2022, EC increased to 4270 µS/cm and reduced slightly to 4,210 µS/cm in March 2022 triggering the TARP Level 2 since February 2022 (Figure 20).



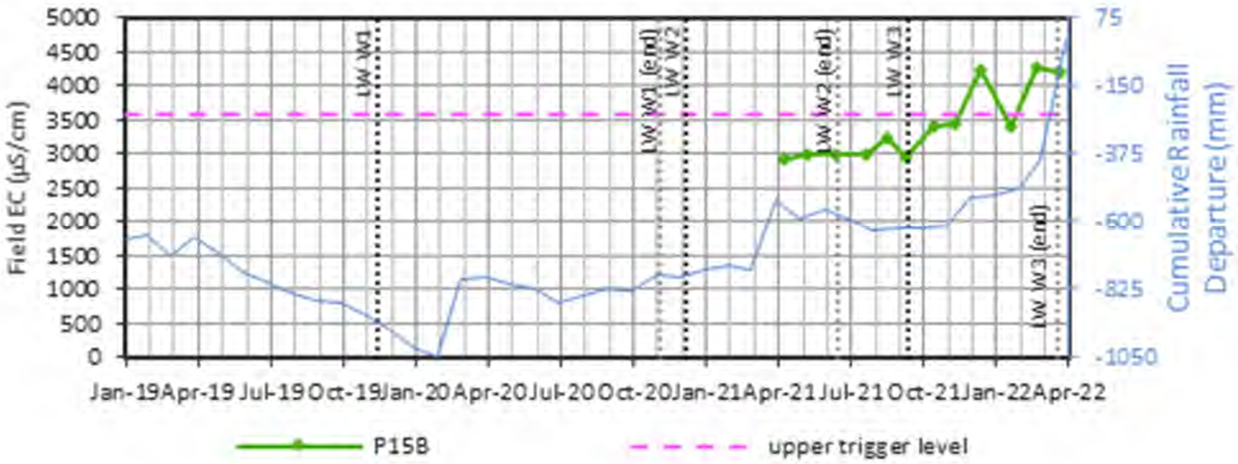




Figure 20 EC Exceedances at P15A and P15B

#### 5.2.1.3 GW115860

The salinity at GW115860 has been steadily increasing from 621 µS/cm in January 2021 to 1,246 µS/cm in March 2022. Final EC in January 2022 at this bore exceeds the trigger level of 948.2 µS/cm for three consecutive recordings (greater than 6 months), resulting in a potential TARP Level 4 (Figure 21). Private bore GW115860 is used for domestic purposes. SLR (2022a) investigated the trigger exceedances at GW115860 for EC. The following summarises the findings presented in SLR (2022a):

- The reason for the increased EC at GW115860 is unclear, although it is consistent with the trend observed at nearby bore GW105228. Therefore, this trigger is only 'potential' Level 4 TARP trigger, and it has not been confirmed that the cause is mining.
- No drawdown was observed during the extraction of LW LW3 at GW115860, and hence drawdown does seem to be the cause of the change in EC;
- The increase in EC at GW115860 (to 1,246 µS/cm) does not change the beneficial use classification of the groundwater extracted at this site, and therefore the currently observed effects are considered to be immaterial. Indeed, salinity (TDS) at GW115860 remains within the desirable palatability of less than 600 mg/L (class A1 category – DPIE, 2012). Groundwater quality at GW115860 remains suitable for all beneficial uses, including the current purpose.
- Given the low salinity of groundwater at GW115860, and the small incremental change in that salinity in relation to the beneficial use classifications it is recommended to continue observing this bore over the next monitoring period (April 2022) to see if EC decreases, otherwise to revise the trigger. The most reliable method to revise the trigger would be to adopt the EC trigger from GW105228 for use at GW115860 as it has been derived from a longer record period.

Further details regarding the investigation of EC exceedances at GW115860 is presented in SLR (2022a).

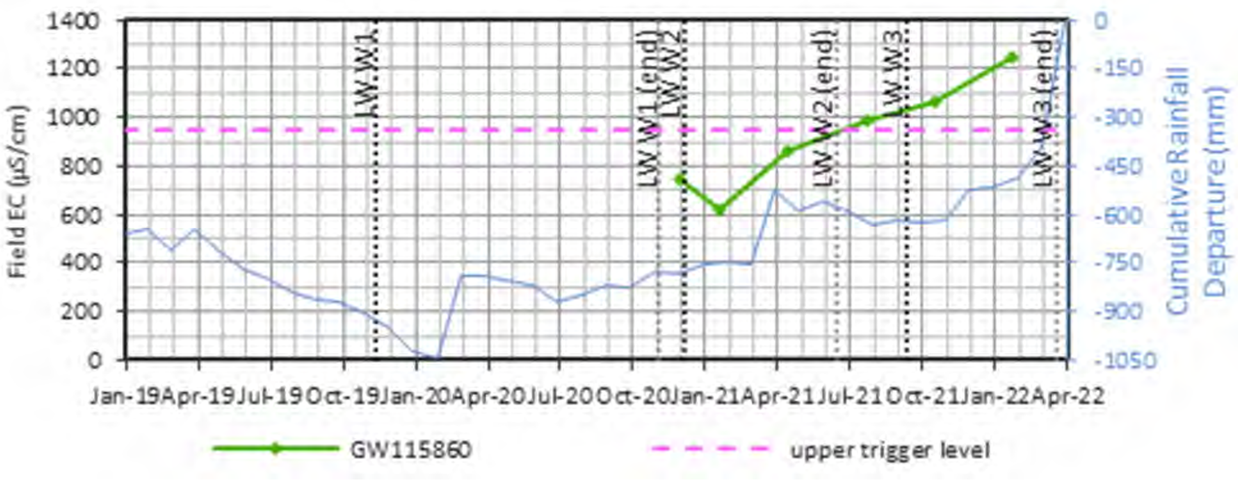



Figure 21 EC Exceedances at GW115860

### 5.2.2 pH Exceedances

Two monitoring sites have triggered pH trigger levels within this six-monthly monitoring period:

- P12B - triggered the upper pH threshold; and
- P16C - triggered the upper pH threshold.

#### 5.2.2.1 P12B

P12B triggered the upper trigger level for pH between December 2021 and March 2022 with a pH of 10.65 in March 2022 (trigger level = 8.16) (Figure 22). 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.

SLR (2022a) investigated the recent rise in pH at P12B in January 2022. The following summarises the findings:

- A rising trend in pH was previously observed at P12A, P12B and P12C around December 2020 to April 2021. It has been previously reported by SLR (2021a), that this could be due to compromised integrity of the monitoring bores combined with high rainfall causing cement to become mobilised into the groundwater.
- No anomalous variations in groundwater level were identified in P12A, P12B and P12C, that could be indication of a compromised bore integrity (SLR, 2022a and Figure A-1).
- The reason for the increase in pH at P12B causing the trigger exceedance is unclear and could potentially be related to compromised bore integrity, however an increasing trend was also observed at GW072402.
- GW072402 has experienced a pH increase from 5.9 to 6.8 between January 2021 and January 2022, however the bore had a pH of 6.5 in December 2019 just after mining began. The pH at GW072402 remains at near-neutral values (close to 7), while the pH at P12B is higher, above 10, where a value of 9.5 is often considered the maximum for some beneficial uses (Department of Environment and Heritage Protection, May 2014).

At this time, a mining-related effect is plausible, however the consequences of this effect (if it is mining-related) are considered minor.

In addition, in March 2022, pH at nearby bores P12A and P12C is within a TARP Level 1 at 6.9 and 8.61 respectively, both relatively neutral, and well below the pH seen at P12B (Figure 22). It is recommended that pH at P12B remains a potential TARP Level 4.

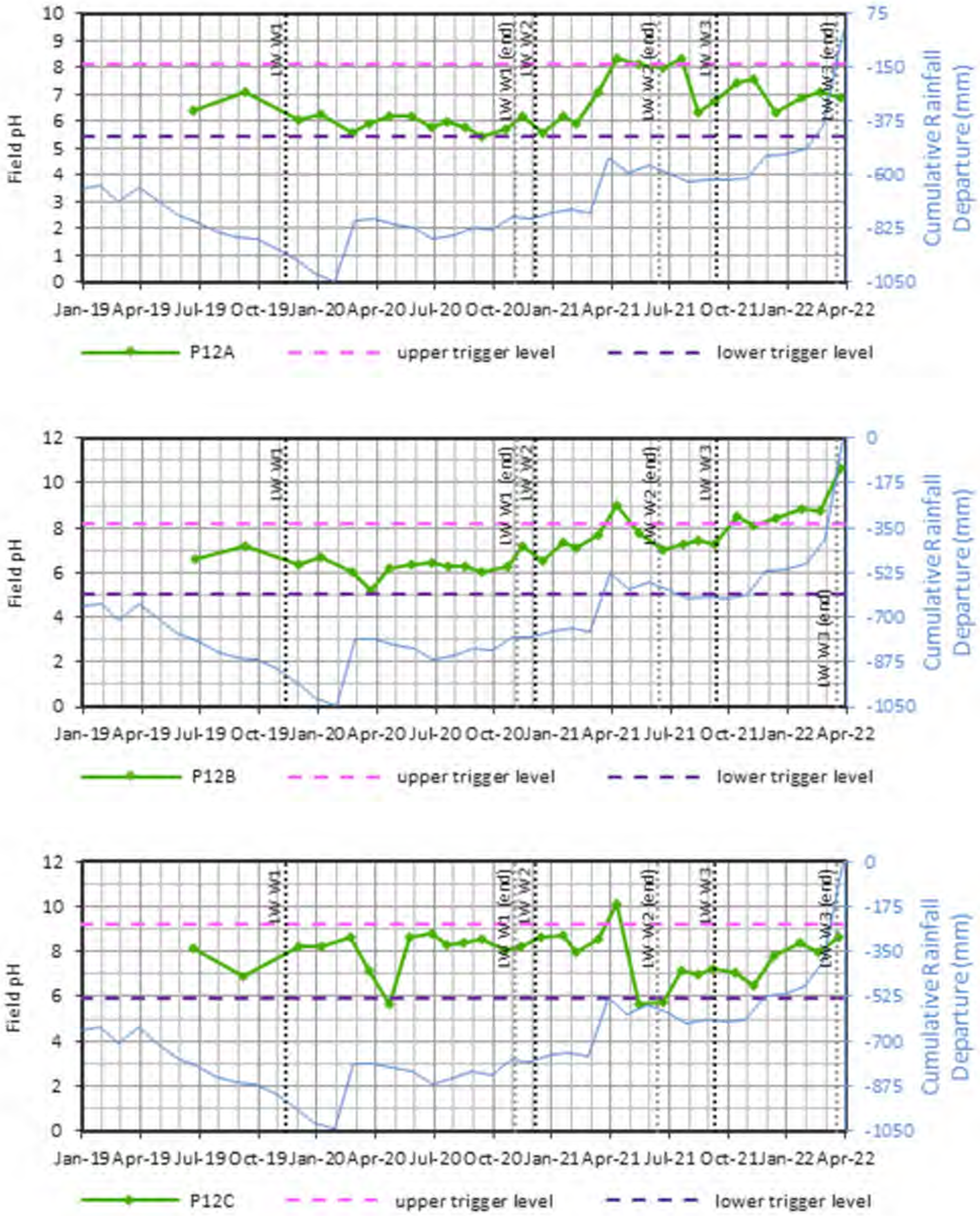



Figure 22 pH at P12A and P12C and pH Exceedances at P12B

#### 5.2.2.2 P16C

pH at P16C exceeded the TARP Level 2 trigger of 9.49 in December 2021. pH increased from 9.36 to 9.5 in December 2021. Between January 2022 and March 2022, pH at P16C shows a fluctuating behaviour ranging from 7.15 to 9.22. As of March 2022, pH at P16C is within a TARP Level 1.

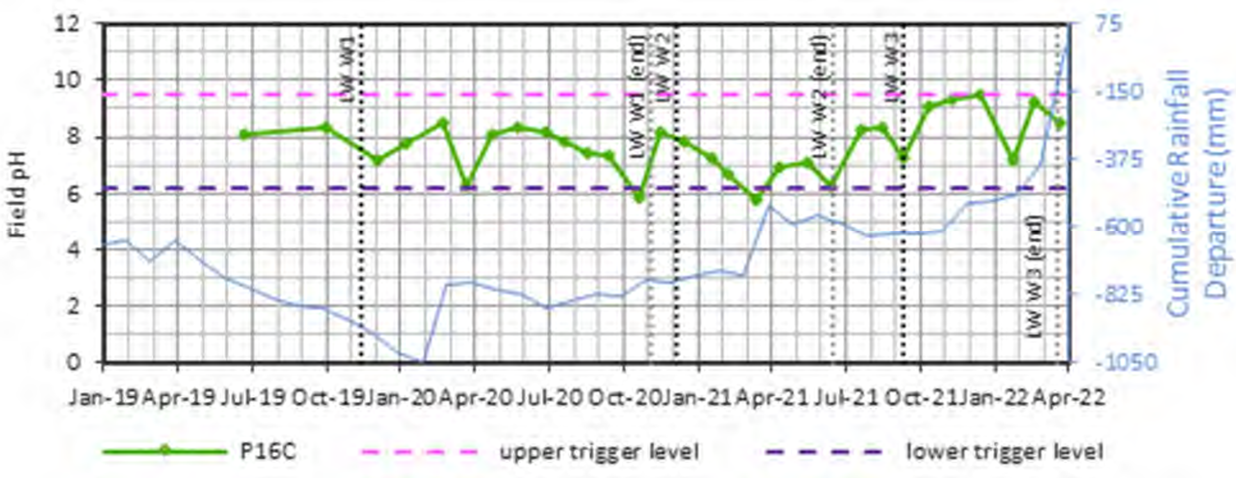



Figure 23 pH Exceedances at P16C

### 5.2.3 Metals

The following metal triggers were exceeded over the five-monthly monitoring period from November 2021 to March 2022 in the respective bores (Appendix D, Figure D-1 to Figure D-25):

- Iron (Fe) - P15D (February), and P16B (December and March)
- Manganese (Mn) – P15C (March)
- Copper (Cu) – P12A (February), P14A (November)
- Lead (Pb) – P12A (February)
- Aluminium (Al) – P12B (December), P12C (November), P14B (December and January), P14C (November and February), P15C (February)
- Lithium (Li) – P12B (March), P14A (November and February)
- Barium (Ba) – P15D (February), P16A (November), GW104090, GW105228, GW072402, GW115860 (all in January);
- Strontium – P14A (November), P15A (all months), P15B (November and March), P15C (November, February and March), P16B (November, December and February), GW104090 (January).

Over the reporting period, there were no exceedances in the lower pH and in dissolved zinc (Zn), nickel (Ni), arsenic (As) and selenium (Se).

#### 5.2.3.1 P12A, B and C

- A TARP Level 2 for dissolved copper (Cu) and lead (Pb) was triggered at P12A in February Cu concentrations increased from 0.001 mg/Lto 0.011 mg/L in February (i.e. at the trigger level) reducing to 0.005 mg/L in March (Appendix D, Figure D-1). Pb concentrations increased from 0.002 mg/l to 0.005 mg/L in February above the trigger level of 0.0044 mg/L and reducing to 0.003 mg/L in March (Appendix D, Figure D-2).
- A TARP Level 2 for dissolved aluminium (Al) and lithium (Li) was triggered in December and March respectively at P12B. Dissolved (Al) increased from 0.01 mg/L to 0.04 mg/L in December. This aluminium concentration remained close to the trigger level (0.038 mg/L) (Appendix D, Figure D-3). It is noted that aluminium concentrations in all standpipes across the site show fluctuations in the range of 0.01 to 0.06 mg/L, and these are considered representative of the natural groundwater system. Thus, the trigger level for P12B may be too conservative considering the background levels, and therefore occasional exceedances of the trigger limit are expected to occur. Dissolved (Li) increased from 0.027 mg/L to 0.065 mg/L in March marginally above the trigger level of 0.042mg/L (Appendix D, Figure D-4).
- A TARP Level 2 for dissolved aluminium (Al) was triggered in November at P12C. Dissolved (Al) increased from 0.01 mg/L to 0.05 mg/L in November (Appendix D, Figure D-5). Like P12B, this aluminium concentration remained close to the trigger level (0.04 mg/L) and is considered representative of the natural groundwater system.

#### 5.2.3.2 P14A

A TARP Level 2 for dissolved copper (Cu) and strontium (Sr) was triggered in November at P14A. Cu concentration increased to 0.003 mg/L in November, above the trigger level of 0.022 mg/L (Appendix D, Figure D-6). Sr concentration increased to 0.069 mg/L in November, above the trigger level of 0.06 mg/L (Appendix D, Figure D-7).

A TARP Level 2 for dissolved lithium (Li) was triggered in November and February at P14A. Concentrations increased to 0.011 mg/L and 0.09 mg/L marginally above the trigger level of 0.066 mg/L (Appendix D, Figure D-8). As of March, lithium concentration reduced to 0.05 mg/L. As of March 2022, Li concentrations are within TARP Level 1.

#### 5.2.3.3 P14B, C

Short-term increases in dissolved Al triggered the TARP Level 2 throughout the reporting period. A TARP Level 2 was triggered in December and January at P14B for dissolved Al with concentrations rising to 0.05 mg/L (trigger level of 0.044 mg/l) (Appendix D, Figure D-9). A TARP Level 2 was recorded at P14C in November and February with concentration observed rising to the trigger level of 0.05 mg/L (Appendix D, Figure D-10). As mentioned above, aluminium concentrations show natural fluctuations in the range of 0.01 to 0.06 mg/L and these exceedances are not considered a cause for concern.

#### 5.2.3.4 P15A

Strontium levels at P15A have continually exceeded the trigger of 2.31 mg/L from September 2021 to March 2022 monitoring rounds resulting in a potential TARP Level 4 exceedance in January 2022 (Appendix D, Figure D-11). Strontium concentrations have decreased from 3.7 mg/L in January 2022 to 3.1 mg/L in March 2022. SLR (2022a) investigated the recent Sr exceedances at P15A in January 2022 with no clear mining-impact identified.

In March 2022, Sr concentrations at nearby bores P15B and P15C resulted in a minor decrease (-0.2 mg/L at P15B) and was stable at P15C at 0.47 mg/L and observed within a TARP Level 1 at bores P15D, P14A-D. As presented in SLR (2022a), the stable and minor increase in Sr concentrations observed at nearby bores suggest that the exceedance in Sr concentrations in March 2022 at P15A remains a potential TARP Level 4.

Further details regarding the strontium investigation are presented in SLR (2022a). The following presents a summary of the findings:

- Since the start of monitoring at site P15A-D, the Sr concentrations are above the ranges reported at the unaffected sites in Morrison *et al*. (2019) and above the pre-mining Sr concentrations at P14A-P14D except for P15D within pre-mining Sr concentrations at P14.
- No exceedances in Sr concentrations were identified at surface water monitoring sites along Stonequarry Creek, with all surface water monitoring sites across the Western Domain within TARP Level 1 for water quality in January 2022 (HEC, 2022b) and during the reporting period (HEC, 2022a).
- From the U.S Environmental Protection Agency, Sr concentrations in drinking water are assessed relative to the health-based screening level benchmark of 4 mg/L (Musgrove, 2021). Values greater than 4 mg/L are considered high, between 2 mg/L and less than 4 mg/L are considerate moderate and less than 2.0 mg/L are considered low. At P15A, Sr concentrations are considered moderate (less than 4.0 mg/L).
- Since monitoring started at P15A, the higher Sr concentrations observed at P15A compared to other sites (i.e. P14, GW105228 and GW115860) and compared to the deeper piezometers (i.e. P15B-D) suggest a localised Sr source in groundwater at piezometer P15A.
- The range of strontium in natural soils is highly variable, from 50 mg/kg to 1000 mg/kg (USEPA, 1983). P15A is located within the mapped alluvium (Figure 1) and may be screened within alluvial soil with a higher Sr concentration compared to the deeper lithology of weathered and fresh Hawkesbury Sandstone. No bore logs are available to review and verify the lithology at this location.

- The Sr concentrations at nearby registered bores GW105228 and GW115860 are considered low (less than 2 mg/L) (Musgrove, 2021) suggesting no risk of human-health concerns and that the increase in Sr concentrations at P15A is possibly localised.

It is recommended to continue monitoring Sr concentration at site P15A-D, P14A-D and at the two nearby registered bores (GW105228 and GW115860).

#### 5.2.3.5 P15B, C and D

At P15B, strontium levels exceeded the trigger of 1.21 mg/L in November (1.3 mg/L) and February (1.4mg/L) triggering the TARP Level 2. As of March 2022, strontium levels reduced to 1.2 mg/L (Appendix D, Figure D-12).

At P15C, strontium levels exceeded the trigger of 0.45 mg/L in November (concentration rising at the trigger level), in February and March (0.47 mg/L) triggering the TARP Level 2 (Appendix D, Figure D-13). Short-term increases in dissolved Al and Mn were also recorded at P15C triggering a TARP Level 2. Al levels increased from 0.01 mg/l in January to 0.04 mg/L in February, being stable in March above the trigger level of 0.03 mg/L (Appendix D, Figure D-14). As mentioned above, aluminium concentrations show natural fluctuations in the range of 0.01 to 0.06 mg/L and these exceedances are not considered a cause for concern. Mn levels were recorded marginally above the trigger level of 0.54 mg/L in November (0.55 mg/L) and in March (0.58 mg/L) (Appendix D, Figure D-15). As of March 2022, Mn levels at P15C appear lower than in the upper Hawkesbury Sandstone recorded at 0.82 mg/L (P15A) and 0.59 mg/L (P15B) and within a TARP Level 1.

A TARP Level 2 for dissolved iron (Fe) and barium (Ba) was triggered in February at P15D. Fe levels increased from 2.3 mg/L in January to 4.8 mg/L in February and as of March reduced to 2.2 mg/L (TARP Level 1) (Appendix D, Figure D-16). Ba levels increased from 0.15mg/L in December to 0.21 mg/L in February and as of March reduced below the trigger level of 0.21 mg/L to 0.17mg/L (Appendix D, Figure D-17).

#### 5.2.3.6 P16A

A TARP Level 2 for barium (Ba) was triggered in November at P16A. Ba levels increased to 8.5 mg/L in November and reduced to 0.1 mg/L for the rest of the reporting period (Appendix D, Figure D-18). This single trigger is likely an outlier and could be attributed to a lab error measurement. Ba levels at P16A have been observed at 0.1 mg/L since monitoring started.

#### 5.2.3.7 P16B

A TARP Level 2 for Sr was triggered in November and December at P16B and returned to TARP Level 1 in January. In February, Sr levels increased to 0.15 mg/L above the trigger level of 0.13 mg/L triggering the TARP Level 2 (Appendix D, Figure D-9). As of March, Sr reduced to 0.08 mg/L within a TARP Level 1. A TARP Level 2 for Fe was triggered in December at P16B which follows a period of decline in levels observed since July 2021. In January and February, Fe levels reduced within TARP Level 1 (i.e. 9.1mg/L) but as of March Fe levels increased to 86 mg/L (Appendix D, Figure D-20). Iron staining was previously reported at this location likely attributed to the installed steel casing.

#### 5.2.3.8 Private Bores

At GW104090 a short-term increase for Sr and Ba triggered a TARP Level 2 in January. Sr levels have continually been increasing since April 2021 from 0.27 mg/L to 1.7 mg/L in January 2022 (trigger level is at 1.2 mg/L) (Appendix D, Figure D-21). Ba levels increased from 0.08 mg/L in October 2021 to 0.44 mg/L (Appendix D, Figure D-22).

At GW105228, Ba concentrations exceeded the trigger of 0.228 mg/L in January resulting in a TARP Level 2. Concentrations increased marginally from 0.23 mg/L in October 2021 to 0.24 mg/L in January 2022 (Appendix D, Figure D-23).

At GW072402 Ba concentrations in January 2022 were reported at 0.28 mg/L, which is marginally above the trigger value of 0.2785 mg/L, resulting in a TARP Level 2 (Appendix D, Figure D-24).

GW115860 is located 400 m north of LW W3. Barium concentrations at GW115860 exceeded the trigger of 0.33 mg/L for the third consecutive time in the January 2022 (i.e. a period of more than six months), resulting in a potential TARP Level 4 exceedance (Appendix D, Figure D-25). Concentrations increased from 0.36 mg/L in October 2021 to 0.39 mg/L in January 2022. The first reported concentration of Ba in January 2021 at GW115860 was 0.3 mg/L with the lowest concentration reported in April 2021 (0.032 mg/L).

SLR (2022a) investigated the potential TARP Level 4 for Ba at GW115860. The following summarises the findings:

- Ba concentration at GW105228 (110 m from GW115860) are stable within 0.20-0.25 mg/L since monitoring started.
- The short record of Ba concentrations at site P15A-D shows fluctuation within the range of 0.08 to 0.21 mg/L, generally lower than at GW105228.
- No exceedances or increasing trends in Ba concentrations were identified at sites P14A-D and P15A-C (only 180 m and 65 m from LW W3) between October 2021 and January 2022 (SLR, 2021a, 2022a) except at P15D (TARP Level 2) in February 2022 slightly increasing at the trigger level.

A mining-related effect on Ba at GW115860 was assessed to be unlikely but could not be excluded at the time of the investigation. A revision to the Ba trigger level was undertaken (SLR, 2022a) as it appeared that the trigger level was conservative and could not be based on pre-mining data.

The revised trigger level for Ba at bore GW115860 is 0.51 mg/L (SLR, 2022a) (Appendix D, Figure D-27).

The revised trigger level was calculated using the maximum Ba concentration recorded at GW115860 (i.e. 0.39 mg/L in January 2022) plus 30% (i.e. 30% being the percentage increase from 0.3 mg/L in January 2021 to 0.39 mg/L January 2022).

Published guideline values for Barium are:

- 1 mg/L for recreational purposes (ANZECC, 2000 / ANZG, 2018).
- There is no guideline value for Ba for freshwater ecosystems (ANZECC, 2000 / ANZG, 2018).
- 2 mg/L for health (i.e. drinking water) (NHMRC, 2011);

The revised trigger level for Ba at GW115860 remains conservative (i.e. lower than) with respect to the guideline values stated above. Further monitoring at GW115860 will be undertaken in April 2022 to confirm trends.

# 6 Predicted and Observed Groundwater Depressurisation

The following section provides a summary of comparison between the modelled and observed groundwater levels using the groundwater model SLR (2021) results (i.e. referred in this report as the "groundwater model") presented in the Groundwater Technical Report: Extraction Plan for LW W3-W4 (SLR, 2021) and latest available observed groundwater data (up to March 2022).

## 6.1 Summary

The drawdowns observed during LW W1, LW W2 and LW W3 show a clear relationship with depth below surface (or height above the mined seam), with drawdowns greatest at depth, and being 8-15 m in the lower or mid-Hawkesbury Sandstone, and less in the shallower horizons (typically 0.5-1 m). The same trend is observed for the subsequent recovery post LW W1 and LW2, with greatest recovery in the deep piezometers (6 m) and being 1-3.5 m in the lower or mid-Hawkesbury Sandstone. As of March 2022, groundwater recovery is complete in the shallower horizons except at some site (P16A) where a potential partial recovery is observed (approximately 0.5-0.7 m below baseline).

The hydrographs for P12, P13, P14, P15, P16, and TNC036 monitoring sites were reviewed in light of the TARP exceedances (Section 4.3) at these monitoring sites (Figure 24 to Figure 29). The modelled water level for the piezometer A at each site is shown, however P13 hydrographs are shown below but no observed groundwater level data are available past October 2021, so no comparison between modelled and observed water levels is possible for this review. The key findings are:

- Piezometers at P12 and P16 are spaced, in a vertical sense, at a smaller spacing than model layers, so that it is not possible nor practical for the model to simulate or replicate water levels at all piezometers. Also, temporal discretisation does not allow all short-term variability, especially to rainfall events, to be simulated.
- The groundwater model does not simulate groundwater abstraction at private bores because the extractions are not metered by WaterNSW nor are there estimated extraction rates available.
- The model matches the groundwater level and mining-related drawdown observed in the shallowest horizons (P12A, P16A and P13A) relatively well, and in P12B and P13B. The model also replicates with accuracy the groundwater response to rainfall recharge in February 2020.
- In the deeper piezometers (P12C, P13C and P16C) the overall rate of the modelled drawdown and magnitude matched accurately the observed drawdown during 2020. Further details on the performance of the model (i.e. mining related drawdown) prior to the reporting period is provided in SLR (2021a).
- The historical period of the model ends in November 2020, which means that all predictions after December 2020 are based on average rainfall. Hence, the model does not capture the response to the rainfall recharge observed in March 2021, February and March 2022 (i.e. flood events). From November 2021, the model continues to match the groundwater level observed in the shallowest horizons (P12A) and slightly overestimates the drawdown in P14A by 1 m over the reporting period. In late 2021, the model captures the stabilisation in groundwater level in the shallow aquifer (P16A) although modelled groundwater levels are within +3 m of observed due to overestimation in modelled drawdown in 2021. This is caused by the underestimation of the modelled recharge in March-April 2021 (i.e. using average rainfall) while the observed recovery was accelerated by the flood events at the same period.

- The short records of groundwater level observed at site P15 are well replicated by the model being within 1 m of observed at the end of the reporting period. We note that piezometers P15A, B, C and D all sit within the same model layer 2. With groundwater drawdown expected at this site, the presence of multiple piezometers within a single layer makes it challenging (if not impossible) to replicate or match all observations. The model overestimates the drawdown at P15 in layer 2 by approximately 5 m while observed groundwater levels show short-term water level decline in the range of 0.5-0.8m. This is expected at this location as the modelled recharge in March-April 2021 and March 2022 are underestimated and the observed groundwater levels show responses to rainfall during the same period. At the end of the reporting period, modelled groundwater levels in Layer 1 and Layer 2 are within +/- 2 m to 5 m within observed groundwater level which is acceptable. Similar observations apply to site P14 in terms of model layering and model performance.
- At P12, the recovery in groundwater level (model layer 2) is a good approximation of the recovery in P12C (i.e. same was true for the drawdown in 2020). The timing of recovery is well replicated, while its magnitude is slightly underestimated by the model (within 3 m of observed). From November 2021, the model replicates the magnitude of drawdown due to LW W3 in the range of 1 m, being similar for observed water levels at P12C. At P13, model layer 2 was also a good approximation of drawdown at P13C however the lack of modelled recharge in early 2021 underestimates the magnitude of recovery but modelled levels at P13C remain within 1 m of observed in October 2021. No observed data is available to compare to modelled water levels after October 2021.
- At P16B and P16C, sitting within the model in Layer 1 and Layer 2 respectively, the model replicates the stabilisation of water level throughout May 2021 but underestimates the observed recovery from June 2021 likely caused by the lower modelled recharge in March 2021. At the start of the reporting period, modelled water levels match the stabilisation in the observed groundwater levels but do not capture the short-term water level decline observed early January 2022. Modelled groundwater levels at the end of the reporting are well captured in P16C sitting 1.5 m of observed water levels.

At TNC036 (Figure 29) the simulation of drawdown in model layer 2 is 16 m, which is higher than in the HBSS-65m piezometer (approximately 6 m drawdown), and less than the 24 m recorded against the HBSS-97 m piezometer. The HBSS-65m and HBSS-97 m piezometers are assigned the same model layer, but the model gives a reasonable estimate in the rate and magnitude of drawdown at this location. The model captures the stabilisation in observed water levels between May and June 2021 relatively well. There is a small underestimation in the model to replicate the observed recovery in June 2021 and later in February-March 2022 but modelled groundwater levels are within 10 m observed as of March 2021 (i.e. similar as modelled prior to LW W1).

- The observed stabilisation and recovery in water levels in BGSS-169 m are well replicated by the model, being within 1 m of observed as of March 2022. This suggests that the height and mode of subsidence fracturing in this area is well represented in the model. The issue with comparing the model to these observed drawdowns and recoveries is that the attribution of depths and stratigraphy is not completely reliable (Section 4.1.2.7).

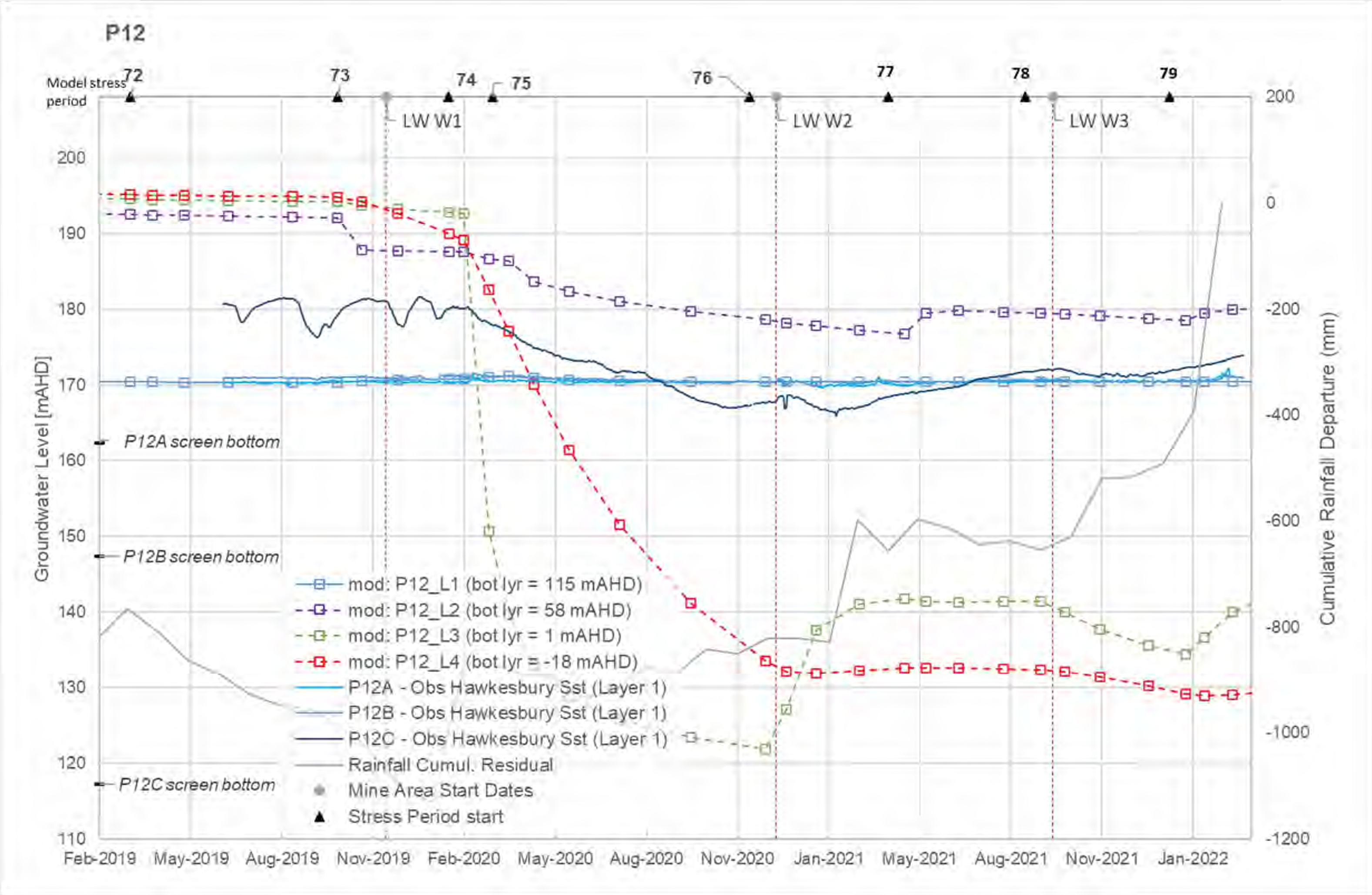



Figure 24 Comparison of Modelled and Observed Groundwater Levels at P12

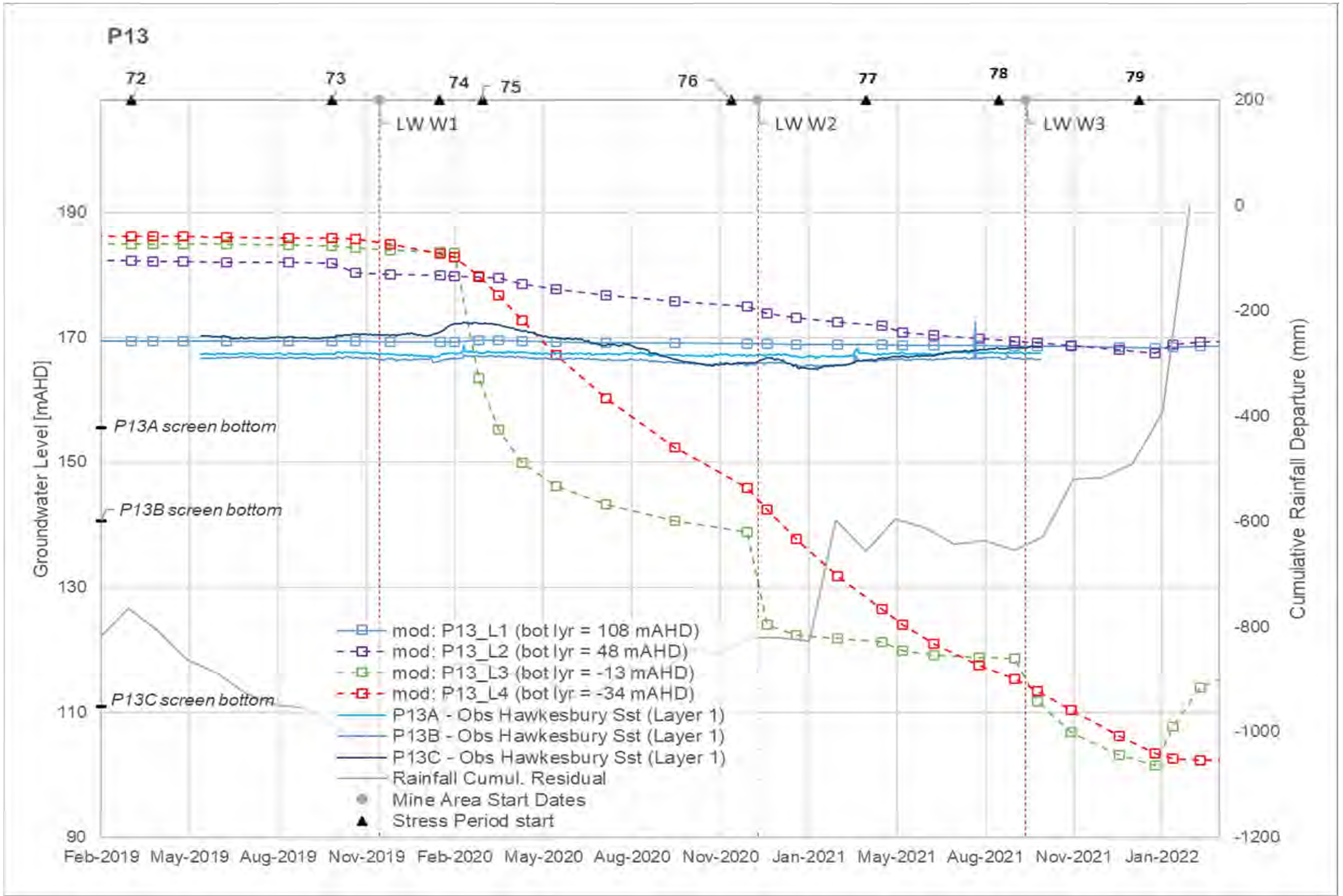



Figure 25 Comparison of Modelled and Observed Groundwater Levels at P13

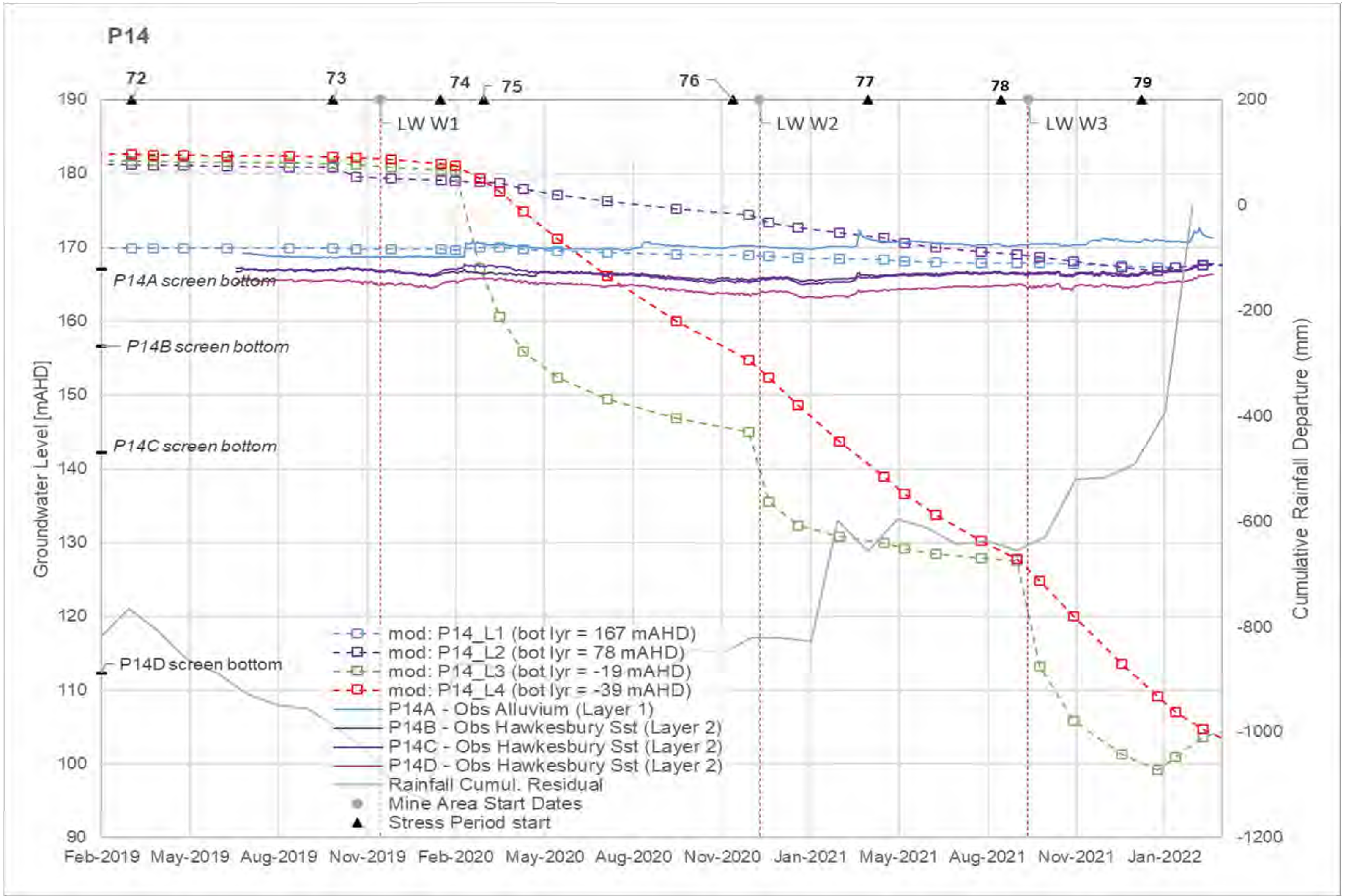



Figure 26 Comparison of Modelled and Observed Groundwater Levels at P14

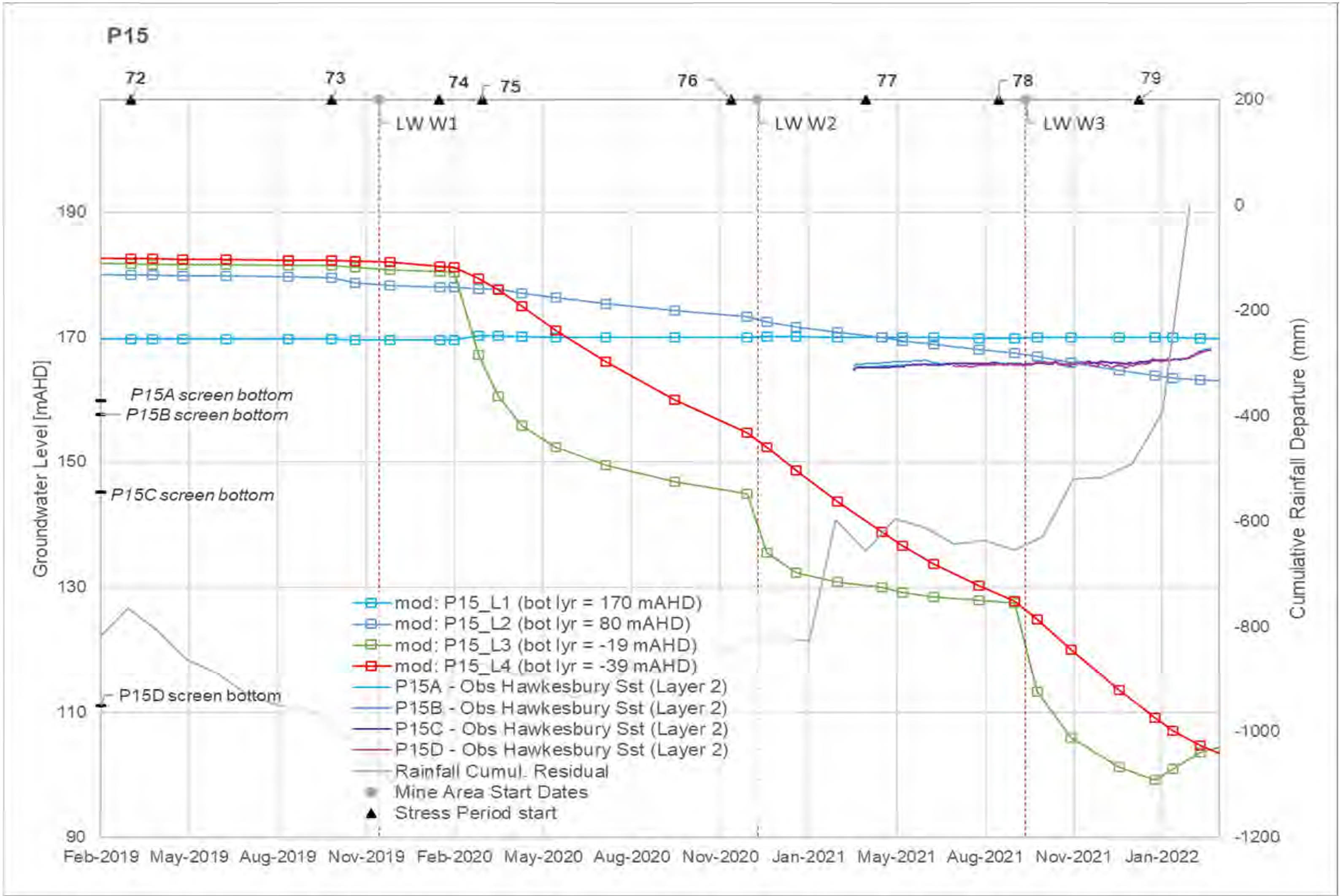



Figure 27 Comparison of Modelled and Observed Groundwater Levels at P15

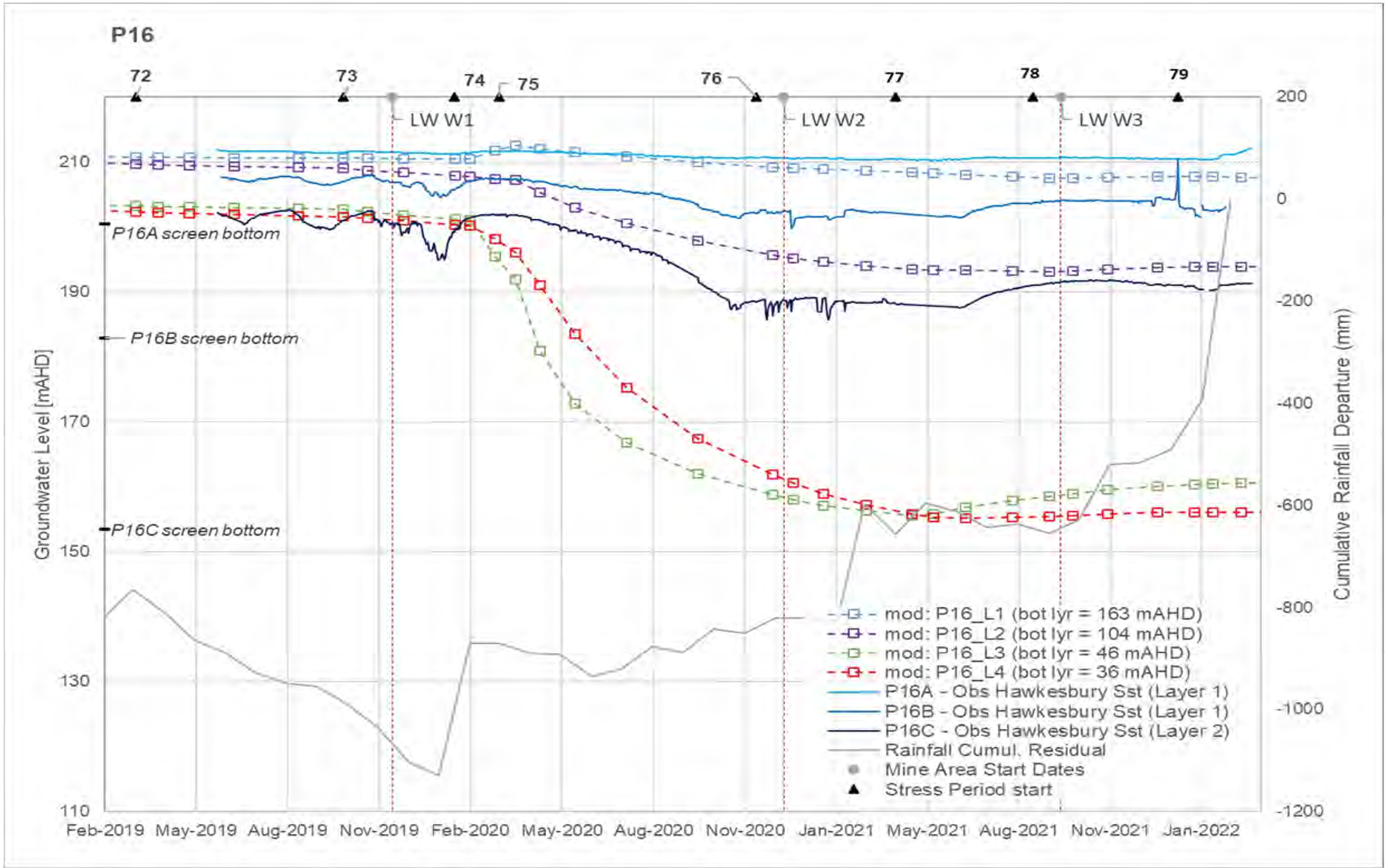



Figure 28 Comparison of Modelled and Observed Groundwater Levels at P16

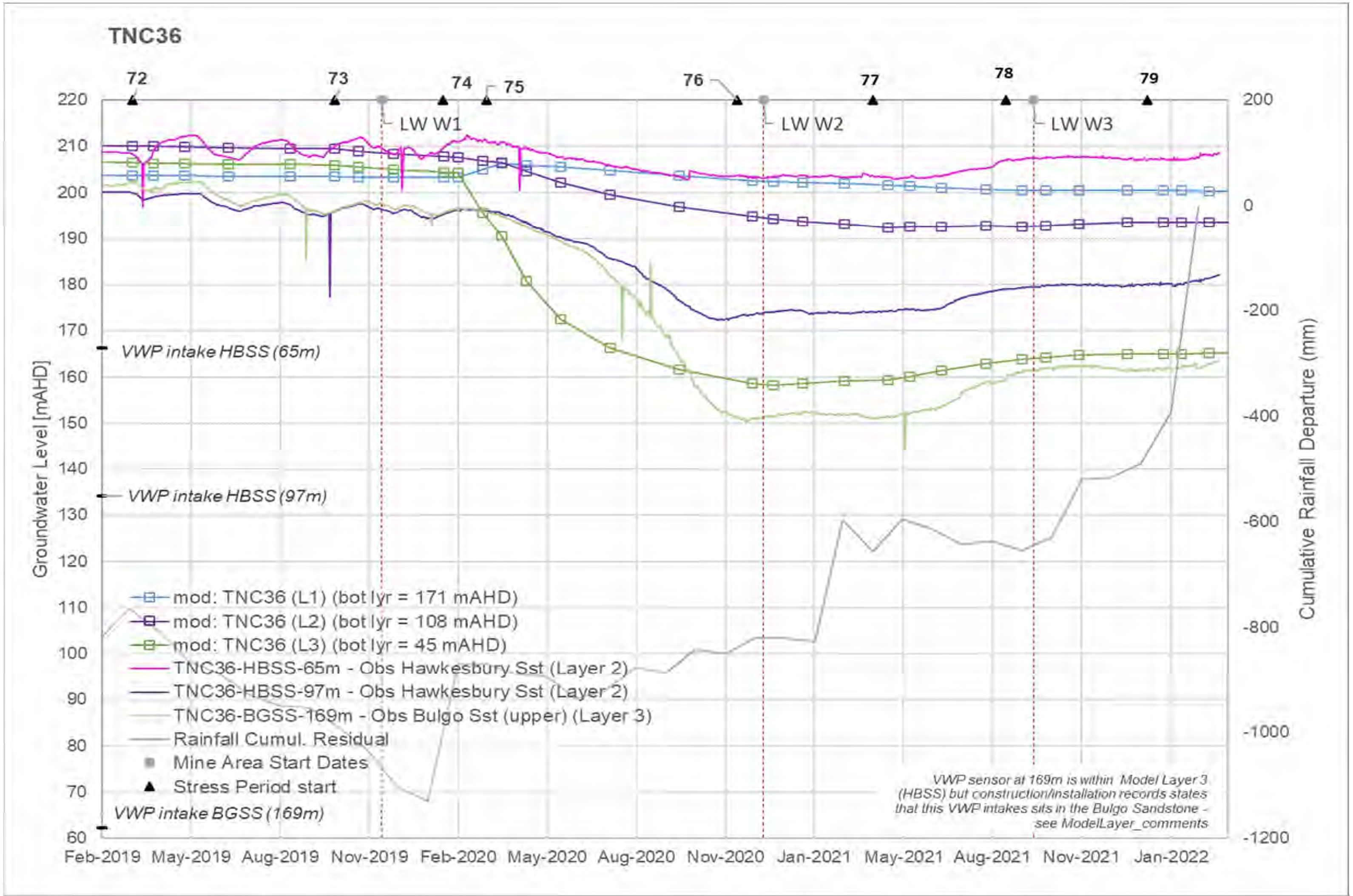



Figure 29 Comparison of Modelled and Observed Groundwater Levels at TNC036

# 7 Mine Groundwater Inflow

For the period 2009 to March 2022 (latest reported record is on 31st March 2022), inflows to Tahmoor Mine have been within the range of 2 to 6 ML/d. Figure 30 shows net groundwater inflows against daily water pumped from the mine, alongside the historic rainfall (based on records dating back to 1900) and the Western Domain longwall start dates. Inflows to the mine remained relatively steady throughout the extraction of Longwalls 24B to 32 (SLR, 2021a).

A spike in inflows occurred following the cutting of Longwall 27, however, between this time and May 2020 inflow rates have declined (SLR, 2021a). The period between mid-2020 shows an increase in inflows to greater than 5 ML/day at the end of July 2020 likely due to the extraction of LW W1. Inflows declined in late 2020, before rising in February 2021 (early in LW W2), with the recent peak at marginally over 6 ML/d in March and April 2021 (Figure 30). Inflows to the Western Domain are not metered in isolation from other parts of Tahmoor North but were estimated to be greater than 2.5 ML/d in early 2021 (based on advice from Tahmoor Coal staff in early 2021).

The increase in mine inflow in the Western Domain between the months of April-May 2021 has been discussed with Tahmoor Coal staff and consultants. Other than the minor fault observed in the southern section of LW W1 and LW2, no other obvious geological structures have been noted as intersecting current longwalls. The faults on the north-eastern edge of LW W4 were mapped (SCT, 2021b) with major splays 1000 m from LW W4. Following this, investigations of the hydraulic properties within the lower fault zone were conducted within P41. The measured hydraulic properties within this zone were not abnormal and within those measured elsewhere at Tahmoor Mine (SCT, 2021b and SLR, 2021a). The latest observations confirm that during extraction of LW W3 groundwater inflow to the mine stayed within ranges previously observed which suggest that no additional inflow to the mine was driven from the faults mapped in the Nepean Fault Complex. During extraction of LW W4, it is expected that groundwater inflow to the mine will remain within similar ranges previously observed. This is if subsidence above and adjacent to LW W3-W4 remain within predictions and mobilisation of fault structures do not occur due to longwall subsidence (SCT, 2021b, SLR, 2021).

Tahmoor Coal continues to monitor changes in mine inflows and identify where in the workings higher inflows can be observed. Analysis of longwall extraction rate (in metres/day) versus inflow rate (ML/d or $m^3$/d) indicates that the consistently higher extraction rates that have been achieved in LW W1 and W2 were at least partly responsible for higher inflows. This is confirmed by the fact that once LW W2 was completed in June 2021 inflow reduced to 3-4 ML/d (i.e. inflow similar prior to LW W1) but then increased up to 5 ML/d in July 2021 and throughout early August 2021 (i.e. probably pumping accounted for an earlier short-fall or in preparation of LW W3). During LW W3 and as of March 2022, the average inflows to the mine have been 4.3 ML/d, remaining below the average entitlement of 4.5 ML/d. A consistent increase in inflow is observed between November 2021 and February 2022 from 3 ML/d to 5.5 ML/d likely attributed to LW W3 extraction. Mine inflow reduced to 3.5 ML/d in early March 2022 before rising back to 5.3 ML/d at the completion of LW W3.

The average inflows to the mine for the last four water years have been: 4.4 ML/d for the current water year (July 2021 to date), 4.5 ML/d for last water year (July 2020 to June 2021), 3.3 ML/d for the July 2019 to June 2020 water year, and 3.4 ML/d for the 2018-2019 water year.

Previously, SLR and their subconsultants have advised Tahmoor Coal staff regarding possible options in the event that inflow rates to the workings rise at a similar rate to that of the recent average inflows seen in March-April 2021. Since April 2021, inflow rates to the mine workings have remained below the previous observed peak of 6 ML/d, with a general reduction in the inflow rates. Groundwater entitlement was not exceeded for the 2021-22 water year and as of March 2022 remain just below the limit for the 2021-22 water year (based on a pro-rata calculation).

Tahmoor Coal is currently in the process of obtaining additional groundwater entitlement to meet the likely requirements of the remaining Western Domain and early Tahmoor South mining operations.

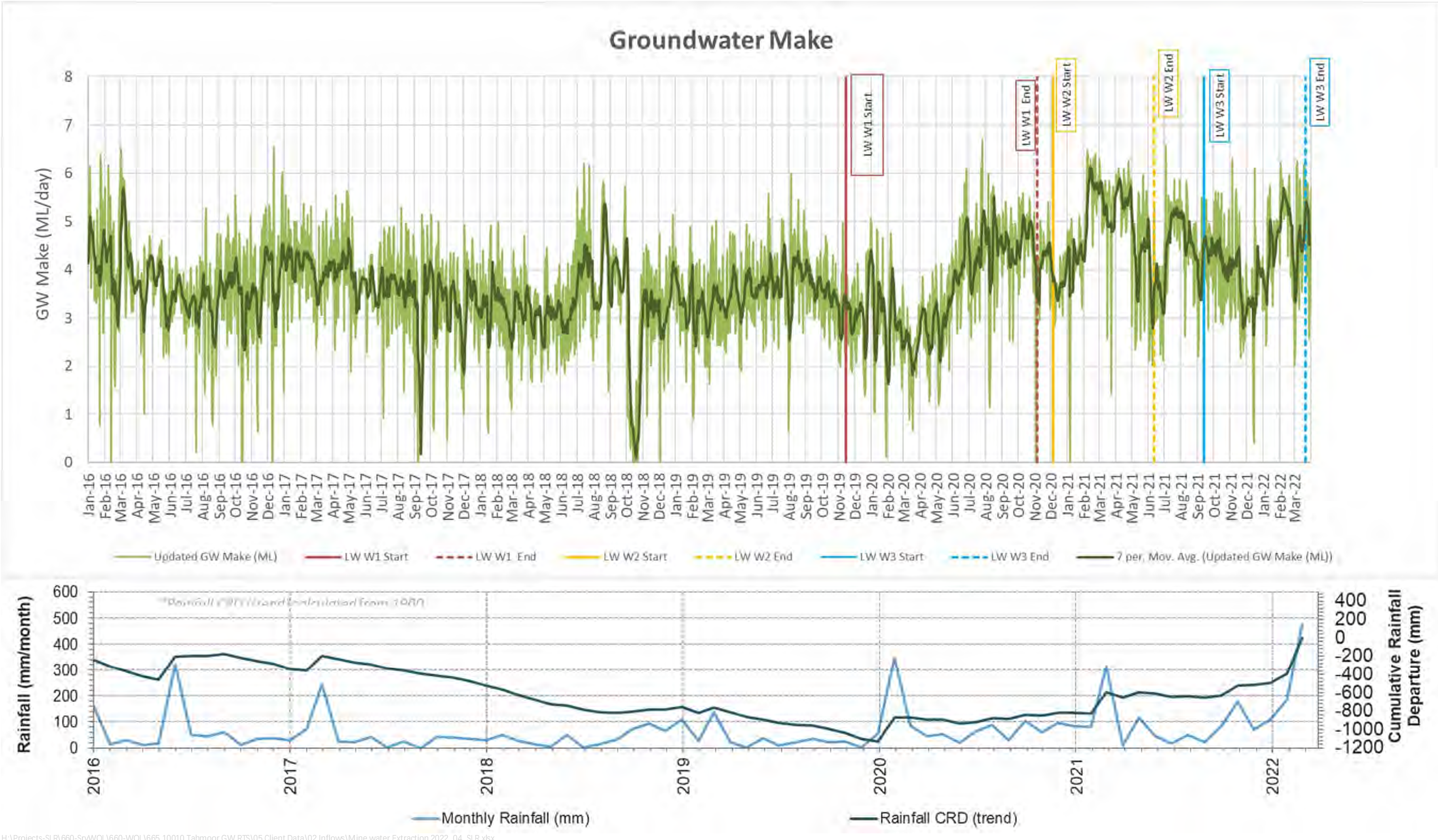



Figure 30 Historical Record of Inflows at Tahmoor North

# 8 Conclusions

The key conclusions from the six-monthly review are summarised as follows:

- At most of the monitoring sites, groundwater levels have clearly responded to the above average rainfall condition observed throughout December 2021 to March 2022 (i.e. marked by floods events in late February – early March 2022), while groundwater levels seemed to have been less responsive to wet conditions in November 2021 although it was the second wettest month in 2021 with 177.8 mm of rainfall. This is likely attributed to a delayed mining effect of LW W2 and the progression of LW W3 during the reporting period.
- A period of stable groundwater level was identified between October and February 2021 in the upper Hawkesbury Sandstone aquifer at the open standpipes P12A, P12B and at TNC36 in the three upper instruments HBSS-65m, HBSS-97m and BGSS-169m.
- The LW W3 extraction throughout the reporting period had no significant effects on shallow and deep groundwater across the Western Domain. However, a series of consistent and minor declines were observed at site P14 and P15 during November 2021 (LW W3 approximately 50% complete) and ranging from 0.3m to 0.5m; similar to observations made in September and October 2021 (SLR, 2022a). These series of decline are likely associated with the progression of LW W3 although short-term responses to rainfall recharge were observed over the same period. No effects on surface water were observed at the rock bar SR 17 (HEC, 2022a) due to LW W3 over the reporting period.
- To the east of the Western Domain, a minor depressurisation was observed in the lower fault zone at P41D and could potentially be due to LW W3 extraction while other VWPs at P41 show stable groundwater levels.
- To the west of the Western Domain, a delayed mining effect from LW W2 and active mining at LW W3 had a short-term effect on groundwater levels at P16B and P16C (i.e. combination of sharp and gradual decline) associated with a subsequent slower groundwater recovery. This could be related to fracturing of the strata due to valley closure along the western side of LW W1 (i.e. increase in porosity hence storage leading to longer recovery time).
- From December 2021, groundwater recovery in the Hawkesbury Sandstone aquifer improved at the open standpipes P12C, P14B-D, P15A-D and P40A-D and from February 2022 at sites P12A, P12B, P16A-B, P41C-D and at TNC036 in the three upper instruments HBSS-65m, HBSS-97m and BGSS-169m. The rate of recovery accelerated in late February 2022 at all monitoring sites. The groundwater recovery is associated with the completion of LW W3, and the exceptional wetter condition in February-March 2022.
- At monitoring site P40, located in between LW W1 and Cedar creek, groundwater levels in the upper Hawkesbury Sandstone (P40A) continued to recover over the reporting period while groundwater recovery in the mid Hawkesbury Sandstone started later in December 2021 (P40B-P40D). The difference in timing may be due to the upper Hawkesbury Sandstone aquifer being recharged first by rainfall and stream flow losses, gradually infiltrating the mid-Hawkesbury Sandstone aquifer.
- Groundwater recovery identified in the upper and mid Hawkesbury Sandstone aquifers confirms a potential for recovery at monitoring site CB. As presented in SLR (2022c), this is following the triggering of TARP Level 3 at monitoring site CB during October 2021 and early November 2021, suggested to be a delayed mining effect due to subsidence over LW W2. It is difficult to assess if drawdown alone was causing the reduction at monitoring site CB, however, if fracturing in the subsurface has occurred it seems that flood events in early 2022 have contributed to fill the increased storage (i.e. pore space) in the Hawkesbury Sandstone aquifer and could have improved baseflow conditions at monitoring site CB.

- The medium-term impact previously identified on shallow groundwater levels at site P16A is difficult to assess at the end of the reporting period to potential surface run-off ingress, showing a rise in water levels of 1.2m and not representative of groundwater condition. Further monitoring at P16A and P40 is required to confirm groundwater trends, and whether recovery is complete and sustained, especially during periods of below average rainfall condition. This will then confirm whether hydrogeological conditions near CB have returned to pre-mining conditions and whether baseflow has improved.
- 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.
- An issue with the integrity of the bore is likely at P12B following the rise in pH since October 2021, and previously observed in April 2021 following rainfall. As of March 2022, nearby monitoring bores are within TARP Level 1, it is suggested to keep the exceedances in pH at P12B as potential 4 TARP Level noting that the consequences of this effect (if it is mining-related) are considered minor.
- 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 late 2021 and intense rainfall in early 2022.
- A consistent rise in the concentration of strontium was observed during the reporting period at site P15A piezometer and requires further monitoring. SLR (2022a) investigated the rise as being localised and further information on stratigraphy in this area may assist assessing reasons for the increasing concentrations.
- Metal concentration exceedances (TARP Level 2) remain active as of March 2022 for Fe (P16B), Mn (P15C), Li (P12B), Ba (GW104090, GW105228, GW072402) Sr (P15A, P15C, GW104090).
- Exceedances in Fe at P16B are likely due to iron staining in the bore (previously observed during bore census conducted by GeoTerra in 2019).
- From available information, there is no depressurisation identified at private bores with available groundwater levels and therefore no groundwater level exceedances are recorded at these locations. Further monitoring at private bores will be undertaken in April 2022 to confirm trends and identify whether the early part of LW W4 extraction has any effect on groundwater levels.
- Single exceedances in metal concentrations (i.e. Sr and Ba) have been recorded in some private bores during the reporting period (i.e. only one sampling event in January 2022). There are no clear trends in metal concentrations that may be linked to mining operations. Metal concentration exceedances (TARP Level 2) remain active as of January 2022 (i.e. last sampling event) for Ba (GW104090, GW105228, GW072402) and Sr (GW104090).
- A potential TARP Level 4 was reported for Ba at GW115860 and investigated in SLR (2022a). This was assessed to be unlikely a mining impact. A revised trigger level was calculated as it appeared that the trigger level was conservative and could not be based on pre-mining data. Further monitoring at GW115860 will be undertaken in April 2022 to confirm trends.
- Deeper strata at TNC036 (BGSS-214m) shows depressurisation as of March 2022 with an ongoing clear depressurisation in BUSM-412m (i.e. due to Tahmoor mine and 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).

# 9 Recommendations

TARP Exceedance

Based on the trigger exceedances assessment in Section 4.4 and Section 5.2 and based on the TARP presented in Appendix B, the following ongoing actions are recommended:

- At P12C, P16C and TNC036 (HBSS-97m) with a Level 3 trigger for groundwater level, to continue monitoring and review as per monitoring program.
- At P16B with a Level 2 trigger for groundwater level, to continue monitoring and review as per monitoring program.
- At TNC036 (BGSS-169m) with Level 2 trigger for groundwater level, to continue monitoring program and develop a review of groundwater level data in the next groundwater monthly.
- 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.
- For 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 is 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). To note that Sr concentrations recorded at surface water monitoring sites along Stonequarry Creek are within a TARP Level 1 over the reporting period (HEC, 2022a).
- Convene Tahmoor Coal Environmental Response Group to review response on a monthly basis.

The following actions are recommended for the next 6-month review:

- Ongoing monthly collection and analysis of monitoring data: monthly monitoring and 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 (Tahmoor Coal, 2021).
- Inclusion of the developed groundwater level trigger for P41 (Nepean Fault Complex piezometer) in the next groundwater monthly report. Inclusion of the site P41 in the TARP will help to identify if any exceedances are related to the proposed LW W4 in the lower reach of Stonequarry Creek (P41), within the Nepean Fault Complex (SCT, 2021).
- As recommended in SLR (2022a), if surface water exceedances at site SC (SC3) are identified during and following mining of LW W4, groundwater levels at site P41C-D 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 for this. Observed groundwater levels were used in the past to identify or infer potential change in groundwater-surface water interaction at surface water monitoring sites (SLR, 2021). 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.
- To assess the implications of lithology on strontium concentrations at P15 or other future exceedances in groundwater quality that may arise in the future, it is recommended that the bore logs are obtained and reviewed for the monitoring bores and VWPs.

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SLR, 2021b. Groundwater Investigation fortnightly review (15 Oct - 27 Oct). Prepared for Tahmoor Coal Pty. Ltd., November 2021, Report No: 665.10010.00907-M03-v1.0.

SLR, 2021c. Groundwater fortnightly review (15 Oct - 27 Oct). Prepared for Tahmoor Coal Pty. Ltd., November 2021, Report No: 665.10010.00907-M03-v1.0.

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SLR, 2022b. Groundwater monthly review (February 2022). Prepared for Tahmoor Coal Pty. Ltd., May 2022, Report No: 665.10010.00207-M0-v2.0.

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Tammetta, P., 2013. Estimation of the height of complete groundwater drainage above mined longwall panels. Groundwater, Volume 51, No. 5, p. 723–734. Paper accepted 2012, published 2013.

Tahmoor Coal Pty. Ltd, 2021. Tahmoor North - Western Domain, LW W3-W4 Water Management Plan. TAH-HSEC-326. September 2021, Ver4.

USEPA Office of Solid Waste and Emergency Response, 1983. Hazardous Waste Land Treatment, SW-874 (April 1983), page 273.

# APPENDIX A

Hydrographs for P12-P17 and P40-P41

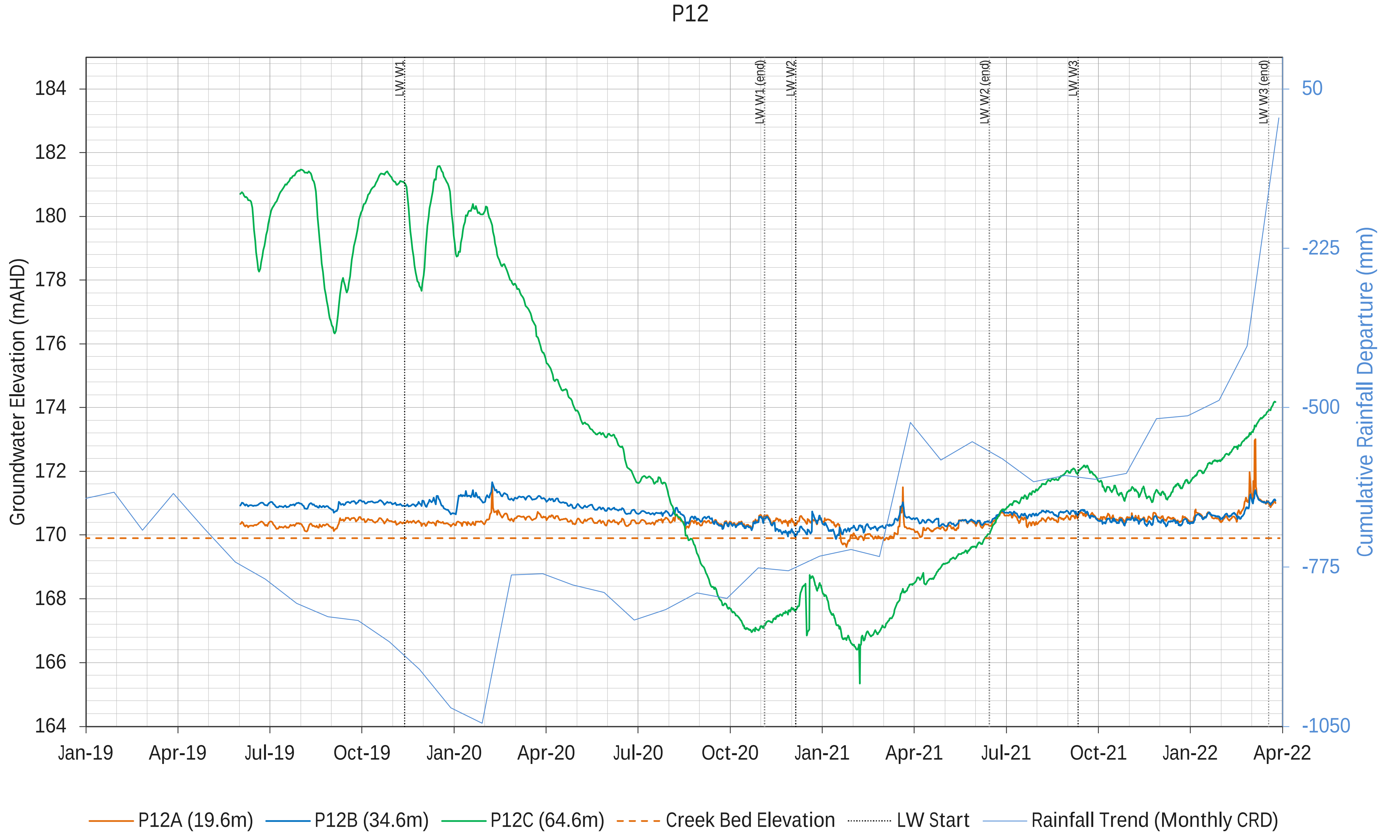

P12
Groundwater Elevation (mAHD)
184
182
180
178
176
174
172
170
168
166
164
Cumulative Rainfall Departure (mm)
50
-225
-500
-775
-1050
Jan-19
Apr-19
Jul-19
Oct-19
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21
Jan-22
Apr-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
P12A (19.6m)
P12B (34.6m)
P12C (64.6m)
Creek Bed Elevation
LW Start
Rainfall Trend (Monthly CRD)

**Figure A-1**

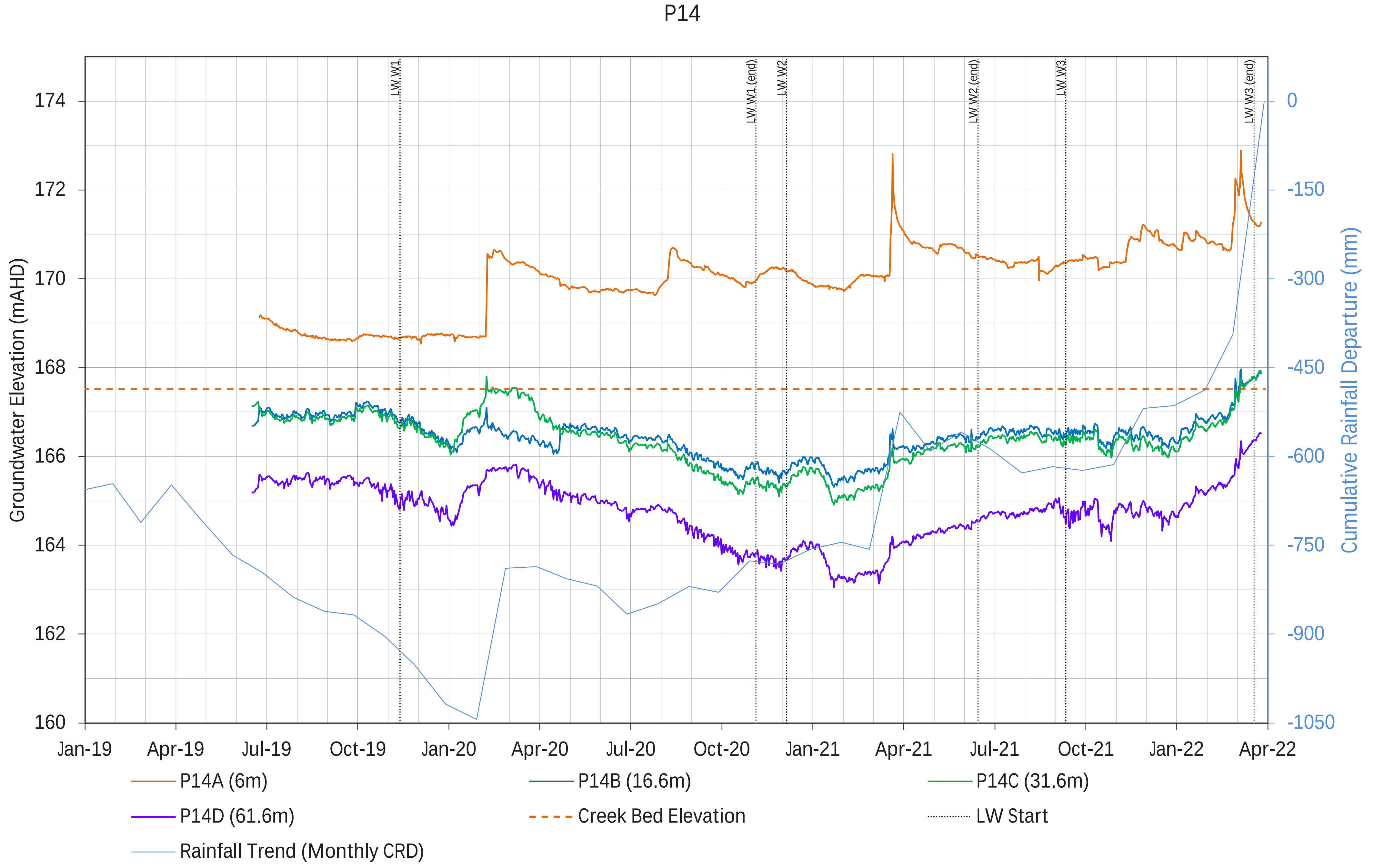

P14
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
174
172
170
168
166
164
162
160
0
-150
-300
-450
-600
-750
-900
-1050
Jan-19
Apr-19
Jul-19
Oct-19
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21
Jan-22
Apr-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
P14A (6m)
P14B (16.6m)
P14C (31.6m)
P14D (61.6m)
Creek Bed Elevation
LW Start
Rainfall Trend (Monthly CRD)

Figure A-2

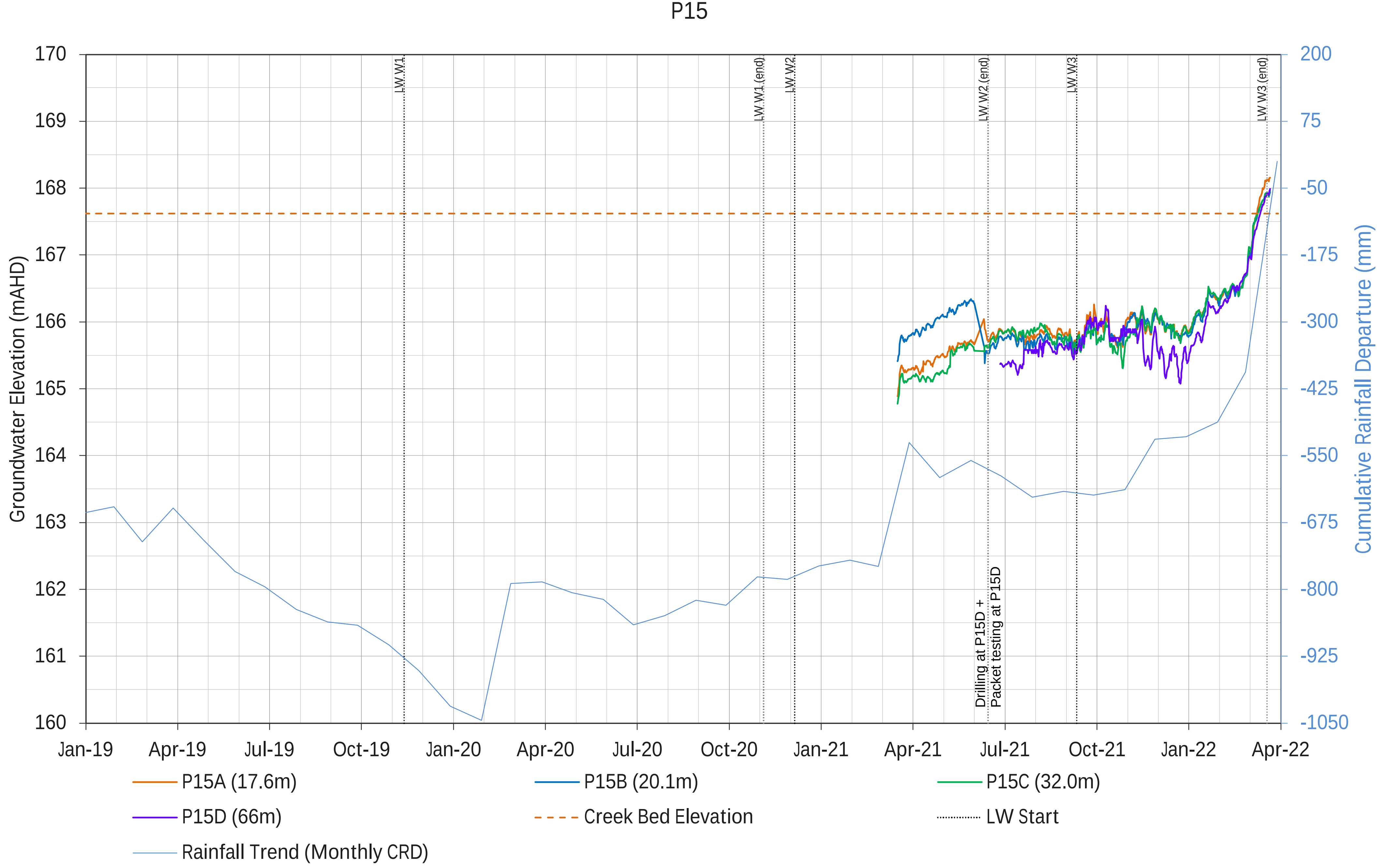

P15
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
170
169
168
167
166
165
164
163
162
161
160
200
75
-50
-175
-300
-425
-550
-675
-800
-925
-1050
Jan-19
Apr-19
Jul-19
Oct-19
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21
Jan-22
Apr-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
Drilling at P15D +
Packet testing at P15D
P15A (17.6m)
P15B (20.1m)
P15C (32.0m)
P15D (66m)
Creek Bed Elevation
LW Start
Rainfall Trend (Monthly CRD)

Figure A-3

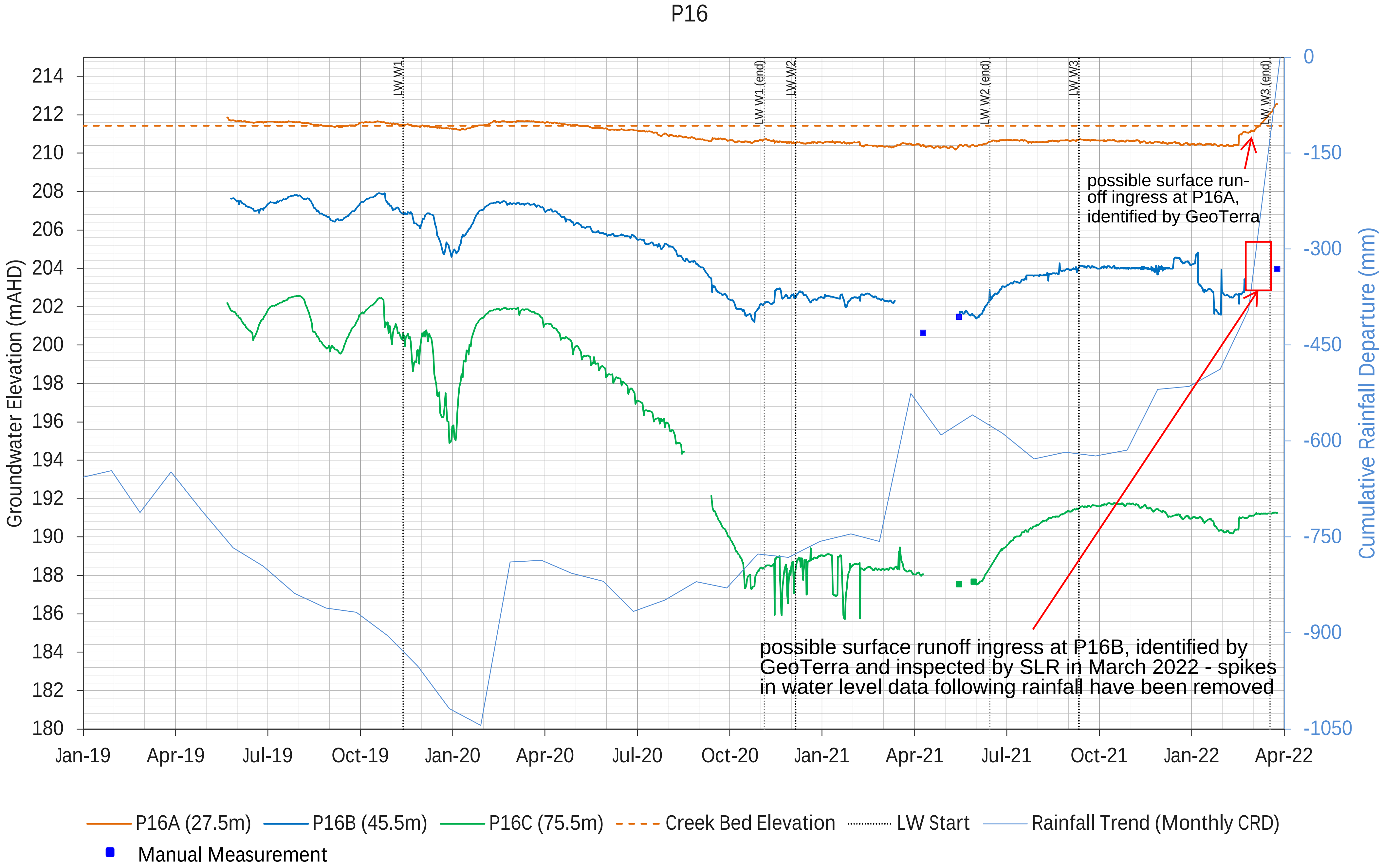

P16
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
214
212
210
208
206
204
202
200
198
196
194
192
190
188
186
184
182
180
0
-150
-300
-450
-600
-750
-900
-1050
Jan-19
Apr-19
Jul-19
Oct-19
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21
Jan-22
Apr-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
possible surface run-off ingress at P16A, identified by GeoTerra
possible surface runoff ingress at P16B, identified by GeoTerra and inspected by SLR in March 2022 - spikes in water level data following rainfall have been removed
P16A (27.5m)
P16B (45.5m)
P16C (75.5m)
Creek Bed Elevation
LW Start
Rainfall Trend (Monthly CRD)
Manual Measurement

Figure A-4

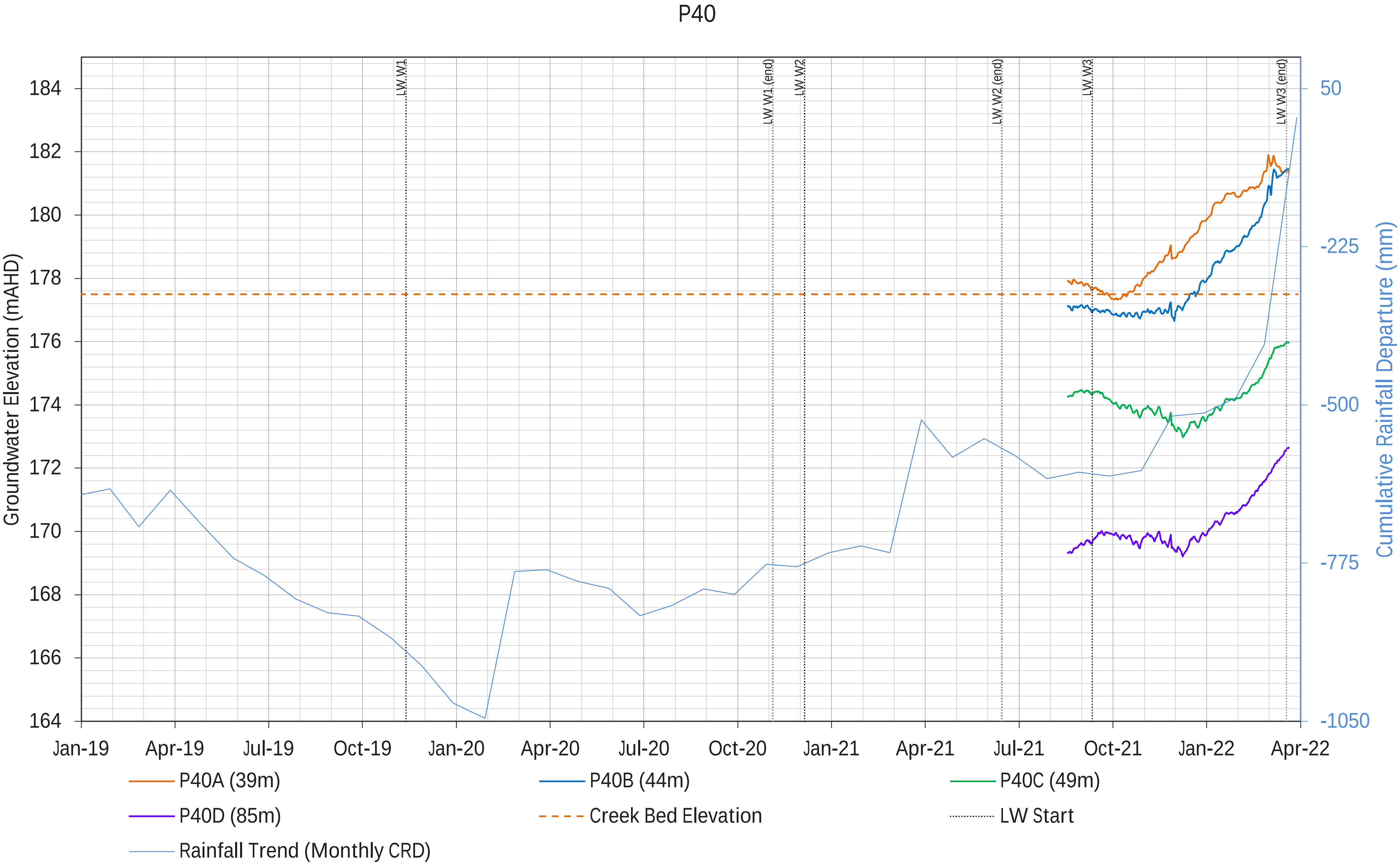
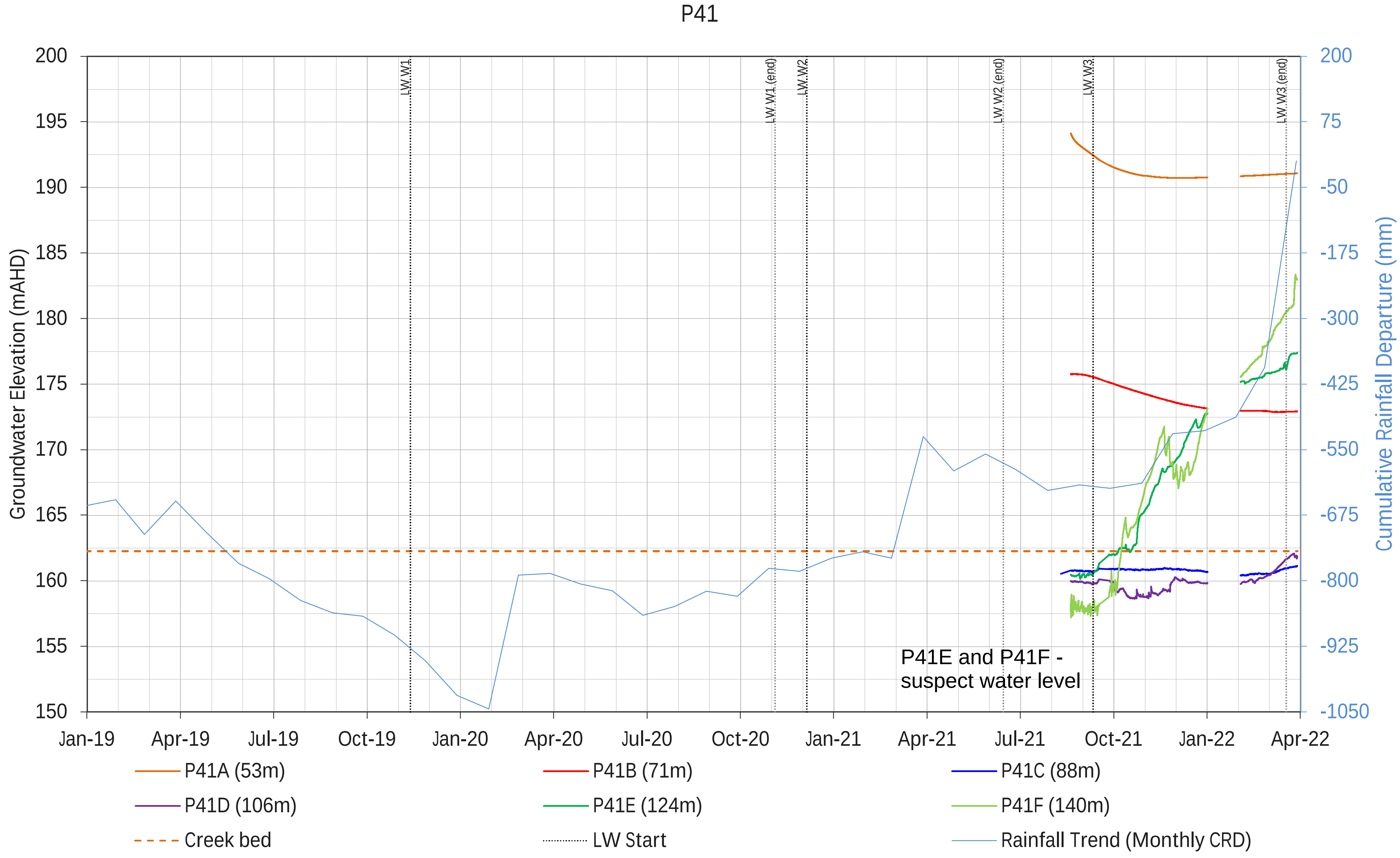

P40
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
184
182
180
178
176
174
172
170
168
166
164
50
-225
-500
-775
-1050
Jan-19
Apr-19
Jul-19
Oct-19
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21
Jan-22
Apr-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
P40A (39m)
P40B (44m)
P40C (49m)
P40D (85m)
Creek Bed Elevation
LW Start
Rainfall Trend (Monthly CRD)

Figure A-5




no groundwater level data available in January 2022 due to downloading issues.

**Figure A-6**

# APPENDIX B

## Trigger Action Response Plans

- Approved Trigger Criteria and Actions from LW W3-W4 (Tahmoor North - Western Domain, LW W3-W4 Water Management Plan TAH-HSEC-326 (September 2021, Ver4))

Table B1 - Trigger Action Response Plan – Groundwater Levels and Pressures

| Feature | Methodology and relevant monitoring | Management | | |
|---|---|---|---|---|
| | | Trigger | Action | Response |
| Groundwater Levels at monitoring bores and private groundwater bores. | GROUNDWATER LEVEL – Monitoring bores<br>**Locations** (refer to Figure 3-5)<br>Impact sites – P12, P13, P14, P15, P16, and any additional bore(s) (to be drilled)<br>Control sites – P17, and possibly P11<br>**Frequency**<br>Pre-mining - Minimum continuous 24-hourly readings with monthly logger download and dip meter. Baseline data available since May 2019.<br>During mining - Minimum continuous 24-hourly readings with monthly logger download and dip meter.<br>Post mining - Minimum continuous 24-hourly readings with monthly logger download and dip meter for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details).<br><br>GROUNDWATER LEVEL – Private groundwater bores<br>**Locations** (refer to Figure 3-5)<br>Control sites - GW72402, GW105228, GW105467, GW115860 and GW105546 and any other private bores where access is negotiated with landholder.<br>**Frequency**<br>Pre-mining - Standing Water Level (where available) and yield data. Pre-mining testing completed in bore census (GeoTerra, 2019).<br>During mining - Manual monitoring (flow rate and, where available, standing water level) on a 3-monthly basis.<br>Post mining - Manual monitoring (flow rate and, where available, standing water level) on a 3-monthly basis for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details). | Level 1 | | |
| | | • Groundwater level remains consistent within baseline variability and/or pre-mining trends, with reductions in groundwater level less than two metres and does not trigger Level 2 to Level 4 Significance Levels (refer to Table 6-2). | • Continue monitoring program.<br>• Ongoing review of water level data. | • No response required. |
| | | Level 2 | | |
| | | • Greater than 2 m water level reduction following the commencement of extraction at LW W1 (and LW W2, W3, W4) (refer to Table 6-2 for TARP Significance Level 2).<br>AND<br>• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors. | • Continue monitoring program.<br>• Ongoing review of water level data.<br>• Review relevant surface water level, groundwater level and streamflow data to assess comparative trends.<br>• Convene Tahmoor Coal Environmental Response Group to review response. | • As defined by the Environmental Response Group. |
| | | Level 3 | | |
| | | • Water level declines below the water level of TARP Significance Level 3 (refer Table 6-2, 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).<br>AND<br>• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors. | • Continue monitoring program.<br>• Ongoing review of water level data and consideration of mining and external stresses (in groundwater monthly report).<br>• Review relevant surface water level, groundwater level and streamflow data to assess comparative trends.<br>• Compare against base case and deterministic model scenarios.<br>• Convene Tahmoor Coal Environmental Response Group to review response. | • As defined by the Environmental Response Group. |
| | | Level 4 | | |
| | | • Water level reduction greater than the maximum modelled drawdown (refer to Table 6-1 for TARP Significance Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4).<br>AND<br>• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors. | • Continue monitoring and review as per monitoring program.<br>• Ongoing review of water level data and consideration of mining and external stresses (in groundwater monthly report).<br>• Review relevant surface water level, groundwater level and streamflow data to assess comparative trends.<br>• Convene Tahmoor Coal Environmental Response Group to review response.<br>• Compare against base case and deterministic model scenarios. | • Report to DPIE and relevant government agencies within 7 days of investigation completion (according to Table 6-1 of the Extraction Plan Main Document).<br>• For monitoring bores: If it is concluded that there has been a mining-related impact, then implement an investigation including review and assessment of streamflow records for downstream monitoring sites in comparison with suitable reference sites.<br>• For private groundwater bores: If it is concluded that there has been a mining-related impact, then implement actions in accordance with the make good provisions (Section 6.2.4 of the Water Management Plan) in consultation with DPIE and the affected landholder. |

| Feature | Methodology and relevant monitoring | Management | | |
|---|---|---|---|---|
| | | Trigger | Action | Response |
| Shallow Groundwater Pressures at VWPs TNC036, TNC040, WD01 and WD02 (once installed). | GROUNDWATER PRESSURE<br>**Locations**<br>Impact sites – TNC36, WD01 and WD02 (once installed) (refer to Section 5.2.2).<br>Control sites - Groundwater bores/VWPs TNC40 (refer to Figure 3-5).<br>**Frequency**<br>Pre-mining - Minimum continuous 24-hourly readings with monthly logger download.<br>During mining - Minimum continuous 24-hourly readings with monthly logger download.<br>Post mining - Minimum continuous 24-hourly readings with monthly logger download for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details). | Level 1 | | |
| | | • No observable mining induced change at VWP intakes located at or above (i.e. shallower than) 200 m depth. | • Continue monitoring program.<br>• Ongoing review of water level data. | • No response required. |
| | | Level 2 | | |
| | | • 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) (refer to Table 6-2 for TARP Significance Level 2).<br>AND<br>• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors. | • Continue monitoring program.<br>• Ongoing review of water level data.<br>• Convene with Tahmoor Coal Environmental Response Group to review response. | • As defined by the Environmental Response Group. |
| | | Level 3 | | |
| | | • Water level declines below the water level of TARP Significance Level 3 (refer Table 6-2, 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).<br>AND<br>• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors. | • Continue monitoring program<br>• Ongoing review of water level data and consideration of mining and external stresses (in groundwater monthly report).<br>• Compare against base case and deterministic model scenarios.<br>• Convene Tahmoor Coal Environmental Response Group to review response. | • As defined by the Environmental Response Group. |
| | | Level 4 | | |
| | | • Water level reduction greater than the maximum modelled drawdown (refer to Table 6-2 for TARP Significance Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4).<br>AND<br>• The reduction in water level is determined not to be controlled by climatic or anthropogenic factors. | • Continue monitoring and review as per monitoring program.<br>• Ongoing review of water level data and consideration of mining and external stresses (in groundwater monthly report).<br>• Convene Tahmoor Coal Environmental Response Group to review response.<br>• Compare against base case and deterministic model scenarios. | • Report to DPIE and relevant government agencies within 7 days of investigation completion (according to Table 6-1 of the Extraction Plan Main Document).<br>• If it is concluded that there has been a mining-related impact, implement an investigation report. |

| Feature | Methodology and relevant monitoring | Management | | |
|---|---|---|---|---|
| | | Trigger | Action | Response |
| Deep Groundwater Pressures at VWPs TNC036. | GROUNDWATER PRESSURE<br>**Locations**<br>Impact site – TNC36 (refer to Figure 3-5).<br>Control site - Groundwater bores/VWPs TNC40 (refer to Figure 3-5).<br>**Frequency**<br>Pre-mining - Minimum continuous 24-hourly readings with monthly logger download.<br>During mining - Minimum continuous 24-hourly readings with monthly logger download.<br>Post mining - Minimum continuous 24-hourly readings for 12 months after LW W4 completed. Monthly logger downloaded for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details). | Level 1 | | |
| | | • Observed data does not exceed predicted (modelled) impacts at VWP intakes located below (i.e. deeper than) 200 m depth (excluding those monitoring the Bulli Coal Seam). | • Continue monitoring program.<br>• Ongoing review of water level data. | • No response required. |
| | | Level 2 | | |
| | | • 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. | • Continue monitoring program.<br>• Ongoing review of water level data.<br>• Convene Tahmoor Coal Environmental Response Group to review response. | • As defined by the Environmental Response Group. |
| | | Level 3 | | |
| | | • Calculated or observed drawdown (based on 2009-2015 baseline data) for VWP intakes below 200 m depth (excluding those within the Bulli Coal Seam) exceeds predicted (modelled) drawdown by 30 m for a period of 6 months or more. | • Continue monitoring program.<br>• Ongoing review of water level data.<br>• Convene Tahmoor Coal Environmental Response Group to review response. | • As defined by the Environmental Response Group.<br>• Consider increasing download frequency at groundwater bores where Level 3 has been reached to a fortnightly basis. Consider increasing review frequency to fortnightly. |
| | | Level 4 | | |
| | | • Calculated or observed drawdown (based on 2009-2015 baseline data) for VWP intakes below 200 m depth (excluding those within the Bulli Coal Seam) exceeds predicted (modelled) drawdown by 30 m for a period of 12 months or more. | • Continue monitoring and review as per monitoring program.<br>• Convene Tahmoor Coal Environmental Response Group to undertake an investigation to assess whether change in behaviour is related to LW W1-W2 mining effects. | • Report to DPIE and relevant government agencies within 7 days of investigation completion (according to Table 6-1 of the Extraction Plan Main Document).<br>• If it is concluded that there has been a mining-related impact, implement an investigation report. |

## Table B2 Trigger Action Response Plan – Groundwater Quality

<table>
<tr><th rowspan="2">Feature</th><th rowspan="2">Methodology and relevant monitoring</th><th colspan="3">Management</th></tr>
<tr><th>Trigger</th><th>Action</th><th>Response</th></tr>
<tr><td rowspan="8">Groundwater Quality at monitoring bores and private groundwater bores.</td><td rowspan="8">GROUNDWATER QUALITY – Monitoring bores<br>**Locations** (refer to Figure 3-5)<br>Impact sites – P12, P13, P14, P15, P16, and any additional bore(s) (to be drilled)<br>Control sites – P17<br>**Frequency**<br>Pre-mining - Field water quality and laboratory analysis monthly (refer to Section 5.2.1 for parameters).<br>During mining - Field water quality and laboratory analysis monthly (refer to Section 5.2.1 for parameters).<br>Post mining - Field water quality and laboratory analysis monthly (refer to Section 5.2.1 for parameters) for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details).<br><br>GROUNDWATER QUALITY – Private groundwater bores<br>**Locations** (refer to Figure 3-5)<br>Control sites - GW72402, GW105228, GW105467, GW115860 and GW105546 and any other private bores where access is negotiated with landholder.<br>**Frequency**<br>Pre-mining - Field water quality (EC, pH) and iron staining. Pre-mining testing completed during bore census (GeoTerra, 2019).<br>During mining - Field water quality and laboratory analysis on a 3-monthly basis (refer to Section 5.2.1 for parameters).<br>Post mining - Field water quality and laboratory analysis on a 3-monthly basis (refer to Section 5.2.1 for parameters) for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details).</td><td colspan="3">Level 1</td></tr>
<tr><td>• No observable change in salinity, pH or metals outside of the baseline variability.</td><td>• Continue monitoring program.<br>• Ongoing review of water quality data.</td><td>• No response required.</td></tr>
<tr><td colspan="3">Level 2</td></tr>
<tr><td>• 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.<br>AND/OR<br>• A similar trend or response has been noted at other monitored bores or private groundwater bores.</td><td>• Continue monitoring program.<br>• Ongoing review of water quality data.<br>• Convene Tahmoor Coal Environmental Response Group to review response.</td><td>• As defined by the Environmental Response Group.</td></tr>
<tr><td colspan="3">Level 3</td></tr>
<tr><td>• Short term increase (< 3 months) in salinity and/or metals or change in pH outside of baseline variability*. The effect persists after a significant rainfall recharge event.<br>AND/OR<br>• The change in water quality is determined not to be controlled by climatic or anthropogenic factors.</td><td>• Continue monitoring program.<br>• Ongoing review of water quality data and consideration of mining and external stresses (in groundwater monthly report).<br>• Convene Tahmoor Coal Environmental Response Group to review response.</td><td>• As defined by the Environmental Response Group.</td></tr>
<tr><td colspan="3">Level 4</td></tr>
<tr><td>• 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.<br>AND<br>• The reduction in water quality is determined not to be controlled by climatic or anthropogenic factors.</td><td>• Continue monitoring and review as per monitoring program.<br>• Continue review of water quality data and consideration of mining and external stresses (in groundwater monthly report).<br>• Convene Tahmoor Coal Environmental Response Group to review response.</td><td>• Report to DPIE and relevant government agencies within 7 days of investigation completion (according to Table 6-1 of the Extraction Plan Main Document).<br>• For monitoring bores: If it is concluded that there has been a mining-related impact, then implement an investigation report.<br>• For private groundwater bores: If it is concluded that there has been a mining-related impact, then implement actions in accordance with the make good provisions (Section 6.2.4 of the Water Management Plan) in consultation with the affected landholder.</td></tr>
</table>

Footnote:
* The baseline variability was estimated using available data and refers to the proposed trigger levels (refer to Section 6.2.2 and Table 6.2 of the Groundwater Technical Report.

# APPENDIX C

Summary of Trigger Levels for Groundwater Level TARPs (revised from Groundwater Technical Report – Table 6-1 SLR, 2021)

| Bore | Groundwater Trigger Level (mAHD) | | |
|---|---|---|---|
| | TARP Level 2 | TARP Level 3 | TARP Level 4 |
| Shallow OSP | | | |
| P12A | 168.6 | - | - |
| P12B | 169.1 | - | - |
| P12C | 179.5 | 175.0 | 170.4 |
| P13A | 165.7 | 163.7 | 161.6 |
| P13B | 165.0 | 163.0 | 161.1 |
| P13C | 168.5 | 163.1 | 157.7 |
| P14A | 167.2 | 165.0 | 162.9 |
| P14B | 165.2 | 159.8 | 154.3 |
| P14C | 165.2 | 159.9 | 154.6 |
| P14D | 163.6 | 158.3 | 152.9 |
| P15A | 163.4 | 156.4 | 149.4 |
| P15B | 163.9 | 156.9 | 149.9 |
| P15C | 163.3 | 156.3 | 149.4 |
| P15D* | 163.7 | 156.7 | 149.7 |
| P16A | 209.9 | 209.3 | 208.8 |
| P16B | 205.9 | 202.3 | 198.7 |
| P16C | 200.6 | 193.9 | 187.2 |
| P17 | 169.7 | 170.6 | 171.6 |
| Shallow VWPs (<200m) | | | |
| TNC036 - HBSS-65 | 204.5* | - | - |
| TNC036 - HBSS-97 | 191.3* | 185.7* | 180* |
| TNC036 - BGSS-169 | 192.5* | 135.7* | 79.0* |
| TNC040 - WNFM-27 | 203.3 | 198.2 | 193.1 |
| TNC040 - HBSS-65 | 182.1 | 175.8 | 169.5 |
| TNC040 - HBSS-111 | # | # | # |
| TNC043 - HBSS-65 | 153.7 | 152.5 | 151.3 |
| TNC043 - HBSS-111.5 | 150.6 | 148.5 | 146.5 |
| WD01- HBSS - 70 | 206.2 | 202.4 | 198.6 |
| WD01- HBSS - 90 | 191.4 | 186.7 | 182.0 |
| WD01- HBSS - 190 | F | F | F |
| Deep VWPs (>200m) | | | |
| TNC036 - BGSS-214 | Refer to table A1 | Refer to table A1 | Refer to table A1 |
| TNC036 - BGSS-298.5 | ^ | ^ | ^ |
| TNC036 - BGSS-412.5 | Refer to table A1 | Refer to table A1 | Refer to table A1 |
| TNC036 - BUSM-463.5 | ^ | ^ | ^ |
| TNC040 - HBSS-225 | # | # | # |
| TNC040 - BHCS-252 | # | # | # |
| TNC040 - BGSS-352 | # | # | # |

| Bore | Groundwater Trigger Level (mAHD) | | |
|---|---|---|---|
| | TARP Level 2 | TARP Level 3 | TARP Level 4 |
| TNC040 - SCSS-482 | # | # | # |
| TNC040 - BUCO-501.9 | # | # | # |
| TNC043 - HBSS-213 | # | # | # |
| TNC043 - BGSS-240 | # | # | # |
| TNC043 - BGSS-332.6 | # | # | # |
| TNC043 - BGSS-405.2 | # | # | # |
| TNC043 - BUCO-476.3 | # | # | # |
| WD01- HBSS - 210 | Refer to table A1 | Refer to table A1 | Refer to table A1 |
| WD01- HBSS - 230 | F | F | F |
| WD01- BGSS - 300 | F | F | F |
| WD01- BGSS - 330 | F | F | F |
| WD01- BGSS - 350 | F | F | F |
| Notes: “#” no data after LW W1. | | | |
| *Trigger levels first developed in September 2021 review, based on maximum water level prior to start of LW W3 as was commissioned after commencement of LW W1. | | | |
| “^” groundwater data not reliable but will still be reported on. | | | |
| “F” Sensors failed during mining of LW W1 and LW W2. | | | |
| “-” Some VWP sensor or piezometer are assigned Layer 1. No drawdown is simulated in Layer 1 at those sites hence no TARP Level 3 and 4 can be derived here. | | | |

# APPENDIX D

## Groundwater Quality and Trigger Levels (metal exceedances only)

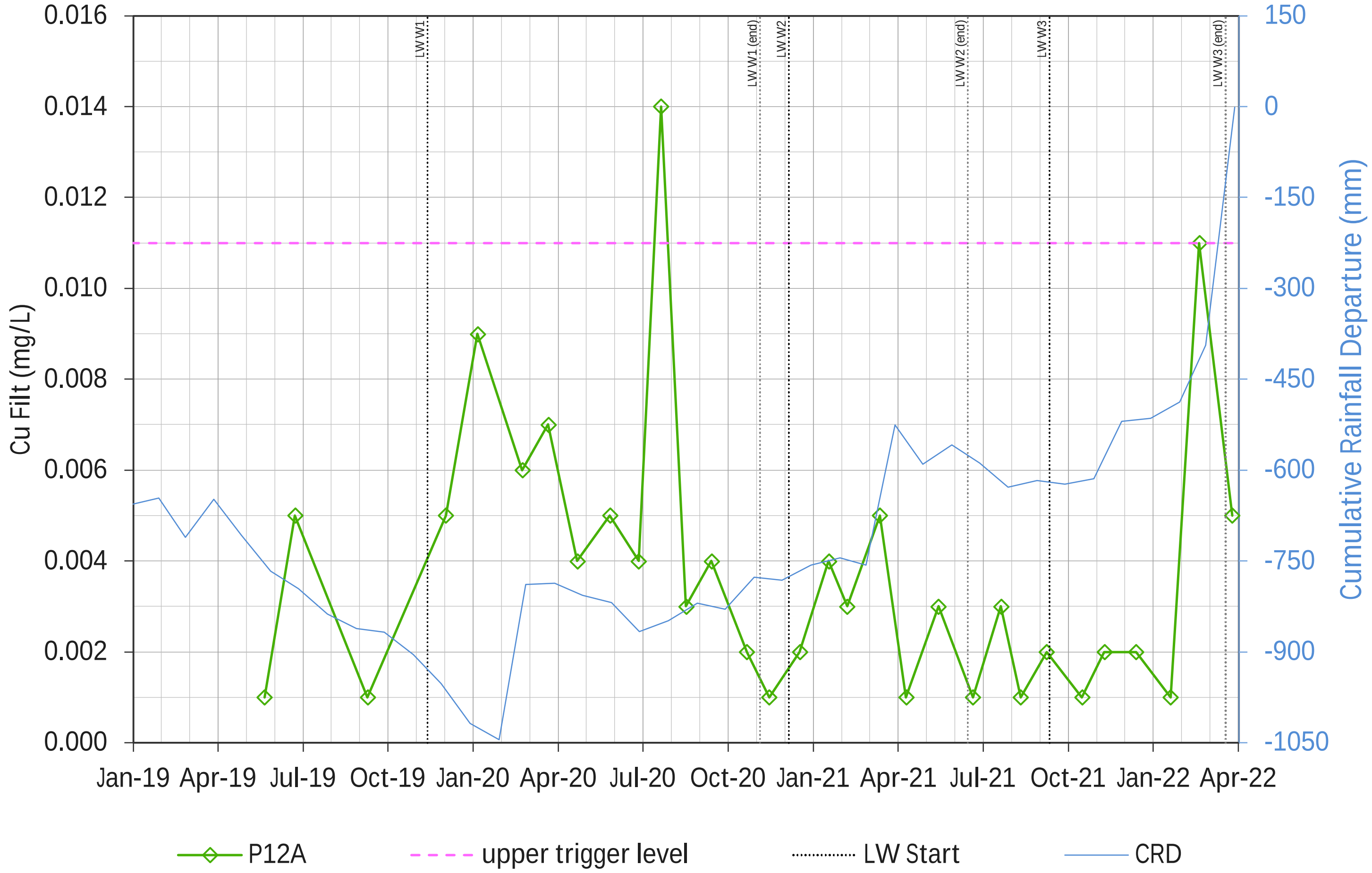
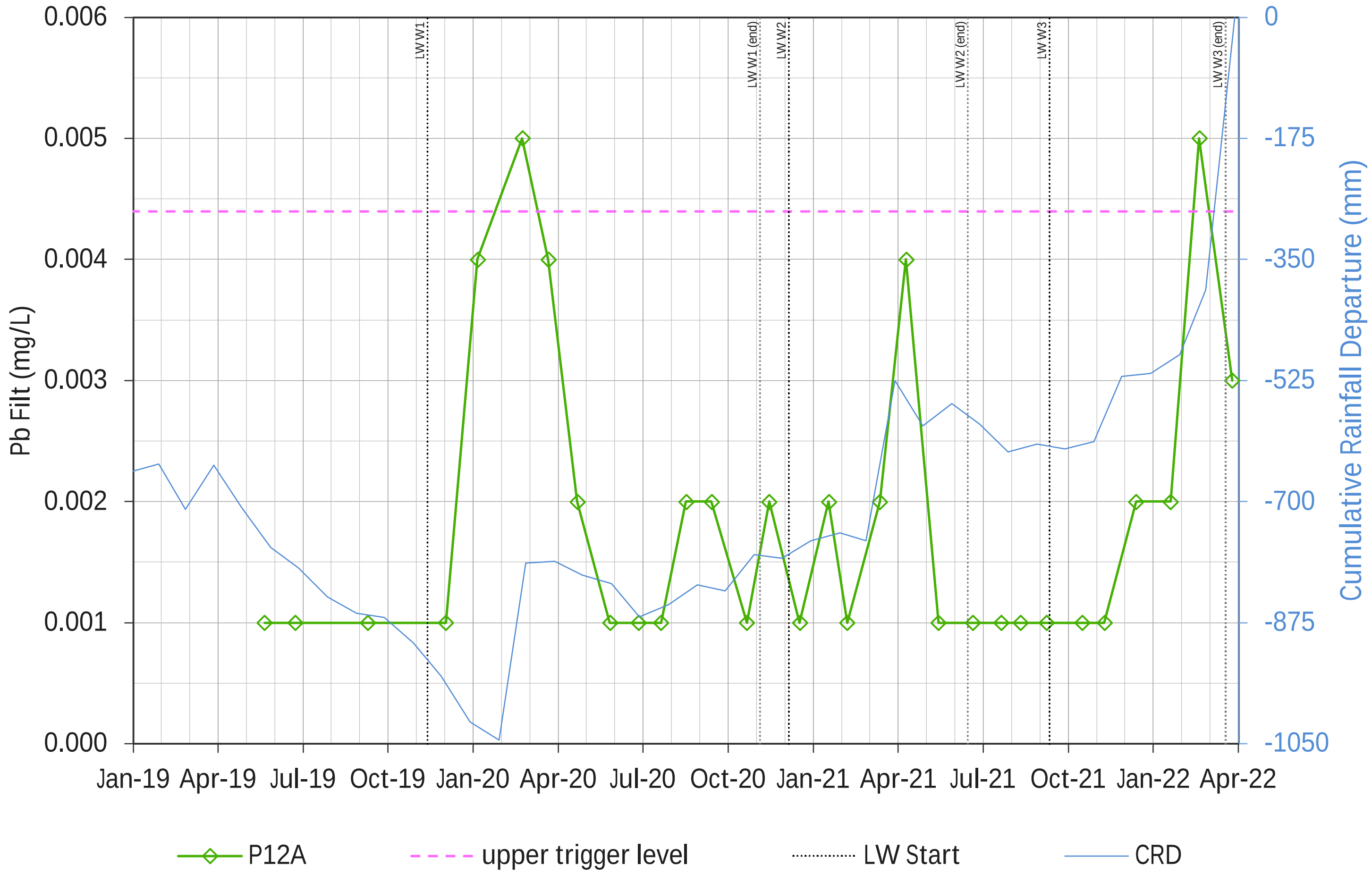



**Figure D-1**

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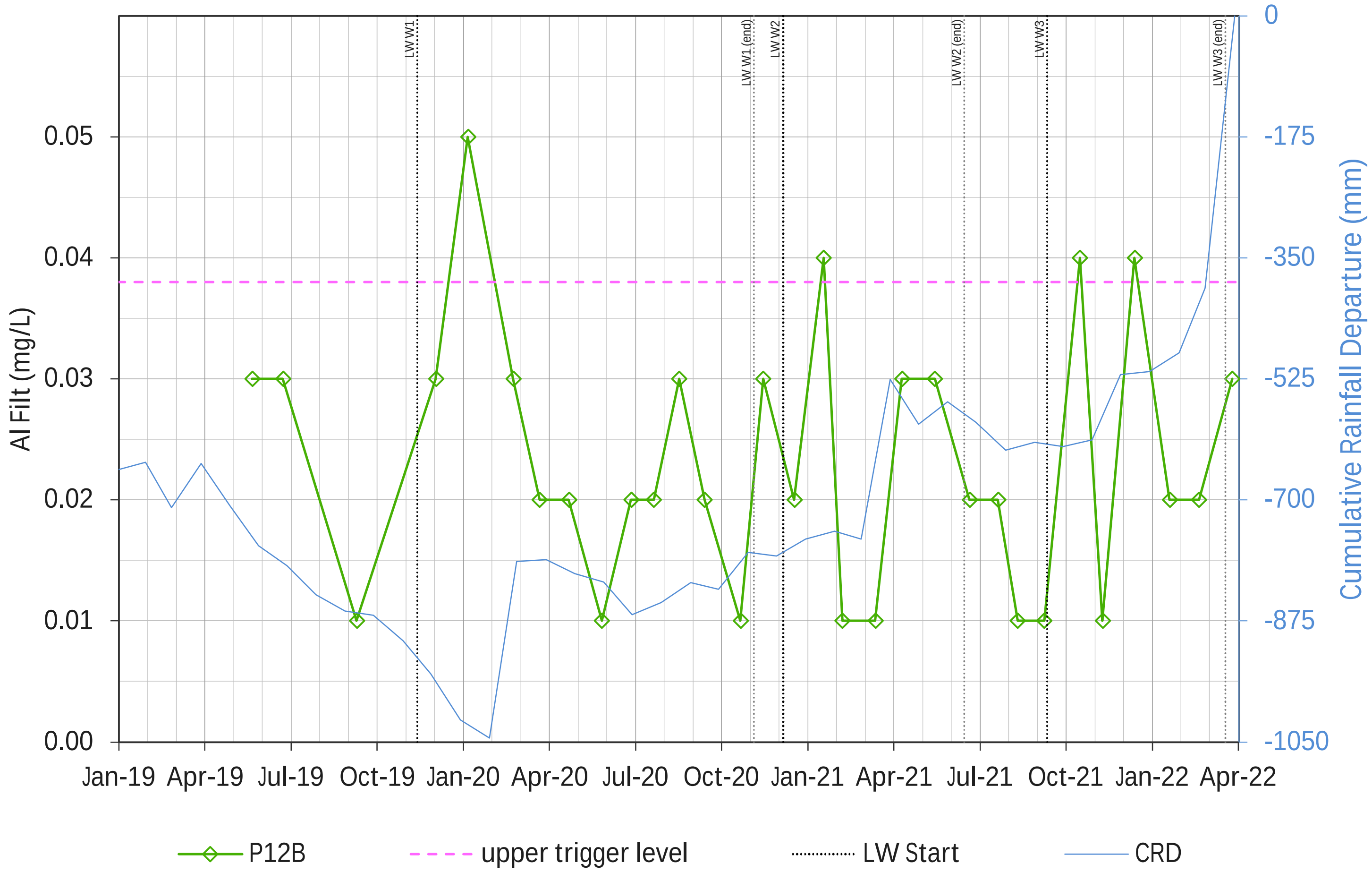


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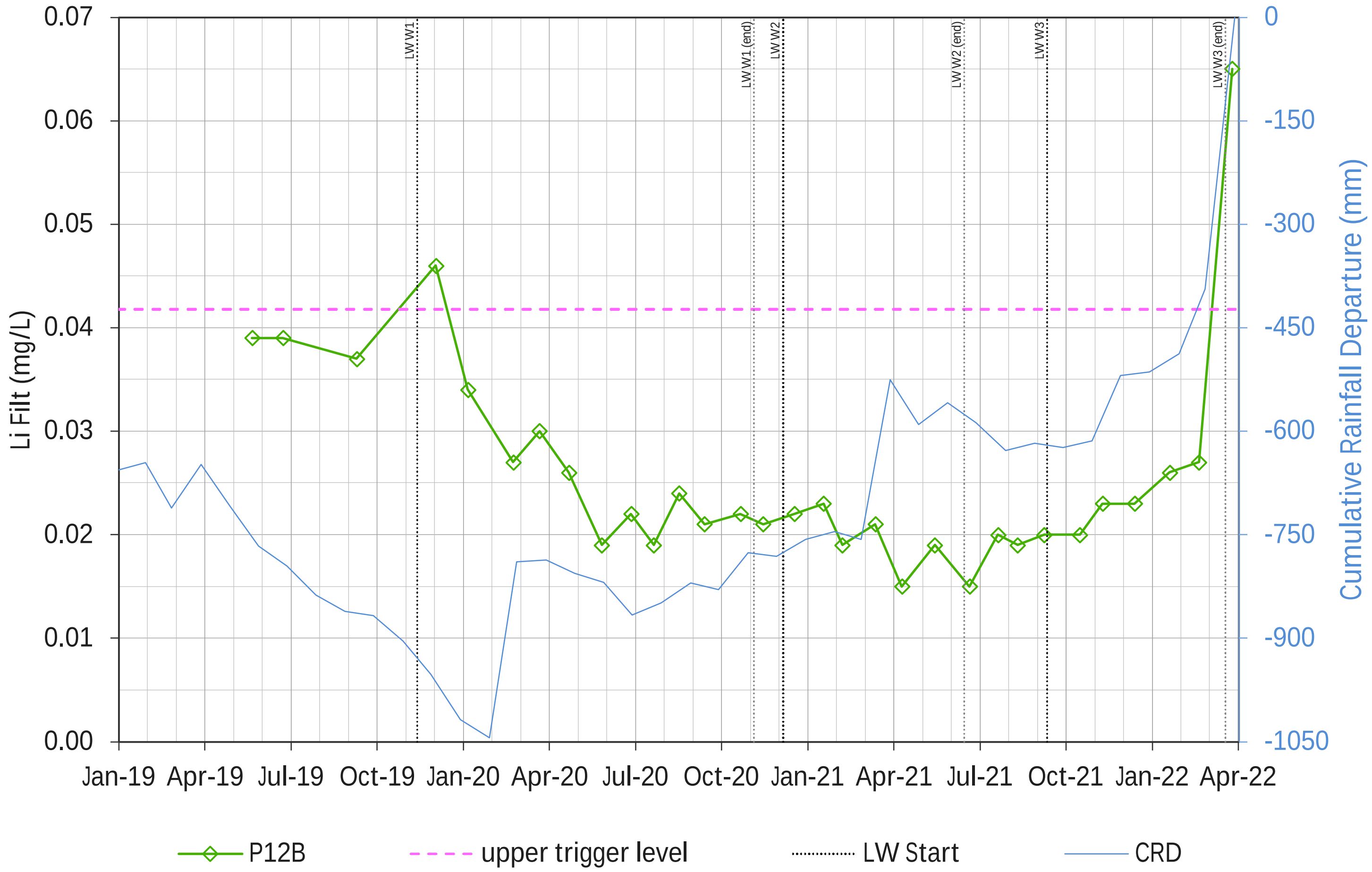


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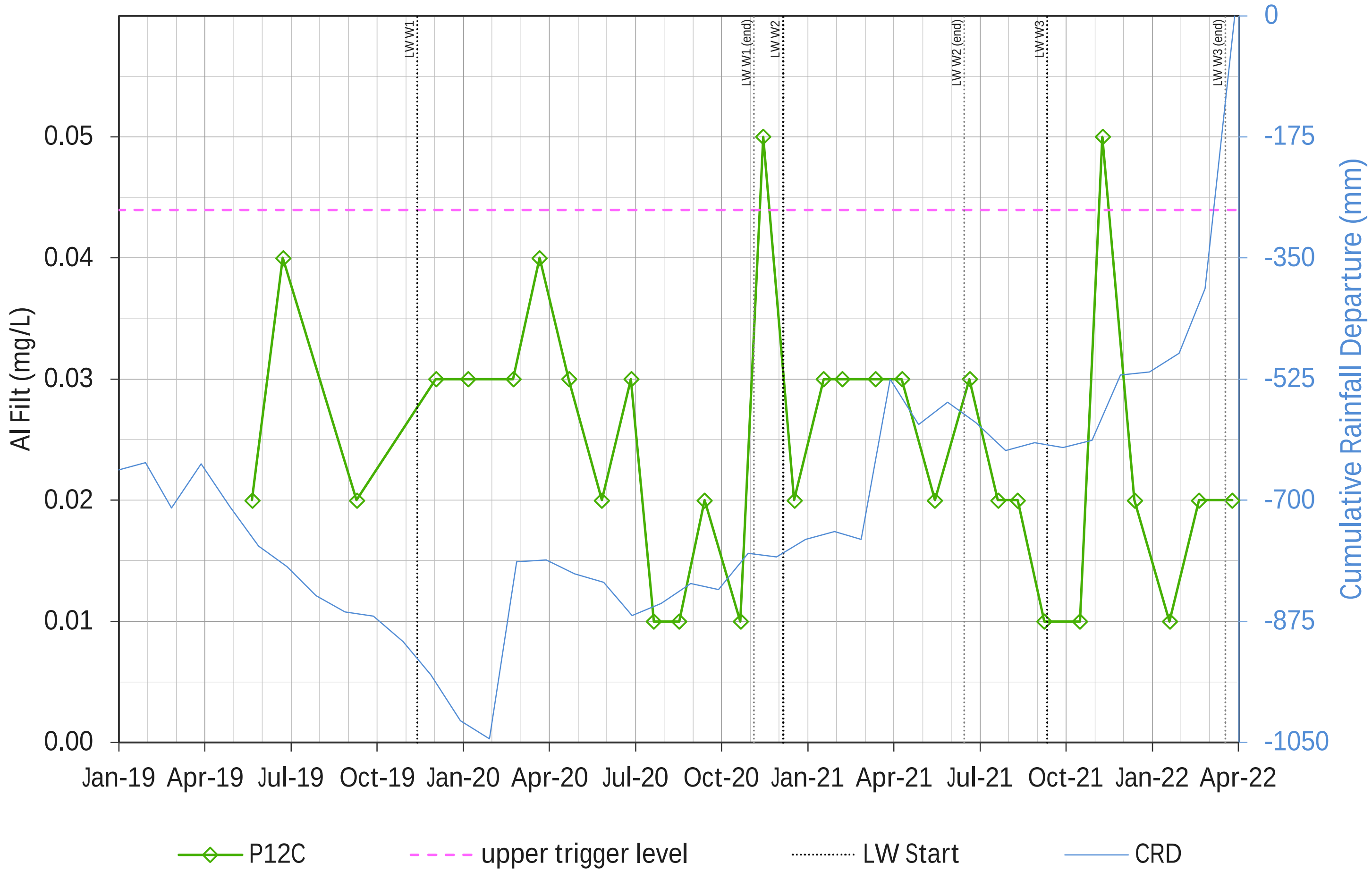


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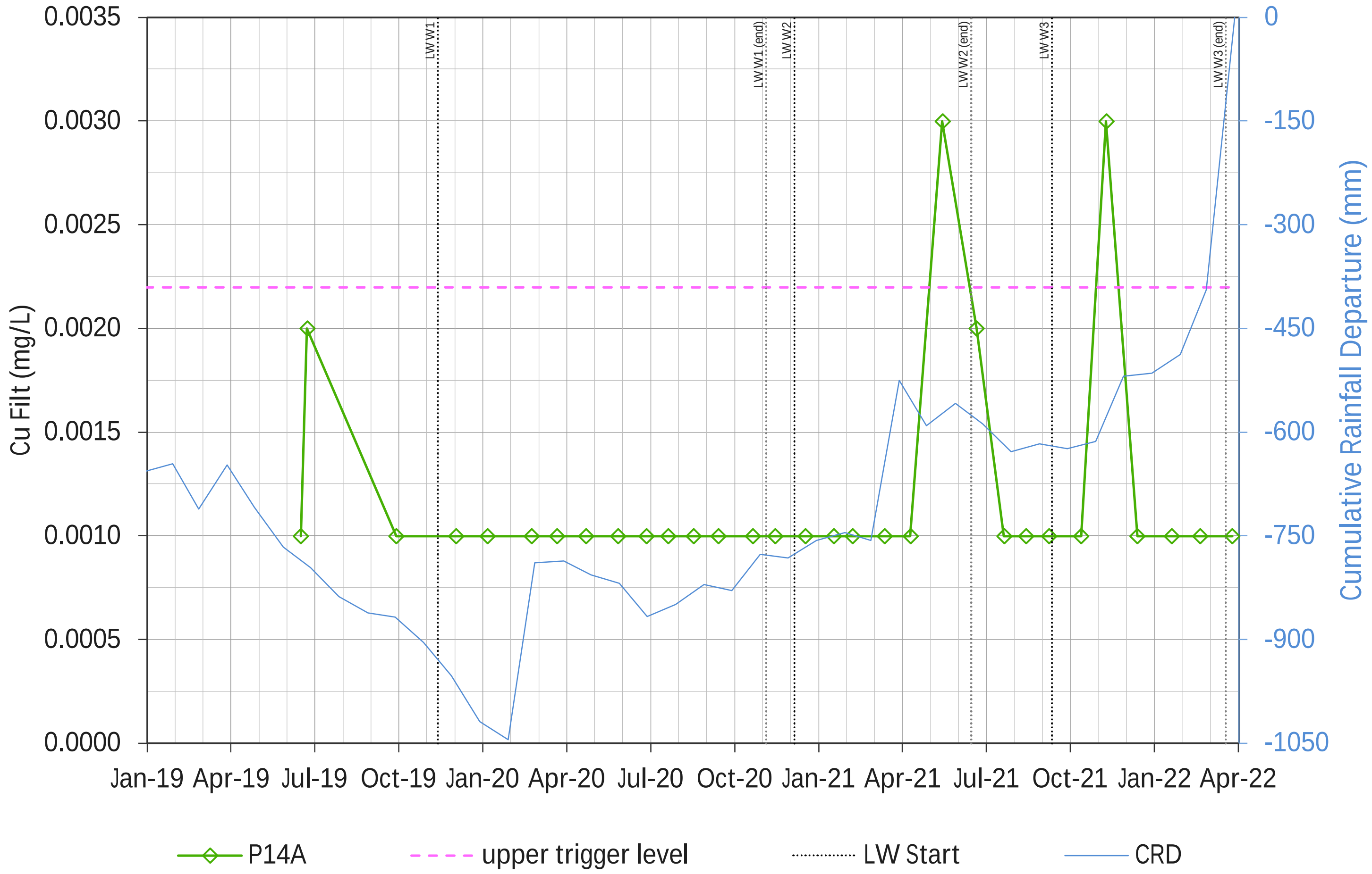


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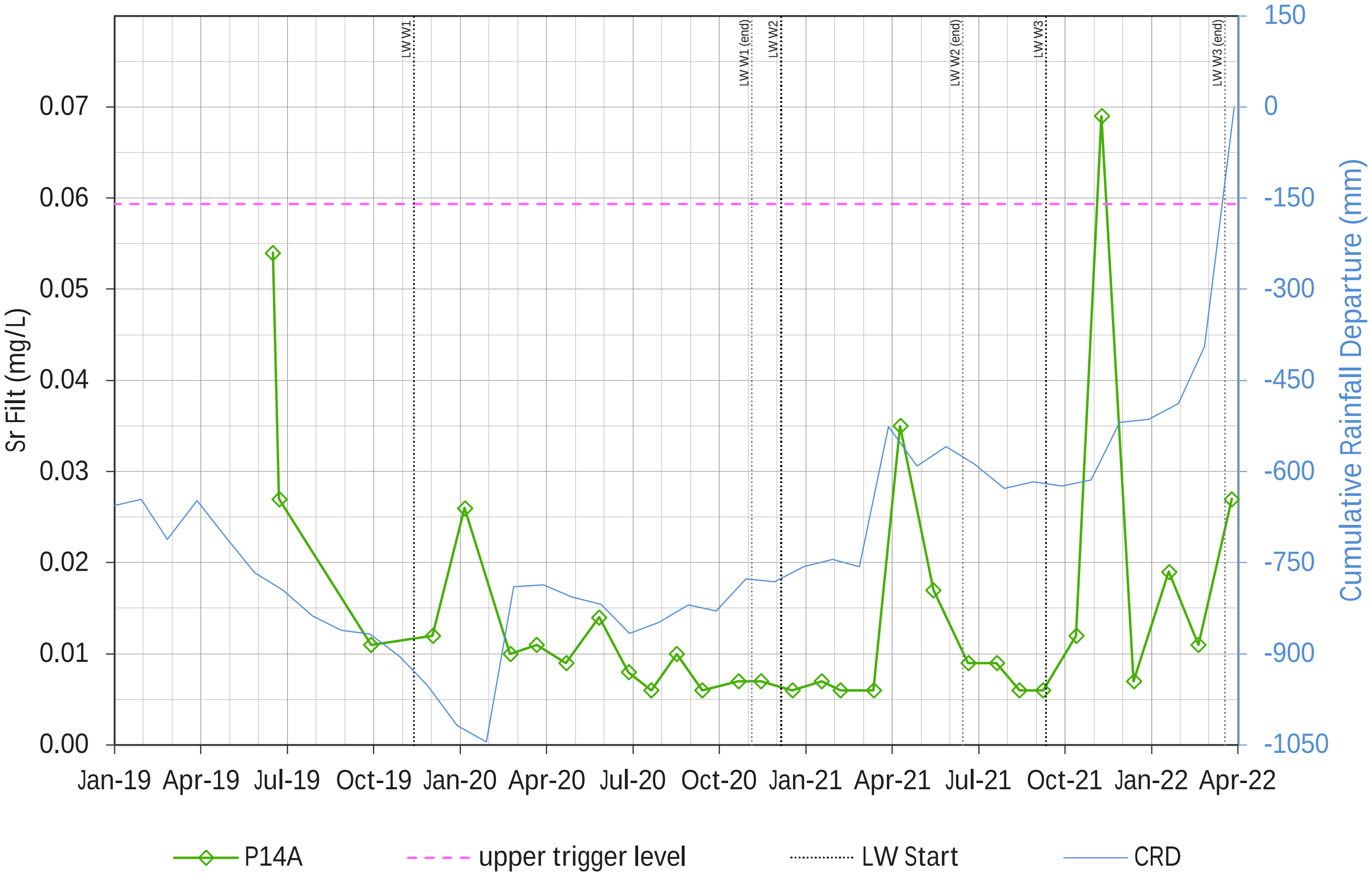


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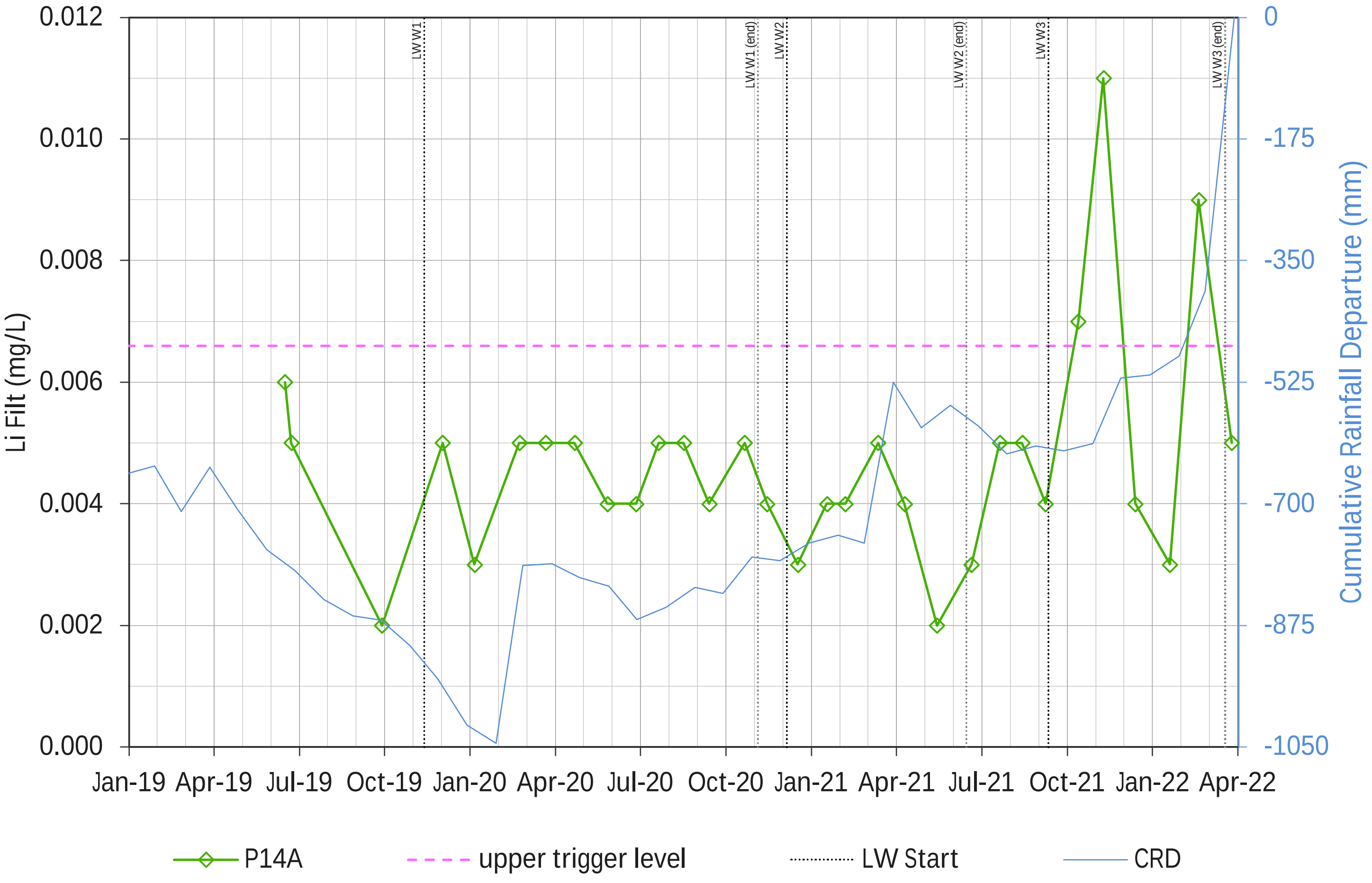


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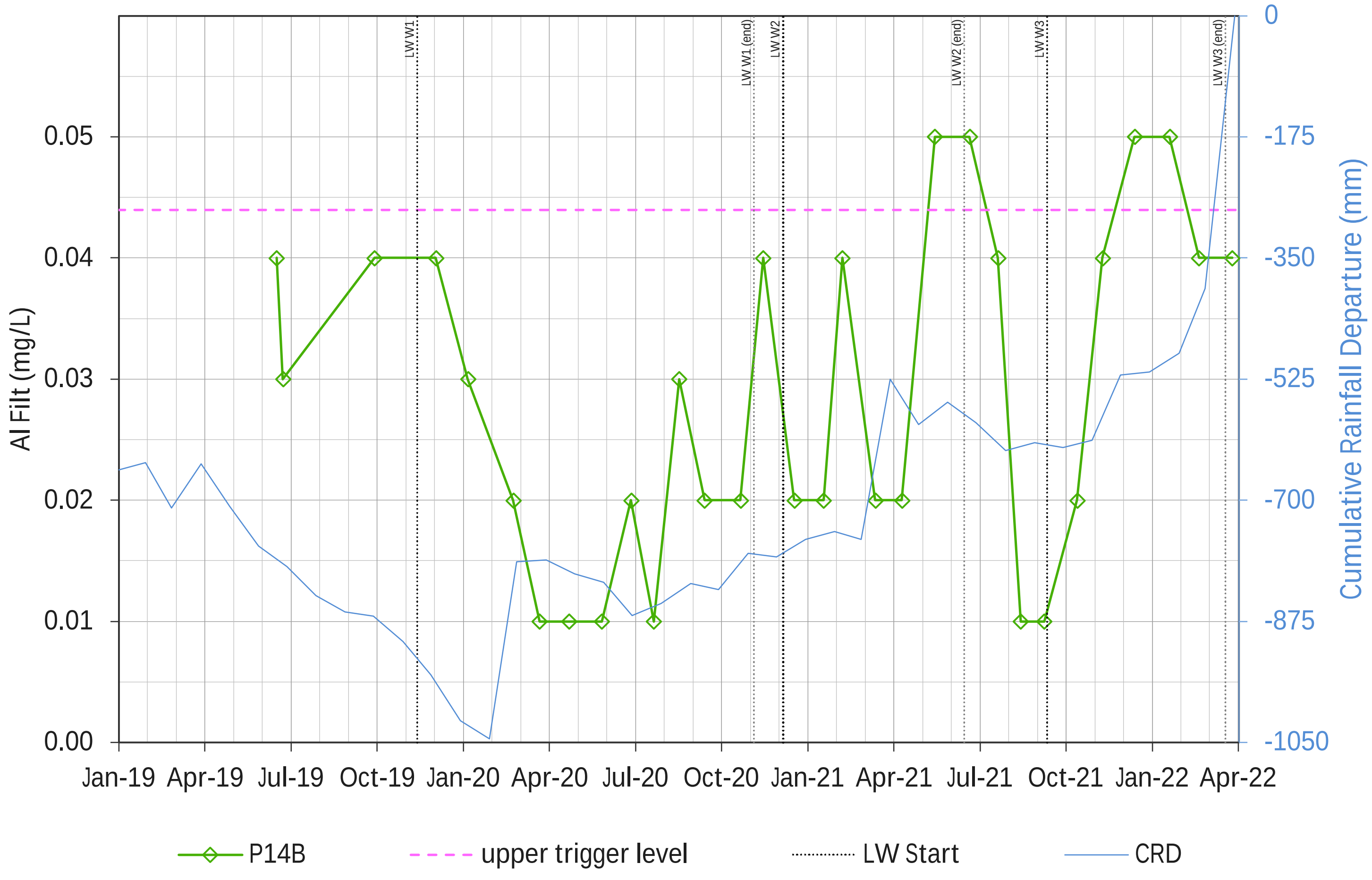


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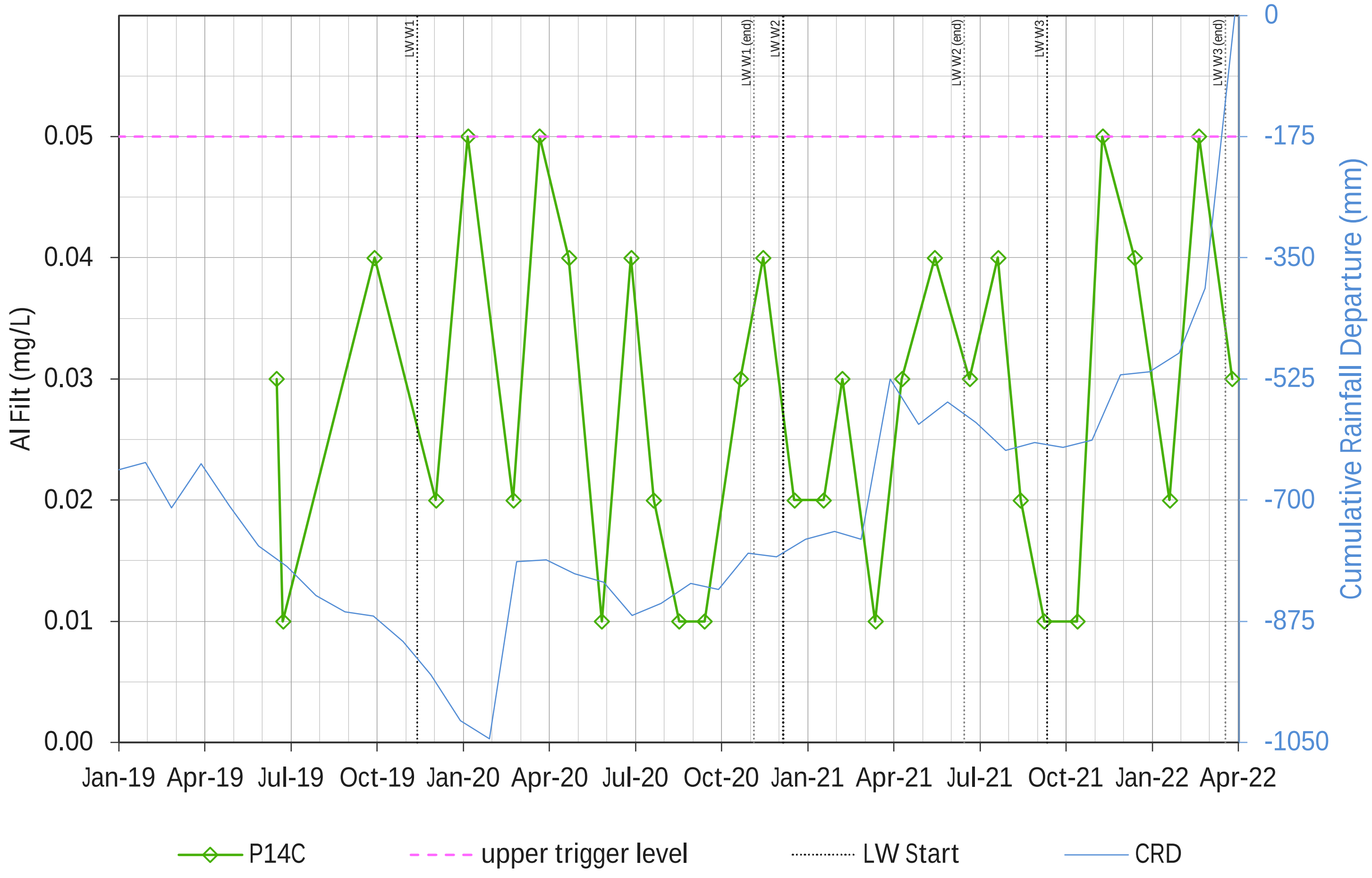


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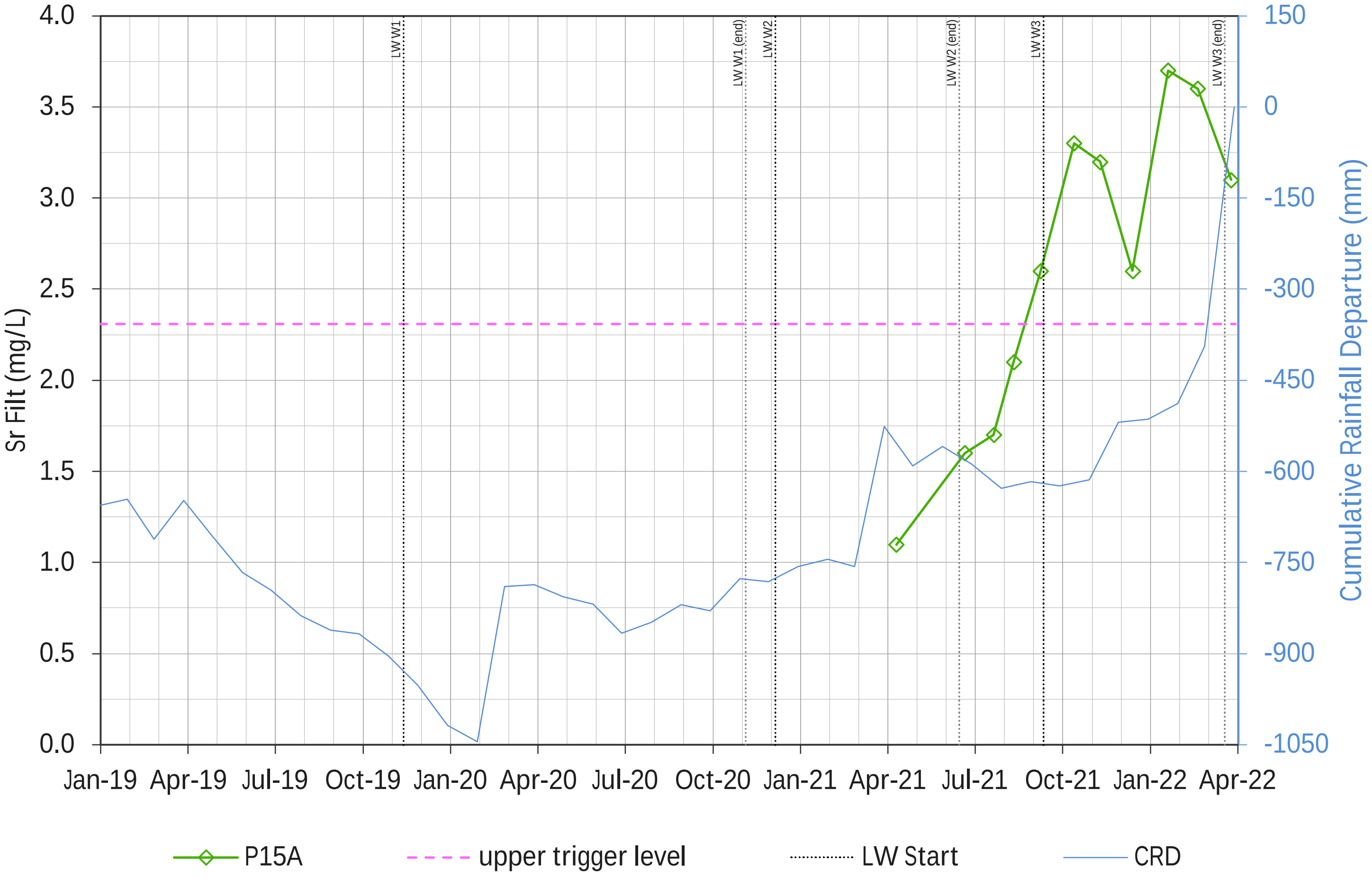


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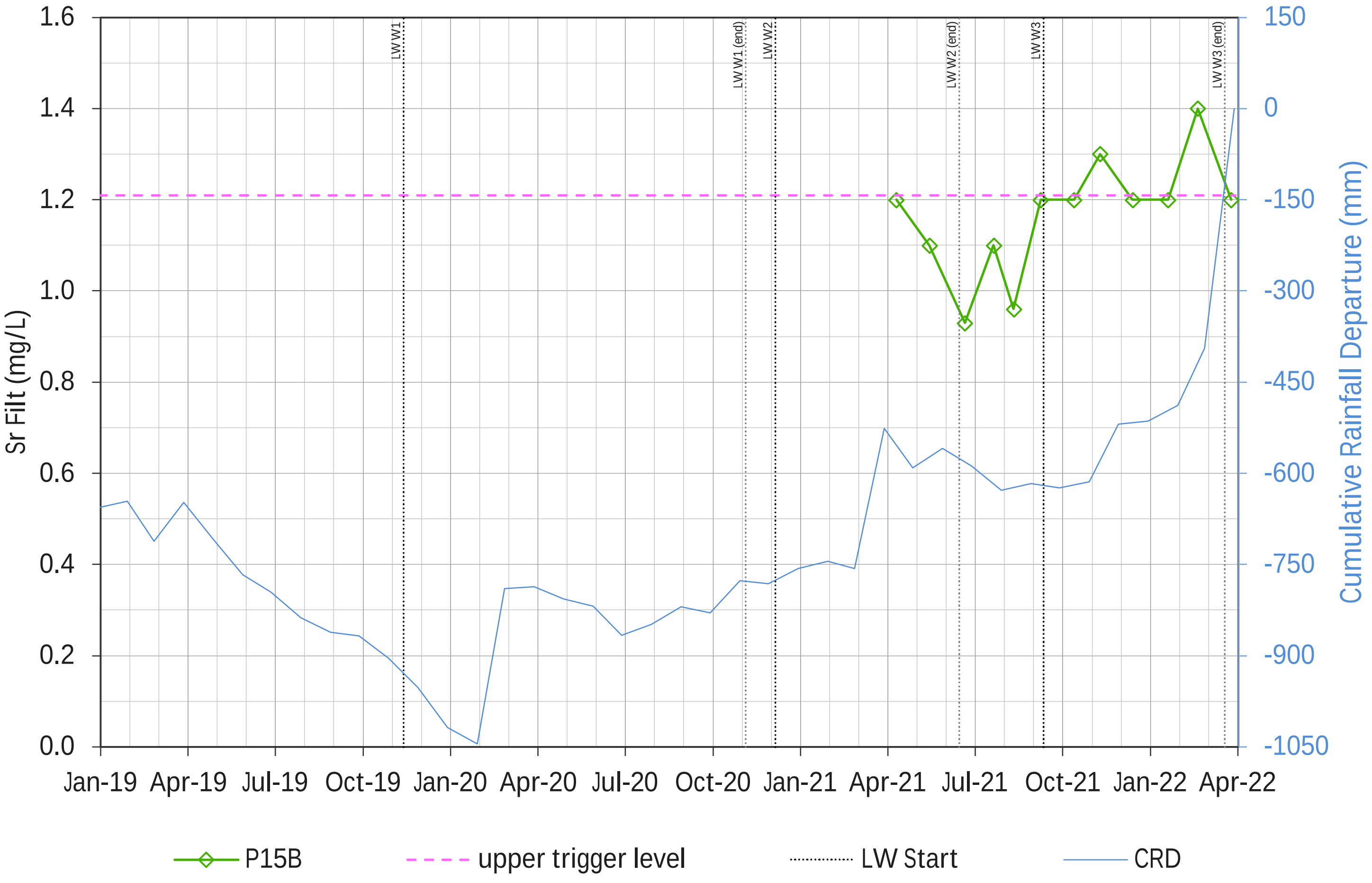


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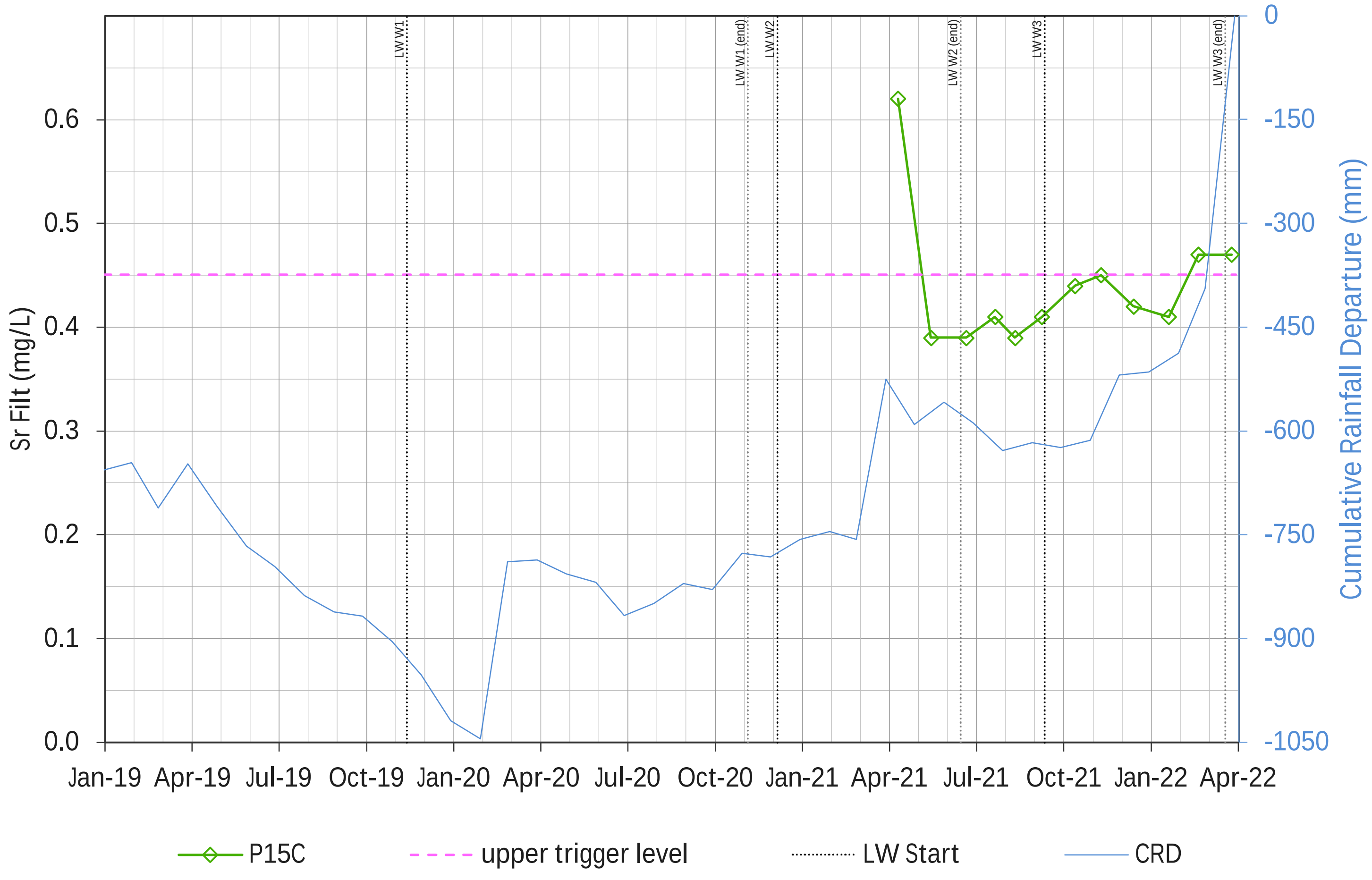


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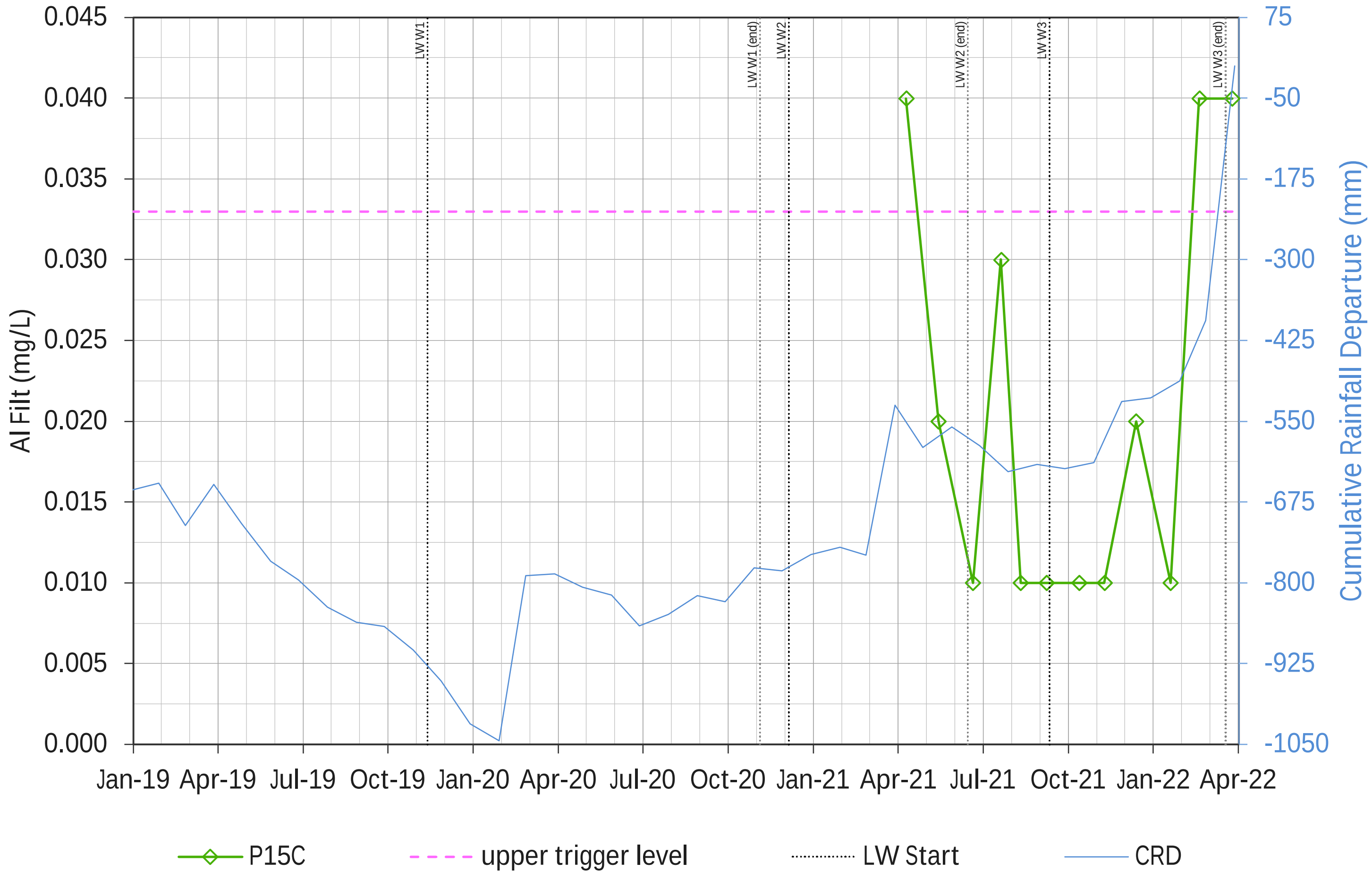


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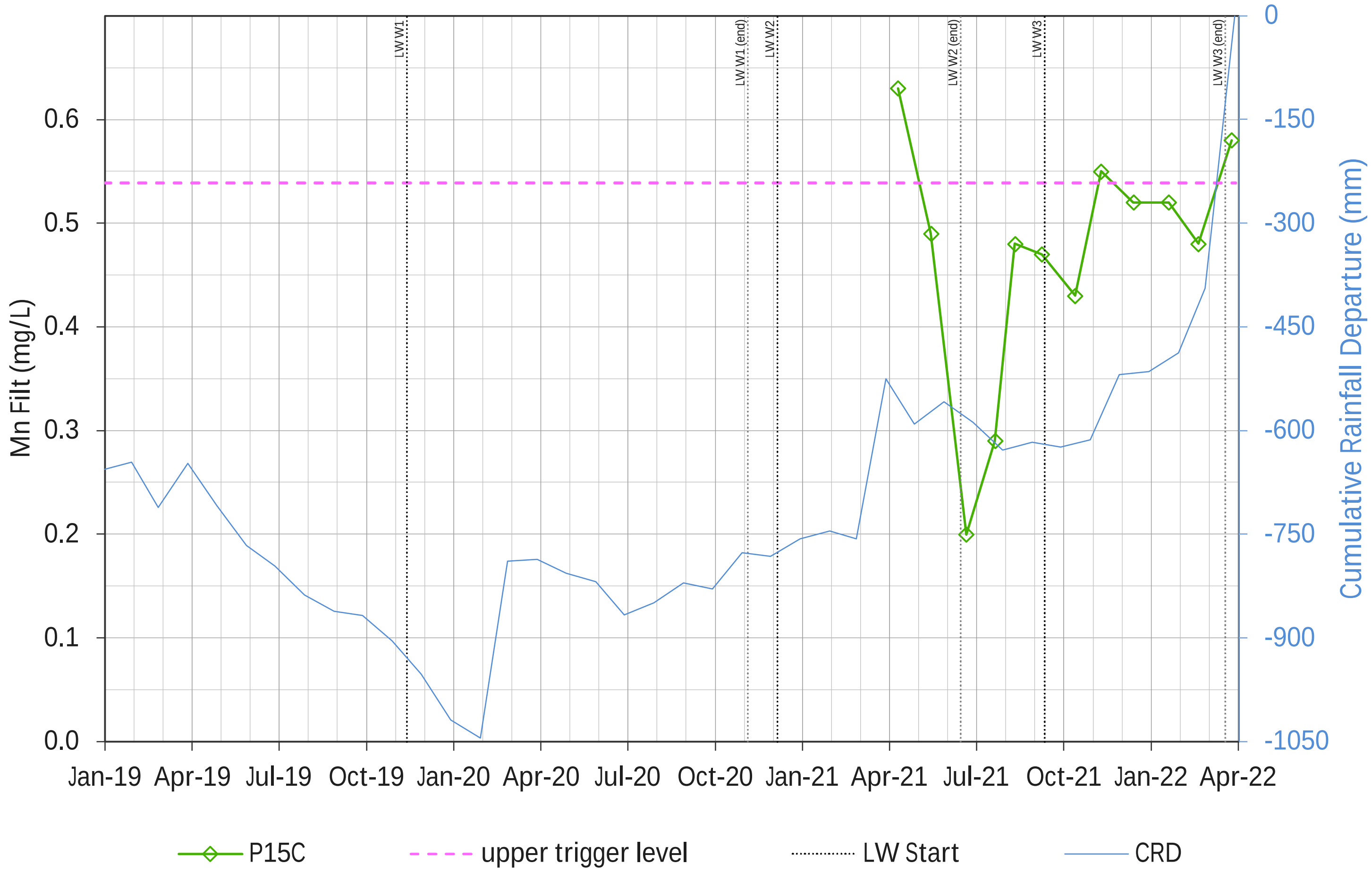


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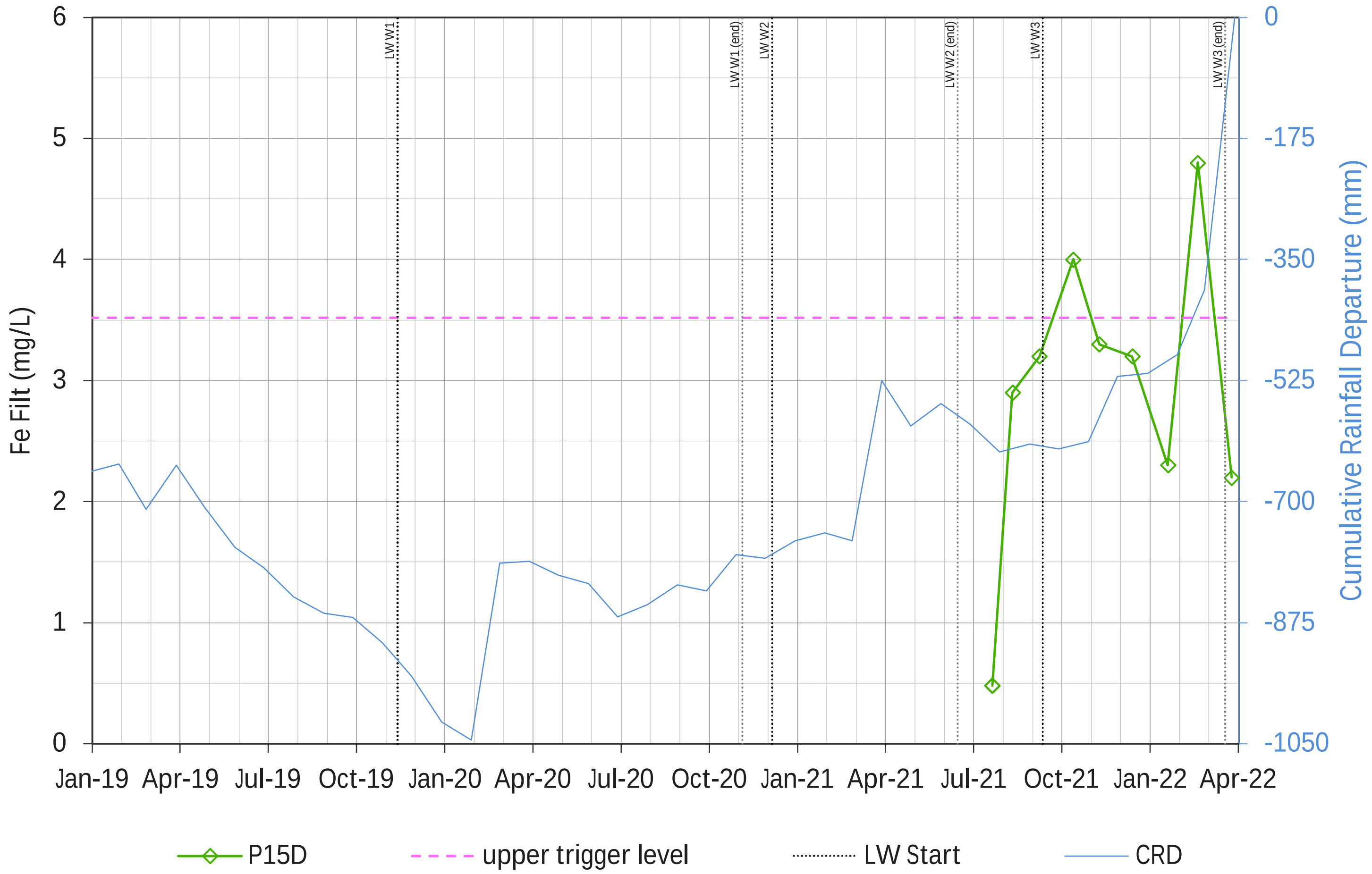


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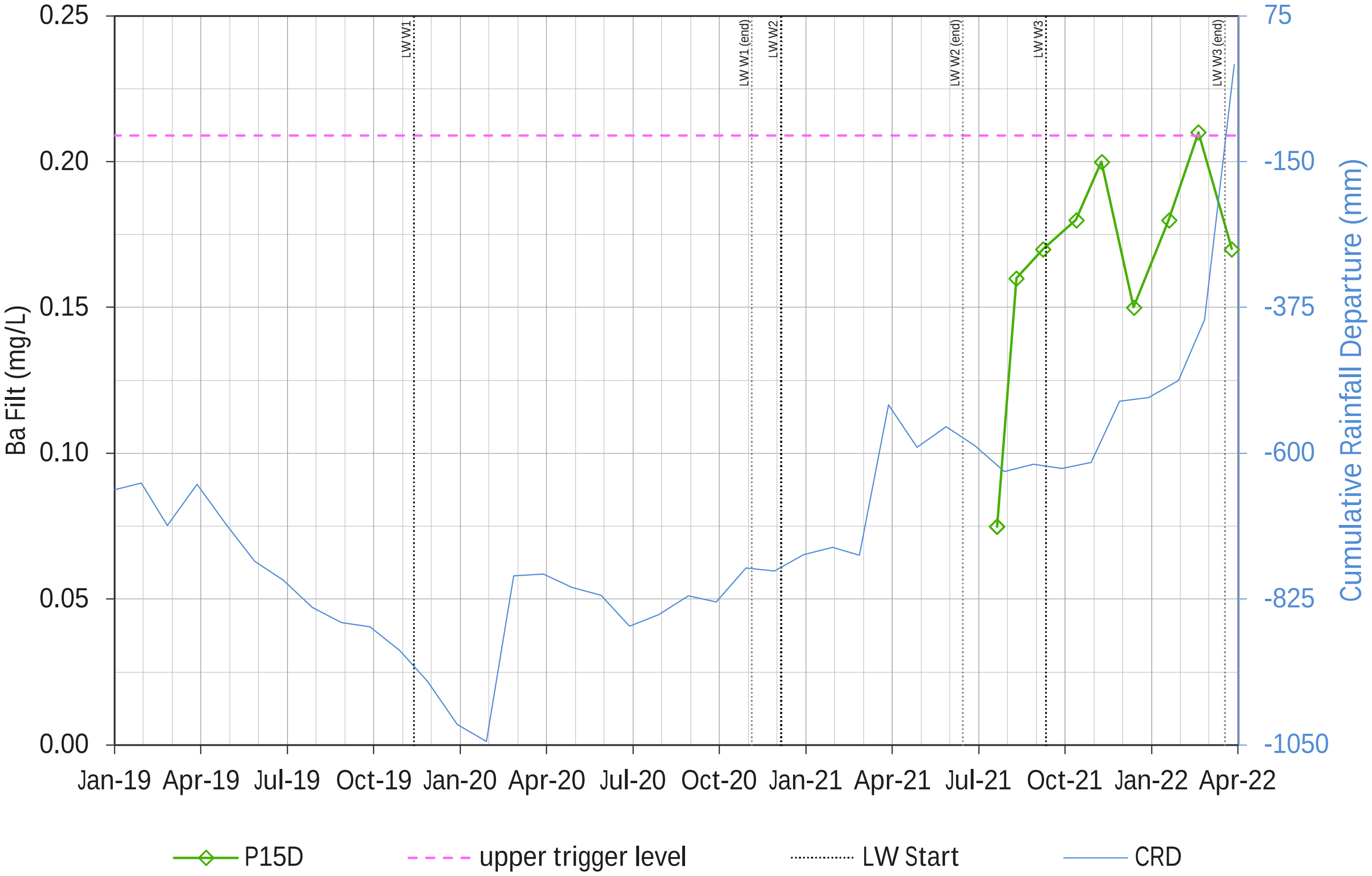


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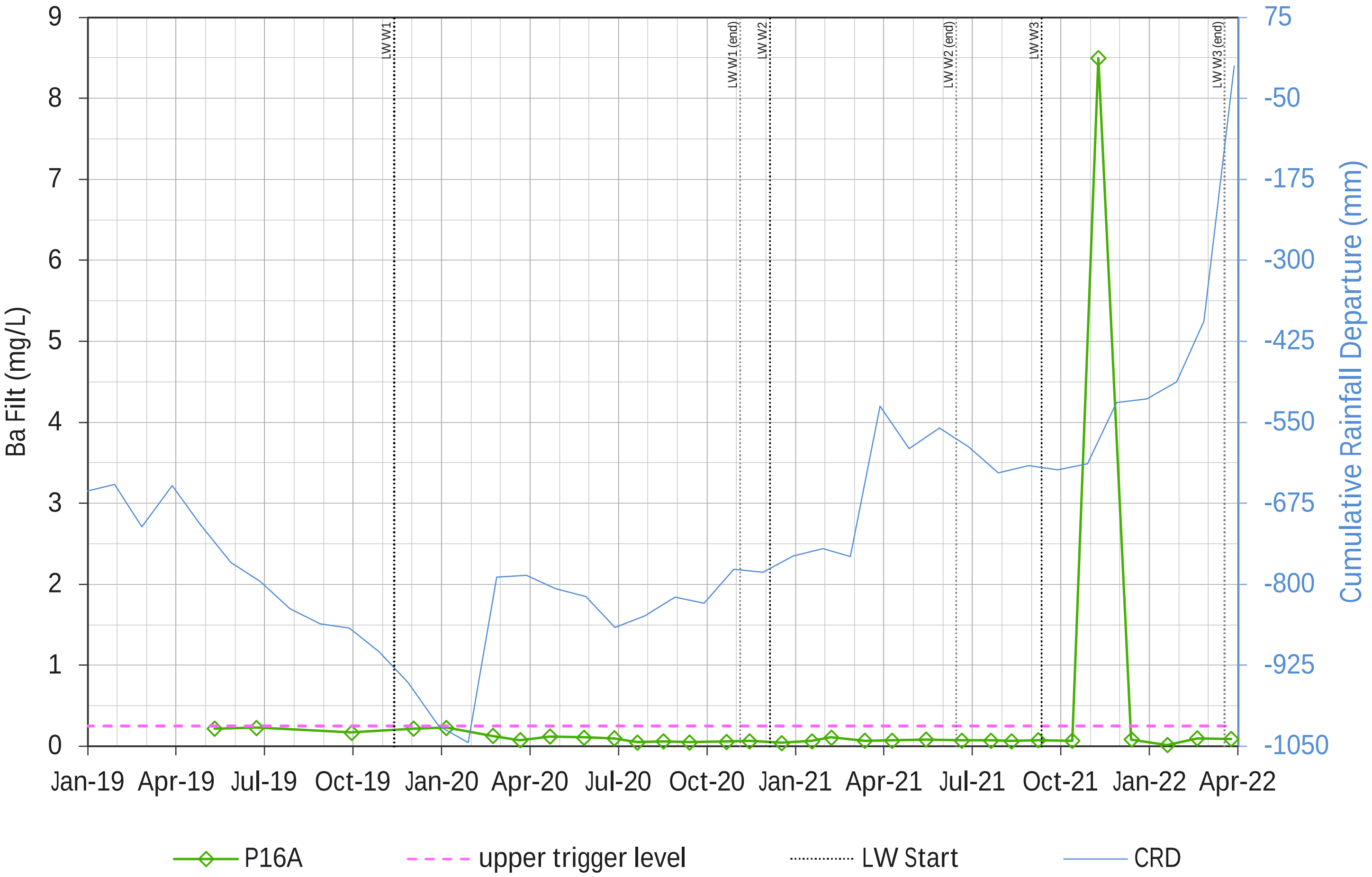


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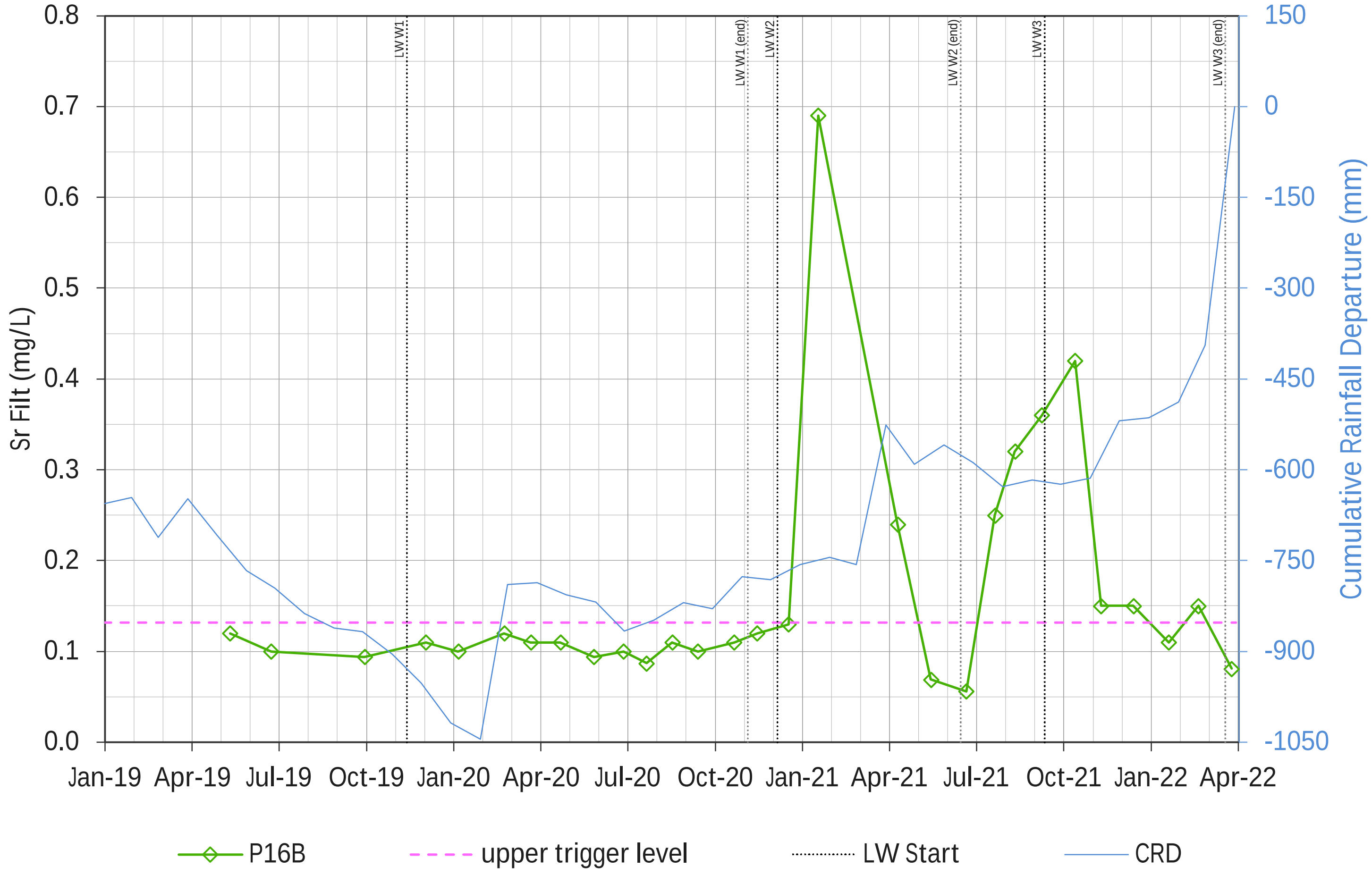


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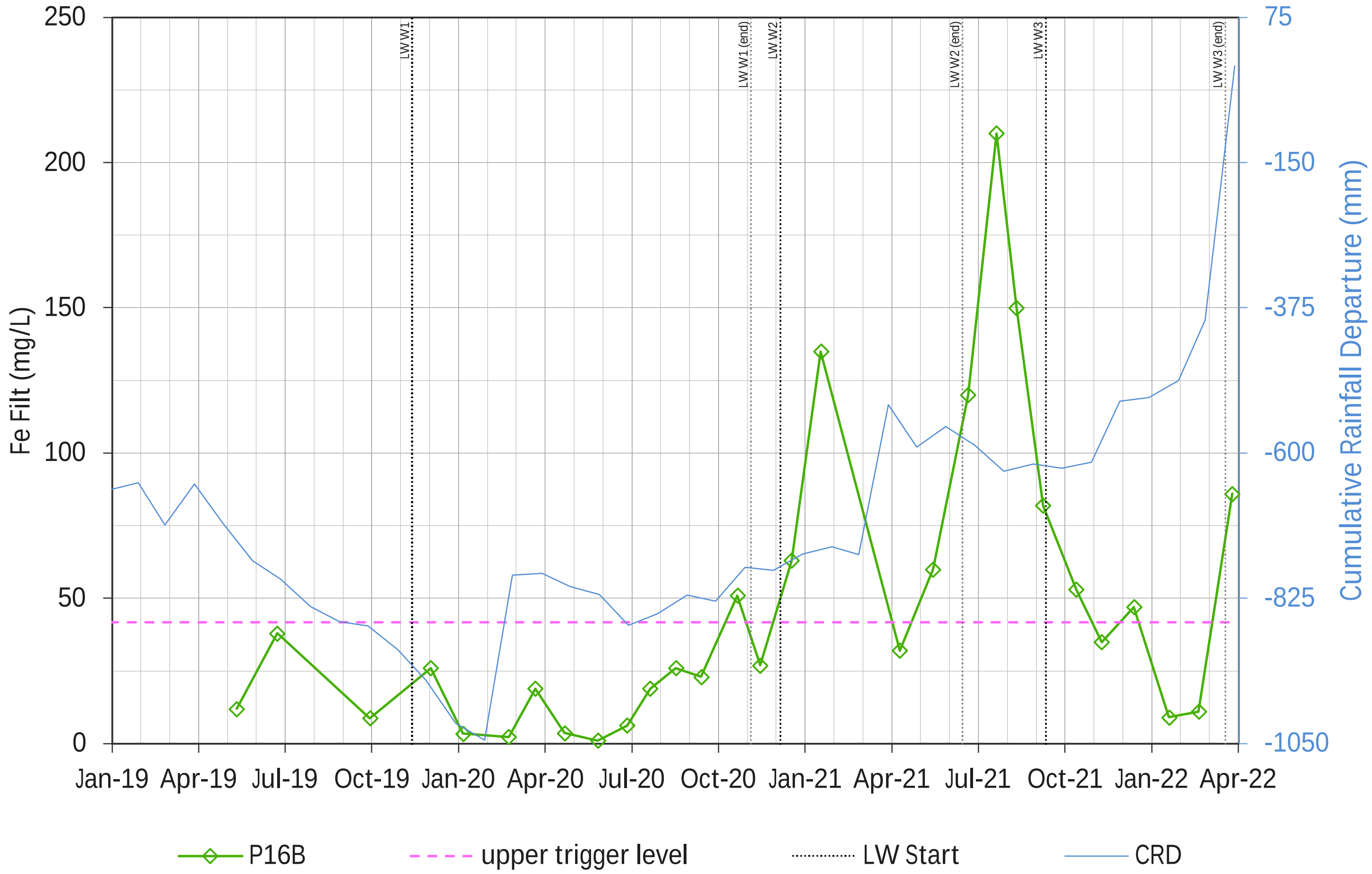


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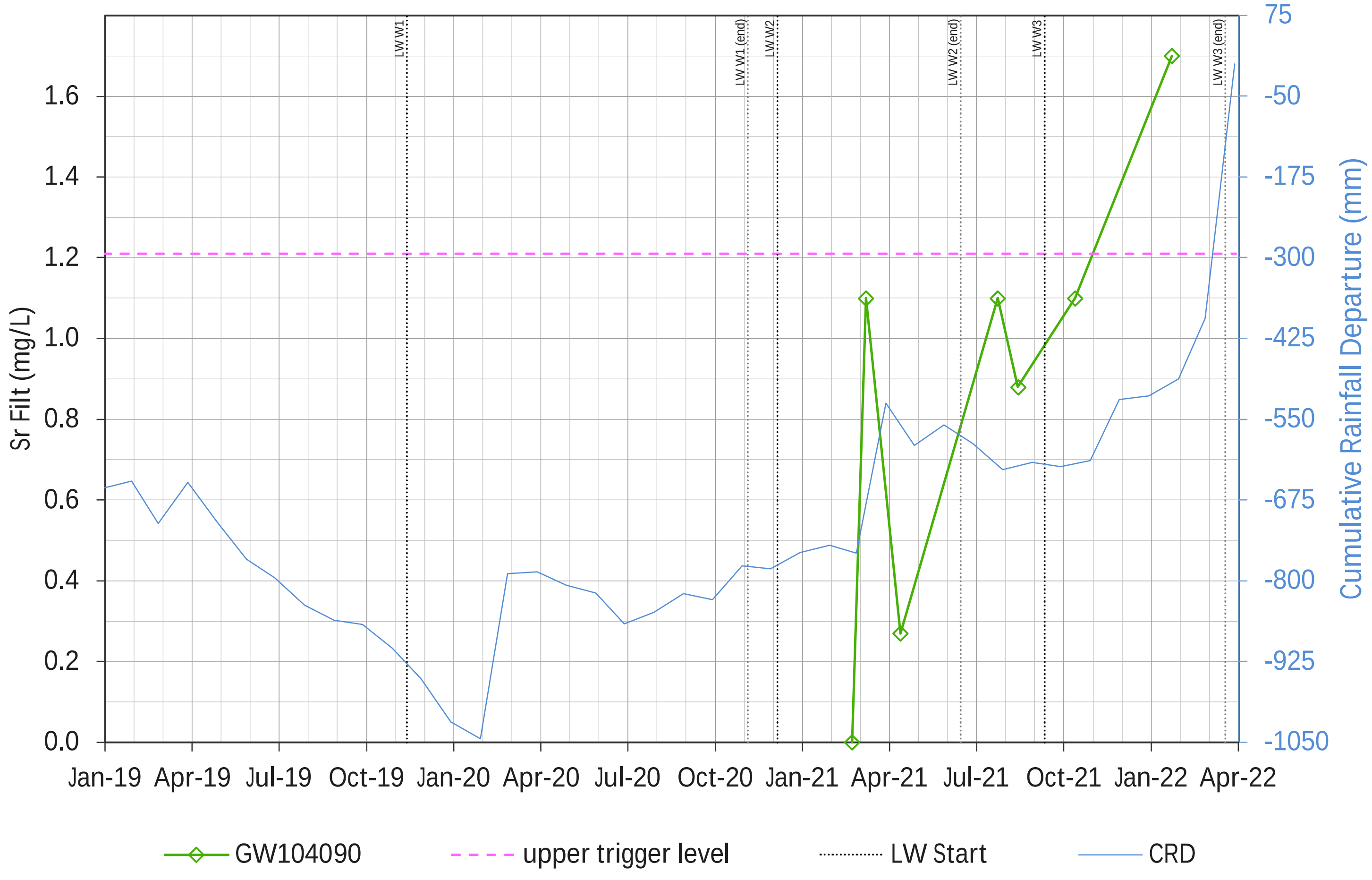


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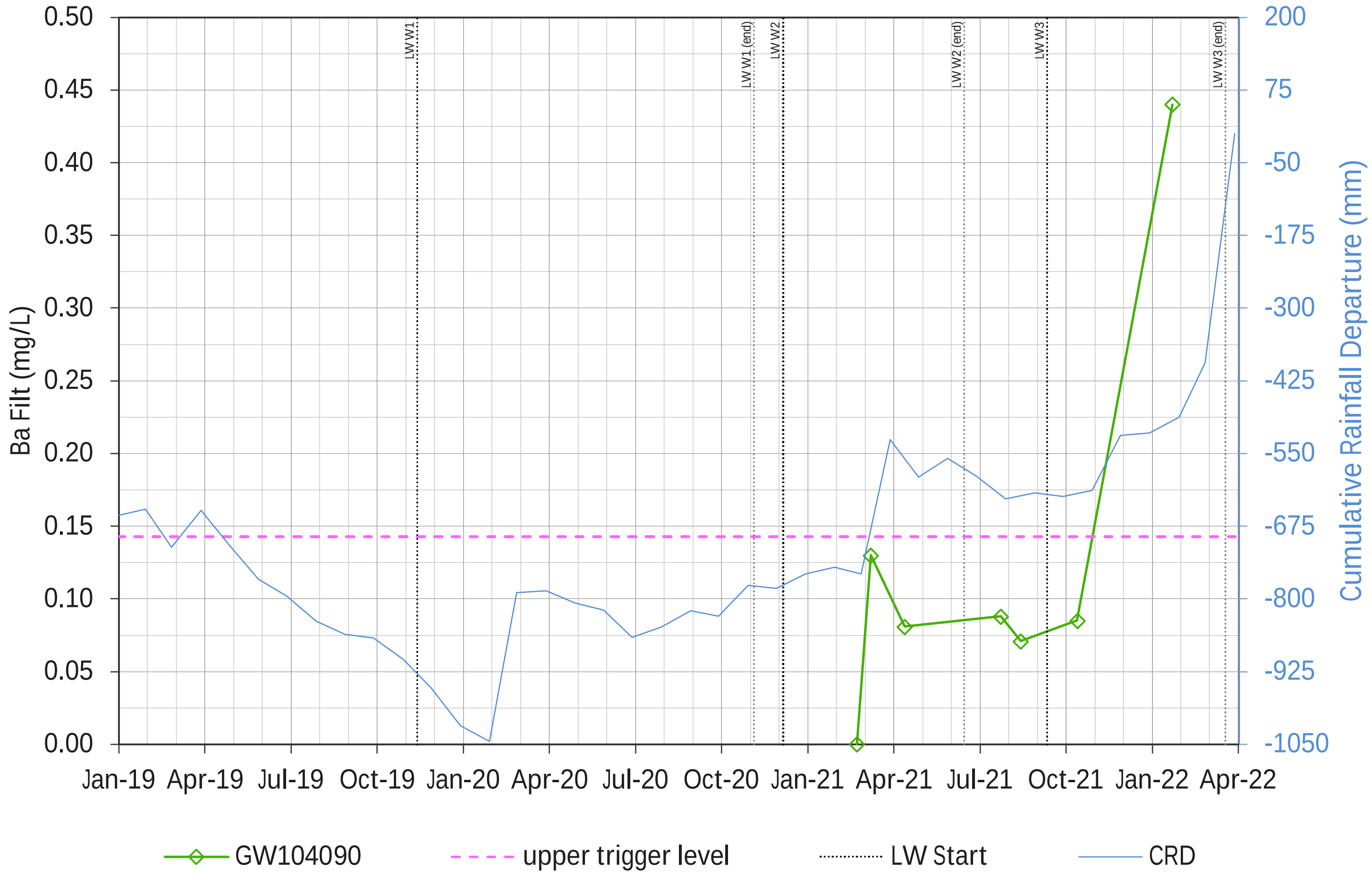


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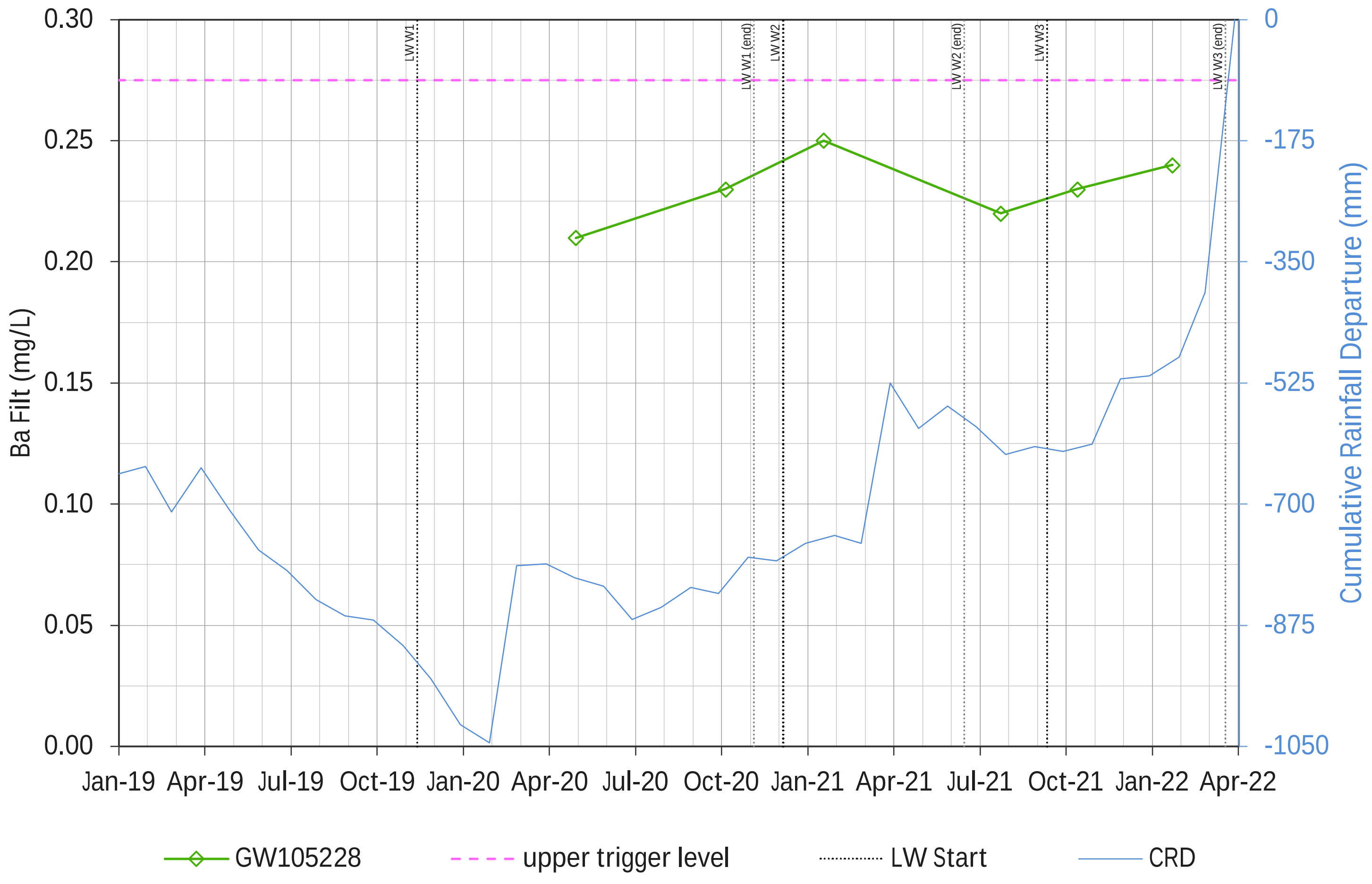


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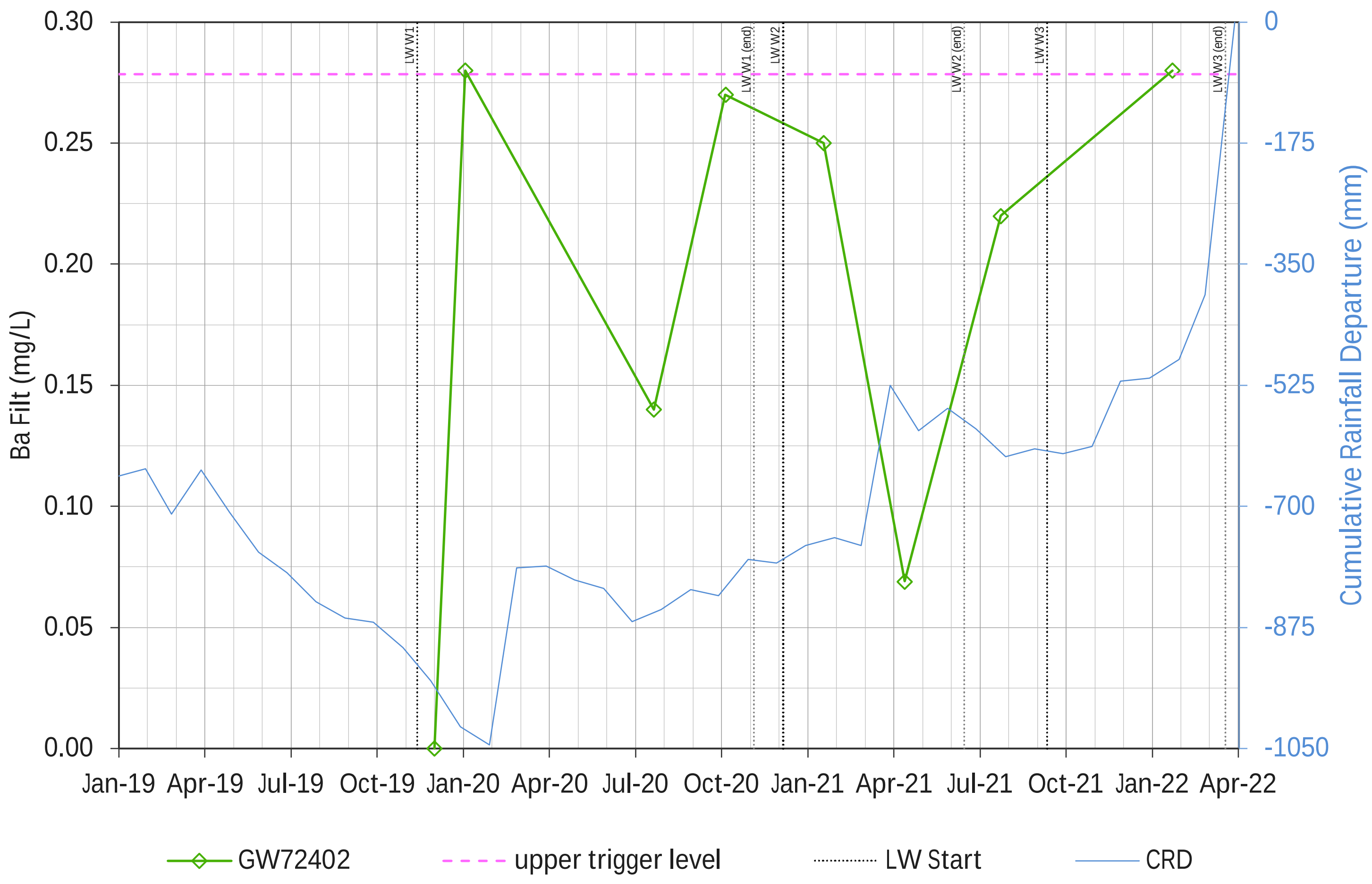


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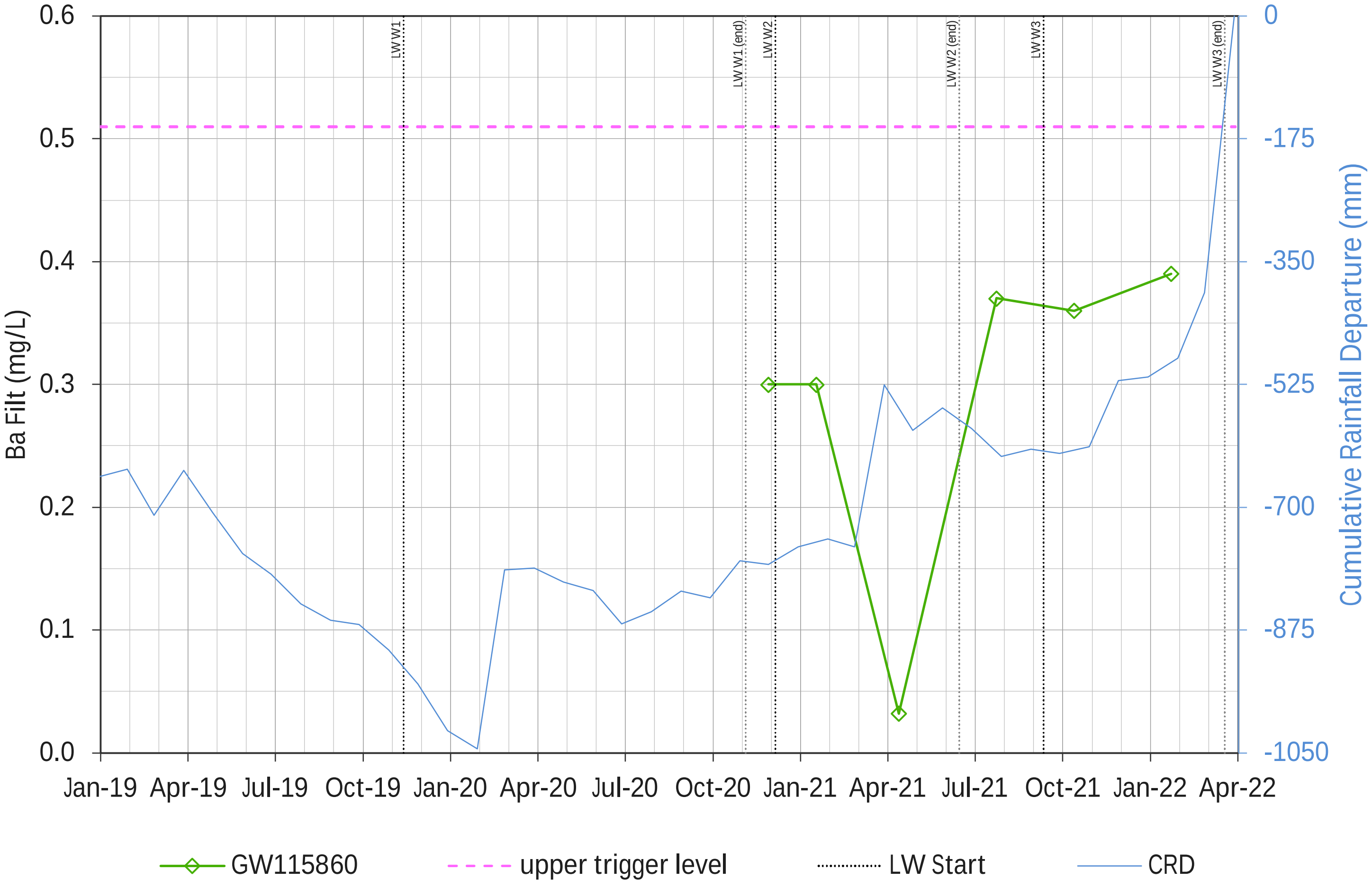

Ba Filt (mg/L)
Cumulative Rainfall Departure (mm)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
-175
-350
-525
-700
-875
-1050
Jan-19
Apr-19
Jul-19
Oct-19
Jan-20
Apr-20
Jul-20
Oct-20
Jan-21
Apr-21
Jul-21
Oct-21
Jan-22
Apr-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
GW115860
upper trigger level
LW Start
CRD


Figure D-25

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# TAHMOOR COAL

**Groundwater Six-Monthly Review**
**April 2022 - September 2022**

**Prepared for:**

Tahmoor Coal Pty Ltd

**SLR Ref: 610.31052.00000-R04**
**Version No: -v2.0**
**December 2022**

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# BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Tahmoor Coal Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

# DOCUMENT CONTROL

| Reference | Date | Prepared | Checked | Authorised |
| --- | --- | --- | --- | --- |
| 610.31052.00000-R04-v2.0-20221205.docx | 5 December 2022 | Maxime Philibert | Will Minchin | Ines Epari |
| 610.31052.00000-R04-v1.0-20221205.docx | 4 November 2022 | Maxime Philibert | Will Minchin | Ines Epari |

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## APPENDICES

# 1 Introduction

## 1.1 Overview

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Tahmoor Coal Pty Ltd (Tahmoor Coal) to undertake a groundwater six-monthly review for the Tahmoor Coal Mine (Tahmoor Mine), located between the towns of Tahmoor and Bargo, New South Wales (NSW). A five-monthly reporting period was chosen to match with the review period presented in the surface water review completed in ATC Williams (2022a).

This review focuses on the five-monthly reporting period from 1st April 2022 to 30th September 2022, and includes:

- A review of groundwater levels in monitoring bores in the context of the water level triggers specified in the Longwall W1-W2 Water Management Plan (WMP) and Longwall W3-W4 Water Management Plan (Tahmoor Coal, 2021), with a subsequent evaluation and analysis of any groundwater level trends that exceed this assessment to determine possible causes for these trends;
- A review of water quality triggers and analysis of any bores that exceed these water quality trigger limits as specified in the WMP (i.e. LW W1-W2 WMP and LW W3-W4 WMP); and
- A review of groundwater inflow to the underground mine and compliance with the water access licence held by Tahmoor Coal.

## 1.2 Site Background

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

Tahmoor Mine has been operated by Tahmoor Coal since Tahmoor Mine commenced in 1979 using board 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 previously mined 36 longwalls to the north and west of Tahmoor Mine's current pit top mine infrastructure location. The 'Western Domain', is located north-west of the Main Southern Rail between the townships of Thirlmere and Picton. The Western Domain is within Mining Lease (ML) 1376 and ML 1539.

The mine plan for the Western Domain includes four longwalls - Longwalls West 1 to West 4. An Extraction Plan for the first two longwalls in the Western Domain, Longwalls West 1 and West 2 (LW W1-W2), was approved by the NSW Department of Planning, Industry and Environment (DPIE[1]) on 8 November 2019. An Extraction Plan for the second two longwalls in the Western Domain, Longwalls West 3 and West 4 (LW W3-W4), was approved by DPIE on 13 September 2021. **Table 1** presents the mining schedule for the Western Domain longwalls.

[1] Currently the Department of Planning and Environment (DPE) since 21 December 2021

**Table 1 Mining schedule for Western Domain longwalls**

| Longwalls | Start date | End date |
|---|---|---|
| LW W1 | 15 November 2019 | 6 November 2020 |
| LW W2 | 7 December 2020 | 17 June 2021 |
| LW W3 | 13 September 2021 | 21 March 2022 |
| LW W4 | 16 May 2022 | 13 September 2022 |

## 1.3 Recent Mining Activity

Over the reporting period from 1 April 2022 to 30 September 2022 the following mining (new and continued mining) activities have taken place at the Tahmoor Mine:

- Longwall West 4 (LW W4) extraction started on 16 May 2022 and was completed on 13 September 2022. The total extraction length for LW W4 is 720.8m.
- No extraction activities at LW W3 took place during the reporting period.

## 1.4 Methodology

This report details the analysis of groundwater levels and quality to comply with the conditions of the WMP, outlined in **Section 2**, focusing on groundwater levels and water quality parameters that have exceeded the trigger levels. To fulfil these requirements this report has carried out the following:

- An analysis of groundwater levels in the relevant monitoring bores to determine groundwater level changes over the reporting period in the vicinity of the Western Domain of Tahmoor Mine to demonstrate the correlation between climatic conditions and groundwater levels. Where any unexpected groundwater level changes and exceedances of defined trigger levels were observed, an analysis is carried out to determine the main reasons for this groundwater change (**Section 4**);
- A review of groundwater quality monitoring, including both field and laboratory data, undertaken during the monitoring period, and identification of any parameters that fall outside those specified in the WMP and the possible causes for these exceedances (**Section 5**);
- A summary of comparison between the modelled and observed groundwater levels using the latest model results presented in the Groundwater Technical Report: Extraction Plan for LW W3-W4 (SLR, 2021) and latest available observed groundwater data (**Section 6**); and
- An analysis of groundwater mine inflow to determine compliance with groundwater licences and the causes of any significant increases or decreases in groundwater take at Tahmoor Mine (**Section 7**).

# 2 Statutory Requirements

The relevant statutory requirements for the Tahmoor Mine six-monthly groundwater review (presented here as a five-month groundwater review, refer to **Section 1.1**) are outlined in the following sections. These requirements outline the licensed take from groundwater and highlight trigger levels for the approved impacts to groundwater levels and quality.

## 2.1 Development Application

The activities at the Tahmoor North Coal Mine were initially approved under the conditions of Development Application (DA 67/98) in 1999. Since this approval five modifications to the DA have been made to maintain the relevance of the approval conditions to changes in legislation and policy, industry practice, as well as environmental and community values.

In September 2018 (Modification 4) additional conditions (13A to 13J) were added to the DA to make provision to report on and measure the impacts of subsidence on natural, built and heritage features in the landscape. Under condition 13H of this modified section, is the request to prepare an Extraction Plan for all longwalls after and including Longwall 33 (now known as LW W1). Condition 13H section (vii) c) required the inclusion of a WMP to accompany the Extraction Plan for LW W3-W4. It is noted that a Modification 5 of DA 67/98 was issued by DPIE in October 2020 and includes only minor alterations to condition 13H. In September 2021, the extraction of LW W3-W4 was approved under the Tahmoor North – Western Domain Longwalls West 3 and West 4 Water Management Plan (Tahmoor Coal, 2021).

## 2.2 Water Licensing

Water Access Licences (WAL) held by Tahmoor Coal under the authority of the *Water Management Act 2000* are listed in **Table 2**.

### Table 2 Tahmoor Coal Water Access Licences (relevant to Western Domain)

| Work approval | WAL title | Issued | Purpose | Share |
|---|---|---|---|---|
| 10WAL18745 | WAL 36442 | 06/12/2013 | Mining dewatering (groundwater) (Nepean Sandstone Groundwater MZ2) | 1,642 ML |
| 10AL103025<br>10AL124203 | WAL 25777<br>WAL 43656 | 27/10/2014<br>09/03/2021 | Surface Water Take (Maldon Weir MZ) | 5 ML<br>25 ML and 11 ML# |
| 10MW119329 | WAL 43572 | 07/05/2021 | Incidental Surface Water Take (Stonequarry Creek MZ) | 16 ML<br>9 ML*<br>24 ML# |

Notes: # Leased until 01/07/2023
*Currently in the process of purchasing

## 2.3 Water Management Plan

The approval of LW W1-W2 was conducted under the WMP for LW W1-W2 and the approval of LW W3-W4 is currently conducted under the WMP for LW W3-W4, which was approved in September 2021.

As part of the Project Approval the WMP outlines the relevant approval conditions and monitoring requirements that the Tahmoor Mine is subject to. As part of the WMP, a Groundwater Technical Report was prepared to determine monitoring and acceptable impacts to groundwater. The Groundwater Technical Report (Appendix D of the WMP, prepared by SLR (2021)) outlines both the groundwater relevant triggers and Trigger Action Response Plan (TARP). Subsequent modifications to the TARP were undertaken to address comments made by DPIE and the Independent Advisory Panel for Underground Mining (IAPUM) prior to the submission of the WMP in September 2021 (Tahmoor Coal, 2021).

A summary of the requirements of the WMP that are relevant to this groundwater assessment and where they are addressed in this document are presented in **Table 3**.

### Table 3 Groundwater Technical Report requirements of the WMP for Water Monitoring

| WMP Parameter | Groundwater Requirements Summary |
|---|---|
| Springs | There are no springs identified in the vicinity of LW W1-W4 or the surrounding watercourses. Therefore, monitoring and management of such features is currently not required. |
| Groundwater level | Detection of a lowering of groundwater (drawdown) that exceeds beyond the trigger (trigger levels detailed further in **Section 4.2**), the Trigger Action Response Plan must be implemented (**Appendix B**). |
| Groundwater quality<br>Field: pH, EC, temperature<br>Lab: pH, EC, Total dissolved solids, sodium, calcium, potassium, magnesium, chloride, fluor, sulphate, total phosphorous, total nitrogen, organic carbon, total alkalinity as calcium carbonate, bicarbonate and carbonate, arsenic, cadmium, copper, iron, lead, manganese, nickel, selenium, zinc, aluminium | Assessment of whether concentrations are within the minimum and maximum background values (detailed further in **Section 5.1**).<br>If the trigger values for selected groundwater quality parameters are exceeded, or are found to be out of the acceptable range, the Trigger Action Response Plan must be implemented (**Appendix B**). |
| Groundwater interception (mine inflow) | Determination of groundwater interception as part of the Annual Review process to identify that the annual inflow to underground workings is covered by the water licence of 1,642 ML (WAL36442). |
| Subsidence performance measures | Subsidence performance measures for natural and heritage features are listed under Condition 13A of DA 67/98. There are no performance measures specific to groundwater. |

# 3 Existing Network and Monitoring Program

At Tahmoor mine, there are six existing boreholes with vibrating wire piezometers (VWPs) (TNC036, TNC040, TNC043, WD01, P40 and P41) that routinely monitor groundwater levels in the aquifers surrounding Tahmoor Western Domain. In addition, there is a set of standpipe monitoring bores (at sites P12, P13, P14, P15, P16 and P17) as shown on **Figure 1**. P13 and P17 were decommissioned in September 2021.

P40, located near the surface water monitoring site CB along Cedar Creek (approximately 115 m east of the creek), was drilled to a depth of 97.8 m (**Figure 1**). Four VWP instruments (P40A-D) were installed at different depths within the Hawkesbury Sandstone (39, 44, 49 and 85 m below ground level (bgl)) at P40 with groundwater levels recorded since late August 2021.

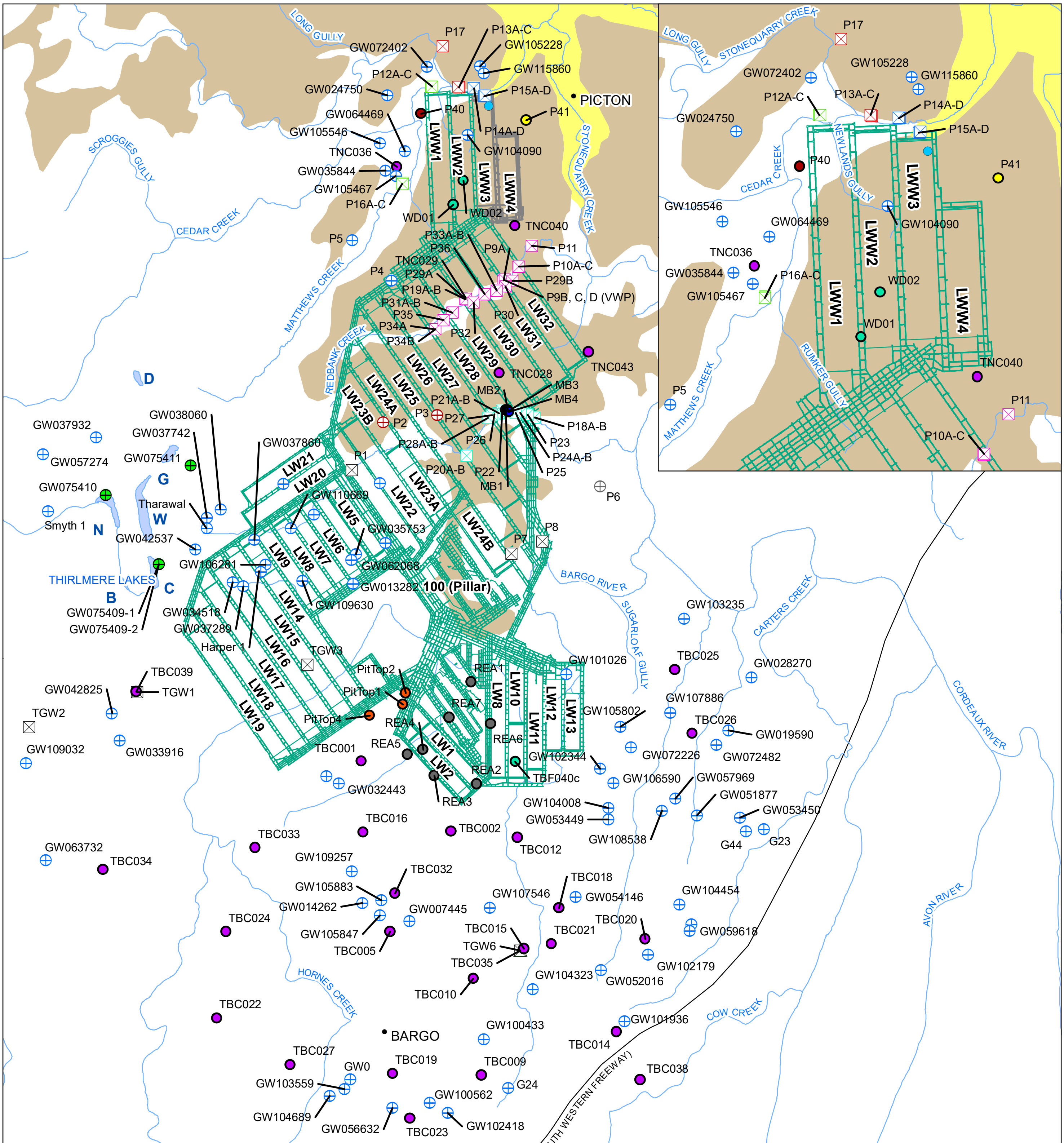
VWPs were installed at bore P41 in early 2021 to monitor the Nepean Fault Complex. These VWPs are located approximately 230 m north-east of LW W4 and 600 m south of Stonequarry Creek within the Nepean Fault Complex. P41 is an angled borehole equipped with six VWPs instruments at different depths (P41A-F) within the Wianamatta Formation and Hawkesbury Sandstone recording groundwater levels since late August 2021.

P40 and P41 provide data on groundwater level throughout the extraction of LW W3 - LW W4. In addition, bores WD01 (existing) and WD02 (proposed) are designed to monitor groundwater level response directly above Western Domain workings.

Vibrating wire piezometer (VWP) monitoring location TNC043 is planned to be decommissioned due to site access. From July 2022, TNC043 has been removed from the TARP assessment. A summary of groundwater trends for the two alternative sites P9 and P11 are presented in **Section 4.1.3** in place of TNC043.

To fulfill the requirements of the WMP, groundwater level monitoring at Tahmoor Mine is carried out in accordance with the WMP conditions. All groundwater level monitoring bores and VWPs in the vicinity of Tahmoor, and their available monitoring details, are listed in **Table 4** below. Some piezometers or bores have failed due to ground movement (subsidence effects) or had equipment fail or logger equipment stolen, which affects the ability to collect data or affects the frequency of data measurement. The status of each instrument is listed in **Table 4**.

In addition to groundwater level monitoring, all shallow standpipe bores are sampled to fulfill the requirements of the WMP groundwater quality monitoring at Tahmoor Mine.




| | | | |
|---|---|---|---|
| Rainfall Monitoring Site - Rail Site Tipping Bucket | Nepean Fault Complex piezometer | Shallow OSP - Stonequarry Creek | Groundwater quality |
| **Groundwater Monitoring Locations** | Cedar Creek piezometer | Shallow OSP - Stonquarry (decommissioned bore) | NSW govt monitoring |
| Pointe Engineering | Shallow OSP | | Regional GW Bore |
| Deep GWL | Shallow OSP - Cedar Creek | Shallow OSP - Matthews Creek | Regional old exploration bore |
| HOF investigation bore | Shallow OSP - Redbank | Shallow OSP - pit-top | Regional GW Bore (destroyed) |
| | Shallow OSP - Myrtle Creek | Shallow OSP - REA | Pool 23 rehab |

0 1 2 km

Coordinate System: GDA 1994 MGA Zone 56
Scale: 1:80,000 at A4
Project Number: 665.10010
Date: 16-May-2022
Drawn by: JG

Town
Tahmoor North and Western Domain
Proposed Areas of Future Mining
Major Roads
Watercourses
Lakes
Alluvium
Wianamatta Formation

Lakes:
D = Dry Lake
G = Gandangarra
W = Werri Berri
C = Couridjah
B = Baraba
N = Nerrigorang

**TAHMOOR COAL GROUNDWATER MODEL CONCEPTUALISATION REPORT**

**Groundwater Monitoring Network**

**FIGURE 1**

H:\Projects-SLR\620-BNE\665-WOL\665.TAH05 Tahmoor GWMP\GIS\66510010 Fig1 Groundwater monitoring locations May 2021- October 2021.mxd

## Table 4 Groundwater Monitoring Network

| Monitoring Bore or VWP ID | Owner | Easting[1] (MGA94) | Northing[1] (MGA94) | Bore screen or VWP sensor depth (mBGL) | Status | Groundwater Level Monitoring Frequency | Groundwater Quality Monitoring Frequency | Impact or Control Bore |
|---|---|---|---|---|---|---|---|---|
| **Shallow Groundwater Levels (Monitoring bores/standpipe piezometers)** | | | | | | | | |
| P12A | Tahmoor Coal (TC) | 277771 | 6216561 | 14.6 - 19.6 | EX | **PRE-MINING** - Minimum continuous 24-hourly readings with monthly logger download and dip meter.<br><br>**DURING MINING** - Minimum continuous 24-hourly readings with monthly logger download and dip meter.<br><br>**POST MINING** - Minimum continuous 24-hourly readings with monthly logger download and dip meter for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group. | **PRE-MINING** - Field water quality and laboratory analysis monthly.<br><br>**DURING MINING** - Field water quality and laboratory analysis monthly.<br><br>**POST MINING** - Field water quality and laboratory analysis monthly for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group. | Impact |
| P12B | TC | 277776 | 6216560 | 31.6 - 34.6 | EX | | | Impact |
| P12C | TC | 277781 | 6216559 | 61.6 - 64.6 | EX | | | Impact |
| P13A | TC | 278180 | 6216550 | 19.5 - 22.5 | D | | | Impact |
| P13B | TC | 278175 | 6216554 | 33.5 - 37.5 | D | | | Impact |
| P13C | TC | 278170 | 6216558 | 64.5 - 67.5 | D | | | Impact |
| P14A | TC | 278398 | 6216536 | 4.5 - 6.0 | EX | | | Impact |
| P14B | TC | 278393 | 6216534 | 13.6 - 16.6 | EX | | | Impact |
| P14C | TC | 278397 | 6216542 | 28.6 - 31.6 | EX | | | Impact |
| P14D | TC | 278391 | 6216540 | 58.6 - 61.6 | EX | | | Impact |
| P15A | TC | 278550 | 6216426 | 16.1-17.6 | EX | | | Impact |
| P15B | TC | 278545 | 6216423 | 18.6-20.1 | EX | | | Impact |
| P15C | TC | 278556 | 6216427 | 30.5-32.0 | EX | | | Impact |
| P15D | TC | 278561 | 6216431 | 66 (bore depth) | EX | | | Impact |
| P16A | TC | 277351 | 6215147 | 24.5 - 27.5 | EX | | | Impact |
| P16B | TC | 277350 | 6215140 | 42.5 - 45.5 | EX | | | Impact |

| Monitoring Bore or VWP ID | Owner | Easting[1] (MGA94) | Northing[1] (MGA94) | Bore screen or VWP sensor depth (mBGL) | Status | Groundwater Level Monitoring Frequency | Groundwater Quality Monitoring Frequency | Impact or Control Bore |
|---|---|---|---|---|---|---|---|---|
| P16C | TC | 277347 | 6215135 | 72.5 - 75.5 | EX | | | Impact |
| P17 | TC | 277941 | 6217153 | 19.6 - 22.6 | D | | | Control |
| GW072402 | Private | 277708 | 6216852 | 8.2 - 72.0 | EX | **PRE-MINING** – Standing water level (where available) and yield data. Pre-mining testing completed in bore census (GeoTerra, 2019, 2021b).<br><br>**DURING MINING** - Manual monitoring (flow rate and, where available, groundwater level) on a 3-monthly basis.<br><br>**POST MINING** - Manual monitoring (flow rate and, where available, groundwater level) on a 3-monthly basis for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group. | **PRE-MINING** - Field water quality (EC, pH) and iron staining. Pre-mining testing completed during bore census (GeoTerra, 2019, 2021b).<br><br>**DURING MINING** - Field water quality and laboratory analysis on a 3-monthly basis.<br><br>**POST MINING** - Field water quality and laboratory analysis on a 3-monthly basis for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group. | Impact |
| GW105228 | Private | 278490 | 6216858 | 23.0 - 63.0 | EX | | | Impact |
| GW105467 | Private | 277253 | 6215247 | 73.0 - 79.0 | EX | | | Impact |
| GW105546 | Private | 277018 | 6215732 | 48.0 - 56.0 | EX | | | Impact |
| GW115860 | Private | 278543 | 6216760 | 20, 48 and 55 | EX | | | Impact |
| GW104090 | Private | 278208 | 6215913 | 79, 98, 123 and 139 | EX | | | Impact |
| **Shallow Groundwater Pressures (VWPs < 200 mBGL)** | | | | | | | | |

| Monitoring Bore or VWP ID | Owner | Easting[1] (MGA94) | Northing[1] (MGA94) | Bore screen or VWP sensor depth (mBGL) | Status | Groundwater Level Monitoring Frequency | Groundwater Quality Monitoring Frequency | Impact or Control Bore |
|---|---|---|---|---|---|---|---|---|
| P40(A-D) | TC | 277620.6 | 6216160.1 | HBSS-39 | EX | **PRE-MINING** - Minimum continuous 24-hourly readings with monthly logger download.<br><br>**DURING MINING** - Minimum continuous 24-hourly readings with monthly logger download.<br><br>**POST MINING** - Minimum continuous 24-hourly readings with monthly logger download for 12 months following the completion of LW W4. The period may be extended as per the decision by the Environmental Response Group. | Not monitored for water quality | Impact |
| | | | | HBSS-44 | EX | | | Impact |
| | | | | HBSS-49 | EX | | | Impact |
| | | | | HBSS-85 | EX | | | Impact |
| P41(A-F) | TC | 279167 | 6216068 | WNFM-53 (vertical) | EX | | | Impact |
| | | | | HBSS-71 (vertical) | EX | | | Impact |
| | | | | HBSS-88 (vertical) | EX | | | Impact |
| | | | | HBSS-106 (vertical) | EX | | | Impact |
| | | | | HBSS-123 (vertical) | EX | | | Impact |
| | | | | 140 (vertical) | EX | | | Impact |
| TNC036 | TC | 277269 | 6215382 | HBSS-65 | EX | | | Impact |
| | | | | HBSS-97 | EX | | | |
| | | | | BGSS-169 | EX | | | |
| TNC040 | TC | 279004 | 6214521 | WNFM-27 | EX | | | Control |
| | | | | HBSS-65 | EX | | | |

| Monitoring Bore or VWP ID | Owner | Easting[1] (MGA94) | Northing[1] (MGA94) | Bore screen or VWP sensor depth (mBGL) | Status | Groundwater Level Monitoring Frequency | Groundwater Quality Monitoring Frequency | Impact or Control Bore |
|---|---|---|---|---|---|---|---|---|
| | | | | HBSS-111 | F | | | |
| TNC043 | TC | 280077 | 6212671 | HBSS-65 | D | | | Control |
| | | | | HBSS-111.5 | D | | | |
| WD01 | TC | 278099 | 6214828 | HBSS-70 | EX | | | Impact |
| | | | | HBSS-90 | F | | | |
| | | | | HBSS-190 | F | | | |
| WD02 | TC | 278246 | 6215178 | Not drilled yet | P | | | Impact |
| **Deep Groundwater Pressures (VWPs > 200 mBGL)** | | | | | | | | |
| TNC036 | TC | 277269 | 6215382 | BGSS-214 | EX | **PRE-MINING** - Minimum continuous 24-hourly readings with monthly logger download.<br><br>**DURING MINING** - Minimum continuous 24-hourly readings with monthly logger download.<br><br>**POST MINING** - Minimum continuous 24-hourly readings with monthly logger download for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group. | Not monitored for water quality | Impact |
| | | | | BGSS-298.5 | F | | | |
| | | | | BGSS-412.5 | EX | | | |
| | | | | BUSM-463.5 | F | | | |
| TNC040 | TC | 279004 | 6214521 | HBSS-225 | F | | | Control (for LW W1-W4) |
| | | | | BHCS-252 | F | | | |
| | | | | BGSS-352 | F | | | |
| | | | | SCSS-482 | F | | | |
| | | | | BUCO-501.9 | F | | | |
| TNC043 | TC | 280077 | 6212671 | HBSS-213 | F | | | Impact |

| Monitoring Bore or VWP ID | Owner | Easting[1] (MGA94) | Northing[1] (MGA94) | Bore screen or VWP sensor depth (mBGL) | Status | Groundwater Level Monitoring Frequency | Groundwater Quality Monitoring Frequency | Impact or Control Bore |
|---|---|---|---|---|---|---|---|---|
| | | | | BGSS-240 | F | | | |
| | | | | BGSS-332.6 | F | | | |
| | | | | BGSS-405.2 | F | | | |
| | | | | BUCO-476.3 | F | | | |
| WD01 | TC | 278099 | 6214828 | 210-HBSS | EX | | | Impact |
| | | | | 230-Newport Fm | F | | | |
| | | | | 300-BGSS | F | | | |
| | | | | 330-BGSS | F | | | |
| | | | | 350-BGSS | F | | | |
| WD02 | TC | 278246 | 6215178 | Not yet drilled | P | | | Impact |

*1 Coordinates in metres (GDA94 Zone 56).*

*WNFM – Wianamatta Group* | *BGSS – Bulgo Sandstone* | *VWP – vibrating wire piezometer* | *HBSS – Hawkesbury Sandstone*

*SCSS – Scarborough Sandstone* | *mBGL – metres below ground level* | *BHCS – Bald Hill Claystone* | *BUCO – Bulli Coal Seam*

*EX – Existing* | *F - Failed* | *P – Proposed monitoring bore* | *"-" - Not drilled yet*

*D – Decommissioned* | *vert. = vertical depth below ground in angled hole*

# 4 Groundwater Level Trigger Review

The following section addresses the compliance of groundwater levels at Tahmoor Coal during the reporting period in relation to both a rainfall cause-and-effect and trigger analysis.

## 4.1 Cause and Effect Analysis

An analysis of rainfall at Tahmoor Mine has been carried out to provide context for observed changes and trends in groundwater levels and quality. This cause-and-effect analysis has then been used to determine if the observed changes in groundwater levels could be attributed to weather conditions, a mining effect, or a combination of both during the reporting period. Groundwater levels may also be affected by local groundwater pumping (at bores unrelated to Tahmoor Mine), however pumping records are not available, and this cause/effect is difficult to identify with confidence.

In accordance with the current TARP in place, any exceedances in groundwater levels or quality identified across the Western Domain are flagged below. A more detailed summary of performance against the associated response plan for each monitoring location is discussed in **Section 4.3**.

### 4.1.1 Rainfall Analysis

Rainfall data in the area is available from several sources. Bureau of Meteorology (BoM) operate two rainfall stations, Picton Council Depot (68052) and Buxton (68166) which are located approximately 1.3 km east and 2.2 km west of Tahmoor Mine respectively. The locations, range of data and comment about quality of the rainfall data are presented in **Table 5.** Tahmoor Coal operates three rainfall stations (Mine gauge, Rail Site and Whiteys Site), and the SILO climate data source provides interpolated and infilled records for 0.05°x0.05° latitude and longitude tiles. Due to the occasional gaps in the data for the BoM sites, and the relatively short record of data held by Tahmoor (the Mine gauge record has no gaps, but only started in July 2006), the SILO record for the 0.05°x0.05° tile centred on the location 274250E, 6212950N has been adopted for this report to understand long-term trends.

**Table 5 Rainfall Data Sources**

| Data Source | Owner | Location | Range of Data | Comment |
|---|---|---|---|---|
| Picton Council Depot (68052) | BOM | Picton | 1880-2020 | Good quality, occasional gaps |
| Buxton (68166) | BOM | Buxton | 1966-2021 | Good quality, occasional gaps |
| Mine gauge | Tahmoor Coal | Western Domain | 2006-2021 | Data quality can be suspect. |
| Rail Site | Tahmoor Coal | Western Domain | Nov-2020 to present | Good quality, short record |
| Whiteys Site | Tahmoor Coal | Upper Stonequarry Creek catchment | Feb-2021 to present | Good quality, short record |
| SILO 0.05x0.05 tiles | SILO | 274250E, 6212950N | Jan-1900 to present | Interpolated infilled record |

Monthly average rainfall is presented on **Figure 2**, alongside potential evaporation and estimated actual evapotranspiration (EVT). Rainfall is generally consistent all year with average monthly totals of 41 to 88 mm. The highest monthly rainfall is typically in January, February and March (82, 88 and 84 mm respectively), while September is typically the driest month (averaging 41 mm) for the period of record. The average annual rainfall at Tahmoor is approximately 769 mm. Since the start of 2022, the total rainfalls at Tahmoor amounts to 1496.7 mm. Evaporation and evapotranspiration show similar trends with higher rates during the summer months and lower rates in winter. The average monthly potential evaporation is highest in December (200 mm). The average annual potential evaporation is 1462 mm.

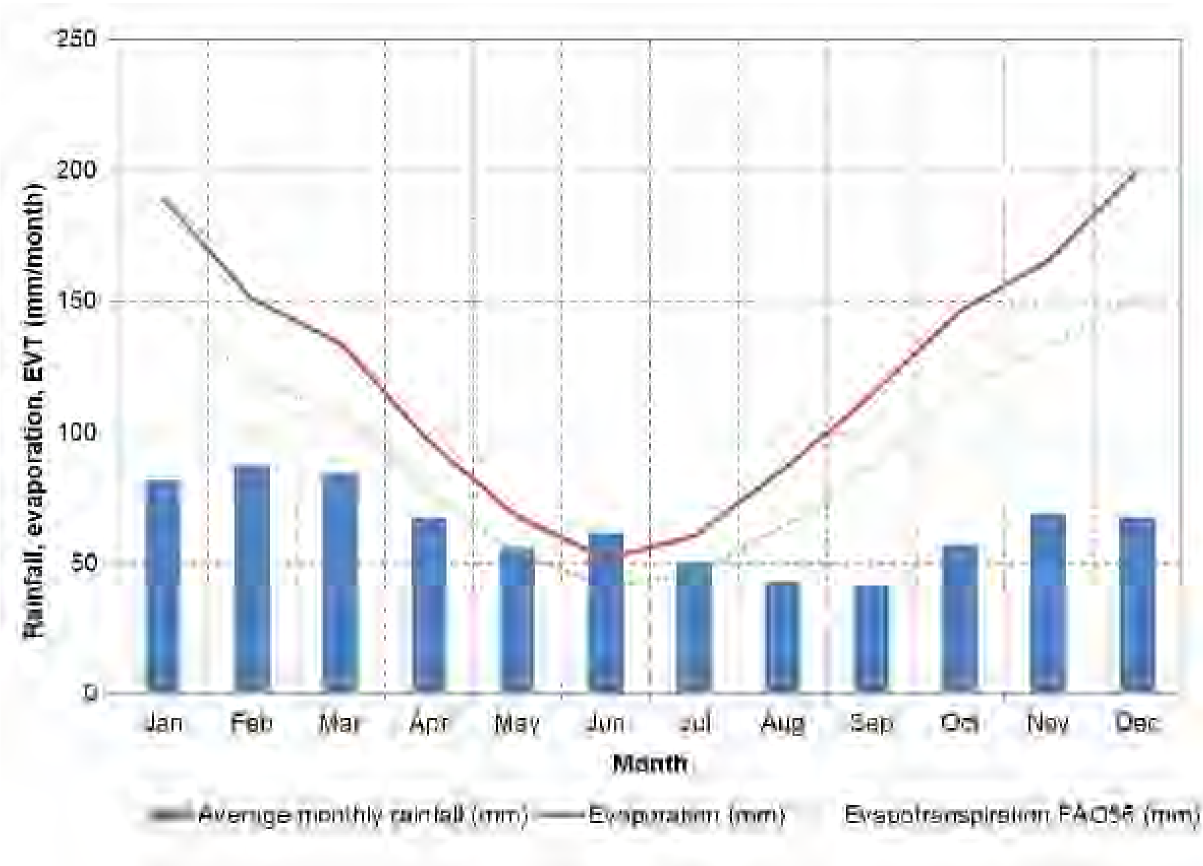



**Figure 2** **Monthly Average Rainfall and Potential Evaporation and Rainfall Trends**

**Figure 3** shows the historical record of monthly rainfall and potential evaporation, and the calculated trend in rainfall (using "cumulative residual departure" from mean method). This trend (dark green line) shows wet periods as upward gradients, droughts as downward gradients, and average conditions as horizontal.

Of note in recent times, there was a significant drought period from mid-2017 until January 2020, with extreme conditions in November 2019 to January 2020, notable for bushfire conditions around Tahmoor Mine and more widely across eastern NSW. Since then, conditions have been wetter than average, including high rainfall totals in February and August 2020, in March 2021, March/April 2022 and more recently in July and September 2022. Wetter than average conditions were observed during the entire reporting period except in June and August 2022.

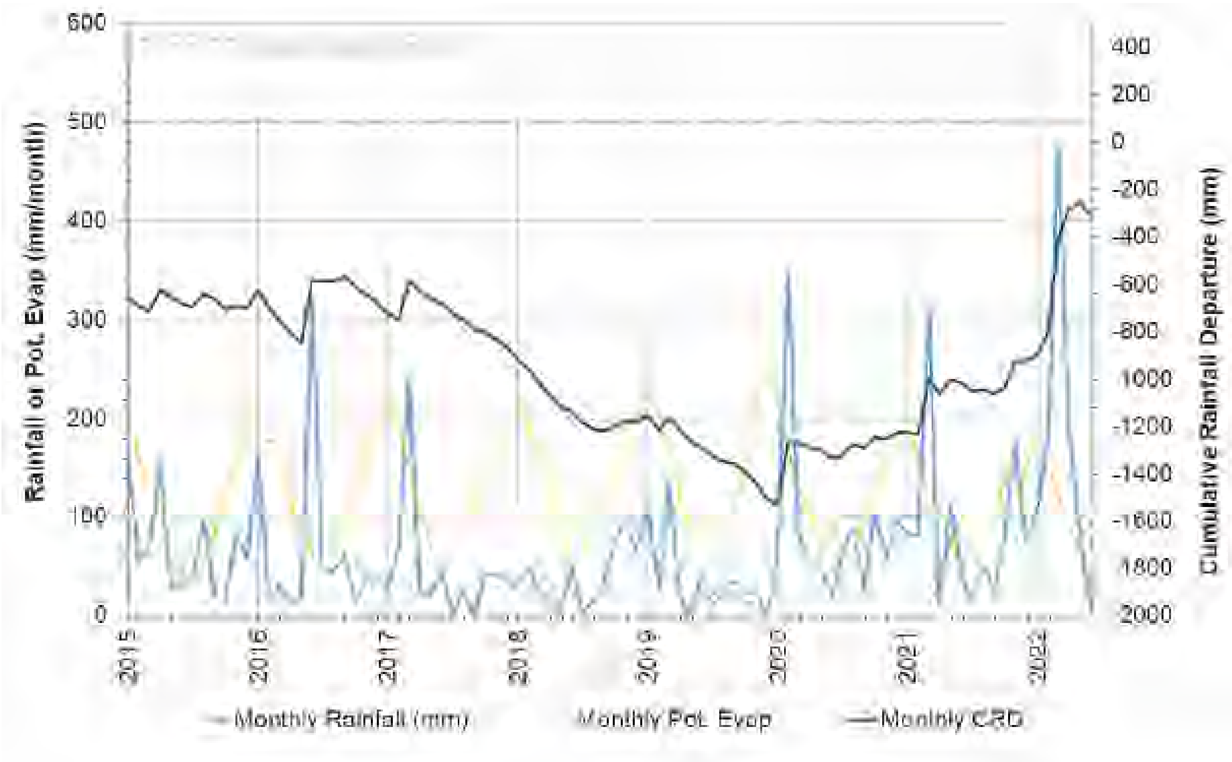



**Figure 3 Long-term Rainfall Record and Trends**

Total rainfall during the reporting period was 725.8 mm and the wettest month was in July 2022 with 312 mm, resulting in major floods in the area (and corresponding with flooding across much of NSW). The monthly rainfall was well above the long-term average of 50.5 mm/month. The cumulative rainfall departure (CRD) gradient in **Figure 3** is based on SILO records dating back to 1900, and clearly illustrates the very high rainfall since the start of 2022 with a steep upward gradient.

### 4.1.2 Western Domain

Hydrographs for the existing shallow standpipe bores (P12-P16) and VWP sites P40 and P41 drilled in 2019 and 2021 around the Western Domain are presented in **Appendix A (A1-A6)** with the rainfall trend (CRD). Monitoring bores P12-P14, P15 and P17 are located north of the Western Domain longwalls, outside the mine footprint and adjacent to Stonequarry Creek (P13, P14, P15 and P17) and Cedar Creek (P12). P16 is situated along Matthew Creek, 300 m west of LW W1 and upstream from the confluence of Matthews Creek and Rumker Gully. P40 is located 115 m east from the surface water site CB and P41, the Nepean Fault Complex site, is located 230 m north-east of LW W4. A brief analysis of the groundwater trends in relation to weather and mining activity is presented below except for sites P13 and P17 which were decommissioned in September 2021. Previous analysis conducted at P13 and P17 are presented in SLR (2021). Locations for the monitoring sites are shown on **Figure 1.**

#### 4.1.2.1 Site P12

P12 bores are the closest monitoring bores to LW W1 (50 m north) and 1.3 km from LW W4.

Groundwater levels at P12A and P12B remained generally stable during the reporting period at approximately 170.5-171 mAHD and 171-171.6 mAHD respectively (**Figure A1**). These levels are similar to water levels record prior to the commencement of LW W1.

During the reporting period, groundwater levels at P12A responded to rainfalls in the range of 0.5-1 m. Responses in groundwater levels were less pronounced in P12B although from April 2022 a change in hydraulic gradient between P12A and P12B was observed following exceptional rainfalls. This suggests the re-pressurisation of the mid Hawkesbury Sandstone aquifer accompanied by an upward vertical head gradient between P12A and P12B. A groundwater head separation of approximately 1 m as previously observed prior mining at the Western Domain was reported during the review period. Although the hydraulic gradient seems to be re-established from the mid to shallow Hawkesbury Sandstone aquifers, further post-mining groundwater data is required to confirm trends in groundwater levels especially during period of below average rainfalls. Additional monitoring during post mining will also inform whether long-term impact such as a local increase in connectivity between the upper (P12A) and mid-Hawkesbury Sandstone (P12B) remains due to mining of LW W1-LW2 (SLR, 2022).

Groundwater levels at P12C declined by 1 m in late 2021, coincident with the commencement of LW W3. Noting that groundwater levels are at similar depths at P13 and P14, which are both closer to LW W3 than P12, it is unlikely that this decline was related to extraction of LW W3, but more a response to a short-lived period with low rainfall.

Groundwater levels at P12C continued to show a recovery trend throughout April and May 2022 favoured by wet conditions before stabilising at 175.6 mAHD in June 2022, period of below average rainfall. Following exceptional rainfalls in early July 2022, groundwater levels at P12C started to increase at a similar rate as observed in late 2021 (i.e. during period of above average rainfall). As of September 2022, groundwater levels at P12C are at 176.7 mAHD, being 0.4 m above the lowest groundwater levels observed prior to LW W1 commencement. The groundwater recovery in P12C results in the strengthening of the upward hydraulic gradient from P12C and P12B (which was the pre-mining condition) and could strengthen inferred gaining condition groundwater to Cedar Creek.

During the reporting period, no mining related effect caused by the extraction of LW W3 and LW W4 was observed on groundwater levels at sites P12A, B and C.

#### 4.1.2.2 Site P14

P14 bores are located 350 m east of LW W1 and 1 km north-north-west of LW W4. Groundwater levels in three of the four piezometers responded to extraction of LW W1 and W2 (drawdown) as well as to the wetter conditions (recovery) from early 2021 to present (**Figure A2**).

Groundwater levels at P14A (in shallow alluvium/colluvium) continued to respond to the wetter conditions in 2022, with short-lived peaks and recessions typically in the range of 1 m during the reporting period.

Groundwater levels at P14B, C and D (all in the Hawkesbury Sandstone) were stable throughout April and May 2022 but declined slightly by approximately 0.5 m in June 2022 likely due to lower rainfall recharge during this month. In early July 2022, groundwater levels increased by 0.5-1 m in each piezometer at P14. The response in groundwater levels to the early July rainfall appears subdued in all piezometers, in comparison to previous responses observed in March 2021 and March 2022 (i.e. in the range of 1 m and up to 2 m in P14A). A buffered response in groundwater levels due to LW W4 mining at P14B, C and D is possible, however it could also be related (for the Hawkesbury Sandstone piezometers P14B, C and D) to the fact that groundwater levels indicate that the aquifer column is close to saturated in July 2022 (being at or above creek bed elevation) and cannot easily accept further recharge. In any case, groundwater levels at P14B and C remain approximately 1.3-1.5m above baseline groundwater levels and the deepest intakes P14D show groundwater level 2 m above baseline levels.

As noted above, groundwater levels at P14B and C remain 0.9 m above the approximate creek bed elevation while groundwater levels at P14D increased to 167.5 mAHD (i.e. equal to the creek bed elevation) in September 2022. A strengthening of inferred gaining condition along Stonequarry Creek in the vicinity of P14 is possible.

#### 4.1.2.3 Site P15

P15 bores are located 540 m and 220 m northeast of LW W1 and LW W2 respectively, 60 m north of LW W3 and 910 m north of LW W4. Groundwater level records commenced at P15A, B, C in March 2021 (**Figure A-3**). Over the reporting period, groundwater levels continued to increase or recover by approximately 0.5 m to 1 m the end of May 2022. This follows a period of wet conditions throughout March and April 2022.

At P15A and P15B, a decline in groundwater levels of approximately 1 m was observed in June 2022. No logger data is available for P15C and P15D from the end of May 2022 due to download issues, but the manual readings confirm a decline in groundwater levels in the range of 0.5 m to 0.8 m in the two deepest piezometers. Similar to P14, it appears that the decline in groundwater levels could be associated with below average rainfall conditions in June 2022 but more likely caused by the extraction of LW W4 (i.e. LW W4 commenced in May 2022).

In early July 2022, groundwater levels at site P15A, B and C show responses to rainfall, in the range of 0.5 m in the mid-lower Hawkesbury Sandstone aquifer and up to 1 m in the upper Hawkesbury Sandstone aquifer (P15A). As of 20th September 2022 (i.e. 7 days following the completion of LW W4), only manual readings were made available and groundwater levels indicate further drawdown, in the order of 1 m (P14B, C and D) and 1.4 m (P15A) lower than the previous reading (28th August 2022) which suggest either a response to climatic conditions (i.e. intermittent drier periods) or delayed mining effect due to LW W4. Once available, the logger data will be compared to manual reading to confirm trends during the reporting period and to assess post mining condition at sites P15.

#### 4.1.2.4 Site P16

At P16 (**Figure A-4**), situated 430 m west of LW W1, groundwater depressurisation stabilised in late October 2020 (coinciding with the end of LW W1 extraction) which was four months earlier than at P12 and P13. Groundwater levels at P16A were consistently observed at approximately 210 mAHD over the reporting period (**Figure A-4**) but remain approximately 1 m below baseline levels. Hence, the previously identified long-term impact from LW W1-W2 mining at this site and the progression of LW W3 to the south remains, although to note that no additional depressurisation due to LW W4 was observed at P16A during the review period.

At P16B, groundwater levels increased by approximately 0.6 m during April 2022 following wet conditions and apparently increased further by 6 m in June 2022, however, note that this is likely an error in the manual groundwater level measurement (**Figure A-4**).

In July 2022, the last available measurement at P16B indicated groundwater levels to be at 205 mAHD which suggests that groundwater levels remain at a similar level as observed in late May 2022 (i.e. after the commencement of LW W4). As such, no depressurisation due to mining of LW W4 was observed until July 2022 (i.e. latest available data). From August 2022, bore P16B was reported blocked, however Tahmoor Coal has since unblocked the bore. It is likely that groundwater pressures at P16B remain approximately 2 m below pre-mining levels.

At P16C, there seem to be discrepancies between groundwater levels (mAHD) from the data logger and the manual measurements since June 2022, showing differences in the range of 3 m **(Figure A-4)**. It is recommended to review the data logger installation depth and the calculations used to convert pressure into a groundwater head (mAHD).

Assessing either the manual measurement or data logger (last available download in August 2022) in this cause-and-effect analysis, no depressurisation due to mining of LW W4 was observed during the reporting period at P16C, and that groundwater pressures in this horizon have recovered by 2 m during the reporting period. It is likely that groundwater pressures at P16C remain approximately 7-8 m below pre-mining levels.

A drain to divert surface run-off was completed in early November 2022 and bore seals have been cleaned and re-installed at P16B and P16C.

Additional groundwater data is required to confirm whether recovery in groundwater occurs post LW W4 at sites P16 and as previously observed from June 2021 following the completion of LW W2.

##### 4.1.2.5 Site P40

P40 is situated between LW W1 and the surface water monitoring site CB, approximately 120 m west of the edge of the longwall and 115 m east of CB (**Figure A-5**). Groundwater levels started to be recorded in late August 2021. P40 is equipped with four VWPs at different depth intervals within the Hawkesbury Sandstone (at 39, 44, 49 and 85 mbgl respectively, reported below as P40A, B, C and D).

Groundwater levels in P40A and P40B have shown a consistent rise throughout the start of the reporting period responding to rainfall recharge with groundwater levels increasing by approximately 0.5 m and 1.8 m respectively, noting a slightly more pronounced response in the deep piezometer P40B compared to P40A. The difference in the rate of recharge has resulted in a change of the hydraulic gradient which suggests the establishment of an upward vertical head gradient between P40B and P40A, likely to support baseflow condition in this area (i.e. near the surface water monitoring site CB).

In June 2022, a month following the commencement of LW W4, groundwater levels at P40A and P40B declined by approximately 1.3 m and 1.7 m respectively. While groundwater levels in P40B seemed to respond to rainfall recharge in early July 2022, groundwater levels at P40A remained stable at 181 mAHD before declining a further 0.3 m in early July 2022. While the decline in June 2022 at P40A and P40B is likely attributed to lower rainfalls during this month. At P40A, the lack of response in groundwater levels in July 2022 and the subsequent minor decline (approximately 0.5 m) suggests a delayed effect related to mining (at nearby LW W1-W2, W3 or recent mining at LW W4, although the latter longwalls are more distant from this site). Similar sudden declines were observed during extraction of LW W3 at the P15 piezometers located adjacent to the northern end of LW W3 (SLR, 2022).

Groundwater levels at P40C and P40D show consistent trends in groundwater levels during the reporting period. Throughout April and May, an increasing trend in groundwater levels was observed at P40B and P40C followed by a short period of stabilisation in June 2022 before increasing again from July 2022. As of August 2022 (i.e. latest available data), no decline in water levels was observed in the mid-lower Hawkesbury Sandstone.

We note that from July 2022 onwards, groundwater levels at P40C increased above the approximate Cedar Creek bed elevation (i.e. 177.5 mAHD) which suggests a strengthening of the inferred gaining condition in the vicinity of the surface water monitoring site CB. The change in hydraulic gradient in the upper-mid Hawkesbury Sandstone (i.e. between P40A and P40B) is also a good indication that baseflow conditions may continue to improve in the vicinity of the surface water monitoring site CB and along Cedar Creek following mining at the Western Domain.

#### 4.1.2.6 Site P41

In addition to the hydrogeological investigations near the creeks, SCT conducted an investigation to quantify the hydraulic properties of the Nepean Fault Complex. A borehole ("Nepean Fault Hole C") was drilled to 202 m at 45 degrees from vertical, angled to intersect the fault splay. This bore intersects two zones of increased jointing inferred to be a secondary splay of the Nepean Fault (SCT, 2021a). The upper zone is within the Wianamatta Formation, and the lower is within the HBSS.

**Figure A-6** presents the hydrographs for P41 located 230 m from the north-east corner of LW W4, within the Nepean Fault Complex. The elevation position of the VWP at P41 are indicated on **Figure A-6** along the y-axis.

The records at P41 indicates a strong downward gradient from P41A to P41C with almost 30 m head difference (**Figure A-6**). This could be explained by the fact that P41A sits within the Wianamatta Formation and P41B sits at the interface between the Wianamatta Formation and Hawkesbury Sandstone suggesting the presence of perched groundwater likely to be disconnected from the upper Hawkesbury Sandstone aquifer (P41C).

Groundwater levels in P41A were stable during the reporting period at 189.9 mAHD with no discernible responses to rainfall recharge. Groundwater levels at P41A were observed at almost the same elevation as the VWP (189.2 mAHD) which suggests near unsaturated condition at this elevation. In P41B, water levels seemed to have stabilised at 173.2 mAHD throughout the reporting period just above the VWP elevation which also suggest unsaturated condition.

At P41C, a gradual increase in groundwater levels was observed over the reporting period. Groundwater levels increased by 1.7 m from 161.1 mAHD in April 2022 to 162.8 mAHD in September 2022. A minor decrease of approximately 0.3 m was observed in June 2022, period marked by lower rainfalls. The P41C piezometer is located at a similar elevation to the surveyed elevation of Stonequarry Creek (SC surface water monitoring site) with groundwater levels at approximately 0.6 m above the Stonequarry Creek bed elevation (labelled "SC base elevation" on **Figure A-6**).

As presented in SLR (2022b), review and analysis of groundwater level exceedances at site P41 is focused on VWPs P41A, P41B, P41C and P41D (i.e. the primary assessment sites). Groundwater levels at P41D, P41E and P41F are likely influenced by faulty sensors but will continue to be reviewed in future reports. P41E and P41F are not considered in the groundwater level trigger assessment and P41D has been removed from the TARP as groundwater trends continue to appear erroneous.

#### 4.1.2.7 TNC036

TNC036 is located almost 500 m to the west of LW W1 and west of Matthews Creek. It has a number of sensors placed in the Hawkesbury and Bulgo Sandstones at various depths, as well as one in the Bulli Coal seam (**Table 4**). Groundwater pressures at TNC036 have recently been re-assessed and resulted in the removal of the transducer records at 298 m and 463 m (Groundwater Exploration Services [GES], 2020). Data collected from 2010 to 2011 at TNC036 appears erroneous, likely due to influence from construction. Consistent data that appears representative of local groundwater conditions has been collected from 2016. Further details on reliability of TNC036 data is presented in the Groundwater Technical Report LW W3-W4 (SLR, 2021).

The hydrographs for the VWPs are presented in **Figure 4.**

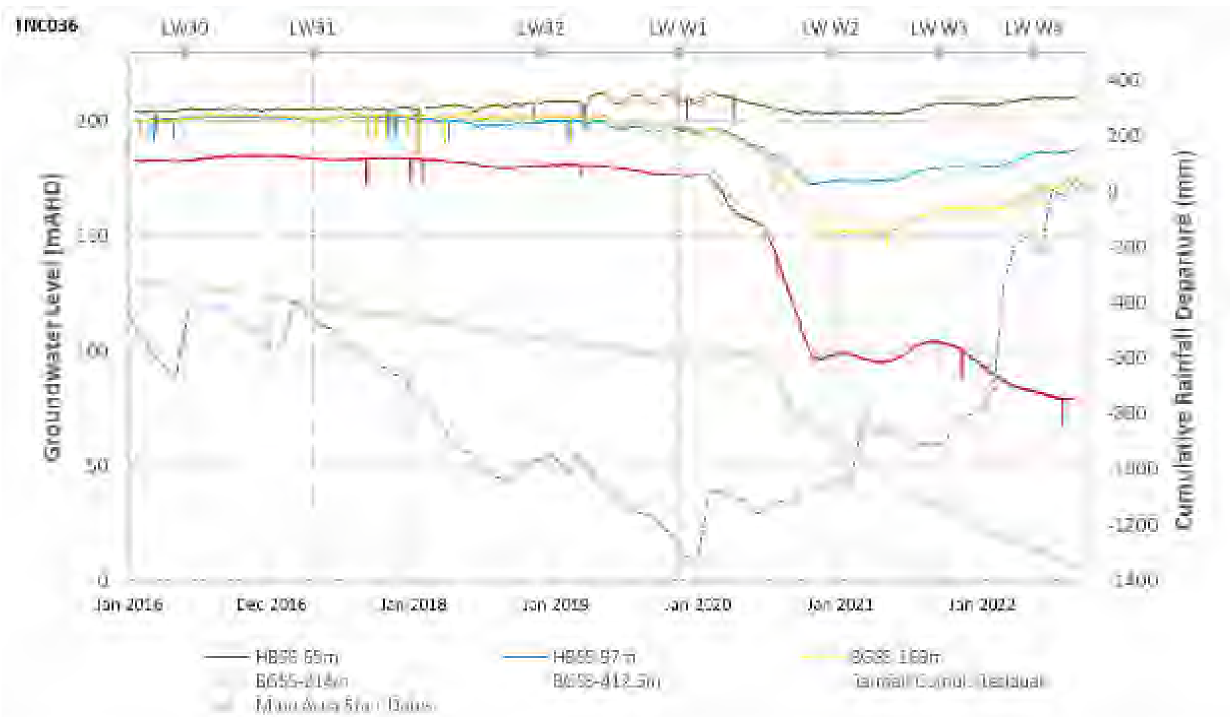



**Figure 4 Hydrograph for TNC036**

Groundwater levels in HBSS-65m, HBSS-97m and BGSS-169m continued to recover during the reporting period and increased by approximately 1.7 m, 5.3 m and 1 m respectively. Groundwater levels in the mid and lower Bulgo Sandstone BGSS-214m and BGSS-412m decreased by 6 m and 9m respectively during the reporting period. It is expected that the depressurisation in the Bulgo Sandstone to reduce over the next months (or years) and start to recover due to the completion of mining at the Western Domain (**Section 1.3**).

**Table 6** compares the depressurisation at site TNC36 in each piezometer in April and September 2022 (i.e. at the start and end of the reporting period).

### Table 6 Groundwater depressurisation at site TNC036

| Piezometer details at TNC036 | Groundwater depressurisation as of Apr 2022 [m] | Groundwater depressurisation as of Sep 2022 [m] |
|---|---|---|
| HBSS-65m | 0.9 | No depressurisation* |
| HBSS-97m | 14 | 8.7 |
| BGSS-169m | 34 | 35 |
| BGSS-214m | 90 | 96 |
| BGSS-412m | 80 | 89 |

*Groundwater levels in HBSS-65m were observed 0.8 m above baseline groundwater levels (i.e. November 2021).

#### 4.1.2.8 WD01

**Figure 5** presents a hydrograph of the pre-mining borehole (WD01) located above a chain pillar between the Western Domain LW W1 and W2. The bore is 570 m north of the closest Tahmoor North (not Western Domain) goaf (LW 32) and was completed while LW W1 was 400 m to the north (**Section 3**). WD01 is instrumented with VWPs at multiple depths and has been recording groundwater pressures/heads since June 2020. The latest available groundwater pressure dataset is dated 31st August 2022. The remaining sensor HBSS-70m continues to show stable groundwater levels at 211 mAHD with no signs of depressurization as of August 2022.

The deeper sensors are not recording pressures, likely due to ground movement at this site. This is not unexpected given the bore's location above LW W1.

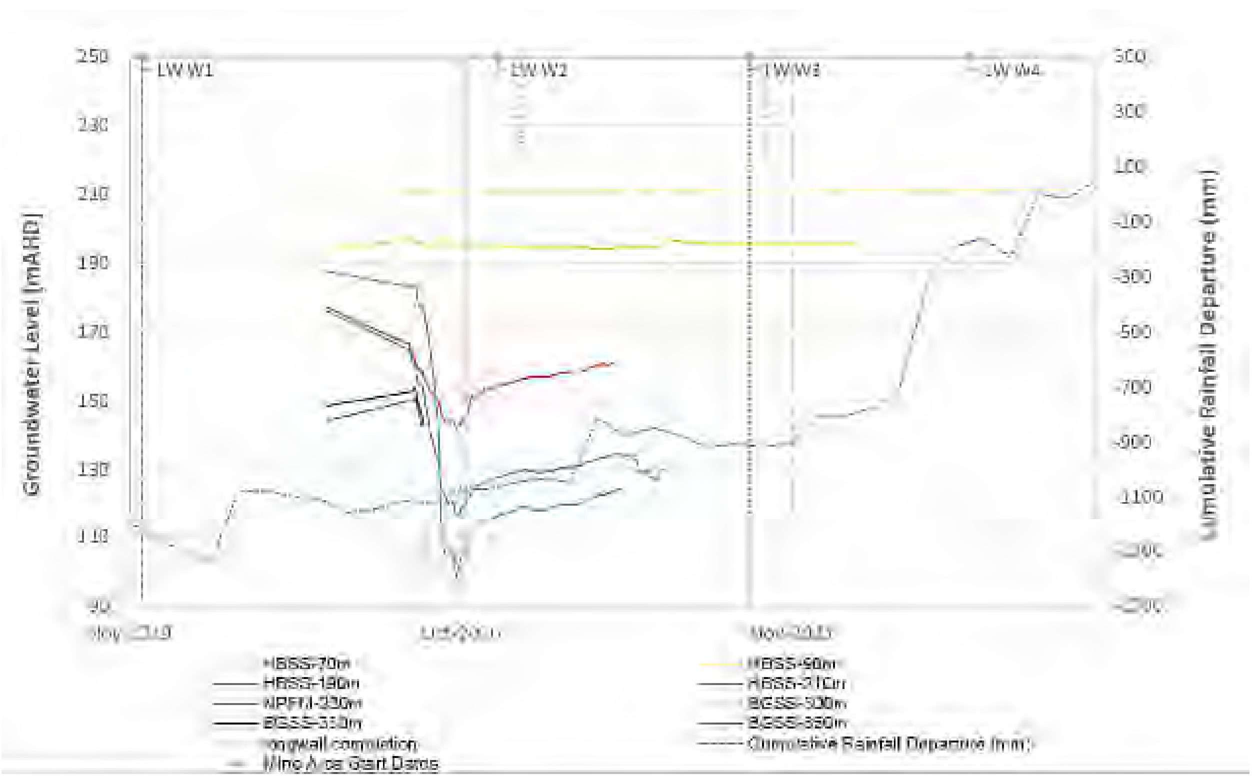



**Figure 5 Groundwater Level Trends at WD01**

#### 4.1.2.9 Private Bores

Several privately-operated and licensed groundwater bores are present to the north and west of LW W3-W4 (**Figure 1**), as identified in the most recent bore census for the Western Domain and surrounding area (GeoTerra, 2019 and 2021b). The primary usage of these bores is for farming and irrigation. Initial monitoring of licensed groundwater user bores was undertaken in the bore census conducted by GeoTerra (2019) prior to the commencement of LW W1 extraction, and by GeoTerra (2021b) prior to the commencement of LW W3 extraction. Monitoring of water levels and field sampling of water quality parameters is undertaken on a three-monthly basis during the extraction of LW W1-W2 and LW W3-W4, and on an annual basis following mining.

Continuous water level data has been collected at private bores GW072402 and GW104090 since January and March 2021 respectively by automatic dataloggers. LiDAR data has been used to estimate ground elevation at the bores and convert depth-to-water (mbgl) to water level elevation (mAHD). Private bores GW105228 and GW115860 are located 500 m and 400 m north of LW W3 respectively and have been equipped with data loggers recording groundwater level data every 15 minutes, with the latest available data dated to 18 October 2021.

The standing water level at other private bores is not available due to pumps and headworks restricting bore access.

GW072402 is located 430 m north of LW W1. Prior to LW W1, groundwater level at GW072402 was observed at 173.1 mAHD with no significant changes in water levels during mining of LW W1 **(Figure A-7**). The latest available groundwater levels at GW072402 are dated 28$^{th}$ April 2022 and observed at 174.3 mAHD. The groundwater levels have been responding to rainfall events until the end of April 2022 before being reported blocked at approximately 3.02 mbgl in July 2022. Tahmoor Coal plans to inspect the private bore shortly by sending a camera down the hole to investigate the cause of the blockage. The findings will be presented in the next review period and logger data will be presented if available.

Since October 2021, this bore is used as a control site in place of monitoring site P17 (now inaccessible) due to their distance to LW W3 being similar; 880-900 m. The short period with available groundwater data (until end of April 2022) shows no mining related effect due to LW W3.

GW104090 is located above the northern half of LW W2, and north of Newlands Gully. The bore census conducted by GeoTerra (2019) before mining of LW W1 indicated water level in GW104090 at approximately 176.2 mAHD. The latest download of the data logger at the end of April 2022 shows that the water levels in GW104090 responded to the March/April rainfall events and increased by approximately 1.4 m to 173.5 mAHD in April 2022 (**Figure A-8**). Since then, a single groundwater level measurement was made available in September 2022 at 172.6 mAHD. There is no data to confirm whether the groundwater level responded to the early July 2022 rainfall event however, groundwater levels has shown consistent recovery behaviour in 2022 following the depressurisation of LW W1-W2 in 2020-21 (groundwater level declined by at least 14 m) and the approximately 2 m decline related to LW W3 in late 2021. As of September 2022, groundwater levels were observed 3.6 m below baseline level and there is approximately 108.5 m of groundwater head available in the bore.

No significant change in yield is identified at these bore locations (see **Section 4.4**).

Groundwater level data at private bores GW105228 and GW115860 are recorded every 15 minutes and presented both on **Figure A-9** due to their proximity to each other (only 110 m apart), with the latest available logger data to 28th April 2022. Groundwater levels for the two private bores show mild response to wetter conditions during April 2022, increasing approximately by 0.5 m in each bore. There is single manual groundwater level measurement available in July 2022 at each bore. At GW115860, groundwater levels were observed at 165.8 mAHD compared to 165.6 mAHD in late April 2022 and prior the commencement of LW W4. At GW105228, groundwater levels were observed at 171.5 mAHD compared to 161.3 mAHD in late April 2022 and prior the commencement of LW W4. Once available, the logger data will help to confirm the groundwater trends in these two bores in particular to confirm the apparent 10 m increase in groundwater levels in GW105228 between April and July 2022.

From the short period of records available at these two locations, these observations suggest that no mining related effect were observed during the late part of LW W3 and until its completion in mid-April 2022. As of late July 2022, no groundwater depressurisation was observed as extraction of LW W4 progressed to the south, although additional groundwater levels data is required to confirm trends.

### 4.1.3 Tahmoor North

#### 4.1.3.1 TNC040

TNC040 is situated 300 m north of LW32, 420 m south-east of LW W3, and 430 m south of LW W4. Eight data sensors installed in TNC040 are positioned within the Wianamatta Group, Hawkesbury Sandstone, Bald Hill Claystone, Bulgo Sandstone, Scarborough Sandstone and Bulli Coal seam (**Table 4**). The hydrograph for this site is shown on **Figure 6**.

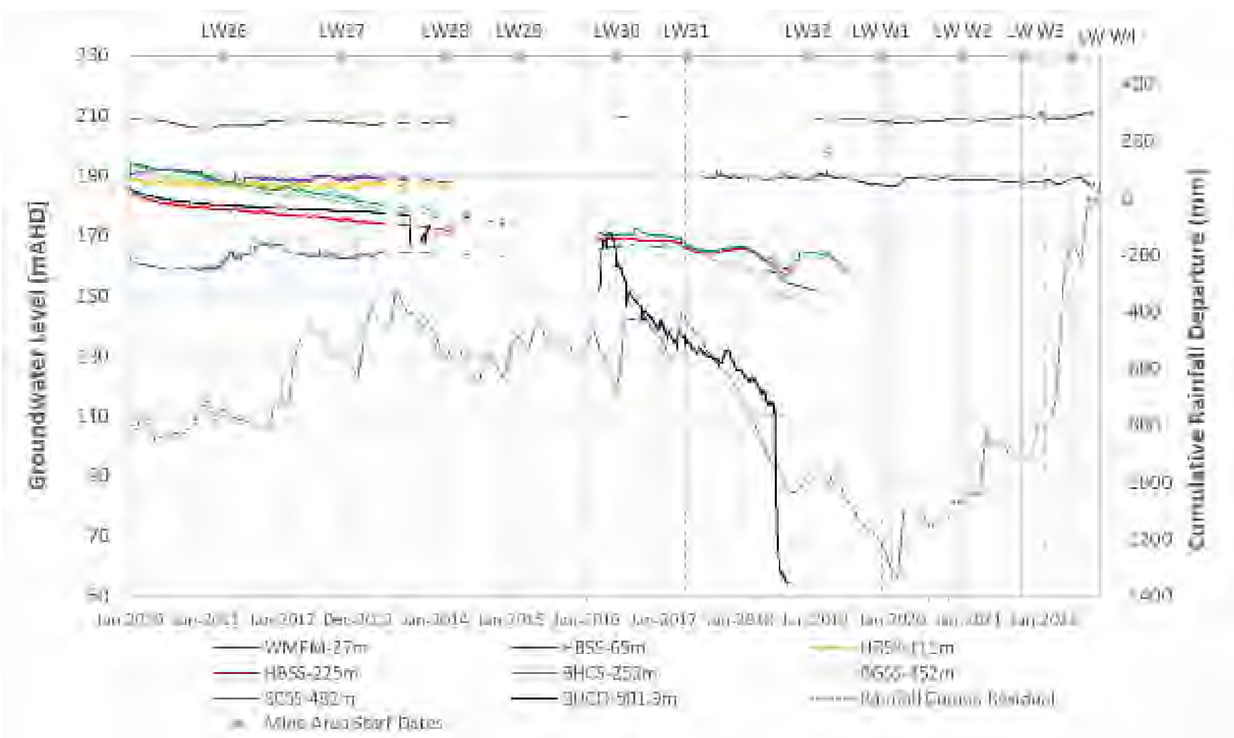



**Figure 6 Groundwater Level Trends at TNC040**

As of February 2019, the lower four VWP sensors were no longer active due to subsidence effects (GES, 2019). The decline in water level shown in late 2018 in the lowest sensor in the Bulli Coal seam (BUCO-501.9m) is a result of a nearby road advancement that has caused depressurisation of this seam.

As of August 2022 (latest data available dated 31st August 2022), the upper two sensors (WMFM-27m, HBSS-65m) remain active. Groundwater levels in WMFM-27m increased by 1.5 m and shows response to rainfall during the reporting period. No mining effect is discernible in the WMFM-27m record.

The groundwater levels in HBSS-65m increased by approximately 1.5 m during the wet months (March-April 2022) and were observed at 189.4 mAHD in early June 2022. A decline of approximately 3 m in groundwater levels is recorded by mid-August 2022 and show no responses to the exceptional rainfalls in July 2022. This suggests a mining related effect in HBSS-65m due to the progression of LW W4 toward the south. At the end of August 2022, around the time of LW W4 completion, a minor recovery (0.3 m) in groundwater levels was observed which suggests that the groundwater depressurisation may have reached its maximum in mid-August 2022 in HBSS-65m although additional groundwater data is required to confirm the magnitude of depressurisation in HBSS-65m at completion of LW W4 and recovery trends post-mining. To note that, as of August 2022, groundwater levels in HBSS-65m are within a similar range as those observed prior the commencement of LW W1 but remain 2.3 m below baseline levels (i.e. prior to LW 32).

#### 4.1.3.2 TNC043

TNC043 is also located 140 m east of the southern end of LW32, at the opposite end to TNC040. Monitoring began at this VWP-instrumented borehole in July 2010, and as with TNC036 and TNC040, there are some gaps in the record. However, data has been consistently collected since mid-2015. The hydrograph is shown on **Figure 7**.

Vibrating wire piezometer (VWP) monitoring location TNC043 has been decommissioned due to site access hence has been removed from the TARP assessment (SLR, 2022c). A summary of groundwater trends for the two alternative sites P9 and P11 are presented in **Sections 4.1.3.3** in place of TNC043.

Until October 2019, the HBSS-65m and HBSS-111.5m piezometers were the only active instruments at this bore, with the remainder failing in 2018 due to subsidence from nearby LW32. The two upper sensors HBSS-65m and HBSS-111.5m at TNC043 remained active until September 2020 before being stolen at the end of 2020 (**Table 4**). Despite the loss of the loggers, manual readings are taken for the upper two sensors approximately monthly.

As of June 2022 (i.e. latest available records) the water levels at HBSS-65m and HBSS-111.5m present similar trends to one another and both have responded to rainfall during the reporting period (**Figure 7**). No mining effect is discernible due to the early part of LW W4 extraction in May and June 2022 in the HBSS-65m and HBSS-111.5m. Groundwater levels in HBSS-65m and HBSS-111.5m were observed at 158.7 mAHD and 154.7 mAHD, respectively 2.1 m and 1.3 m above water levels observed during the baseline period (i.e. prior to LW 32).

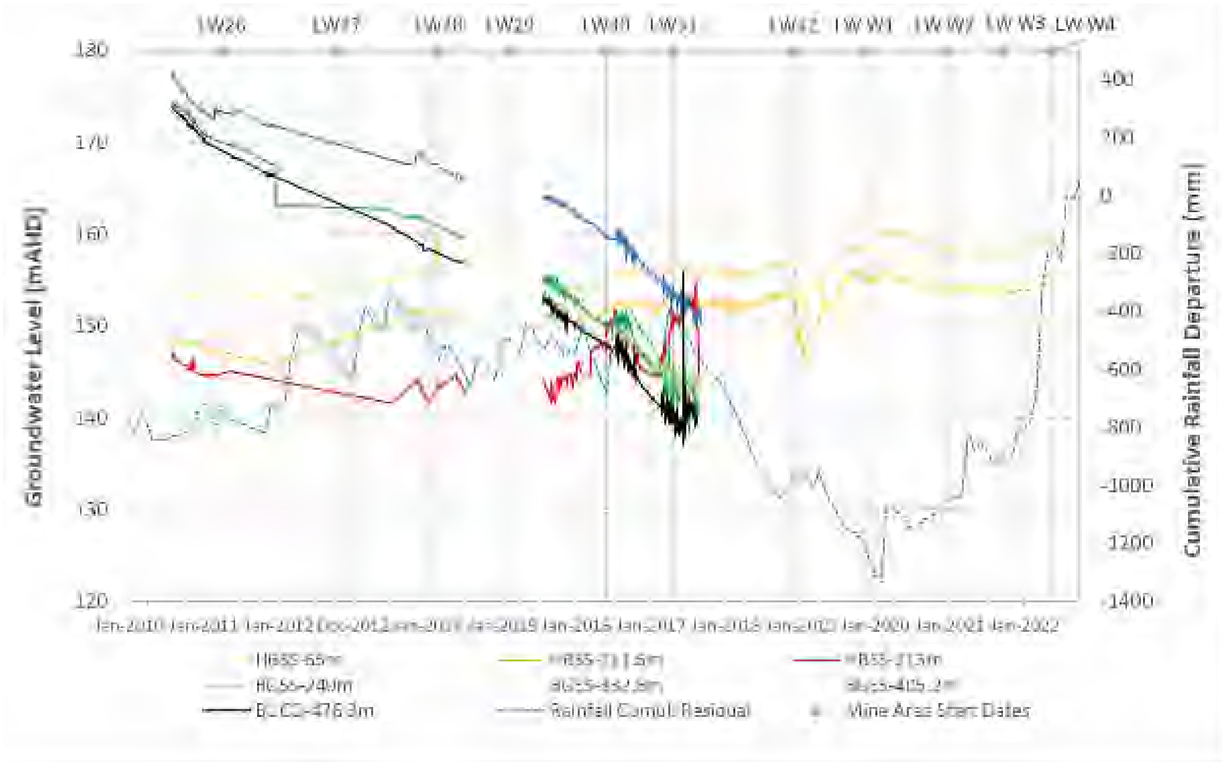



**Figure 7 Groundwater Level Hydrographs at TNC043**

#### 4.1.3.3 Site P9 and site P11

Groundwater levels at site P9 and P11 are collected on a quarterly basis. In place of monitoring groundwater levels at TNC043 (decommissioned), groundwater levels at P9 and P11 are now reviewed in the monthly compliance reporting. P9 and P11 sites are located 1.6 km and 1.7 km south of TNC043. Their distance to active mining (LW W4) and post mining (LW 32) differ. However, P9 and P11 remain appropriate alternative sites to assess groundwater conditions with the progression of LW W4 to the south and following completion of mining.

P9 monitoring sites are located on the northern bank of Redbank Creek and overlie the pillar between LW31 and LW32, where extraction commenced in November 2018.

Groundwater data has been recorded at P9 since October 2017. The open standpipe bores are screened at 22-24 m (P9A), 37-40 m (P9B) and 65-68 m (P9D), all within the Hawkesbury Sandstone. There were also three VWPs installed in a single P9 bore at 28 m, 40 m and 68 m depths, corresponding to some of the open standpipe intervals (**Table 4**). P9A-24m and P9B-40m are equipped with data loggers and remain the two active piezometers monitored (**Figure 8**).

Groundwater levels in P9A-24m and P9B-40m show similar trends during the review period, both responding to rainfalls in the range of 1 m in early July 2022 and are stable for the remaining of the monitored period (i.e. latest available data is 26th August 2022). Water levels at P9A-24m were observed above the creek bed elevation during the reporting period which suggests strengthening of gaining conditions along Redbank Creek in the vicinity of P9. No recent mining effect is discernible in the P9A-24m and P9B-40m piezometers.

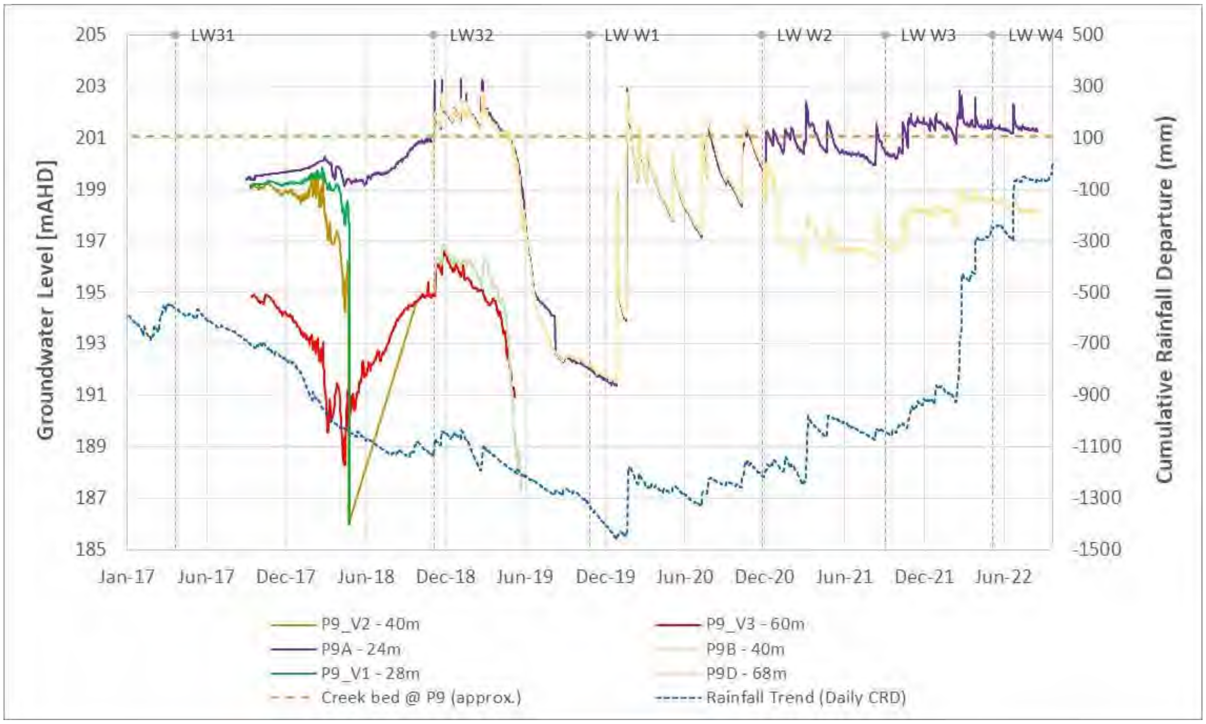



**Figure 8 Groundwater Level Hydrographs at P9**

Bore P11 is located along Redbank Creek, 300 m east of (downstream of) LW 32 and 700 m south-east of LW W4. The groundwater levels along Redbank Creek are correlated to weather patterns or rainfall events (**Figure 9**). The latest available groundwater data is dated 10th June 2022.

As of June 2022, water levels at P11 are around 3 m above the first recorded level in February 2019 (prior to LW 32 passing this site). No discernible effects on water levels due to LW W3 and early parts of LW W4 are identified during the reporting period. Additional groundwater data at P11 will be available and reviewed in November 2022.

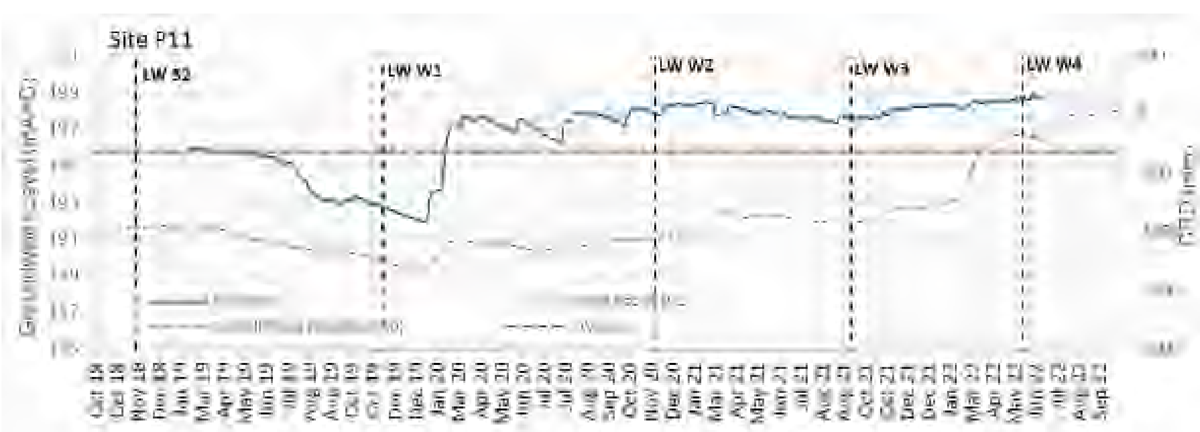



**Figure 9 Groundwater Level Hydrograph at P11**

## 4.2 Trigger Criteria

TARPs have been developed based on the groundwater management program outlined in the Groundwater Technical Report LW W3-W4 (SLR, 2021) and the WMP (Tahmoor Coal, 2021), and describe necessary responses for exceedances in groundwater quality and groundwater level triggers at open standpipe 'P' bores, as well as exceedance of groundwater pressure triggers developed for VWPs. The approved trigger criteria for shallow and deep groundwater levels are summarised and presented in **Table 7. Appendix B1** details the latest approved impact assessment trigger criteria from the LW W3-W4 Extraction Plan presented in the WMP (Tahmoor Coal, 2021) and the appropriate action plan to be enacted should a trigger exceedance occur during mining of LW W1-W2 and LW W3-W4. **Appendix B (Figure B-1 to B-27)** present groundwater hydrographs at each site with the associated groundwater level triggers.

Prior to the approval of LW W3 in September 2021, groundwater levels and quality observations were assessed against the TARPs developed for and outlined in the Groundwater Technical Report LW W1-W2 (HS/SLR, 2019). From September 2021, as stated above, groundwater levels and quality observation across the Western Domain are now assessed against latest approved impact assessment trigger criteria (Tahmoor Coal, 2021). The following sections present the groundwater exceedances identified during the reporting period.

Further details regarding the development of the TARPs are provided in SLR (2021).

### Table 7 Groundwater TARP Level Criteria for Open Standpipes, Shallow VWPs and Deep VWPs (Tahmoor Coal, 2021).

| Significance Level | Criteria | | |
|---|---|---|---|
| | Open standpipes | Shallow VWPs (<200m bgl) | Deep VWPS (>200m bgl) |
| Level 1 | Groundwater level remains consistent within baseline variability and/or pre-mining trends, with reductions in groundwater level less than two metres and does not trigger Level 2 to Level 4 Significance Levels (refer to Appendix C). | No observable mining induced change at VWP intakes located at or above (i.e. shallower than) 200 m depth. | Observed data does not exceed predicted (modelled) impacts (excluding those monitoring the Bulli Coal Seam). |
| Level 2 | Greater than 2 m water level reduction following the commencement of extraction at LW W1 (and LW W2, W3, W4) (refer to Appendix C for TARP Significance Level 2).<br>AND<br>The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors. | 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) (refer to Appendix C for TARP Significance Level 2).<br>AND The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors. | Calculated or observed drawdown (based on 2009-2015 baseline data and excluding VWPs within the Bulli Coal Seam) is within 30 m of predicted (modelled) drawdown. |
| Level 3 | Water level declines below the water level of TARP Significance Level 3 (refer Appendix C, 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).<br>AND<br>The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors. | Water level declines below the water level of TARP Significance Level 3 (refer Appendix C, 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. | Calculated or observed drawdown (based on 2009-2015 baseline data and excluding VWPs within the Bulli Coal Seam) exceeds predicted (modelled) drawdown by 30 m for a period of 6 months or more. |
| Level 4 | Water level reduction greater than the maximum modelled drawdown (refer to Appendix C for TARP Significance Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4).<br>AND<br>The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors. | Water level reduction greater than the maximum modelled drawdown (refer to Appendix C for TARP Significance Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4). AND<br>The reduction in water level is determined not to be controlled by climatic or anthropogenic factors. | Calculated or observed drawdown (based on 2009-2015 baseline data and excluding VWPs within the Bulli Coal Seam) exceeds predicted (modelled) drawdown by 30 m for a period of 12 months or more. |

## 4.3 Trigger Exceedances

**Table 8** presents the occurrence of trigger level exceedances in groundwater levels since the start of mining at Western Domain as per the trigger values (HS/SLR, 2019; SLR, 2021) and the TARP trigger criteria presented in **Table 7** and **Appendix Table B1**.

**Table 8 Groundwater Level Trigger Exceedances over September 2021 – September 2022 for the Shallow Open Standpipes, Shallow and Deep VWPs.**

| Bore | Groundwater Level prior to LW W1 (m AHD) (pre-mining) | Trigger Level Exceedances | | | | | | | | | | | | | Future Review Period | | | | | | Maximum drawdown Nov 2020 - Aug 2021 | GWL Prior to LW W4 (15-MAY-22) (m AHD) | Drawdown as of Sep 2022 compared to pre-mining GWL (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sep 21 | Oct 21 | Nov 21 | Dec 21 | Jan 22 | Feb 22 | Mar 22 | **Apr 22** | **May 22** | **Jun 22** | **Jul 22** | **Aug 22** | **Sep 22** | Oct 22 | Nov 22 | Dec 22 | Jan 23 | Feb 23 | Mar 23 | | | |
| **Shallow OSP** | | TARP (Tahmoor Coal, 2021) | | | | | | | | | | | | | | | | | | | | | |
| P12A | 170.1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | | | | 0.5 | 170.7 | - |
| P12B | 170.7 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | | | | 0.8 | 171.3 | - |
| P12C | 176.3 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | L2 | L2 | L2 | L2 | L2 | | | | | | | 11.0 | 175.6 | 4.3 |
| P14A | 168.6 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | | | | 0.2 | 171.5 | - |
| P14B | 166.7 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | # | L1 | L1 | L1 | | | | | | | 1.4 | 168.4 | - |
| P14C | 166.6 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | | | | 1.7 | 168.5 | - |
| P14D | 164.8 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | # | # | L1 | L1 | | | | | | | 1.8 | 167.4 | |
| P15A | 164.7^ | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | | | | - | 169.2 | - |
| P15B | 165.2^ | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | | | | - | 168.8 | - |
| P15C | 164.9^ | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | # | L1 | | | | | | | - | 168.8 | - |
| P15D | 165.4^ | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | # | # | L1 | | | | | | | # | 169.1 | - |
| P16A | 211.3 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | | | | 1.1 | 210.7 | 0.9 |
| P16B | 206.4 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | # | # | # | | | | | | | 5.7 | 205 | 1.3 [Jun 22] |
| P16C | 199.6 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | | | | | | | 13.8 | 191.7 | 3.3 |
| | | | | | | | | | | | | | | | | | | | | | | | |

| Bore | Groundwater Level prior to LW W1 (m AHD) (pre-mining) | Trigger Level Exceedances | | | | | | | | | | | | | Future Review Period | | | | | | Maximum drawdown Nov 2020 - Aug 2021 | GWL Prior to LW W4 (15-MAY-22) (m AHD) | Drawdown as of Sep 2022 compared to pre-mining GWL (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sep 21 | Oct 21 | Nov 21 | Dec 21 | Jan 22 | Feb 22 | Mar 22 | **Apr 22** | **May 22** | **Jun 22** | **Jul 22** | **Aug 22** | **Sep 22** | Oct 22 | Nov 22 | Dec 22 | Jan 23 | Feb 23 | Mar 23 | | | |
| **Shallow VWPs (<200m)** | | TARP (Tahmoor Coal, 2021) | | | | | | | | | | | | | | | | | | | | | |
| P41A | 194 | # | # | # | # | # | # | # | # | L1 | L1 | L1 | L1 | L1 | | | | | | | - | 190 | 0.1 |
| P41B | 172.9 | # | # | # | # | # | # | # | # | L1 | L1 | L1 | L1 | L1 | | | | | | | - | 173 | - |
| P41C | 161.0 | # | # | # | # | # | # | # | # | L1 | L1 | L1 | L1 | L1 | | | | | | | - | 161.7 | - |
| P41D | 160.0 | # | # | # | # | # | # | # | # | L1 | L1 | L1 | L1 | L1 | | | | | | | - | 164.4 | - |
| TNC036 - HBSS-65 | 209.5 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | # | | | | | | | 6.7 | 209.8 | - |
| TNC036 - HBSS-97 | 196.3 | L4 | L4 | L4 | L4 | L4 | L4 | L3 | L3 | L3 | L3 | L2 | L2 | # | | | | | | | 24.0 | 185.5 | 8.7 [Aug 22] |
| TNC036 - BGSS-169 | 197.5 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | # | | | | | | | 47.6 | 164.5 | 35.2 [Aug 22] |
| TNC040-WNFM-27 | 208.3 | L1 | # | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | # | | | | | | | - | 209.6 | - [Aug 22] |
| TNC040 - HBSS-65 | 187.1 | L1 | # | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | # | | | | | | | - | 189 | - [Aug 22] |

| Bore | Groundwater Level prior to LW W1 (m AHD) (pre-mining) | Trigger Level Exceedances | | | | | | | | | | | | | Future Review Period | | | | | | Maximum drawdown Nov 2020 - Aug 2021 | GWL Prior to LW W4 (15-MAY-22) (m AHD) | Drawdown as of Sep 2022 compared to pre-mining GWL (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sep 21 | Oct 21 | Nov 21 | Dec 21 | Jan 22 | Feb 22 | Mar 22 | **Apr 22** | **May 22** | **Jun 22** | **Jul 22** | **Aug 22** | **Sep 22** | Oct 22 | Nov 22 | Dec 22 | Jan 23 | Feb 23 | Mar 23 | | | |
| TNC043 - HBSS-65 | 158.7 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | NA | NA | NA | | | | | | | | | - [Jun 22] |
| TNC043 - HBSS-111.5 | 155.6 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | NA | NA | NA | | | | | | | | | 0.9 [Jun 22] |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **Deep VWPs (>200m)** | TARP (Tahmoor Coal, 2021) | | | | | | | | | | | | | | | | | | | | | | |
| TNC036 - BGSS-214 | 176.5 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | # | | | | | | | 81.4 | 82.9 | 96.5 [Aug 22] |
| TNC036 - BGSS-412.5 | 96.8 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | # | | | | | | | 49.7 | 13.9 | 13.9 [Aug 22] |

TARP Level 1 TARP Level 2 TARP Level 3 TARP Level 4

*LX: maximum trigger level exceedances recorded* *"-": no observed drawdown* *"#": groundwater levels not available*

*^ baseline groundwater level at P15 (A,B,C,D) is the groundwater level recorded in June 2021.*

*"*" not assessed due to disruption in groundwater levels during drilling and packer testing at P15D.*

## Table 9 Groundwater Level Trigger Exceedances over the Reporting Period (January 2021 – Sep 2022) for Private Bores

| Bore | Baseline Maximum Ground water Depth (m bgl) | Baseline Groundwater Yield (L/s) | Trigger Level Exceedances | | | | | | | | | Groundwater Depths as of July 2022 (m bgl) | Ground water Yield as of July 2022 (L/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Jan 22 | Feb 22 | Mar 22 | Apr 22 | May 22 | Jun 22 | Jul 22 | Aug 22 | Sep 22 | | |
| **Private Bores** | | | | | | | | | | | | | |
| GW104090 | 39.0 | # | ^ | ^ | ^ | ^ | ^ | ^ | ~ | ^ | | 42.6 | # |
| GW105467 | 32.0 | 0.5 | * | * | * | * | * | * | * | * | * | # | # |
| GW105228 | 23.0 | 1.8 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | x | x | 10.6 | 1.1 to 2.5 |
| GW072402 | 11.76 | # | L1 | L1 | L1 | L1 | L1 | L1 | ~ | blocked | blocked | # | # |
| GW115860 | # | # | L1 | L1 | L1 | L1 | L1 | L1 | L1 | x | x | 10.6 | 2.5 |
| GW105546 | 31.9 | 1.6 | * | * | * | * | * | * | * | * | * | # | # |

*LX: maximum trigger level exceedances recorded* *#: not applicable* ** no site access* *"-"standing water level not available (access is not available inside the bore)*
*m bgl – metres below ground level* *^Bore blocked at 48.3 m bgl* *~sampling did not occur in July 2022, reported in Sept 22.* *"x": to be assessed in next review period (Oct 22)*

TARP Level 1 TARP Level 2 TARP Level 3 TARP Level 4

## 4.4 Discussion of Groundwater Level Exceedances

This section discusses any exceedances observed over the reporting period from April 2022 to September 2022. Hydrographs for monitoring locations with approved groundwater level triggers are presented in **Appendix C (Figures C1-C27)**.

TARP level exceedances were observed in bores as follows:

- TARP Level 3 at the shallow open standpipes P16C during the reporting period;
- TARP Level 3 at the shallow VWP sensors at TNC036 (HBSS-97m) from March 2022 to June 2022, with a reduction in TARP to Level 2 in July 2022;
- TARP Level 3 at the shallow open standpipes P12C in April 2022, with a reduction in TARP to Level 2 in May 2022;
- TARP Level 2 at the shallow open standpipe P16B during the reporting period;
- 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.

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

In terms of yield and groundwater level at the private bores, the following observations are noted over the reporting period (to July/September 2022):

- 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 (GeoTerra, 2019). 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 is 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. Further monitoring is planned at this location, if site access allows it.
- 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 unblock the bore.

### 4.4.1 Shallow Open Standpipes

#### 4.4.1.1 P12C

Groundwater levels are stable at 176.7 mAHD in September 2022 following a period of recovery. Groundwater levels have increased above the trigger TARP Level 3 (175 mAHD) in May 2022 which reduced the TARP to Level 2 (179.5 mAHD). Groundwater levels are 2.8m below the TARP Level 2 hence a TARP Level 2 applies (**Appendix C, Figure C-3**).

#### 4.4.1.2 P16B and P16C

Since July 2022 no groundwater levels are recorded for P16B due to blockage of the bore. Groundwater levels were at approximately 205 mAHD in July 2022 and a TARP Level 2 was applied at P16B (**Appendix C, Figure C-13**). The groundwater monitoring bore P16B has been unblocked in October 2022 with groundwater data expected in the next review period.

In September 2022, groundwater levels at P16C were observed below the trigger TARP Level 3 (193.9 mAHD) (**Appendix C, Figure C-14**). There seem to be discrepancies between groundwater levels (mAHD) from the data logger and the manual measurements since June 2022, showing differences in the range of 3 m **(Appendix C, Figure C-14)**. While the groundwater levels from the data logger are used in the groundwater level TARP assessment, it is recommended to record several (i.e. 2-3) records of the depth to water at P16C using a water level meter to make sure the correct standing water level is recorded. Additionally, it is recommended to record the data logger installation depth and use this record in the calculations to convert pressure into a groundwater head (mAHD).

A drain to divert surface run-off has been developed in early November 2022 at P16B and P16C along with re-sealing the monitoring bores. These should ensure that no surface water run-off flows into the bore.

### 4.4.2 Shallow VWPs – TNC036

#### 4.4.2.1 TNC036 - HBSS-97m

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 were observed at 187.2 mAHD still below the threshold for TARP Level 2 (191.3 mAHD). (**Appendix C, Figure C-16)**

#### 4.4.2.2 TNC036-169m

Groundwater levels were observed at 174.2 mAHD in late August 2022 (**Appendix C, Figure C-17**). The latest measurement taken on the 31st 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.

### 4.4.3 Deep VWPs – TNC036

**Figure 10** and **Figure 11** present the modelled (blueline) and observed (orange marker) drawdown at TNC036 sensors (BGSS-214m, BGSS-412.5m) since the start of LW LW1 extraction. The blue dashed line represents a threshold established as per the TARP for deep VWP sensors which is the modelled drawdown plus 30 m (**Table 7**).

The groundwater level observed at TNC036-BGSS-214m and TNC036-BGSS-412.5m exceeds the modelled drawdown from mid-2020 but remains within the 30 m predicted drawdown as of August 2022 (**Figure 10** and **Figure 11**). A Level 2 TARP criteria (exceeds modelled drawdown but less than 30 m exceedance) still applies at TNC036-BGSS-214m and TNC036-BGSS-412.5m over the reporting period (**Table 8**).

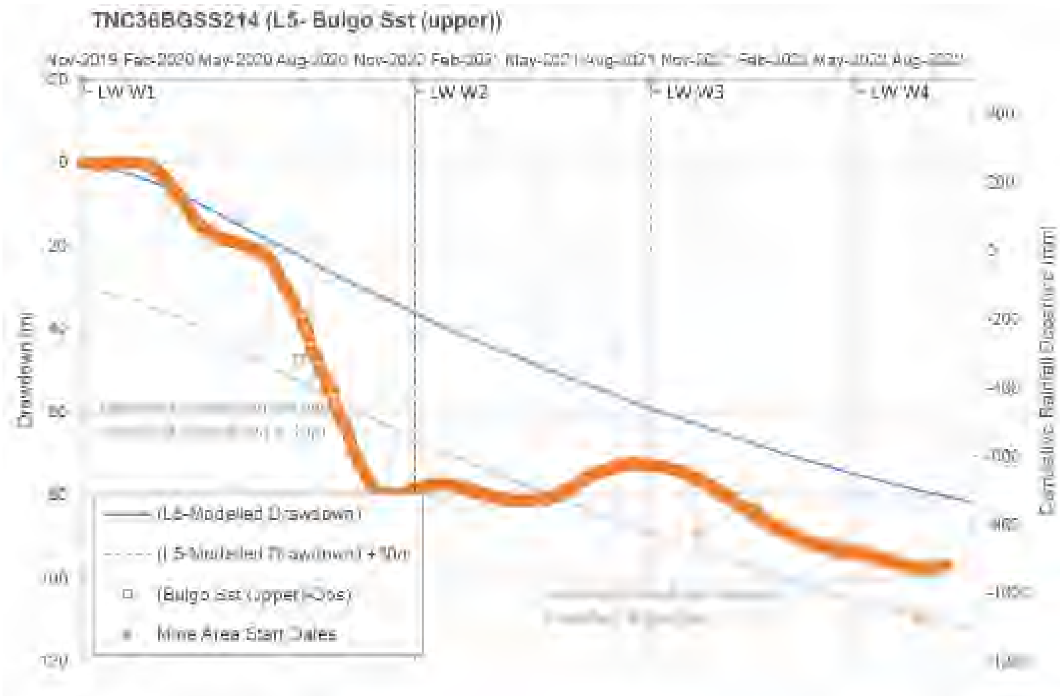



**Figure 10 Comparison of Modelled and Observed Drawdown at TNC036 (BGSS-214m) with the +30m Threshold Modelled Drawdown**

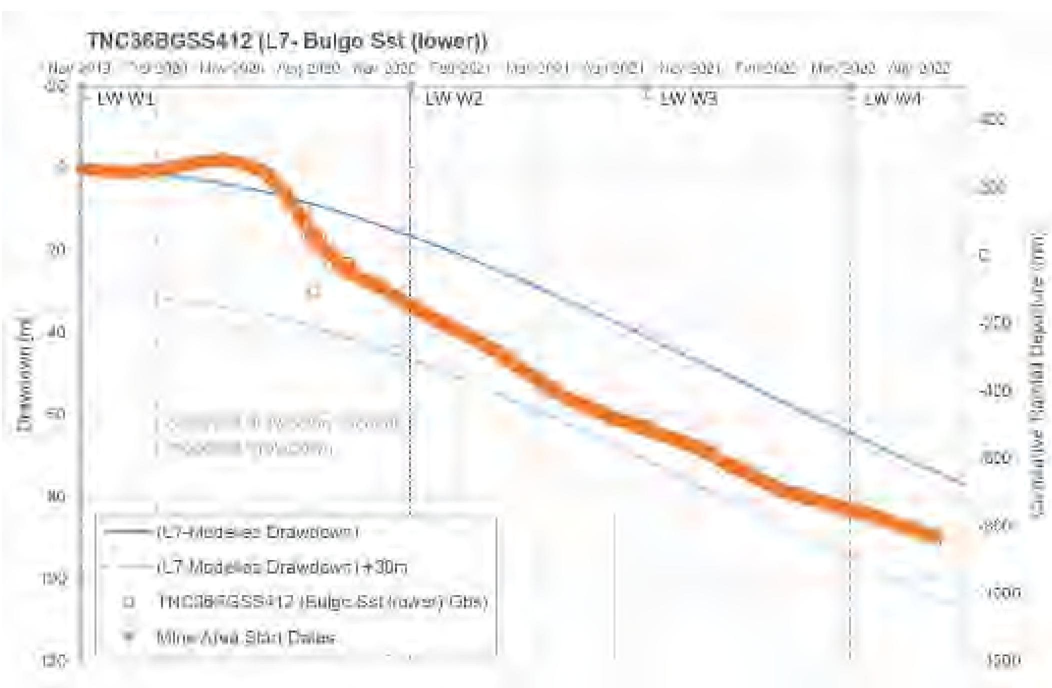



**Figure 11 Comparison of Modelled and Observed Drawdown at TNC036 (BGSS-412.5m) with the +30m Threshold Modelled Drawdown**

# 5 Groundwater Quality Trigger Review

## 5.1 Trigger Criteria

The approved trigger criteria for groundwater quality are summarised in **Table 10. Appendix B2** details the water quality impact assessment trigger criteria from the LW W3-W4 Extraction Plan (Tahmoor Coal, 2021) and the appropriate action plan to be enacted should a trigger exceedance in groundwater quality occur during mining of LW W3-W4.

The groundwater triggers for water quality parameters are detailed in the Groundwater Technical Report (SLR, 2021) and reproduced in **Table 11** below. These values were set for each bore. The water quality triggers were assigned as follows:

- pH - each bore was assigned a lower and upper pH trigger level based on the minimum and maximum pH value recorded in the available dataset minus/plus a pH unit;
- electrical conductivity (EC) - this trigger was established for each bore as the maximum observed EC during the pre-mining baseline and early mining period, plus ten percent of this maximum value; and
- for metals, either:
    - when the maximum metal concentration was recorded during the mining period, the trigger was set at the 95$^{th}$ percentile of the full historical data record (pre-mining and mining period); or
    - when the maximum metal concentration was recorded during the baseline period, the trigger level was defined as the maximum concentration plus ten percent of that value.

Further details on the methodology to develop the proposed groundwater quality trigger levels are provided in the Section 6.2.2 of the Groundwater Technical Report LWW3-W4 (SLR, 2021).

### Table 10 Groundwater Quality TARP Criteria for Open Standpipes and Private Bores (Tahmoor Coal, 2021)

| Significance Level | Criteria |
|---|---|
| | Open Standpipes |
| Level 1 | No observable change in salinity, pH or metals outside of the baseline variability*. |
| Level 2 | 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.<br>AND/OR A similar trend or response has been noted at other monitored bores or private groundwater bores. |
| Level 3 | Short term increase (< 3 months) in salinity and/or metals or change in pH outside of baseline variability*. The effect persists after a significant rainfall recharge event.<br>AND/OR the change in water quality is determined not to be controlled by climatic or anthropogenic factors. |
| Level 4 | 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.<br>AND The reduction in water quality is determined not to be controlled by climatic or anthropogenic factors. |

*the baseline variability was estimated using available data and refers to the proposed trigger levels (refer the section 6.2.2 and Table 6.2 of Groundwater Technical Report (SLR,2021)

## Table 11 Triggers for Groundwater Quality TARPs

| Bore | Trigger Level | | | Trigger Level Concentrations (mg/L) for Metals | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | EC (µS/cm) | pH lower | pH upper | Fe | Mn | Cu | Pb | Zn | Ni | Al | As | Li | Ba | Sr | Se |
| P12A | 942 | 5.4 | 8.1 | 26.4 | 1.7 | 0.0110 | 0.0044 | 75.90 | 0.011 | 0.06 | 0.011 | 0.06 | 0.3 | 0.1 | 0.011 |
| P12B | 729 | 5.0 | 8.2 | 15.2 | 1.3 | 0.0044 | 0.0076 | 50.6 | 0.011 | 0.04 | 0.011 | 0.04 | 0.4 | 0.2 | 0.011 |
| P12C | 528 | 5.9 | 9.2 | 23.1 | 0.8 | 0.0034 | 0.0011 | 0.90 | 0.011 | 0.04 | 0.011 | 0.1 | 0.2 | 0.1 | 0.011 |
| P13A | 1232 | 5.2 | 9.4 | 69.3 | 1.5 | 0.0036 | 0.0014 | 0.91 | 0.011 | 0.04 | 0.011 | 0.03 | 0.4 | 0.3 | 0.011 |
| P13B | 1269 | 5.4 | 9.6 | 16.6 | 1.2 | 0.0020 | 0.0011 | 0.22 | 0.011 | 0.06 | 0.011 | 0.04 | 0.2 | 0.3 | 0.011 |
| P13C | 376 | 6.3 | 10.2 | 46.2 | 1.4 | 0.0011 | 0.0011 | 0.1 | 0.011 | 0.1 | 0.011 | 0.02 | 0.1 | 0.3 | 0.011 |
| P14A | 396 | 4.1 | 9.1 | 15.4 | 2.0 | 0.0022 | 0.0011 | 0.21 | 0.011 | 0.05 | 0.011 | 0.01 | 0.1 | 0.1 | 0.011 |
| P14B | 915 | 4.6 | 8.8 | 46.2 | 0.9 | 0.0022 | 0.0011 | 0.22 | 0.011 | 0.04 | 0.011 | 0.07 | 0.1 | 0.2 | 0.011 |
| P14C | 1881 | 5.3 | 9.4 | 19.8 | 1.5 | 0.0011 | 0.0011 | 0.04 | 0.011 | 0.1 | 0.011 | 0.11 | 0.2 | 0.4 | 0.011 |
| P14D | 1198 | 5.5 | 9.6 | 11.0 | 1.9 | 0.0011 | 0.0011 | 0.04 | 0.011 | 0.04 | 0.011 | 0.35 | 0.1 | 0.2 | 0.011 |
| P15A* | 4620 | 4.63 | 8.22 | 5.7 | 1.0 | 0.0011 | 0.0011 | 0.28 | 0.0011 | 0.055 | 0.011 | 0.13 | 2.9 | **4.0** | 0.011 |
| P15B | 3575 | 4.11 | 12.1 | 4.8 | 0.9 | 0.0011 | 0.0011 | 0.09 | 0.0011 | 0.055 | 0.011 | 0.14 | 1.3 | 1.2 | 0.011 |
| P15C | 2090 | 5.04 | 8.66 | 6.2 | 0.5 | 0.0011 | 0.0011 | 0.19 | 0.0011 | 0.033 | 0.011 | 0.20 | 0.5 | 0.5 | 0.011 |
| P15D | 1430 | 5.48 | 7.72 | 3.5 | 0.9 | 0.0011 | 0.0011 | 0.13 | 0.0011 | 0.055 | 0.011 | 0.19 | 0.2 | 0.4 | 0.011 |
| P16A | 1539 | 4.9 | 7.8 | 116.0 | 3.9 | 0.0011 | 0.0011 | 0.1 | 0.011 | 0.04 | 0.011 | 0.06 | 0.3 | 0.5 | 0.011 |
| P16B | 1180 | 5.9 | 9.6 | 41.8 | 1.8 | 0.0011 | 0.0011 | 0.03 | 0.011 | 0.05 | 0.011 | 0.04 | 0.2 | 0.1 | 0.011 |
| P16C | 1212 | 6.2 | 9.5 | 46.6 | 1.6 | 0.0011 | 0.0011 | 0.02 | 0.011 | 0.05 | 0.011 | 0.1 | 0.1 | 0.1 | 0.011 |
| P17 | 2019 | 4.8 | 8.3 | 10.6 | 0.6 | 0.0011 | 0.0011 | 0.2 | 0.011 | 0.04 | 0.011 | 0.11 | 0.2 | 0.7 | 0.011 |
| GW105546 | 448 | 3.5 | 7.2 | 37.4 | 1.6 | 0.0011 | 0.0011 | 0.1 | 0.011 | 0.03 | 0.011 | 0.011 | 0.05 | 0.04 | 0.011 |
| GW105467 | 1041 | 3.7 | 6.8 | 77.0 | 3.9 | 0.094 | 0.0019 | 0.2 | 0.039 | 0.04 | 0.011 | 0.072 | 0.1 | 0.04 | 0.011 |

| Bore | Trigger Level | | | Trigger Level Concentrations (mg/L) for Metals | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | EC (µS/cm) | pH lower | pH upper | Fe | Mn | Cu | Pb | Zn | Ni | Al | As | Li | Ba | Sr | Se |
| GW105228 | 1793 | 4.6 | 7.1 | 31.4 | 2.7 | 0.0011 | 0.0011 | 0.2 | 0.0181 | 0.04 | 0.011 | 0.026 | 0.23 | 0.15 | 0.011 |
| GW072402 | 8151 | 4.7 | 7.5 | 63.8 | 0.9 | 0.0019 | 0.0011 | 0.2 | 0.011 | 0.03 | 0.011 | 0.157 | 0.3 | 0.5 | 0.011 |
| GW115860* | 948.2 | 4.9 | 7.25 | 16.5 | 0.9 | 0.0011 | 0.0011 | 0.02 | 0.011 | 0.022 | 0.011 | 0.253 | 0.51 | 0.3 | 0.011 |
| GW104090 | 3861 | 5.3 | 7.5 | 50.6 | 1.4 | 0.0011 | 0.0011 | 0.05 | 0.022 | 0.033 | 0.011 | 1.650 | 0.1 | 1.2 | 0.011 |

'*" Revised trigger level for Ba at bore GW115860 following the groundwater trigger investigation presented in SLR (2022a) and revised trigger level for SR at bore P15A following the groundwater investigation in SLR (2022b)

## 5.2 Summary of Groundwater Quality Exceedances

The following section details the groundwater quality compliance at Tahmoor Coal in relation to the groundwater quality triggers. **Table 12** presents the occurrence of trigger level exceedances in groundwater quality (EC, pH and metals) over the reporting period as per the proposed trigger values (**Table 11**) and the TARP trigger criteria found respectively in **Appendix B.**

A brief analysis of the EC, pH and metal concentrations in relation to climate and mining activity during the reporting period is presented in **Sections 5.2.1** to **5.2.3** alongside trigger exceedances. Time series plots with the approved trigger values (EC, pH, metals) with exceedances only are shown in **Appendix D, Figures D1-D44.**

**Table 12 Trigger Exceedances for pH, EC and Metal Concentrations over the Reporting Period (April 2022 – September 2022)**

| Bore | Month | Trigger Level Exceedance | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EC | pH lower | pH upper | Fe | Mn | Cu | Pb | Zn | Ni | Al | As | Li | Ba | Sr | Se |
| **Shallow OSP** | | | | | | | | | | | | | | | | |
| **P12A** | Apr | | | | | | | | | | | | | | | |
| | May | | | | | | | | | | | | | | | |
| | Jun | | | | | | | | | | | | | | | |
| | Jul | | | | | | | L2 | | | L2 | | | | | |
| | Aug | | | | | | | L2 | | | L2 | | | | | |
| | Sep | | | | | | | L2 | | | L2 | | | | | |
| **P12B** | Apr | | | *L4 | | | | | | | L2 | | | | | |
| | May | | | *L4 | | | | | | | | | | | | |
| | Jun | | | | | | | | | | | | | | | |
| | Jul | | | | L2 | | | | | | | | | | | |
| | Aug | | | | L2 | | | | | | | | | | | |
| | Sep | | | | L2 | | | | | | | | | | | |
| **P12C** | Apr | | | | | | | | | | | | | | | |
| | May | | | | | | | | | | | | | | | |
| | Jun | | | | L2 | L2 | | | | | | | | | | |
| | Jul | | | | L2 | L2 | | | | | | | | | | |
| | Aug | | | | L2 | L2 | | | | | | | | | | |
| | Sep | | | | L2 | L2 | | | | | | | | | | |
| **P14A** | Apr | | | | | | | | | | | | | | | |
| | May | | | | | | | | L2 | | | | | | | |
| | Jun | | | | | | | | | | L2 | | | | | |
| | Jul | | | | | | | | | | | | | | | |

| Bore | Month | Trigger Level Exceedance | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EC | pH lower | pH upper | Fe | Mn | Cu | Pb | Zn | Ni | Al | As | Li | Ba | Sr | Se |
| | Aug | | | | | | L2 | | | | | | | | | |
| | Sep | | | | | | L2 | | | | | | | | | |
| P14B | Apr | | | | | | | | | | | | | | | |
| | May | | | | | | | | | | | | | | | |
| | Jun | | | | | | | | | | | | | | | |
| | Jul | | | | | | | | | | | | | | | |
| | Aug | | | | | | | | | | | | | | | |
| | Sep | | | | | | | | | | | | L2 | L2 | L2 | |
| P14C | Apr | | | | | | | | | | | | | | | |
| | May | | | | | | | | L2 | | | | | | | |
| | Jun | | | | | | | | | | | | | | | |
| | Jul | | | | | | | | | | | | | | | |
| | Aug | | | | | | L2 | | | | | | | | | |
| | Sep | | | | | | | | | | | | | | | |
| P14D | Apr | | | | | | | | | | | | | | | |
| | May | | | | | | | | L2 | | | | | | | |
| | Jun | | | | | | | | | | | | | | | |
| | Jul | | | | | | | | | | | | | | | |
| | Aug | | | | L2 | | L2 | | | | | | | | | |
| | Sep | | | | | | L2 | | | | | | | | | |
| P15A | Apr | L2 | | | | | | | | | | | | | *L4 | |
| | May | L2 | | | | | | | | | | | | | *L4 | |
| | Jun | | | | | L2 | | | | | | | L2 | | L2 | |
| | Jul | | | | | L2 | | | | | | | L2 | | L2 | |
| | Aug | | | | | | | | | | | | L2 | | L2 | |
| | Sep | L2 | | | | | | | | | | | L2 | | L2 | |
| P15B | Apr | L2 | | | | | | | L2 | | | | | | L2 | |
| | May | L2 | | | | | | | L2 | | | | | | | |
| | Jun | L2 | | | | | | | | | | | | | L2 | |
| | Jul | | | | | | | | | | | | | | L2 | |
| | Aug | | | | | | | | | | | | | | L2 | |
| | Sep | L2 | | | | | L2 | | | | | | | | | |
| P15C | Apr | | | | | | | | | | | | | | | |
| | May | | | | L2 | | | | | | | | | | | |

| Bore | Month | Trigger Level Exceedance | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EC | pH lower | pH upper | Fe | Mn | Cu | Pb | Zn | Ni | Al | As | Li | Ba | Sr | Se |
| | Jun | L2 | | | L2 | | | | | | | | | | L2 | |
| | Jul | | | | | | | | | | | | | | L2 | |
| | Aug | | | | | | | | | | | L2 | | | L2 | |
| | Sep | L2 | | | | | | | | | L2 | | | | L2 | |
| **P15D** | Apr | | | | L2 | | | | | | | | | | | |
| | May | | | | L2 | | | | | | | | | | | |
| | Jun | L2 | | | L2 | L2 | | | | | | | | | | |
| | Jul | | | | L2 | | | | | | | | | | | |
| | Aug | | | | L2 | | | | | | | | | | | |
| | Sep | | | | L2 | | | | | | | | | | | |
| **P16A** | Apr | | | | | | | | | | | | | | | |
| | May | | | | | | | | L2 | | | | | | | |
| | Jun | | | L2 | | | | | | | | | | | | |
| | Jul | | | | | | | | | | | | | | | |
| | Aug | | | | | | L2 | | | | | | | | | |
| | Sep | | | | | | | | | | | | | | | |
| **P16B** | Apr | | | | | | | | | | | | | | | |
| | May | | | | | | | | L2 | | | | L2 | | | |
| | Jun | | | | | | | | | | | | | | | |
| | Jul | | | | | | | | | | | | | | | |
| | Aug | | | | | | | | | | | | | | | |
| | Sep | | | | | | | | | | | | | | | |
| **P16C** | Apr | | | | | | | | | | | | | | | |
| | May | | | | | | | | L2 | | | | | | | |
| | Jun | | | | | | | | L2 | | L2 | | | | | |
| | Jul | | | | | | L2 | | L2 | | | | | | | |
| | Aug | | | | | | L2 | | L2 | | | | | | | |
| | Sep | | | | | | L2 | | L2 | | L2 | | | | | |
| **Private Bores** | | | | | | | | | | | | | | | | |
| **GW104090** | Apr | | | | | | | | | | | | | | | |
| | Jul | | | | | | | | | | | | | | | |
| **GW105467** | Apr | | | | | | | | | | | | | | | |
| | Jul | | | | | | | | | | | | | | | |
| **GW105228** | Apr | | | | | | | | | | | | | | | |

| Bore | Month | Trigger Level Exceedance | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EC | pH lower | pH upper | Fe | Mn | Cu | Pb | Zn | Ni | Al | As | Li | Ba | Sr | Se |
| | Jul | | | | | | | | | | | | L2 | | | |
| GW072402 | Apr | | | | | | | | | | | | | | | |
| | Jul | | | | | | | | | | | | | | | |
| GW115860 | Apr | L2 | | | | | | | | | | | | | | |
| | Jul | L2 | | | | | | | | | | | | | L2 | |
| GW105546 | Apr | | | | | | | | | | | | | | | |
| | Jul | | | | | | | | | | | | | | | |

TARP Level 1 TARP Level 2 TARP Level 3 Potential TARP Level 4 no site access

*LX: maximum trigger level exceedances recorded*

"*" remains a potential Level 4 TARP trigger

### 5.2.1 Electrical Conductivity (EC) and pH

During this reporting period, EC and pH recorded at the following groundwater monitoring bores were observed above the TARP Level 2 trigger level:

- EC at P15A, B, C and D – TARP Level 2 (**Appendix D, Figure D1-D4**);
- EC at GW115860 – TARP Level 2 (**Appendix D, Figure D5**);
- pH at P12B – potential TARP Level 4 reducing to TARP Level 1 June 2022 (**Appendix D, Figure D6**); and
- pH at P16A (**Appendix D, Figure D7**) – TARP Level 2.

The increase in EC and pH at the groundwater monitoring bores presented above is not a result of a mining effect in the Western Domain (SLR, 2022d). As of September 2022, there were no groundwater quality trigger exceedances for EC and pH.

All others EC and pH measurements from the Tahmoor Coal standpipes and private bores were observed within the Level 1 TARP.

### 5.2.2 Metals

During this reporting period, metal concentrations for all groundwater monitoring bores, and three private bores were observed above the trigger level as presented in **Table 12** and **Appendix D, Figure D8-D43**. The increases in metal concentrations observed across the Western Domain bores are short-term increases (less than three months) and likely due to natural fluctuations in groundwater quality rather than a mining related effect (SLR, 2022). Further discussion on increases in metal concentrations at specific locations is presented in **Section 5.2.3.**

### 5.2.3 Discussion of Groundwater Quality Exceedances

**Table 13** presents a discussion of trigger exceedances at each groundwater monitoring and private bores observed during the reporting period. Metal concentrations measurements above the trigger level for a single month are listed as TARP Level 2 in **Table 12** and briefly mentioned in **Table 13** although not discussed in details below as natural fluctuations in groundwater quality is likely the reason for the short-term (1 month) increase.

**Table 13 Groundwater Quality Trigger Exceedances - Discussion**

| Site | Discussion |
|---|---|
| **P12A** | TARP Level 2 metals for lead (**Figure D22**) and aluminium (**Figure D30**) from July to September 2022. The increase in metal concentrations (Pb and Al) in July 2022 is likely due to wet conditions (i.e. flooding) rather than mining. A decreasing trend was observed since August 2022 for both metals justifying the TARP Level 2. Additional monitoring required to confirm trends. |
| **P12B** | Potential TARP Level 4 pH upper exceedance observed in May 2022 but is reduced to a TARP Level 1 in June 2022. The higher pH at bore P12B is likely due to an issue with the integrity of the bore, with the recent flooding flushing cement/grout in the bore (**Figure D6**). The potential TARP Level 4 put in place since April 2022 at P12B reduces to a TARP Level 1 in June 2022 as the source of the pH increase is not related to mining but to grout contamination. The consequences of this effect (unlikely to be mining-related) were assessed as minor in the latest six-monthly review (SLR, 2022). Since July 2022 pH at P12B reduced within baseline level and was observed within a TARP Level 1. The pH at nearby monitoring bores P12A and P12C remain within a TARP Level 1 during the reporting period. A greater volume of water was purged from bore P12B in the May round of monitoring to remove groundwater potentially contaminated with grout before sampling. Additional purging will be conducted in the next review period prior sampling.<br>TARP Level 2 metals (iron) observed between July and September 2022 (**Figure D8**). This exceedance for dissolved metal concentration is a short-term increase (three months) and likely due to above average rainfalls and bore construction material. In fact, the increase in iron is likely due to iron staining on the steel casing rather than mining related effect. Further monitoring is required to confirm Fe trends. |
| **P12C** | TARP Level 2 metals (iron and manganese) exceedance observed since June 2022 (**Figure D9-D13**). A decreasing trend in manganese was observed from August 2022 hence a TARP Level 2.<br>The increase in dissolved iron is likely caused by the dissolution of iron present on the steel casing rather than mining related effect. Additional monitoring required to confirm trends. |
| **P14A** | Single measurement in zinc concentration observed above the trigger level in May 2022 **(Figure D23**).<br>Single measurement in aluminium concentration observed above the trigger level in June 2022. **(Figure D32**)<br>Two consecutive measurements in copper concentration observed above the trigger levels in August and September 2022 (**Figure D16**).<br>These higher dissolved metals concentrations are short-term increases (less than three months) and no mining effect is identified. |
| **P14B** | Single measurement in lithium, barium, strontium concentrations observed above the trigger levels in September 2022 (**Figure D37, D40**). These higher dissolved metal concentrations are short-term increases (less than three months) and no mining effect is identified. |

| Site | Discussion |
|---|---|
| **P14C** | Single measurement in zinc and copper concentrations observed above the trigger levels in May 2022 and August 2022 respectively (**Figure D24, D17**). These exceedances for dissolved metals concentrations are short-term increases (less than three months) and no mining effect is identified. |
| **P14D** | Single measurement in zinc and iron concentrations observed above the trigger levels in May 2022 and August 2022 respectively (**Figure D25, D10**).<br>Two consecutive measurements in copper concentrations observed above the trigger level in August and September 2022 (**Figure D18**).<br>These higher dissolved metals concentrations are short-term increases (less than three months) and no mining effect is identified. |
| **P15A** | Potential TARP Level 4 metals (strontium) exceedance observed in April and May 2022, but it is reduced to a TARP Level 2 in June 2022. Concentration of strontium increased by approximately 9 mg/L over the reporting period to 11.7 mg/L in June 2022 but has decreased and is stable at 8.1 mg/L since July 2022. At P15D, strontium concentration has fluctuated between 0.1 and 0.3 mg/L, which suggests that the deeper strata have not been impacted by the strontium observed in the shallow groundwater (P15A). 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 as discussed in SLR (2022c).<br>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 (Figure D-20), as the trigger was assessed to be too conservative for this site (SLR 2022c).<br>The concentration of strontium was 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. Strontium concentration at P14 sites and nearby private bores should be closely monitored in the next review period.<br>TARP Level 2 metals (lithium) exceedances observed since June 2022 (more than 3 months) however a decline in lithium concentration was observed in September 2022 hence a TARP Level 2 applies (**Figure D38**).<br>Two consecutive measurements in manganese concentration observed above the trigger levels in June and July 2022 (**Figure D4**).<br>Reduction to a TARP Level 1 for EC due to a decrease in EC in July 2022 following rainfall events (**Figure D1**). As of September 2022, TARP Level 2 applies following an increase in EC to 5,250 µS/cm. |
| **P15B** | TARP Level 2 EC reduces to a TARP Level 1 in July 2022 following a steady decline which could be associated to rainfall recharge (**Figure D2**). As of September 2022, EC increased above the trigger level hence a TARP Level 2 applies. Mining effect is unlikely.<br>Two consecutive measurements in zinc concentration observed above the trigger levels in April and May 2022 (**Figure D26**). These higher dissolved metal concentrations are short-term increase (less than three months) and no mining effect is identified.<br>TARP Level 2 metals (strontium) exceedance observed in April and between June and August 2022 (**Figure D42**). As of September 2022, strontium concentrations decreased below 0.1 mg/L within a TARP Level 1. It is recommended to continue closely monitoring strontium concentrations, with respect to TARP Level 2 in place for strontium for site P15A. |

| Site | Discussion |
|---|---|
| **P15C** | TARP Level 2 EC exceedance observed in June 2022 (**Figure D3**). EC at P15C decreased in May 2022 before sharply increasing to a maximum of 3,595 µS/cm in June 2022. A decline in EC was observed between July and August 2022 (TARP L1) before increasing to 2,400 µS/cm in September 2022 (TARP L2).<br>Two consecutive measurements in iron concentration observed above the trigger levels in May and June 2022 (**Figure D11**). These are a short-term increase (less than three months) and no mining effect is identified.<br>Single measurement in aluminium and arsenic concentrations observed above the trigger levels in September 2022 and August 2022 respectively.<br>TARP Level 2 metals (strontium) exceedance observed between June and September although a declining trend was observed from August 2022 (**Figure D43**). Over the reporting period the overall increase in strontium concentration at P15C is approximately 0.35 mg/L compared to 9 mg/L at P15A in June 2022. It is recommended to continue closely monitoring strontium concentrations, with respect to a TARP Level 2 in place for strontium for site P15A. |
| **P15D** | Single measurement in EC observed above the trigger levels in June 2022 resulting in a TARP Level 2 (**Figure D4**).<br>Large fluctuations in iron concentrations were observed and above the trigger level for most of the reporting period (**Figure D12**). Maximum iron concentration peaked at 27mg/L in June 2022, declined in August and increased slightly in September 2022 to 17 mg/L. Recent increase in iron may be due to iron precipitation within the bore. Insufficient baseline data is available to assess potential mining influences. Continued monitoring is recommended to assess if concentration stabilise post-mining.<br>Single measurement in manganese concentrations observed above the trigger levels in June 2022 (**Figure D15**). This is a short-term increase (less than three months) and no mining effect is identified. |
| **P16A** | Single measurement in pH observed above the trigger levels in June 2022 (Figure D7).<br>Single measurement in copper and zinc concentrations observed above the trigger levels in August and May 2022 (**Figure D20**).<br>These exceedances for pH and dissolved metal concentration are short-term increases (less than three months) and no mining effect is identified. |
| **P16B** | Single measurement in zinc and lithium concentrations observed above the trigger levels in May 2022. These exceedances for dissolved metals concentrations are short-term increases (less than three months) and no mining effect is identified. |
| **P16C** | TARP Level 2 metals (zinc) exceedance observed from May to September 2022 (**Figure D29**). The source of the recent increase in zinc concentration is unknown but likely due to surface runoff flowing into the bore however a mining effect is not excluded. Purging of the bore to remove the potential surface water run-off has been recommended. Additional monitoring will be conducted to confirm trends. Zinc concentrations at the nearby shallow piezometers P16A is within a TARP Level 1.<br>Three consecutive measurements in copper concentrations observed from June 2022 (**Figure D21**). Recent decline in copper concentration observed in September 2022 hence TARP Level 2 applies.<br>Single measurements in aluminium concentrations observed above the trigger levels in June and September 2022 (**Figure D34**).<br>Except for the exceedances in zinc which required further monitoring, exceedances at P16C for other dissolved metals concentrations are a short-term increase (less than three months) and no mining effect is identified. |

| Site | Discussion |
|---|---|
| **GW105228** | Recent increases in lithium concentrations above the trigger level was observed since April 2022. Further monitoring is required to confirmed trends however the lack of baseline data is likely to make the trigger level too conservative (**Figure D36**). |
| **GW115860** | EC observed above the trigger level since July 2021. Given the low salinity of groundwater at GW115860, and the small incremental change in that salinity in relation to the beneficial use classifications (SLR, 2022) a TARP Level 2 remains. In addition, EC has declined since April 2022 to 1,029 µS/cm (trigger level set at 948.2 µS/cm) (**Figure D5**). No mining effect identified.<br>Single measurement in strontium concentration observed marginally above the trigger levels in September 2022 (**Figure D39**). Further monitoring to be conducted in the area in relation to the higher strontium concentration observed in P15A. |

# 6 Predicted and Observed Groundwater Depressurisation

The following section provides a summary of comparison between the modelled and observed groundwater levels using the groundwater model SLR (2021) results (i.e. referred in this report as the "groundwater model") presented in the Groundwater Technical Report: Extraction Plan for LW W3-W4 (SLR, 2021) and latest available observed groundwater data (up to March 2022).

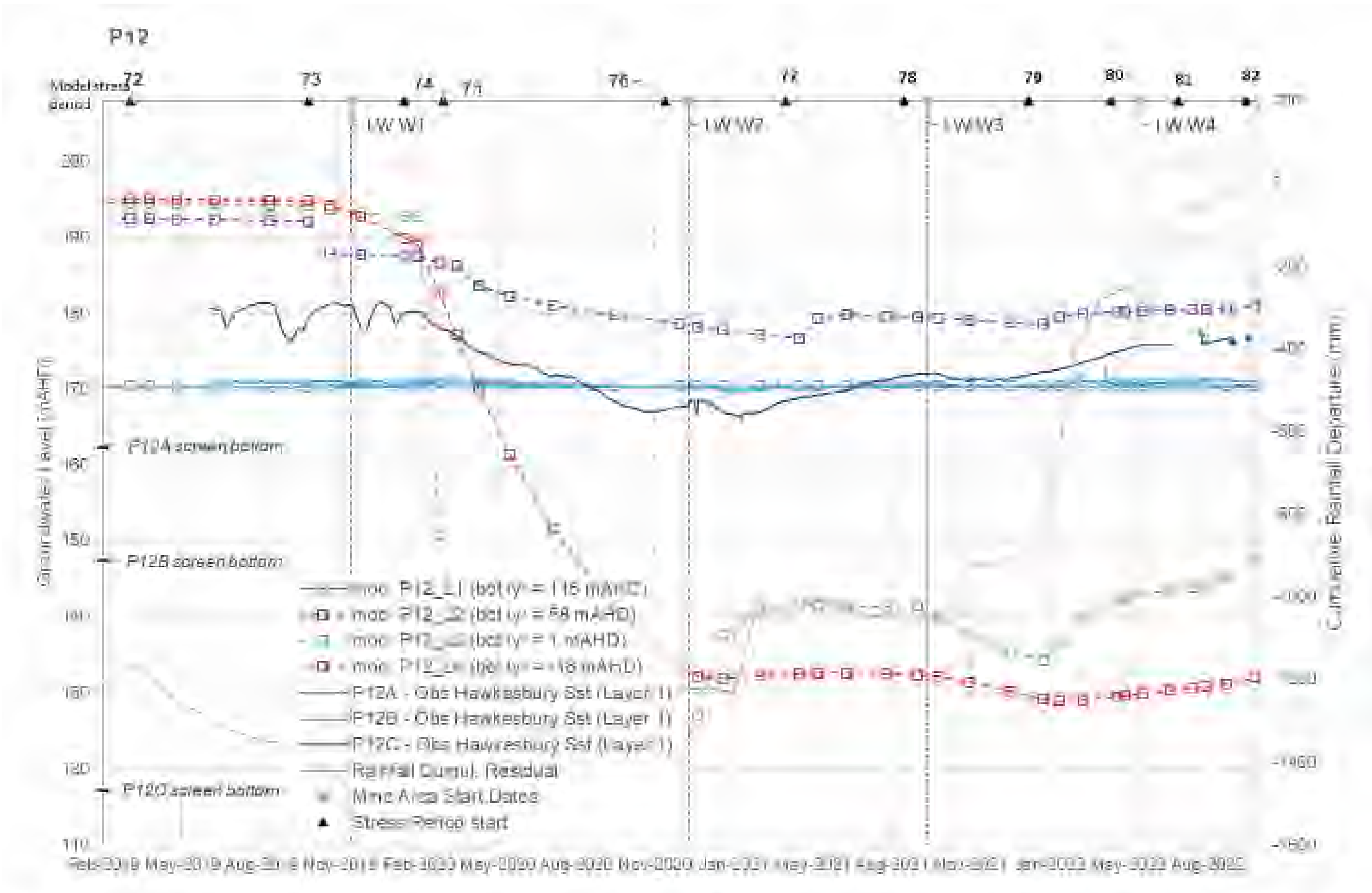
## 6.1 Summary

The drawdowns observed during LW W1, LW W2 and LW W3 show a clear relationship with depth below surface (or height above the mined seam), with drawdowns greatest at depth, and being 8-15 m in the lower or mid-Hawkesbury Sandstone, and less in the shallower horizons (typically 0.5-1 m). The same trend was observed for the subsequent recovery post LW W1 and LW2, with greatest recovery in the deep piezometers (6 m) and being 1-3.5 m in the lower or mid-Hawkesbury Sandstone. As of September 2022, groundwater recovery is complete in the shallower horizons except at some site (P16A) where a potential partial recovery was observed (approximately 0.5-0.8 m below baseline).

The hydrographs for P12, P14, P15, P16, and TNC036 monitoring sites were reviewed in light of the TARP exceedances (**Section 4.3**) at these monitoring sites (**Figure 12** to **Figure 16**). The modelled water level for the piezometer A at each site is shown. The key findings over the reporting period are:

- Piezometers at P12 and P16 are spaced, in a vertical sense, at a smaller interval than the model layers, so that it is not possible nor practical for the model to simulate or replicate water levels at all piezometers. Also, temporal discretisation does not allow all short-term variability, especially to rainfall events, to be simulated.
- The groundwater model does not simulate groundwater abstraction at private bores because the extractions are not metered by WaterNSW nor are there estimated extraction rates available.
- The historical period of the model ends in November 2020, which means that all predictions after December 2020 are based on average rainfall. Hence, the model does not capture the response to the rainfall recharge observed in 2021 and more recently in July 2022 (i.e. flood events).
- To the north-west area of the Western Domain, the groundwater levels in upper (P12A) and mid (P12B) Hawkesbury Sandstone aquifers continue to be well replicated by the model (within +/- 1-2m of observed). In the deeper start at P12C, the recovery in groundwater level (model layer 2) continues to be a good approximation of the recovery in P12C (i.e. same was true for the drawdown in 2020). The timing of recovery is well replicated, while its magnitude is slightly underestimated by the model (within 3 m of observed) over the reporting period. No mining effect due to LW W4 is simulated at P12C (model layer 2) which is also reflected in the observed groundwater levels.
- North to the Western Domain, it was previously reported that the modelled drawdown was slightly overestimated at sites P14 and P15 (during LW W2 and early parts of LW W3). From April 2022, in all piezometers at site P14, modelled groundwater levels in model layers 1 and 2 are within 1m of the observed groundwater levels.

- During 2022, the modelled drawdown at P15 is overestimated by approximately 3-4m in model layer 2 however modelled groundwater levels in model layer 1 are within 1m of observed. The modelled groundwater levels in model layers 1 and 2 remain a good approximation of observed groundwater levels for all piezometers at site P15. We note that piezometers P15A, B, C and D all sit within the same model layer 2. The presence of multiple piezometers within a single layer makes it challenging (if not impossible) to replicate or match all observations. Similar observations apply to site P14 in terms of model layering and model performance.
- At P16B and P16C, sitting within the model in Layer 1 and Layer 2 respectively, the model replicates the stabilisation of water level throughout the reporting period. Modelled groundwater levels in model layer 2 replicates well the observed groundwater levels in P16C within +/-2m. Further monitoring data is required at P16B to compare to modelled estimates however it is within 3m of observed groundwater levels at the start of the reporting period which is acceptable as the modelled trends is generally well matched.
- At TNC036 (Figure 16) there is a small underestimation in the model to replicate the observed recovery during 2022 but modelled groundwater levels are within 5-10 m observed as of August 2022 (i.e. similar as modelled prior to LW W1). The HBSS-65m and HBSS-97 m piezometers are assigned the same model layer, which makes difficult to match the difference in groundwater head between the two shallow piezometers, but previously the model gives a reasonable estimate in the rate and magnitude of drawdown at this location.
- The observed stabilisation and recovery in water levels in BGSS-169 m are well replicated by the model, being within 1 m of observed prior the start of LW W4. This suggests that the height and mode of subsidence fracturing in this area is well represented in the model. The modelled underestimates the groundwater recovery in the upper model layers due to the July rainfall recharge not being captured in the model. This explains why the modelled groundwater levels diverge from observed groundwater levels from July 2021 in TNC36-169m. The model performance at this site remains acceptable.




## Figure 12 Comparison of Modelled and Observed Groundwater Levels at P12

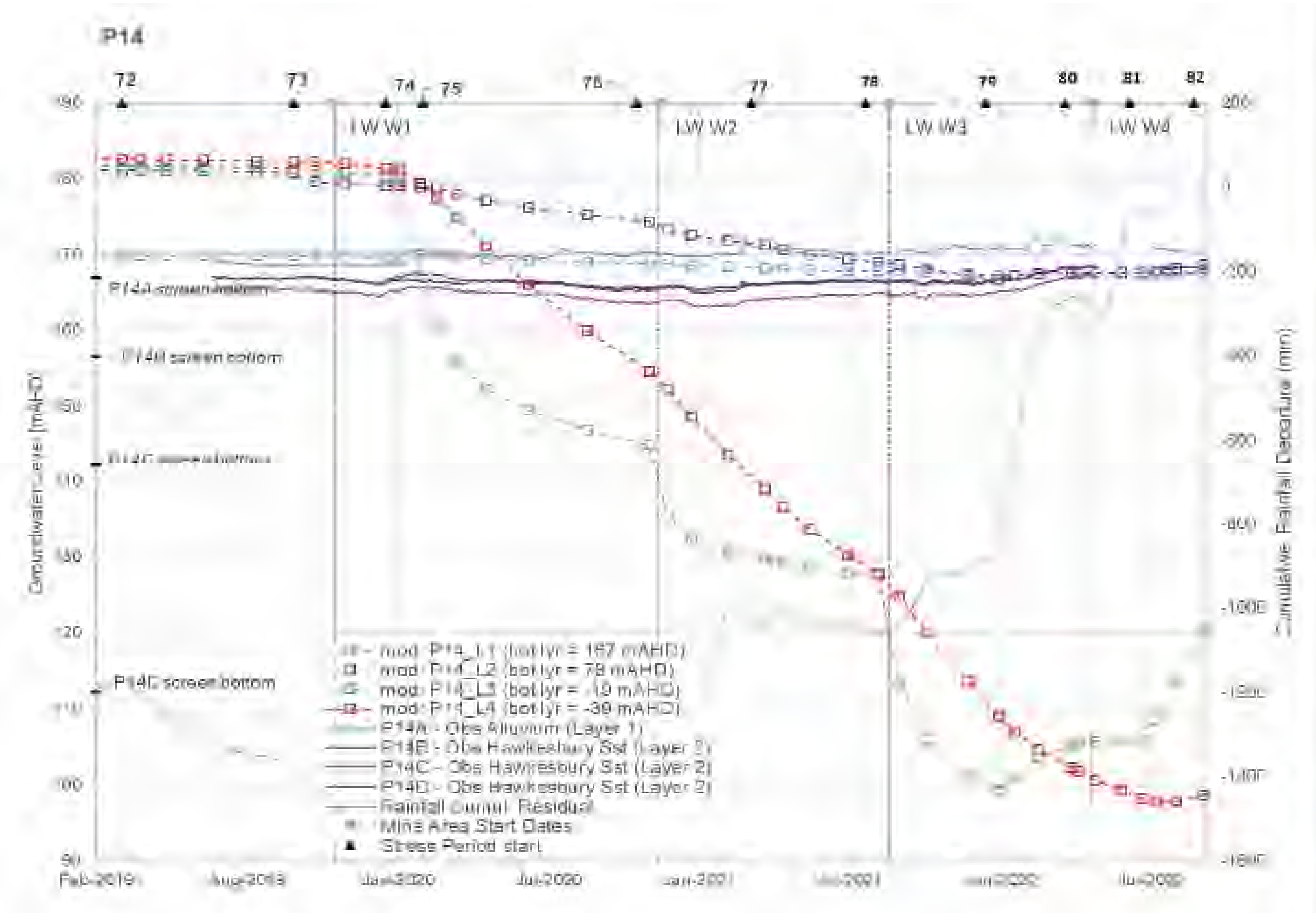


**Figure 13 Comparison of Modelled and Observed Groundwater Levels at P14**

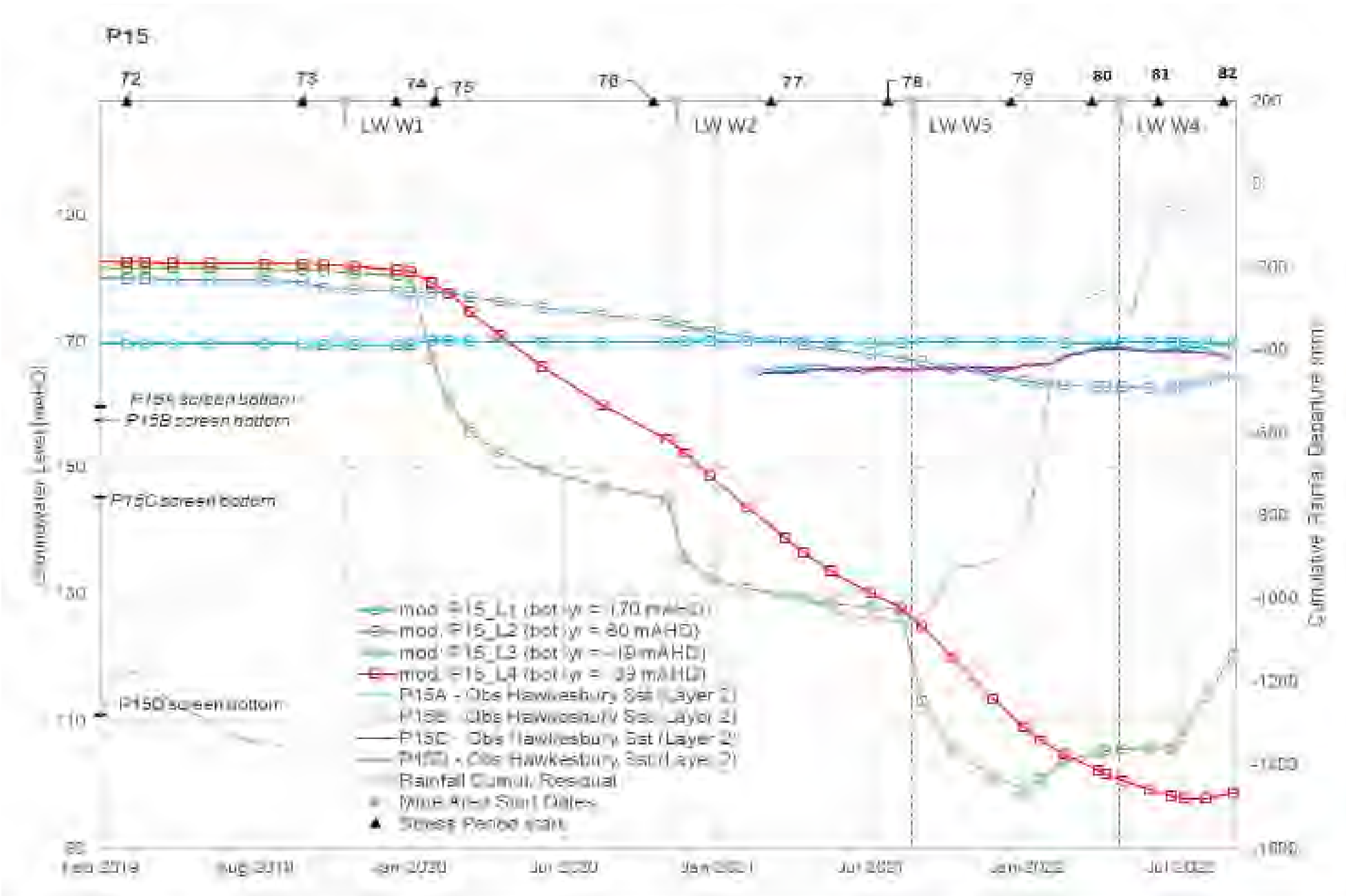



**Figure 14 Comparison of Modelled and Observed Groundwater Levels at P15**

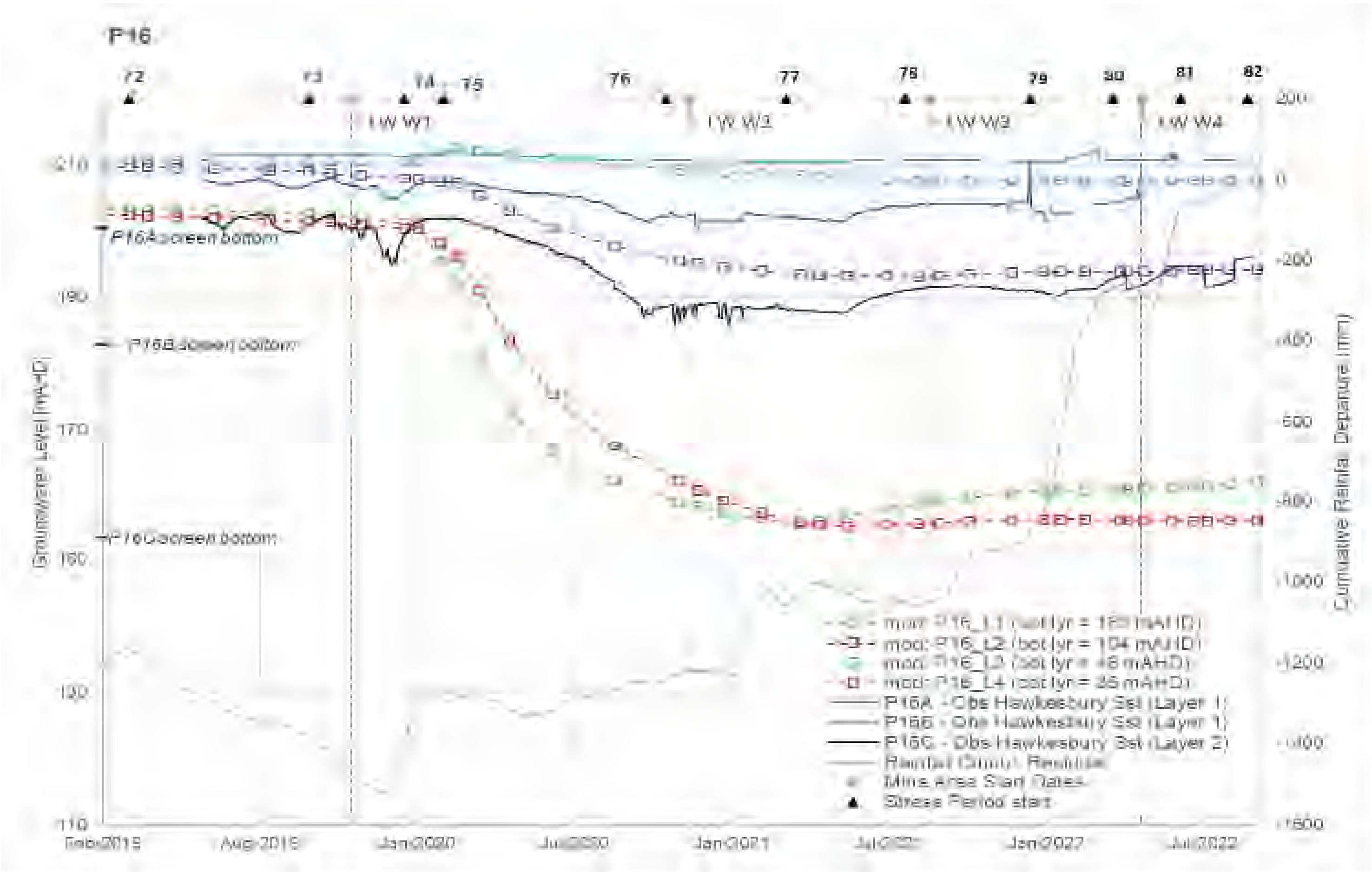
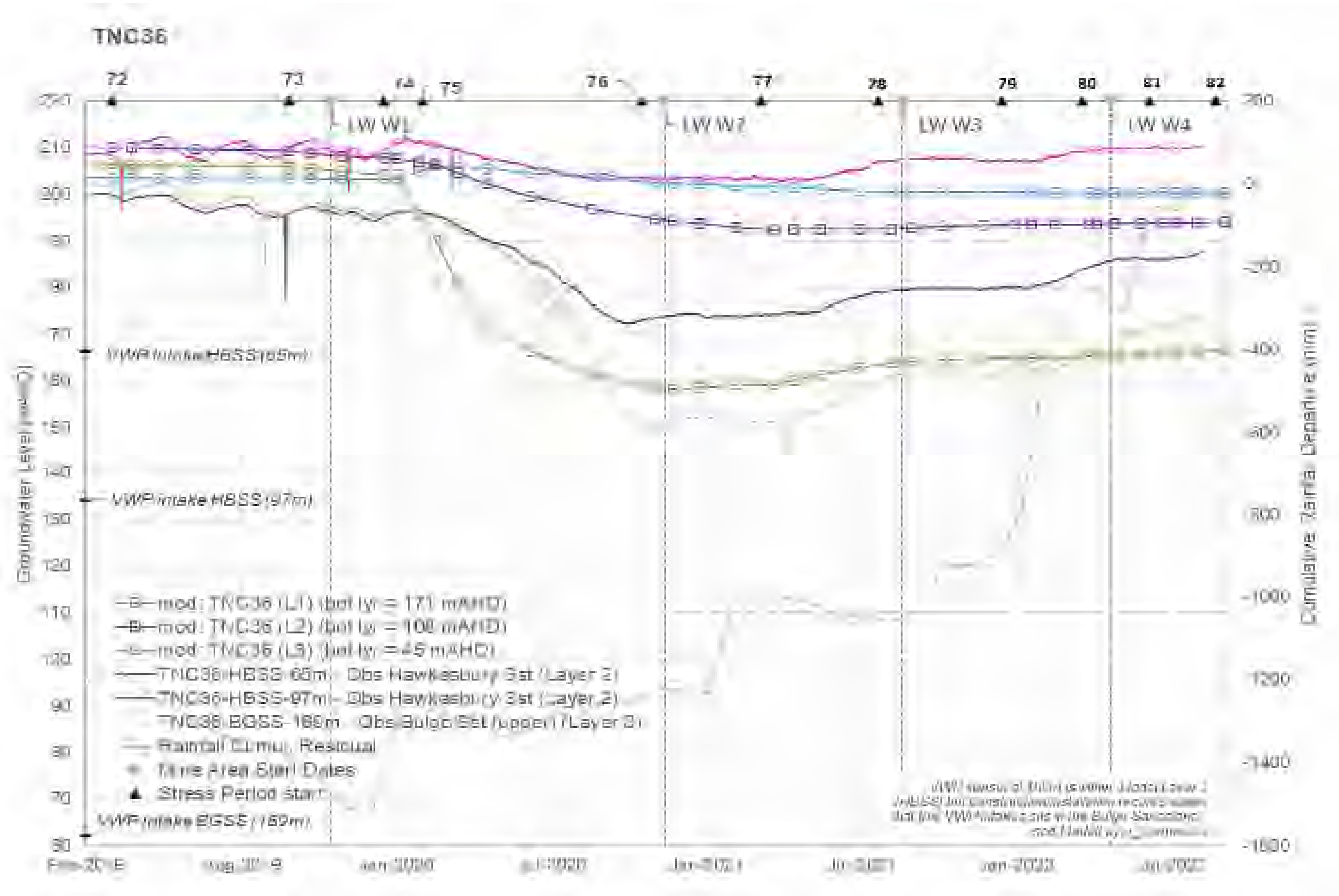



**Figure 15 Comparison of Modelled and Observed Groundwater Levels at P16**




## Figure 16 Comparison of Modelled and Observed Groundwater Levels at TNC036

# 7 Mine Groundwater Inflow

For the period 2009 to September 2022 (latest reported record is on 30th September 2022), observed inflows to Tahmoor Mine have been within the range of 2 to 6 ML/d. **Figure 17** shows net groundwater inflows (as calculated from the mine water balance and pump-out records), alongside the historic rainfall (based on records dating back to 1900) and the Western Domain longwall start dates. Inflows to the Western Domain are not metered in isolation from other parts of Tahmoor North. For the following analysis we focus on the 7-day moving average on **Figure 17**, as short-term peaks are unlikely to be related to groundwater, but more related to deliberate changes in pumping or water management in the underground mine workings.

During the near completion of LW W3 in April 2022, the mine inflows remained stable at around 4.5-5 ML/day. Following the completion of LW W3 and early part of LW W4 in May 2022, mine inflows decreased to approximately 4 ML/day before peaking for a very short period to 5.5-7 ML/day in July 2022 (16th-17th July). The peak in groundwater inflow in mid July 2022 is probably pumping accounting for an earlier shortfall. During the latter part of LW W4, mine inflows decreased to approximately 2.5 ML/day, which is the lowest rate observed since April 2020. A spike is mine inflows to approximately 4 ML/day was observed at the completion of LW W4.

The latest observations 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, was a potential risk related to the faults mapped in the Nepean Fault Complex to the west of LW W4.

Recent groundwater inflow observations remain below the March/April 2021 peak marginally over 6 ML/d during the extraction of LW W2.

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.

The average inflows to the mine for the last four water years have been: 3.4 ML/d for the current water year (July 2022 to date), 4.3 ML/d for last water year (July 2021 to June 2022), 4.5 ML/d for the July 2020 to June 2021 water year, and 3.3 ML/d for the 2019-2020 water year.

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).

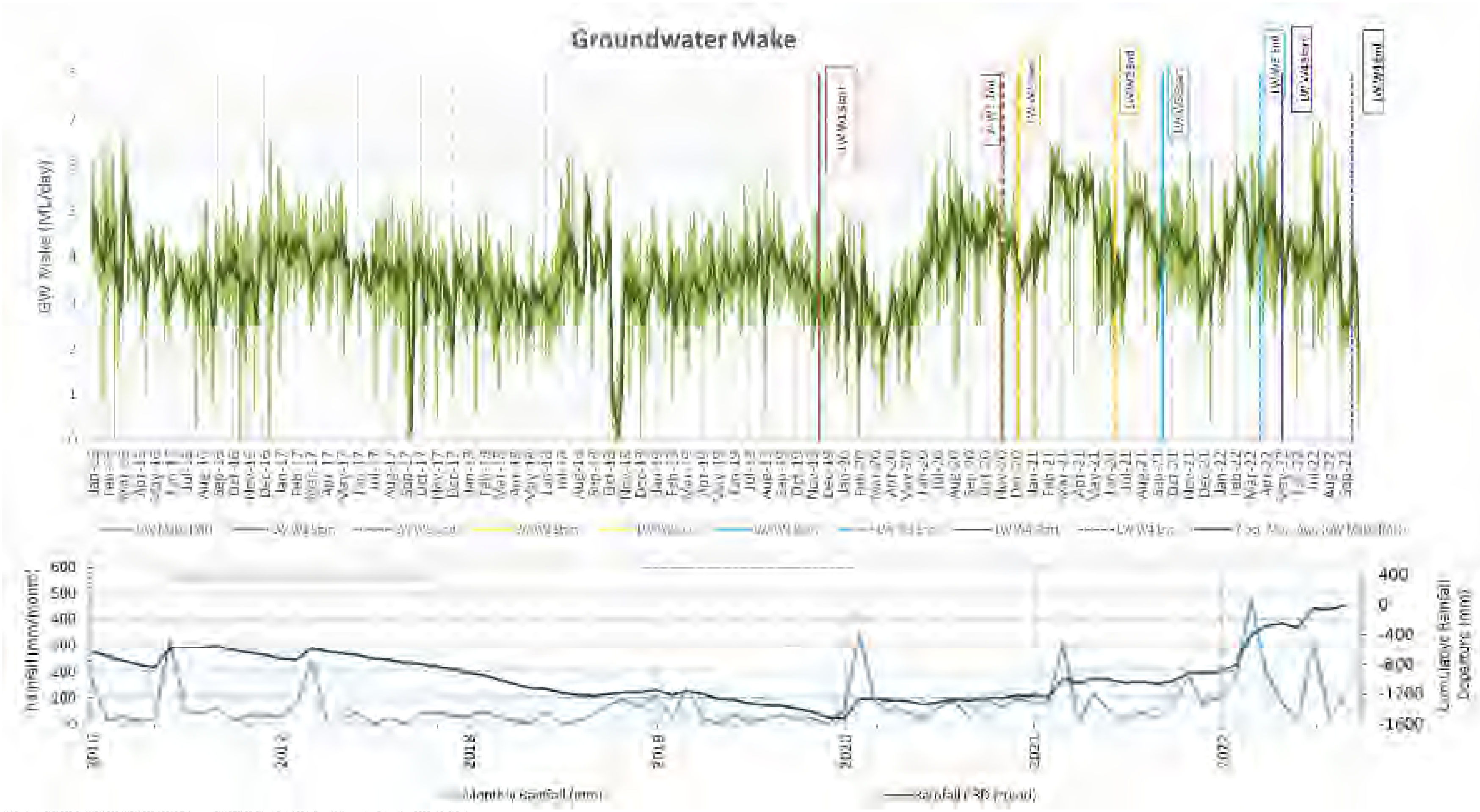



**Figure 17 Historical Record of Inflows at Tahmoor North**

# 8 Conclusions

The key conclusions from the six-monthly review are summarised as follows:

- 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). Water level reduction in the range of 0.5 m to 3 m 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 is 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 (SLR, 2022). 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 (ATC, 2022), 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 (SLR, 2022). 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. We note that this 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.
- 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).
- 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, to identify whether any delayed post mining effects occur.
- 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).

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

# 9 Recommendations

**TARP Exceedance**

Based on the trigger exceedances assessment in **Section 4.4** and **Section 5.2** and based on the TARP presented in **Appendix B**, the following ongoing actions are recommended:

- At P16C and with a Level 3 trigger for groundwater level, to continue monitoring and review as per monitoring program.
- At P16B, TNC036 (HBSS-97m), TNC036 (BGSS-169m) with a Level 2 trigger for groundwater level, to continue monitoring and review as per monitoring program.
- 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 quarterly 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 in relation to higher strontium and zinc concentrations respectively. Groundwater purging at P12B was completed in November 2022.
- Convene Tahmoor Coal Environmental Response Group to review response.

The following actions are recommended for the next 6-monthly review:

- Ongoing monthly collection and monthly 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 (Tahmoor Coal, 2021).
- 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 (SLR, 2021). 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.
- At P16C, it is recommended to record the data logger installation depth and use this record in the calculations to convert pressure into a groundwater head (mAHD).
- Confirm the installation depth of the pump at GW104090 and conduct work on the suspected blockage of bore GW072402.

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SCT, 2020c. *Tahmoor Western Domain, Height of Fracturing Boreholes – Pre and Post Mining Borehole Locations* for Tahmoor Coal, doc TAH5156, March 2020.

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# APPENDIX A

Hydrographs for P12-P17 and P40-P41 and Private Bores

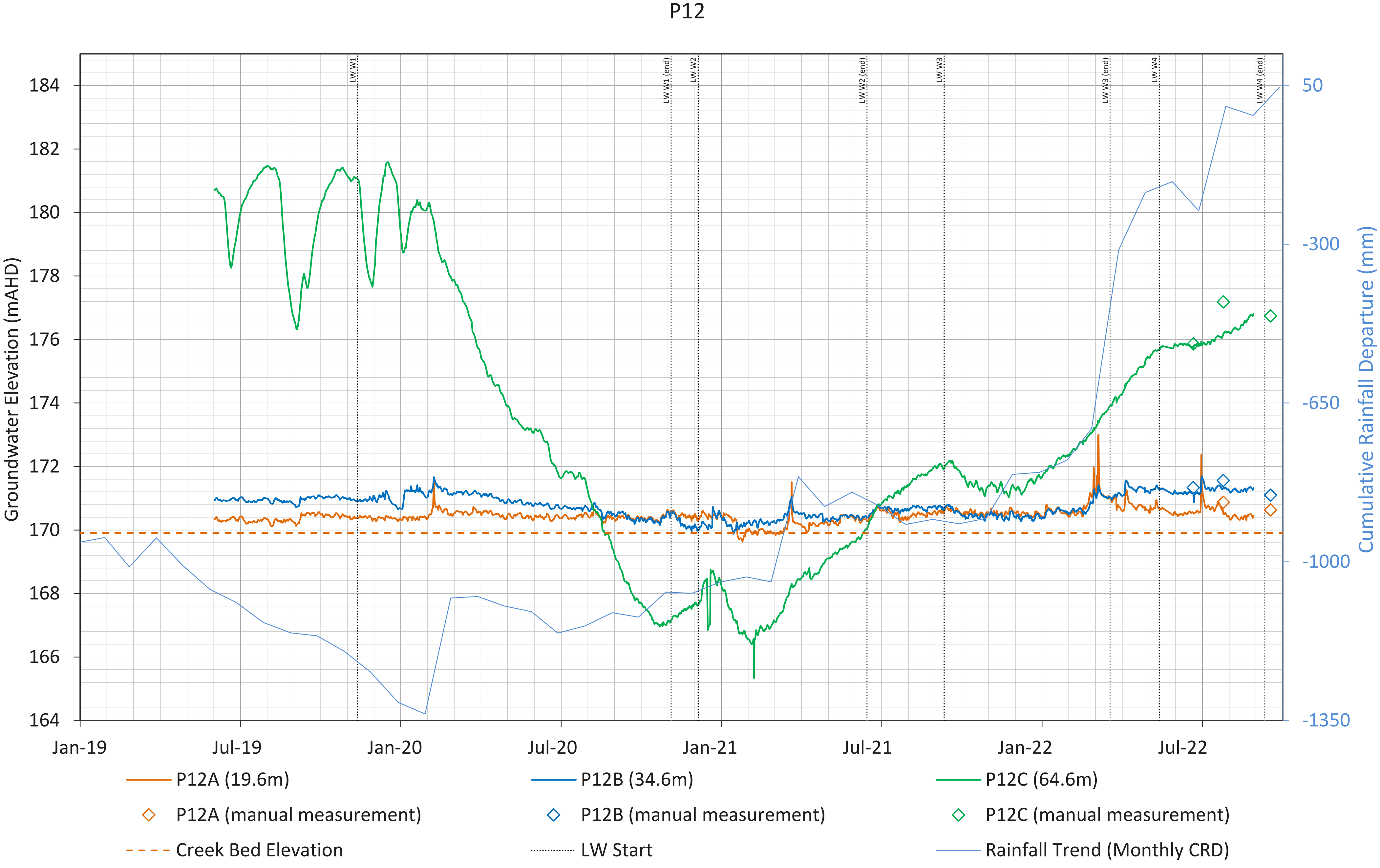

P12
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
184
182
180
178
176
174
172
170
168
166
164
50
-300
-650
-1000
-1350
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
P12A (19.6m)
P12B (34.6m)
P12C (64.6m)
P12A (manual measurement)
P12B (manual measurement)
P12C (manual measurement)
Creek Bed Elevation
LW Start
Rainfall Trend (Monthly CRD)

**Figure A-1**

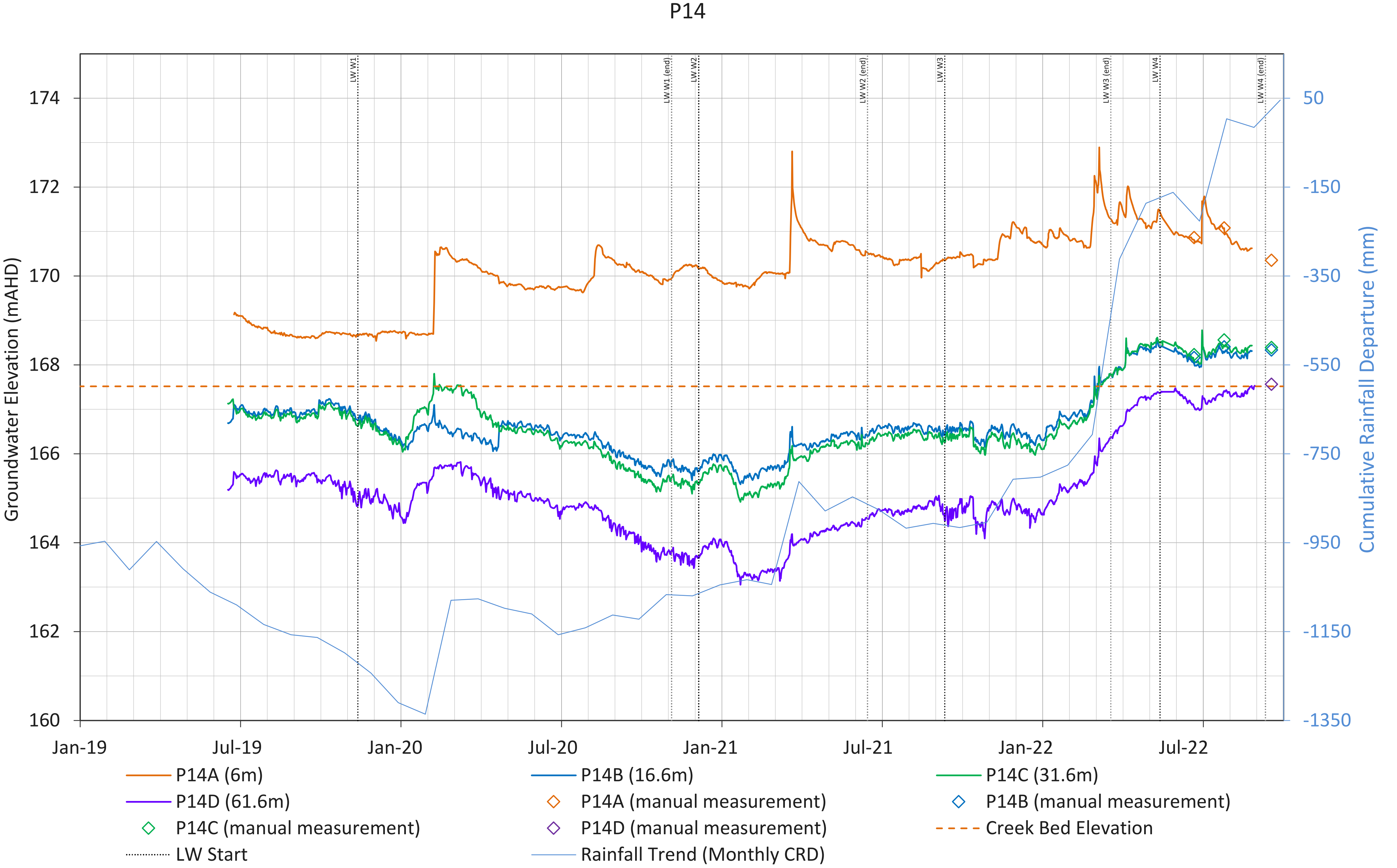

P14
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
174
172
170
168
166
164
162
160
50
-150
-350
-550
-750
-950
-1150
-1350
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
P14A (6m)
P14B (16.6m)
P14C (31.6m)
P14D (61.6m)
P14A (manual measurement)
P14B (manual measurement)
P14C (manual measurement)
P14D (manual measurement)
Creek Bed Elevation
LW Start
Rainfall Trend (Monthly CRD)

Figure A-2

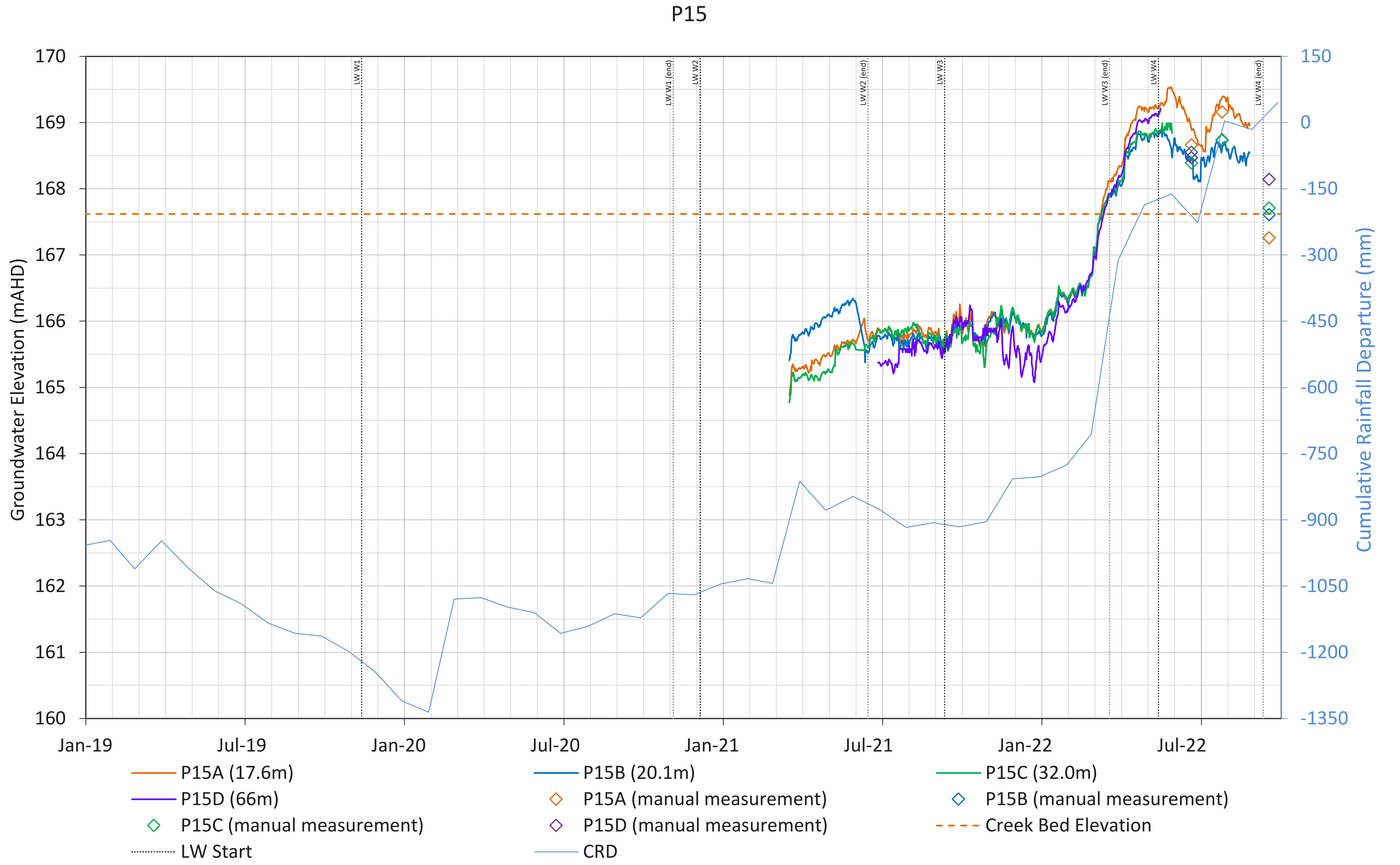

P15
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
170
169
168
167
166
165
164
163
162
161
160
150
0
-150
-300
-450
-600
-750
-900
-1050
-1200
-1350
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
P15A (17.6m)
P15B (20.1m)
P15C (32.0m)
P15D (66m)
P15A (manual measurement)
P15B (manual measurement)
P15C (manual measurement)
P15D (manual measurement)
Creek Bed Elevation
LW Start
CRD

Figure A-3

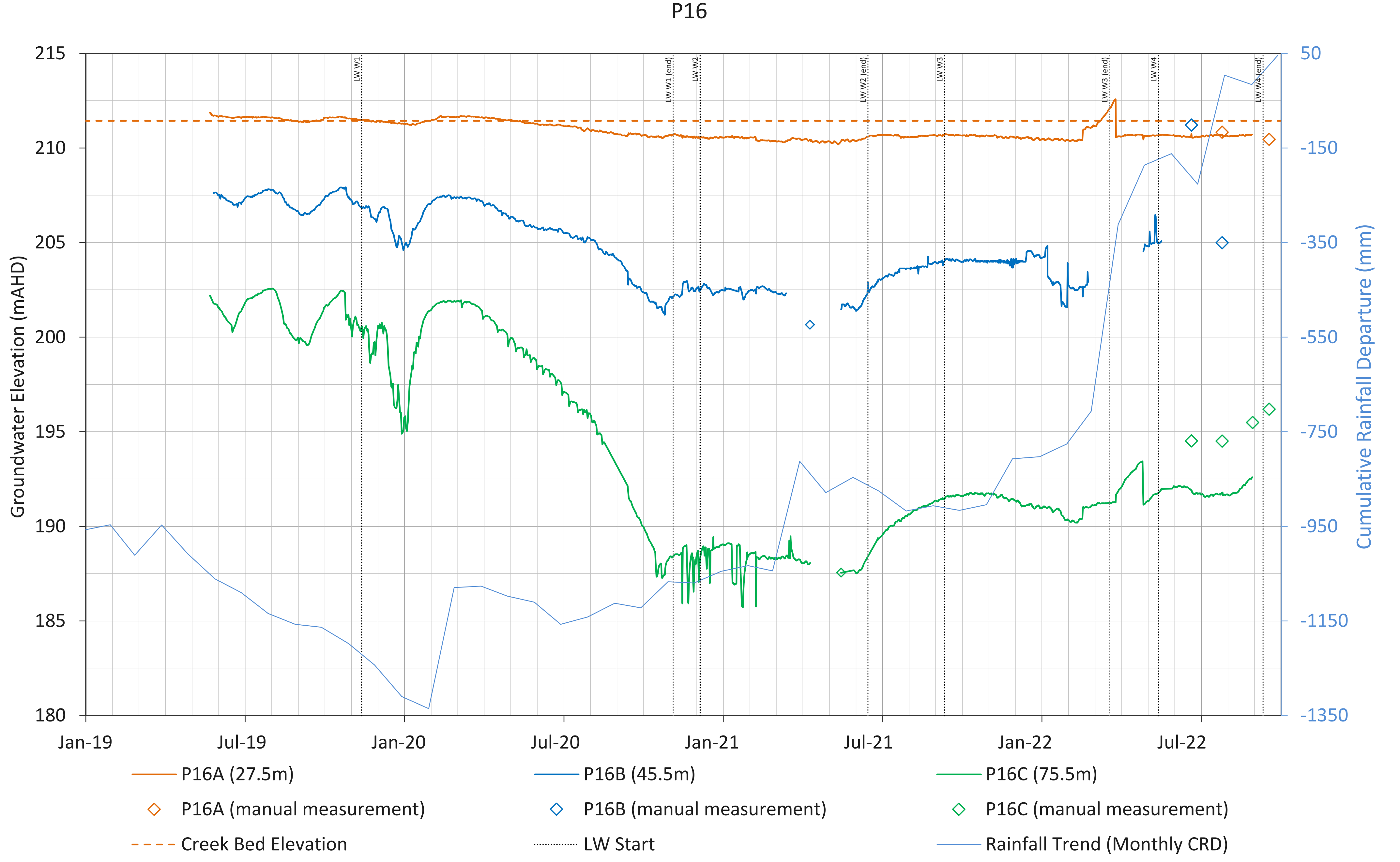

P16
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
215
210
205
200
195
190
185
180
50
-150
-350
-550
-750
-950
-1150
-1350
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
P16A (27.5m)
P16B (45.5m)
P16C (75.5m)
P16A (manual measurement)
P16B (manual measurement)
P16C (manual measurement)
Creek Bed Elevation
LW Start
Rainfall Trend (Monthly CRD)

**Figure A-4**

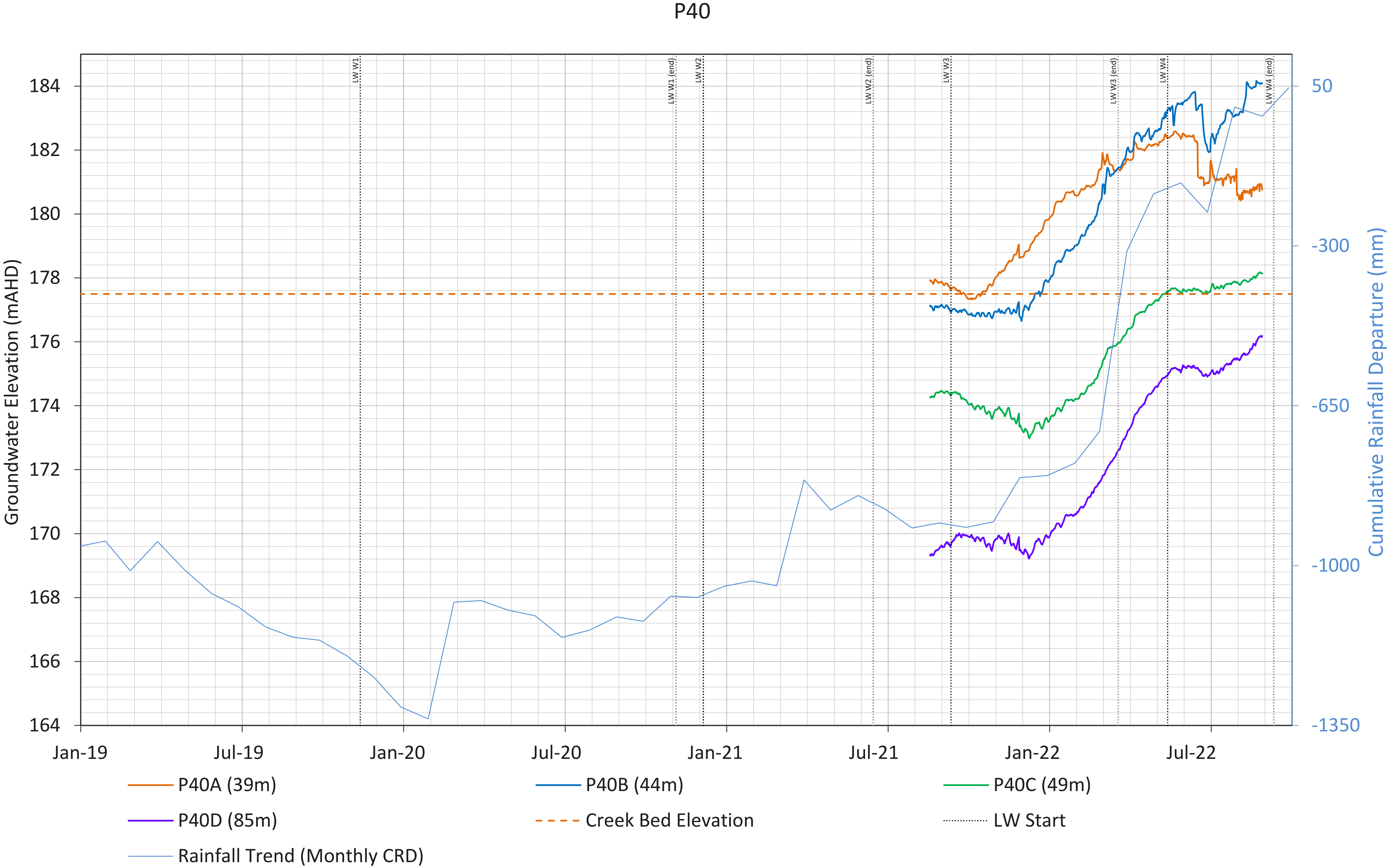

P40
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
184
182
180
178
176
174
172
170
168
166
164
50
-300
-650
-1000
-1350
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
P40A (39m)
P40B (44m)
P40C (49m)
P40D (85m)
Creek Bed Elevation
LW Start
Rainfall Trend (Monthly CRD)

Figure A-5

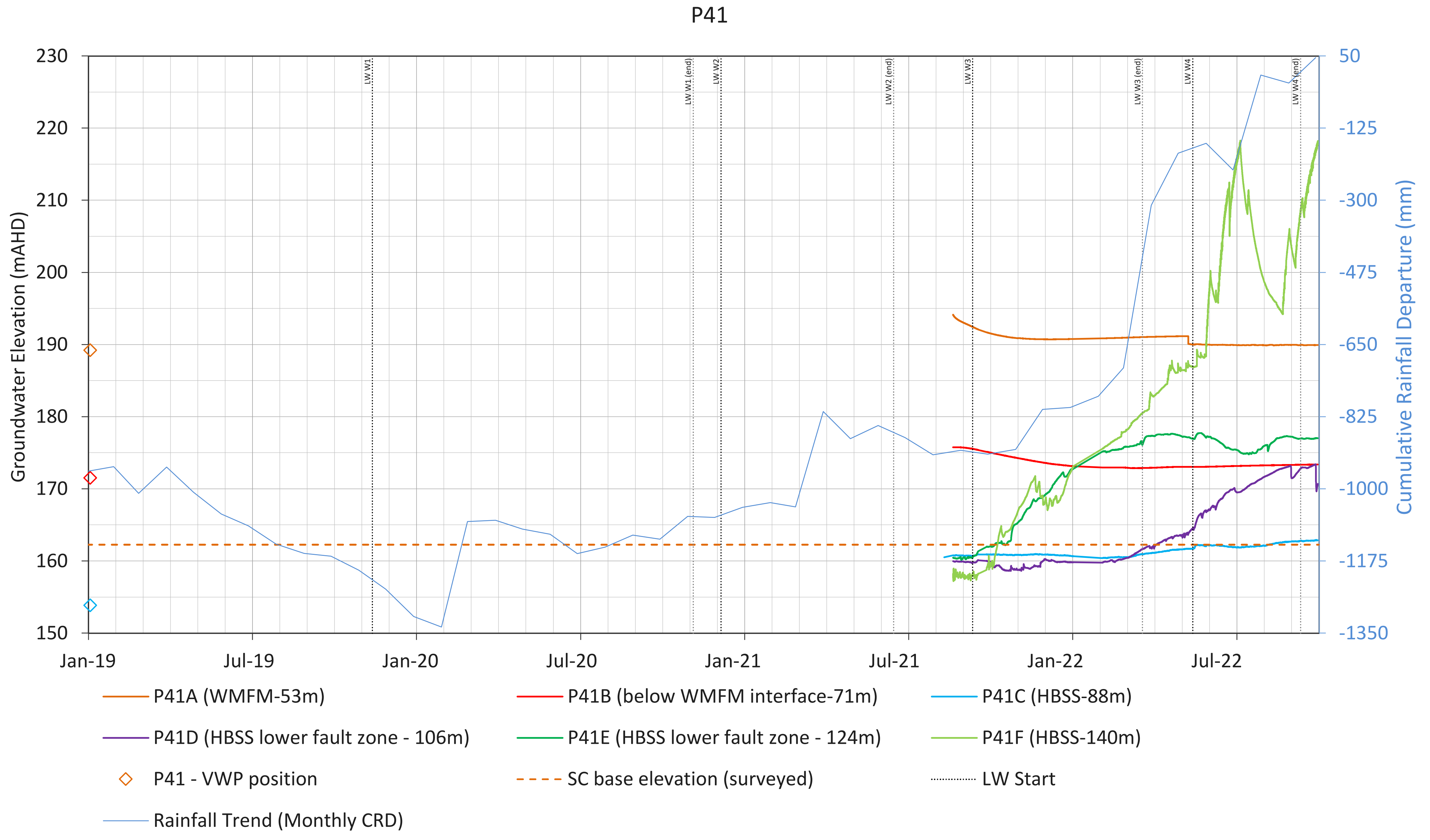
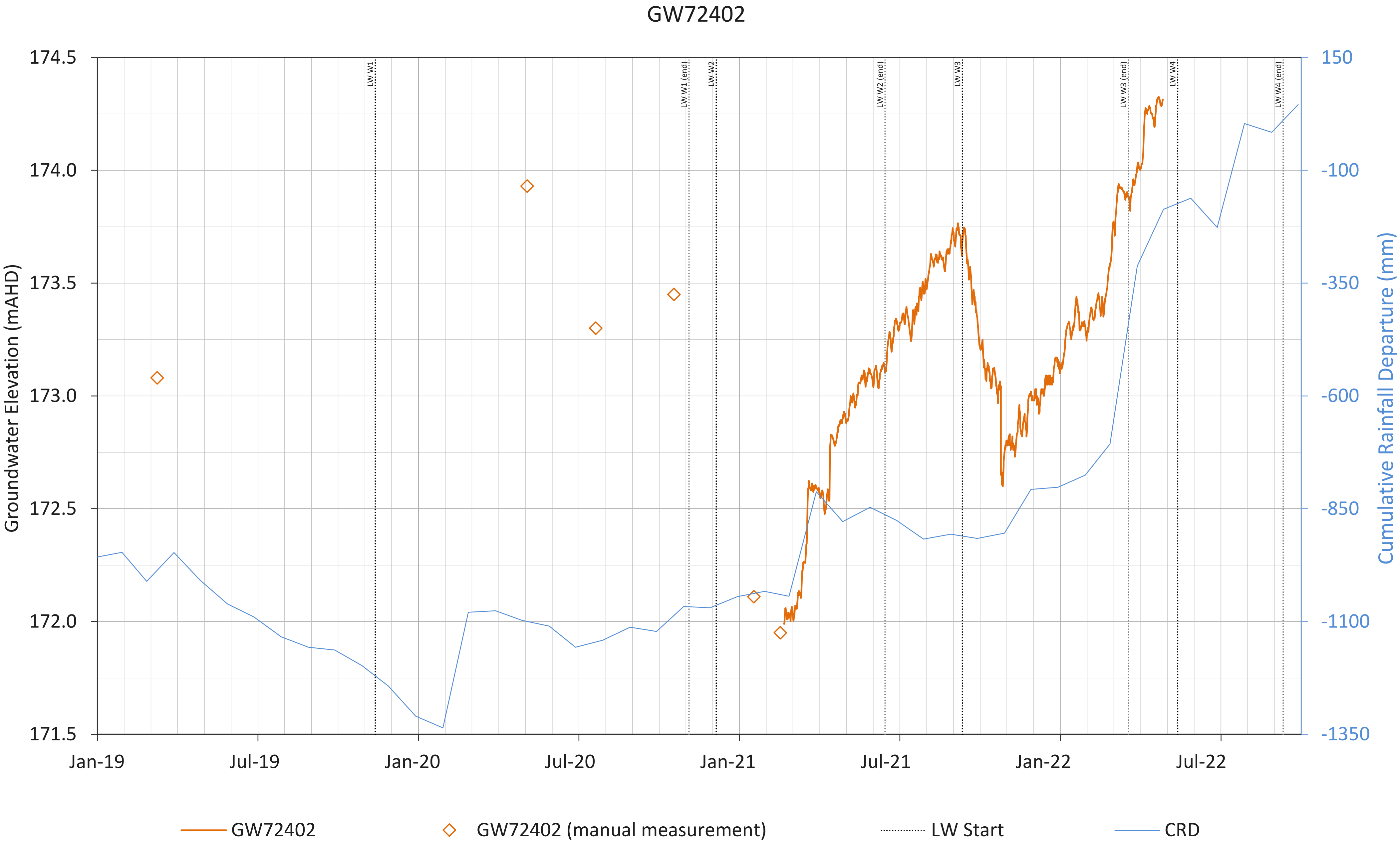

P41
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
230
220
210
200
190
180
170
160
150
50
-125
-300
-475
-650
-825
-1000
-1175
-1350
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
P41A (WMFM-53m)
P41B (below WMFM interface-71m)
P41C (HBSS-88m)
P41D (HBSS lower fault zone - 106m)
P41E (HBSS lower fault zone - 124m)
P41F (HBSS-140m)
P41 - VWP position
SC base elevation (surveyed)
LW Start
Rainfall Trend (Monthly CRD)

Figure A-6



GW72402
174.5
174.0
173.5
173.0
172.5
172.0
171.5
Groundwater Elevation (mAHD)
150
-100
-350
-600
-850
-1100
-1350
Cumulative Rainfall Departure (mm)
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
GW72402
GW72402 (manual measurement)
LW Start
CRD


Figure A-7

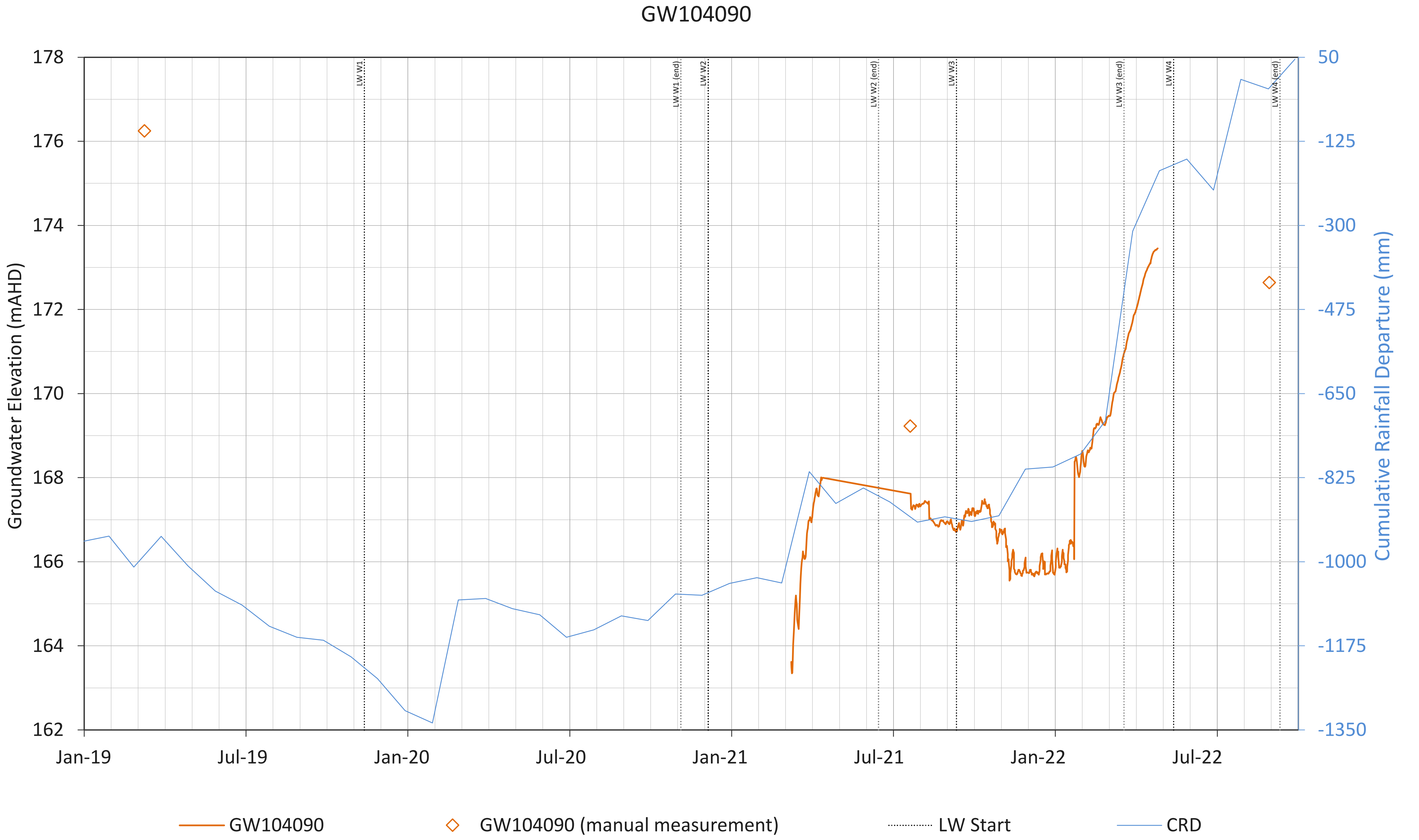

GW104090
178
176
174
172
170
168
166
164
162
50
-125
-300
-475
-650
-825
-1000
-1175
-1350
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
GW104090
GW104090 (manual measurement)
LW Start
CRD

Figure A-8

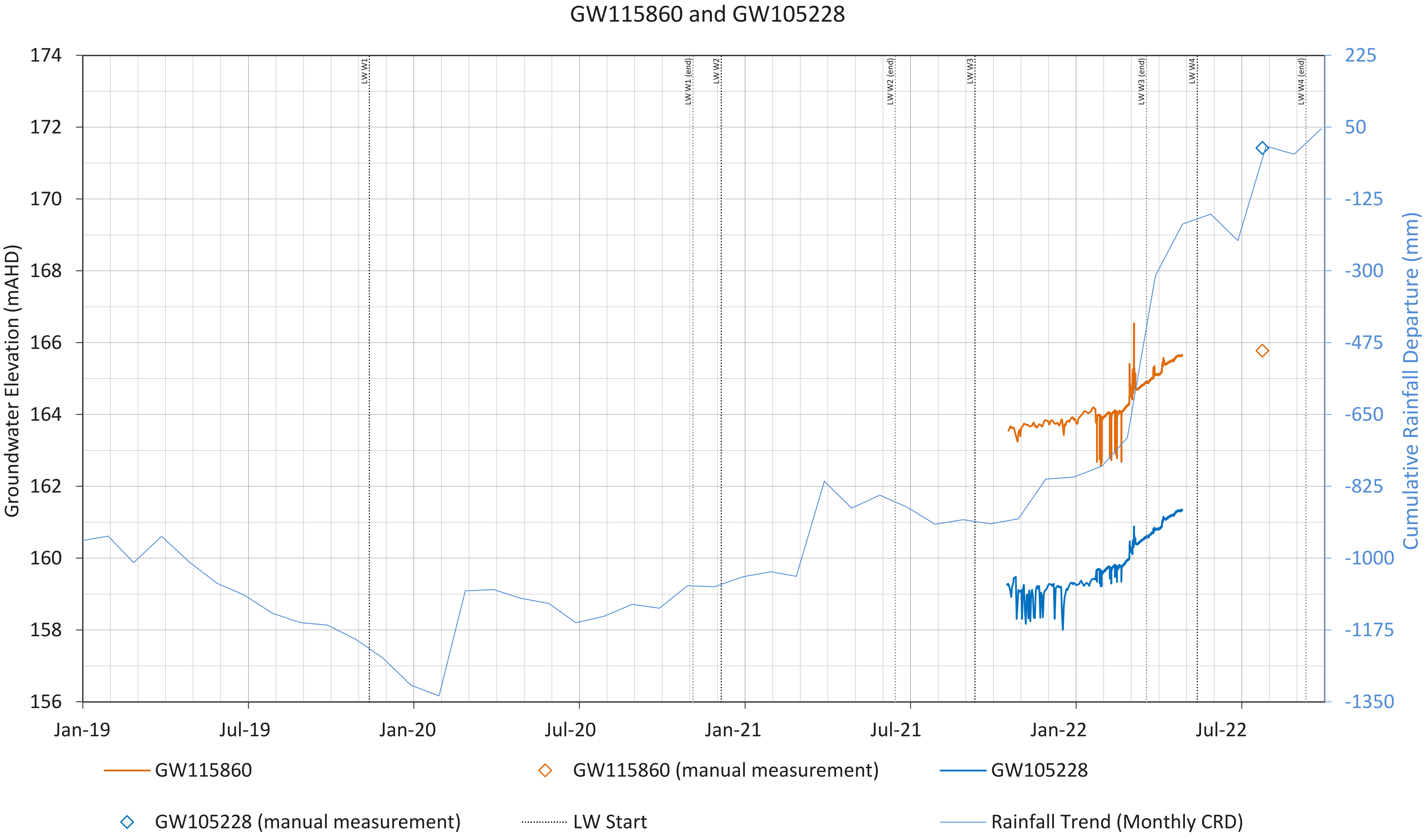

GW115860 and GW105228
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
174
172
170
168
166
164
162
160
158
156
225
50
-125
-300
-475
-650
-825
-1000
-1175
-1350
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
GW115860
GW115860 (manual measurement)
GW105228
GW105228 (manual measurement)
LW Start
Rainfall Trend (Monthly CRD)

**Figure A-9**

# APPENDIX B

## Trigger Action Response Plans

- Approved Trigger Criteria and Actions from LW W3-W4 (Tahmoor North - Western Domain, LW W3-W4 Water Management Plan TAH-HSEC-326 (September 2021, Ver4))

<table>
<tr><th rowspan="2">Feature</th><th rowspan="2">Methodology and relevant monitoring</th><th colspan="3">Management</th></tr>
<tr><th>Trigger</th><th>Action</th><th>Response</th></tr>
<tr><td rowspan="8">Groundwater Levels at monitoring bores and private groundwater bores.</td><td rowspan="8">GROUNDWATER LEVEL – Monitoring bores<br>Locations (refer to Figure 3-5)<br><u>Impact sites</u> – P12, P13, P14, P15, P16, and any additional bore(s) (to be drilled)<br><u>Control sites</u> – P17, and possibly P11<br>Frequency<br><u>Pre-mining</u> - Minimum continuous 24-hourly readings with monthly logger download and dip meter. Baseline data available since May 2019.<br><u>During mining</u> - Minimum continuous 24-hourly readings with monthly logger download and dip meter.<br><u>Post mining</u> - Minimum continuous 24-hourly readings with monthly logger download and dip meter for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details).<br><br>GROUNDWATER LEVEL – Private groundwater bores<br>Locations (refer to Figure 3-5)<br><u>Control sites</u> - GW72402, GW105228, GW105467, GW115860 and GW105546 and any other private bores where access is negotiated with landholder.<br>Frequency<br><u>Pre-mining</u> - Standing Water Level (where available) and yield data. Pre-mining testing completed in bore census (GeoTerra, 2019).<br><u>During mining</u> - Manual monitoring (flow rate and, where available, standing water level) on a 3-monthly basis.<br><u>Post mining</u> - Manual monitoring (flow rate and, where available, standing water level) on a 3-monthly basis for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details).</td><td colspan="3">Level 1</td></tr>
<tr><td>• Groundwater level remains consistent within baseline variability and/or pre-mining trends, with reductions in groundwater level less than two metres and does not trigger Level 2 to Level 4 Significance Levels (refer to Table 6-2).</td><td>• Continue monitoring program.<br>• Ongoing review of water level data.</td><td>• No response required.</td></tr>
<tr><td colspan="3">Level 2</td></tr>
<tr><td>• Greater than 2 m water level reduction following the commencement of extraction at LW W1 (and LW W2, W3, W4) (refer to Table 6-2 for TARP Significance Level 2).<br>AND<br>• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.</td><td>• Continue monitoring program.<br>• Ongoing review of water level data.<br>• Review relevant surface water level, groundwater level and streamflow data to assess comparative trends.<br>• Convene Tahmoor Coal Environmental Response Group to review response.</td><td>• As defined by the Environmental Response Group.</td></tr>
<tr><td colspan="3">Level 3</td></tr>
<tr><td>• Water level declines below the water level of TARP Significance Level 3 (refer Table 6-2, 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).<br>AND<br>• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.</td><td>• Continue monitoring program.<br>• Ongoing review of water level data and consideration of mining and external stresses (in groundwater monthly report).<br>• Review relevant surface water level, groundwater level and streamflow data to assess comparative trends.<br>• Compare against base case and deterministic model scenarios.<br>• Convene Tahmoor Coal Environmental Response Group to review response.</td><td>• As defined by the Environmental Response Group.</td></tr>
<tr><td colspan="3">Level 4</td></tr>
<tr><td>• Water level reduction greater than the maximum modelled drawdown (refer to Table 6-1 for TARP Significance Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4).<br>AND<br>• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.</td><td>• Continue monitoring and review as per monitoring program.<br>• Ongoing review of water level data and consideration of mining and external stresses (in groundwater monthly report).<br>• Review relevant surface water level, groundwater level and streamflow data to assess comparative trends.<br>• Convene Tahmoor Coal Environmental Response Group to review response.<br>• Compare against base case and deterministic model scenarios.</td><td>• Report to DPIE and relevant government agencies within 7 days of investigation completion (according to Table 6-1 of the Extraction Plan Main Document).<br>• For monitoring bores: If it is concluded that there has been a mining-related impact, then implement an investigation including review and assessment of streamflow records for downstream monitoring sites in comparison with suitable reference sites.<br>• For private groundwater bores: If it is concluded that there has been a mining-related impact, then implement actions in accordance with the make good provisions (Section 6.2.4 of the Water Management Plan) in consultation with DPIE and the affected landholder.</td></tr>
</table>

| Feature | Methodology and relevant monitoring | Management | | |
|---|---|---|---|---|
| | | Trigger | Action | Response |
| Shallow Groundwater Pressures at VWPs TNC036, TNC040, WD01 and WD02 (once installed). | GROUNDWATER PRESSURE<br>**Locations**<br>Impact sites – TNC36, WD01 and WD02 (once installed) (refer to Section 5.2.2).<br>Control sites - Groundwater bores/VWPs TNC40 (refer to Figure 3-5).<br>**Frequency**<br>Pre-mining - Minimum continuous 24-hourly readings with monthly logger download.<br>During mining - Minimum continuous 24-hourly readings with monthly logger download.<br>Post mining - Minimum continuous 24-hourly readings with monthly logger download for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details). | Level 1 | | |
| | | • No observable mining induced change at VWP intakes located at or above (i.e. shallower than) 200 m depth. | • Continue monitoring program.<br>• Ongoing review of water level data. | • No response required. |
| | | Level 2 | | |
| | | • 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) (refer to Table 6-2 for TARP Significance Level 2).<br>AND<br>• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors. | • Continue monitoring program.<br>• Ongoing review of water level data.<br>• Convene with Tahmoor Coal Environmental Response Group to review response. | • As defined by the Environmental Response Group. |
| | | Level 3 | | |
| | | • Water level declines below the water level of TARP Significance Level 3 (refer Table 6-2, 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).<br>AND<br>• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors. | • Continue monitoring program<br>• Ongoing review of water level data and consideration of mining and external stresses (in groundwater monthly report).<br>• Compare against base case and deterministic model scenarios.<br>• Convene Tahmoor Coal Environmental Response Group to review response. | • As defined by the Environmental Response Group. |
| | | Level 4 | | |
| | | • Water level reduction greater than the maximum modelled drawdown (refer to Table 6-2 for TARP Significance Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4).<br>AND<br>• The reduction in water level is determined not to be controlled by climatic or anthropogenic factors. | • Continue monitoring and review as per monitoring program.<br>• Ongoing review of water level data and consideration of mining and external stresses (in groundwater monthly report).<br>• Convene Tahmoor Coal Environmental Response Group to review response.<br>• Compare against base case and deterministic model scenarios. | • Report to DPIE and relevant government agencies within 7 days of investigation completion (according to Table 6-1 of the Extraction Plan Main Document).<br>• If it is concluded that there has been a mining-related impact, implement an investigation report. |

| Feature | Methodology and relevant monitoring | Management | | |
|---|---|---|---|---|
| | | Trigger | Action | Response |
| Deep Groundwater Pressures at VWPs TNC036. | GROUNDWATER PRESSURE<br>**Locations**<br>Impact site – TNC36 (refer to Figure 3-5).<br>Control site - Groundwater bores/VWPs TNC40 (refer to Figure 3-5).<br>**Frequency**<br>Pre-mining - Minimum continuous 24-hourly readings with monthly logger download.<br>During mining - Minimum continuous 24-hourly readings with monthly logger download.<br>Post mining - Minimum continuous 24-hourly readings for 12 months after LW W4 completed. Monthly logger downloaded for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details). | Level 1 | | |
| | | • Observed data does not exceed predicted (modelled) impacts at VWP intakes located below (i.e. deeper than) 200 m depth (excluding those monitoring the Bulli Coal Seam). | • Continue monitoring program.<br>• Ongoing review of water level data. | • No response required. |
| | | Level 2 | | |
| | | • 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. | • Continue monitoring program.<br>• Ongoing review of water level data.<br>• Convene Tahmoor Coal Environmental Response Group to review response. | • As defined by the Environmental Response Group. |
| | | Level 3 | | |
| | | • Calculated or observed drawdown (based on 2009-2015 baseline data) for VWP intakes below 200 m depth (excluding those within the Bulli Coal Seam) exceeds predicted (modelled) drawdown by 30 m for a period of 6 months or more. | • Continue monitoring program.<br>• Ongoing review of water level data.<br>• Convene Tahmoor Coal Environmental Response Group to review response. | • As defined by the Environmental Response Group.<br>• Consider increasing download frequency at groundwater bores where Level 3 has been reached to a fortnightly basis. Consider increasing review frequency to fortnightly. |
| | | Level 4 | | |
| | | • Calculated or observed drawdown (based on 2009-2015 baseline data) for VWP intakes below 200 m depth (excluding those within the Bulli Coal Seam) exceeds predicted (modelled) drawdown by 30 m for a period of 12 months or more. | • Continue monitoring and review as per monitoring program.<br>• Convene Tahmoor Coal Environmental Response Group to undertake an investigation to assess whether change in behaviour is related to LW W1-W2 mining effects. | • Report to DPIE and relevant government agencies within 7 days of investigation completion (according to Table 6-1 of the Extraction Plan Main Document).<br>• If it is concluded that there has been a mining-related impact, implement an investigation report. |

Table B2 Trigger Action Response Plan – Groundwater Quality

| Feature | Methodology and relevant monitoring | Management | | |
|---|---|---|---|---|
| | | Trigger | Action | Response |
| Groundwater Quality at monitoring bores and private groundwater bores. | GROUNDWATER QUALITY – Monitoring bores<br>**Locations** (refer to Figure 3-5)<br>Impact sites – P12, P13, P14, P15, P16, and any additional bore(s) (to be drilled)<br>Control sites – P17<br>**Frequency**<br>Pre-mining - Field water quality and laboratory analysis monthly (refer to Section 5.2.1 for parameters).<br>During mining - Field water quality and laboratory analysis monthly (refer to Section 5.2.1 for parameters).<br>Post mining - Field water quality and laboratory analysis monthly (refer to Section 5.2.1 for parameters) for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details).<br><br>GROUNDWATER QUALITY – Private groundwater bores<br>**Locations** (refer to Figure 3-5)<br>Control sites - GW72402, GW105228, GW105467, GW115860 and GW105546 and any other private bores where access is negotiated with landholder.<br>**Frequency**<br>Pre-mining - Field water quality (EC, pH) and iron staining. Pre-mining testing completed during bore census (GeoTerra, 2019).<br>During mining - Field water quality and laboratory analysis on a 3-monthly basis (refer to Section 5.2.1 for parameters).<br>Post mining - Field water quality and laboratory analysis on a 3-monthly basis (refer to Section 5.2.1 for parameters) for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details). | Level 1 | | |
| | | • No observable change in salinity, pH or metals outside of the baseline variability. | • Continue monitoring program.<br>• Ongoing review of water quality data. | • No response required. |
| | | Level 2 | | |
| | | • 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.<br>AND/OR<br>• A similar trend or response has been noted at other monitored bores or private groundwater bores. | • Continue monitoring program.<br>• Ongoing review of water quality data.<br>• Convene Tahmoor Coal Environmental Response Group to review response. | • As defined by the Environmental Response Group. |
| | | Level 3 | | |
| | | • Short term increase (< 3 months) in salinity and/or metals or change in pH outside of baseline variability*. The effect persists after a significant rainfall recharge event.<br>AND/OR<br>• The change in water quality is determined not to be controlled by climatic or anthropogenic factors. | • Continue monitoring program.<br>• Ongoing review of water quality data and consideration of mining and external stresses (in groundwater monthly report).<br>• Convene Tahmoor Coal Environmental Response Group to review response. | • As defined by the Environmental Response Group. |
| | | Level 4 | | |
| | | • 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.<br>AND<br>• The reduction in water quality is determined not to be controlled by climatic or anthropogenic factors. | • Continue monitoring and review as per monitoring program.<br>• Continue review of water quality data and consideration of mining and external stresses (in groundwater monthly report).<br>• Convene Tahmoor Coal Environmental Response Group to review response. | • Report to DPIE and relevant government agencies within 7 days of investigation completion (according to Table 6-1 of the Extraction Plan Main Document).<br>• For monitoring bores: If it is concluded that there has been a mining-related impact, then implement an investigation report.<br>• For private groundwater bores: If it is concluded that there has been a mining-related impact, then implement actions in accordance with the make good provisions (Section 6.2.4 of the Water Management Plan) in consultation with the affected landholder. |

Footnote:
* The baseline variability was estimated using available data and refers to the proposed trigger levels (refer to Section 6.2.2 and Table 6.2 of the Groundwater Technical Report.

# APPENDIX C

Summary of Trigger Levels for Groundwater Level TARPs (revised from Groundwater Technical Report – Table 6-1 SLR, 2021)

| Bore | Groundwater Trigger Level (mAHD) | | |
|---|---|---|---|
| | TARP Level 2 | TARP Level 3 | TARP Level 4 |
| Shallow OSP | | | |
| P12A | 168.6 | - | - |
| P12B | 169.1 | - | - |
| P12C | 179.5 | 175.0 | 170.4 |
| P13A | 165.7 | 163.7 | 161.6 |
| P13B | 165.0 | 163.0 | 161.1 |
| P13C | 168.5 | 163.1 | 157.7 |
| P14A | 167.2 | 165.0 | 162.9 |
| P14B | 165.2 | 159.8 | 154.3 |
| P14C | 165.2 | 159.9 | 154.6 |
| P14D | 163.6 | 158.3 | 152.9 |
| P15A | 163.4 | 156.4 | 149.4 |
| P15B | 163.9 | 156.9 | 149.9 |
| P15C | 163.3 | 156.3 | 149.4 |
| P15D* | 163.7 | 156.7 | 149.7 |
| P16A | 209.9 | 209.3 | 208.8 |
| P16B | 205.9 | 202.3 | 198.7 |
| P16C | 200.6 | 193.9 | 187.2 |
| P17 | 169.7 | 170.6 | 171.6 |
| Shallow VWPs (<200m) | | | |
| TNC036 - HBSS-65 | 204.5* | - | - |
| TNC036 - HBSS-97 | 191.3* | 185.7* | 180* |
| TNC036 - BGSS-169 | 192.5* | 135.7* | 79.0* |
| TNC040 - WNFM-27 | 203.3 | 198.2 | 193.1 |
| TNC040 - HBSS-65 | 182.1 | 175.8 | 169.5 |
| TNC040 - HBSS-111 | # | # | # |
| TNC043 - HBSS-65 | 153.7 | 152.5 | 151.3 |
| TNC043 - HBSS-111.5 | 150.6 | 148.5 | 146.5 |
| WD01- HBSS - 70 | 206.2 | 202.4 | 198.6 |
| WD01- HBSS - 90 | 191.4 | 186.7 | 182.0 |
| WD01- HBSS - 190 | F | F | F |
| Deep VWPs (>200m) | | | |
| TNC036 - BGSS-214 | Refer to table A1 | Refer to table A1 | Refer to table A1 |
| TNC036 - BGSS-298.5 | ^ | ^ | ^ |
| TNC036 - BGSS-412.5 | Refer to table A1 | Refer to table A1 | Refer to table A1 |
| TNC036 - BUSM-463.5 | ^ | ^ | ^ |
| TNC040 - HBSS-225 | # | # | # |
| TNC040 - BHCS-252 | # | # | # |
| TNC040 - BGSS-352 | # | # | # |

| Bore | Groundwater Trigger Level (mAHD) | | |
|---|---|---|---|
| | TARP Level 2 | TARP Level 3 | TARP Level 4 |
| TNC040 - SCSS-482 | # | # | # |
| TNC040 - BUCO-501.9 | # | # | # |
| TNC043 - HBSS-213 | # | # | # |
| TNC043 - BGSS-240 | # | # | # |
| TNC043 - BGSS-332.6 | # | # | # |
| TNC043 - BGSS-405.2 | # | # | # |
| TNC043 - BUCO-476.3 | # | # | # |
| WD01- HBSS - 210 | Refer to table A1 | Refer to table A1 | Refer to table A1 |
| WD01- HBSS - 230 | F | F | F |
| WD01- BGSS - 300 | F | F | F |
| WD01- BGSS - 330 | F | F | F |
| WD01- BGSS - 350 | F | F | F |
| Notes: "#" no data after LW W1. | | | |
| *Trigger levels first developed in September 2021 review, based on maximum water level prior to start of LW W3 as was commissioned after commencement of LW W1. | | | |
| "^" groundwater data not reliable but will still be reported on. | | | |
| "F" Sensors failed during mining of LW W1 and LW W2. | | | |
| "-" Some VWP sensor or piezometer are assigned Layer 1. No drawdown is simulated in Layer 1 at those sites hence no TARP Level 3 and 4 can be derived here. | | | |

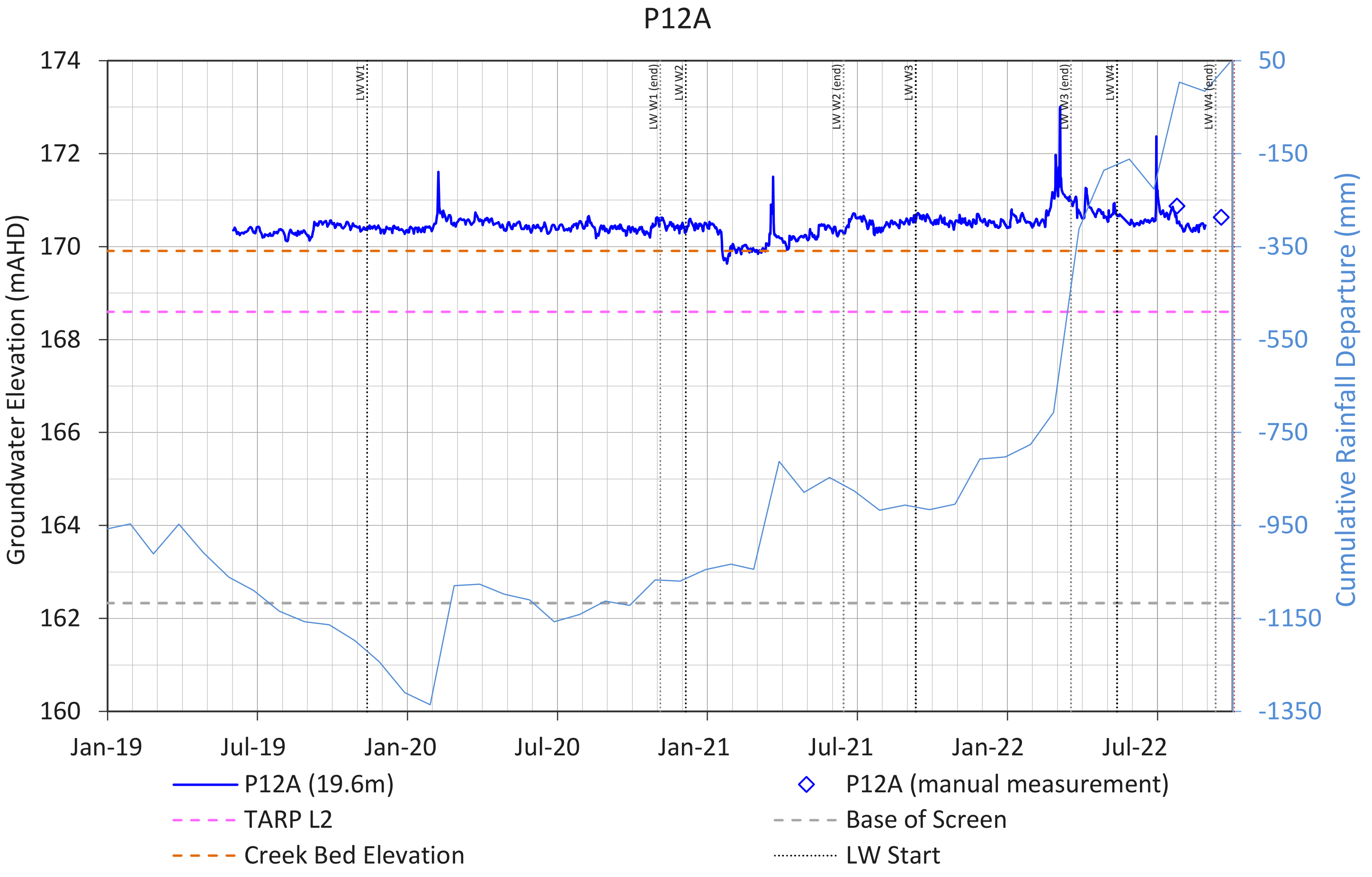



**Figure C-1**

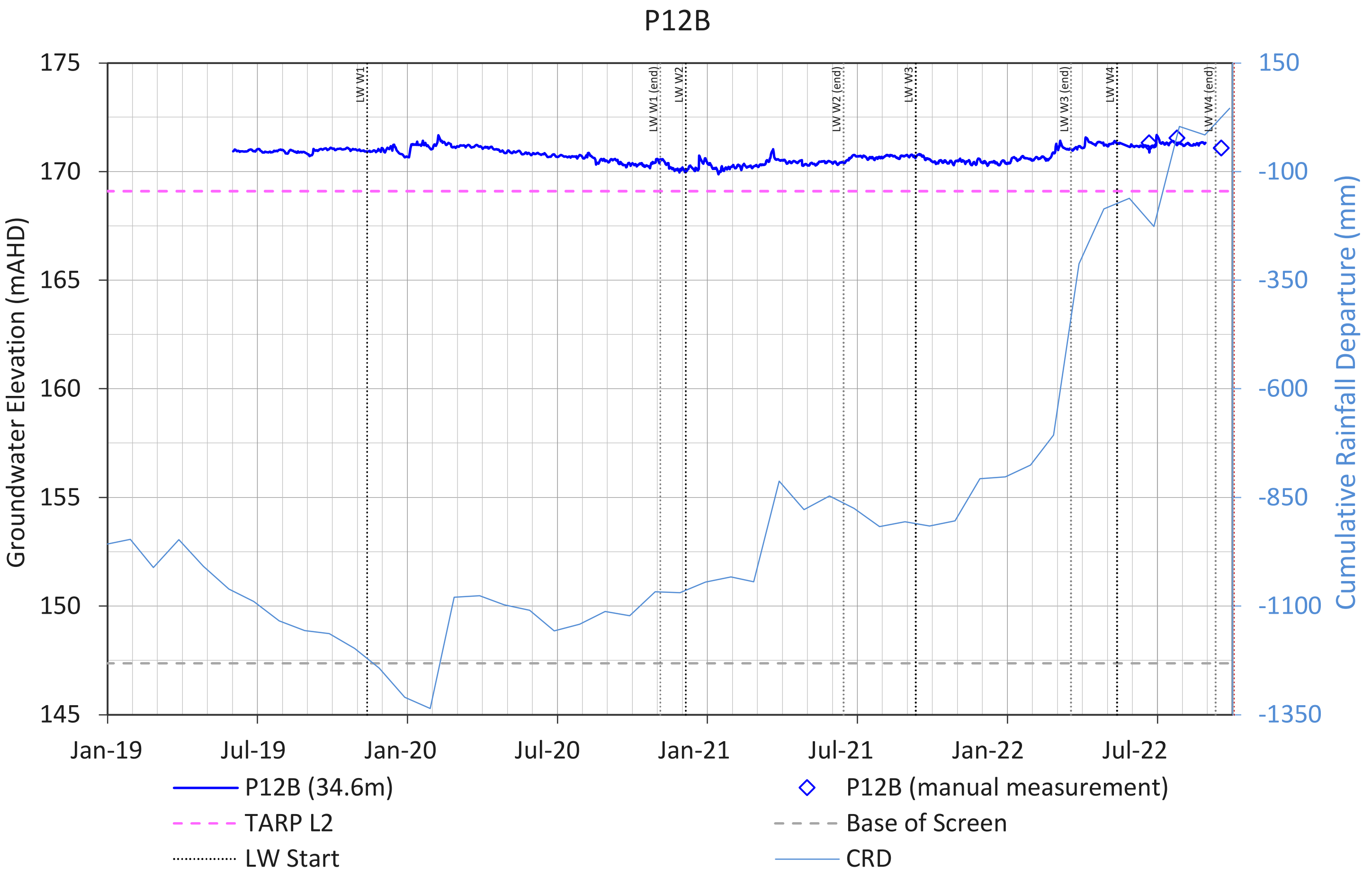



**Figure C-2**

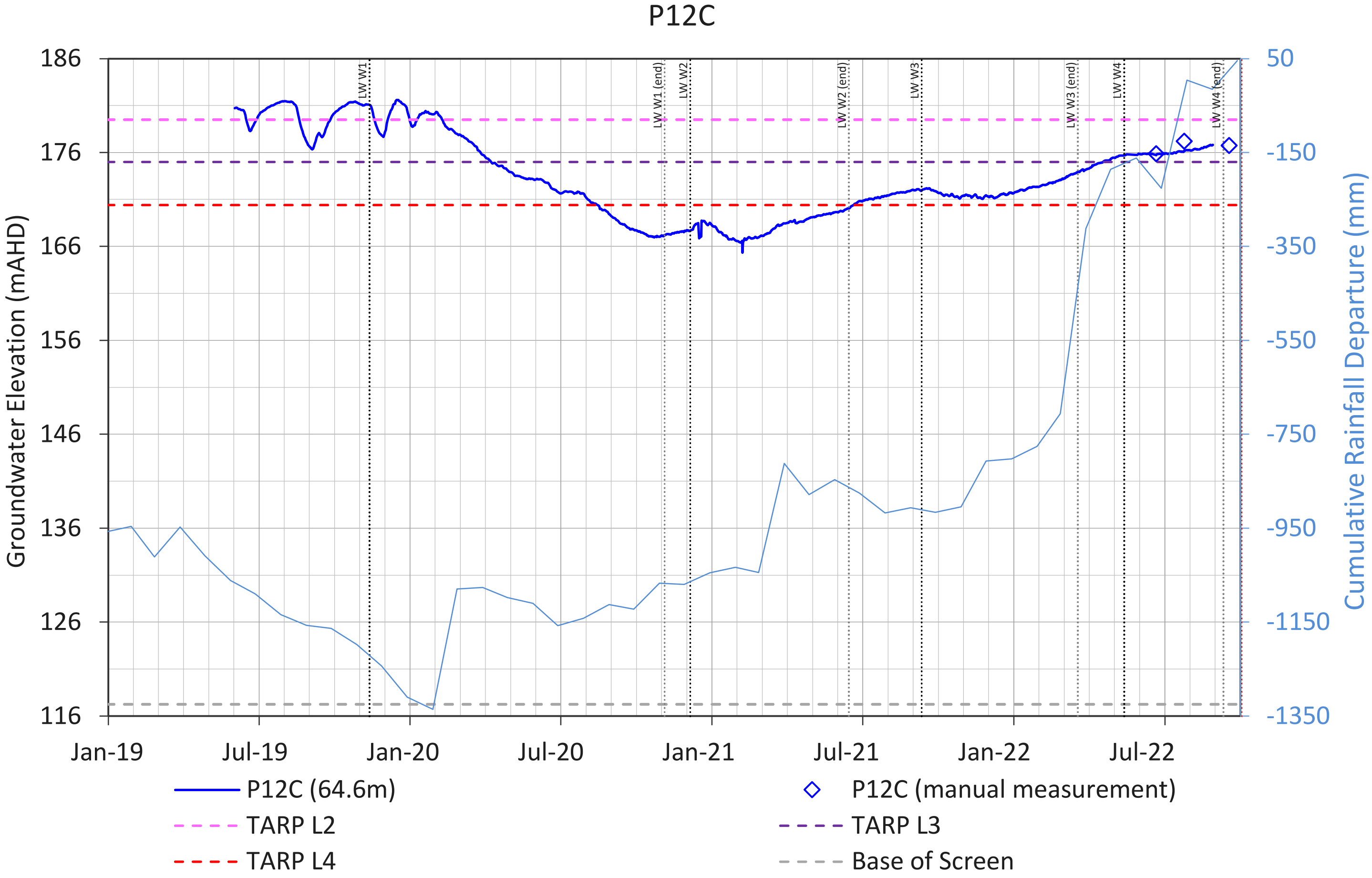



**Figure C-3**

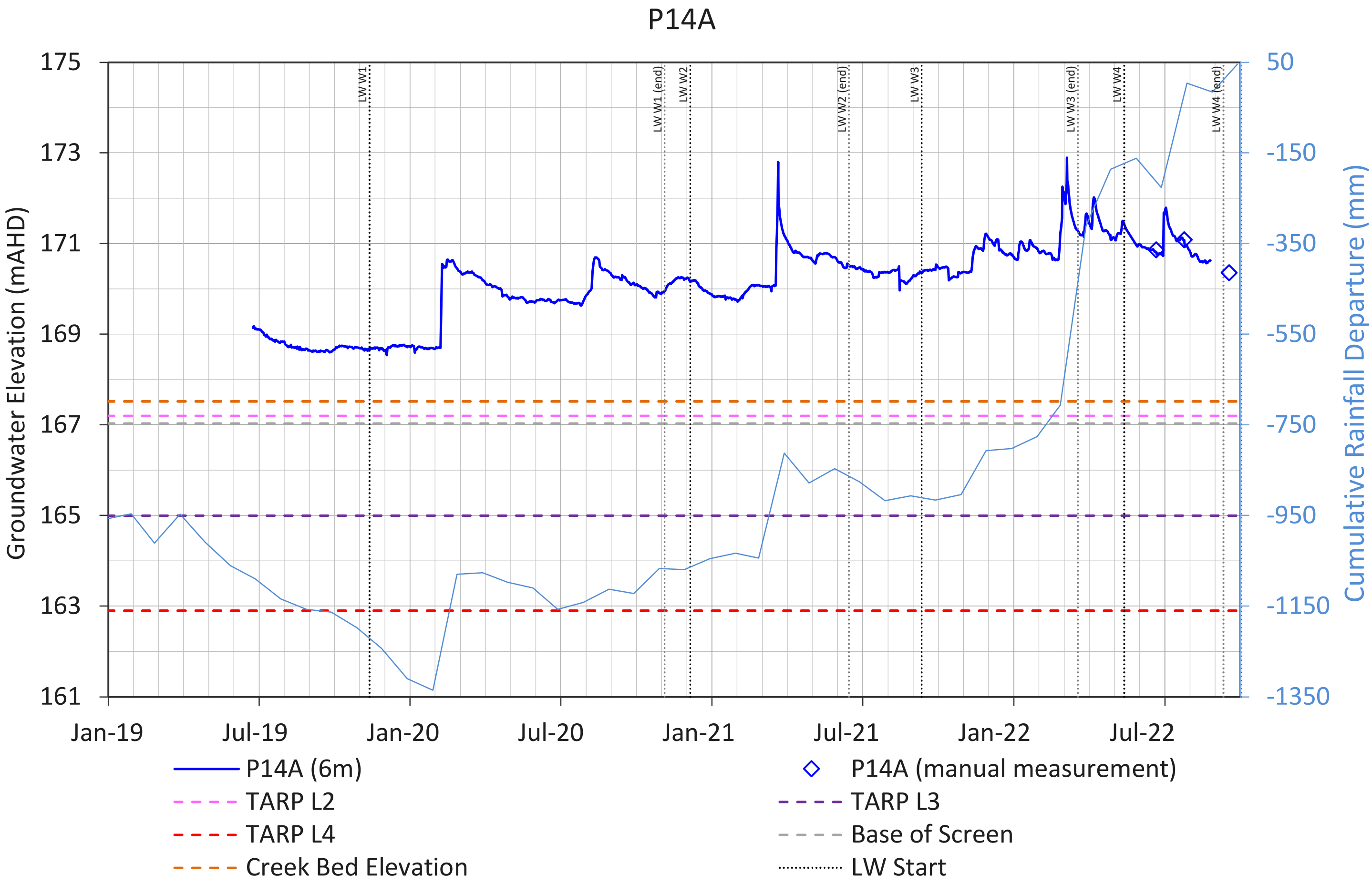



**Figure C-4**

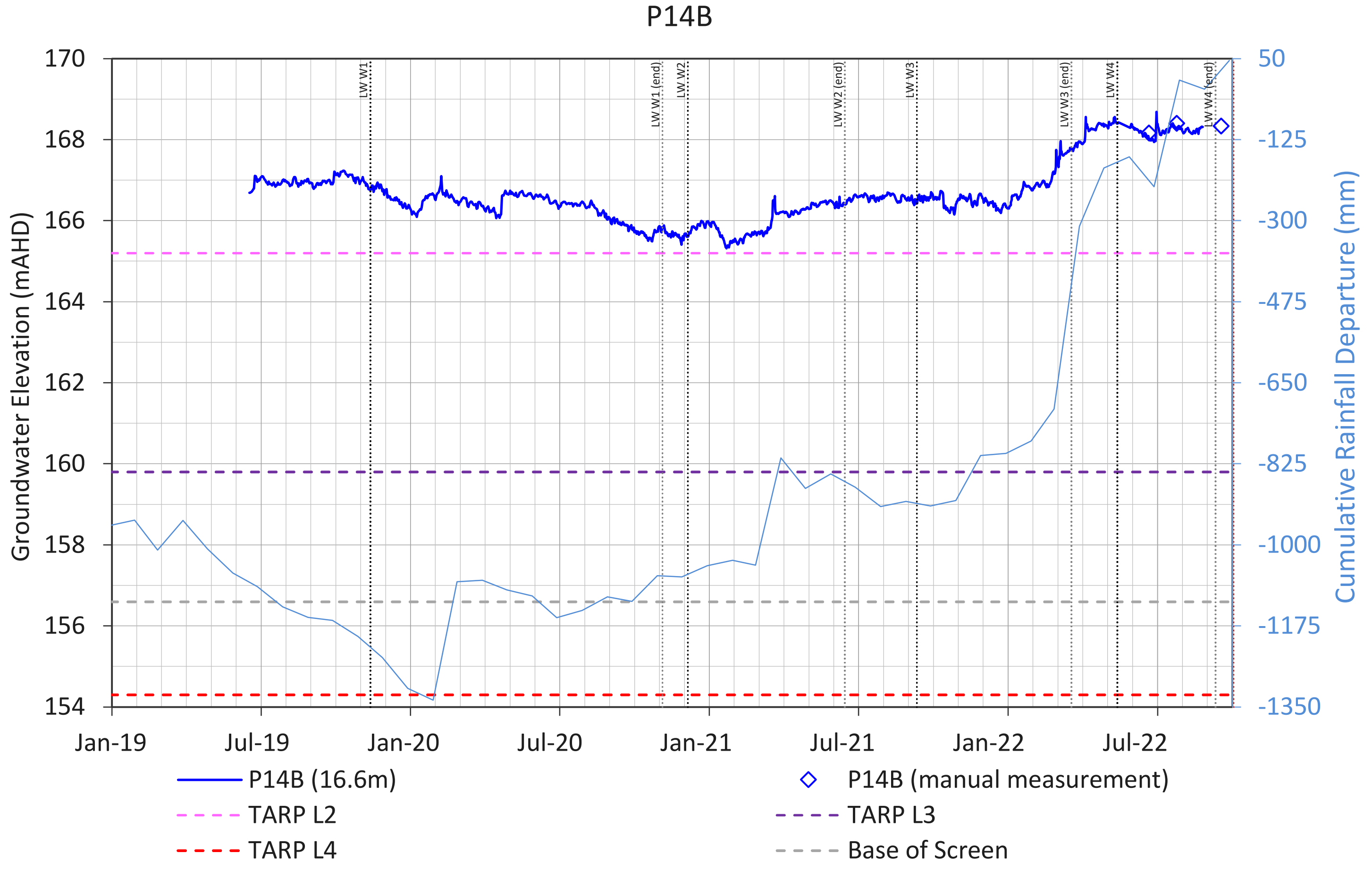



**Figure C-5**

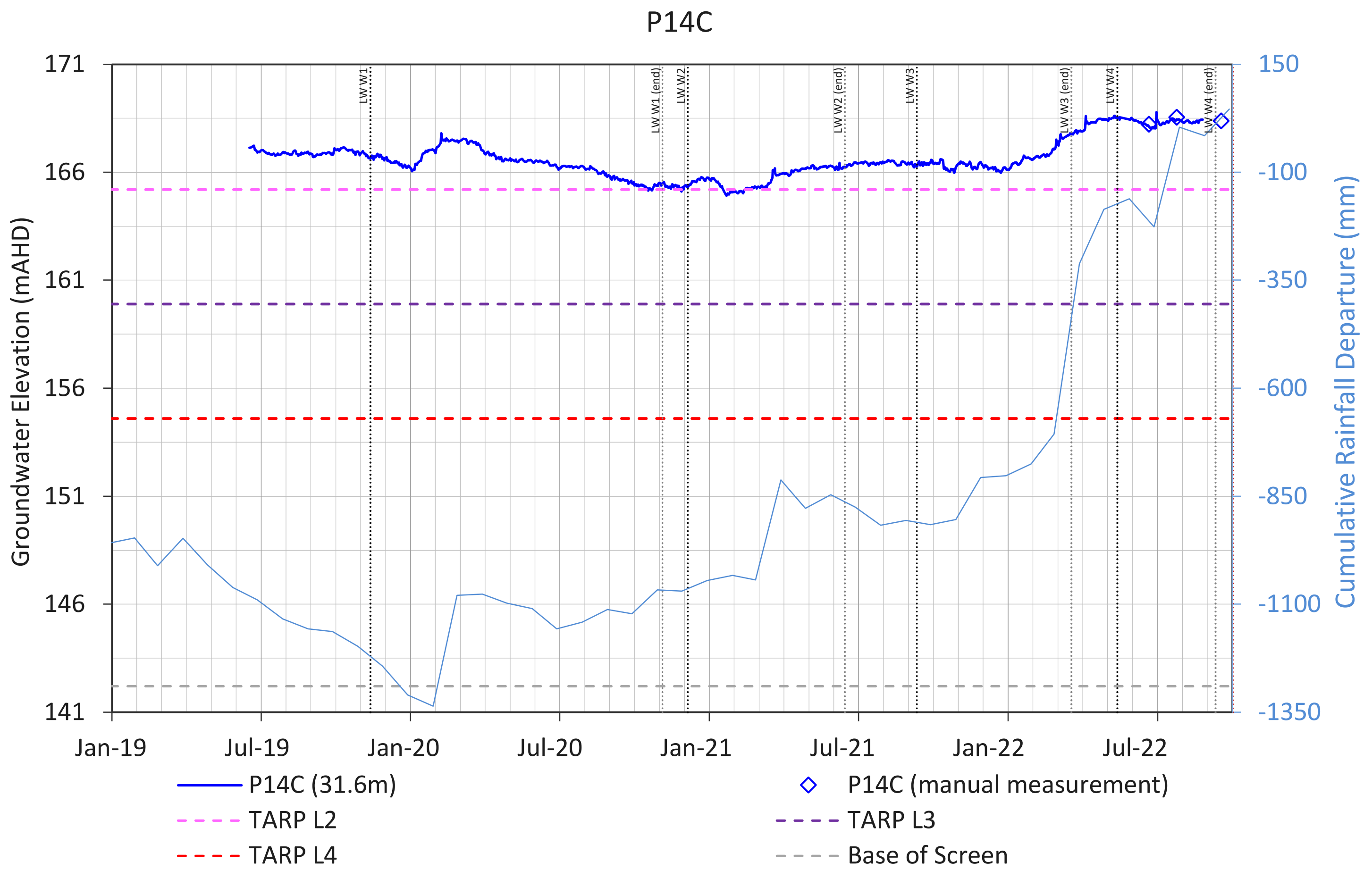



**Figure C-6**

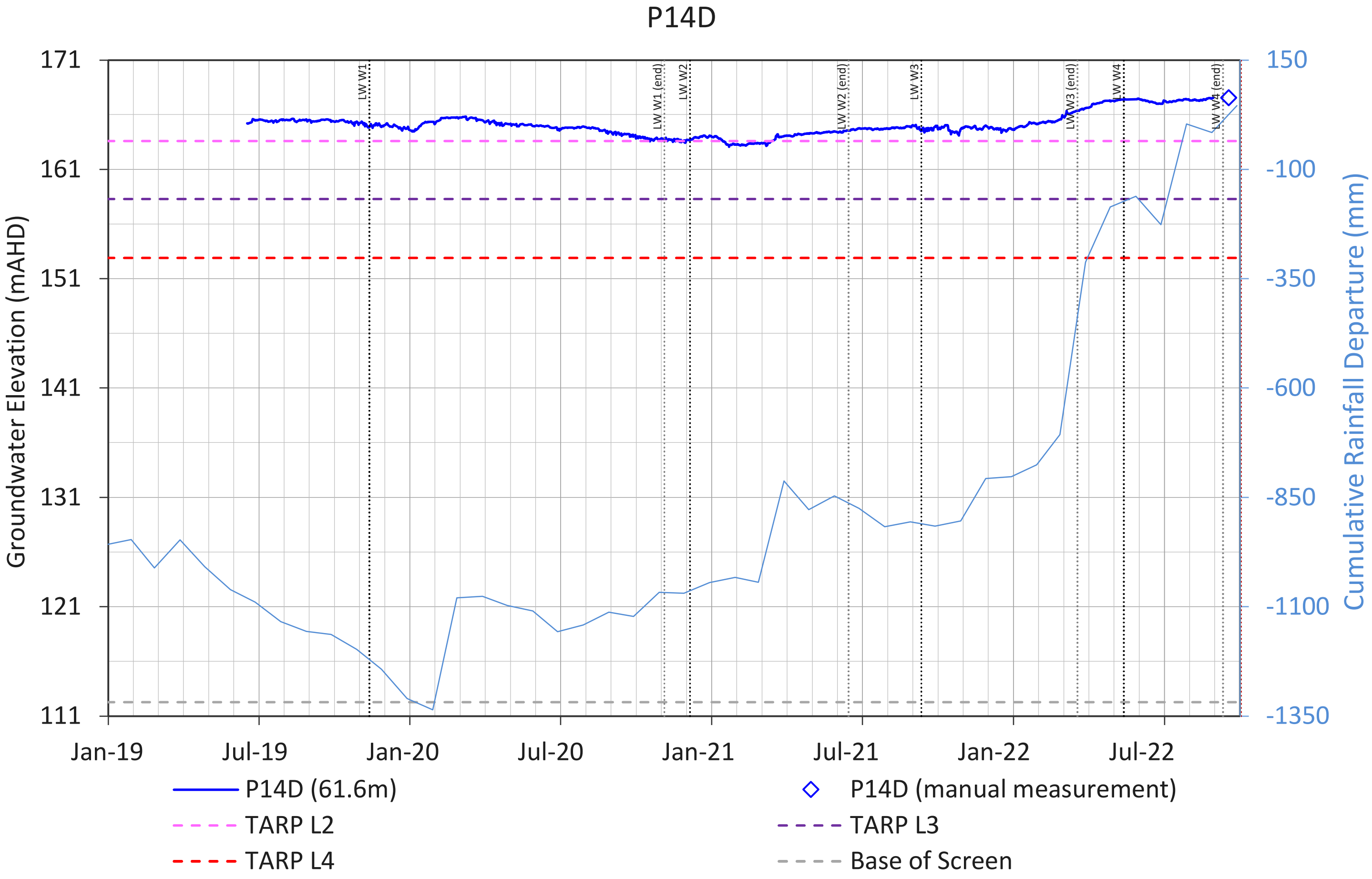



Figure C-7

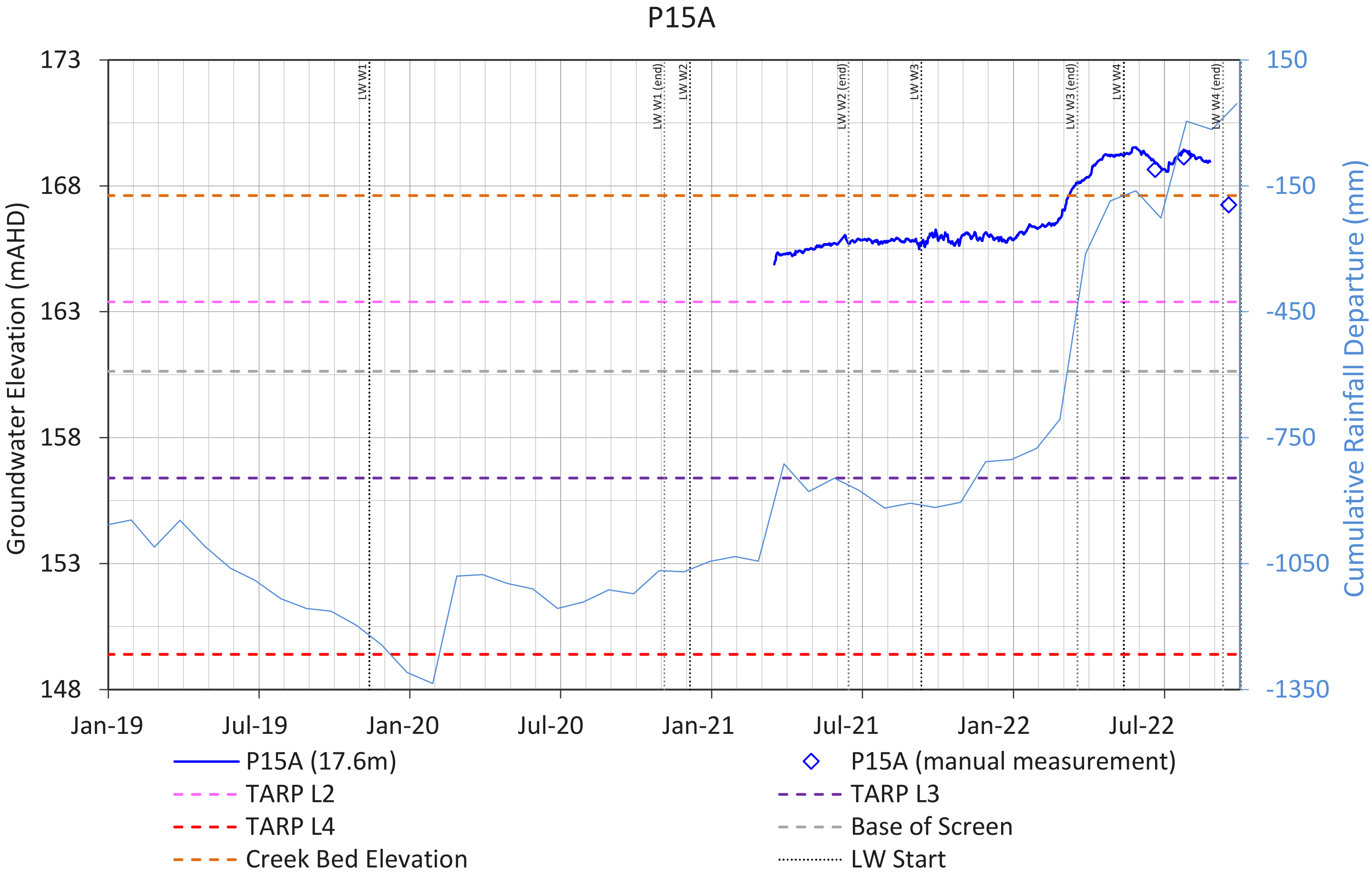



Figure C-8

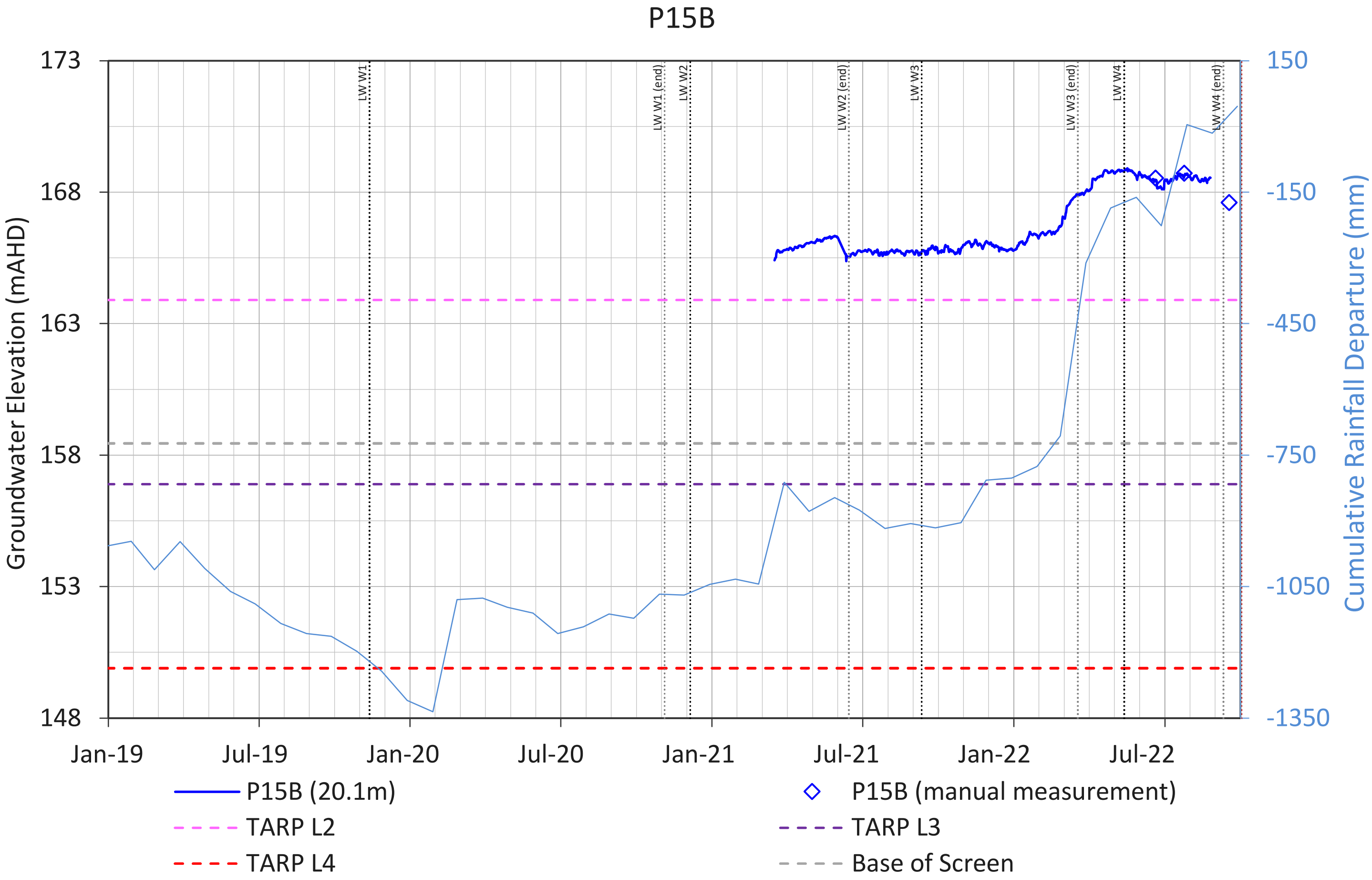



**Figure C-9**

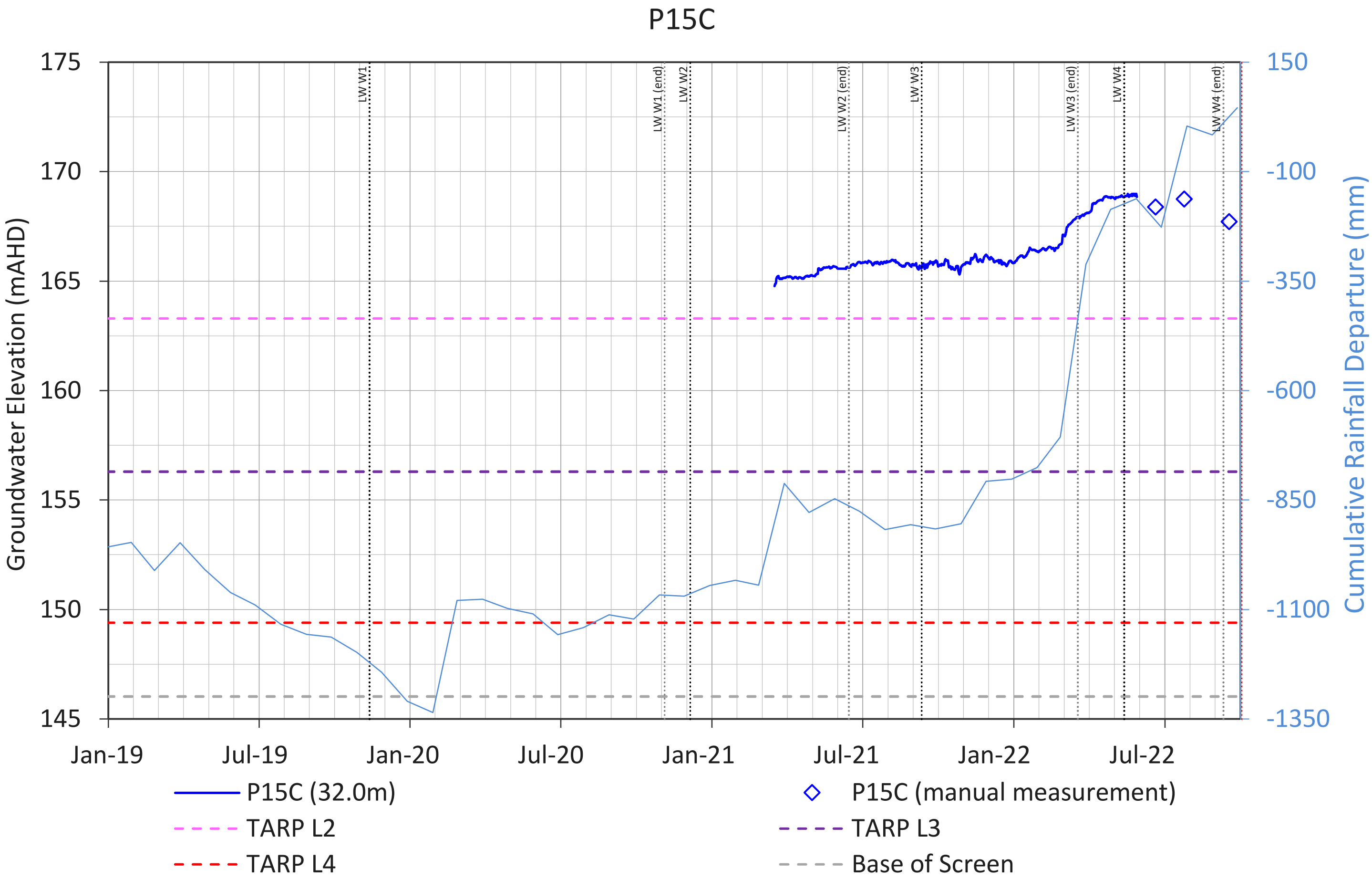



**Figure C-10**

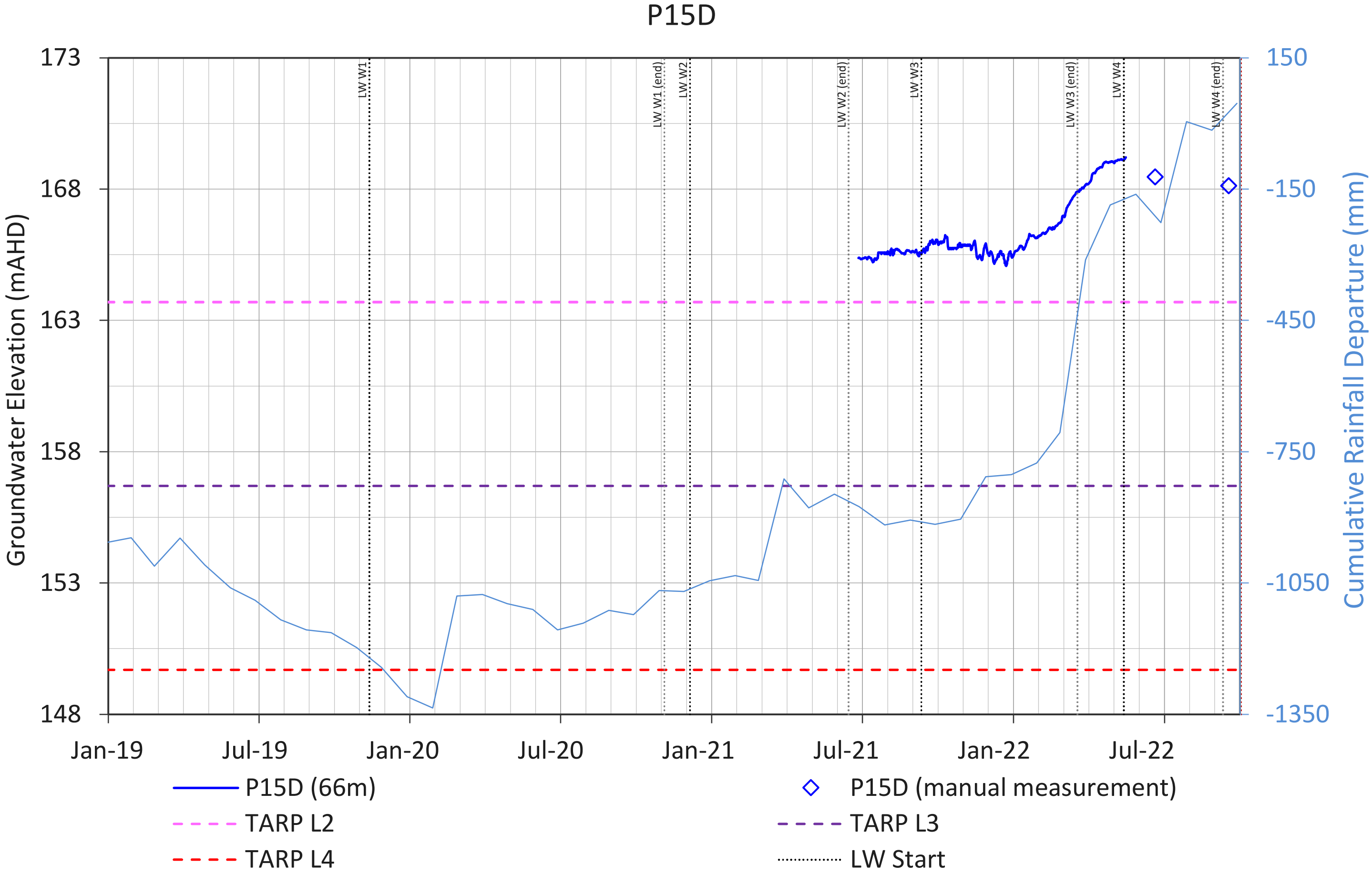



**Figure C-11**

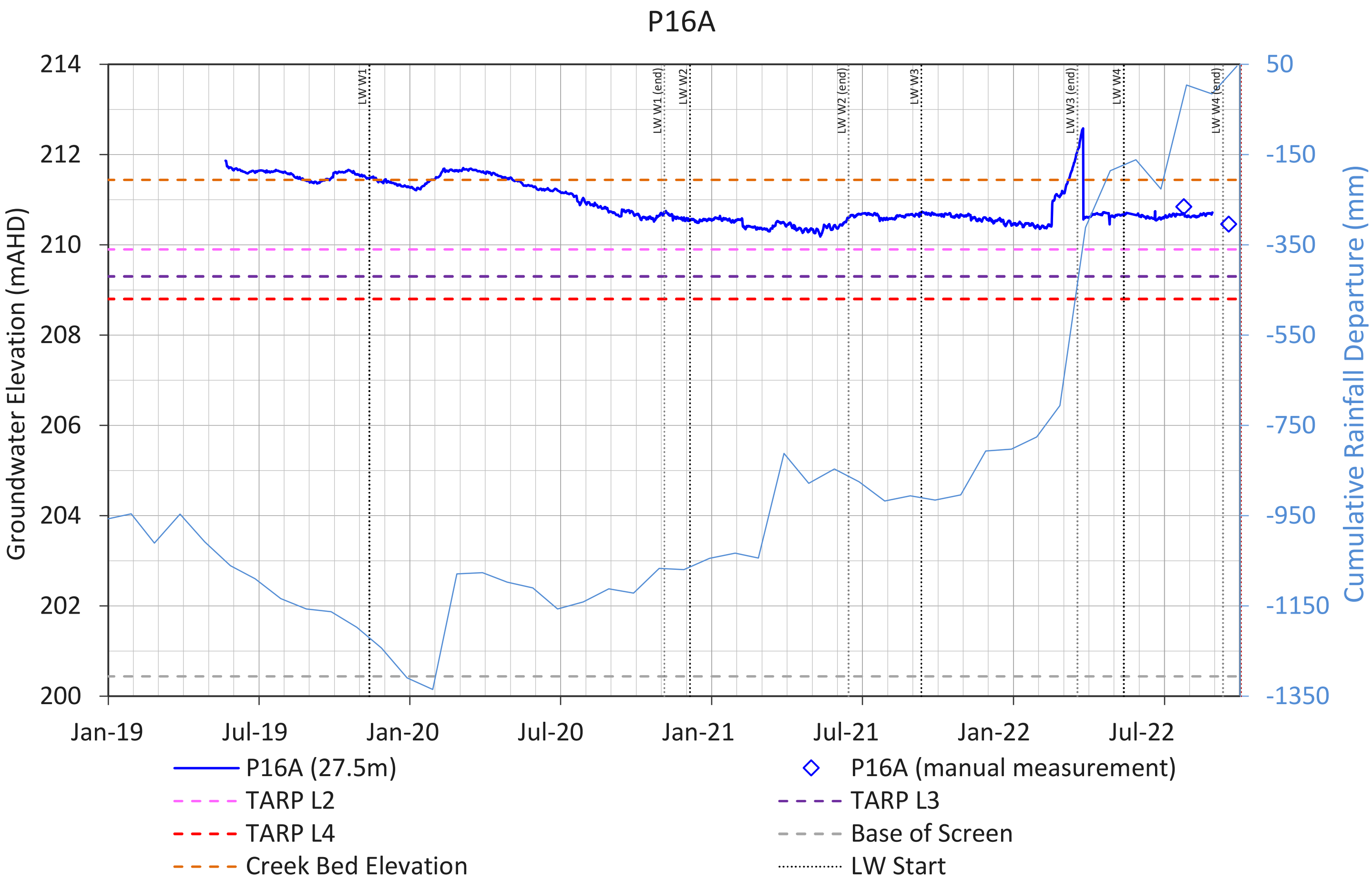



**Figure C-12**

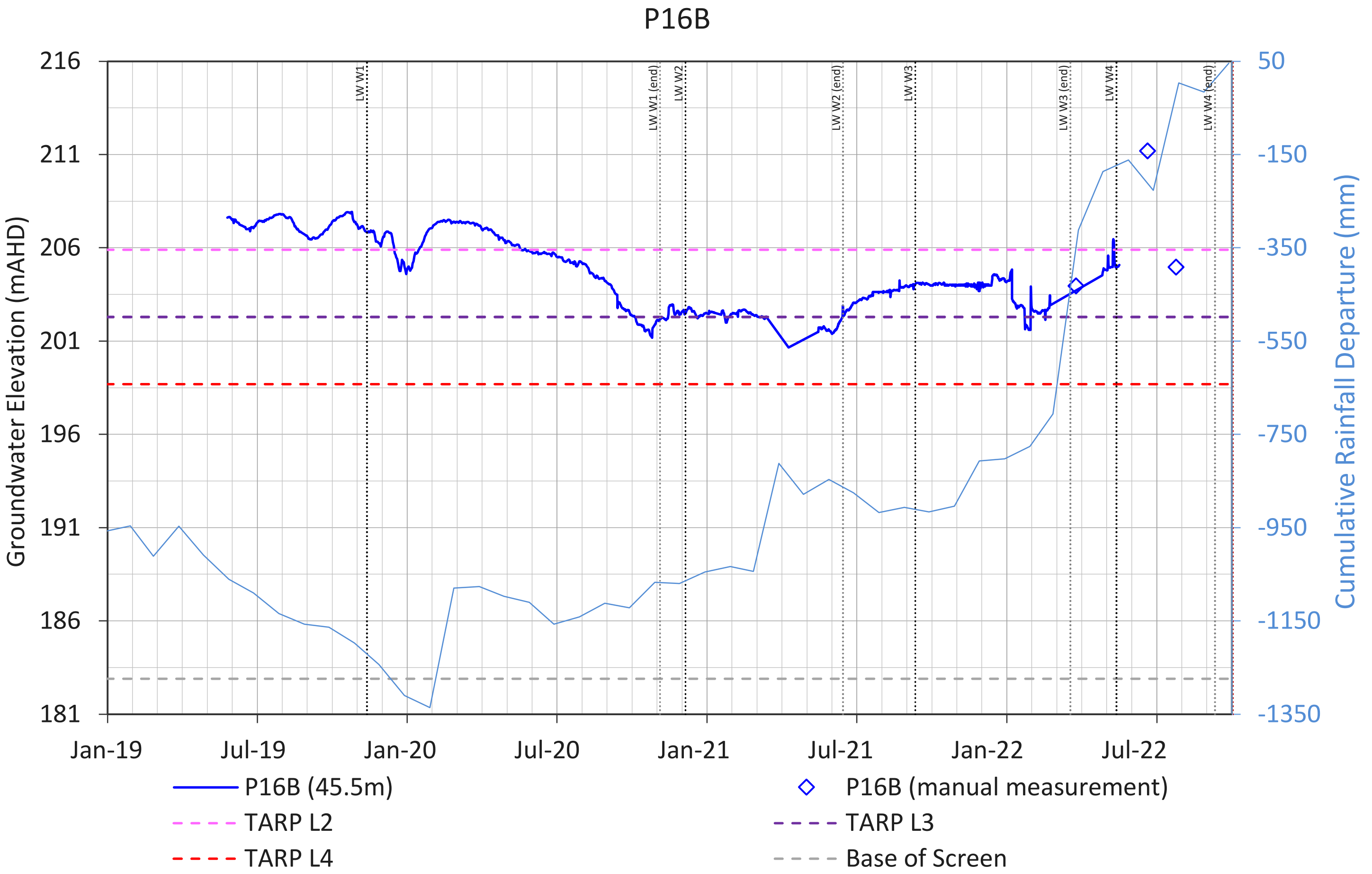



**Figure C-13**

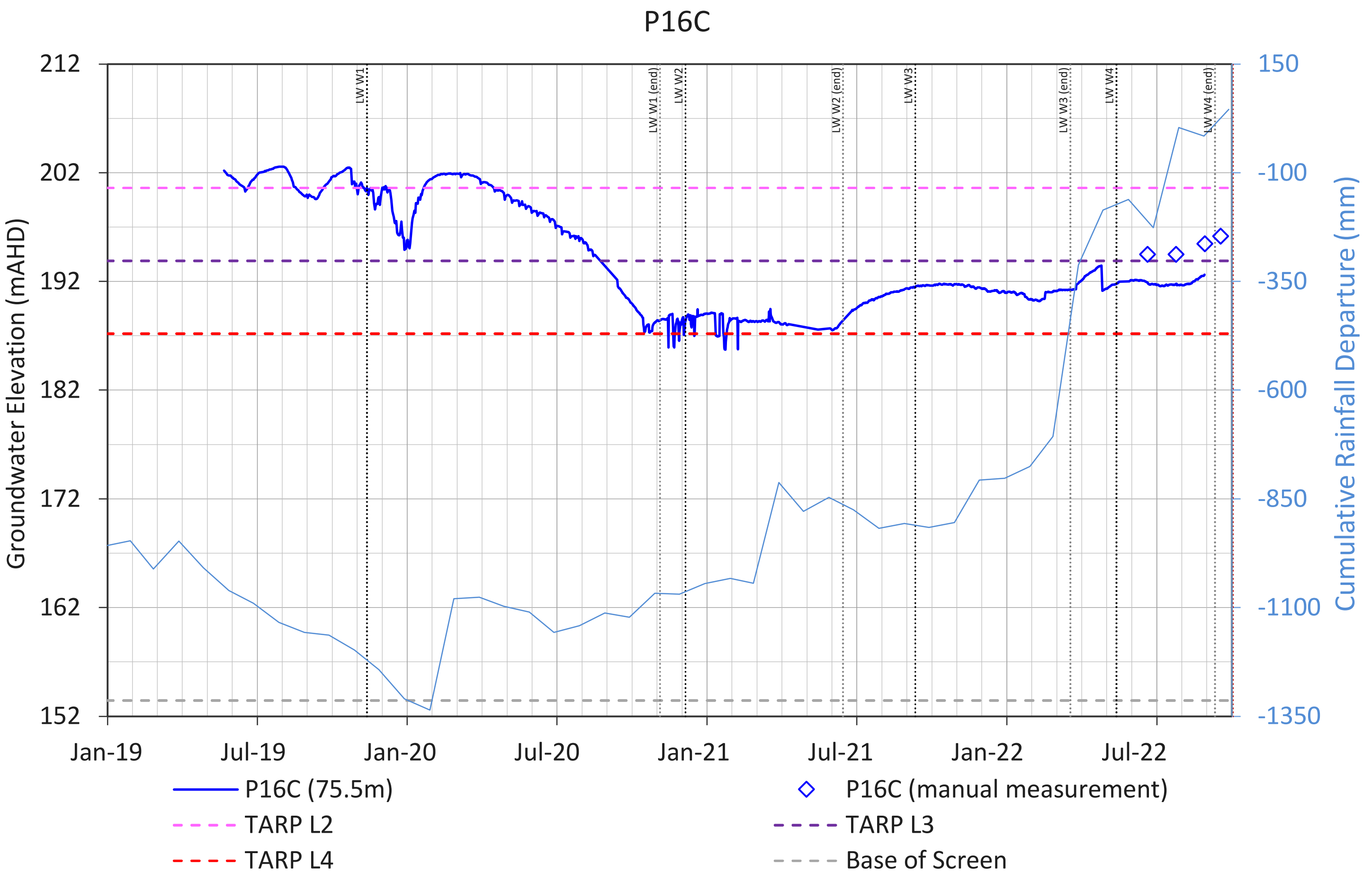



**Figure C-14**

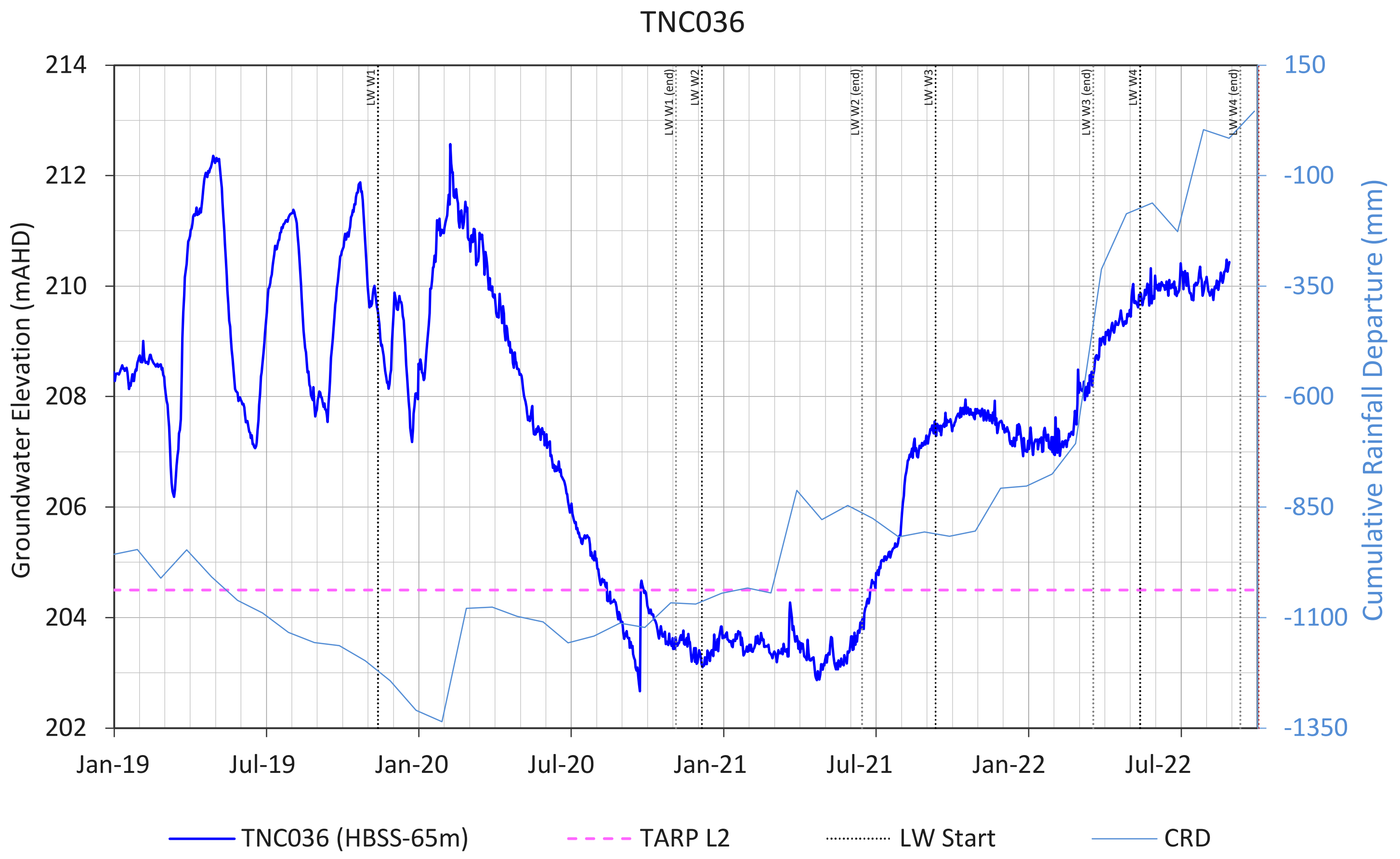



Figure C-15

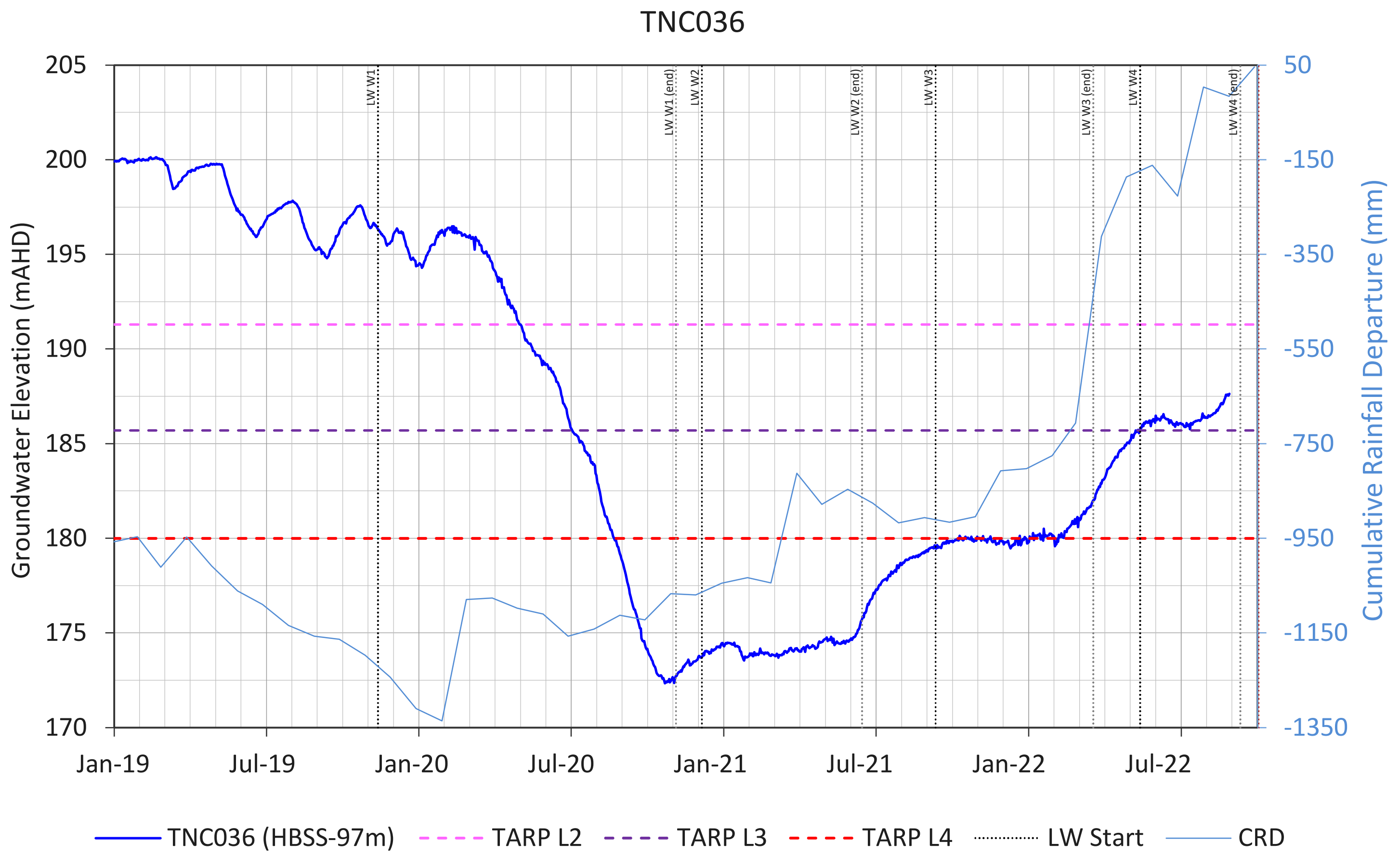



Figure C-16

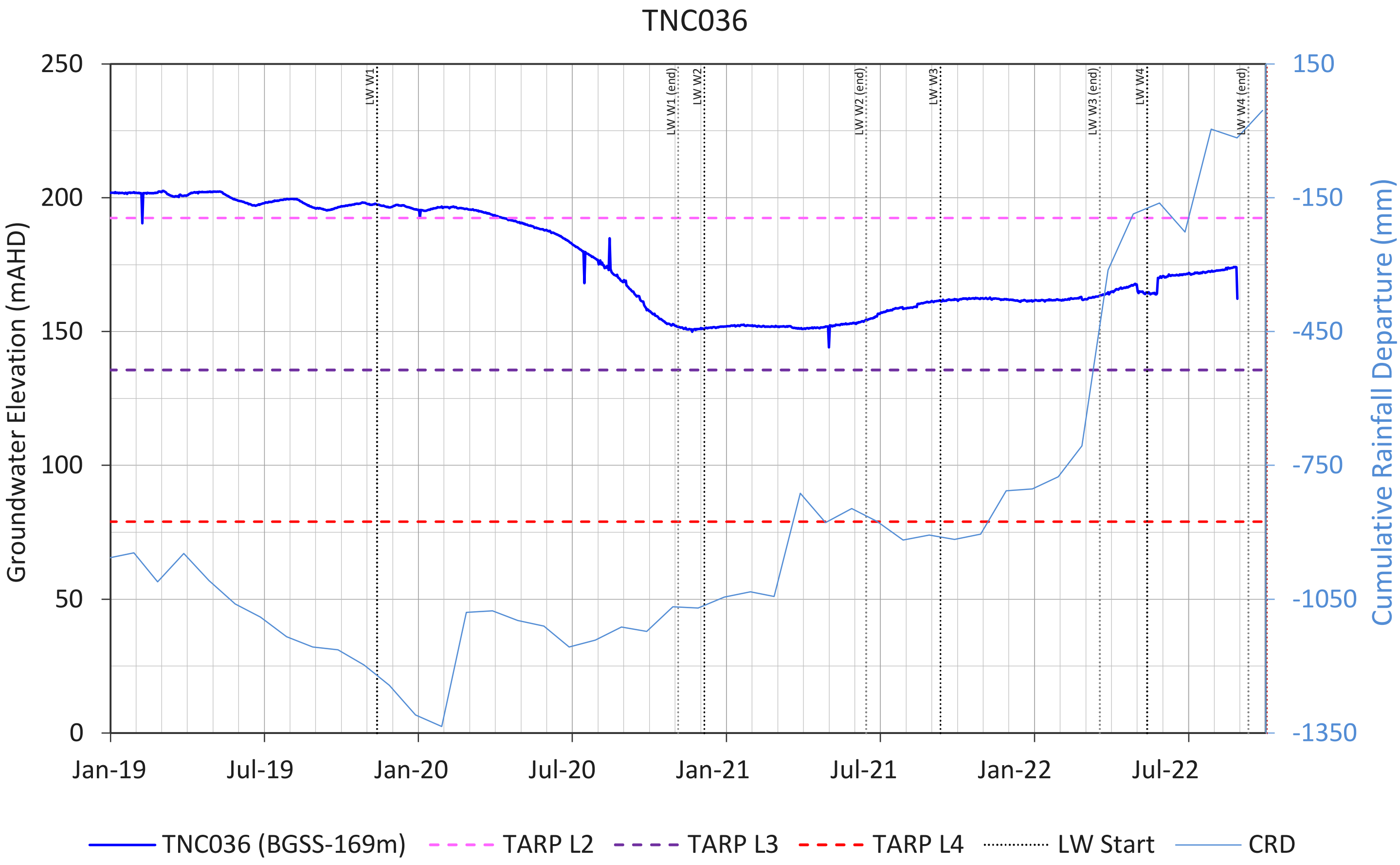



**Figure C-17**

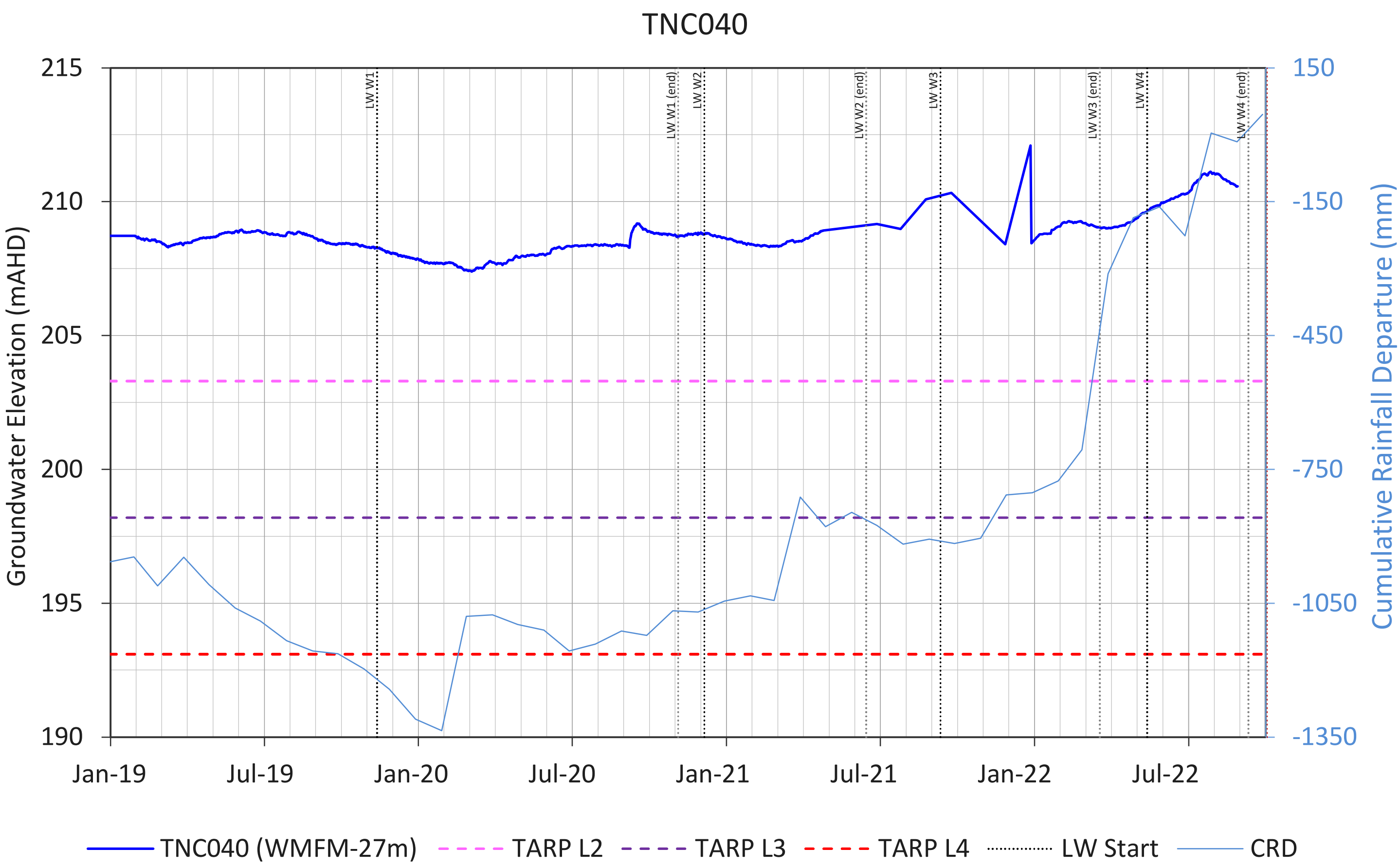



**Figure C-18**

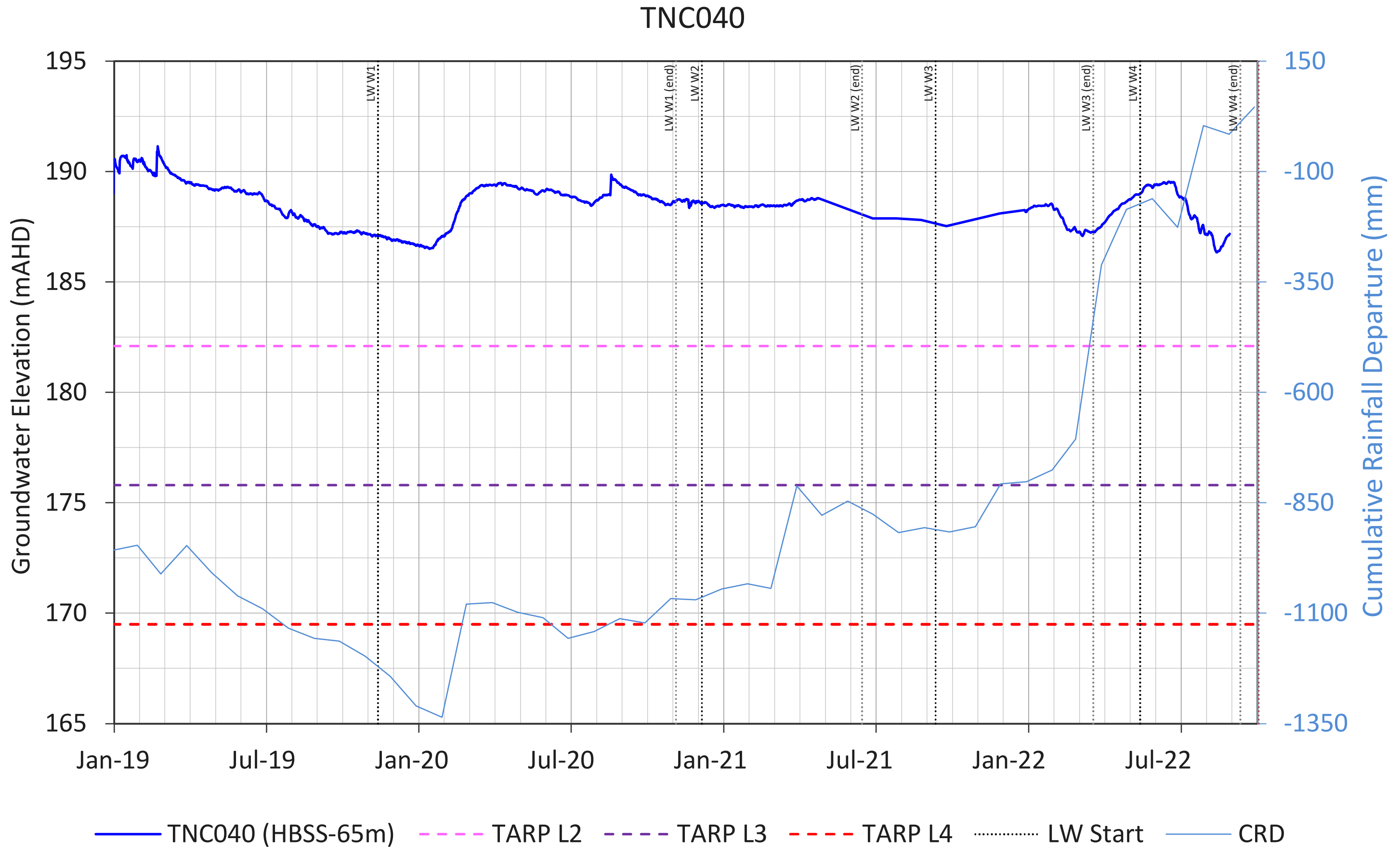



**Figure C-19**

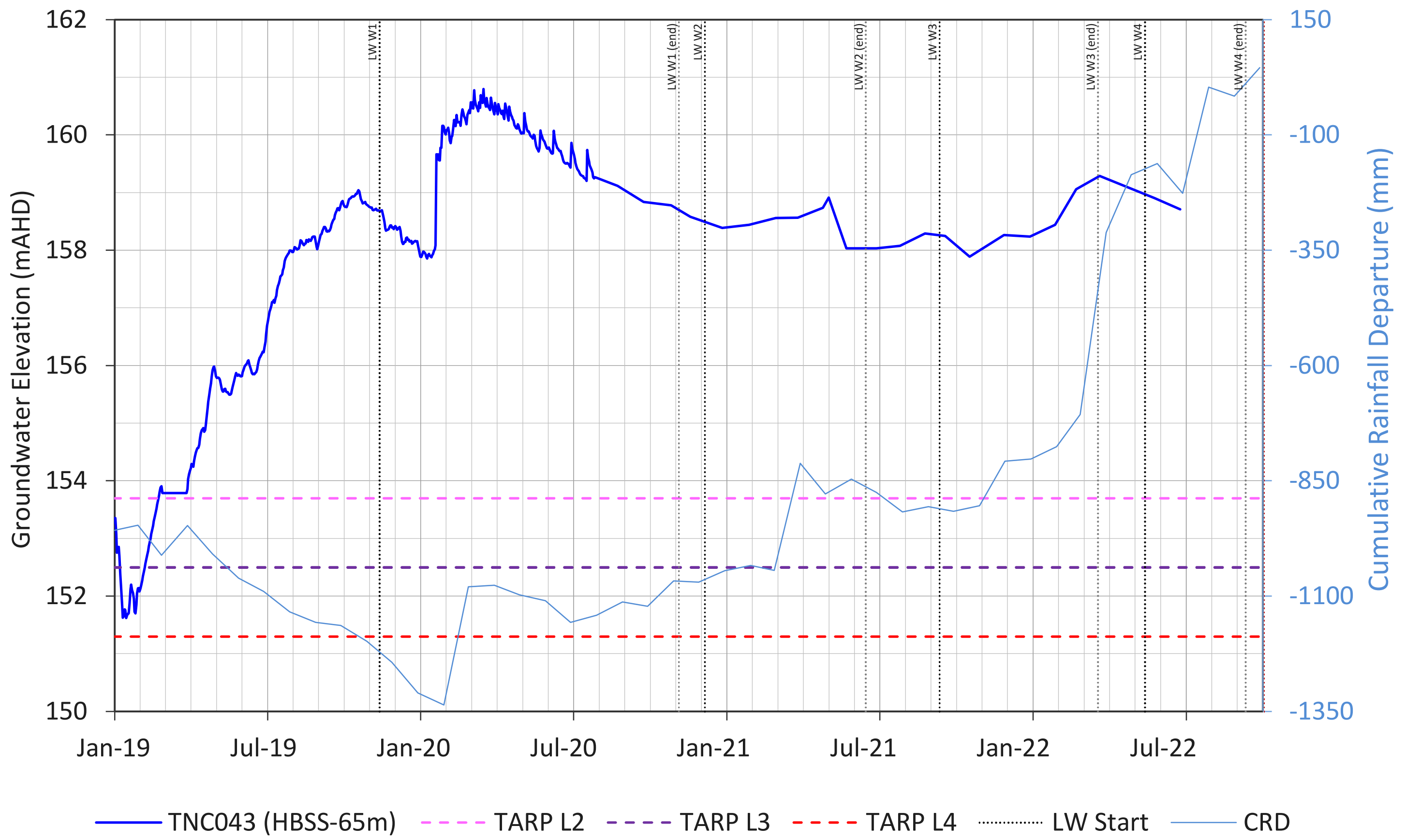



**Figure C-20**

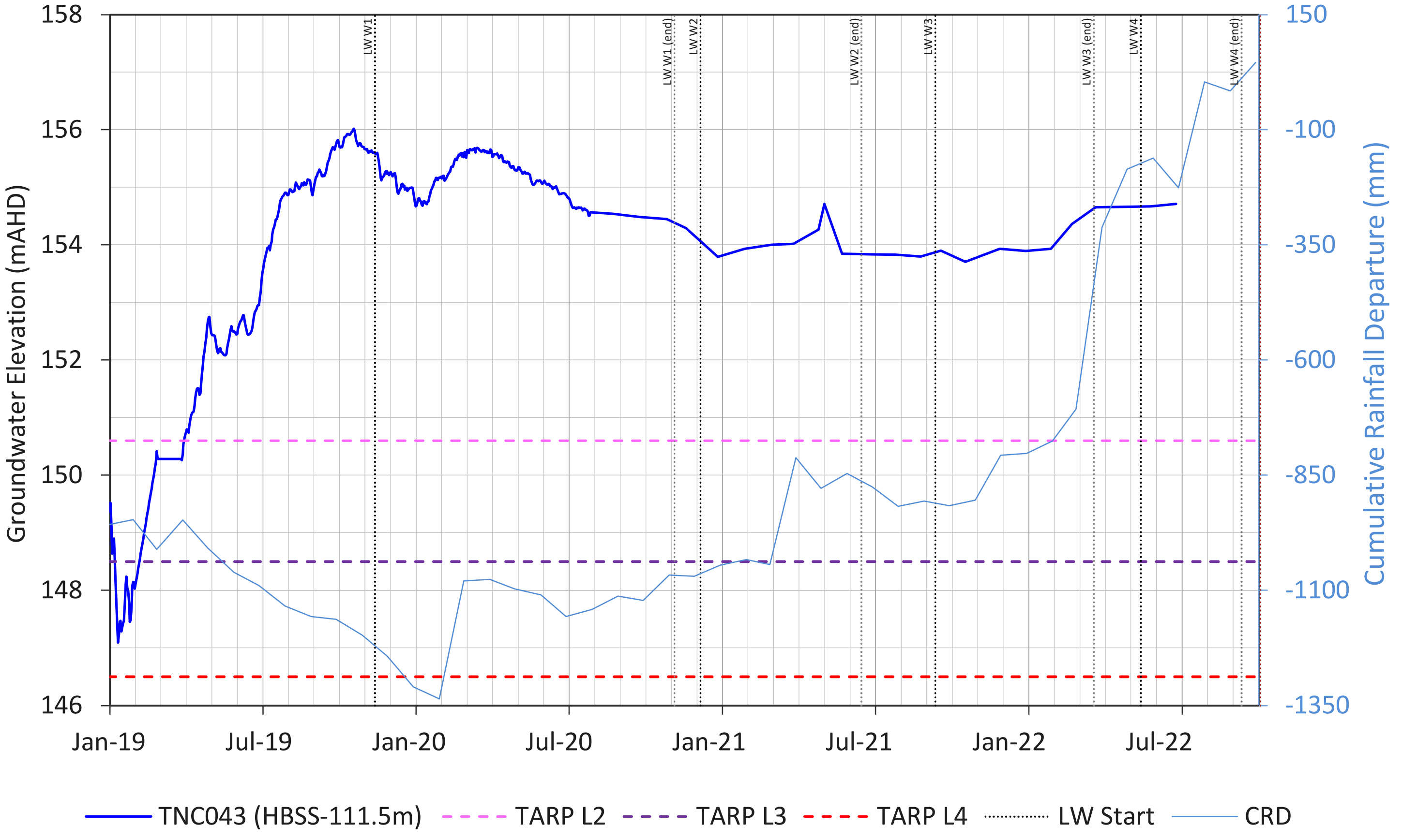



**Figure C-21**

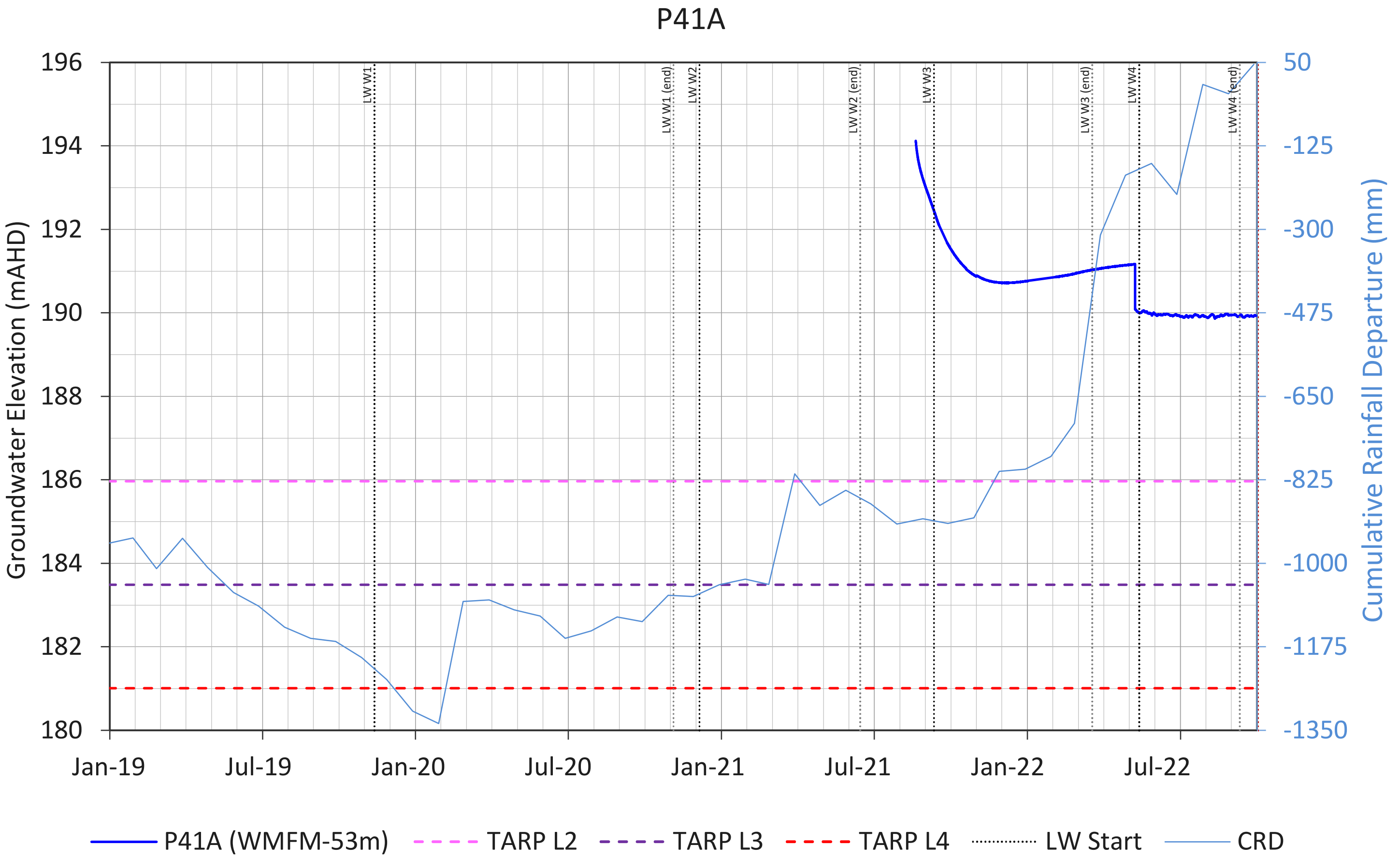



**Figure C-22**

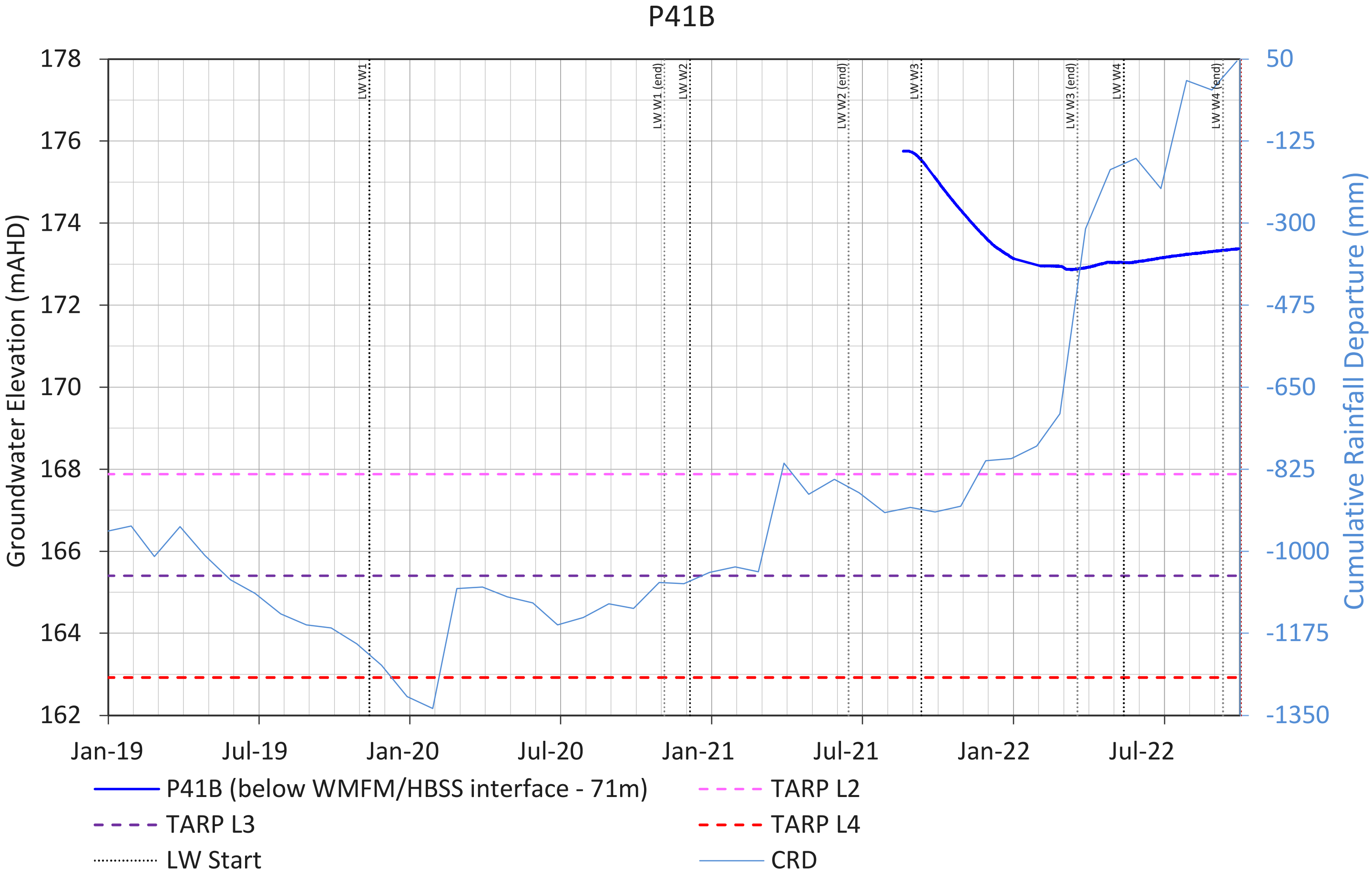



**Figure C-23**

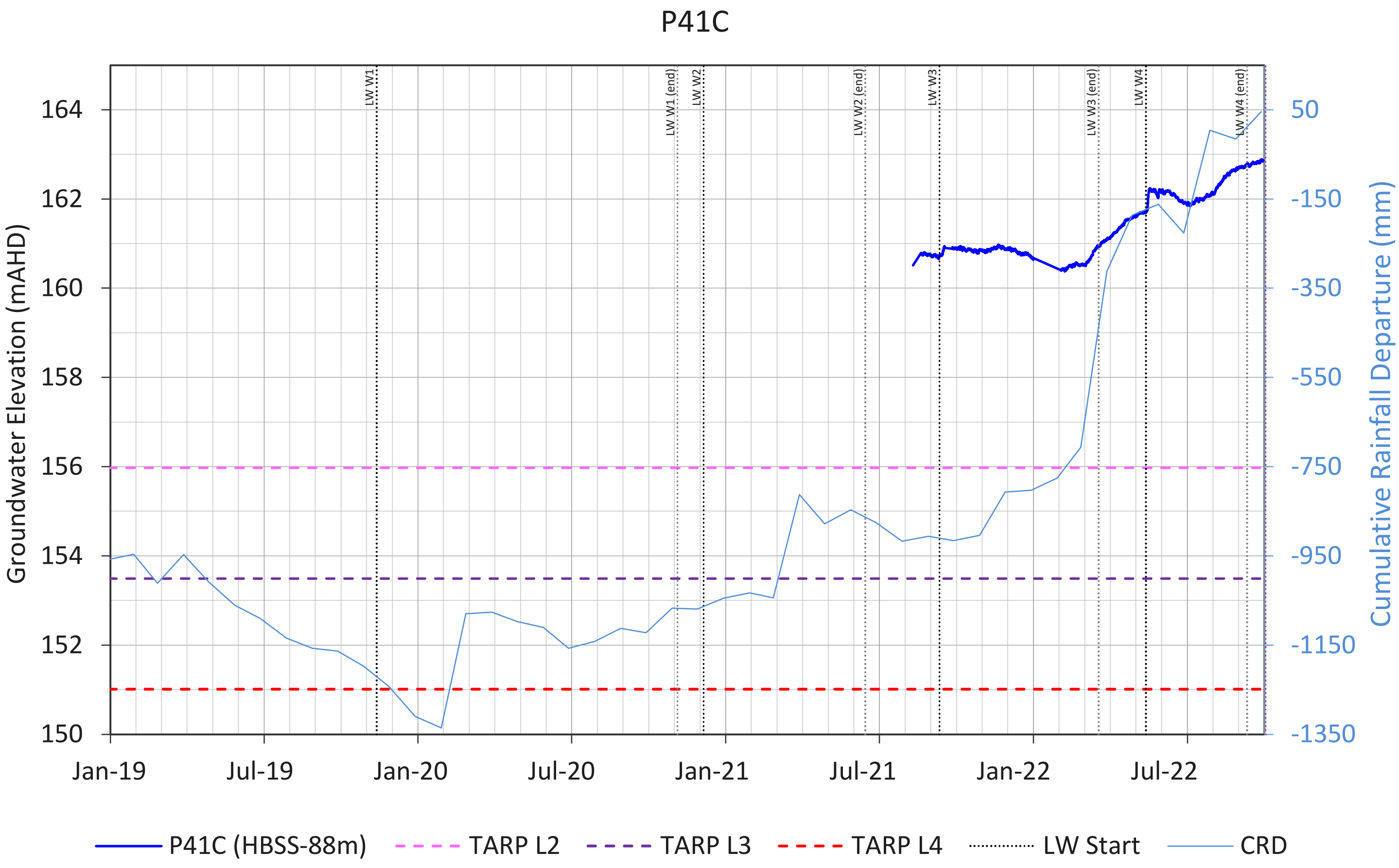



**Figure C-24**

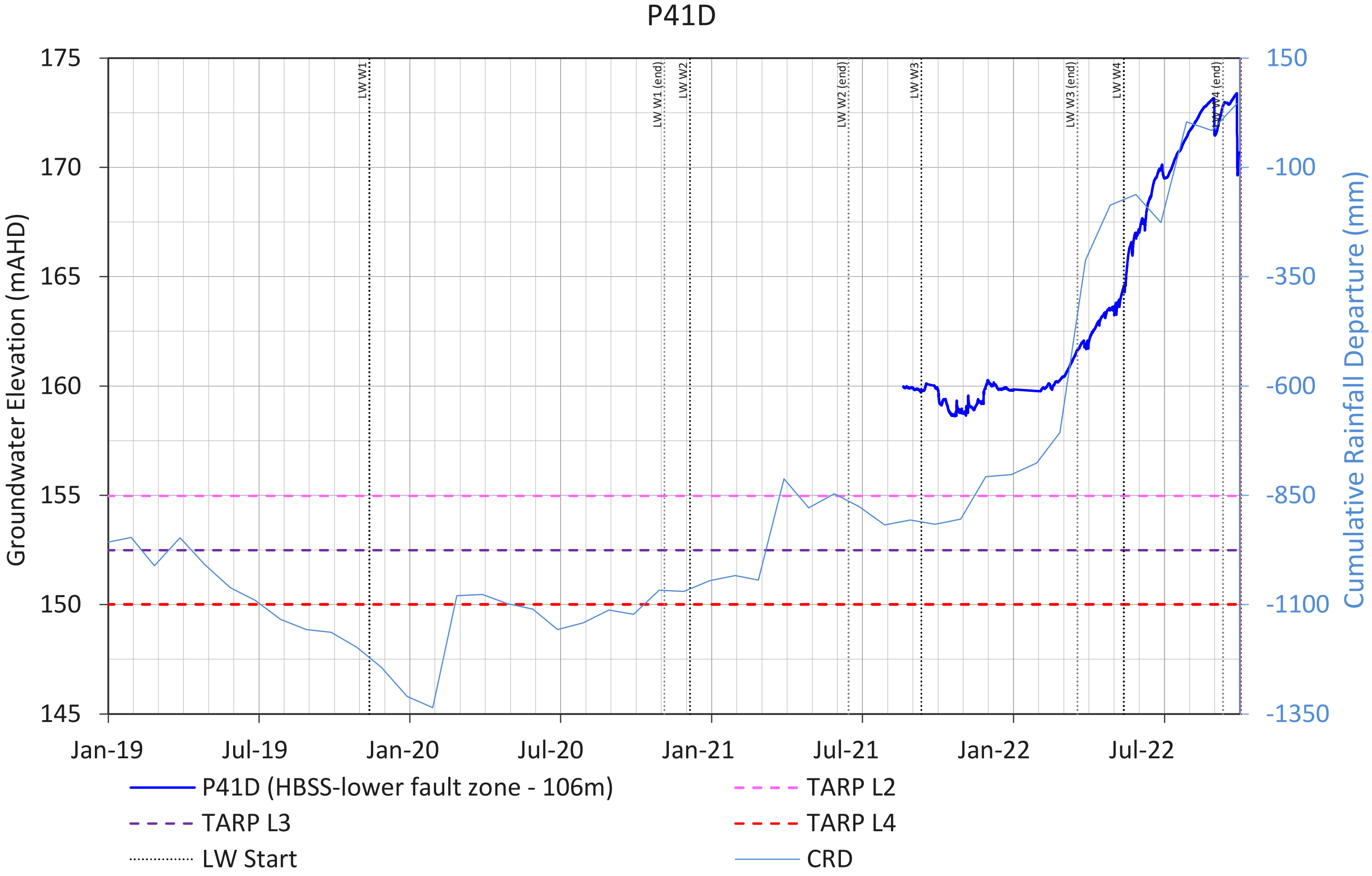



Figure C-25

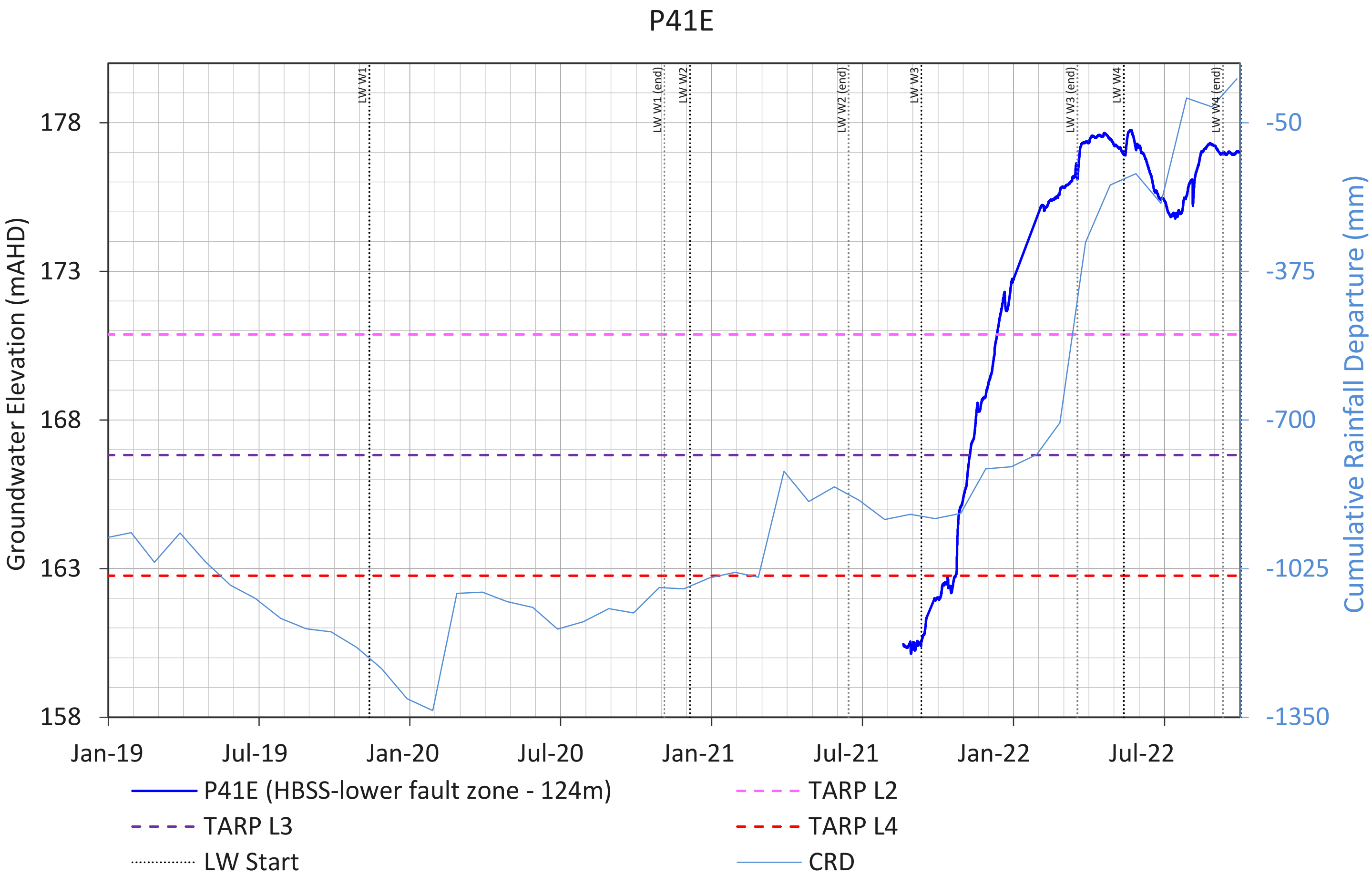



Figure C-26

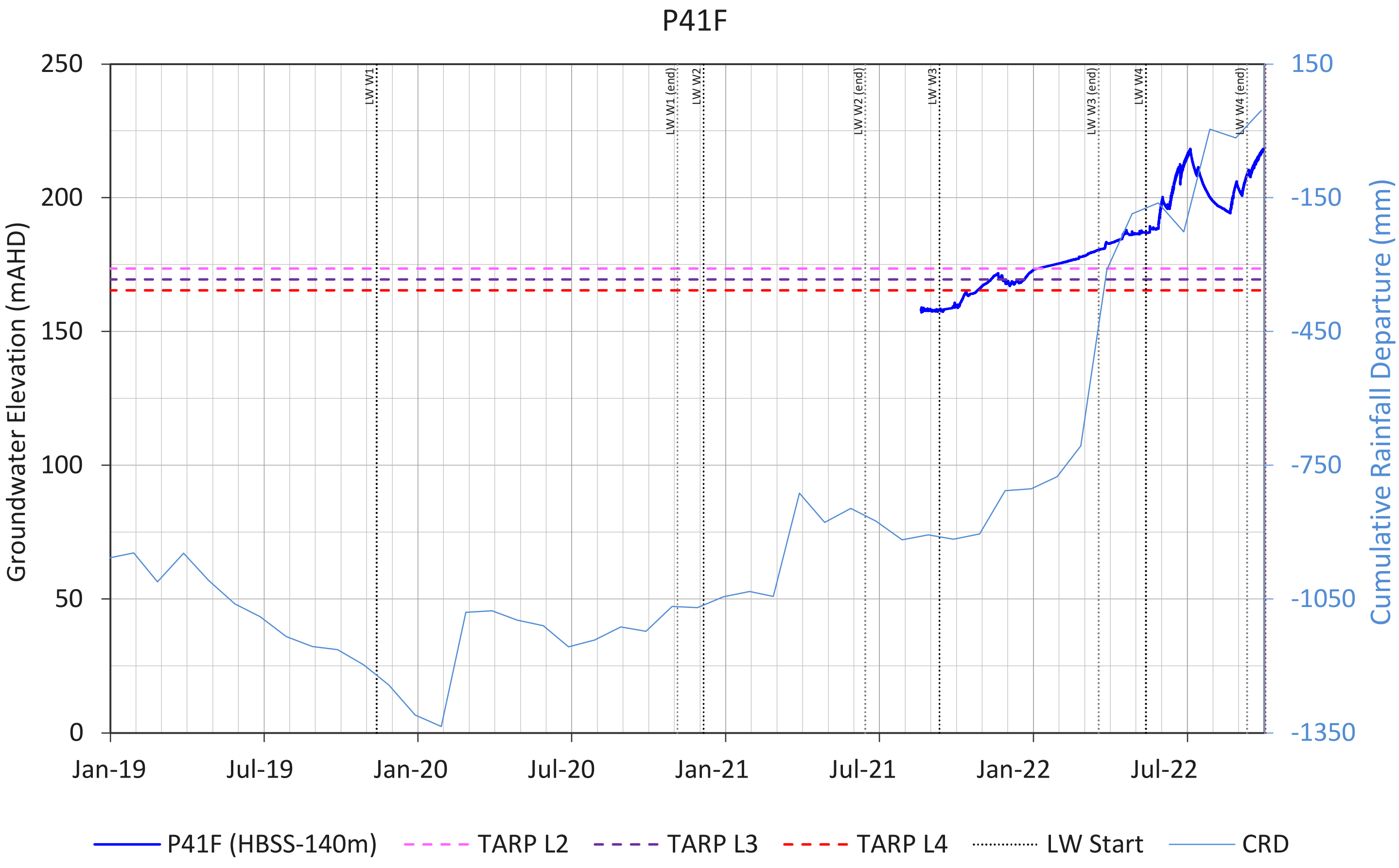

P41F
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
250
200
150
100
50
0
150
-150
-450
-750
-1050
-1350
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
P41F (HBSS-140m)
TARP L2
TARP L3
TARP L4
LW Start
CRD

**Figure C-27**

# APPENDIX D

Groundwater Quality and Trigger Levels (EC, pH and metal exceedances only)

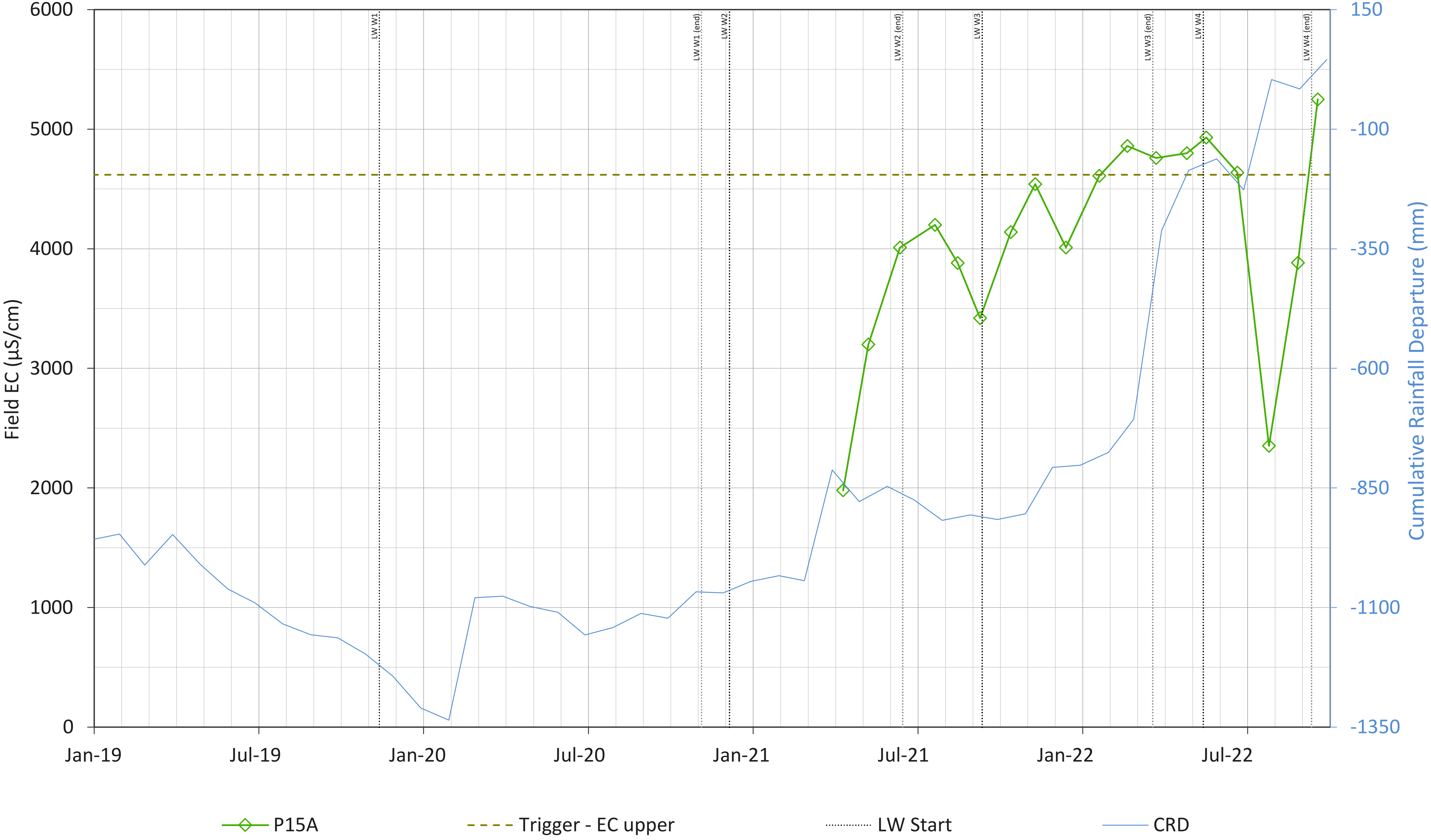
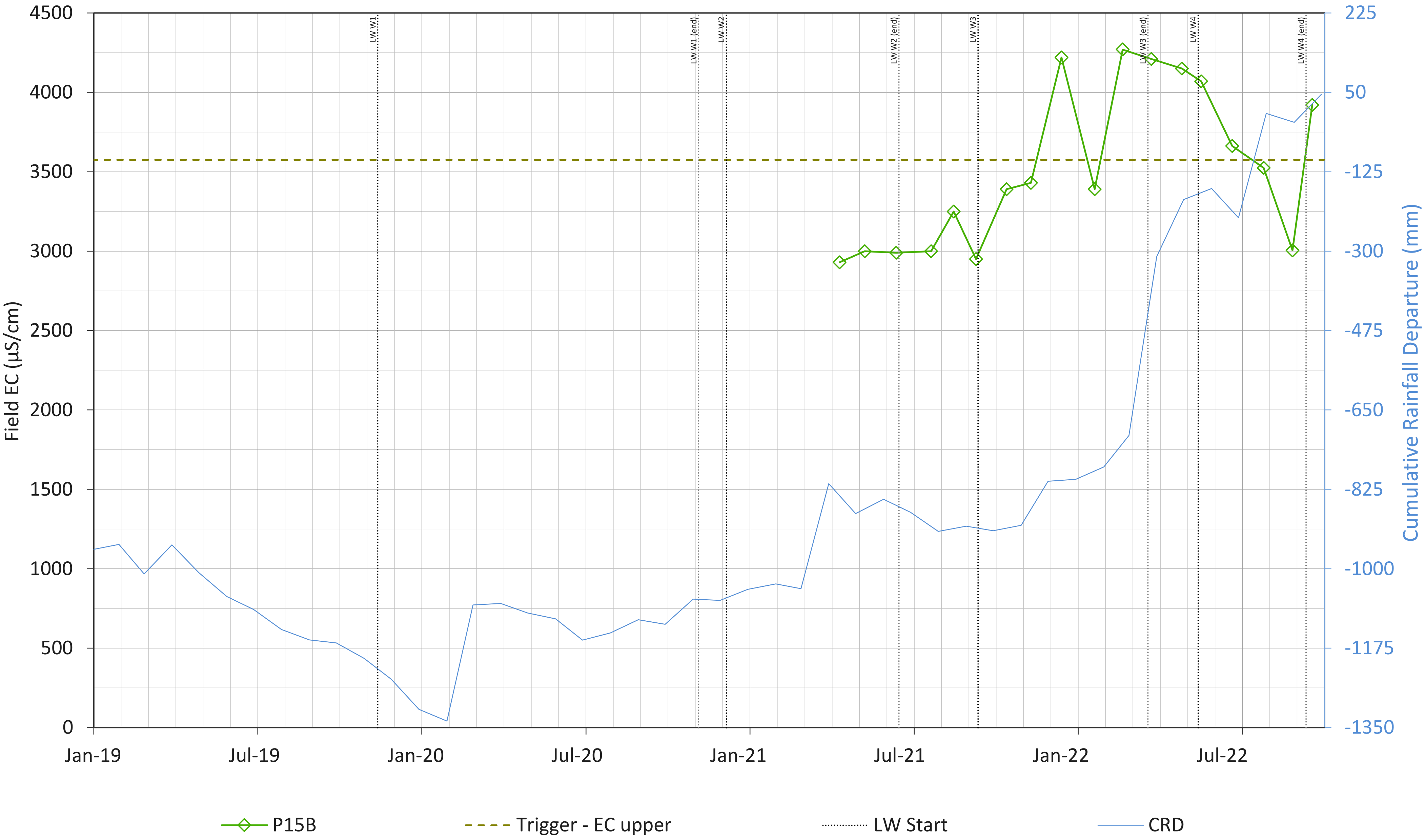
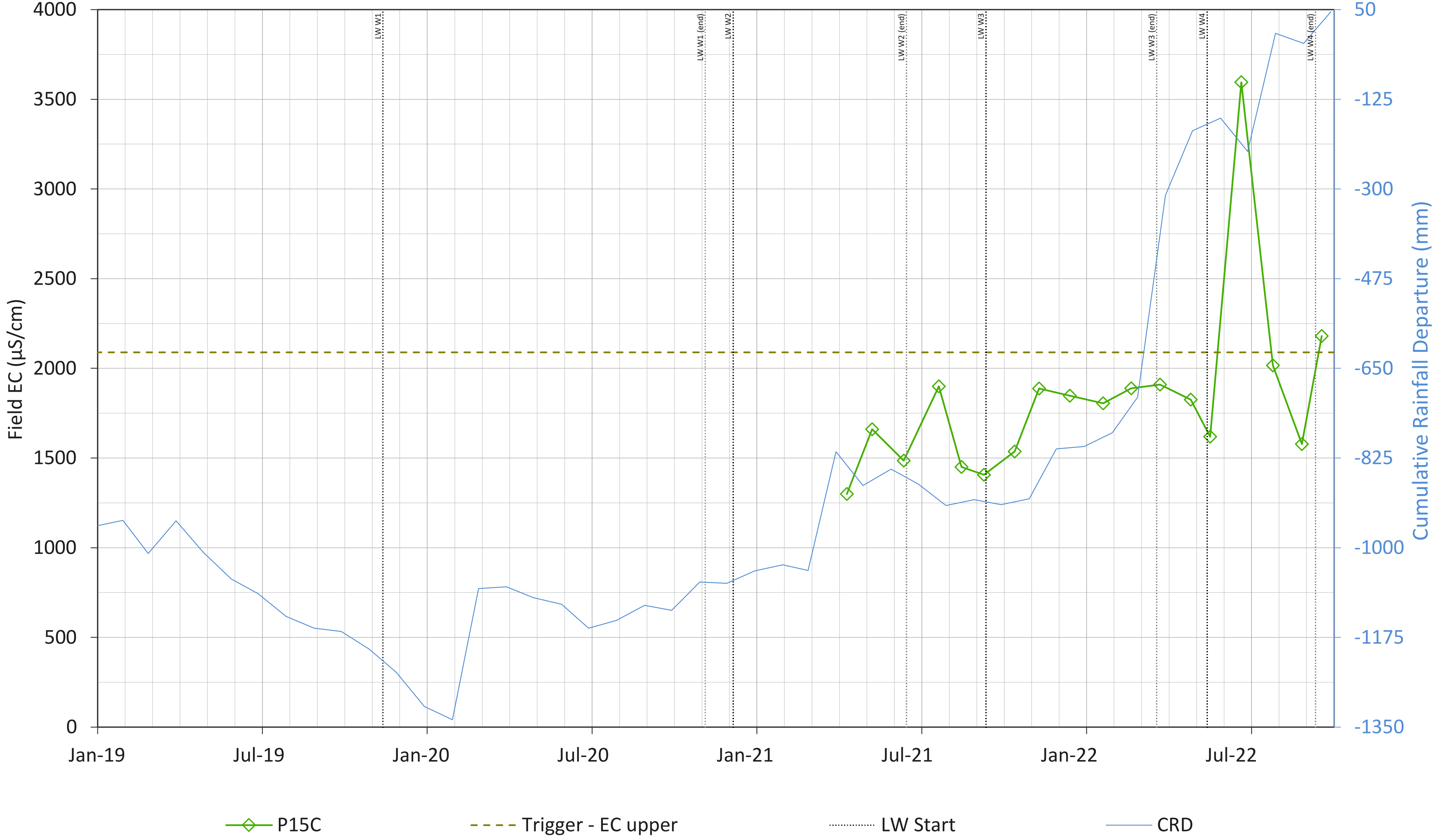

6000
5000
4000
3000
2000
1000
0
150
-100
-350
-600
-850
-1100
-1350
Field EC (µS/cm)
Cumulative Rainfall Departure (mm)
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
P15A
Trigger - EC upper
LW Start
CRD

Figure D1



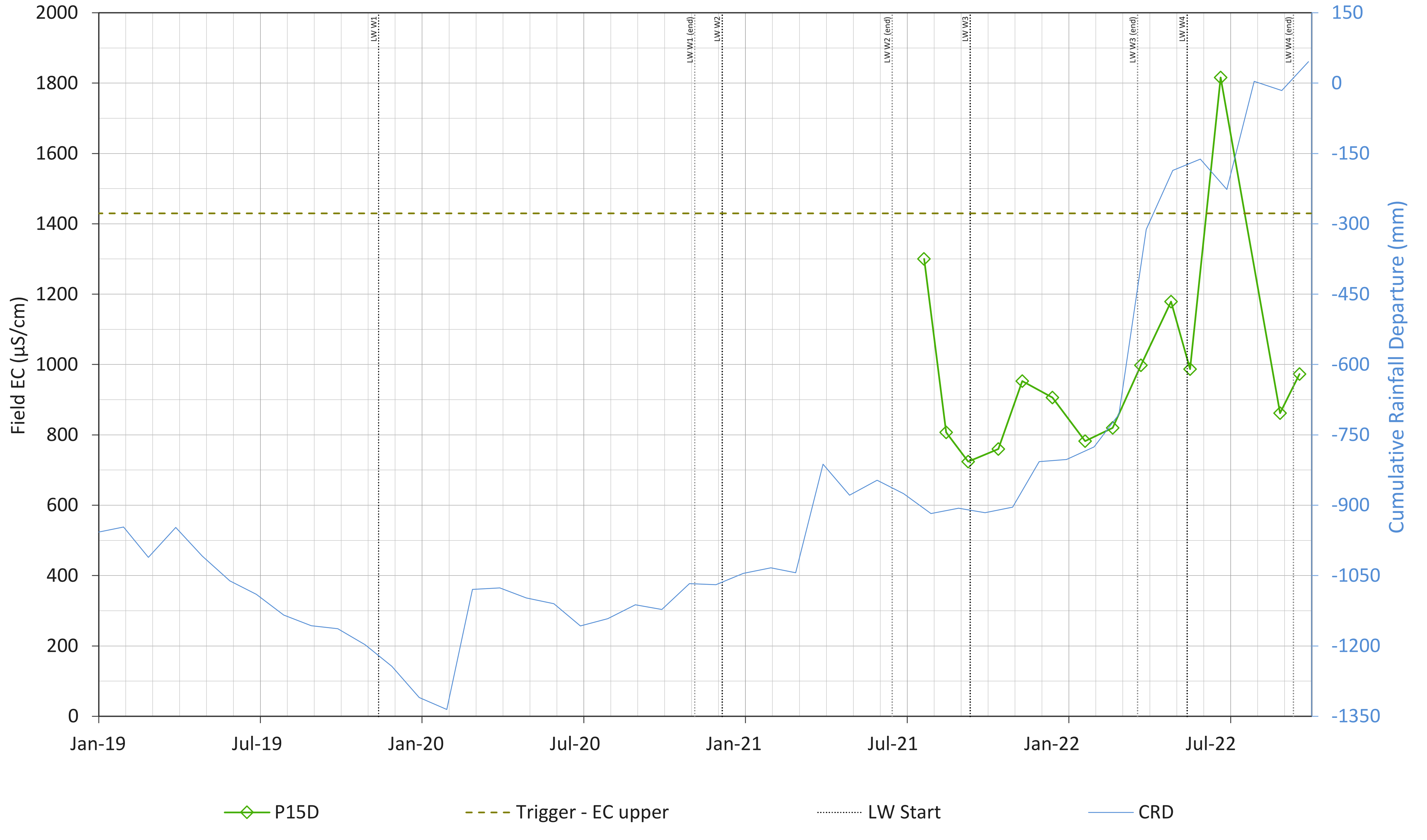
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Field EC (µS/cm)
225
50
-125
-300
-475
-650
-825
-1000
-1175
-1350
Cumulative Rainfall Departure (mm)
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
P15B
Trigger - EC upper
LW Start
CRD


Figure D2



Field EC (µS/cm)
Cumulative Rainfall Departure (mm)
4000
3500
3000
2500
2000
1500
1000
500
0
50
-125
-300
-475
-650
-825
-1000
-1175
-1350
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
P15C
Trigger - EC upper
LW Start
CRD


Figure D3



Field EC (µS/cm)
Cumulative Rainfall Departure (mm)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
150
0
-150
-300
-450
-600
-750
-900
-1050
-1200
-1350
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
P15D
Trigger - EC upper
LW Start
CRD


Figure D4

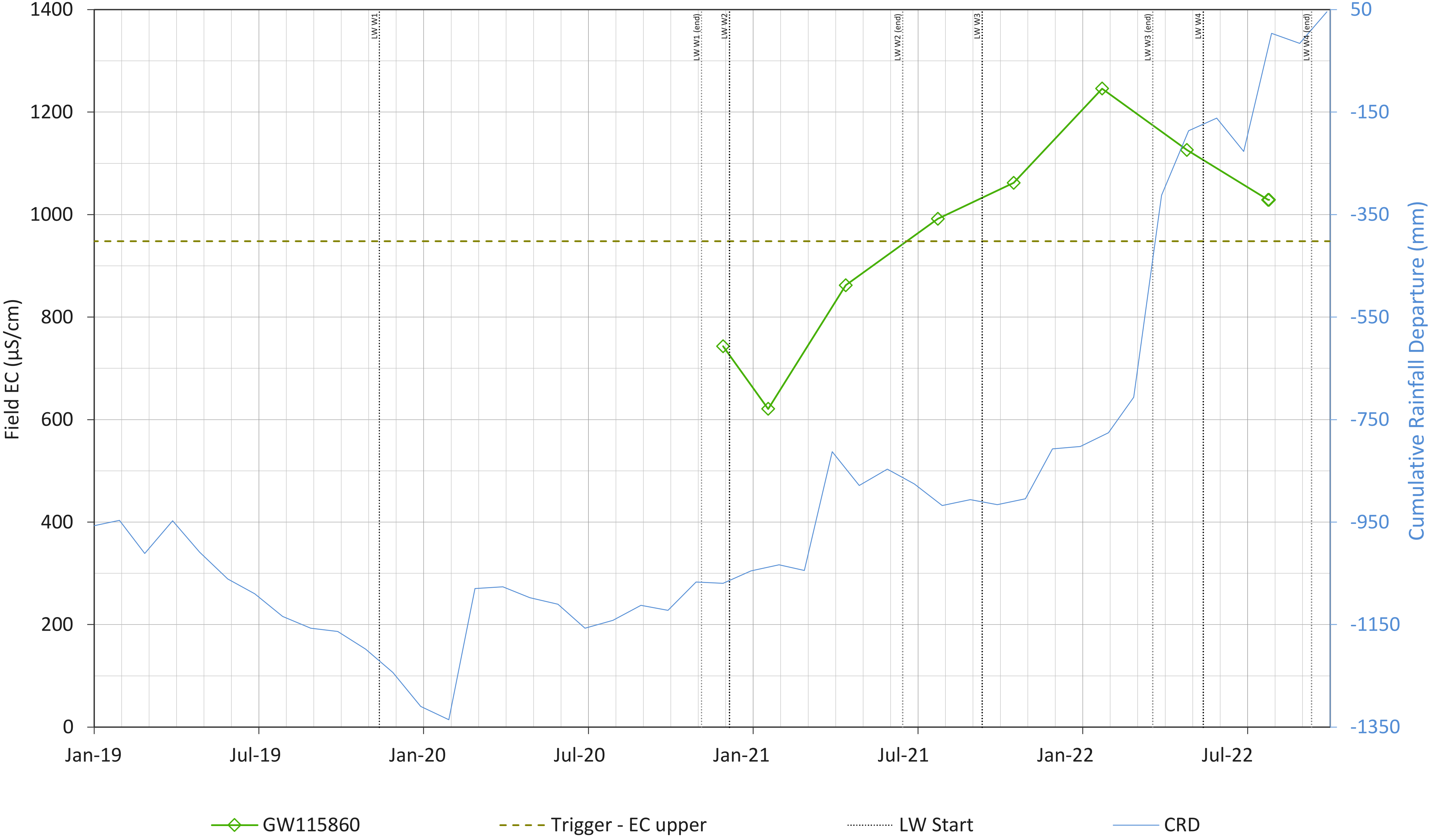
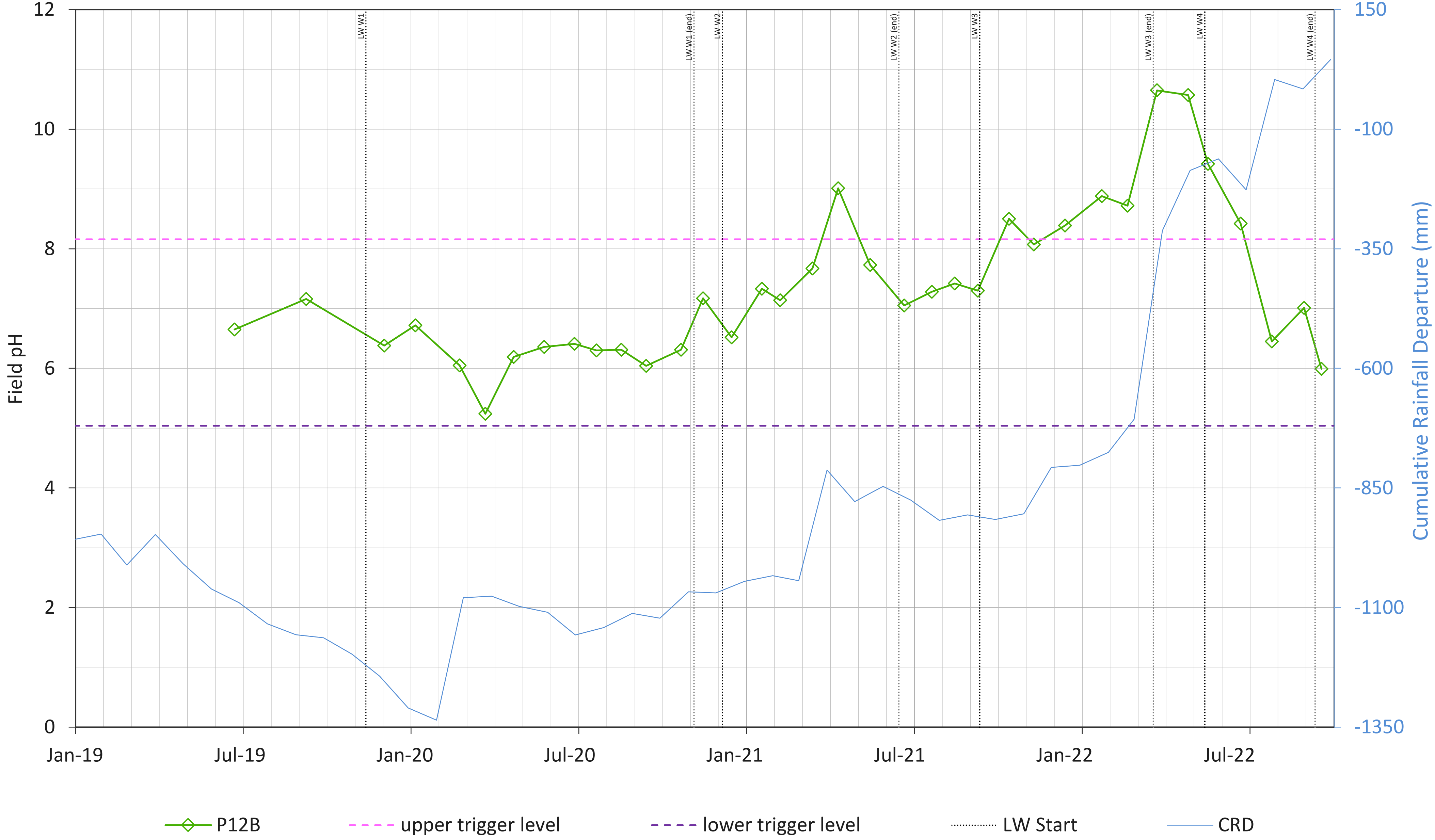

LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
1400
1200
1000
800
600
400
200
0
Field EC (µS/cm)
50
-150
-350
-550
-750
-950
-1150
-1350
Cumulative Rainfall Departure (mm)
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
GW115860
Trigger - EC upper
LW Start
CRD

Figure D5



Field pH
Cumulative Rainfall Departure (mm)
12
10
8
6
4
2
0
150
-100
-350
-600
-850
-1100
-1350
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
P12B
upper trigger level
lower trigger level
LW Start
CRD


Figure D6

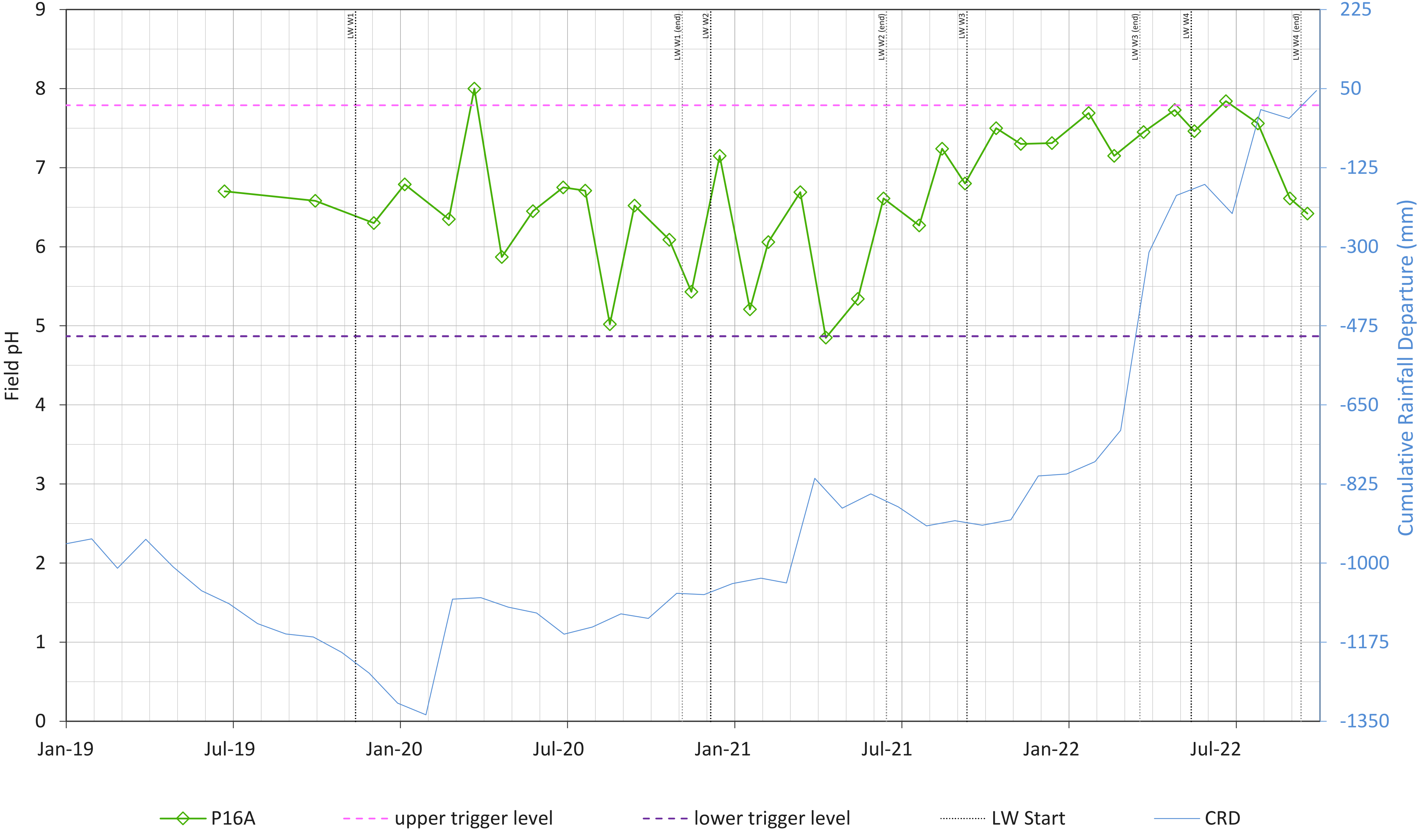

Field pH
Cumulative Rainfall Departure (mm)
9
8
7
6
5
4
3
2
1
0
225
50
-125
-300
-475
-650
-825
-1000
-1175
-1350
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
P16A
upper trigger level
lower trigger level
LW Start
CRD

Figure D7

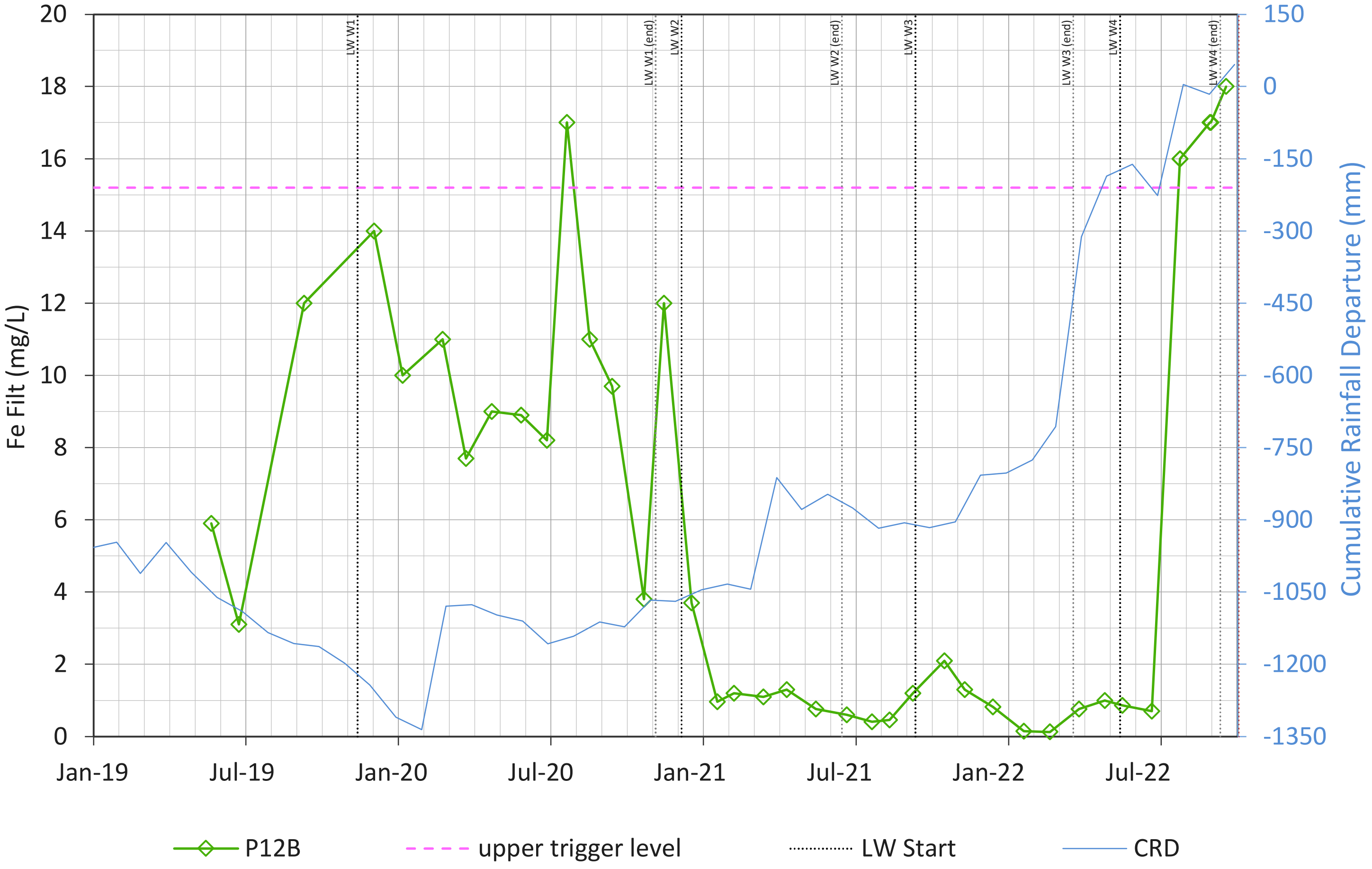



**Figure D8**

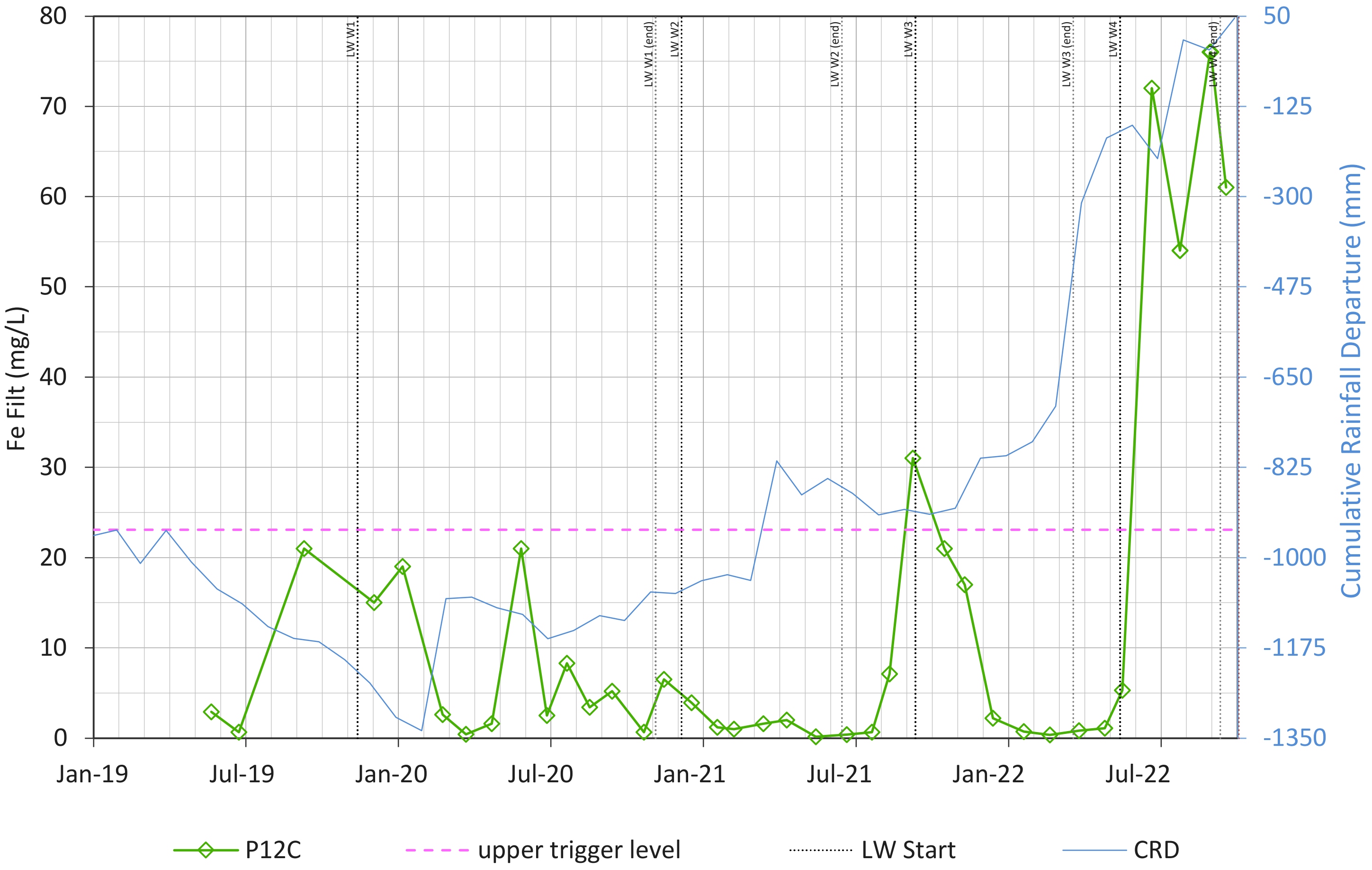



**Figure D9**

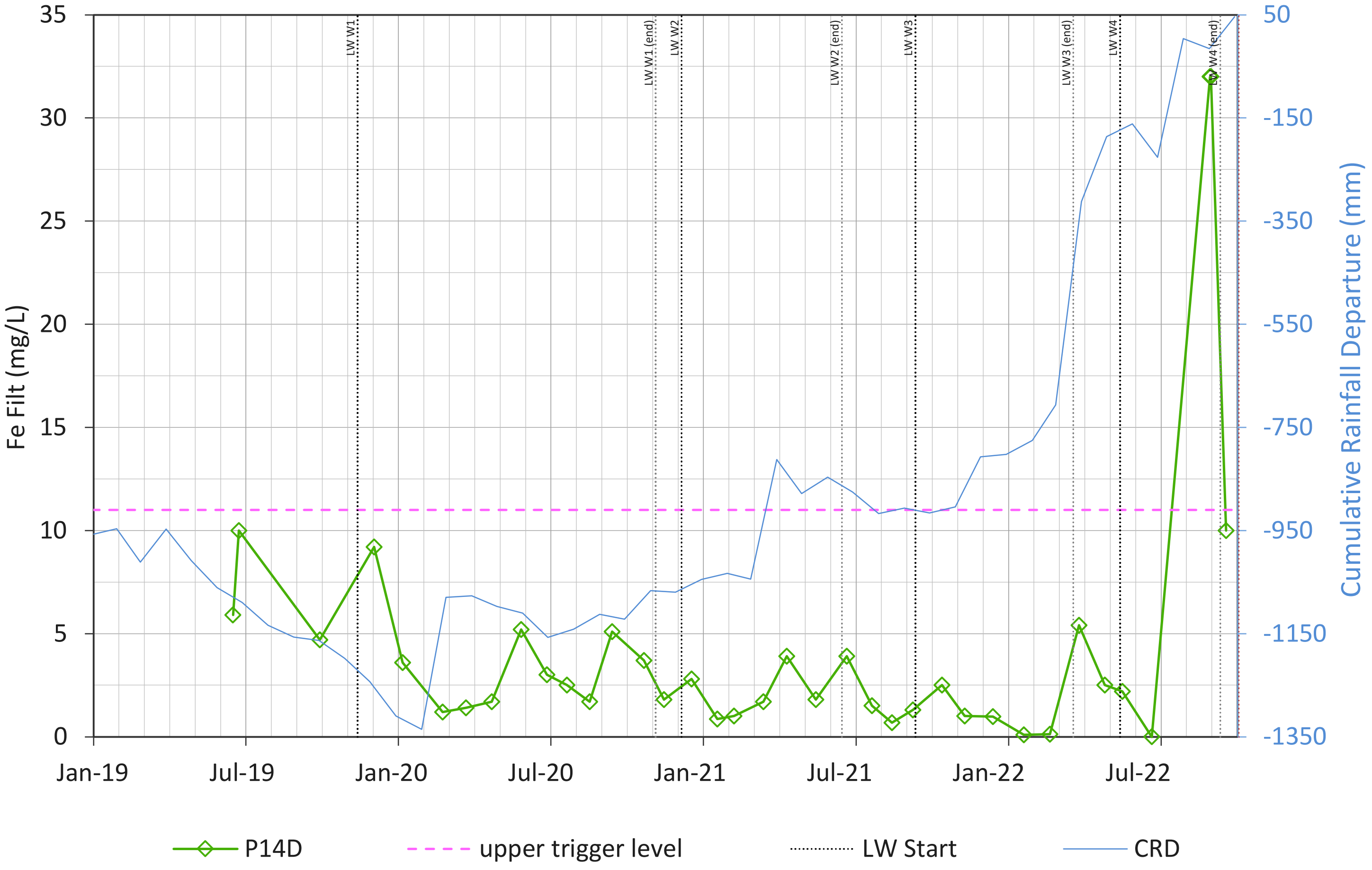



**Figure D10**

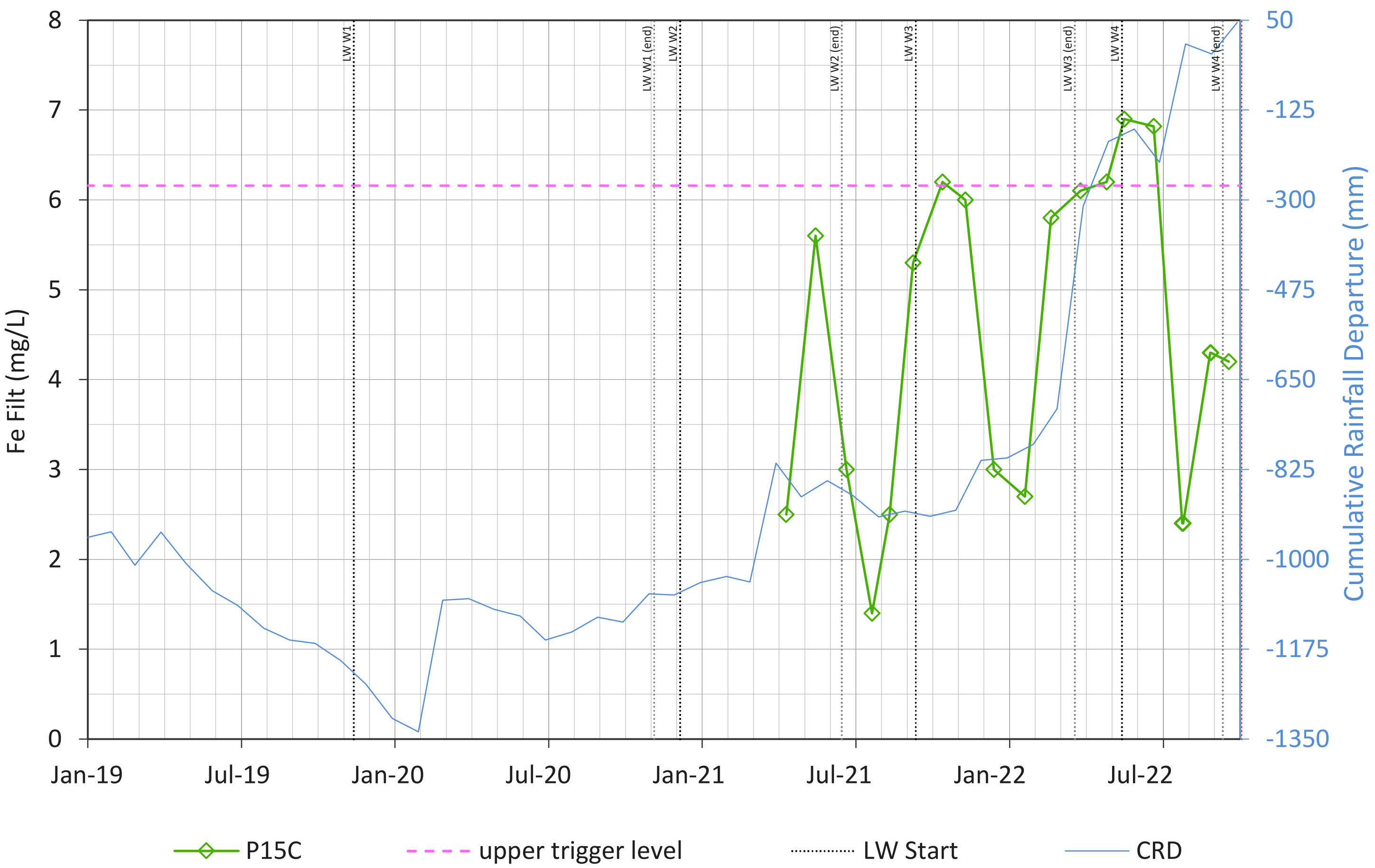



**Figure D11**

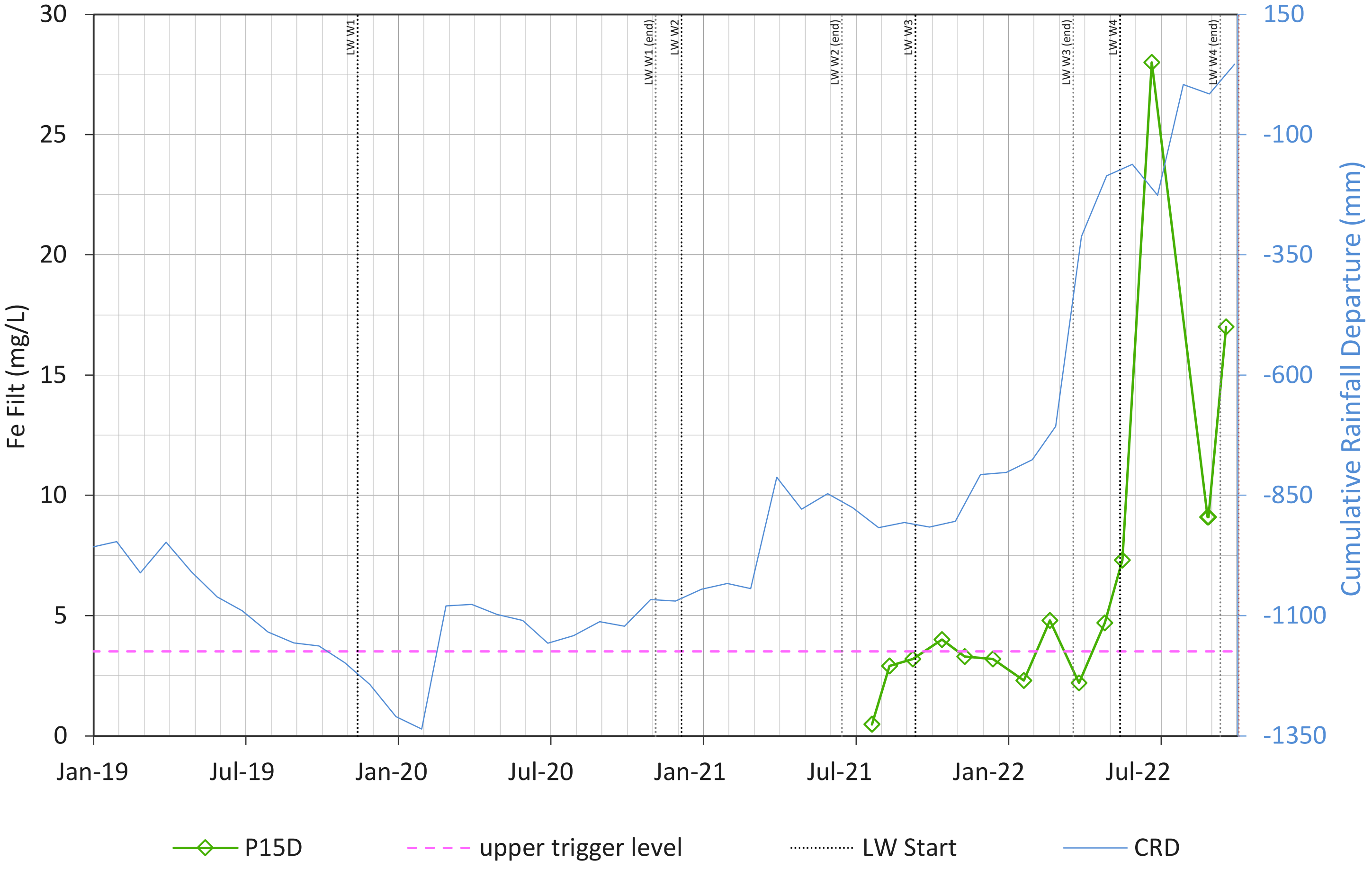



**Figure D12**

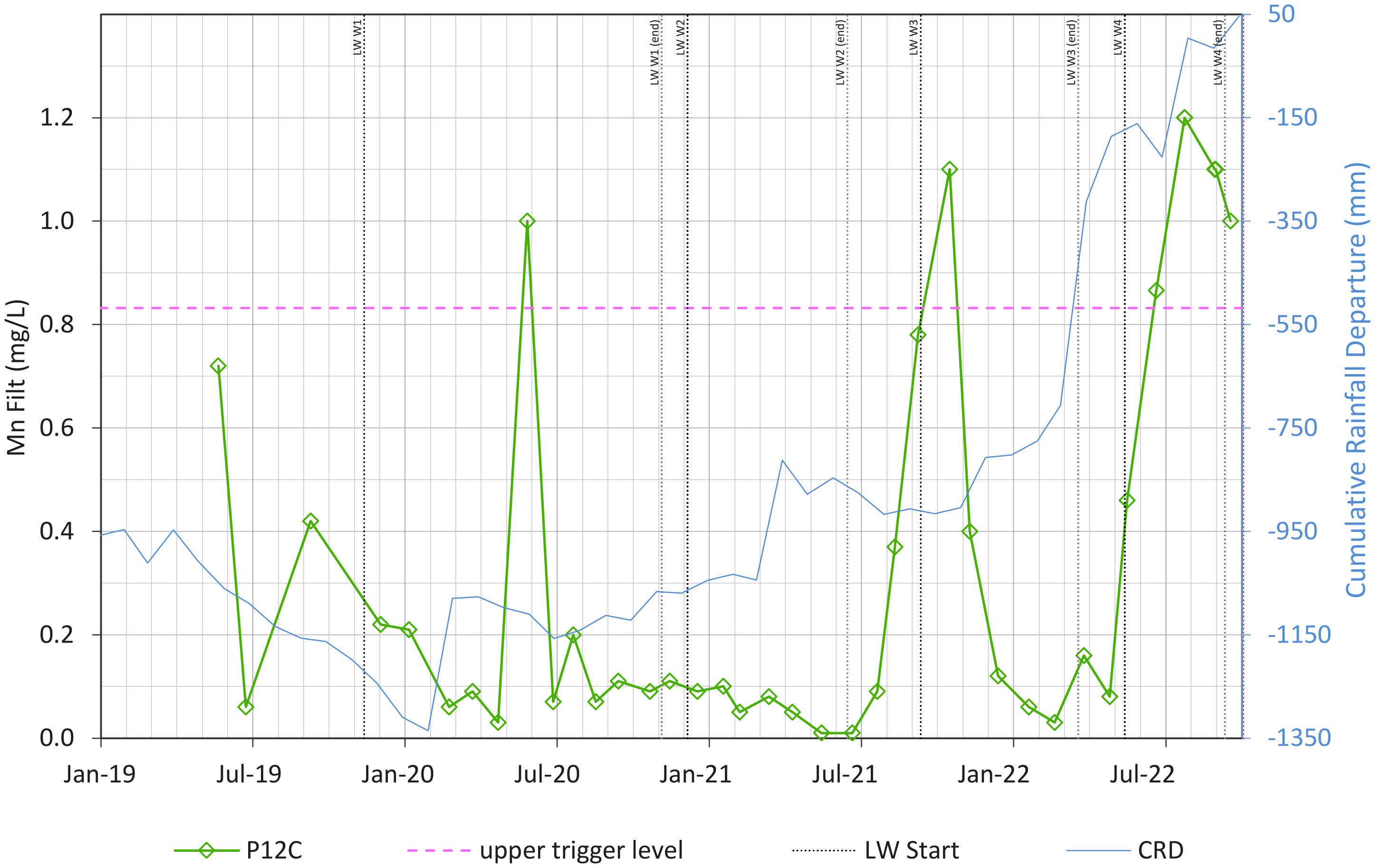



**Figure D13**

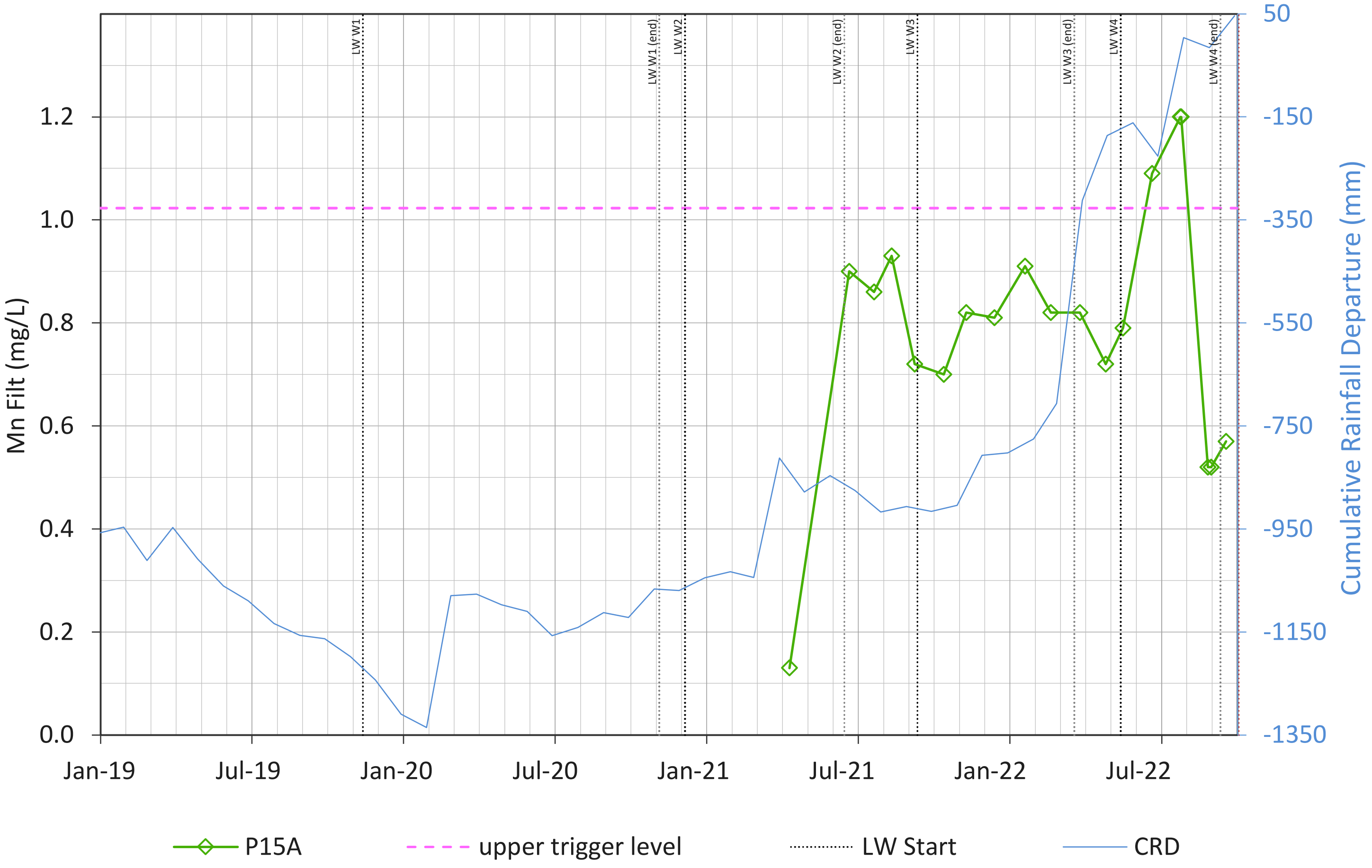



**Figure D14**

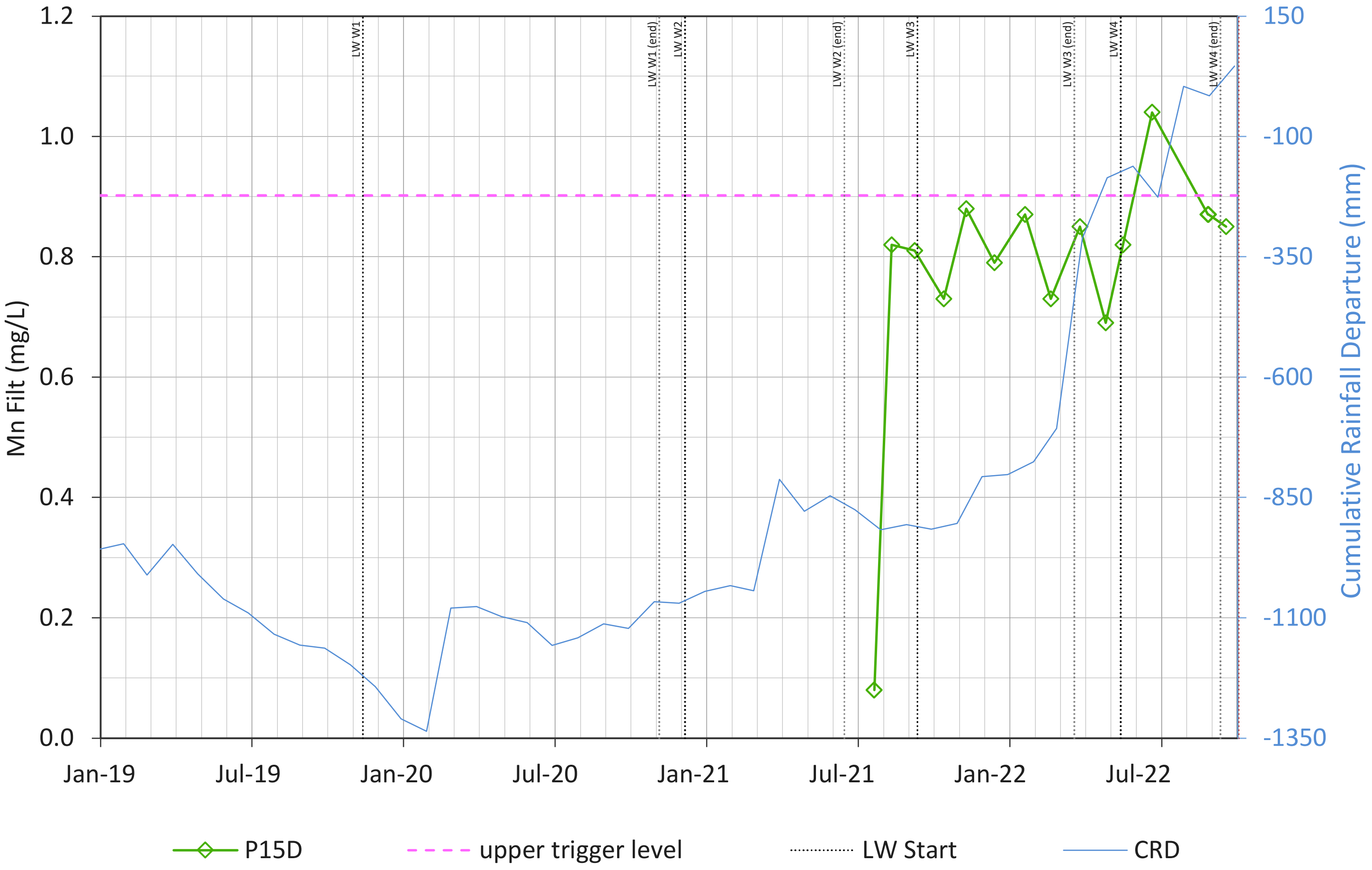



**Figure D15**

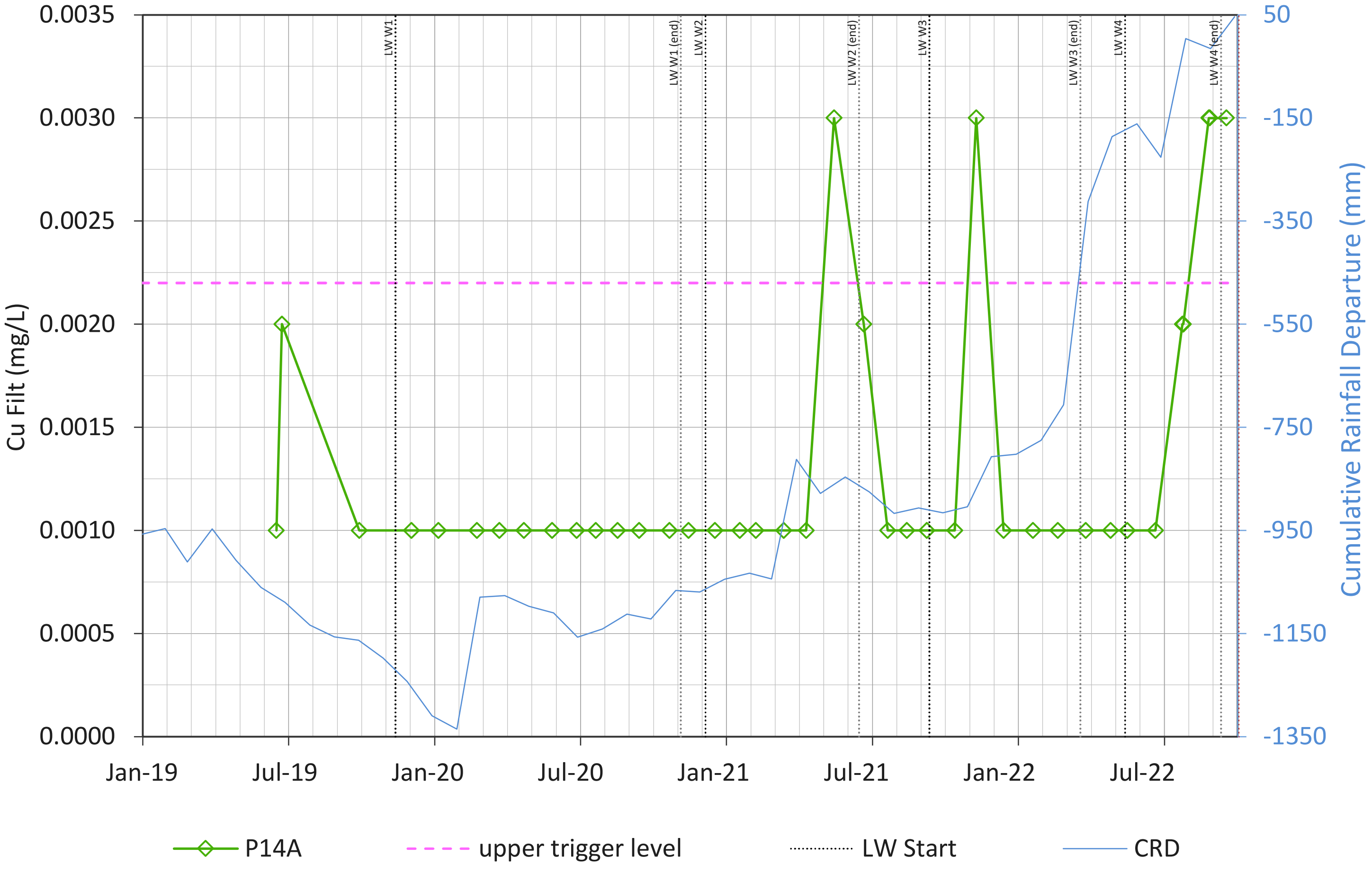
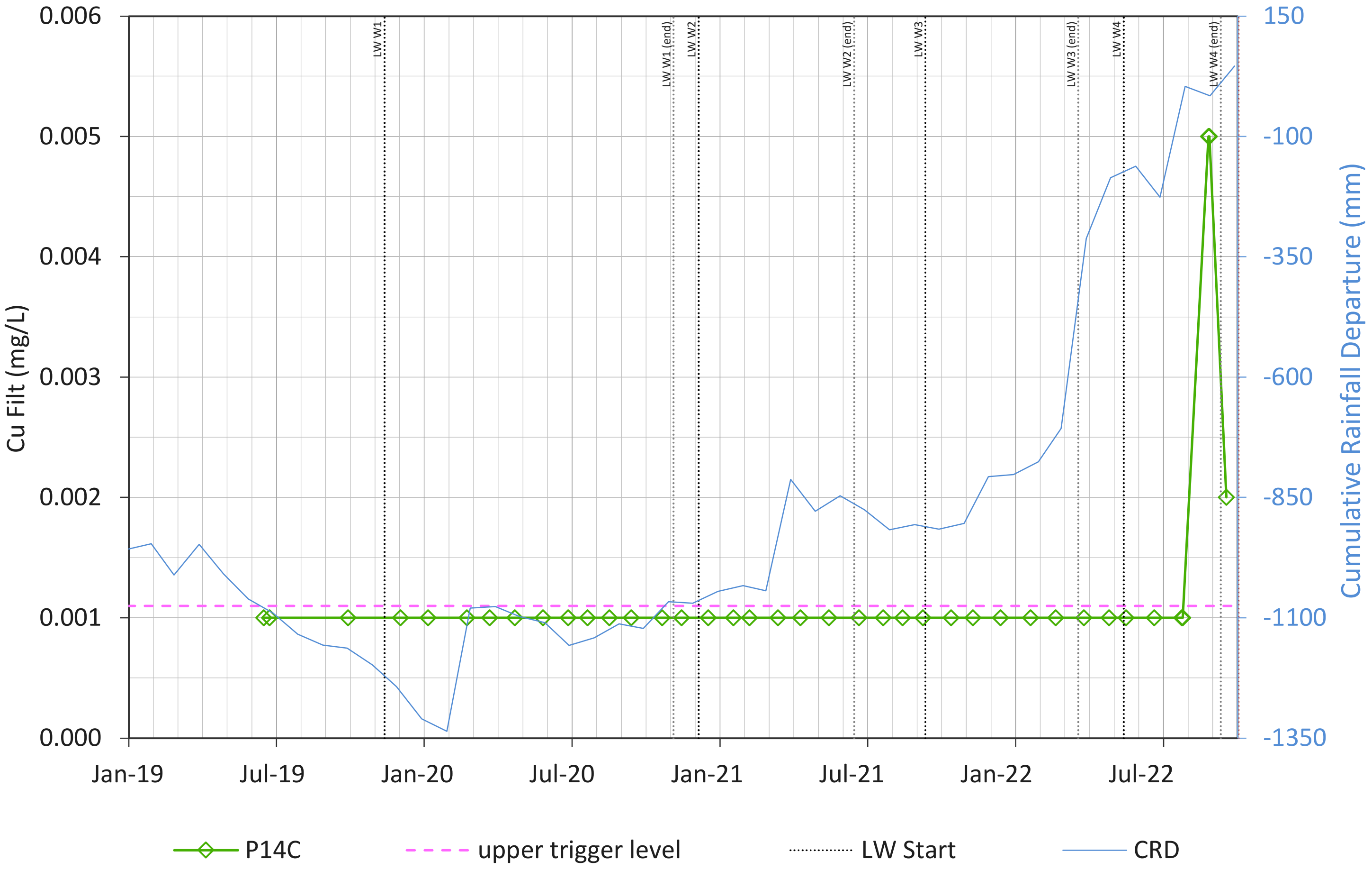



**Figure D16**

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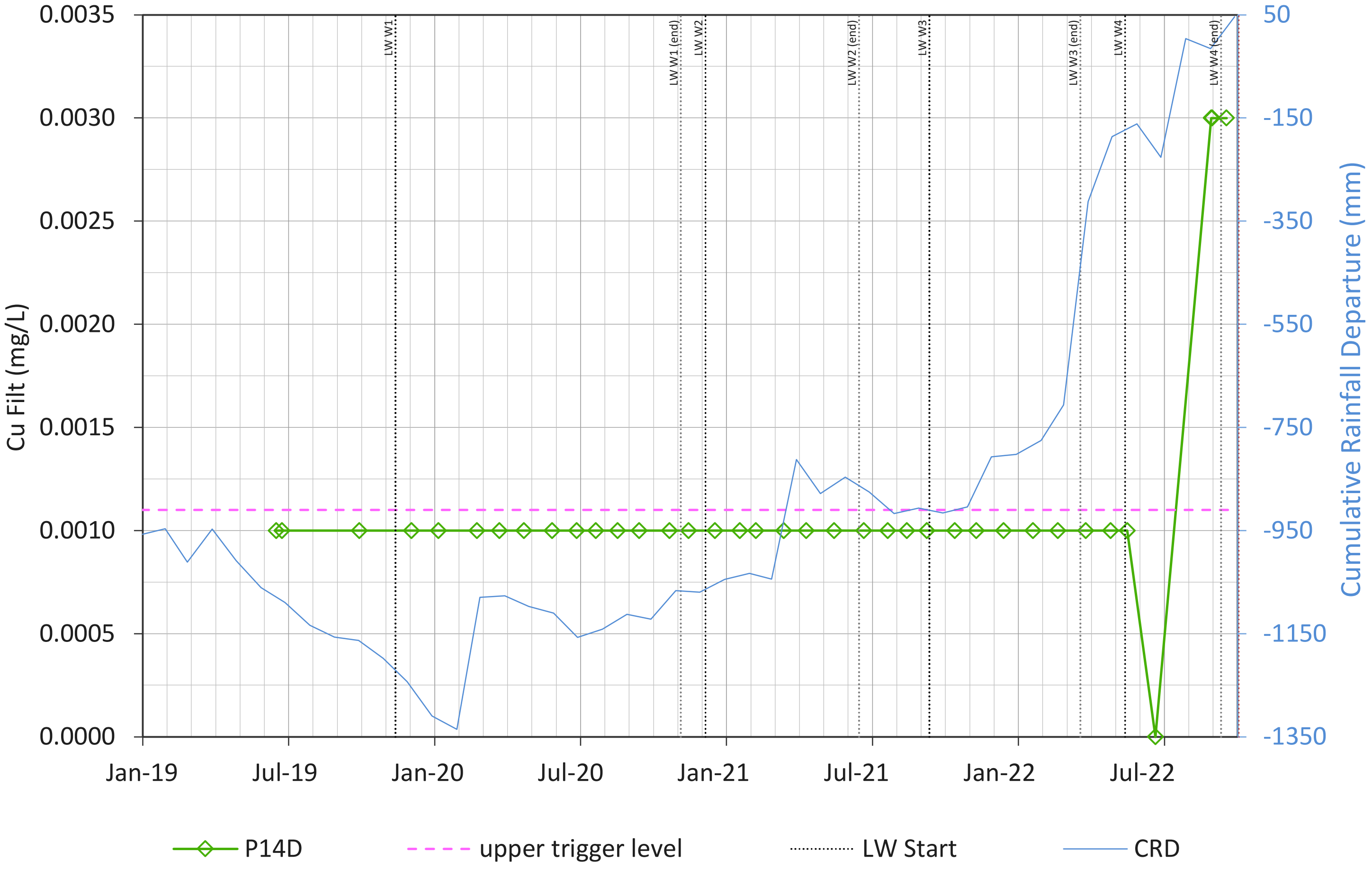


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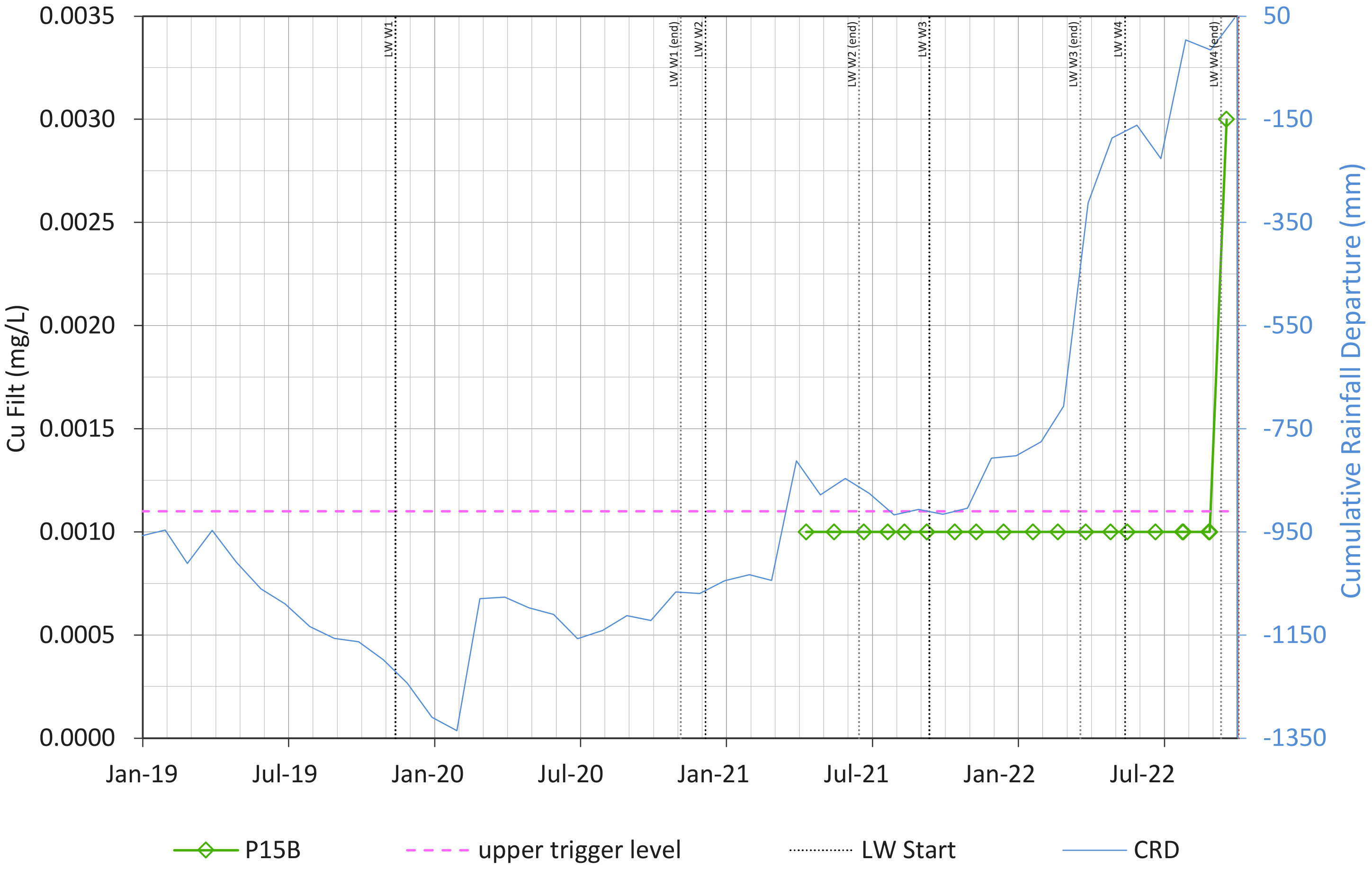


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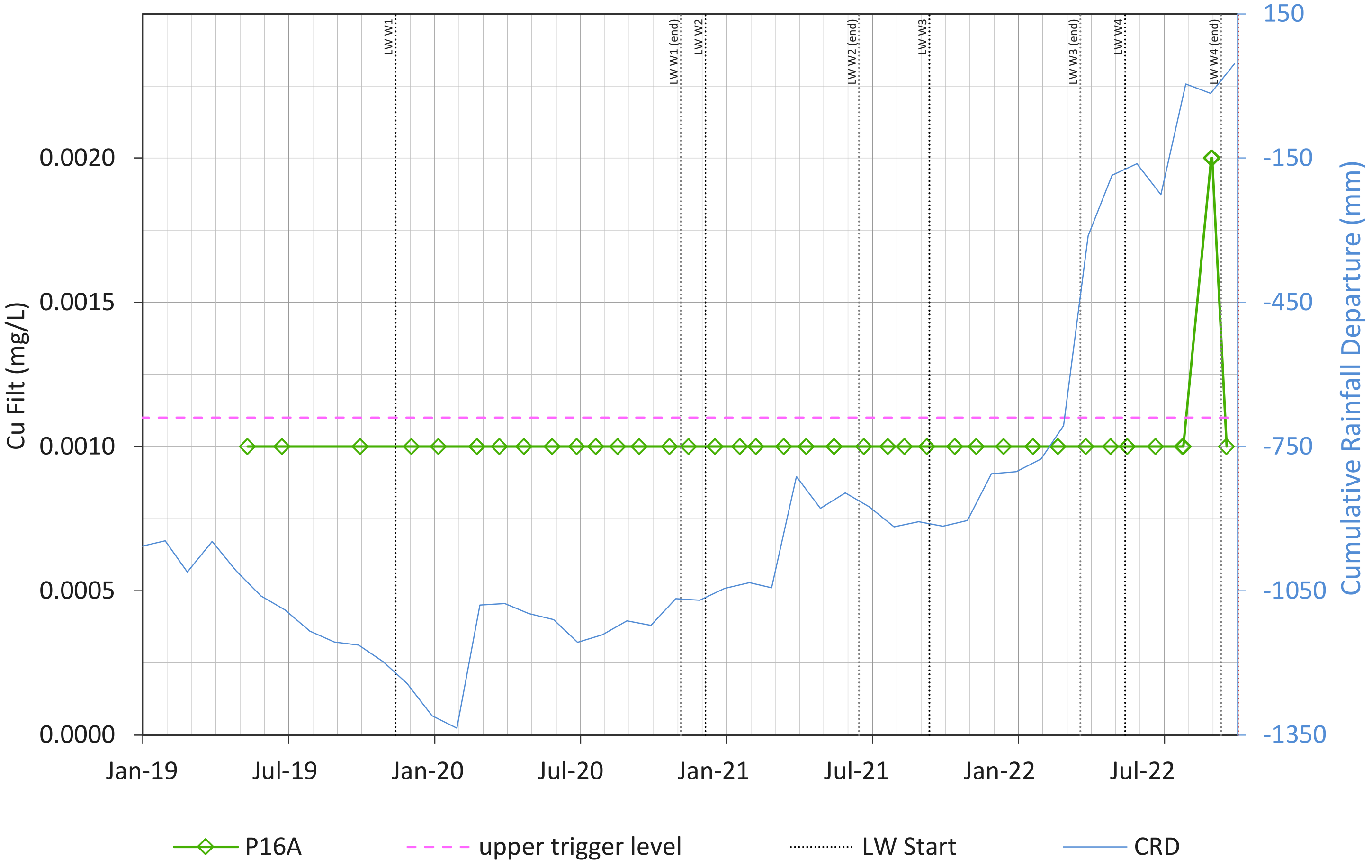


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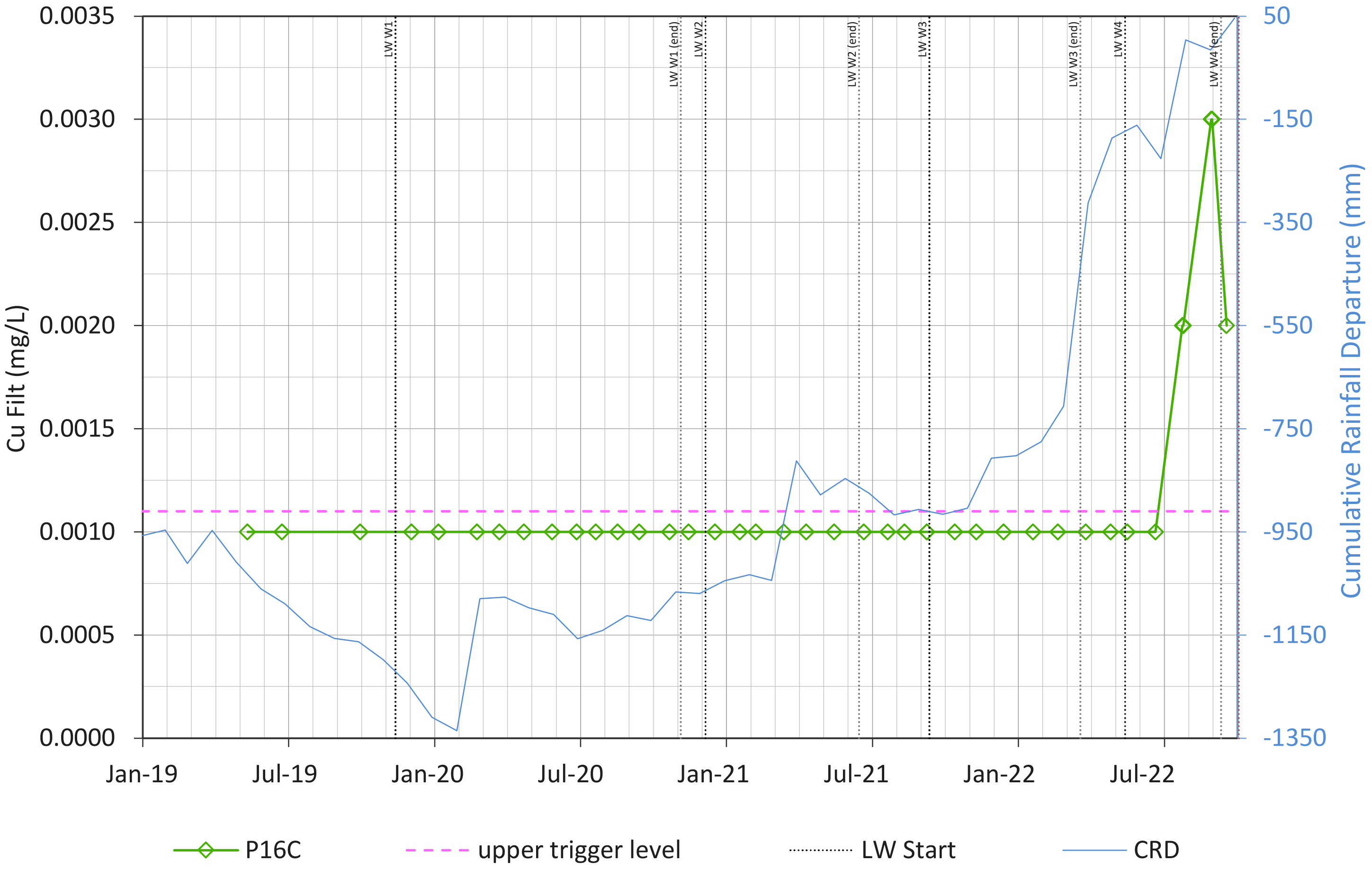


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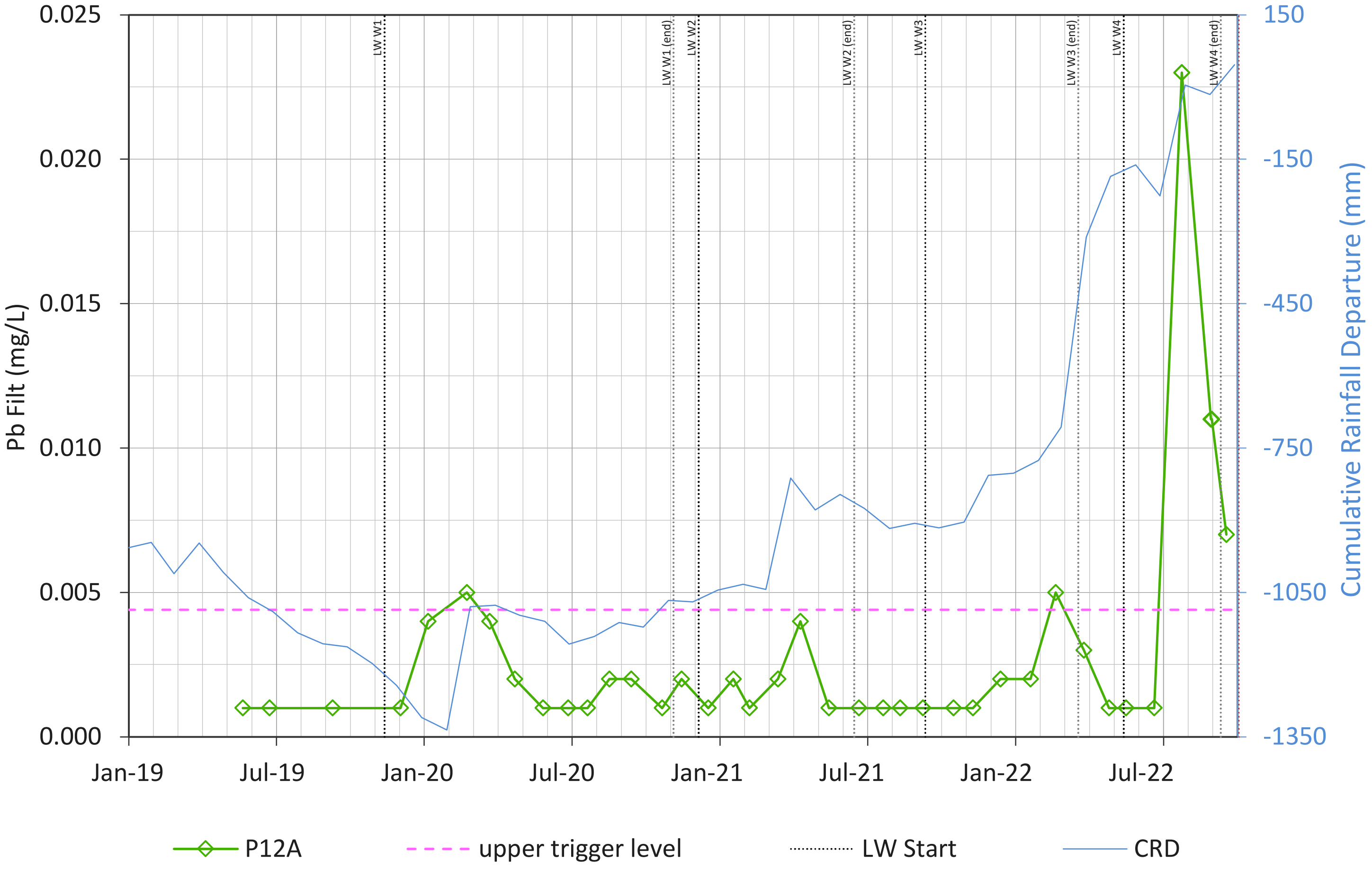


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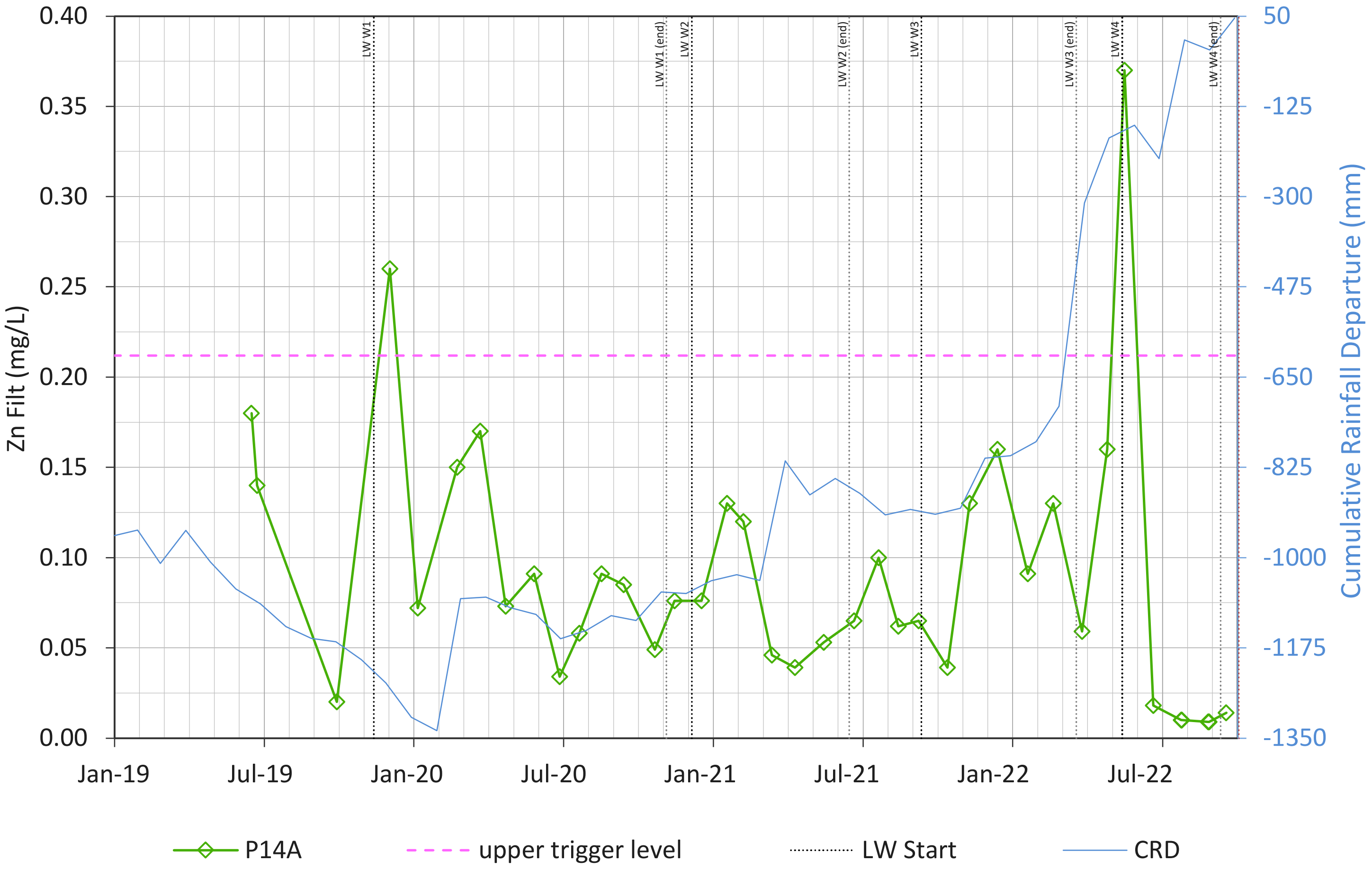


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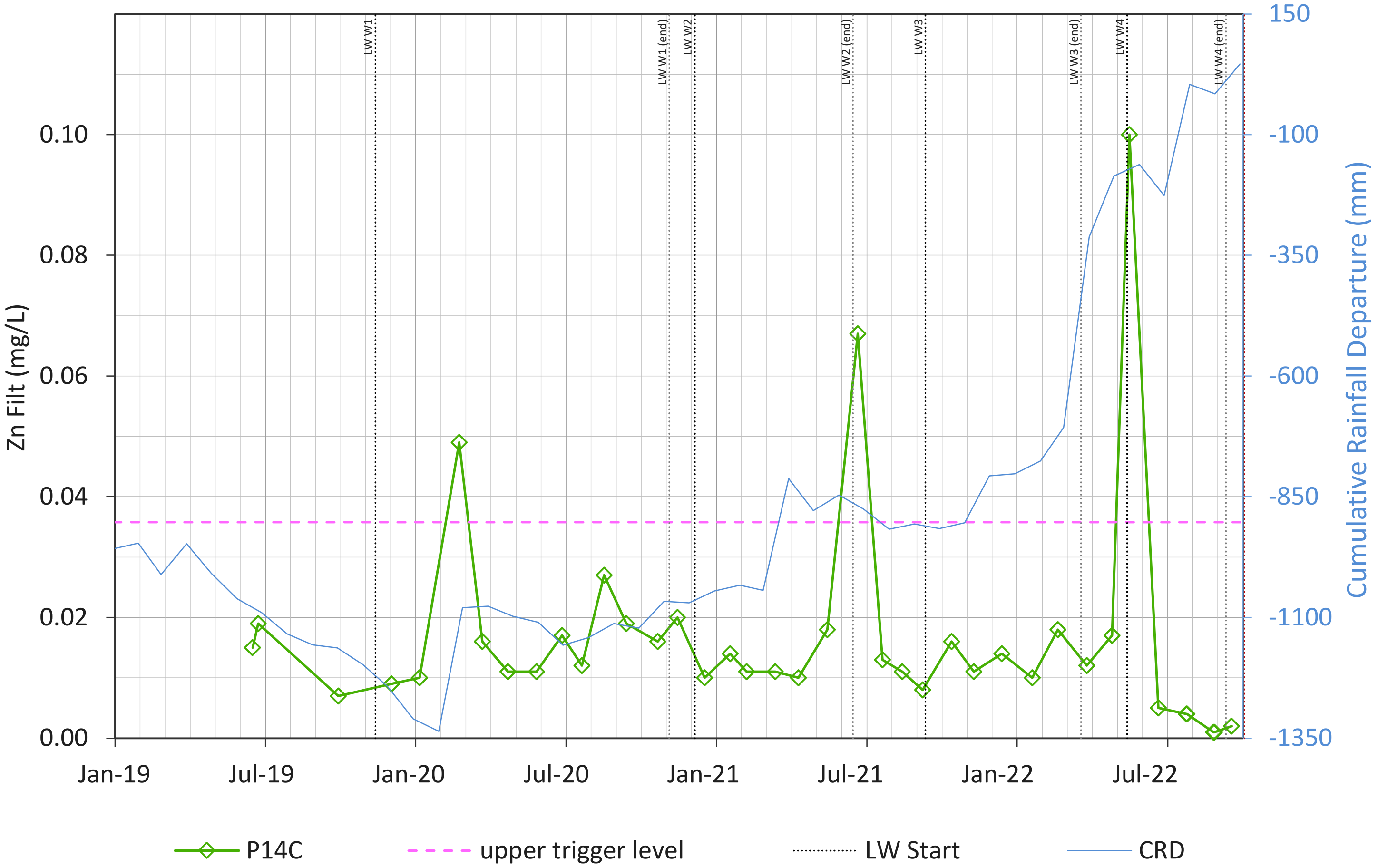


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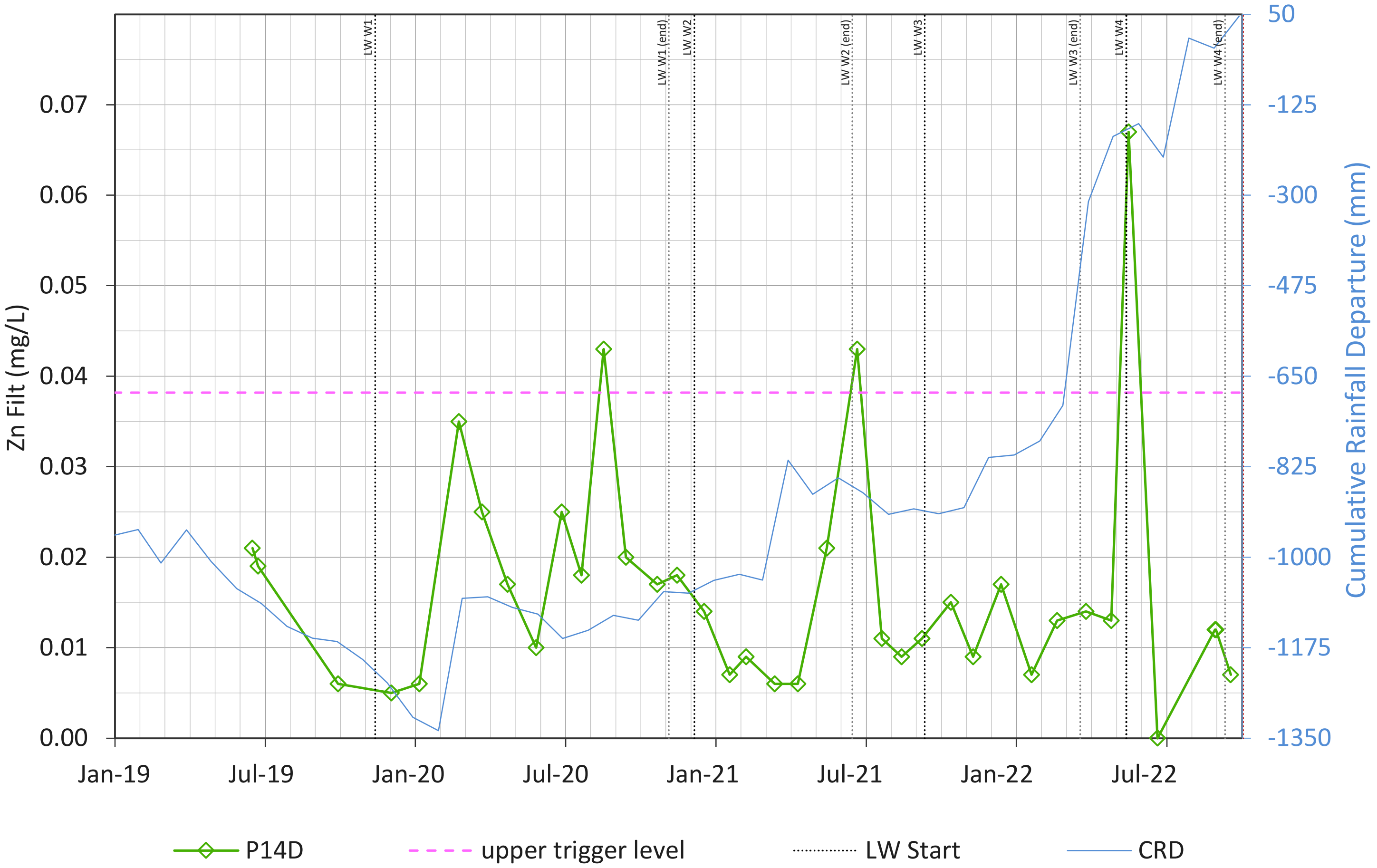


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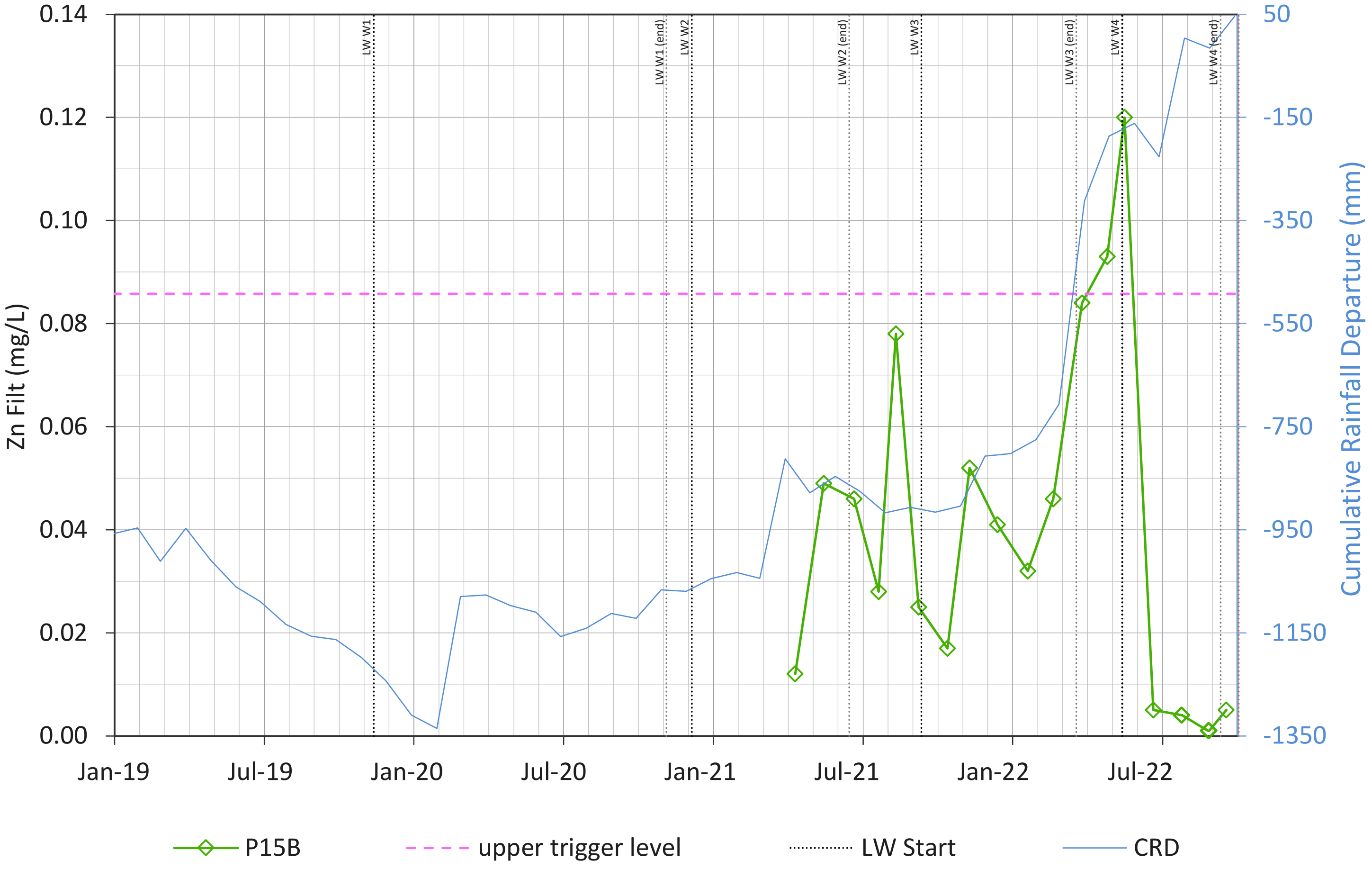


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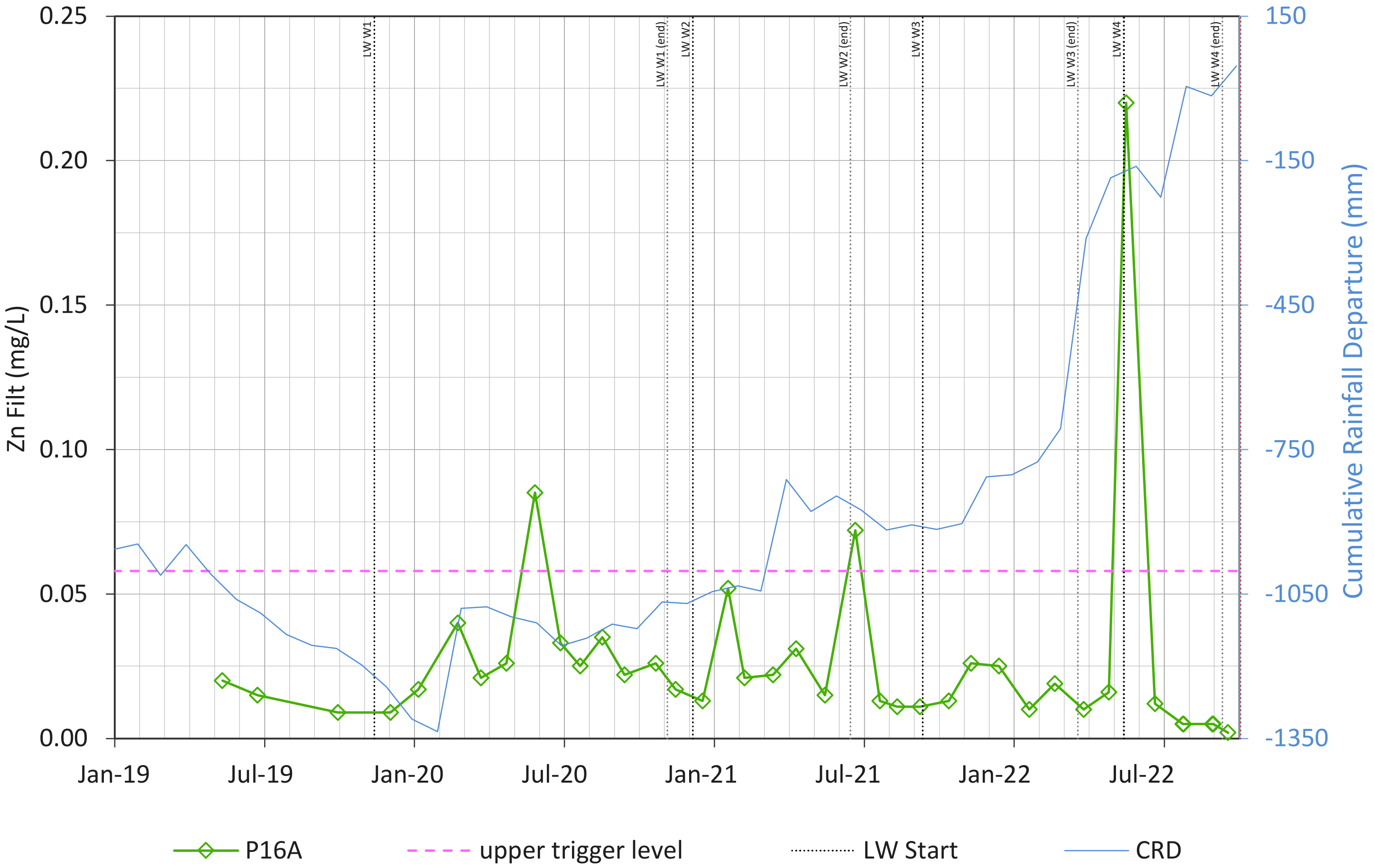


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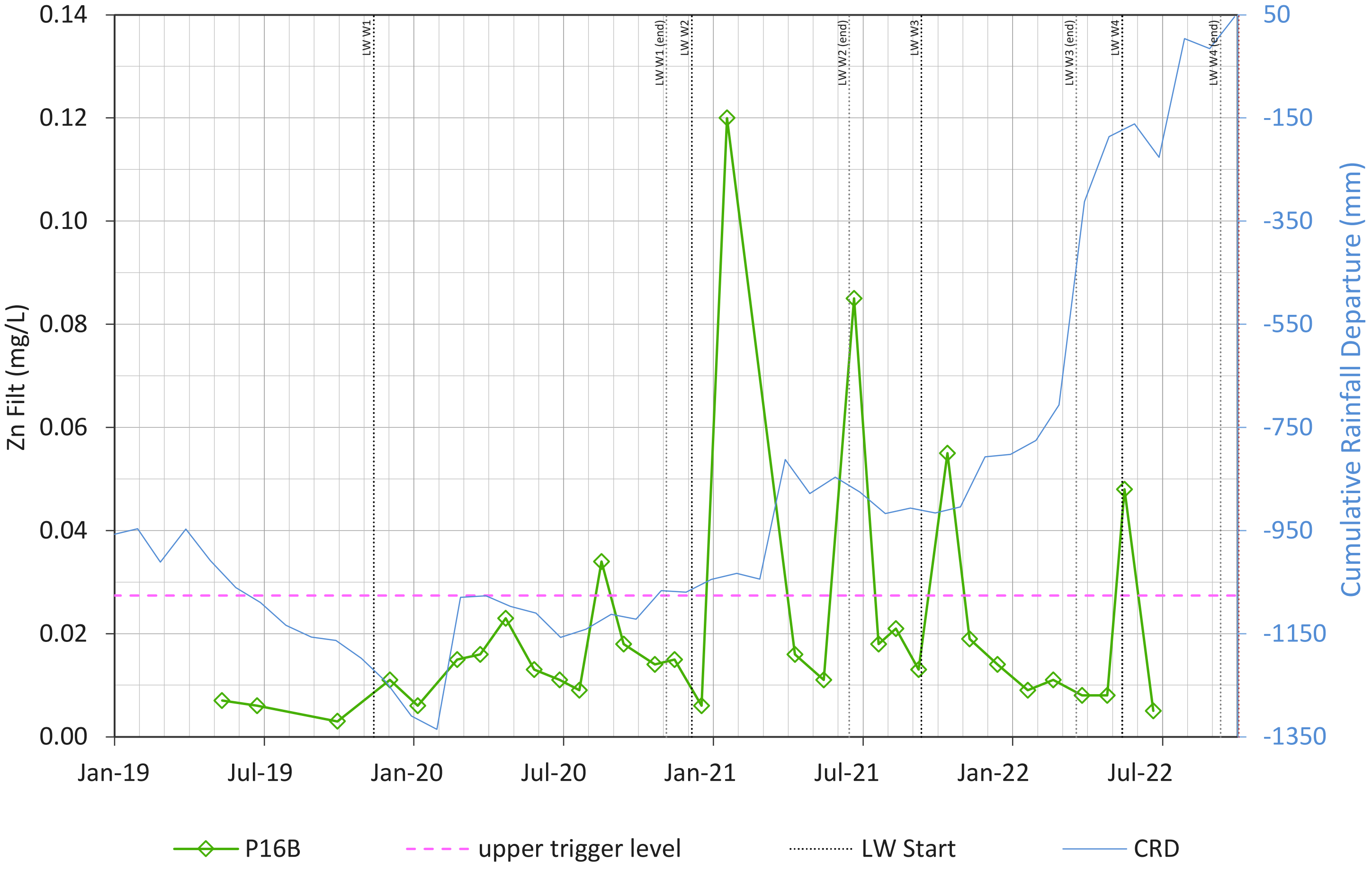


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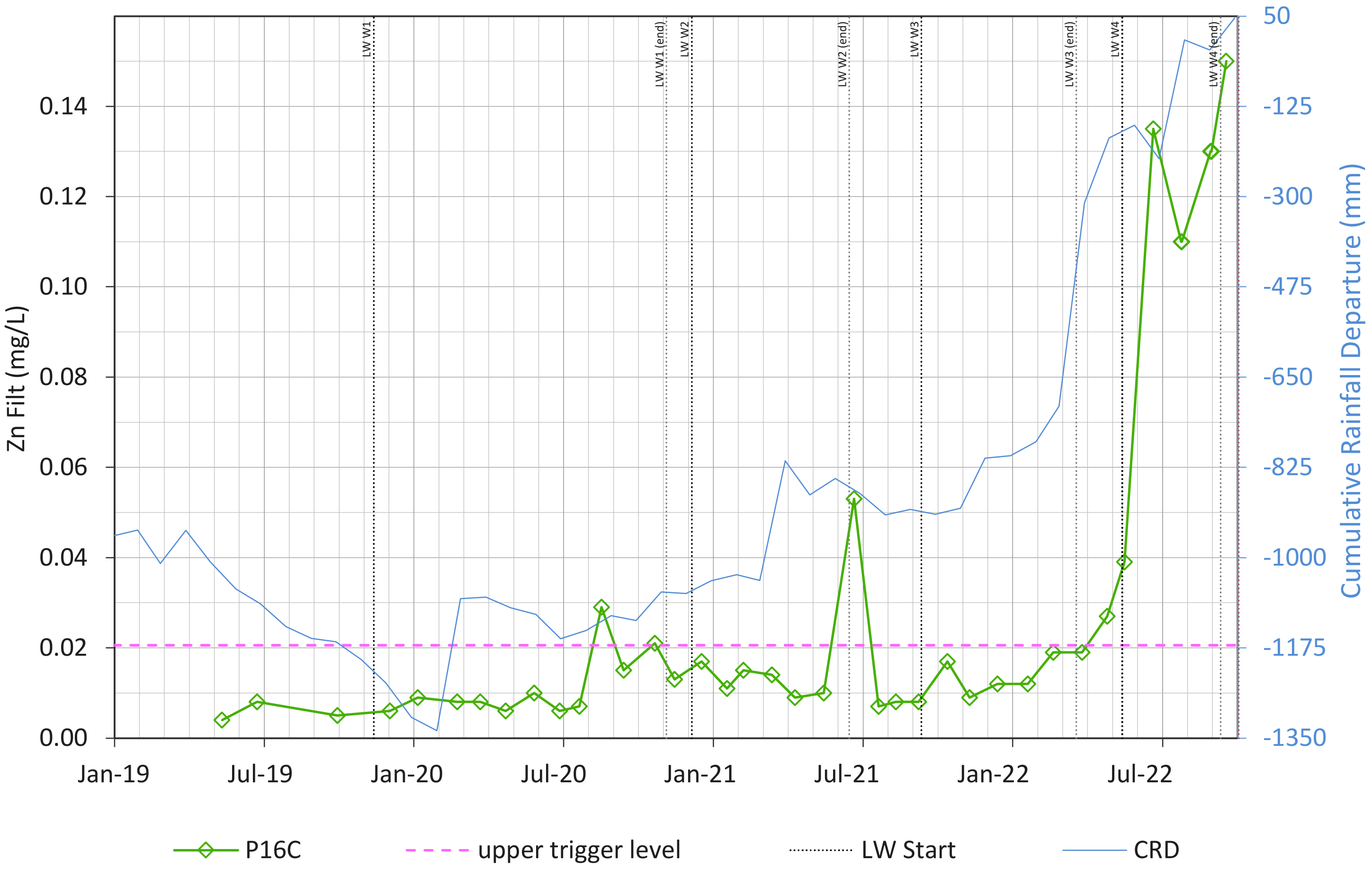


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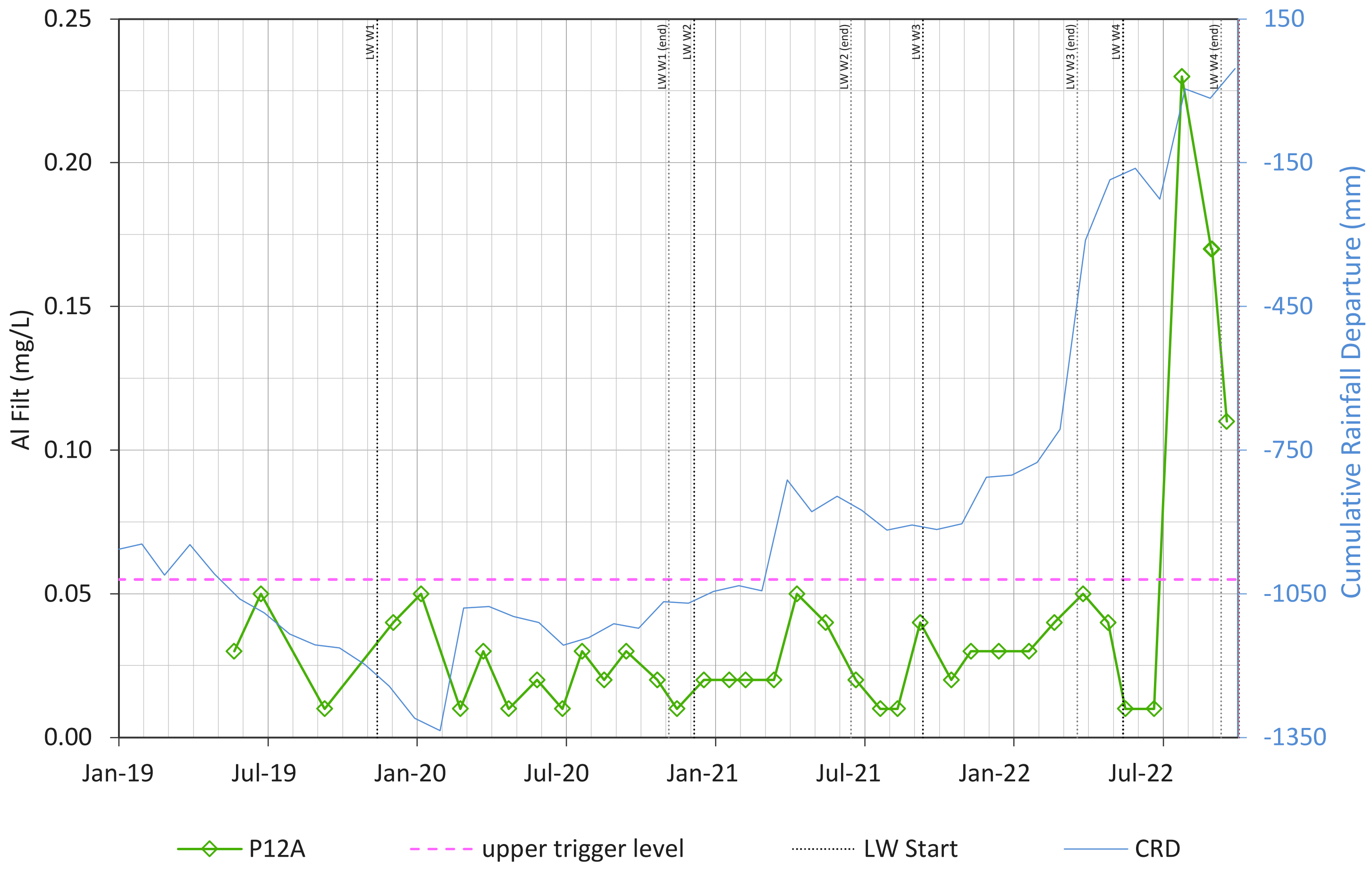


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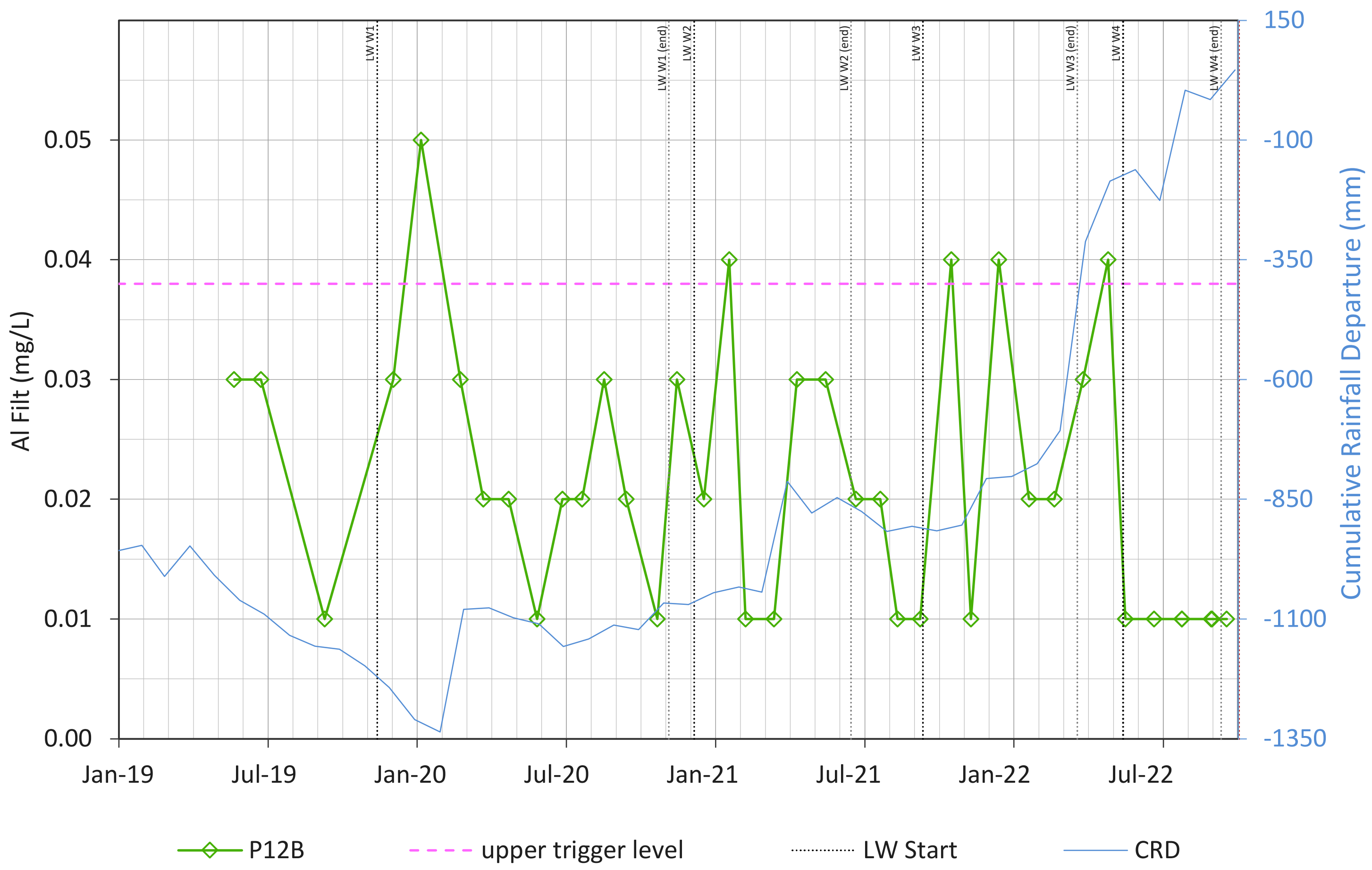


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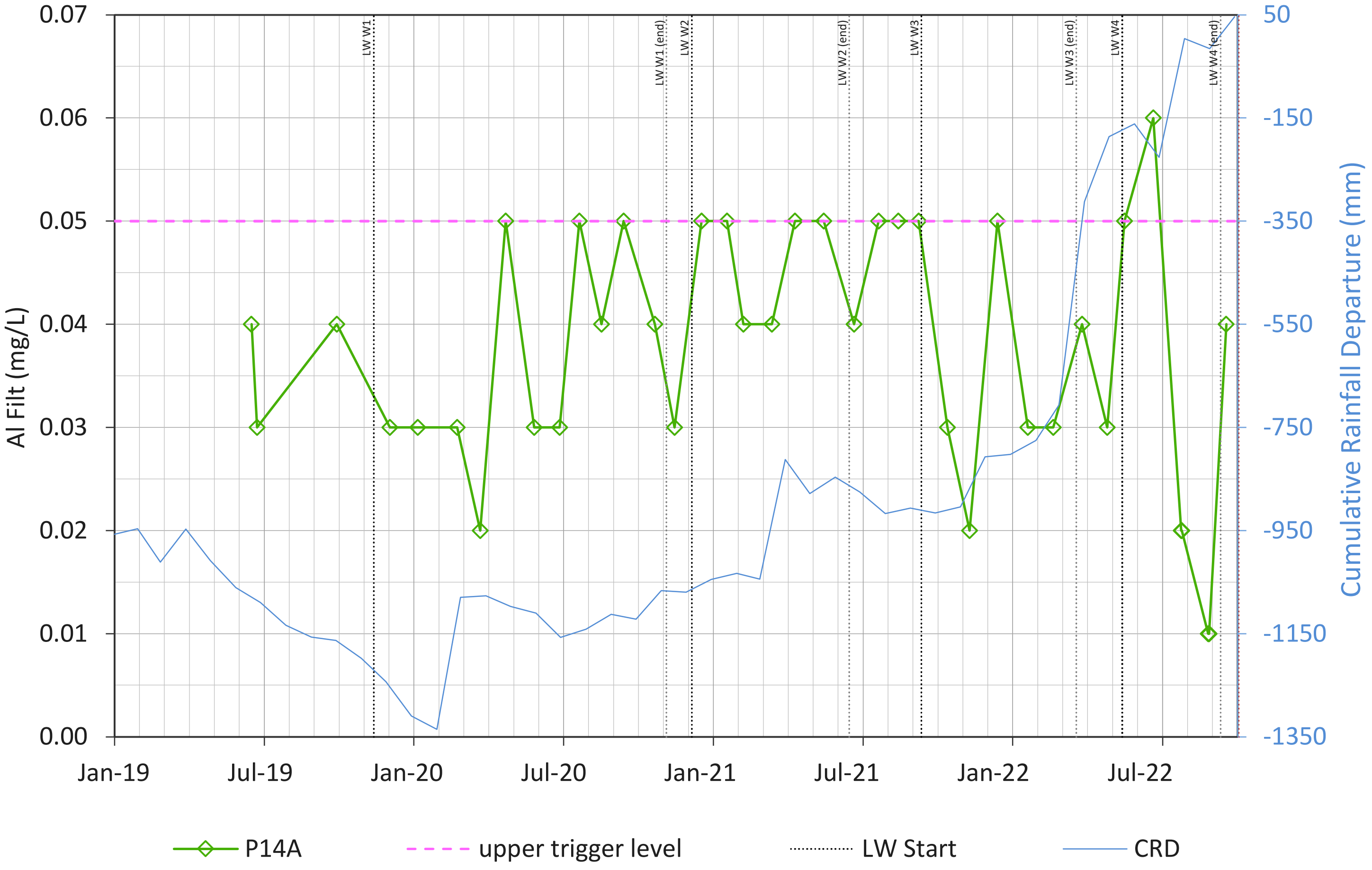


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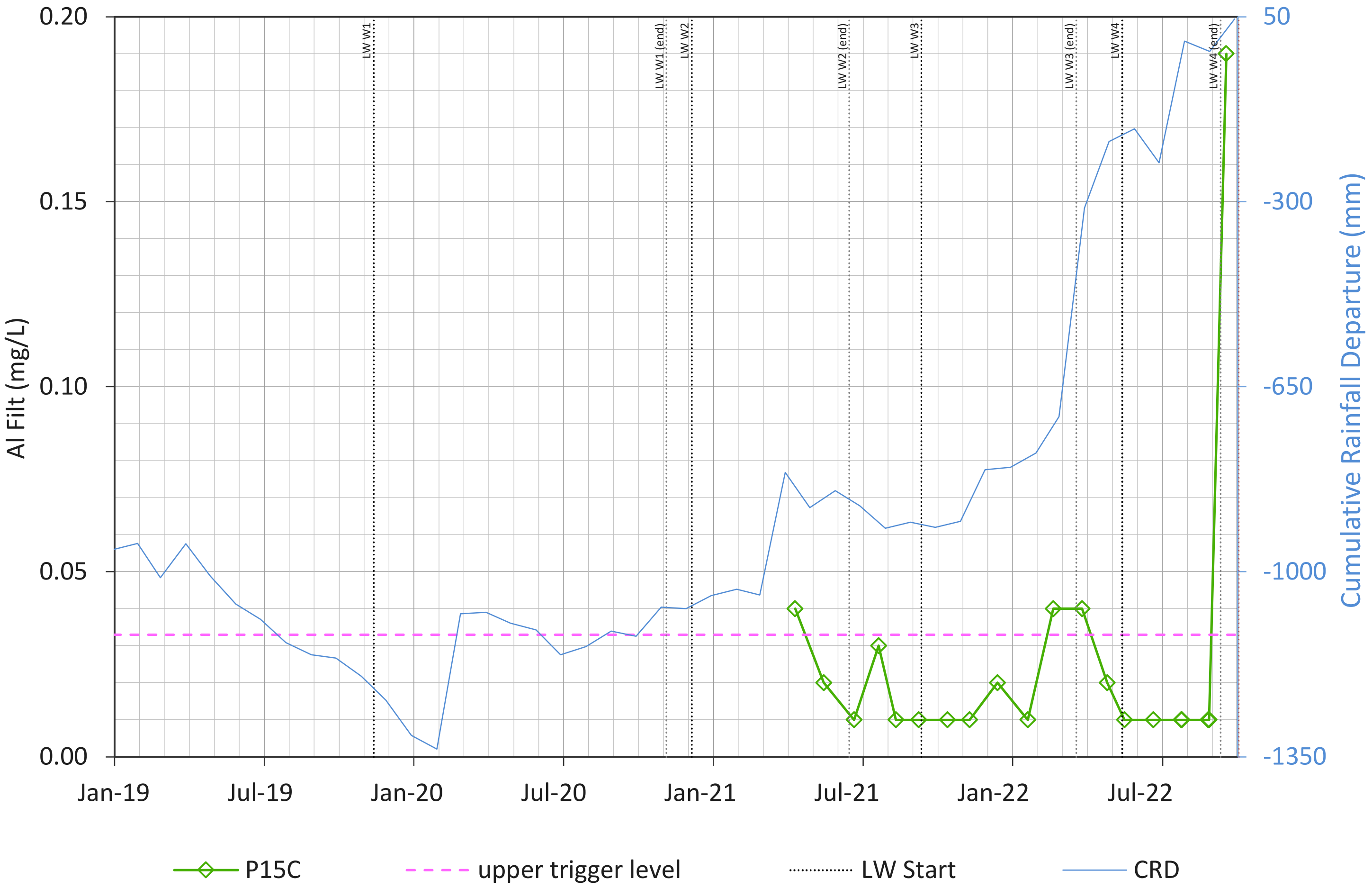


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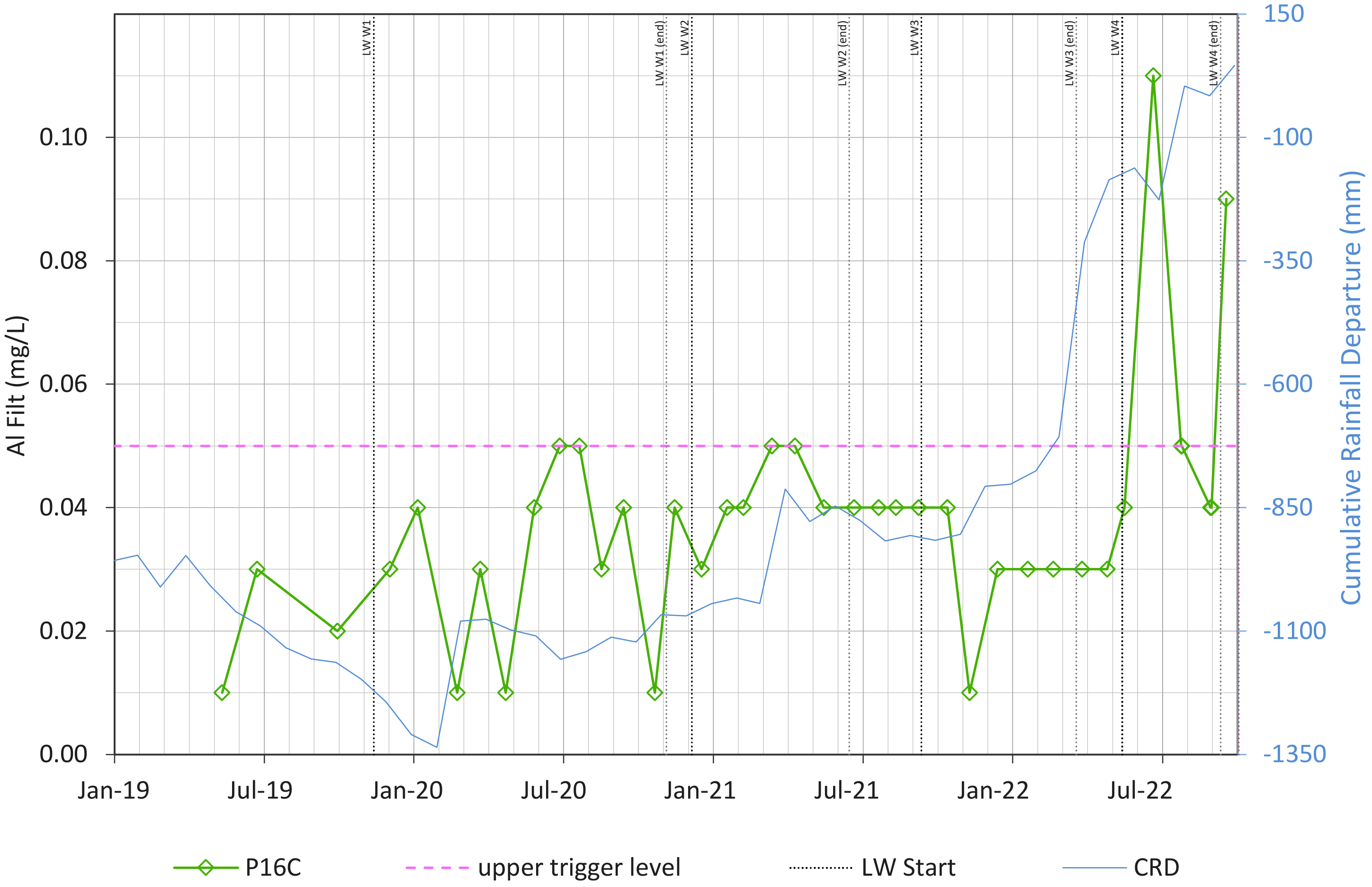


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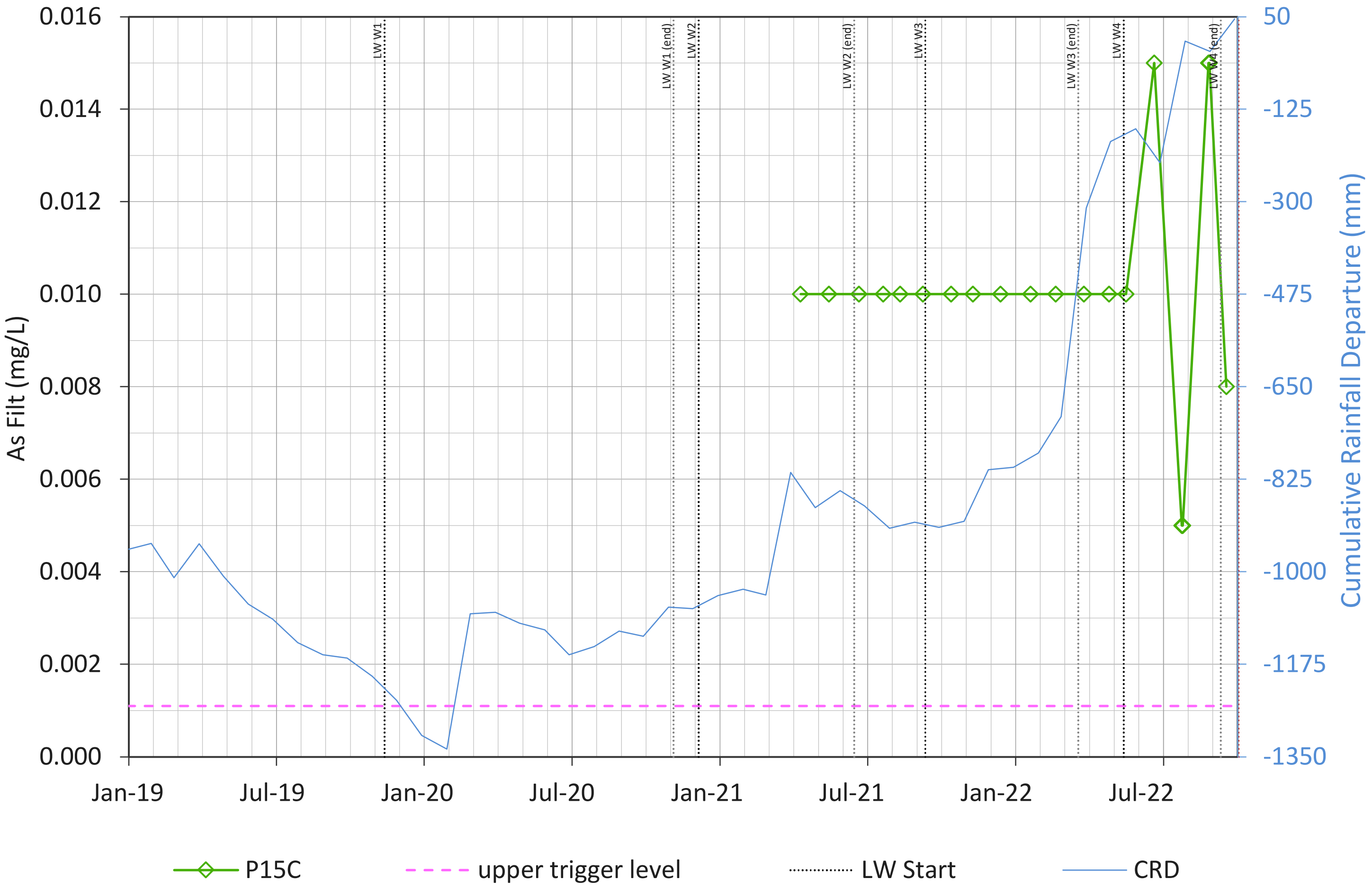


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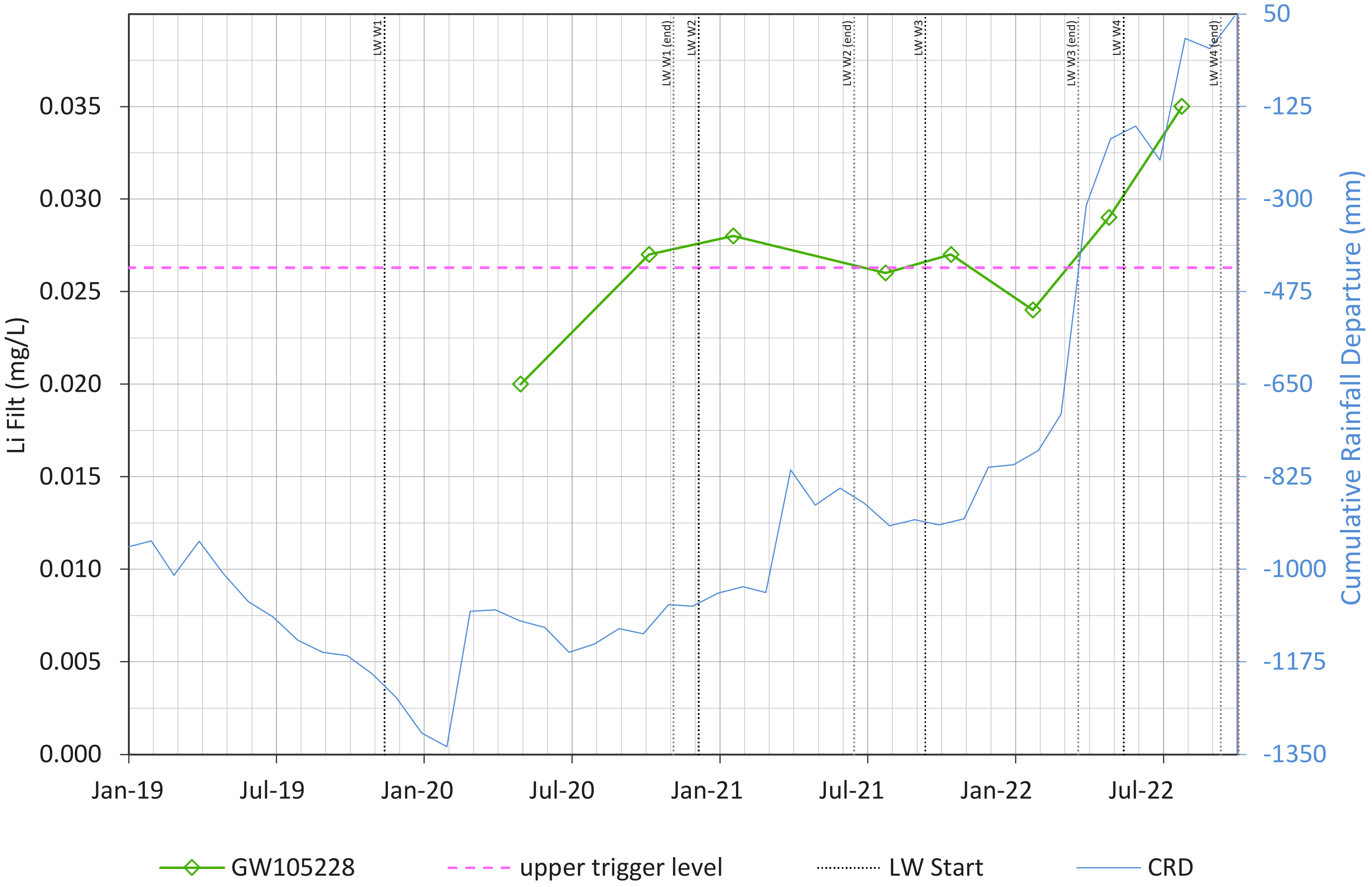


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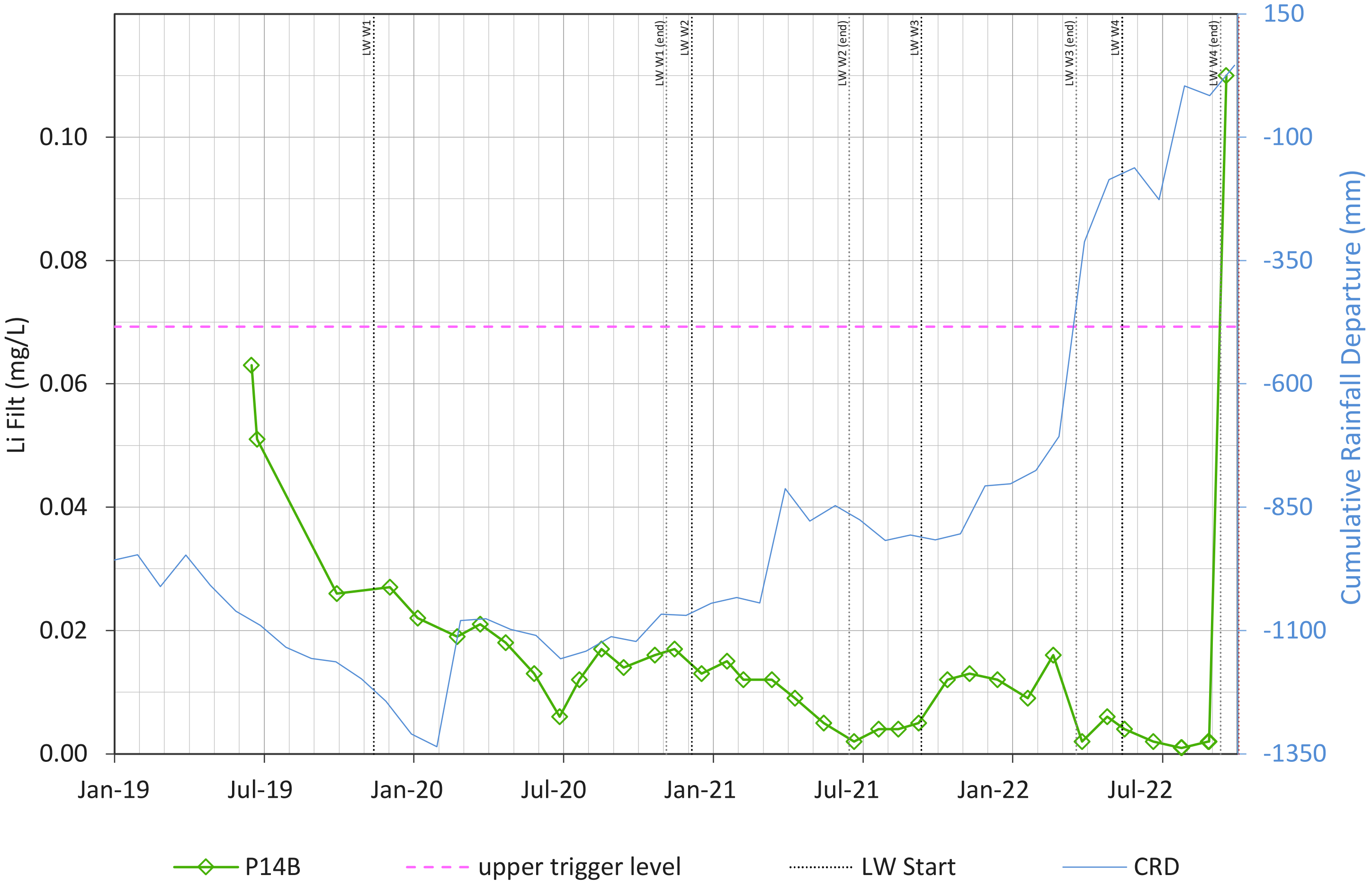


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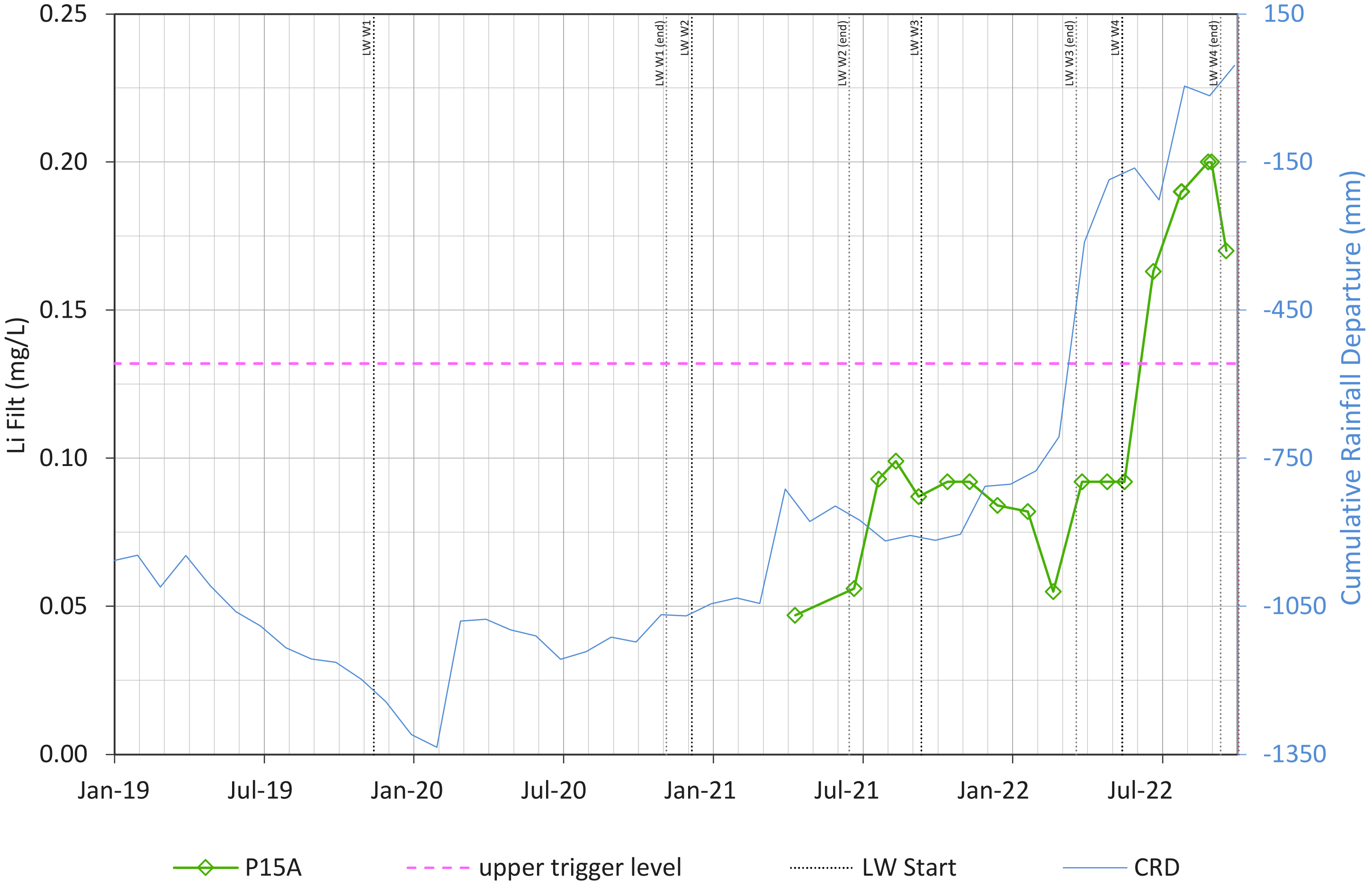


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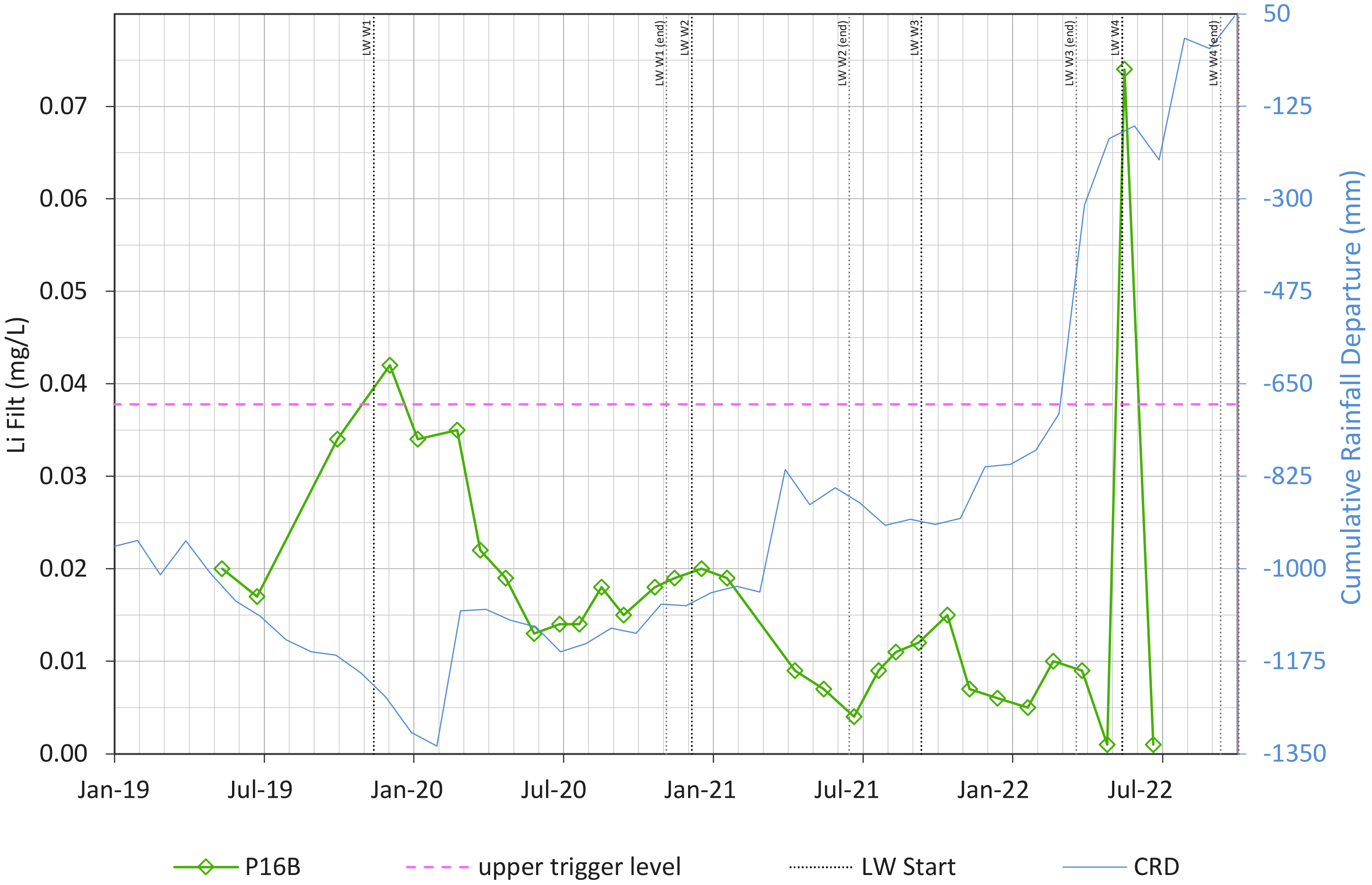


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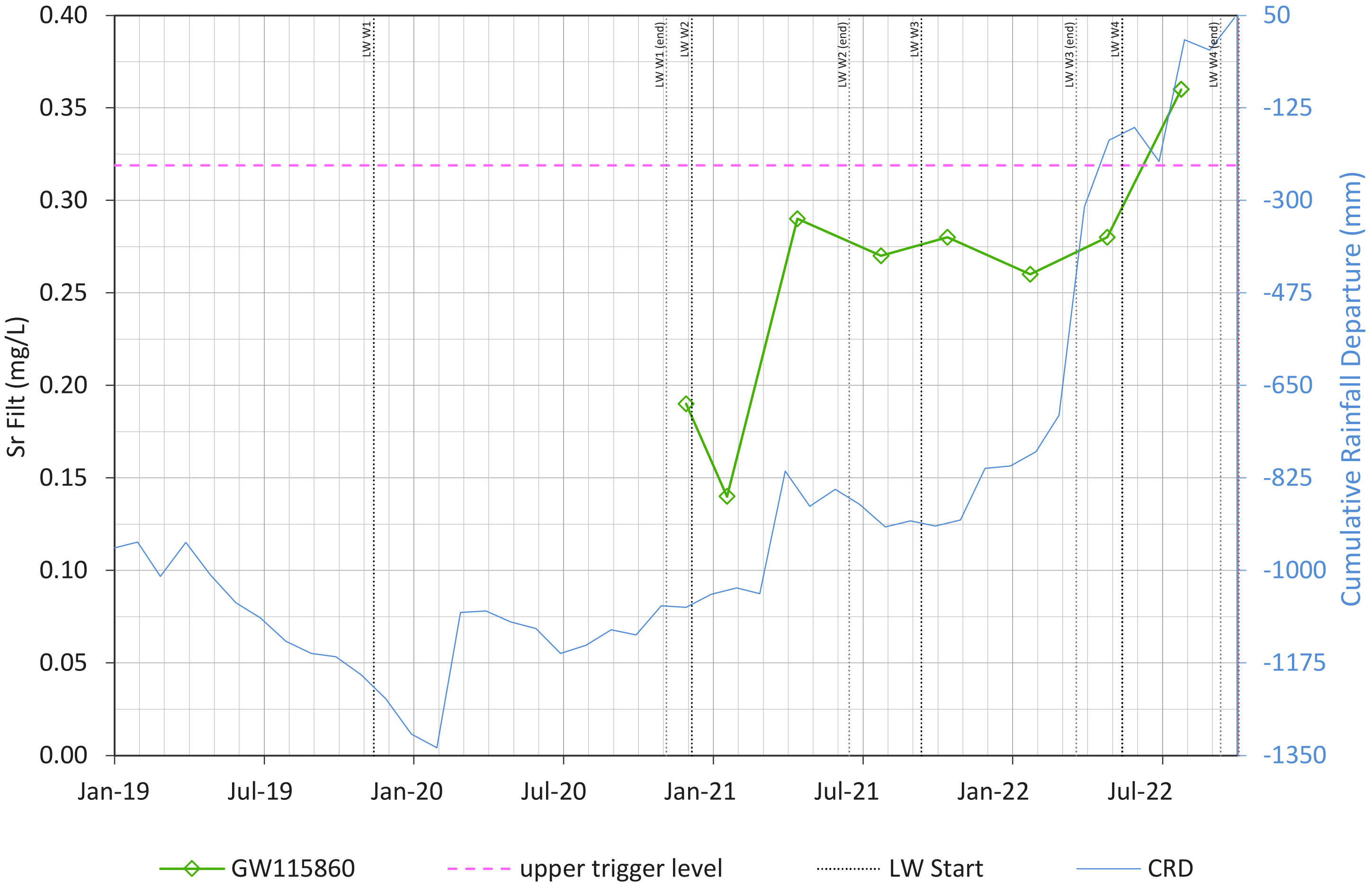


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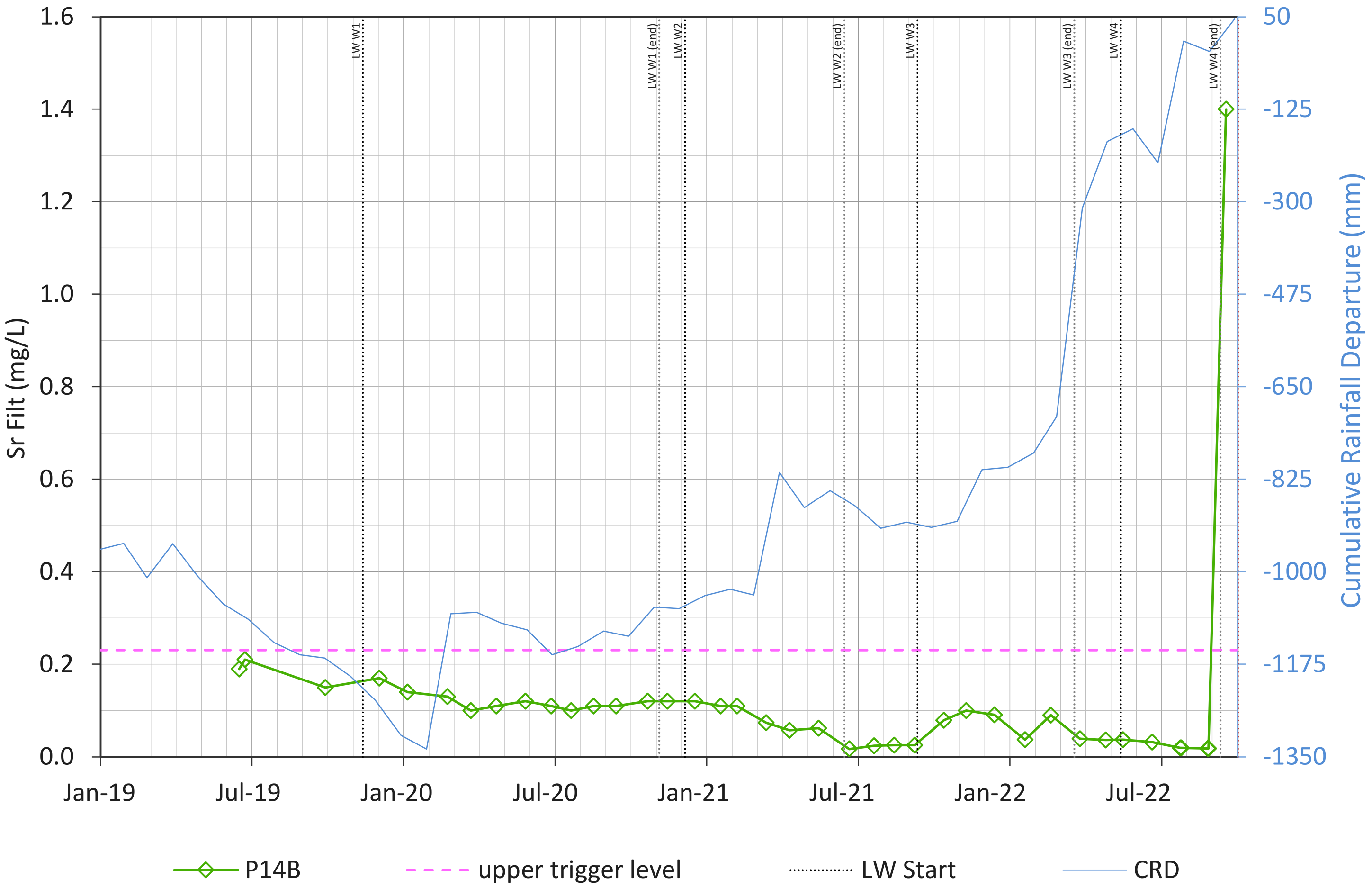


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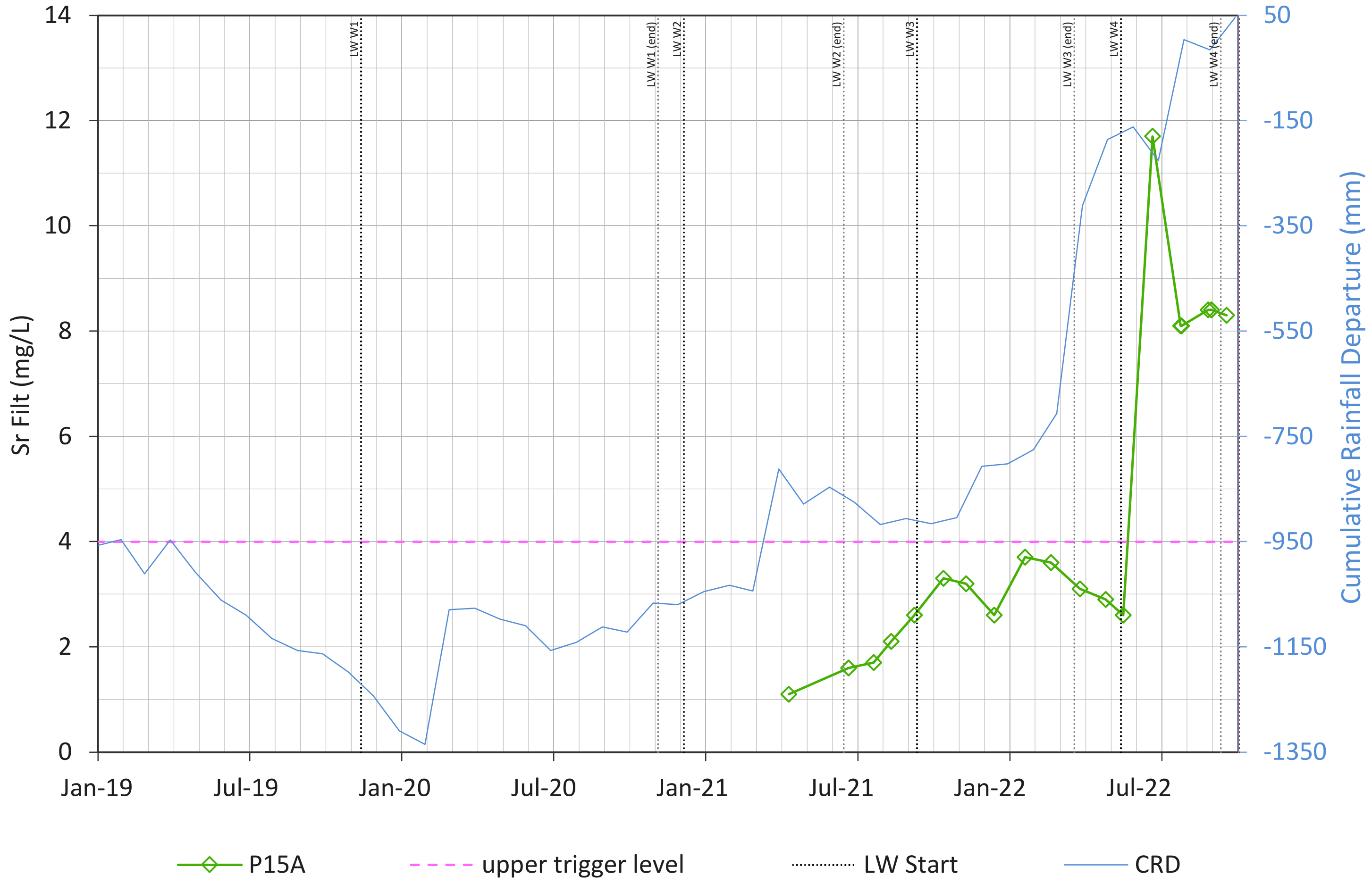


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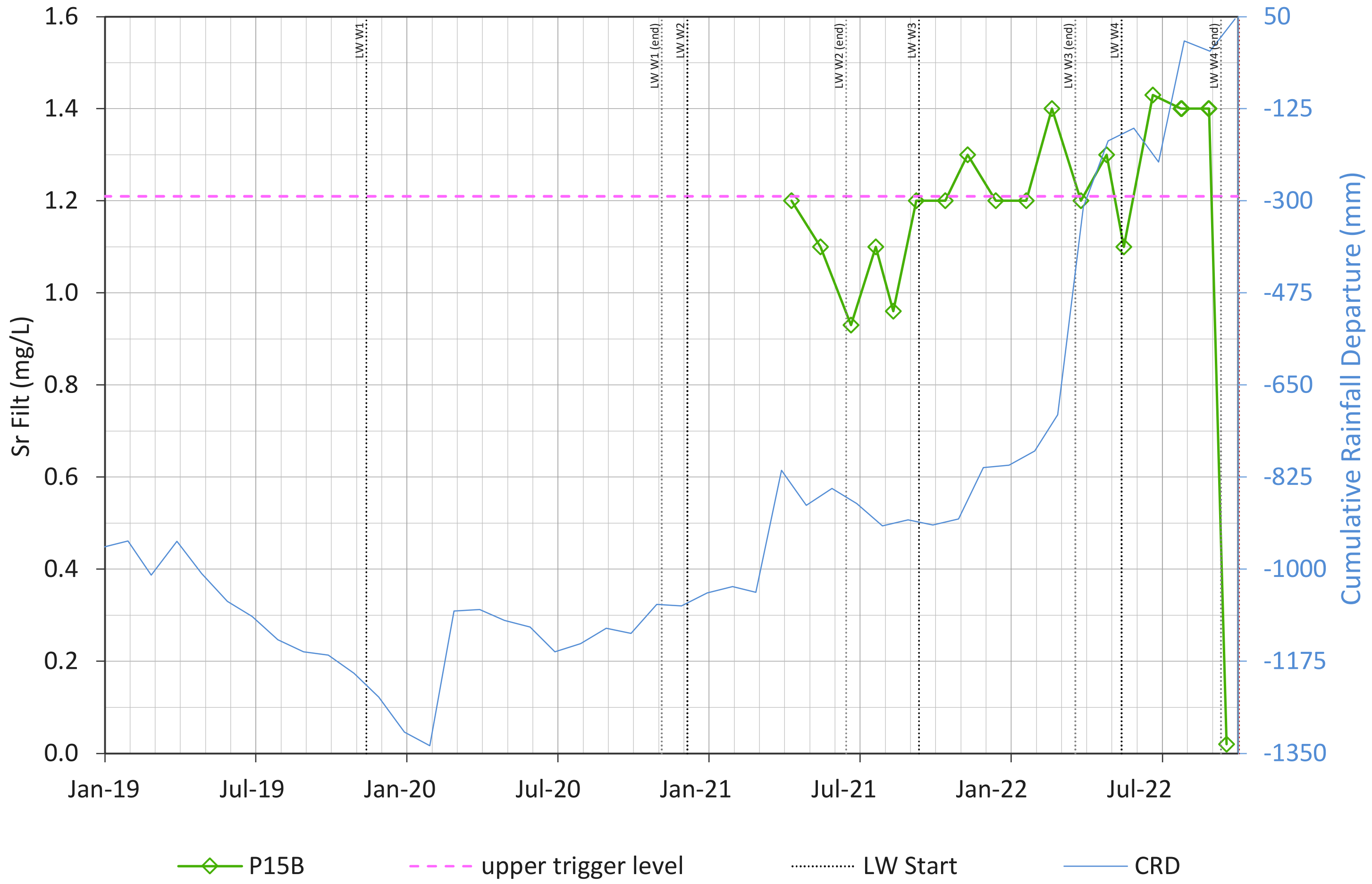


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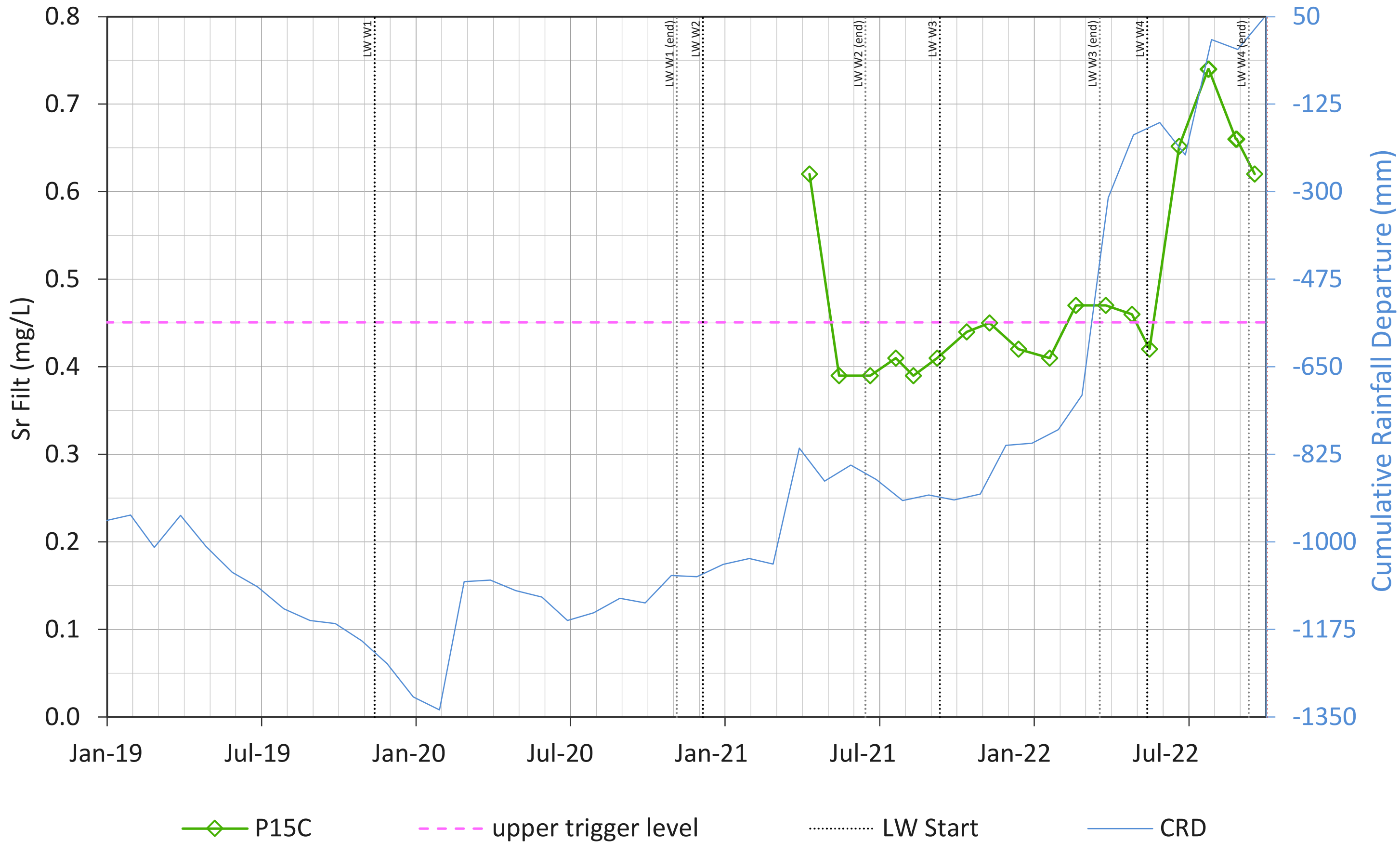


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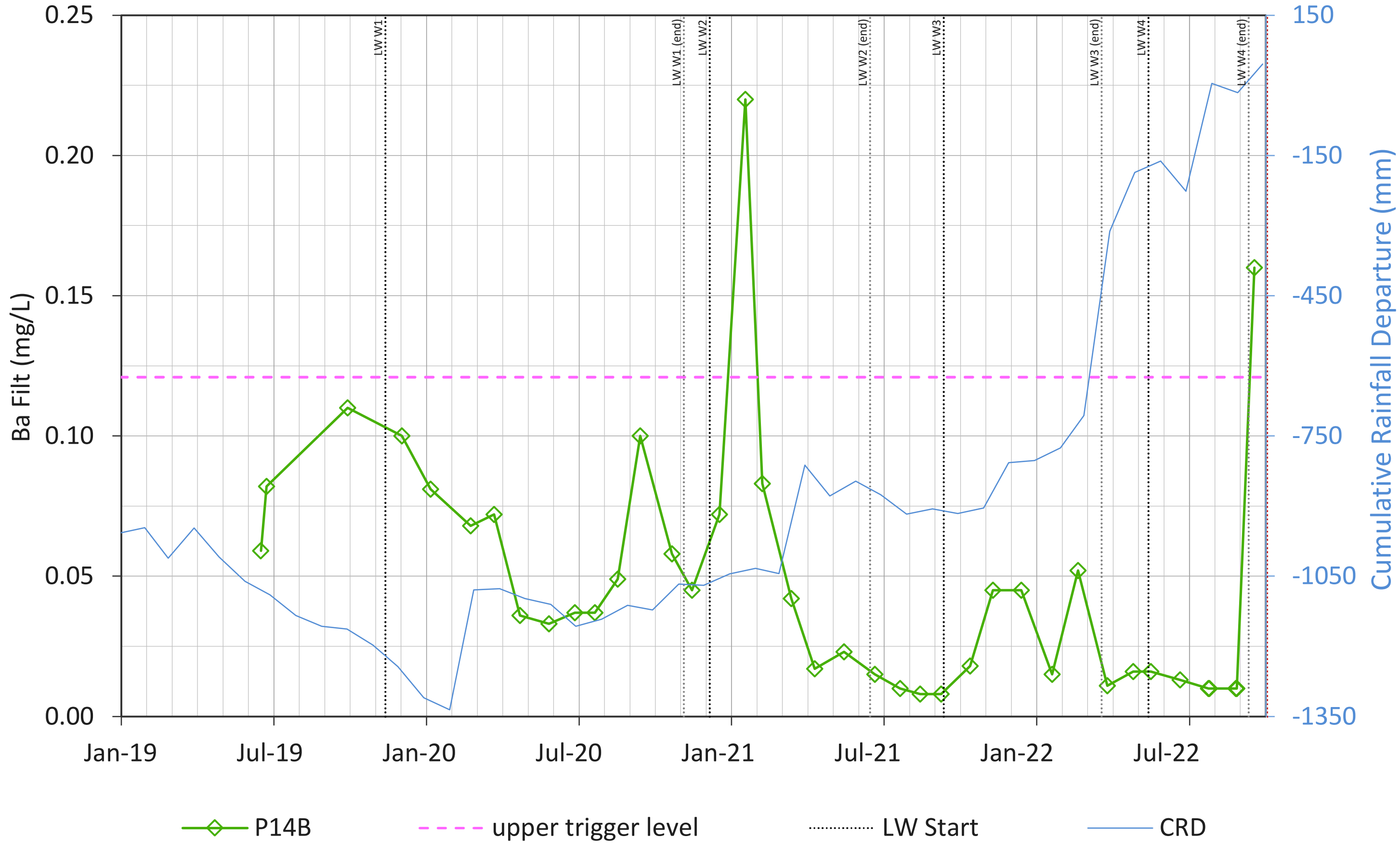


Figure D44

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# Memorandum

| | | | |
|---|---|---|---|
| To: | April Hudson | At: | Tahmoor Coal |
| From: | Maxime Philibert | At: | SLR Consulting Australia Pty Ltd |
| Date: | 28 March 2023 | Ref: | 610.30977.0000-M01-v3.0-20230328.docx |
| Subject: | Tahmoor Western Domain Quarterly Groundwater Report Oct - Dec 2022 | | |

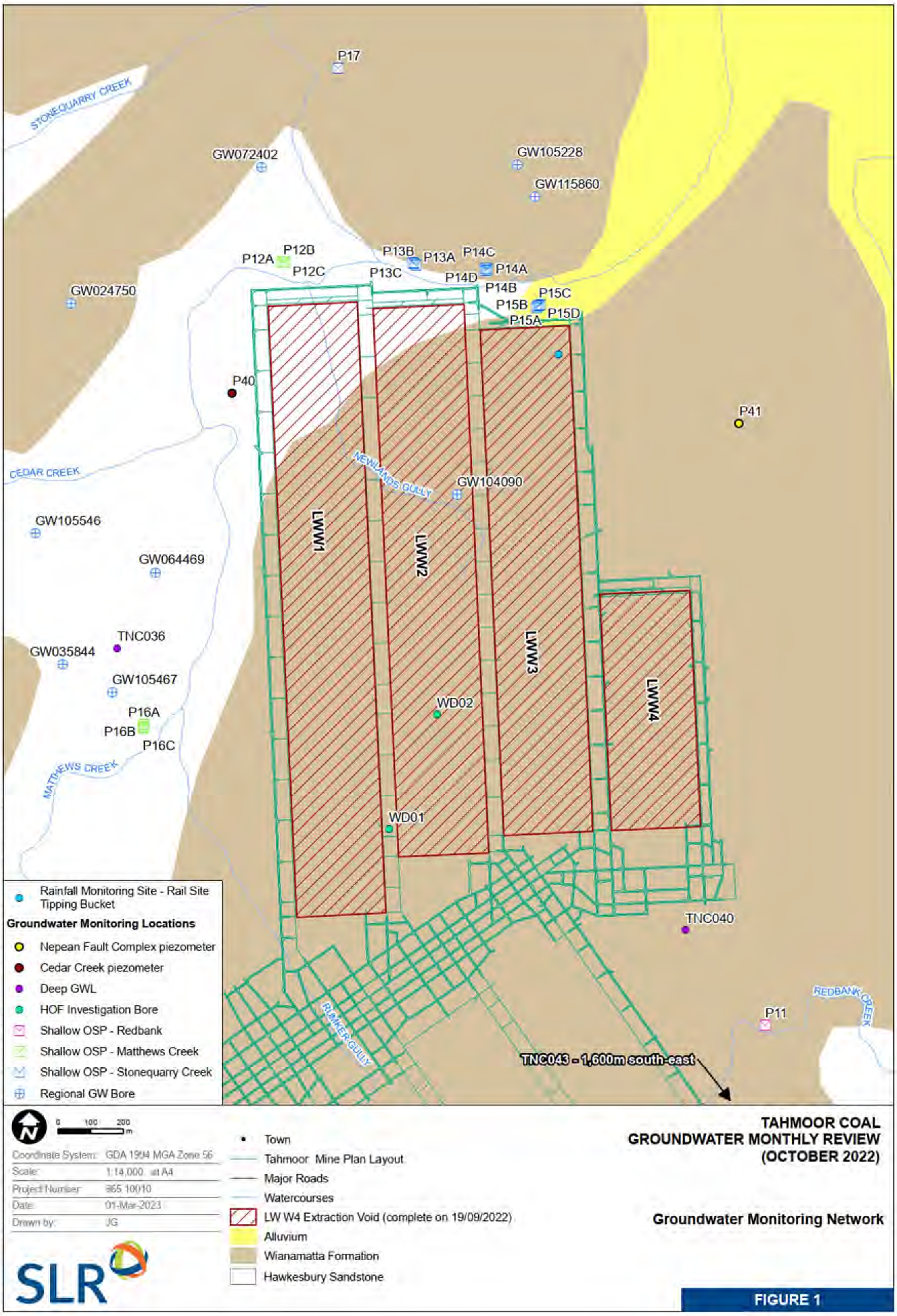
## 1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Tahmoor Coal Pty Ltd (Tahmoor Coal) to undertake a quarterly groundwater review of groundwater monitoring data for the Western Domain of the Tahmoor Coal Mine (Tahmoor Mine).

This memo provides:

- A quarterly groundwater review, which summarises the last three months (October to December 2022) of data and supports the annual review reporting conducted by Tahmoor Coal;
- An overview of the groundwater data collected at monitored locations (see Figure 1) over the period from 1st October to 31st December 2022;
- An assessment of collected groundwater data against the Trigger Action Response Plan (TARP) (SLR, 2021; Tahmoor Coal, 2021) in the Longwall W3-W4 Water Management Plan, taking effect at the start of LW W3 in September 2021, prior to the commencement of LW W3, the TARP in the Longwall W1-W2 Water Management Plan (HydroSimulations/SLR, 2019) was applied; and
- A summary of groundwater level (see Section 4) and groundwater quality (see Section 5) TARP Level exceedances, and a brief analysis of the potential influencing factors for these exceedances, as previously compiled by SLR in the latest six-monthly report (SLR, 2022).

This quarterly groundwater report is an important component of monitoring and routine reporting for the Western Domain, which acts as an early warning procedure for any performance trigger exceedances.




## Figure 1 Groundwater Monitoring Locations

# 2 Monitoring Period Summary

## 2.1 Mine operation

Over the reporting period from 1 October 2022 to 31 December 2022 no mining activities were conducted across the Western Domain. Table 1 presents the mining schedule for the Western Domain longwalls.

Table 1 Mining schedule for Western Domain longwalls

| Longwalls | Start date | End date |
|---|---|---|
| LW W1 | 15 November 2019 | 6 November 2020 |
| LW W2 | 7 December 2020 | 17 June 2021 |
| LW W3 | 13 September 2021 | 21 March 2022 |
| LW W4 | 16 May 2022 | 13 September 2022 |

## 2.2 Rainfall Analysis

The SILO record for the 0.05° x 0.05° tile centred on the location 274250E, 6212950N has been adopted for this assessment to understand long-term rainfall trends. Table 2 shows the 2022 rainfall in comparison to the long-term average (January 1900 to present). October 2022 was particularly a wet month, with rainfall having a surplus over long-term average of 132.7 mm. Comparatively, December 2022 was relatively dry, with rainfall having a deficit of 42.8.

Monthly average rainfall is presented on Figure 2, alongside potential evaporation and estimated actual evapotranspiration. Figure 3 shows the historical record of monthly rainfall and the calculated trend in rainfall (using cumulative residual departure from mean method), where a positive gradient indicates above average rainfall, whilst a declining trend represents below average.

Table 2 2021-22 Monthly Rainfall in Comparison to the Long-Term Average

| SILO (274250E, 6212950N) | Jan 22 | Feb 22 | Mar 22 | Apr 22 | May 22 | Jun 22 | Jul 22 | Aug 22 | Sep 22 | Oct 22 | Nov 22 | Dec 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Long-term average rainfall (mm) | 82.4 | 87.6 | 84.4 | 66.1 | 56.1 | 61.9 | 50.2 | 42.8 | 41.5 | 58.5 | 69 | 67.5 |
| 2022 rainfall (mm) | 108.4 | 186.1 | 476.4 | 193.1 | 84.5 | 1.9 | 274.7 | 31.8 | 104.4 | 191.2 | 66.5 | 24.7 |
| Surplus (+) /Deficit (-) (mm) | +26 | +98.5 | +392 | +127 | +28.4 | -60 | +224.5 | -11 | +62.9 | +132.7 | -2.5 | -42.8 |

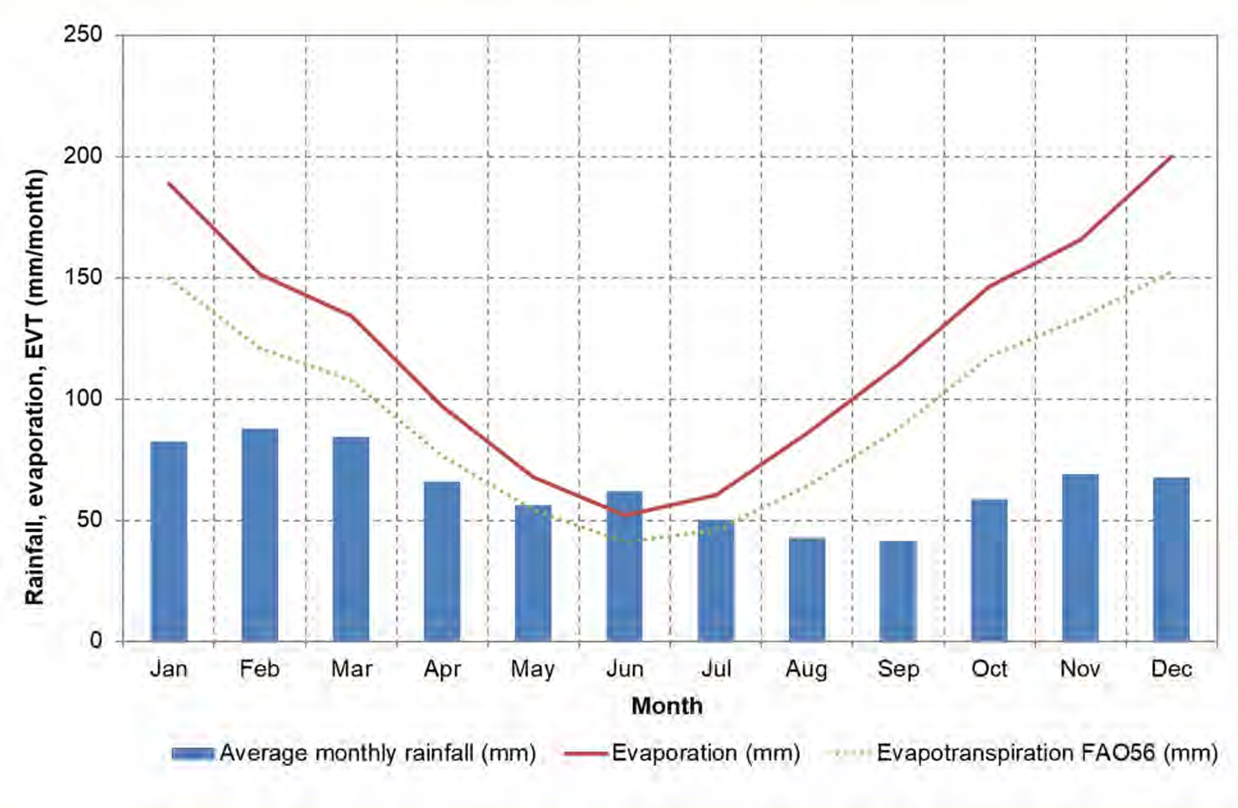



Figure 2 Average Monthly Rainfall, Evaporation and Evapotranspiration


Figure 3 Cumulative Rainfall Departure and Total Monthly Rainfall

## 2.3 Groundwater Monitoring Network Status Update

All groundwater level monitoring bores and vibrating wire piezometers (VWPs) in the vicinity of the Western Domain, and their available completion details, are listed in Table 3 below.

Updates on the status of the groundwater monitoring network and operations from 1 October 2022 to 31 December 2022 are as follows:

- No groundwater levels were available at P16B in October 2022 and at GW72402 during the reporting period due to blockage of the bores.
- No groundwater levels nor groundwater quality sampling was undertaken in October 2022 at GW105546 and GW105467.
- Manual measurements of groundwater levels were taken at private bores GW115860 and GW105228 in October 2022.

Table 3 Groundwater Monitoring Network

| Monitoring bore or VWP ID | Owner | Easting[1] (GDA94) | Northing[1] (GDA94) | Bore screen or VWP sensor depth (mBGL) | Status |
|---|---|---|---|---|---|
| Shallow Groundwater Levels (monitoring bores/standpipe piezometers) | | | | | |
| P12A | Tahmoor Coal | 277771 | 6216561 | 14.6 - 19.6 | EX |
| P12B | Tahmoor Coal | 277776 | 6216560 | 31.6 - 34.6 | EX |
| P12C | Tahmoor Coal | 277781 | 6216559 | 61.6 - 64.6 | EX |
| P13A | Tahmoor Coal | 278180 | 6216550 | 19.5 - 22.5 | D |
| P13B | Tahmoor Coal | 278175 | 6216554 | 33.5 - 37.5 | D |
| P13C | Tahmoor Coal | 278170 | 6216558 | 64.5 - 67.5 | D |
| P14A | Tahmoor Coal | 278398 | 6216536 | 4.5 - 6.0 | EX |
| P14B | Tahmoor Coal | 278393 | 6216534 | 13.6 - 16.6 | EX |
| P14C | Tahmoor Coal | 278397 | 6216542 | 28.6 - 31.6 | EX |
| P14D | Tahmoor Coal | 278391 | 6216540 | 58.6 - 61.6 | EX |
| P15A | Tahmoor Coal | 278550 | 6216426 | 16.1-17.6 | EX |
| P15B | Tahmoor Coal | 278545 | 6216423 | 18.6-20.1 | EX |
| P15C | Tahmoor Coal | 278556 | 6216427 | 30.5-32.0 | EX |
| P15D | Tahmoor Coal | 278561 | 6216431 | 66 (bore depth) | EX |
| P16A | Tahmoor Coal | 277351 | 6215147 | 24.5 - 27.5 | EX |
| P16B | Tahmoor Coal | 277350 | 6215140 | 42.5 - 45.5 | EX |
| P16C | Tahmoor Coal | 277347 | 6215135 | 72.5 - 75.5 | EX |
| P17 | Tahmoor Coal | 277941 | 6217153 | 19.6 - 22.6 | D |
| GW072402 | Private | 277708 | 6216852 | 8.2 - 72.0 | EX |
| GW105228 | Private | 278490 | 6216858 | 23.0 - 63.0 | EX |
| GW105467 | Private | 277253 | 6215247 | 73.0 - 79.0 | EX |
| GW105546 | Private | 277018 | 6215732 | 48.0 - 56.0 | EX |

| Monitoring bore or VWP ID | Owner | Easting[1] (GDA94) | Northing[1] (GDA94) | Bore screen or VWP sensor depth (mBGL) | Status |
|---|---|---|---|---|---|
| GW115860 | Private | 278543 | 6216760 | 20, 48 and 55 | EX |
| Shallow Groundwater Pressures (VWPs < 200 mBGL) | | | | | |
| P40(A-D) | Tahmoor Coal | 277620.6 | 6216160.1 | HBSS-39 | EX |
| | | | | HBSS-44 | EX |
| | | | | HBSS-49 | EX |
| | | | | HBSS-85 | EX |
| P41(A-F) | Tahmoor Coal | 279167 | 6216068 | WMFM-53 (vertical) | EX |
| | | | | HBSS-71 (vertical) | EX |
| | | | | HBSS-88 (vertical) | EX |
| | | | | HBSS-106 (vertical) | EX |
| | | | | HBSS-123 (vertical) | EX |
| | | | | 140 (vertical) | EX |
| TNC036 | Tahmoor Coal | 277269 | 6215382 | HBSS-65 | EX |
| | | | | HBSS-97 | EX |
| | | | | BGSS-169 | EX |
| TNC040 | Tahmoor Coal | 279004 | 6214521 | WMFM-27 | EX |
| | | | | HBSS-65 | EX |
| | | | | HBSS-111 | F |
| TNC043 | Tahmoor Coal | 280077 | 6212671 | HBSS-65 | L |
| | | | | HBSS-111.5 | L |
| WD01 | Tahmoor Coal | 278099 | 6214828 | HBSS-70 | EX |
| | | | | HBSS-90 | EX |
| | | | | HBSS-190 | F |
| WD02 | Tahmoor Coal | 278246 | 6215178 | Drilling in Feb 23 | TBC |
| Deep Groundwater Pressures (VWPs > 200 mBGL) | | | | | |
| TNC036 | Tahmoor Coal | 277269 | 6215382 | BGSS-214 | EX |
| | | | | BGSS-298.5 | F |
| | | | | BGSS-412.5 | EX |
| | | | | BUSM-463.5 | F |
| TNC040 | Tahmoor Coal | 279004 | 6214521 | HBSS-225 | F |
| | | | | BHCS-252 | F |
| | | | | BGSS-352 | F |
| | | | | SCSS-482 | F |
| | | | | BUCO-501.9 | F |
| TNC043 | Tahmoor Coal | 280077 | 6212671 | HBSS-213 | D |

| Monitoring bore or VWP ID | Owner | Easting[1] (GDA94) | Northing[1] (GDA94) | Bore screen or VWP sensor depth (mBGL) | Status |
|---|---|---|---|---|---|
| | | | | BGSS-240 | D |
| | | | | BGSS-332.6 | D |
| | | | | BGSS-405.2 | D |
| | | | | BUCO-476.3 | D |
| WD01 | Tahmoor Coal | 278099 | 6214828 | 210-HBSS | EX |
| | | | | 230-Newport Fm | F |
| | | | | 300-BGSS | F |
| | | | | 330-BGSS | F |
| | | | | 350-BGSS | F |
| WD02 | Tahmoor Coal | 278246 | 6215178 | Drilling in Feb 23 | TBC |

*1 Coordinates in metres (GDA 1994 MGA Zone 56).*

*WMFM – Wianamatta Group*
*BGSS – Bulgo Sandstone*
*HBSS – Hawkesbury Sandstone*
*SCSS – Scarborough Sandstone*
*BHCS – Bald Hill Claystone*
*BUCO – Bulli Coal Seam*
*VWP – vibrating wire piezometer*
*EX – Existing*
*P – Proposed monitoring bore*
*L – Loss of logger (stolen), manual readings still taken.*
*"-" - Not drilled yet*
*mBGL – metres below ground level*
*F - Failed*
*D – Decommissioned*

# 3 Groundwater Level Trends

During the reporting period, groundwater level trends were observed across the shallow open standpipes (P12, P14-P16), shallow vibrating wire piezometers (P40, P41 and TNC036/40) and the deep vibrating wire piezometers (TNC036). The cause and effect of key groundwater trends observed at these sites, over the reporting period, are briefly discussed in this section.

Groundwater level trends which represented TARP Level exceedances are discussed in Section 4.

Hydrographs for groundwater levels at P12, P14, P15, P16, P40, P41, TNC036, TNC40, P9, P11 and private bores are presented in Appendix A.

Some of the key groundwater trends over the reporting period include:

- Site P12: groundwater levels at P12A and P12B remained relatively stable at 170.4 mAHD and 171 mAHD respectively during the review period (Appendix A, Figure A-1). At P12C, the observed trend of previous months continued with groundwater levels increasing by approximately 1.5 m over the reporting period to 178.4 mAHD in December 2022. As of December 2022, groundwater levels at sites P12 are within baseline level (P12A), 0.5m above baseline level (P12B) and have mostly recovered in P12C as groundwater levels are observed within baseline level. The recovery period at P12C follows a maximum groundwater depressurisation of 11m in February 2021 caused by mining of LW W1-W2.

- Site P14: groundwater levels at P14A decreased by approximately 1.1 m over the reporting period, to 169.9 mAHD in December 2022, which is likely attributable to lower rainfall recharge in November and December 2022 (Figure A-2). As of December 2022, groundwater levels at P14A are observed 1.2m above baseline levels. Overall, groundwater levels fluctuated within 0.5 m, and were observed above the creek bed elevation at P14B, P14C and P14D which suggest strengthening of baseflow conditions along Stonequarry Creek over the reporting period (Figure A-2).
- Site P15: overall, groundwater levels fluctuated within 0.5-1 m over the reporting period, and decreased in late November 2022, at P15A, P15B, P15C and P15D, which aligned with observed CRD trends (Figure A-3). Similar to the observations for the P14 sites, groundwater levels at P15 sites (P15A, B, C and D) remained above the creek bed elevation favouring baseflow conditions along Stonequarry Creek.
- Site P16: groundwater levels at P16A were consistently observed at approximately 210.5 mAHD over the reporting period (Figure A-4). As observed in previous years, there are no responses observed in groundwater levels to rainfall at P16A during the reporting period with groundwater levels being approximately 1m below baseline level. A localised long-term impact on groundwater levels is to be considered at P16A. At P16B, the available groundwater levels in November and December 2022 indicated that groundwater conditions have remained stable with groundwater levels observed at a similar elevation as in May 2022 prior the commencement of LW W4 (Figure A-4). At P16C, groundwater levels stabilised at approximately 197.4 mAHD following successive periods of recovery in 2021-2022. Groundwater levels in the mid and lower Hawkesbury Sandstone aquifers (P16B and P16C respectively) are observed approximately 1.5m and 3m below baseline levels. Additional groundwater monitoring data will inform whether post mining conditions (i.e., following valley closure) will allow groundwater to completely recover at sites P16.
- Site P40: groundwater levels at P40A and P40B fluctuated by 0.5m during the review period (Figure A-5). To note at P40B a groundwater decline of approximately 1.2m in late November 2022 likely due to lower rainfalls. A similar groundwater decline was observed in June 2022 likely associated with drier condition this month. At P40C observed groundwater levels were remain stable at 178.7 mAHD. In the lower Hawkesbury Sandstone aquifer at P40D, groundwater levels continued to increase and for the first time in November 2022 increased above the Cedar Creek bed elevation. The increase in groundwater levels at P40D between October and December 2022 was observed at a lower rate than previously measured in early and mid-2022. During the review period, groundwater levels at P40A, B, C and D remained above the surveyed creek bed elevation at Cedar Creek which favour baseflow condition (i.e. gaining condition) in the vicinity of surface monitoring site CB.
- Site P41: Groundwater levels at P41A were observed at almost the same elevation as the VWP (189.2 mAHD) which suggests near unsaturated condition at this elevation. In P41B, water levels are stable at 173.2 mAHD throughout the reporting period at the same VWP elevation which also suggest unsaturated condition. At P41C, a gradual increase in groundwater levels was observed since October 2022 and from early November 2022 started to stabilise at 163.3mAHD. The P41C piezometer is located at a similar elevation to the surveyed elevation of Stonequarry Creek (SC surface water monitoring site) with groundwater levels at approximately 1m above the Stonequarry Creek bed elevation (labelled "SC base elevation" on Figure A-6). As presented in SLR (2022), review and analysis of groundwater level exceedances at site P41 is focused on VWPs P41A, P41B, P41C and P41D (i.e. the primary assessment sites). Groundwater levels at P41D, P41E and P41F are likely influenced by faulty sensors but will continue to be reviewed in future reports. P41E and P41F are not considered in the groundwater level trigger assessment and P41D has been removed from the TARP as groundwater trends continue to appear erroneous (SLR, 2022).

- TNC36: Groundwater levels in HBSS-65m and HBSS-97m increased by 1.1m and 2m during the reporting period (Figure A-7). In the Bulgo Sandstone aquifer, groundwater levels in the sensor BGSS-169m recorded an increase in groundwater levels of 8.5m and are observed at 181.8 mAHD in December 2022. Groundwater levels in the lower Bulgo Sandstone aquifer started to recover in late September 2022 and have shown a significant recovery during the review period of approximately 9m to 93.2 mAHD. In the deepest piezometer BGSS-463m, a groundwater levels continued to decrease with an observed groundwater depressurisation of 5.5m during the reporting period.
- TNC40: The two remaining sensors at TNC040 WHFM-27m and HBSS-65m recorded an increase in groundwater level of 0.3m and 0.7m respectively during the review period (Figure A-8). No delayed groundwater depressurisation due to mining of LW W4 is identified at TNC040.
- Private Bores: Groundwater levels in the private bores (i.e. where available) generally responded to rainfall events in the range of 0.5m at GW104090 between October and December 2022 (Figure A-10). To the north of the LW W3-W4 and as of October 2022 groundwater levels in GW115860 and GW105228 were observed at a stable elevation compared to water levels in April and July 2022 (Figure A-11). To note that the manual measurement taken in July 2022 (171.4 mAHD) at GW105228 is likely a measurement error. For the private bores, no effects on groundwater levels due to post-mining operations at LW W4 during the review period is identified. Additional groundwater monitoring data is required at GW72402 to confirm groundwater trends post LW W4.
- P9 and P11 (Tahmoor North Domain): The latest groundwater available for P9A, P9B and P11 are dated 30 November 2022. Groundwater levels at P9A and P9B remained stable over the reporting period fluctuating by 0.5m following rainfall events (Figure A-12). Groundwater levels at P9A-24m were observed above the creek bed elevation during the reporting period which suggests strengthening of gaining conditions along Redbank Creek in the vicinity of P9. At P9B, following a possible groundwater depressurisation in early 2021 during mining of LW W1-W2, groundwater levels have shown an increasing trend since late 2021. However as of November 2022, groundwater levels at P9-40m remain approximately 3m below baseline level. Hence since early 2021, a downward vertical head gradient between P9A and P9B (i.e. groundwater head separation of 3m) is established which suggests a possible medium-long term impact at P9B due to historic mining (i.e. LW 32) and LW W1-W2. Further monitoring data is required at P9A-B to assess post-mining groundwater conditions. Groundwater levels in P11 (i.e. located 700 m south-east of LW W4) have also remained stable with groundwater levels being close to surface (1m below ground level) which explain the subdued response to rainfall 2021-22 compared to March 2020 (Figure A-13). No delayed mining effect on groundwater levels due to mining of LW W4 is observed at P9A-B and P11 during the review period.

# 4 Groundwater Level Trigger Review

## 4.1 Summary of Groundwater Level Exceedances

Approved Trigger Action Response Plan (TARP) levels are defined for each site (Tahmoor Coal, 2021) and presented in Appendix B. Groundwater hydrographs for each monitoring site where the groundwater trigger level is plotted is also presented in Appendix B (Figure B1-B28).

An assessment of groundwater levels at each of the monitored bore and VWP locations against the TARP trigger levels has been undertaken. During the reporting period, the following exceedances were observed:

- TARP Level 2
  - Shallow bores: P16B across the whole reporting period. Bore P12C during the review period likely to be reduced to a TARP level 1 in the next review period.
  - A reduction form TARP Level 3 to Level 2 at P16C in October 2022 onwards.

- Shallow VWPs: TNC036 (HBSS-97m) and TNC036 (BGSS-169m) across the whole reporting period.
- Deep VWPs: TNC036 (BGSS-214m) until November 2022, then reduced to a TARP Level 1 in December 2022. TNC036 (BGSS-412.5m) across the whole reporting period.

No TARP Level 3 and 4 for groundwater levels are identified during the review period.

All other groundwater monitoring sites remained within TARP Level 1 across the quarterly reporting period. A summary of the groundwater level trigger exceedances during the reporting period, in comparison to previous months, at the monitored bores are presented in Table 4 and Table 5 (note private bores were only scheduled for sampling in October 2022).

Hydrographs for groundwater levels with approved groundwater trigger levels at P12, P14, P15, P16, P40, P41, GW72402, GW104090, GW115860, GW105228, TNC036, TNC040 are presented in Appendix B.

## Table 4 Groundwater Level Trigger Exceedances - Shallow-Open Standpipes (Shallow OSP), Shallow and Deep Vibrating Wire Piezometers (VWPs)

| Bore | Groundwater Level prior to LW W1 (m AHD) (pre-mining) | Trigger Level Exceedances | | | | | | | | | | | | | | | | | | | Maximum drawdown Nov 2020 - Aug 2021 | GWL Prior to LW W4 (15-MAY-22) (m AHD) | Drawdown as of Sep 2022 compared to pre-mining GWL (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sep 21 | Oct 21 | Nov 21 | Dec 21 | Jan 22 | Feb 22 | Mar 22 | Apr 22 | May 22 | Jun 22 | Jul 22 | Aug 22 | Sep 22 | Oct 22 | Nov 22 | Dec 22 | Jan 23 | Feb 23 | Mar 23 | | | |
| Shallow OSP | | TARP (Tahmoor Coal, 2021) | | | | | | | | | | | | | | | | | | | | | |
| P12A | 170.1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | 0.5 | 170.7 | - |
| P12B | 170.7 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | 0.8 | 171.3 | - |
| P12C | 176.3 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | | | | 11.0 | 175.6 | - |
| P14A | 168.6 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | 0.2 | 171.5 | - |
| P14B | 166.7 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | # | L1 | L1 | L1 | L1 | L1 | L1 | | | | 1.4 | 168.4 | - |
| P14C | 166.6 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | 1.7 | 168.5 | - |
| P14D | 164.8 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | # | # | L1 | L1 | L1 | L1 | L1 | | | | 1.8 | 167.4 | |
| P15A | 164.7^ | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | - | 169.2 | - |
| P15B | 165.2^ | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | - | 168.8 | - |
| P15C | 164.9^ | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | # | L1 | L1 | L1 | L1 | | | | - | 168.8 | - |
| P15D | 165.4^ | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | # | # | L1 | L1 | L1 | L1 | | | | # | 169.1 | - |
| P16A | 211.3 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | 1.1 | 210.7 | 0.7 |
| P16B | 206.4 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | # | # | # | L2 | L2 | | | | 5.7 | 205 | 0.7 |
| P16C | 199.6 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | L3 | L2 | L2 | L2 | | | | 13.8 | 191.7 | 2.2 |

| Bore | Groundwater Level prior to LW W1 (m AHD) (pre-mining) | Trigger Level Exceedances | | | | | | | | | | | | | | | | | | | Maximum drawdown Nov 2020 - Aug 2021 | GWL Prior to LW W4 (15-MAY-22) (m AHD) | Drawdown as of Sep 2022 compared to pre-mining GWL (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sep 21 | Oct 21 | Nov 21 | Dec 21 | Jan 22 | Feb 22 | Mar 22 | Apr 22 | May 22 | Jun 22 | Jul 22 | Aug 22 | Sep 22 | Oct 22 | Nov 22 | Dec 22 | Jan 23 | Feb 23 | Mar 23 | | | |
| Shallow VWPs (<200m) | | TARP (Tahmoor Coal, 2021) | | | | | | | | | | | | | | | | | | | | | |
| P41A | 194 | # | # | # | # | # | # | # | # | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | - | 190 | - |
| P41B | 172.9 | # | # | # | # | # | # | # | # | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | - | 173 | - |
| P41C | 161.0 | # | # | # | # | # | # | # | # | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | - | 161.7 | - |
| P41D | 160.0 | # | # | # | # | # | # | # | # | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | - | 164.4 | - |
| TNC036 - HBSS-65 | 209.5 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | 6.7 | 209.8 | - |
| TNC036 - HBSS-97 | 196.3 | L4 | L4 | L4 | L4 | L4 | L4 | L3 | L3 | L3 | L3 | L2 | L2 | L2 | L2 | L2 | L2 | | | | 24.0 | 185.5 | 5.0 |
| TNC036 - BGSS-169 | 197.5 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | | | | 47.6 | 164.5 | 15.7 |
| TNC040-WNFM-27 | 208.3 | L1 | # | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | - | 209.6 | - |
| TNC040 - HBSS-65 | 187.1 | L1 | # | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | L1 | | | | - | 189 | - |
| Deep VWPs (>200m) | | TARP (Tahmoor Coal, 2021) | | | | | | | | | | | | | | | | | | | | | |

| Bore | Groundwater Level prior to LW W1 (m AHD) (pre-mining) | Trigger Level Exceedances | | | | | | | | | | | | | | | | | | | Maximum drawdown Nov 2020 - Aug 2021 | GWL Prior to LW W4 (15-MAY-22) (m AHD) | Drawdown as of Sep 2022 compared to pre-mining GWL (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Sep 21 | Oct 21 | Nov 21 | Dec 21 | Jan 22 | Feb 22 | Mar 22 | Apr 22 | May 22 | Jun 22 | Jul 22 | Aug 22 | Sep 22 | Oct 22 | Nov 22 | Dec 22 | Jan 23 | Feb 23 | Mar 23 | | | |
| TNC036 - BGSS-214 | 176.5 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L1 | | | | 81.4 | 82.9 | 83.4 |
| TNC036 - BGSS-412.5 | 96.8 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | L2 | | | | 49.7 | 13.9 | 94 |

TARP Level 1 TARP Level 2 TARP Level 3 TARP Level 4

*LX: maximum trigger level exceedances recorded "-": no observed drawdown "#": groundwater levels not available*

*^ baseline groundwater level at P15 (A,B,C,D) is the groundwater level recorded in June 2021.*

*"*" not assessed due to disruption in groundwater levels during drilling and packer testing at P15D.*

## Table 5 Groundwater Level Trigger Exceedances - Private Bores

| Bore | Baseline Maximum Ground water Depth (m bgl) | Baseline Groundwater Yield (L/s) | Trigger Level Exceedances | | | | | | Future Reviews | | | Groundwater Depths as of Dec 2022 (m bgl) | Ground water Yield as of Dec 2022 (L/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Jul 22 | Aug 22 | Sep 22 | Oct 22 | Nov 22 | Dec 22 | Jan 23 | Feb 23 | Mar 23 | | |
| GW104090 | 39.0 | # | blocked | L1 | L1 | L1 | L1 | L1 | | | | 20.32 | # |
| GW105467 | 32.0 | 0.5 | * | * | * | * | * | * | | | | # | # |
| GW105228 | 23.0 | 1.8 | L1 | L1 | L1 | L1 | L1 | L1 | | | | 10.6 | # |
| GW072402 | 11.76 | # | blocked | blocked | blocked | blocked | blocked | blocked | | | | # | # |
| GW115860 | # | # | L1 | L1 | L1 | L1 | L1 | L1 | | | | 10.6 | # |
| GW105546 | 31.9 | 1.6 | * | * | * | * | * | * | | | | # | # |

*LX: maximum trigger level exceedances recorded* *#: not applicable* ** no site access* *"-"standing water level not available (access is not available inside the bore)*
*m bgl – metres below ground level*

TARP Level 1 TARP Level 2 TARP Level 3 TARP Level 4

## 4.2 Discussion of Groundwater Level Exceedances

During the reporting period, groundwater level triggers were exceeded at P12, P16 and TNC036. Analysis of the observed exceedances, and a high-level outline of the potential influencing factors for the exceedances, are briefly discussed in Table 6.

Table 6 Groundwater Level Trigger Exceedances – Discussion

| Site | Discussion |
|---|---|
| P12C | TARP Level 2 exceedance was observed from October to December 2022. Groundwater level increased at 178.4 mAHD, just 1m below the TARP Level 2. TARP Level 1 is likely to apply at P12C in the next review period. |
| P16B | TARP Level 2 exceedance was observed from October to December 2022. Groundwater levels are observed at 205.6 mAHD in December 2022, 0.3m below the TARP Level 2. TARP Level 2 could remain in the short to medium term as a long-term groundwater impact is likely at P16. |
| P16C | TARP Level reduced from Level 3 to Level 2 exceedance in October 2022.<br>Groundwater levels are observed at 197.4 mAHD in December 2022, 3.2m below the TARP Level 2. TARP Level 2 could remain in the short to medium term as a long-term groundwater impact is likely at P16. |
| TNC036 (BGSS - 97m) | TARP Level 2 exceedance was observed from October to December 2022. Groundwater level increased to the TARP Level 2 end of December 2022. It is likely that TNC036-HBSS 97m TARP Level will reduce to a TARP Level 1 in the next review period. |
| TNC036 (BGSS - 169m) | TARP Level 2 exceedance was observed from October to December 2022. Groundwater levels are observed at 181.6 mAHD in December 2022 and increased by approximately 8.5 m during the reporting period. As of December 2022, groundwater levels remain below the trigger TARP Level 2 (192.5 mAHD), hence a TARP Level 2 still applies. |
| TNC036 (BGSS - 214m) | A reduction from TARP Level 2 exceedance to TARP Level 1 was observed during the review period. The groundwater level observed at TNC036-BGSS-214m exceeds the modelled drawdown from mid-2020 but remains within the 30 m predicted drawdown in October and November 2022 (Figure 4). As of December 2022, the observed drawdown does not exceed the modelled drawdown resulting in a TARP Level 1. |
| TNC036 (BGSS – 412.5m) | TARP Level 2 exceedance was observed during the review period. The groundwater level observed at TNC036-BGSS-412.5m exceeds the modelled drawdown from mid-2020 but remains within the 30 m predicted drawdown as of December 2022 (Figure 5). A Level 2 TARP criteria (exceeds modelled drawdown but less than 30 m exceedance) still applies at TNC036-BGSS-412.5m over the reporting period. |

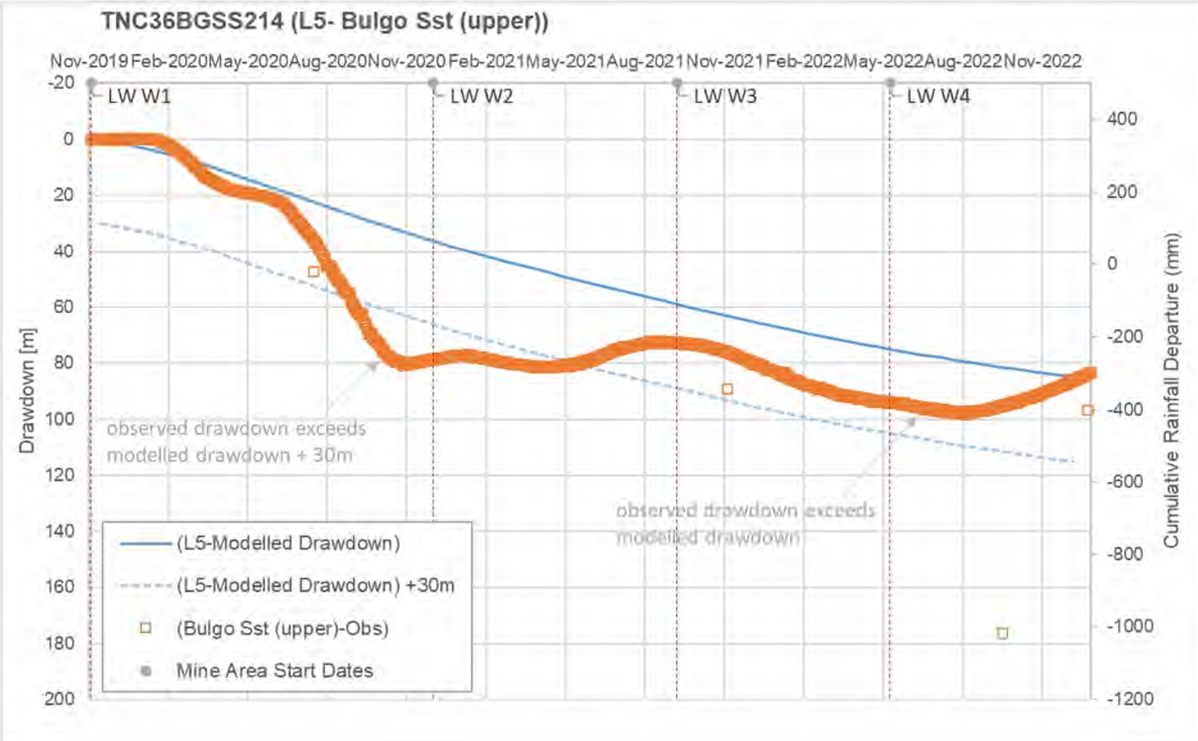



Figure 4 Comparison of Modelled and Observed Drawdown at TNC036 (BGSS-214m) with the +30m Threshold Modelled Drawdown

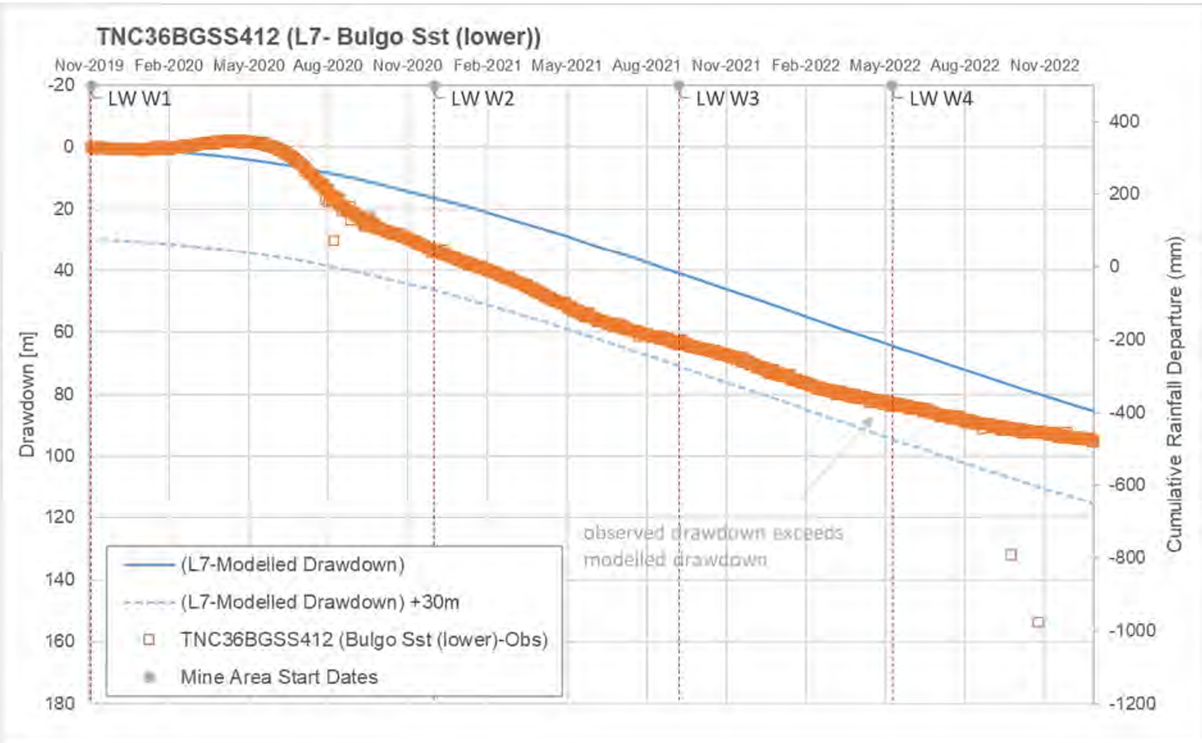



Figure 5 Comparison of Modelled and Observed Drawdown at TNC036 (BGSS-412.5m) with the +30m Threshold Modelled Drawdown

# 5 Groundwater Quality Trigger Review

## 5.1 Summary of Groundwater Quality Exceedances

Approved Trigger Action Response Plan (TARP) levels are defined for each site (Tahmoor Coal, 2021) and presented in Appendix B (Table B1-B2). Graphs for pH, electrical conductivity (EC) and metals exceedances are presented in Appendix C and Appendix D.

An assessment of groundwater quality at each of the monitored bore locations against the TARP trigger levels has been undertaken. During the reporting period, the following exceedances and reduction in TARP Level were observed:

- TARP Level 3
    - Metals – zinc (Zn): bore P16C. Dissolved zinc concentrations have fluctuated above the trigger level (0.021 mg/L) since May 2022 but declined following rainfall events (i.e July and October 2022). In October 2022, dissolved zinc concentrations decreased to 0.034 mg/L (marginally above the trigger level). As of December 2022, zinc concentrations increased to 0.12 mg/L, where a TARP Level 3 applies (Appendix D, Figure D12).
- TARP Level 2 (EC, pH and metals)
    - EC: bore P15A and P15B in October and November 2022. P16B in November 2022.
    - pH upper: bore P16A, GW115860, GW105228, GW104090 in October 2022.
    - pH lower: bore P16A in December 2022.
    - Fe (P12C), Mn (P12C, P15D), Cu (P14A, P14C, P14D, P15D, P16A, P16B, P16C), Zn (P16C), Al (P12A, P14D, P16C), As (P15C), Sr (P15A, P15B, P15C, P16B, P16C, GW104090)

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

A summary of the groundwater quality (electrical conductivity, pH, and metals) trigger exceedances during the reporting period at the monitored bores are presented in Table 7.

Groundwater quality parameters are sampled every three months as per the Water Management Plan and TARPs (Tahmoor Coal, 2021), and as such private bores were last sampled in October 2022 and the exceedances from that sampling event are presented in Table 7.

## Table 7 Trigger Exceedances for pH, EC, and Metal Concentrations

| Bore | Month | Trigger Level Exceedance | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EC (µS/cm) | pH lower | pH upper | Fe | Mn | Cu | Pb | Zn | Ni | Al | As | Li | Ba | Sr | Se |
| Shallow OSP | | | | | | | | | | | | | | | | |
| P12A | Oct | | | | | | | | | | L2 | | | | | |
| | Nov | | | | | | | | | | | | | | | |
| | Dec | | | | | | | | | | | | | | | |
| P12B | Oct | | | | | | | | | | | | | | | |
| | Nov | | | | | | | | | | | | | | | |
| | Dec | | | | | | | | | | | | | | | |
| P12C | Oct | | | | | L2 | | | | | | | | | | |
| | Nov | | | | L2 | L2 | | | | | | | | | | |
| | Dec | | | | L2 | L2 | | | | | | | | | | |
| P14A | Oct | | | | | | L2 | | | | | | | | | |
| | Nov | | | | | | L2 | | | | | | | | | |
| | Dec | | | | | | | | | | | | | | | |
| P14B | Oct | | | | | | | | | | | | | | | |
| | Nov | | | | | | | | | | | | | | | |
| | Dec | | | | | | | | | | | | | | | |
| P14C | Oct | | | | | | L2 | | | | | | | | | |
| | Nov | | | | | | | | | | | | | | | |
| | Dec | | | | | | L2 | | | | | | | | | |
| P14D | Oct | | | | | | | | | | | | | | | |
| | Nov | | | | | | L2 | | | | L2 | | | | | |
| | Dec | | | | | | | | | | | | | | | |
| P15A | Oct | L2 | | | | | | | | | | | L1^ | | L2 | |
| | Nov | L2 | | | | | | | | | | | L1^ | | L2 | |
| | Dec | | | | | | | | | | | | L1^ | | L2 | |
| P15B | Oct | L2 | | | | | | | | | | | | | L2 | |
| | Nov | L2 | | | | | | | | | | | | | L2 | |
| | Dec | * | | | | | | | | | | | | | L2 | |
| P15C | Oct | | | | | | | | | | | | | | L2 | |
| | Nov | | | | | | | | | | | L2 | | | L2 | |
| | Dec | | | | | | | | | | | | | | L2 | |
| P15D | Oct | | | | L1^ | | | | | | | | | | | |
| | Nov | | | | L1^ | L2 | | | | | | | | | | |
| | Dec | | | | L1^ | | L2 | | | | | | | | | |
| P16A | Oct | | | L2 | | | L2 | | | | | | | | | |

| Bore | Month | Trigger Level Exceedance | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | EC (µS/cm) | pH lower | pH upper | Fe | Mn | Cu | Pb | Zn | Ni | Al | As | Li | Ba | Sr | Se |
| | Nov | | | | | | | | | | | | | | | |
| | Dec | | L2 | | | | | | | | | | | | | |
| P16B | Oct | | | | | | | | | | | | | | | |
| | Nov | | | | | | L2 | | | | | | | | L2 | |
| | Dec | * | | | | | L2 | | | | | | | | L2 | |
| P16C | Oct | | | | | | L2 | | L2 | | | | | | L2 | |
| | Nov | | | | | | | | L2 | | | | | | | |
| | Dec | | | | | | L2 | | L3 | | L2 | | | | | |
| GW104090 | Oct | | | L2* | | | | | | | | | | | L2 | |
| GW105467 | Oct | # | # | # | # | # | # | # | # | # | # | # | # | # | # | # |
| GW105228 | Oct | | | L2* | | | | | | | | | L1^ | | | |
| GW072402 | Oct | | | | | | | | | | | | | | | |
| GW115860 | Oct | | | L2* | | | | | | | | | | | | |
| GW105546 | Oct | # | # | # | # | # | # | # | # | # | # | # | # | # | # | # |

TARP Level 1 TARP Level 2 TARP Level 3 Potential TARP Level 4

*LX: maximum trigger level exceedances recorded* *possible measurement error in EC and pH calibration #: no data available

*^: TARP Level 1 following revision of the trigger level*

## 5.2 Discussion of Groundwater Quality Exceedances

During the reporting period, groundwater quality triggers were exceeded at sites P12, P14, P15, P16, and GW105228 and overall, the:

- EC levels are observed within a TARP Level 2 at site P15A and P15B over the reporting period;
- pH levels are observed within a TARP Level 2 at site P16A, GW115860, GW105228 and GW104090; and
- Metals concentrations are observed within a potential TARP Level 3 at site P16C and within a TARP Level 2 at sites P12, P14, P15, P16 and GW104090. All metals observations within a TARP Level 2 are likely short-term increases (less than three months), otherwise specified in Table 8 and are not identified as a mining related effect.

Assessment of the observed exceedances, short-term increases (less than three months) and a high-level outline of the potential influencing factors for the exceedances, are briefly discussed in Table 8.

## Table 8 Groundwater Quality Trigger Exceedances – Discussion

| Site | Discussion |
|---|---|
| P12A | Short-term increase in aluminium observed in October 2022 (TARP Level 2) (Figure D13) |
| P12C | TARP Level 2 metals (iron and manganese) (Figure D1 and Figure D3). Dissolved iron concentrations have shown significant fluctuations in the past six-months with a peak observed in September 2022 to 76 mg/L followed by a sharp decline to 18 mg/L (below the trigger level) in October 2022 (Figure 6). However dissolved iron concentrations fluctuated between 64 and 38 mg/L and above the trigger level in November and December 2022. Dissolved iron concentrations remained below the trigger level at P12A and P12B being recorded at 5.2 mg/L and 14 mg/L respectively which show that dissolved iron concentrations in the shallow Hawkesbury Sandstone aquifer remain within baseline level (Figure 6). The increase in dissolved iron at P12C is suggested to be localised and likely the result of iron being mobilised during the groundwater recovery observed over the past six months. Iron staining may have formed along the steel casing during the period of groundwater depressurisation and is likely mobilised as groundwater levels increased in the bore. It is recommended to purge the bore for a longer period in the next monitoring round to confirm trends in dissolved iron concentrations.<br>The increase of dissolved manganese concentrations above the trigger level during the reporting period (i.e. peak at 1.3. mg/L in October 2022) could also be linked to the staining of the casing. As shown on Figure 6 and Figure 7, dissolved iron and manganese concentrations appear to be correlated. Also, dissolved manganese concentrations at P12A and P12B were recorded between 1 and 1.5 mg/L and are observed within similar level as P12C during the reporting period. This suggests that natural fluctuation in groundwater quality could be associated with the increasing trend at sites P12. As for dissolved iron concentration trigger level, prior to undertake a revision to the dissolved iron trigger level, it is recommended to purge the bore for a longer period in the next monitoring round to confirm trends in dissolved manganese concentrations. |
| P14A, P14C, P14D, P16A, P16B, P16C, P15D | Figure D5 to Figure D11 —TARP Level 2 metals (copper) – short-term fluctuations in dissolved copper concentrations above the trigger level likely to be the result of above average rainfall in 2022. |
| P14D | Short-term increase in aluminium observed in November 2022 (TARP Level 2) (Figure D14) |

| Site | Discussion |
|---|---|
| P15A | Groundwater EC was observed marginally above the trigger level in October and November 2022 before declining below the trigger level in December at 4,000 uS/cm. (Figure C1).<br>TARP Level 2 metals (strontium) – dissolved strontium concentrations continue to decrease over the reporting period to 5.7 mg/L following a peak to 11.7 mg/L in June 2022 (Figure D18).<br>TARP Level 2 metals (lithium) (Figure D23) – dissolved lithium concentrations have fluctuated marginally above the trigger level (0.13 mg/L) since June 2022 between 0.17-0.21 mg/L. Since June 2022 minor increases in lithium concentrations in the range of 0.05 mg/L are observed in the mid Hawkesbury Sandstone (P15B and P15C) and at less than 0.05mg/L in the lower Hawkesbury Sandstone (P15D) (Figure 10) and within TARP Level 1. Also, lithium concentrations at the nearby private bores are observed at less than 0.05 mg/L. The nearby groundwater monitoring sites P14A, B, C and D record lithium concentrations of less than 0.025 mg/L and are observed within a TARP Level 1 (Figure 11). This suggests that the slight increase in lithium concentrations above the trigger level at P15A is localised and not driven by upwelling of groundwater with higher lithium concentration (i.e. unlikely to be mining related). Since no significant increases in lithium concentration is observed at nearby bores P14, P15B, C, D and private bores, the trigger level was revised to 0.25 mg/L in line with the private bores GW115860. Further monitoring for lithium concentrations should continue at P15A and nearby groundwater monitoring bores and private bores. |
| P15B | Groundwater EC was observed marginally above the trigger level (3,575 uS/cm) in October and November 2022 at 3,741 uS/cm (Figure C2). The groundwater EC data point for December 2022 was removed the datasets as the record appears erroneous (i.e. greater than 6,500uS/cm) while TDS is recorded at 233.5 mg/L. The TDS value suggests that the groundwater EC would be close to 348.5 uS/cm (i.e. EC approximately equals to TDS / 0.67).<br>TARP Level 2 metals (strontium) exceedance observed across the reporting period (Figure D19). Strontium concentrations peaked to 1.5 mg/L in October 2022 and have declined to 1.3 mg/L in December 2022, marginally above the trigger level of 1.21 mg/L (Figure D19). It is recommended to continue closely monitoring strontium concentrations at P15B although the fluctuations in lithium concentrations slightly above the trigger level are likely due to floods events in 2022. |
| P15C | TARP Level 2 metals (strontium) exceedance observed across the reporting period (Figure D20). Strontium concentrations peaked to 0.74 mg/L in July 2022 and have gradually declined to 0.52 mg/L in December 2022, marginally above the trigger level of 0.45 mg/L. Fluctuations in strontium concentrations just above the trigger level is likely the result of flood events in 2022 and the local geology mobilising a slightly higher source of lithium following rainfall events than at P14 or nearby private bores (within TARP Level 1). The strontium concentrations observed at P15B and P15C remain well below the US health-based screening level benchmark of 4 mg/L. |

| Site | Discussion |
|---|---|
| P15D | TARP Level 2 metals (iron) (Figure D2). While dissolved iron concentrations increased above the trigger level since April 2022, concentrations have moderately fluctuated (i.e. from less than 30 mg/L in June 2022 to less than 10 mg/L in August 2022) (Figure D2). The range in dissolved iron concentrations observed at P15D is not significantly different and is even lower than iron concentrations observed at other monitoring sites (P14A) or private bores (GW105228) observed within TARP Level 1. In addition, no exceedance in dissolved iron is observed at GW115860 (i.e. closest private bore to P15D) during the reporting period. No significant increases in dissolved iron concentrations are observed in the shallow and mid Hawkesbury aquifer (P15A, B and C) which suggest that the increase at P15D is localised and likely natural. The trigger level for dissolved iron concentrations at P15D is too conservative as the trigger level was calculated using data points taken during July-September 2021, period associated with rainfalls and decline in dissolved iron concentrations at most groundwater monitoring sites (Figure 8). It is recommended to revise the trigger level for dissolved iron at P15D to 25 mg/L, just below the peak value of 28 mg/L in June 2022. Following the revised trigger level dissolved iron concentrations at P15D are observed within a TARP Level 1 during the review period.<br>TARP Level 2 metals (manganese) in November 2022 and marginally above the trigger level and observed within TARP Level 1 in December 2022 (Figure D4). |
| P16A | pH at P16A has fluctuated significantly as it triggered the upper pH level in October 2022 and lower pH level in December 2022 (Figure C4). pH at P16A has previously shown large fluctuations. Additional monitoring data is required to confirm pH trends. TARP Level 2 applies in October and December 2022. |
| P16B | Short-term increase in strontium observed in November and December 2022 (TARP Level 2) (Figure D16). |
| P16C | TARP Level 3 metals (zinc) (Figure D12). Dissolved zinc concentrations have fluctuated above the trigger level (0.021 mg/L) since May 2022 but declined following rainfall events (i.e July and October 2022). In October 2022, dissolved zinc concentrations decreased to 0.034 mg/L (marginally above the trigger level). As of December 2022, zinc concentrations increased to 0.12 mg/L, where a TARP Level 3 applies. For comparisons, P16A and P16B have shown natural fluctuations in zinc concentrations (i.e in the range of 0.1 mg/L) following rainfall events however no increases are observed during the reporting period. This suggest that the increase in zinc in the lower Hawkesbury Sandstone (P16C) is localised (Figure D12). Since early 2022, the sustained increase in groundwater levels seen at P16C could locally mobilised a naturally occurring source of zinc (i.e in the range of 0.10-0.15 mg/L). Also, the mild steel casing at P16C could contribute to a higher zinc concentration. Higher zinc concentrations at P16C could be related to a post mining impact however natural fluctuations in groundwater quality and major flood events in 2022 are likely the reason for higher zinc concentrations.<br>As of December 2022, it is recommended to apply a TARP Level 3 at P16C for dissolved zinc concentrations. A TARP Level 4 should be considered in the next review period if further increase in zinc at P16C is observed and if zinc concentrations increase above the trigger level at P16A and P16B.<br>Short-term increase in aluminium observed in December 2022 (TARP Level 2) (Figure D15)<br>Short-term increase in strontium observed in November and December 2022 (TARP Level 2) – (Figure D17). |

| Site | Discussion |
|---|---|
| GW115860, GW105228, GW104090 | pH at these private bores increased significantly in October 2022 compared to the last pH reading in July 2022 (i.e. pH increased up to 5 pH units) (Figure C5 to C7). Since monitoring of pH started at these bores, pH did not fluctuate significantly only within 1 pH unit and did not exceed the upper or lower pH trigger level. The recorded pH in October 2022 is likely a measurement error. pH in January 2023 (i.e. reported in the next review period) is observed within baseline level. |
| GW104090 | TARP Level 2 metals (strontium) (Figure D21) – following a peak in strontium concentration to 1.7 mg/L in January 2022 and above the trigger level of 1.2 mg/L, strontium concentrations have continued to decline to 1.1 mg/L in October 2022 hence a TARP Level 2 remains. Further monitoring is required to confirm post-mining trend in strontium concentrations although minimal baseline data exist at this site. |
| GW105228 | TARP Level 2 metals (lithium) (Figure D22) – since April 2022 lithium concentrations have gradually increased above the trigger level (0.026mg/L) from 0.024 mg/L in April 2022 to 0.037 mg/L in October 2022. A couple of data points have been used to develop the lithium trigger level at GW105228, which make the trigger level too conservative. For comparison, the trigger level at GW115860 was set at 0.25 mg/L. Lithium concentrations at GW115860 and GW105228, located a couple of hundreds of meters apart, show similar lithium concentrations (Figure 10). It is considered appropriate to revise the trigger level at GW105228 in line with GW115860 to 0.25 mg/L. Using the revised trigger level of 0.25 mg/L at GW105228, a TARP Level 1 applies. |

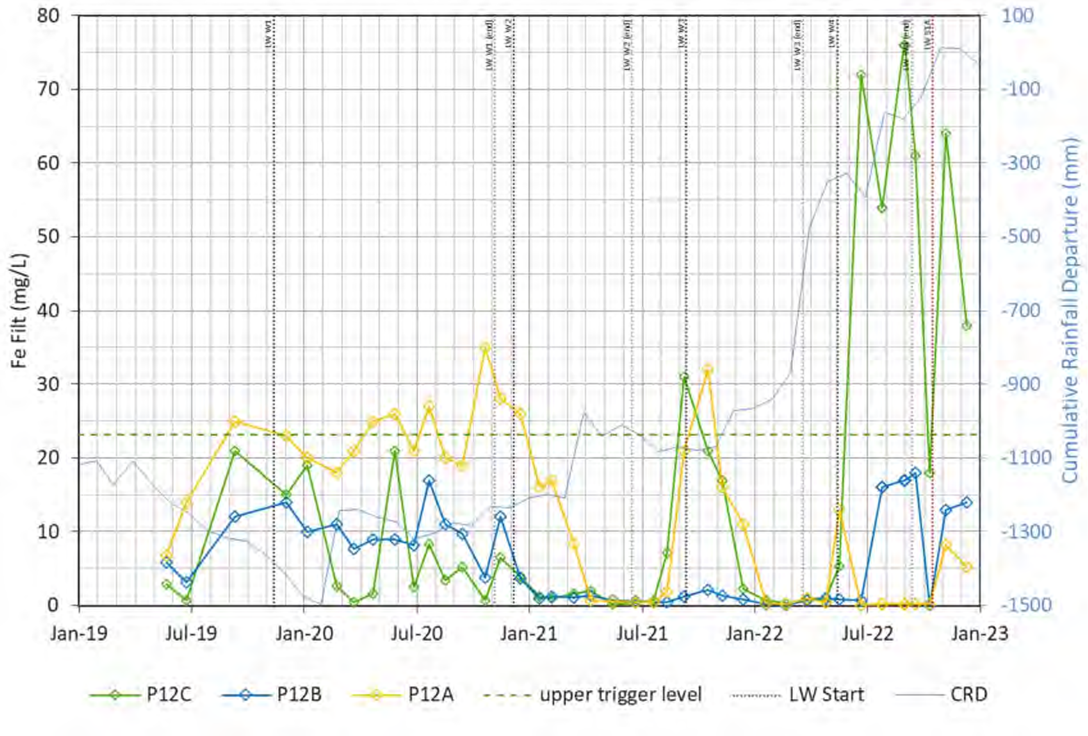



Figure 6 Dissolved Iron (Fe) concentrations at sites P12

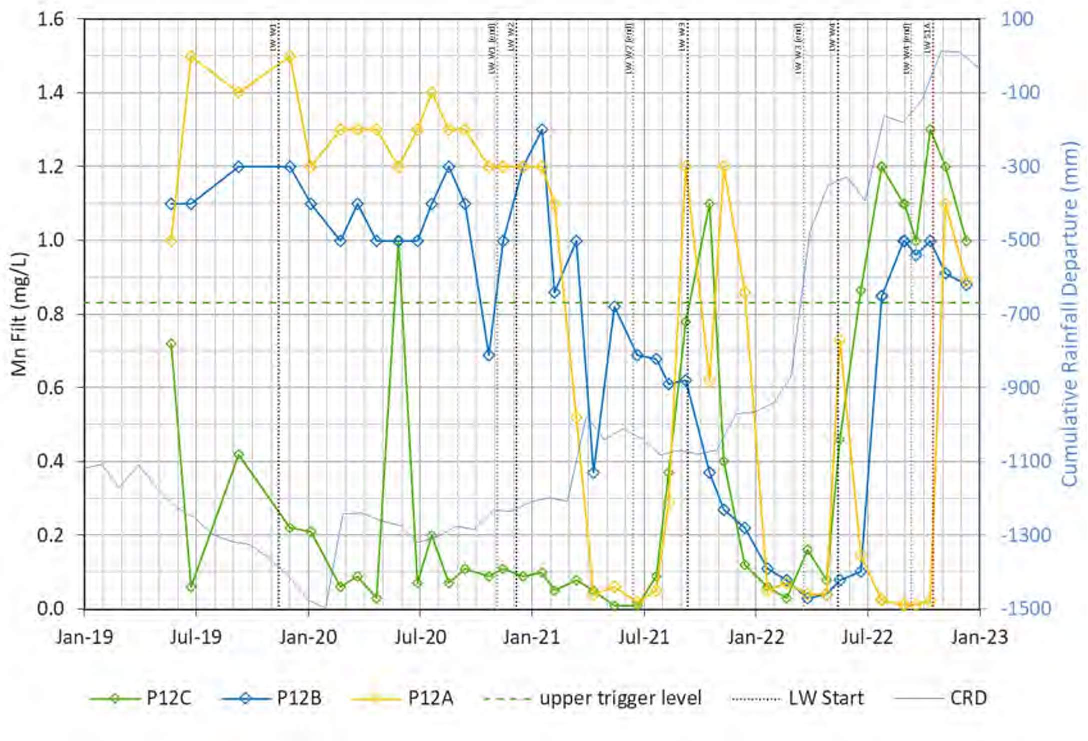



Figure 7 Dissolved Manganese (Mn) concentrations at sites P12

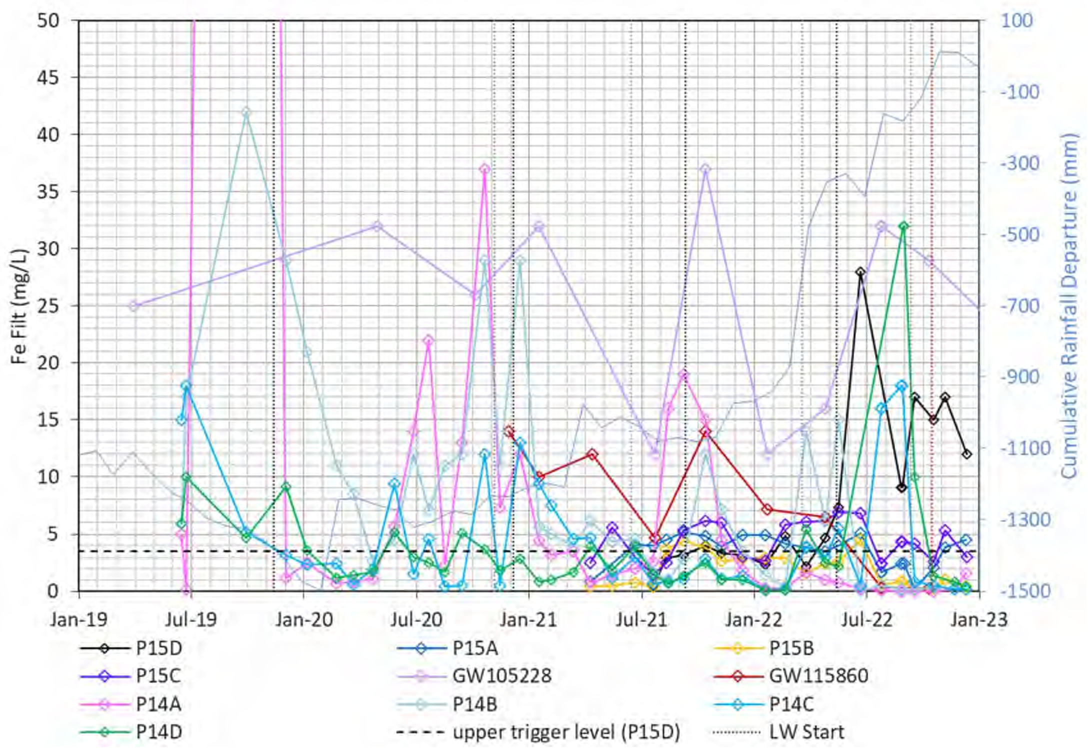



Figure 8 Dissolved Iron (Fe) concentrations at sites P14, P15 and nearby private bores GW105228 and GW115860

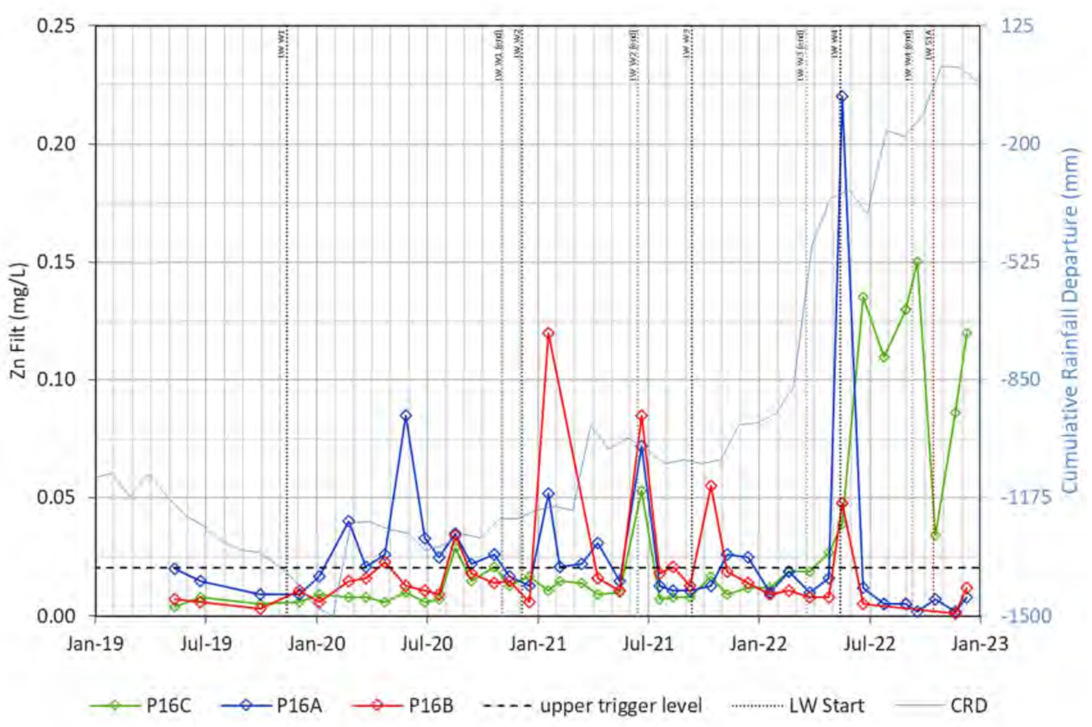



Figure 9 Dissolved Zinc (Zn) concentrations at sites P16

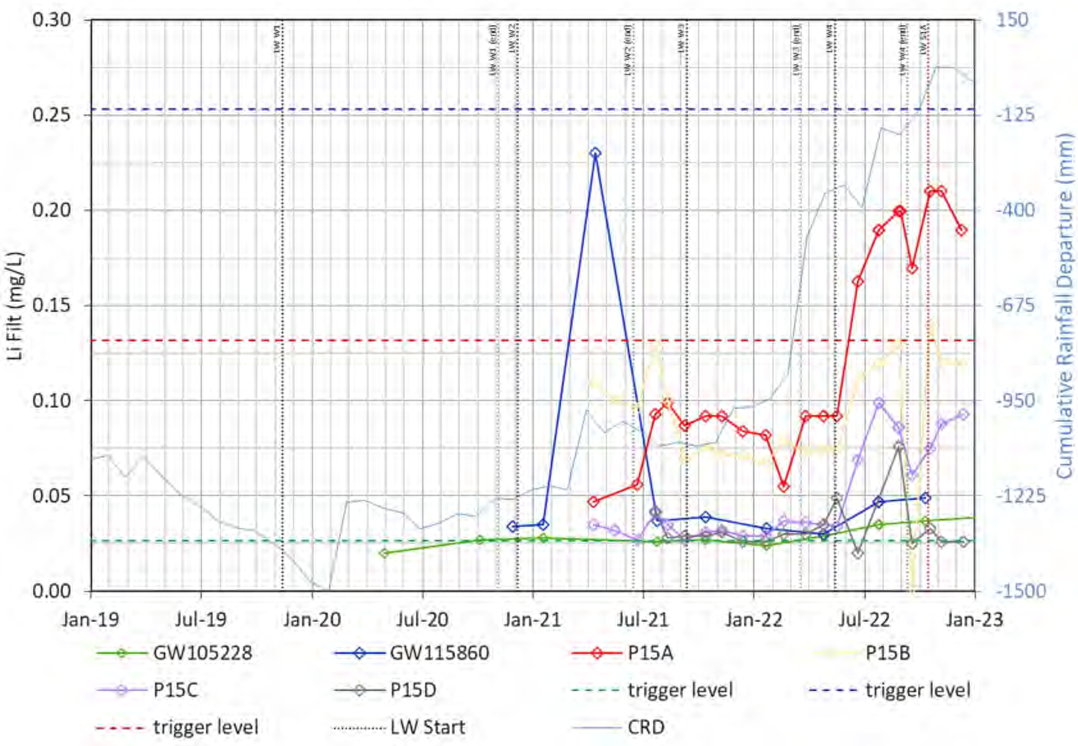



Figure 10 Dissolved Lithium (Li) concentrations at sites P15 and private bores GW105228 and GW115860

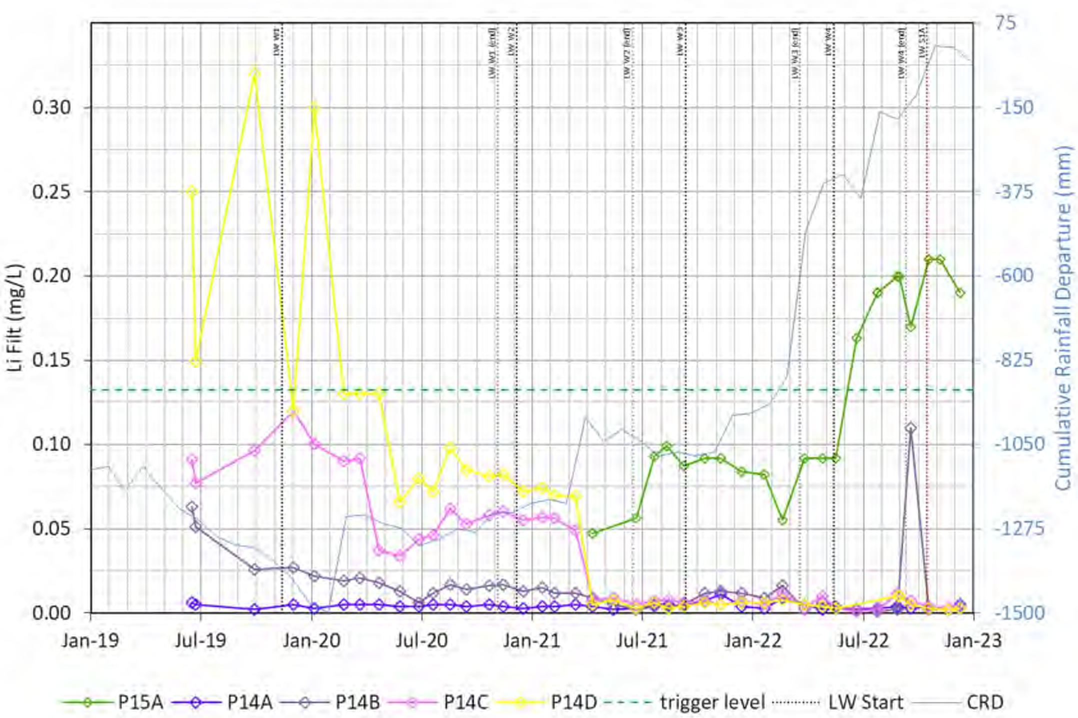



Figure 11 Dissolved Lithium (Li) concentrations at sites P15A and P14A, B, C and D

# 6 Mine Inflows

For the period 2009 to December 2022 (latest record used in calculations up to 31th December 2022), observed inflows to Tahmoor Mine have been within the range of 2 to 6 ML/d.

Figure 12 shows the cumulative groundwater inflows (as calculated from the mine water balance and pump-out records) for each water year since the 2019-2020 water year (i.e. since the commencement of mining on the Western Domain).

The reporting period October-December 2022 falls within the water year calendar 2022-23. The observed cumulative groundwater makes for the water 2022-23 is 546 ML and remains below the groundwater entitlement of 1,642 ML per annum (i.e. water year) as of December 2022 (Figure 12).

The Western Domain blocks have been sealed in October 2022 and since then an average groundwater inflow of 2.3 ML/day is reported from the Tahmoor North workings.

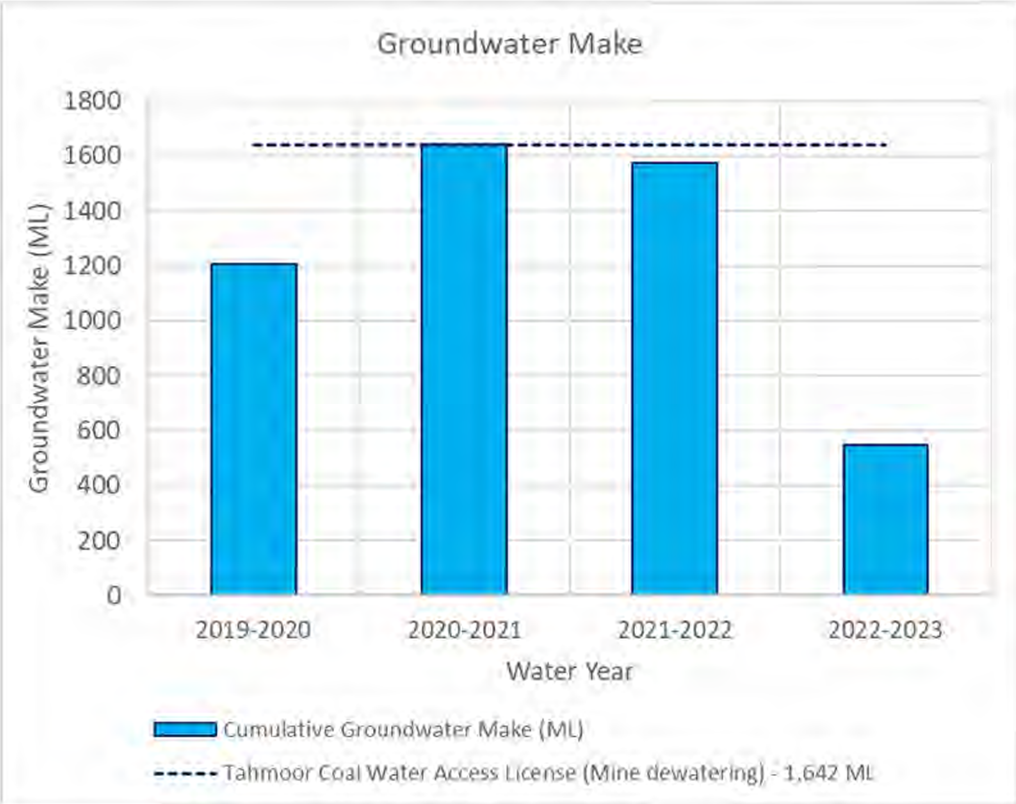



Figure 12 Groundwater Make per Water Year (from 2019-20 to 2022-23)

# 7 Recommendations for Trigger Exceedances

Based on the trigger exceedances assessed in Section 4 and Section 5 and based on the TARPs presented in Appendix B, the following actions are recommended:

- Continue the monitoring program, reporting groundwater level and quality data in the next groundwater review report for January-March 2023.
- For P12C, P16B, P16C, TNC036 (HBSS-97m) and TNC036-169m with Level 2 TARPs in place for groundwater levels, continue monitoring and reviewing groundwater level response.
- 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.
- For all sites with Level 1 TARPs in place for groundwater quality, continue monitoring pH, EC and metal concentrations against TARP trigger levels.
- For all sites with Level 2 TARPs in place for groundwater quality (EC, pH and metals), continue monitoring concentrations against TARP trigger levels.
- For site P12C with a Level 2 TARP in place for groundwater quality (iron and manganese), continue closely monitoring Fe and Mn concentrations at the nearby monitoring bores (P12A and P12C).
- For site P15D with a Level 2 TARP in place for groundwater quality (iron), continue closely monitoring Fe concentrations at the nearby monitoring bores (P14A-D) and nearby private registered bores GW105228 and GW115860.
- For site P16C with a Level 3 TARP in place for groundwater quality (zinc), continue closely monitoring Zn concentrations at the nearby monitoring bores (P16A, B and private bore GW105546 and GW105467).
- For site P15A, B and C with a Level 2 TARP in place for groundwater quality (strontium), continue closely monitoring Sr concentrations at the nearby monitoring bores (P14A-D) and nearby private registered bores GW105228 and GW115860.
- For site P15A and GW105228 with a Level 2 TARP in place for groundwater quality (lithium), continue closely monitoring Li concentrations at the nearby monitoring bores (P14A-D) and nearby private registered bores GW115860.
- Complete an extended purge at P12C, P15A, P15D, P16C in the next round of monitoring to remove groundwater potentially contaminated with iron stain, grout or other localised source of metals before sampling.
- For the next round of monitoring, undertake sampling of groundwater levels and yield test at GW105546 and GW105467.
- No groundwater levels were available at P16B in October 2022 and at GW072402 during the reporting period due to blockage of the bores. P16B was unblocked in late November 2022. The landowner of the property where GW072402 is located advised that this bore has been blocked for several years. The reason for the blockage of the bore is unknown and unlikely to be related to a mining effect. Indeed, the blockage is suspected to have occurred prior mining at the Western Domain. Groundwater monitoring at GW072402 will no longer occur.
- Convene the Tahmoor Coal Environmental Response Group to review results.

## 7.1 Previous SLR (2022) Recommendations

- Drilling of the new VWP borehole WD02 above LW W2 is in progress at time of writing. 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.
- At P16C, the pressure data collected by the data logger have been converted into a groundwater head (mAHD).
- An extended purge at P15A, P16C and P12B in relation to higher strontium, zinc and pH respectively was conducted in December 2022.
- GW104090 has no pump installed and was reported as sheared. An active subsidence claim with SA NSW is in place at GW104090.

Reviewer: I Epari
Review date: 28/2/2023

# 8 References

HydroSimulations/SLR, 2019. Tahmoor LW W1-W2 Extraction Plan: Groundwater Technical Report. Report HS2019/14c for Tahmoor Coal Pty. Ltd., July 2019.

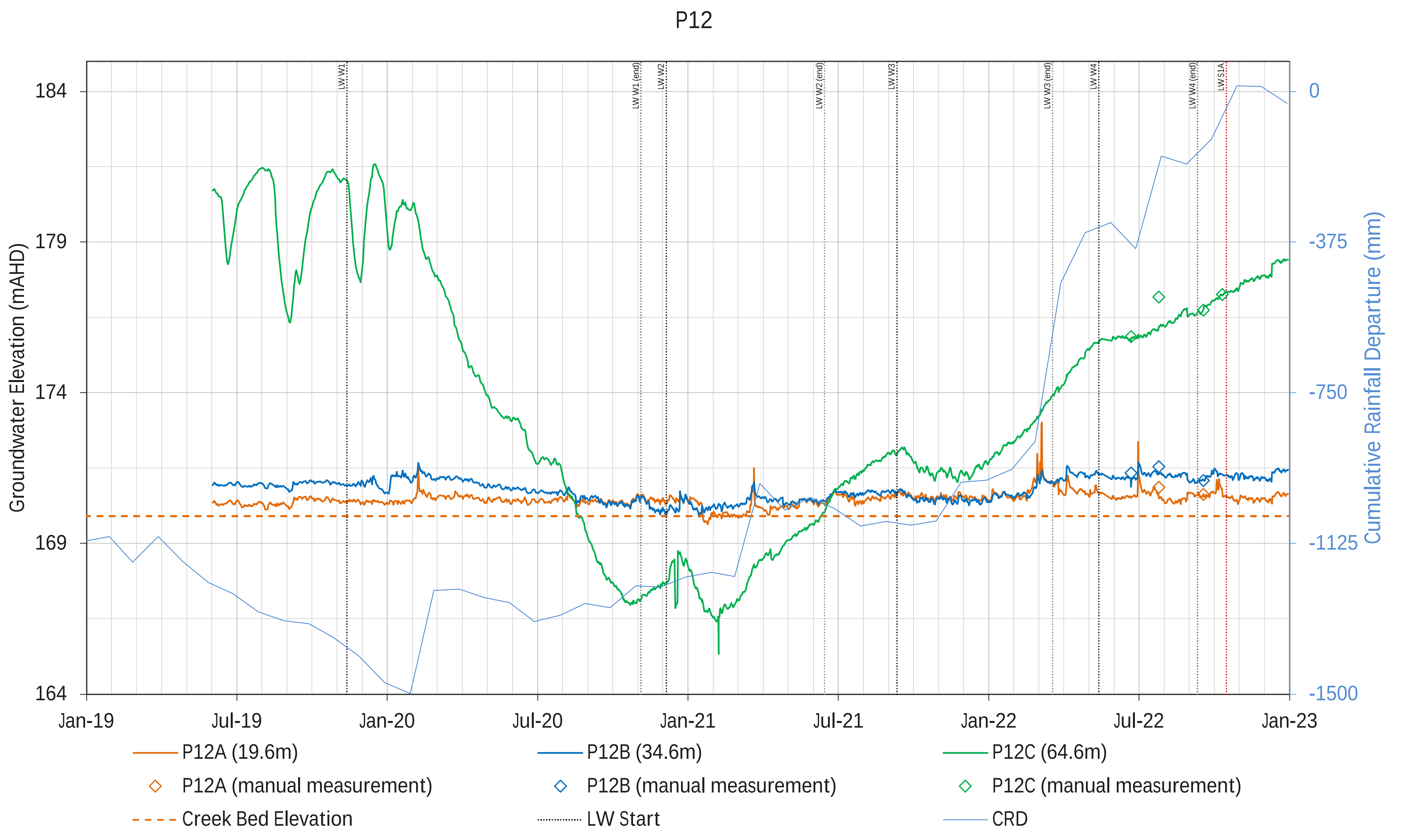
SLR, 2021. Tahmoor Coal LW W3-W4 Extraction Plan: Groundwater Technical Report. Prepared for Tahmoor Coal Pty Ltd, Report No: 665.10010.00006-R01-v3.0.

SLR, 2022. Groundwater Six-Monthly Review (April 2022 – September 2022). Prepared for Tahmoor Coal Pty. Ltd., December 2022, Report No: 610.31052.00000-R04.

Tahmoor Coal Pty Ltd, 2021. Tahmoor North - Western Domain, LW W3-W4 Water Management Plan. TAH-HSEC-326 (September 2021, Ver4)

# APPENDIX A

## Groundwater Levels (P12-P17;P40-41; TNC036-40-43 and private bores)



P12
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
184
179
174
169
164
0
-375
-750
-1125
-1500
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
P12A (19.6m)
P12B (34.6m)
P12C (64.6m)
P12A (manual measurement)
P12B (manual measurement)
P12C (manual measurement)
Creek Bed Elevation
LW Start
CRD


Figure A-1

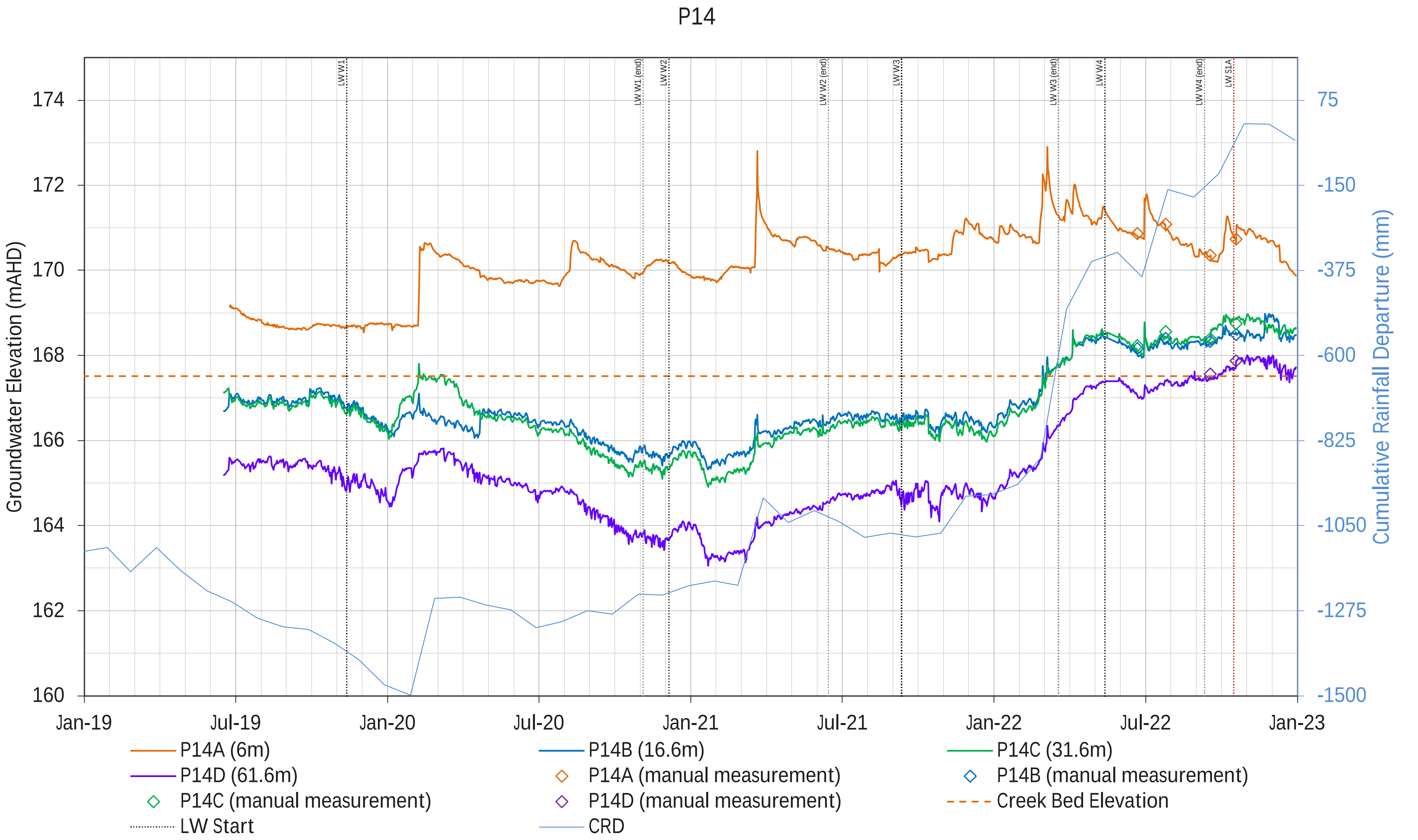
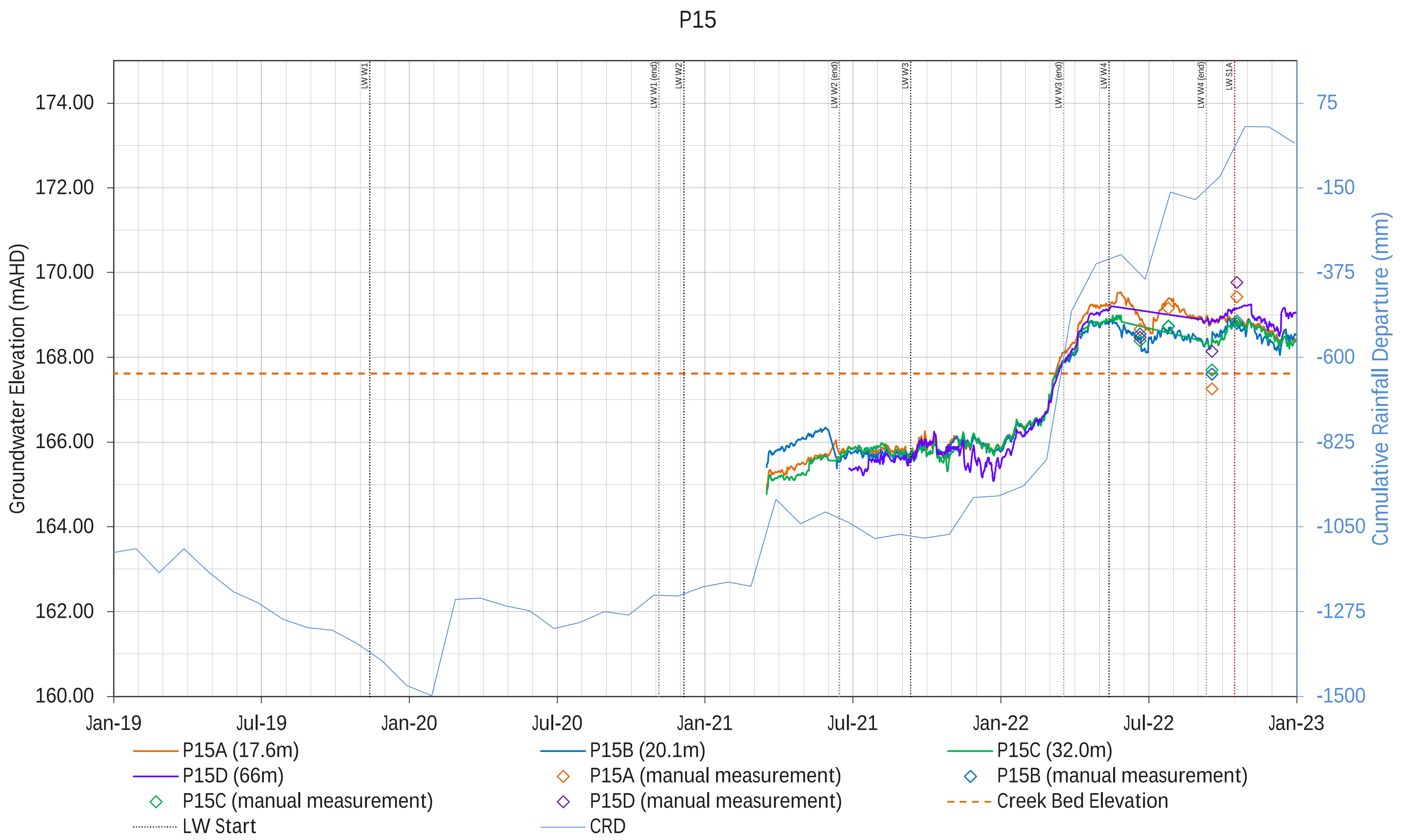

P14
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
174
172
170
168
166
164
162
160
75
-150
-375
-600
-825
-1050
-1275
-1500
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
P14A (6m)
P14B (16.6m)
P14C (31.6m)
P14D (61.6m)
P14A (manual measurement)
P14B (manual measurement)
P14C (manual measurement)
P14D (manual measurement)
Creek Bed Elevation
LW Start
CRD

**Figure A-2**



P15
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
174.00
172.00
170.00
168.00
166.00
164.00
162.00
160.00
75
-150
-375
-600
-825
-1050
-1275
-1500
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
P15A (17.6m)
P15B (20.1m)
P15C (32.0m)
P15D (66m)
P15A (manual measurement)
P15B (manual measurement)
P15C (manual measurement)
P15D (manual measurement)
Creek Bed Elevation
LW Start
CRD


**Figure A-3**

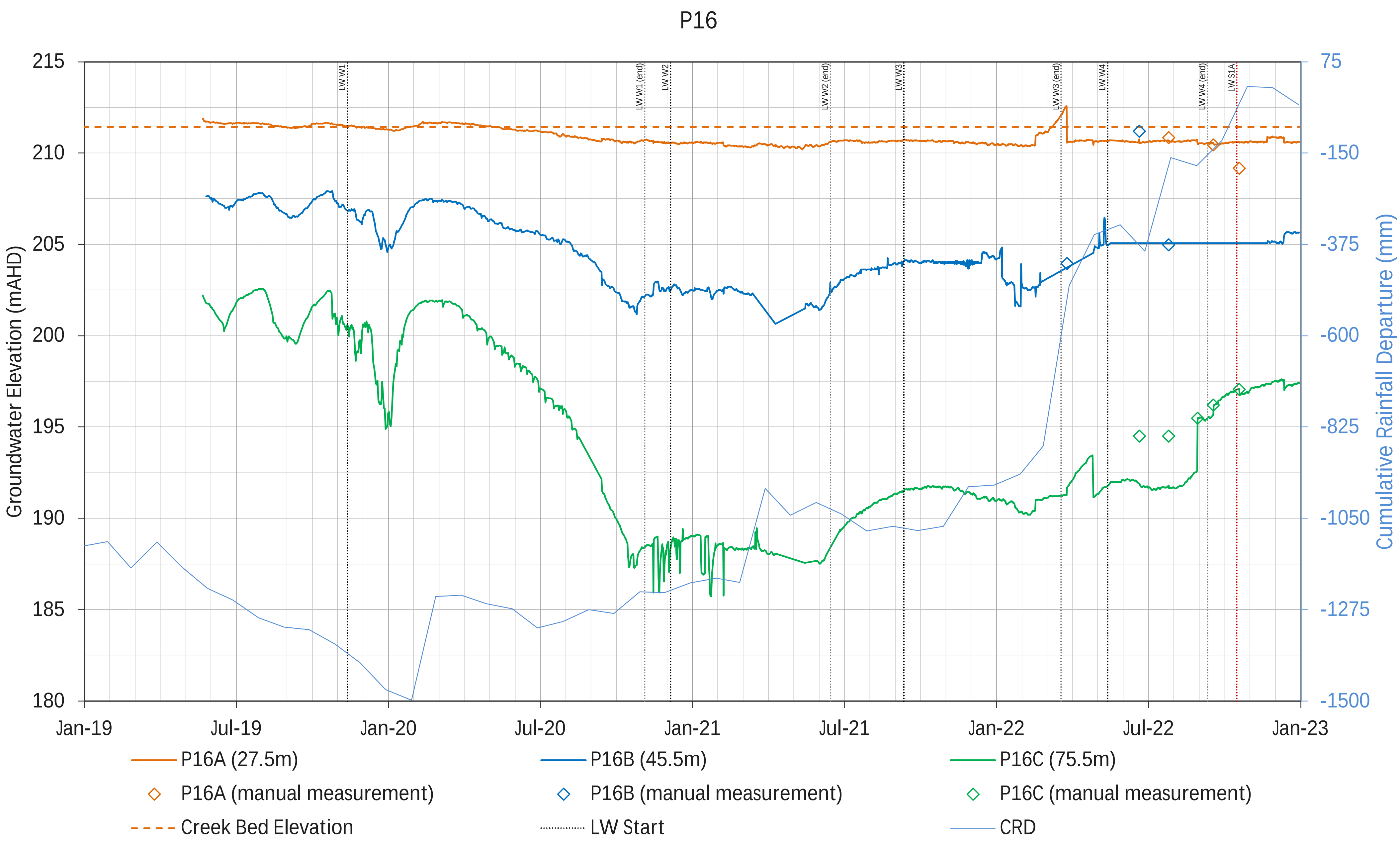
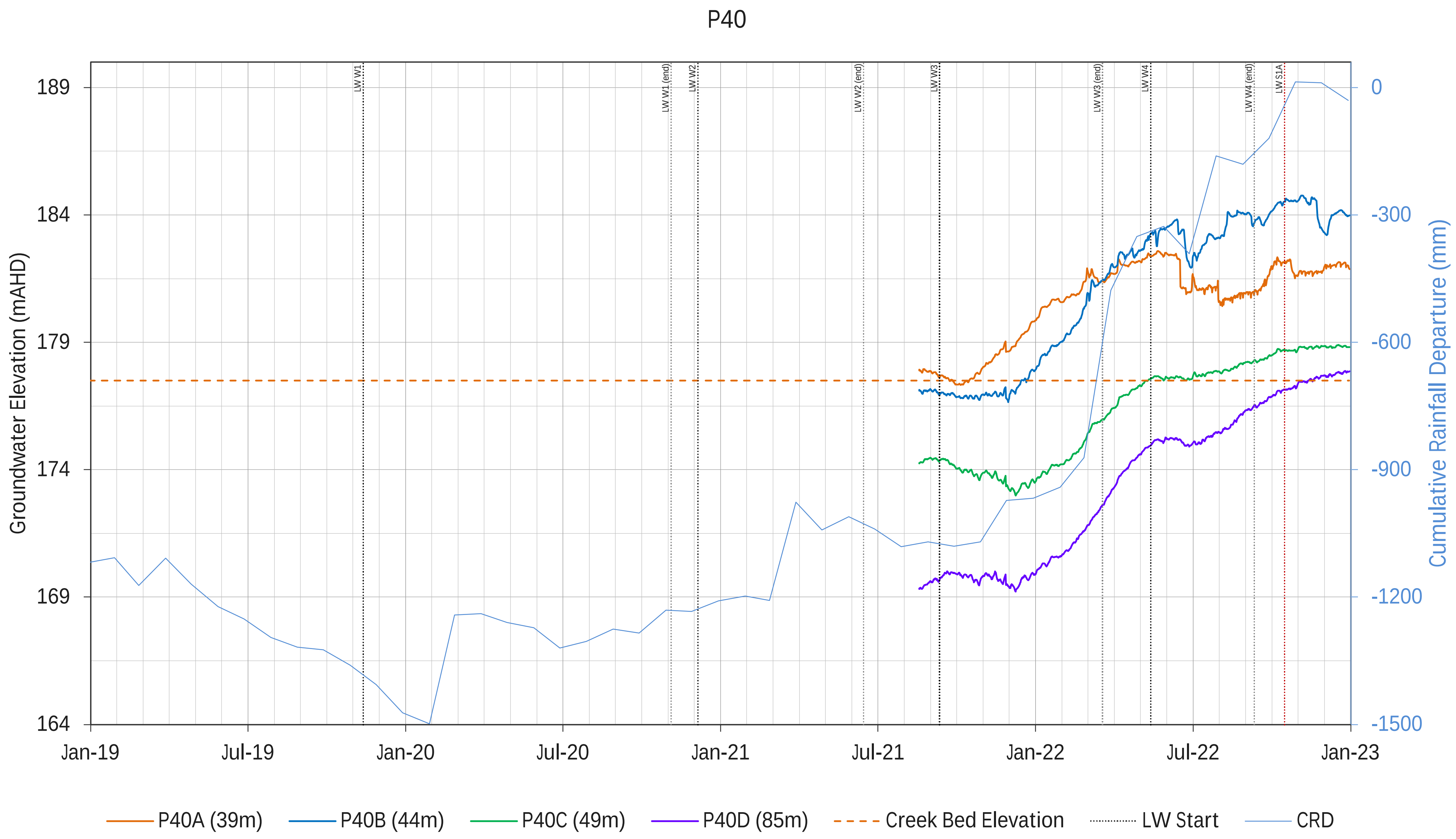

P16
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
215
210
205
200
195
190
185
180
75
-150
-375
-600
-825
-1050
-1275
-1500
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
P16A (27.5m)
P16B (45.5m)
P16C (75.5m)
P16A (manual measurement)
P16B (manual measurement)
P16C (manual measurement)
Creek Bed Elevation
LW Start
CRD

**Figure A-4**



P40
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
189
184
179
174
169
164
0
-300
-600
-900
-1200
-1500
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
P40A (39m)
P40B (44m)
P40C (49m)
P40D (85m)
Creek Bed Elevation
LW Start
CRD


**Figure A-5**

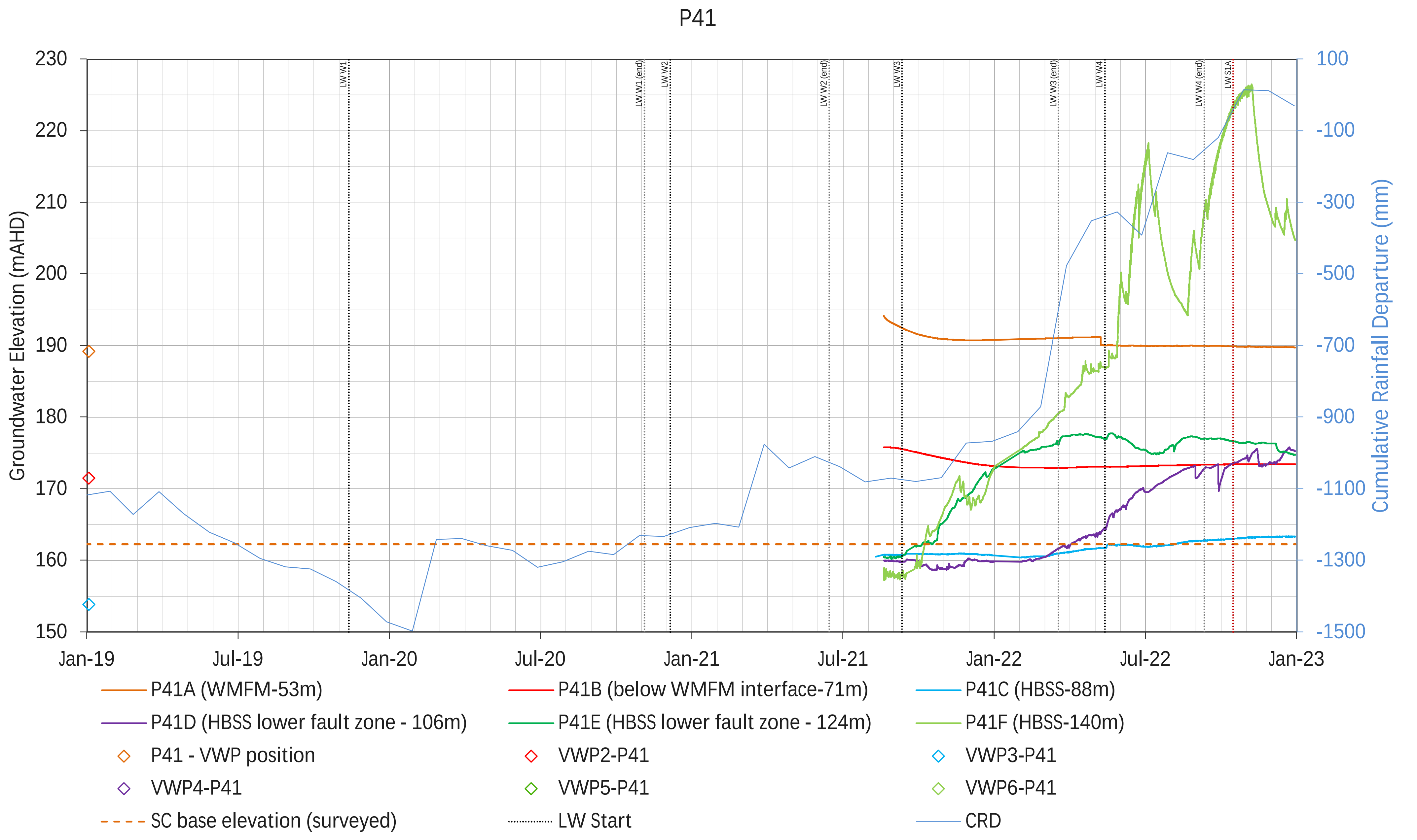

P41
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
230
220
210
200
190
180
170
160
150
100
-100
-300
-500
-700
-900
-1100
-1300
-1500
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
P41A (WMFM-53m)
P41B (below WMFM interface-71m)
P41C (HBSS-88m)
P41D (HBSS lower fault zone - 106m)
P41E (HBSS lower fault zone - 124m)
P41F (HBSS-140m)
P41 - VWP position
VWP2-P41
VWP3-P41
VWP4-P41
VWP5-P41
VWP6-P41
SC base elevation (surveyed)
LW Start
CRD

**Figure A-6**

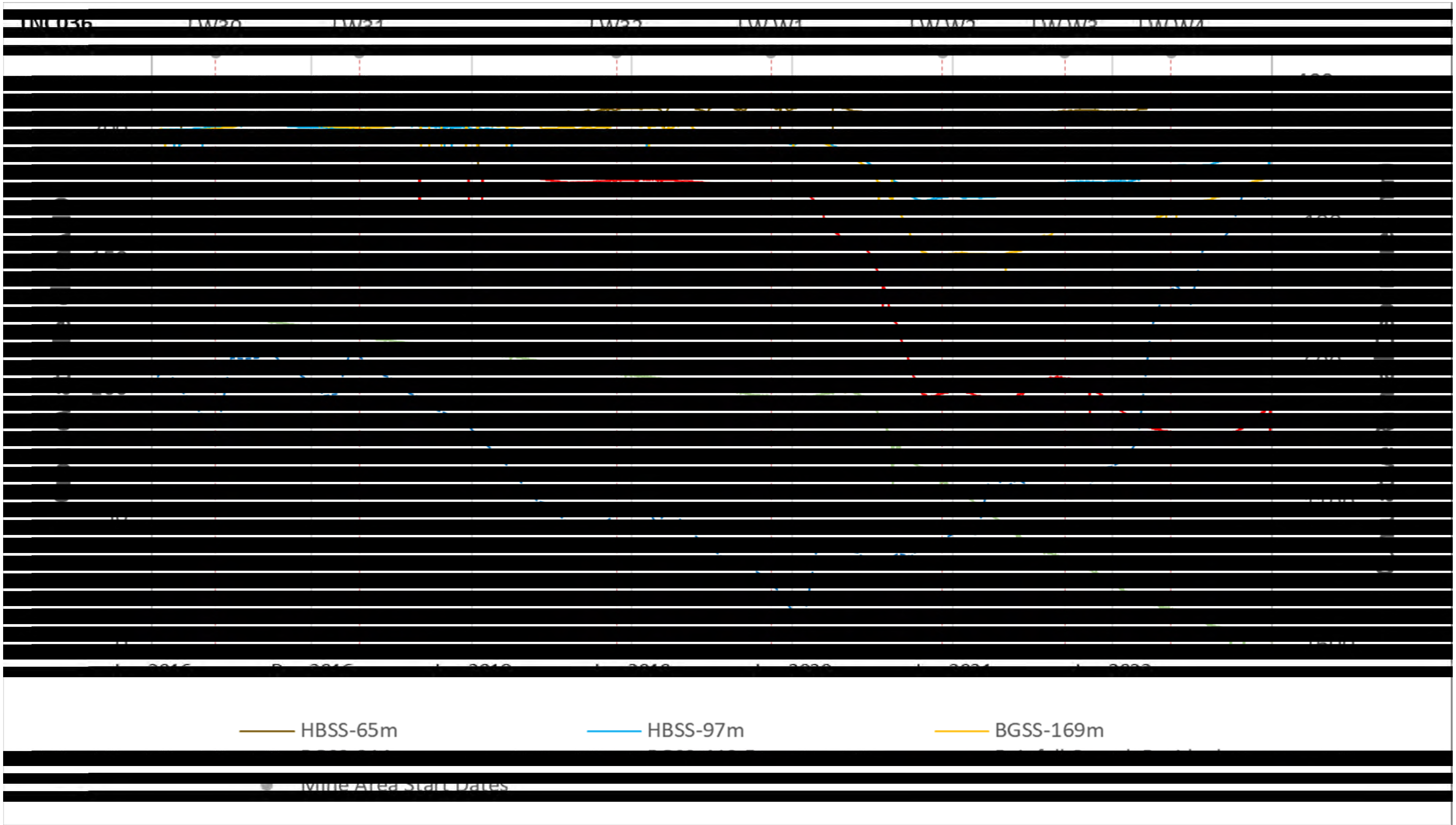



Figure A-7


Figure A-8

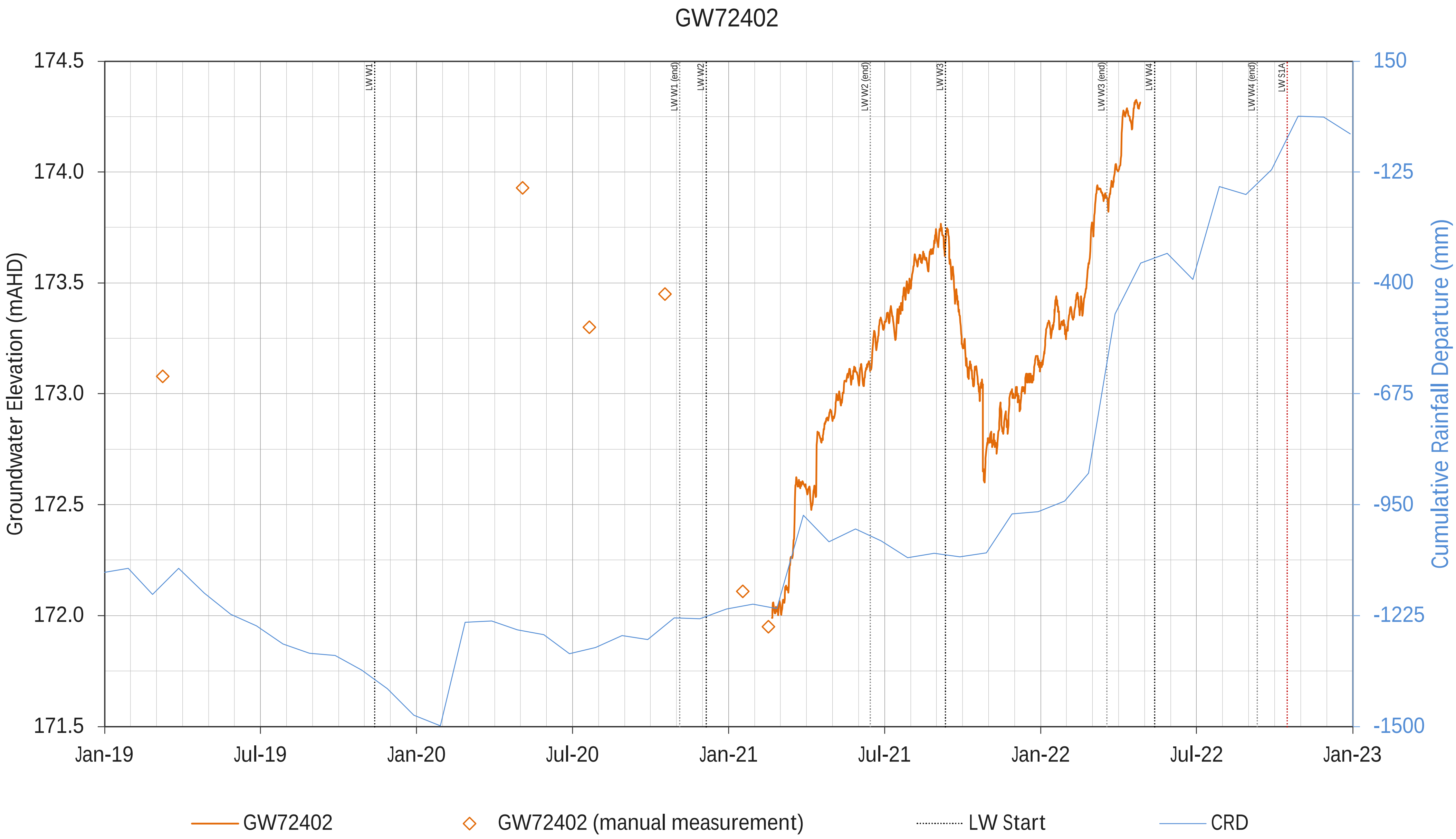
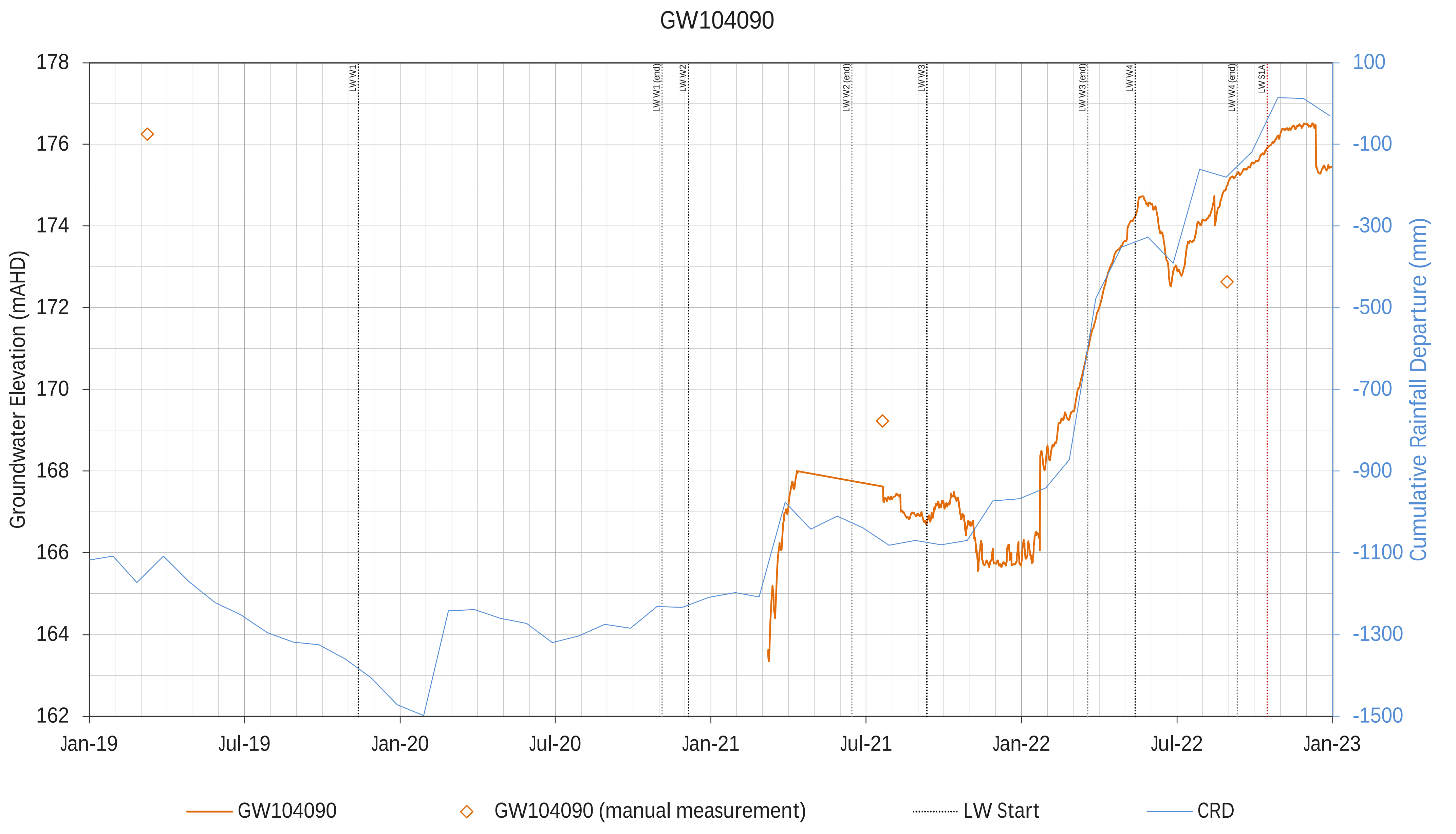

GW72402
174.5
174.0
173.5
173.0
172.5
172.0
171.5
150
-125
-400
-675
-950
-1225
-1500
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
GW72402
GW72402 (manual measurement)
LW Start
CRD

**Figure A-9**



GW104090
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
178
176
174
172
170
168
166
164
162
100
-100
-300
-500
-700
-900
-1100
-1300
-1500
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
GW104090
GW104090 (manual measurement)
LW Start
CRD


**Figure A-10**

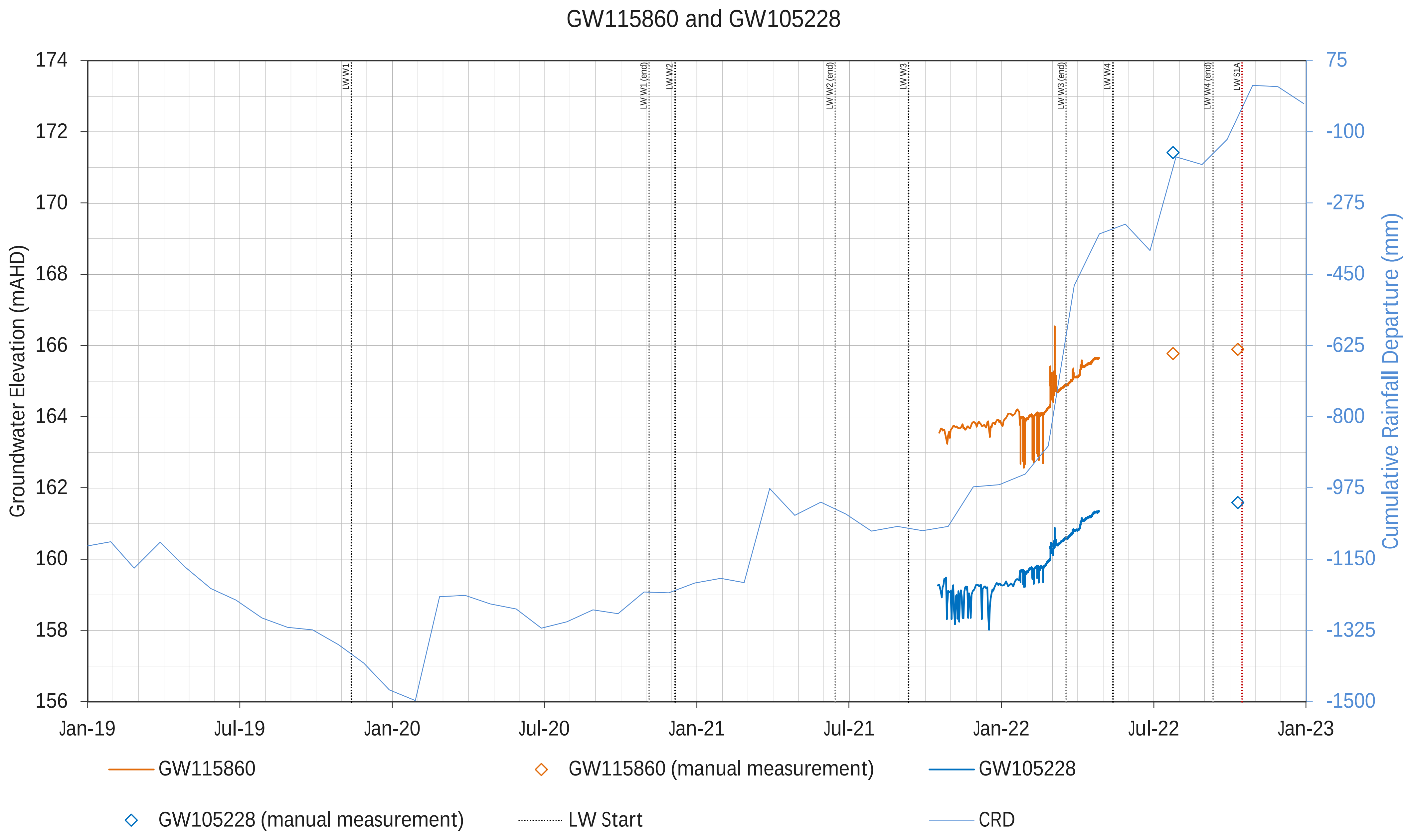

GW115860 and GW105228
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
174
172
170
168
166
164
162
160
158
156
75
-100
-275
-450
-625
-800
-975
-1150
-1325
-1500
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
GW115860
GW115860 (manual measurement)
GW105228
GW105228 (manual measurement)
LW Start
CRD

**Figure A-11**

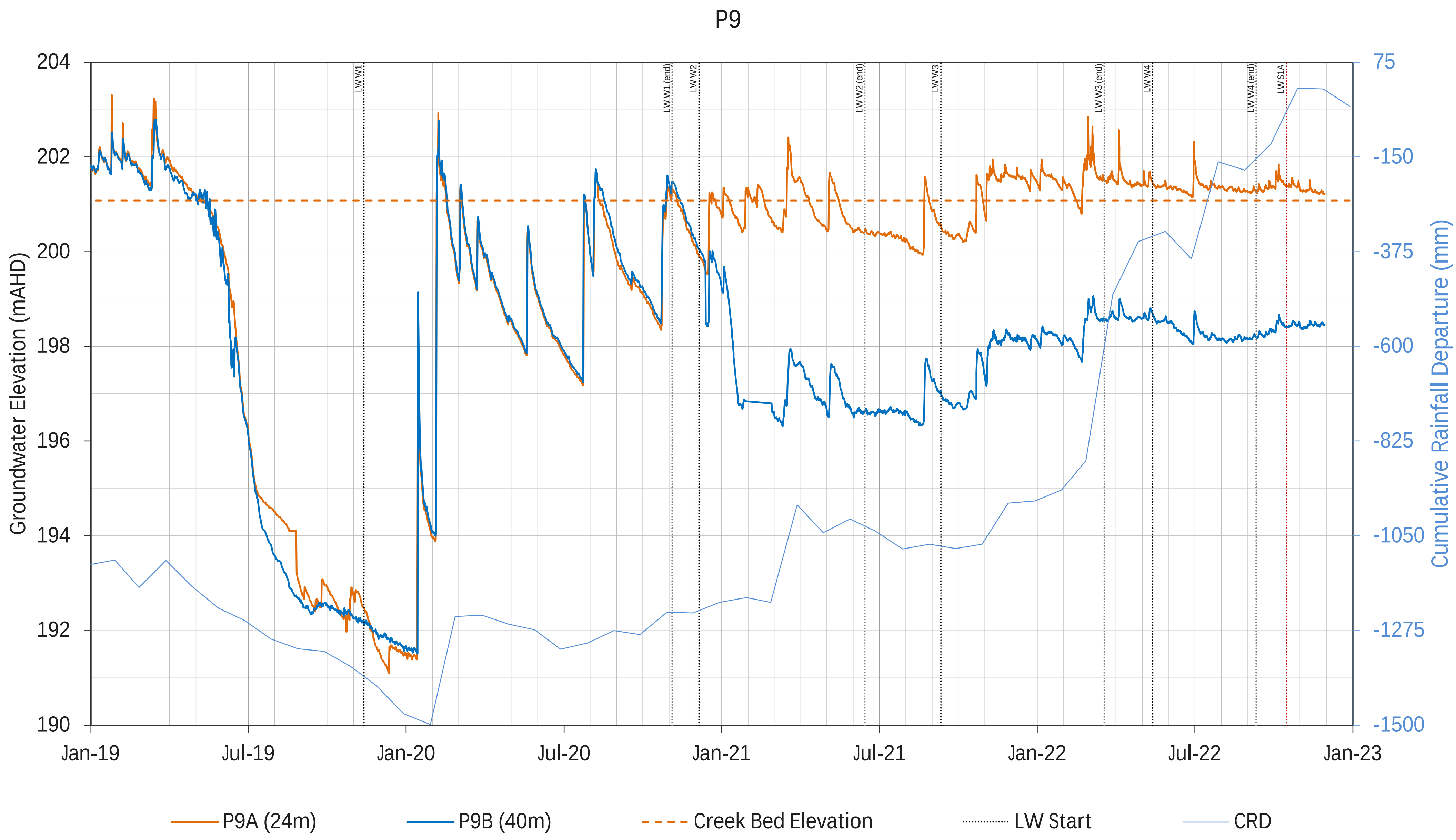
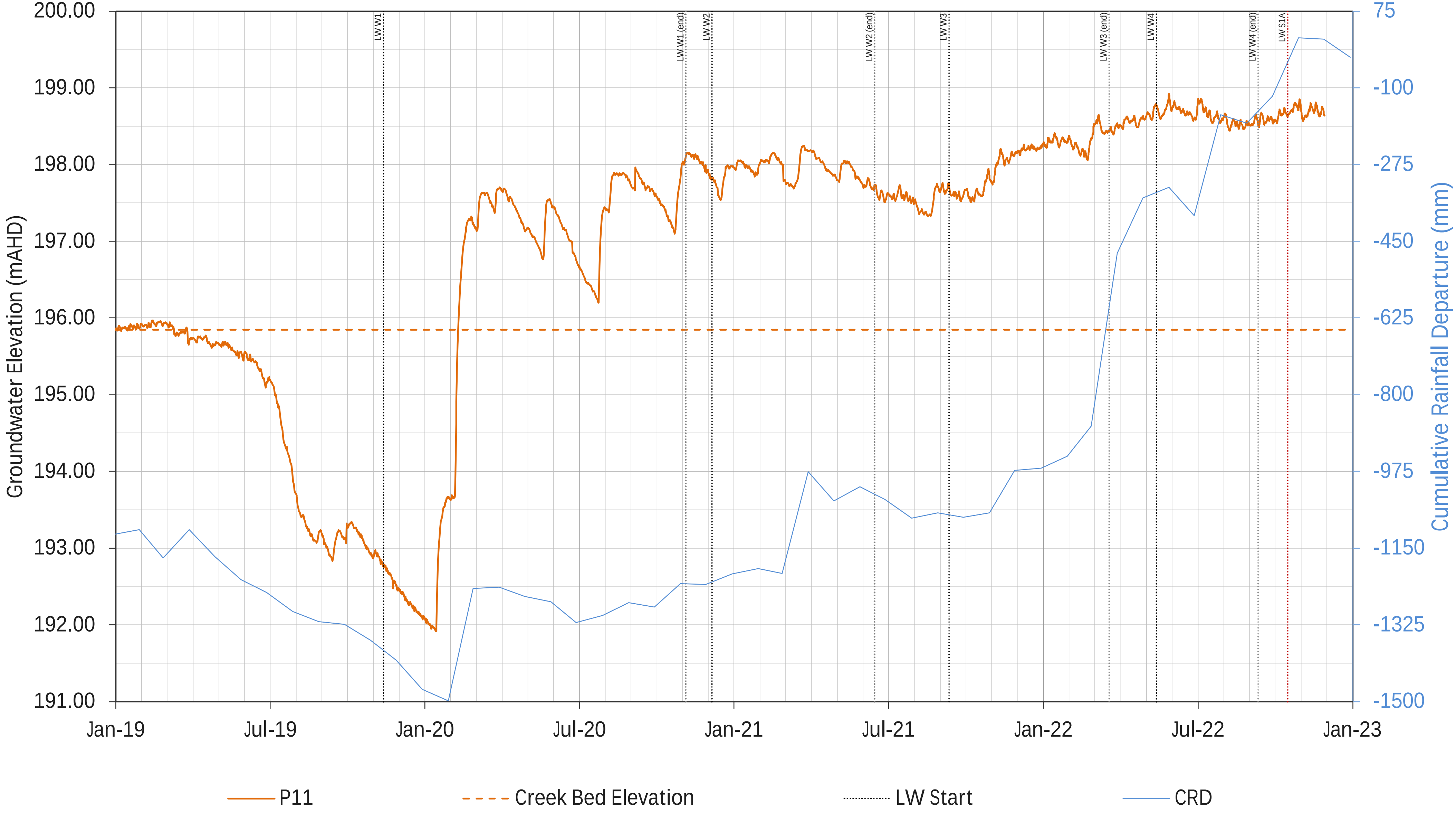

P9
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
204
202
200
198
196
194
192
190
75
-150
-375
-600
-825
-1050
-1275
-1500
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
P9A (24m)
P9B (40m)
Creek Bed Elevation
LW Start
CRD

**Figure A-12**



Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
200.00
199.00
198.00
197.00
196.00
195.00
194.00
193.00
192.00
191.00
75
-100
-275
-450
-625
-800
-975
-1150
-1325
-1500
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
P11
Creek Bed Elevation
LW Start
CRD


**Figure A-13**

# APPENDIX B

## Trigger Action Response Plans and Groundwater Hydrographs (Figures B1-B28)

- Approved Trigger Criteria and Actions from LW W3-W4 (Tahmoor North - Western Domain, LW W3-W4 Water Management Plan TAH-HSEC-326 (September 2021, Ver4))

Table B1 - Trigger Action Response Plan – Groundwater Levels and Pressures

<table>
<tr><th rowspan="2">Feature</th><th rowspan="2">Methodology and relevant monitoring</th><th colspan="3">Management</th></tr>
<tr><th>Trigger</th><th>Action</th><th>Response</th></tr>
<tr><td rowspan="8">Groundwater Levels at monitoring bores and private groundwater bores.</td><td rowspan="8">GROUNDWATER LEVEL – Monitoring bores<br>Locations (refer to Figure 3-5)<br><u>Impact sites</u> – P12, P13, P14, P15, P16, and any additional bore(s) (to be drilled)<br><u>Control sites</u> – P17, and possibly P11<br>Frequency<br><u>Pre-mining</u> - Minimum continuous 24-hourly readings with monthly logger download and dip meter. Baseline data available since May 2019.<br><u>During mining</u> - Minimum continuous 24-hourly readings with monthly logger download and dip meter.<br><u>Post mining</u> - Minimum continuous 24-hourly readings with monthly logger download and dip meter for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details).<br><br>GROUNDWATER LEVEL – Private groundwater bores<br>Locations (refer to Figure 3-5)<br><u>Control sites</u> - GW72402, GW105228, GW105467, GW115860 and GW105546 and any other private bores where access is negotiated with landholder.<br>Frequency<br><u>Pre-mining</u> - Standing Water Level (where available) and yield data. Pre-mining testing completed in bore census (GeoTerra, 2019).<br><u>During mining</u> - Manual monitoring (flow rate and, where available, standing water level) on a 3-monthly basis.<br><u>Post mining</u> - Manual monitoring (flow rate and, where available, standing water level) on a 3-monthly basis for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details).</td><td colspan="3">Level 1</td></tr>
<tr><td>• Groundwater level remains consistent within baseline variability and/or pre-mining trends, with reductions in groundwater level less than two metres and does not trigger Level 2 to Level 4 Significance Levels (refer to Table 6-2).</td><td>• Continue monitoring program.<br>• Ongoing review of water level data.</td><td>• No response required.</td></tr>
<tr><td colspan="3">Level 2</td></tr>
<tr><td>• Greater than 2 m water level reduction following the commencement of extraction at LW W1 (and LW W2, W3, W4) (refer to Table 6-2 for TARP Significance Level 2).<br>AND<br>• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.</td><td>• Continue monitoring program.<br>• Ongoing review of water level data.<br>• Review relevant surface water level, groundwater level and streamflow data to assess comparative trends.<br>• Convene Tahmoor Coal Environmental Response Group to review response.</td><td>• As defined by the Environmental Response Group.</td></tr>
<tr><td colspan="3">Level 3</td></tr>
<tr><td>• Water level declines below the water level of TARP Significance Level 3 (refer Table 6-2, 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).<br>AND<br>• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.</td><td>• Continue monitoring program.<br>• Ongoing review of water level data and consideration of mining and external stresses (in groundwater monthly report).<br>• Review relevant surface water level, groundwater level and streamflow data to assess comparative trends.<br>• Compare against base case and deterministic model scenarios.<br>• Convene Tahmoor Coal Environmental Response Group to review response.</td><td>• As defined by the Environmental Response Group.</td></tr>
<tr><td colspan="3">Level 4</td></tr>
<tr><td>• Water level reduction greater than the maximum modelled drawdown (refer to Table 6-1 for TARP Significance Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4).<br>AND<br>• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors.</td><td>• Continue monitoring and review as per monitoring program.<br>• Ongoing review of water level data and consideration of mining and external stresses (in groundwater monthly report).<br>• Review relevant surface water level, groundwater level and streamflow data to assess comparative trends.<br>• Convene Tahmoor Coal Environmental Response Group to review response.<br>• Compare against base case and deterministic model scenarios.</td><td>• Report to DPIE and relevant government agencies within 7 days of investigation completion (according to Table 6-1 of the Extraction Plan Main Document).<br>• For monitoring bores: If it is concluded that there has been a mining-related impact, then implement an investigation including review and assessment of streamflow records for downstream monitoring sites in comparison with suitable reference sites.<br>• For private groundwater bores: If it is concluded that there has been a mining-related impact, then implement actions in accordance with the make good provisions (Section 6.2.4 of the Water Management Plan) in consultation with DPIE and the affected landholder.</td></tr>
</table>

| Feature | Methodology and relevant monitoring | Management | | |
|---|---|---|---|---|
| | | Trigger | Action | Response |
| Shallow Groundwater Pressures at VWPs TNC036, TNC040, WD01 and WD02 (once installed). | GROUNDWATER PRESSURE<br>**Locations**<br><u>Impact sites</u> – TNC36, WD01 and WD02 (once installed) (refer to Section 5.2.2).<br><u>Control sites</u> - Groundwater bores/VWPs TNC40 (refer to Figure 3-5).<br>**Frequency**<br><u>Pre-mining</u> - Minimum continuous 24-hourly readings with monthly logger download.<br><u>During mining</u> - Minimum continuous 24-hourly readings with monthly logger download.<br><u>Post mining</u> - Minimum continuous 24-hourly readings with monthly logger download for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details). | Level 1 | | |
| | | • No observable mining induced change at VWP intakes located at or above (i.e. shallower than) 200 m depth. | • Continue monitoring program.<br>• Ongoing review of water level data. | • No response required. |
| | | Level 2 | | |
| | | • 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) (refer to Table 6-2 for TARP Significance Level 2).<br>AND<br>• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors. | • Continue monitoring program.<br>• Ongoing review of water level data.<br>• Convene with Tahmoor Coal Environmental Response Group to review response. | • As defined by the Environmental Response Group. |
| | | Level 3 | | |
| | | • Water level declines below the water level of TARP Significance Level 3 (refer Table 6-2, 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).<br>AND<br>• The reduction in water level is determined not to be controlled by climatic or external anthropogenic factors. | • Continue monitoring program<br>• Ongoing review of water level data and consideration of mining and external stresses (in groundwater monthly report).<br>• Compare against base case and deterministic model scenarios.<br>• Convene Tahmoor Coal Environmental Response Group to review response. | • As defined by the Environmental Response Group. |
| | | Level 4 | | |
| | | • Water level reduction greater than the maximum modelled drawdown (refer to Table 6-2 for TARP Significance Level 4) following the commencement of extraction at LW W1 (and LW W2, W3 and W4).<br>AND<br>• The reduction in water level is determined not to be controlled by climatic or anthropogenic factors. | • Continue monitoring and review as per monitoring program.<br>• Ongoing review of water level data and consideration of mining and external stresses (in groundwater monthly report).<br>• Convene Tahmoor Coal Environmental Response Group to review response.<br>• Compare against base case and deterministic model scenarios. | • Report to DPIE and relevant government agencies within 7 days of investigation completion (according to Table 6-1 of the Extraction Plan Main Document).<br>• If it is concluded that there has been a mining-related impact, implement an investigation report. |

| Feature | Methodology and relevant monitoring | Management | | |
|---|---|---|---|---|
| | | Trigger | Action | Response |
| Deep Groundwater Pressures at VWPs TNC036. | GROUNDWATER PRESSURE<br>**Locations**<br>Impact site – TNC36 (refer to Figure 3-5).<br>Control site - Groundwater bores/VWPs TNC40 (refer to Figure 3-5).<br>**Frequency**<br>Pre-mining - Minimum continuous 24-hourly readings with monthly logger download.<br>During mining - Minimum continuous 24-hourly readings with monthly logger download.<br>Post mining - Minimum continuous 24-hourly readings for 12 months after LW W4 completed. Monthly logger downloaded for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details). | Level 1 | | |
| | | • Observed data does not exceed predicted (modelled) impacts at VWP intakes located below (i.e. deeper than) 200 m depth (excluding those monitoring the Bulli Coal Seam). | • Continue monitoring program.<br>• Ongoing review of water level data. | • No response required. |
| | | Level 2 | | |
| | | • 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. | • Continue monitoring program.<br>• Ongoing review of water level data.<br>• Convene Tahmoor Coal Environmental Response Group to review response. | • As defined by the Environmental Response Group. |
| | | Level 3 | | |
| | | • Calculated or observed drawdown (based on 2009-2015 baseline data) for VWP intakes below 200 m depth (excluding those within the Bulli Coal Seam) exceeds predicted (modelled) drawdown by 30 m for a period of 6 months or more. | • Continue monitoring program.<br>• Ongoing review of water level data.<br>• Convene Tahmoor Coal Environmental Response Group to review response. | • As defined by the Environmental Response Group.<br>• Consider increasing download frequency at groundwater bores where Level 3 has been reached to a fortnightly basis. Consider increasing review frequency to fortnightly. |
| | | Level 4 | | |
| | | • Calculated or observed drawdown (based on 2009-2015 baseline data) for VWP intakes below 200 m depth (excluding those within the Bulli Coal Seam) exceeds predicted (modelled) drawdown by 30 m for a period of 12 months or more. | • Continue monitoring and review as per monitoring program.<br>• Convene Tahmoor Coal Environmental Response Group to undertake an investigation to assess whether change in behaviour is related to LW W1-W2 mining effects. | • Report to DPIE and relevant government agencies within 7 days of investigation completion (according to Table 6-1 of the Extraction Plan Main Document).<br>• If it is concluded that there has been a mining-related impact, implement an investigation report. |

Table B2 Trigger Action Response Plan – Groundwater Quality

| Feature | Methodology and relevant monitoring | Management | | |
|---|---|---|---|---|
| | | Trigger | Action | Response |
| Groundwater Quality at monitoring bores and private groundwater bores. | GROUNDWATER QUALITY – Monitoring bores<br>**Locations** (refer to Figure 3-5)<br>Impact sites – P12, P13, P14, P15, P16, and any additional bore(s) (to be drilled)<br>Control sites – P17<br>**Frequency**<br>Pre-mining - Field water quality and laboratory analysis monthly (refer to Section 5.2.1 for parameters).<br>During mining - Field water quality and laboratory analysis monthly (refer to Section 5.2.1 for parameters).<br>Post mining - Field water quality and laboratory analysis monthly (refer to Section 5.2.1 for parameters) for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details).<br><br>GROUNDWATER QUALITY – Private groundwater bores<br>**Locations** (refer to Figure 3-5)<br>Control sites - GW72402, GW105228, GW105467, GW115860 and GW105546 and any other private bores where access is negotiated with landholder.<br>**Frequency**<br>Pre-mining - Field water quality (EC, pH) and iron staining. Pre-mining testing completed during bore census (GeoTerra, 2019).<br>During mining - Field water quality and laboratory analysis on a 3-monthly basis (refer to Section 5.2.1 for parameters).<br>Post mining - Field water quality and laboratory analysis on a 3-monthly basis (refer to Section 5.2.1 for parameters) for 12 months following the completion of LW W4. This period may be extended as per the decision by the Environmental Response Group (refer to Section 5.2 for further details). | Level 1 | | |
| | | • No observable change in salinity, pH or metals outside of the baseline variability. | • Continue monitoring program.<br>• Ongoing review of water quality data. | • No response required. |
| | | Level 2 | | |
| | | • 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.<br>AND/OR<br>• A similar trend or response has been noted at other monitored bores or private groundwater bores. | • Continue monitoring program.<br>• Ongoing review of water quality data.<br>• Convene Tahmoor Coal Environmental Response Group to review response. | • As defined by the Environmental Response Group. |
| | | Level 3 | | |
| | | • Short term increase (< 3 months) in salinity and/or metals or change in pH outside of baseline variability*. The effect persists after a significant rainfall recharge event.<br>AND/OR<br>• The change in water quality is determined not to be controlled by climatic or anthropogenic factors. | • Continue monitoring program.<br>• Ongoing review of water quality data and consideration of mining and external stresses (in groundwater monthly report).<br>• Convene Tahmoor Coal Environmental Response Group to review response. | • As defined by the Environmental Response Group. |
| | | Level 4 | | |
| | | • 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.<br>AND<br>• The reduction in water quality is determined not to be controlled by climatic or anthropogenic factors. | • Continue monitoring and review as per monitoring program.<br>• Continue review of water quality data and consideration of mining and external stresses (in groundwater monthly report).<br>• Convene Tahmoor Coal Environmental Response Group to review response. | • Report to DPIE and relevant government agencies within 7 days of investigation completion (according to Table 6-1 of the Extraction Plan Main Document).<br>• For monitoring bores: If it is concluded that there has been a mining-related impact, then implement an investigation report.<br>• For private groundwater bores: If it is concluded that there has been a mining-related impact, then implement actions in accordance with the make good provisions (Section 6.2.4 of the Water Management Plan) in consultation with the affected landholder. |

Footnote:
* The baseline variability was estimated using available data and refers to the proposed trigger levels (refer to Section 6.2.2 and Table 6.2 of the Groundwater Technical Report.

*Rainfall CRD (trend) calculated from 1900
Daily Rainfall (mm)
Cumulative Rainfall Departure (mm)
250
225
200
175
150
125
100
75
50
25
0
400
200
0
-200
-400
-600
-800
-1000
-1200
-1400
-1600
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Daily Rainfall (mm)
Rainfall Trend (Monthly CRD)


**Figure B-1**

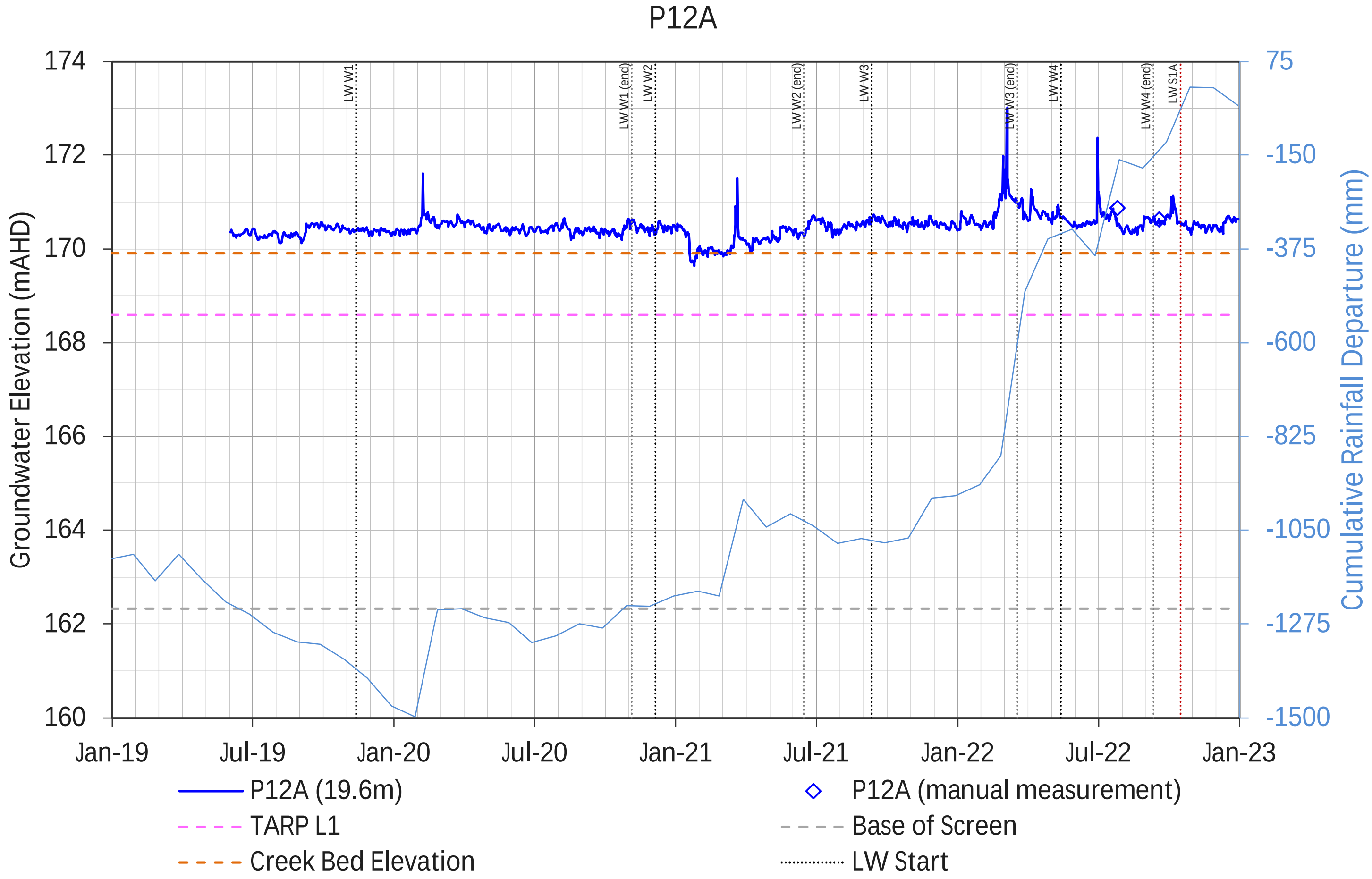
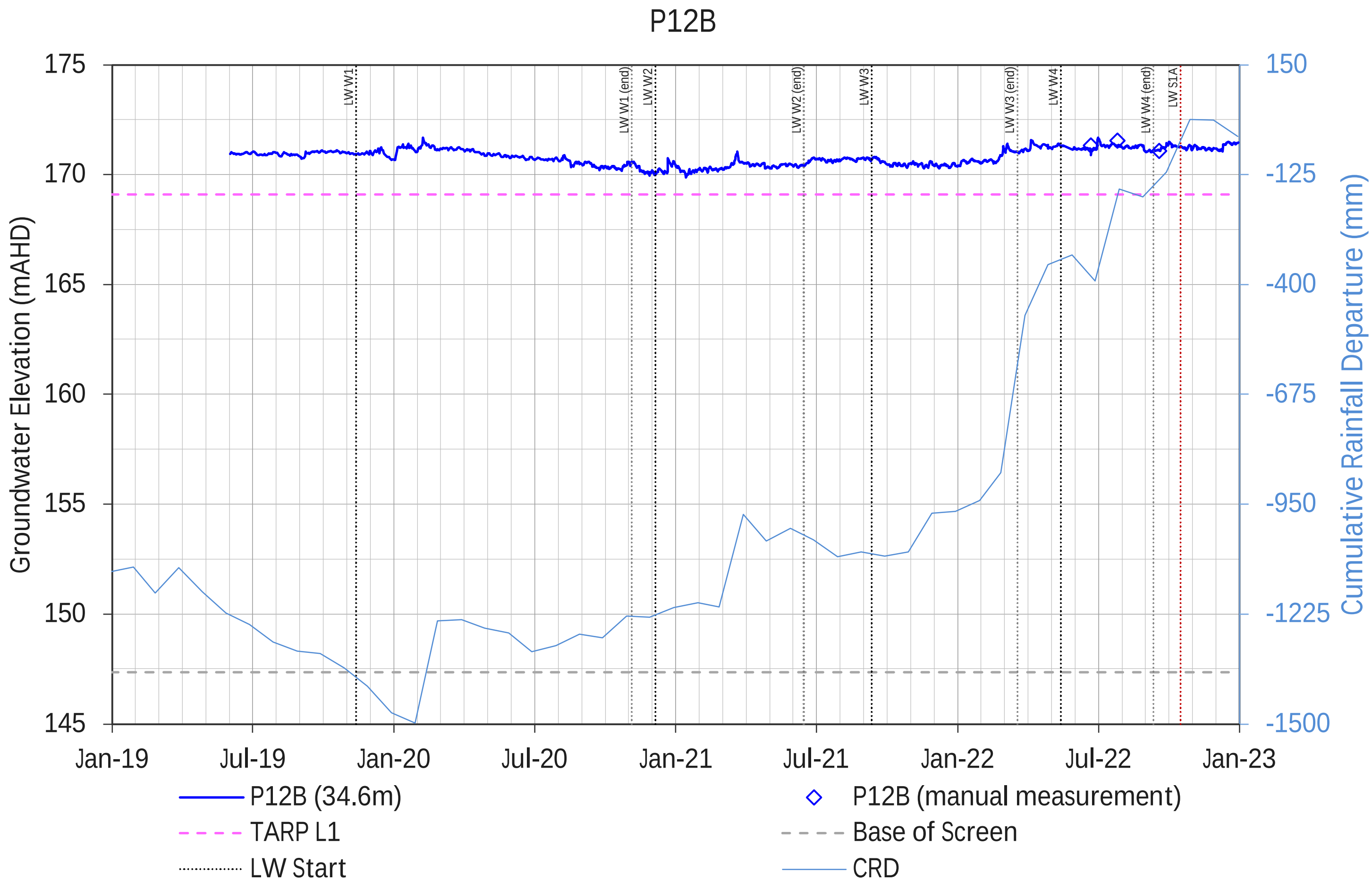



**Figure B-2**

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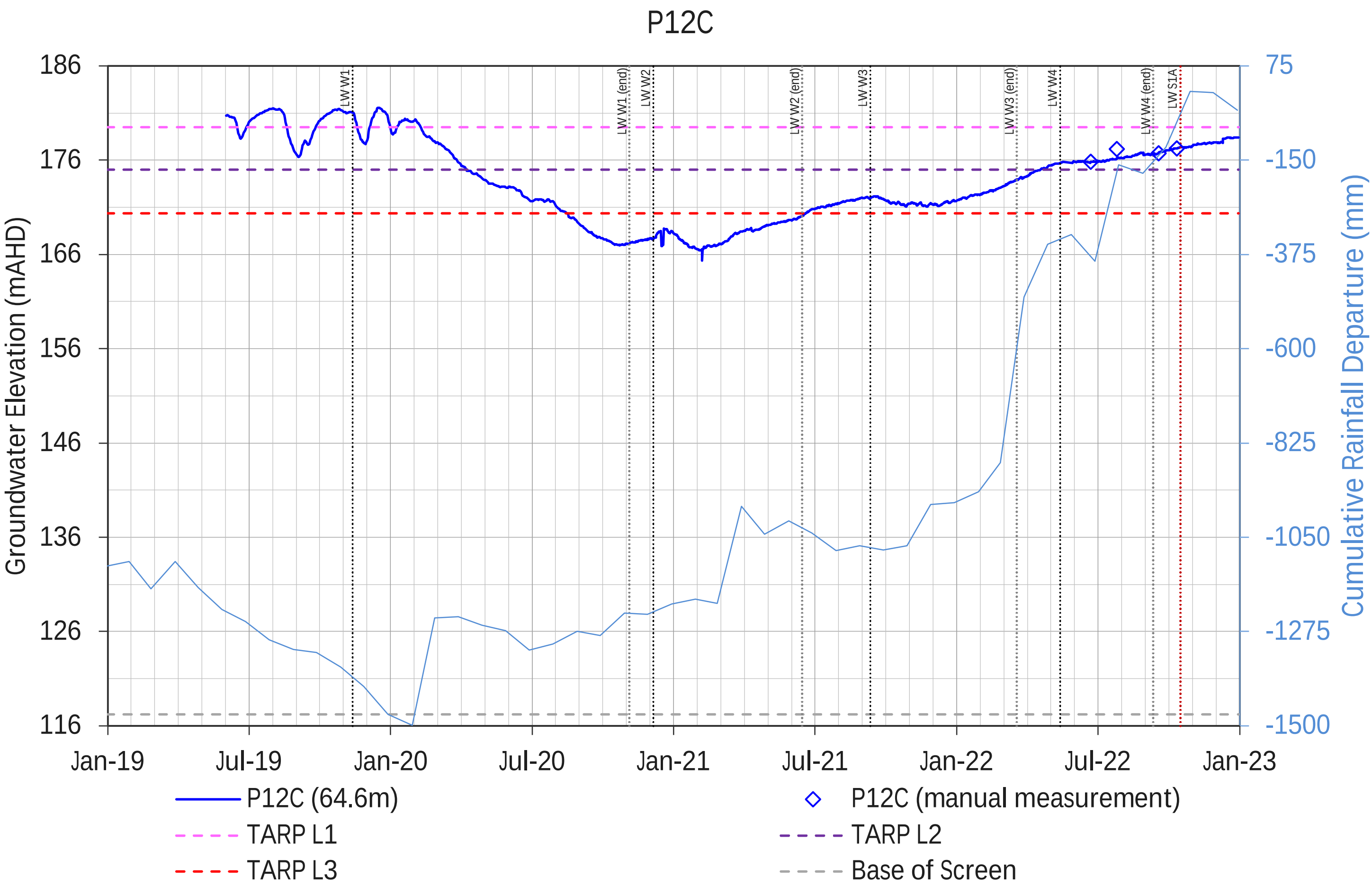


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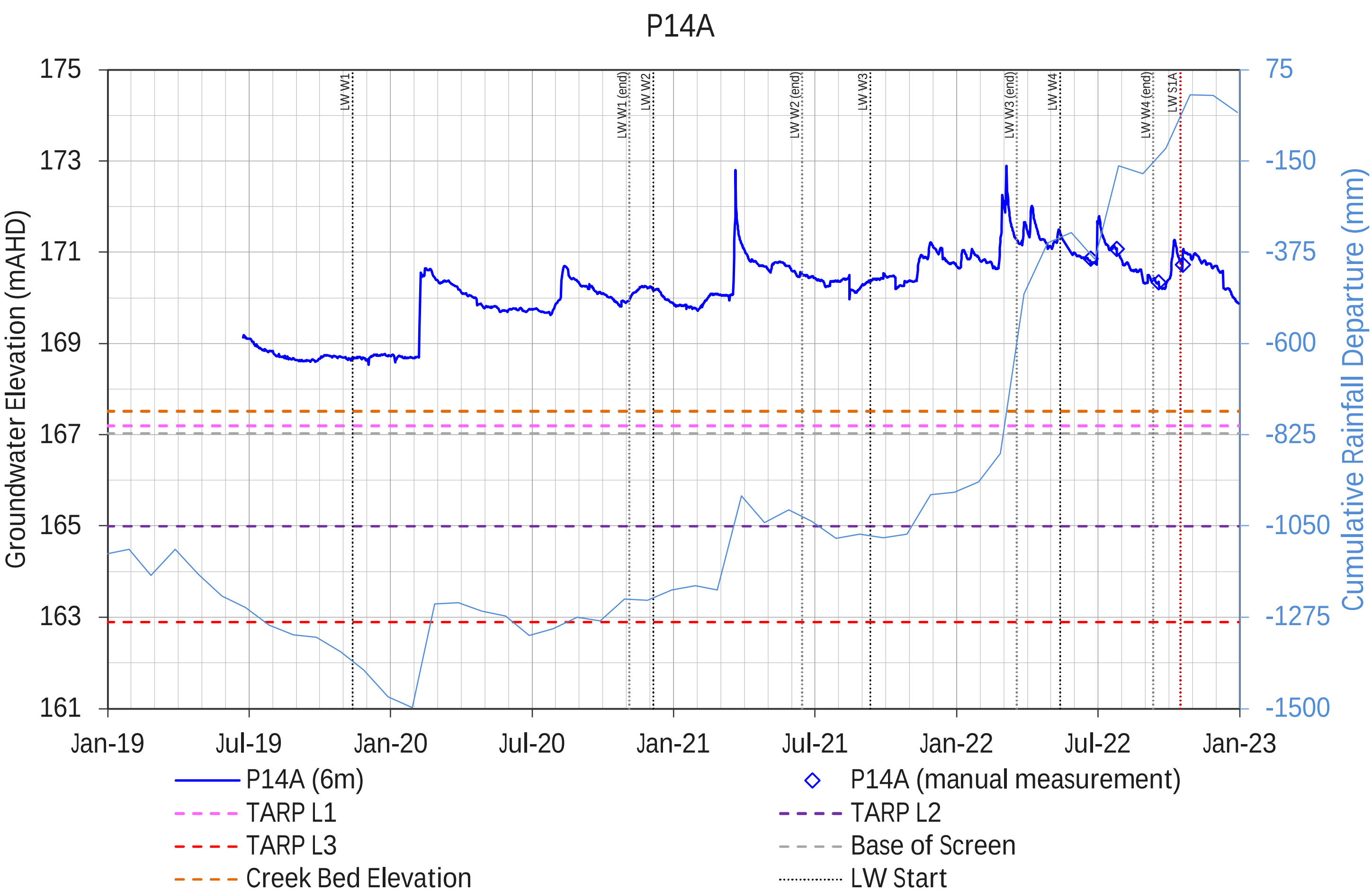


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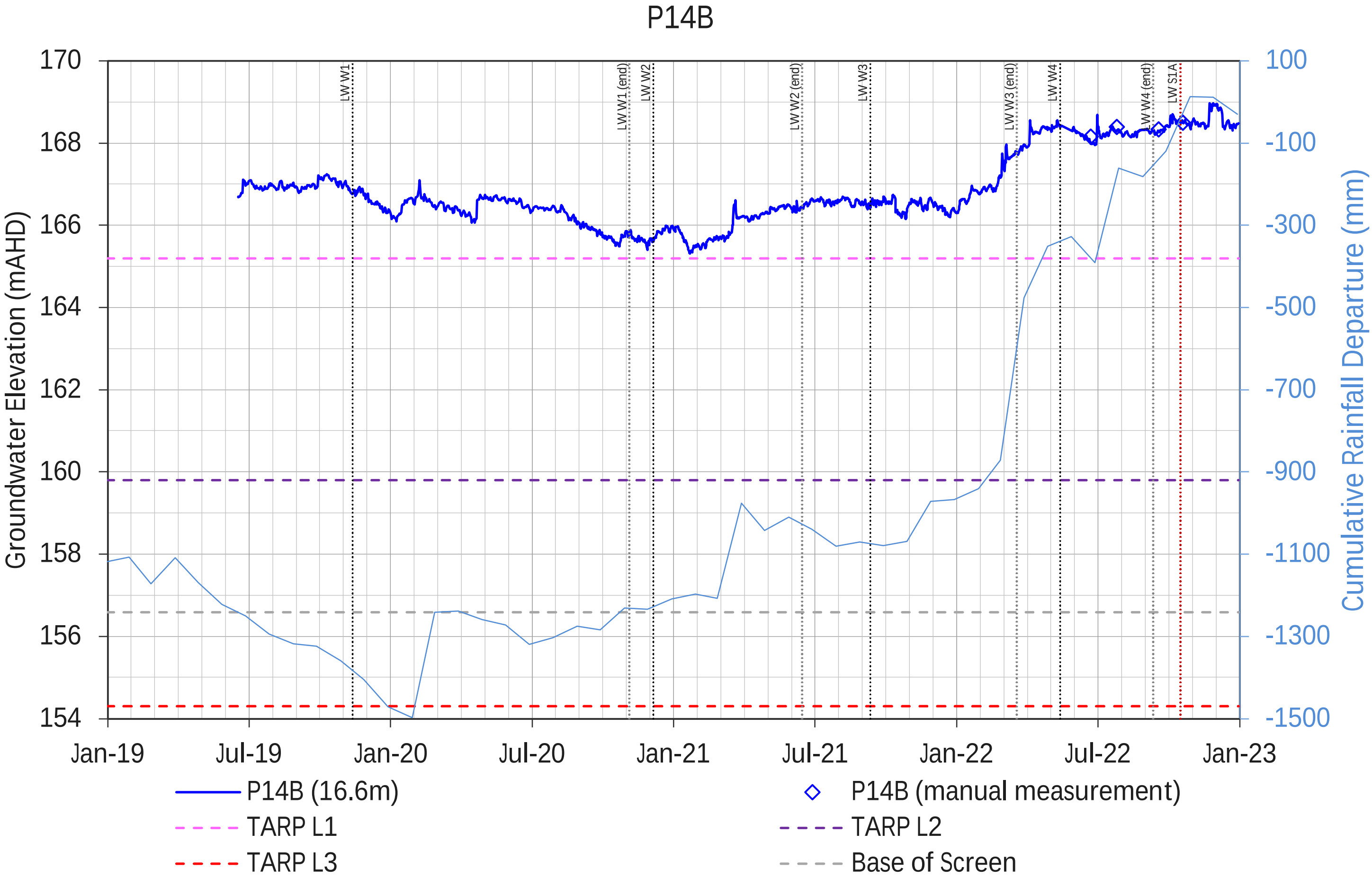


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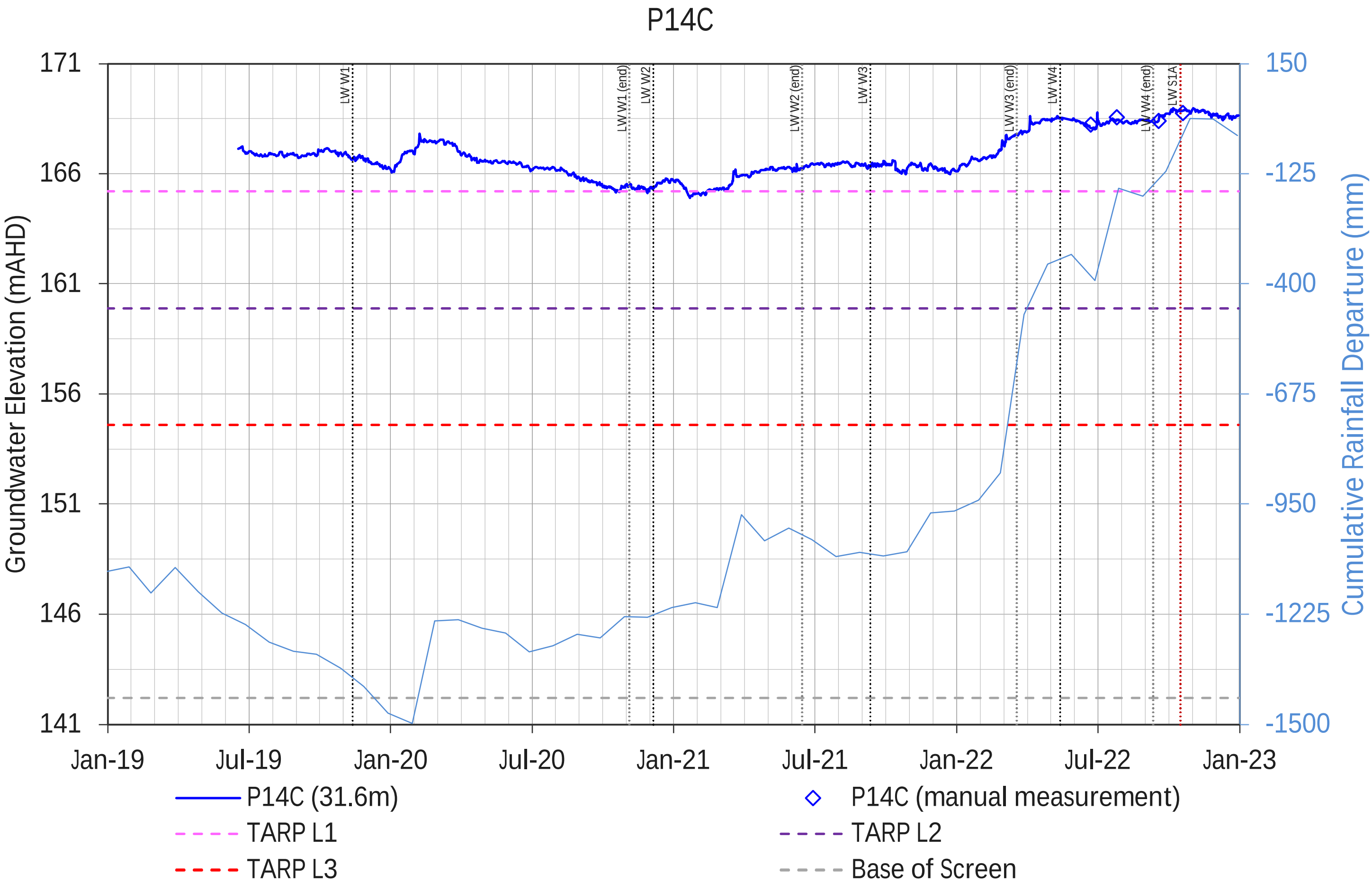


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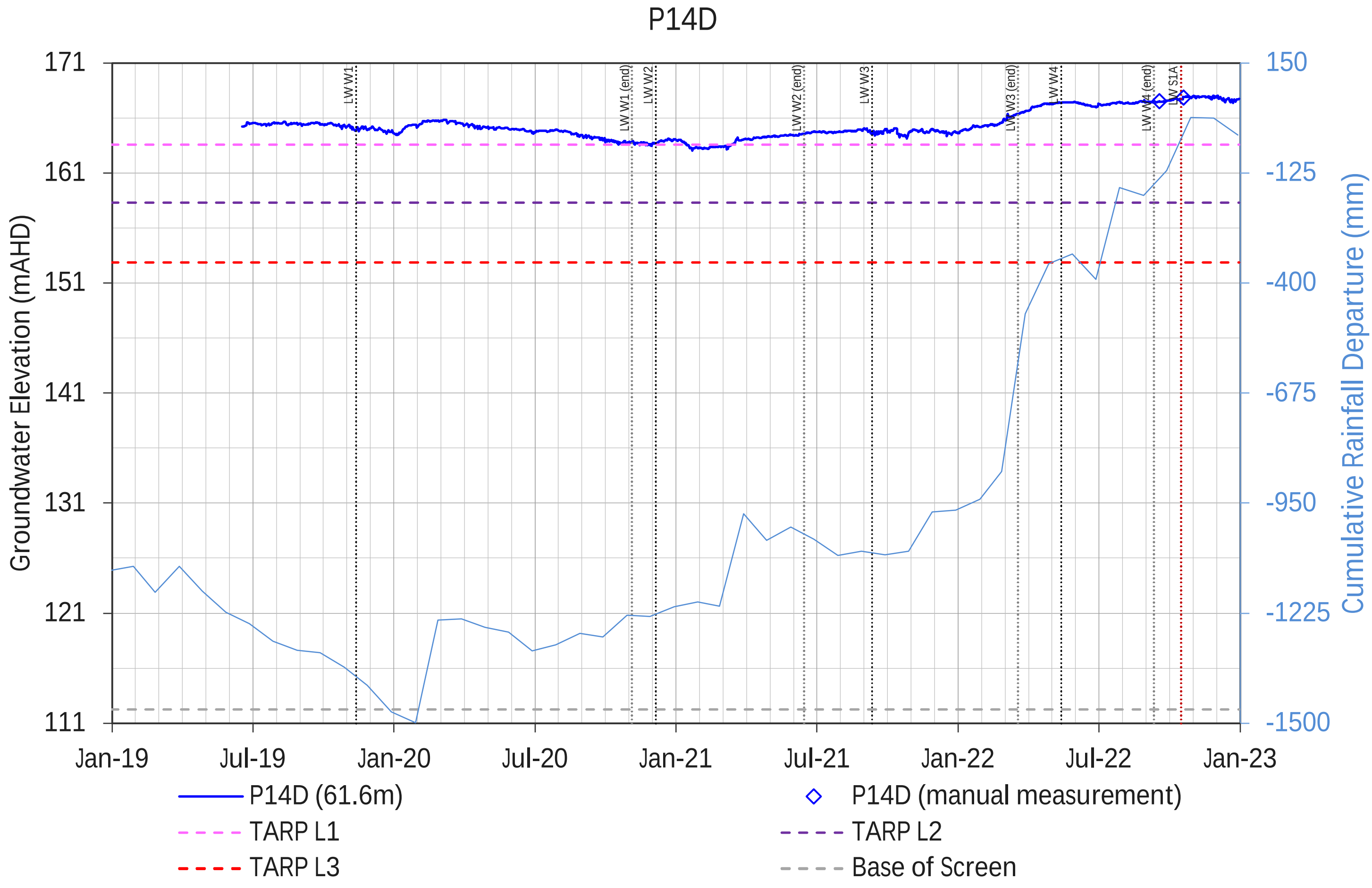


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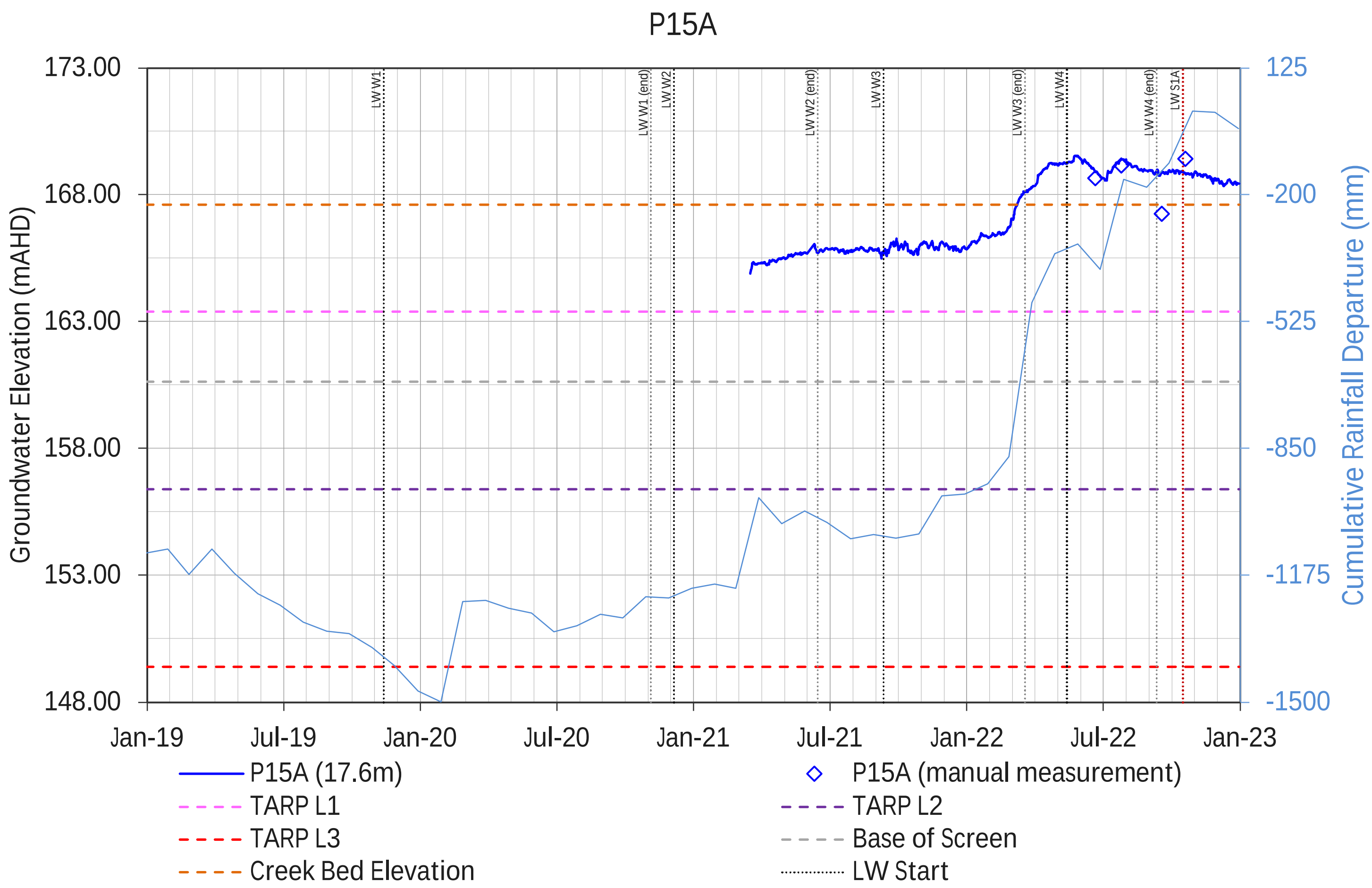


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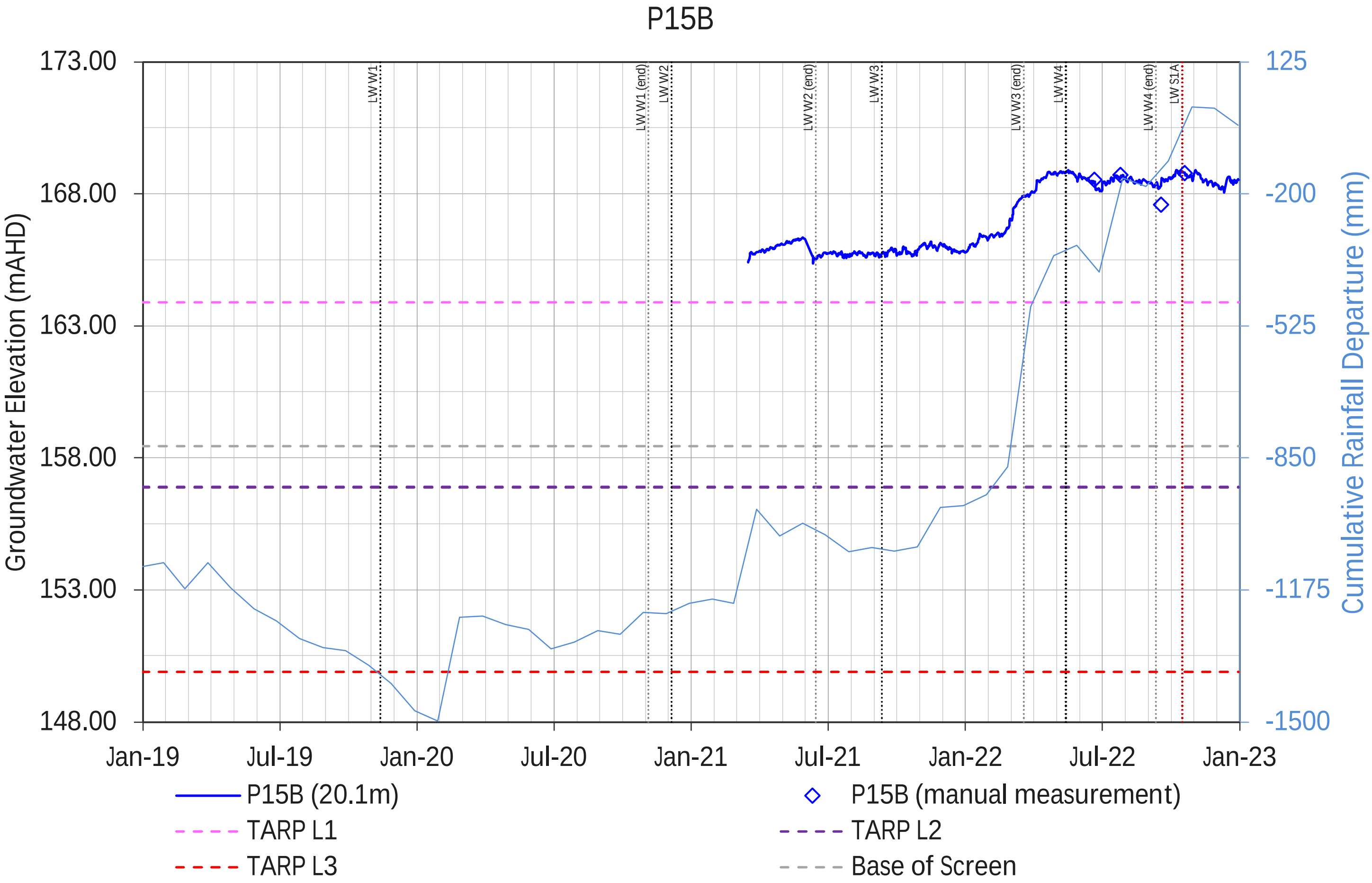


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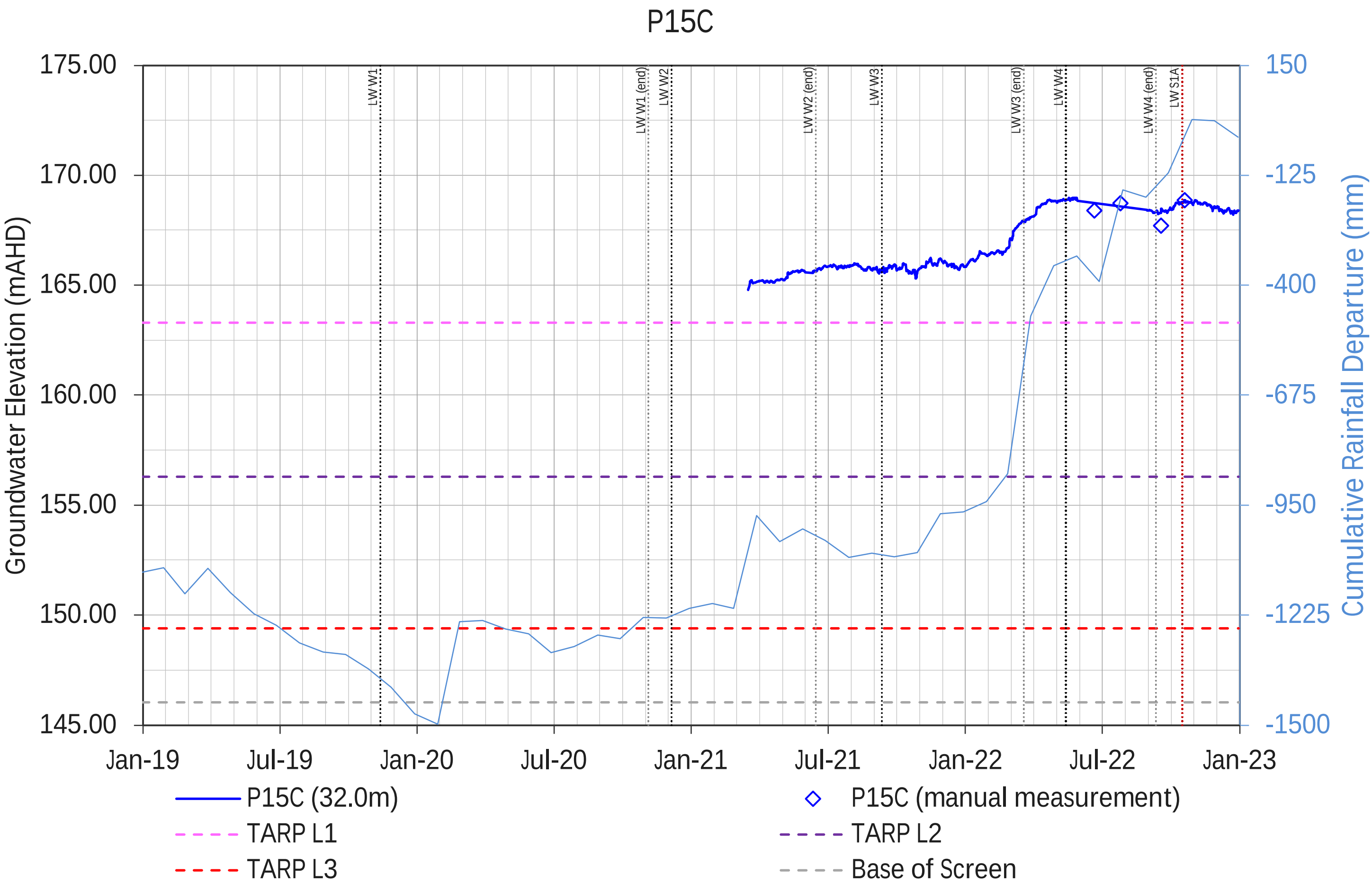


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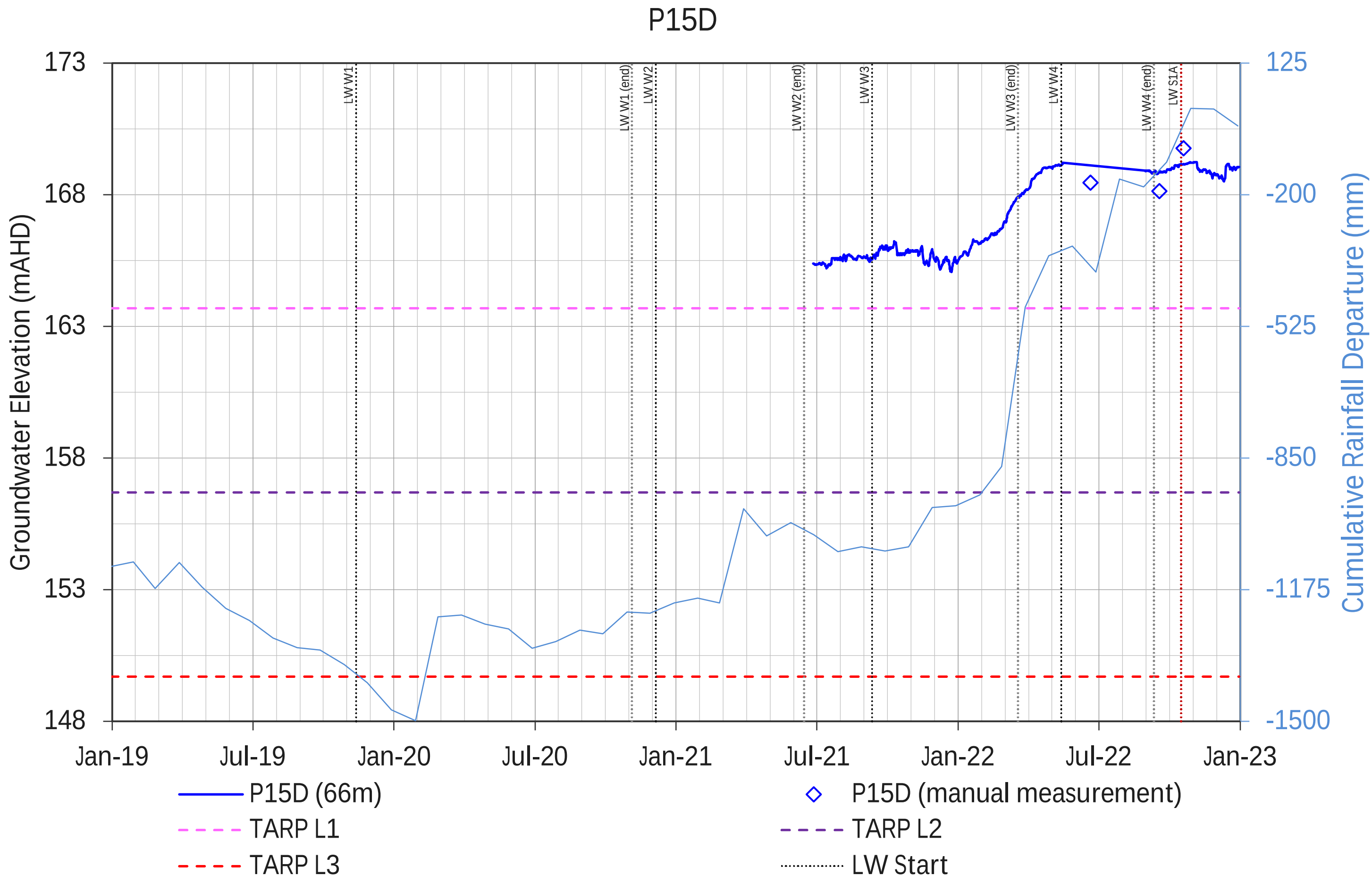
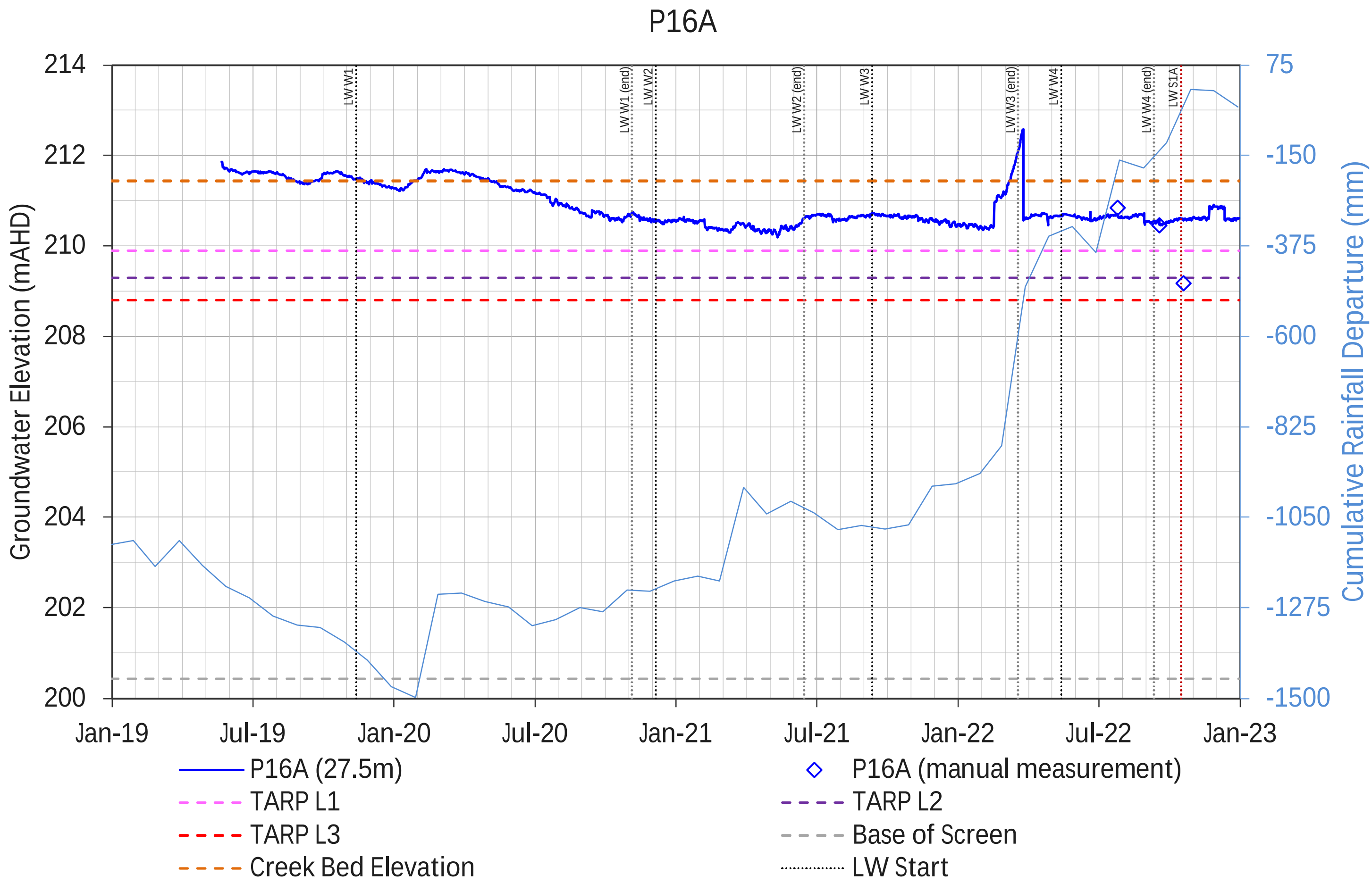



Figure B-12

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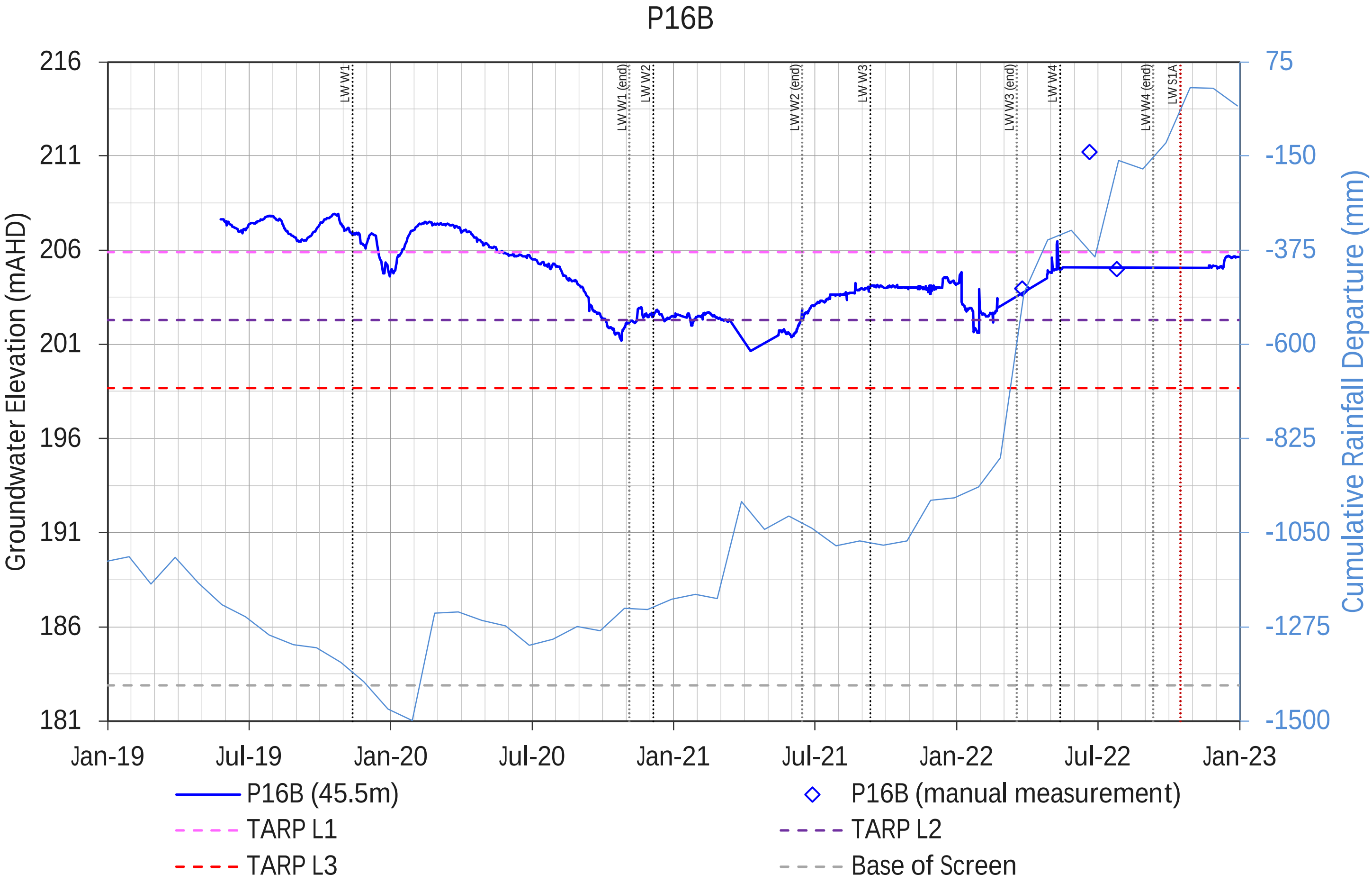


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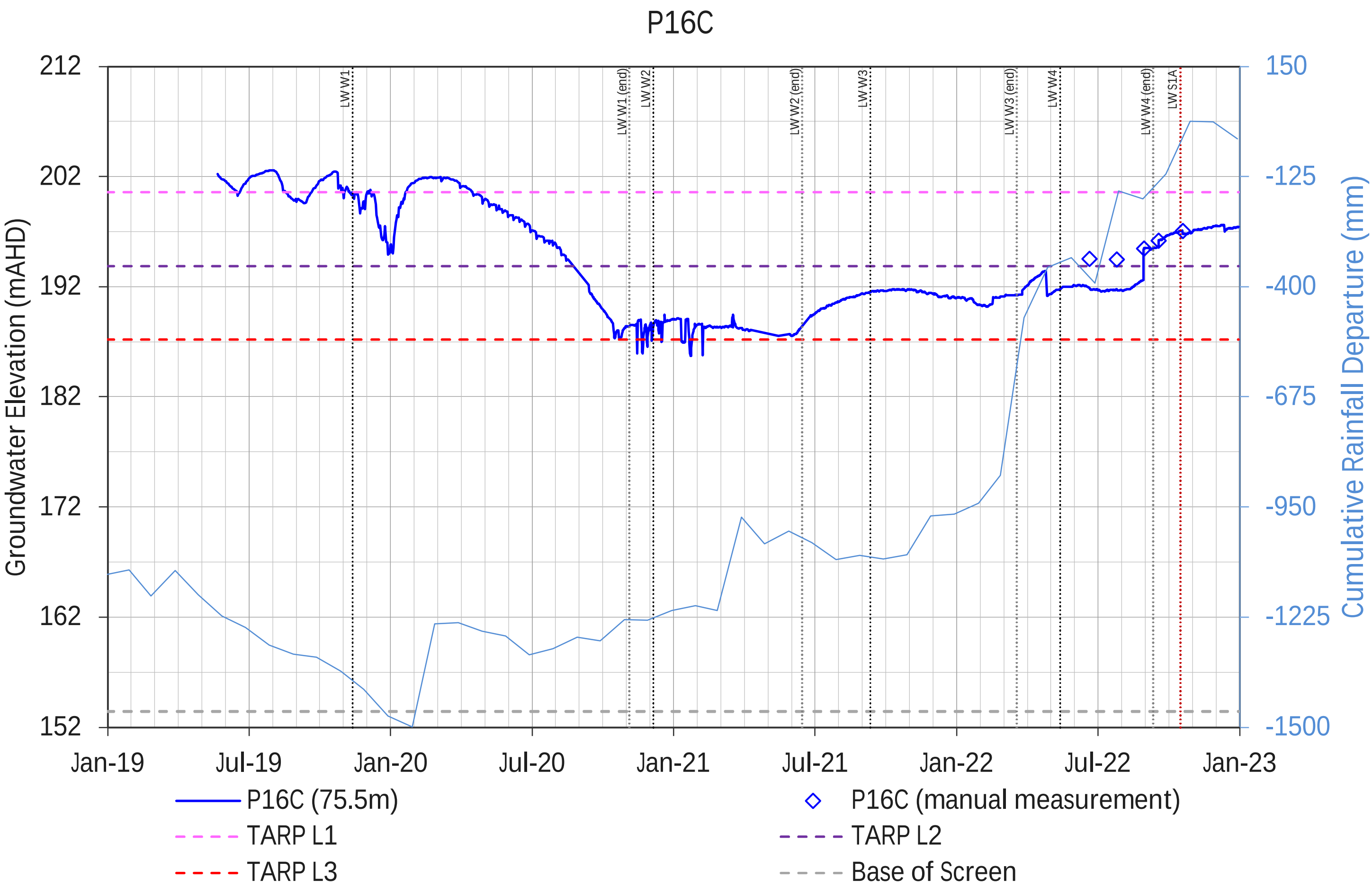


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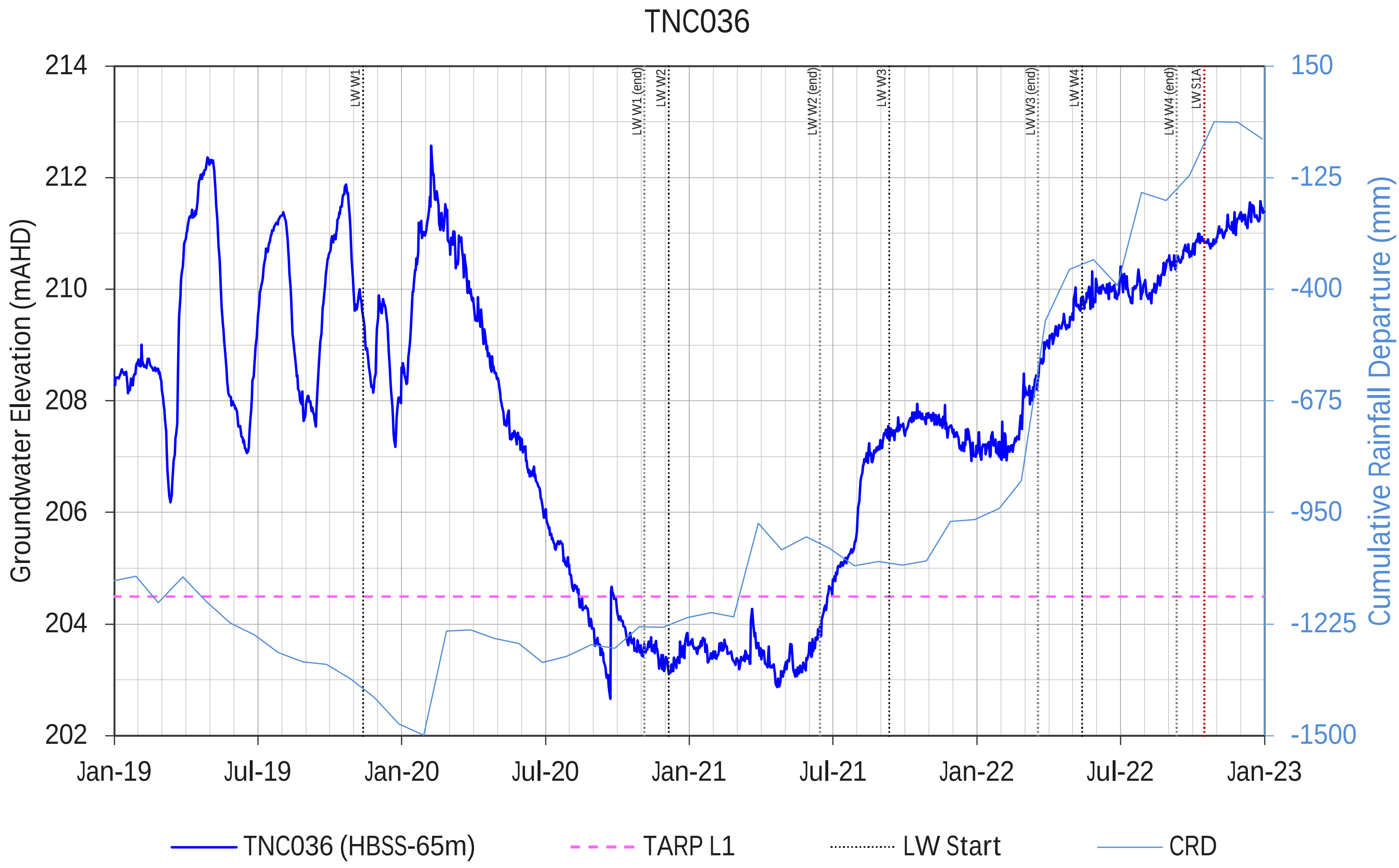


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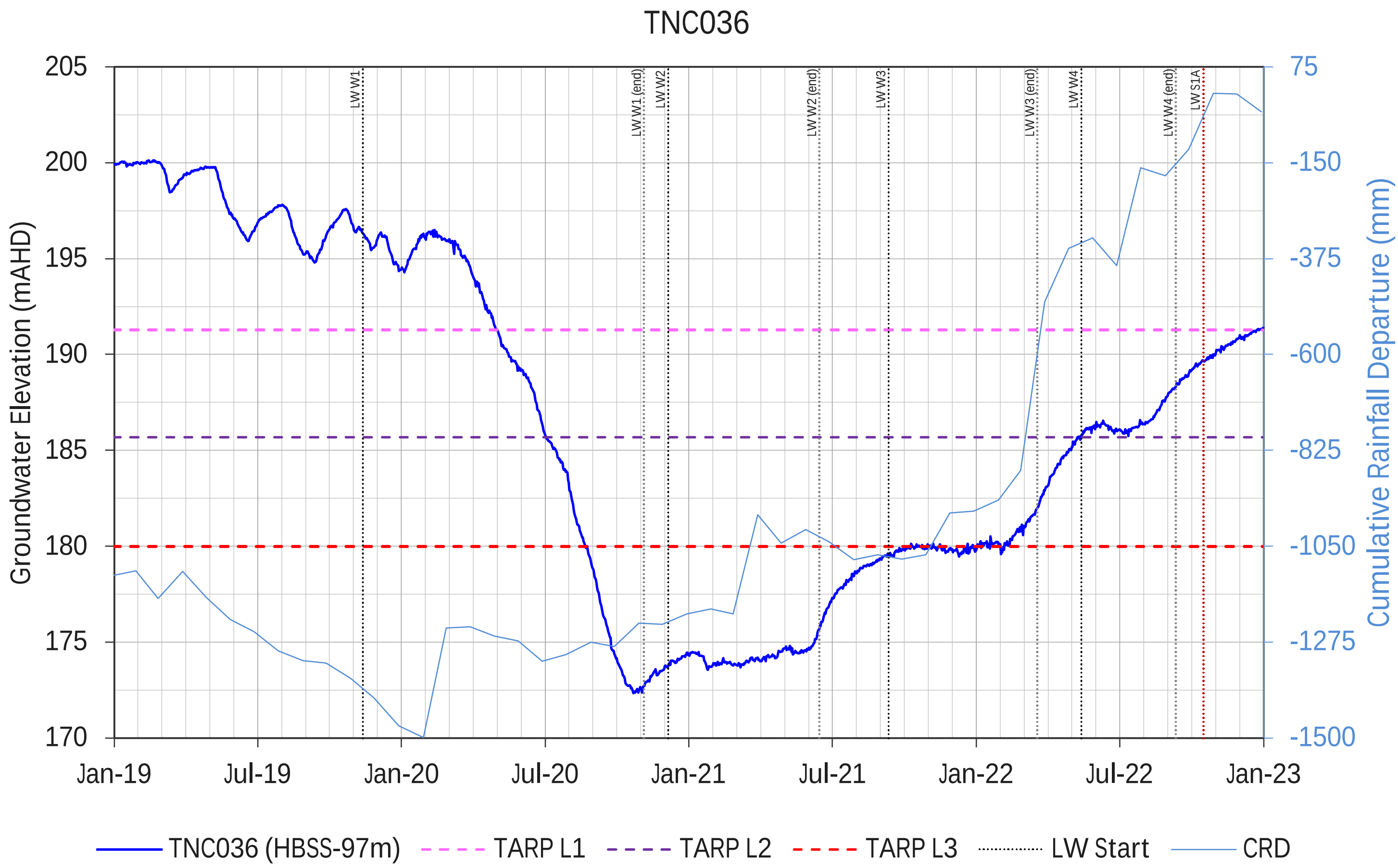


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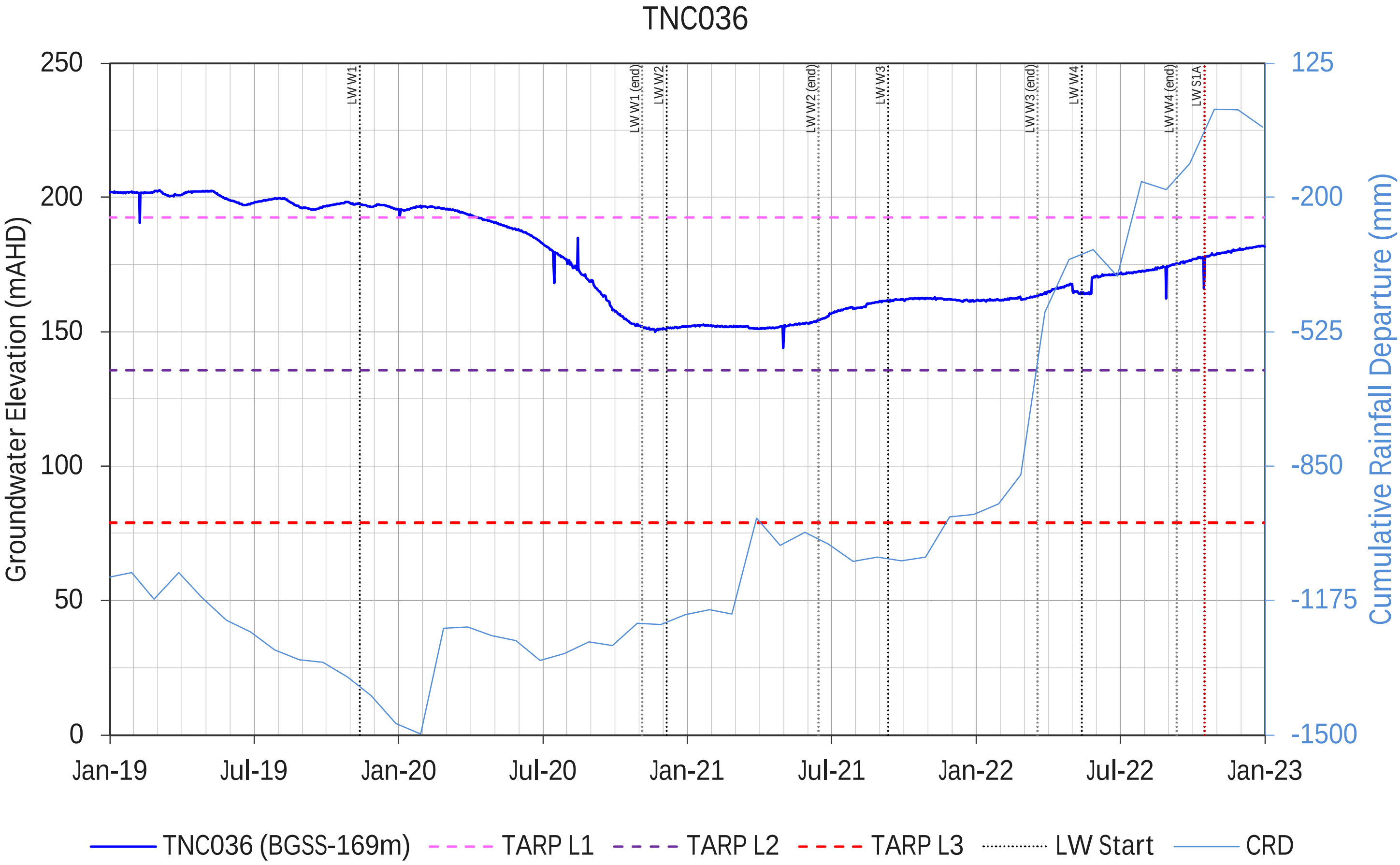


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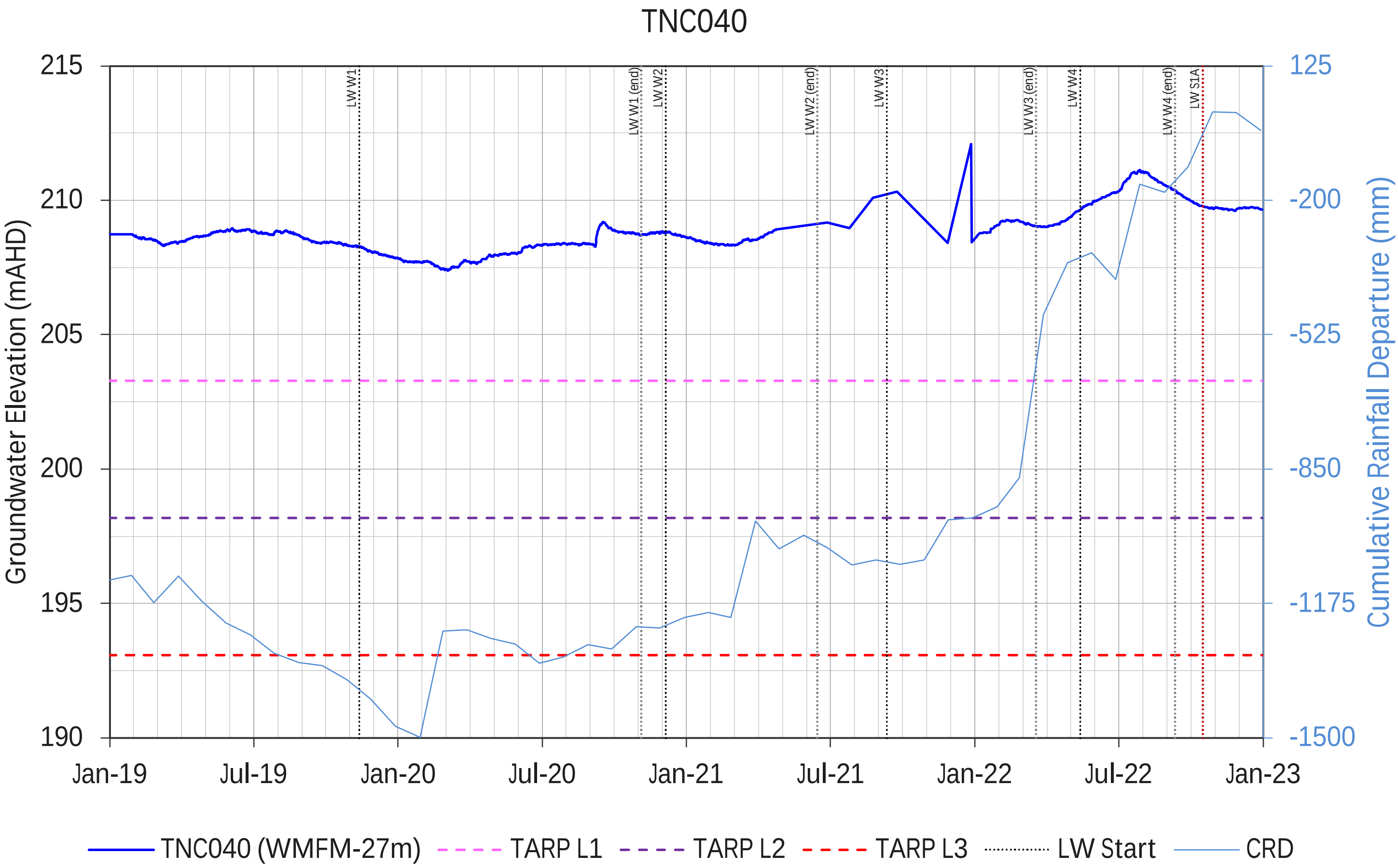
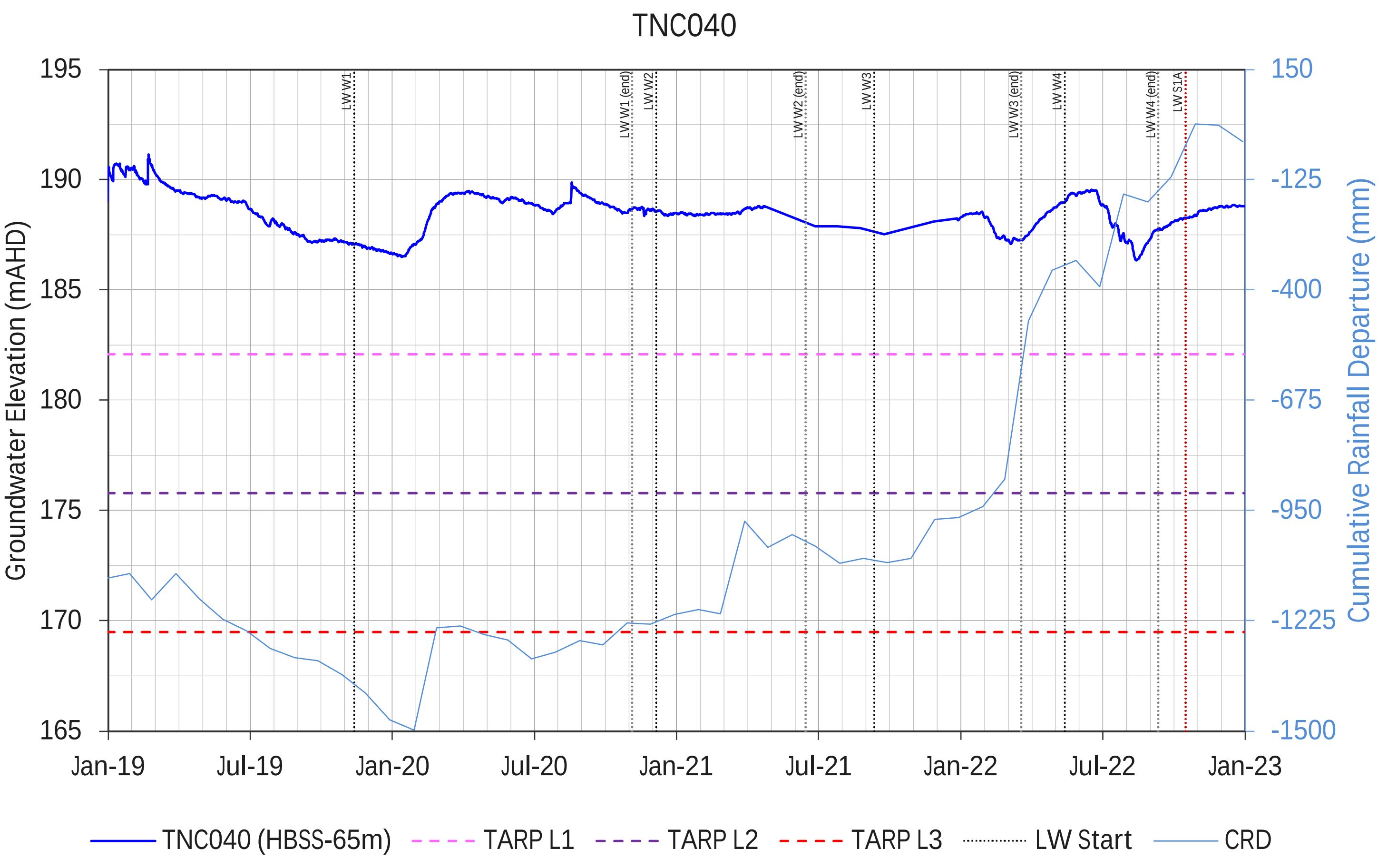



Figure B-19

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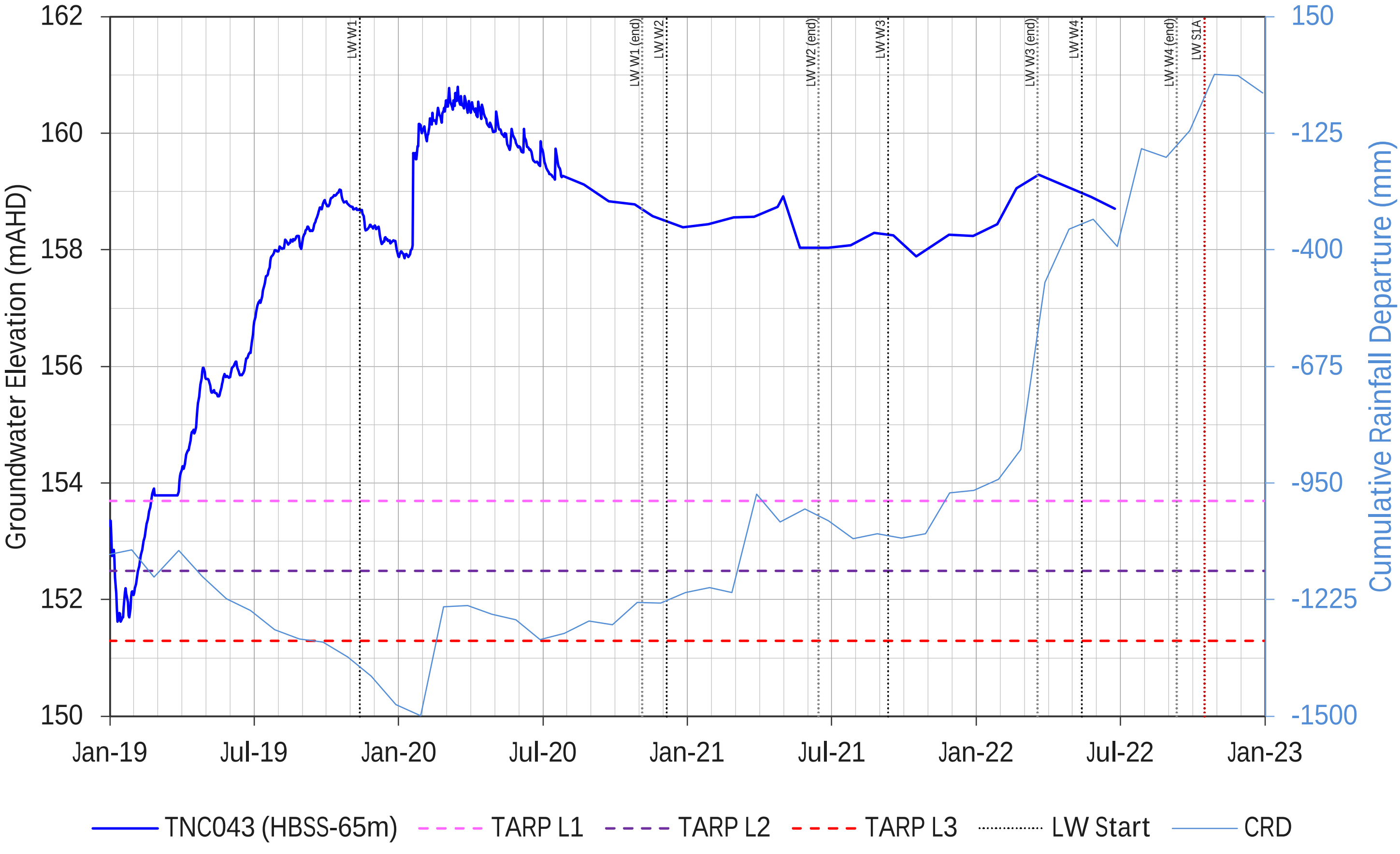


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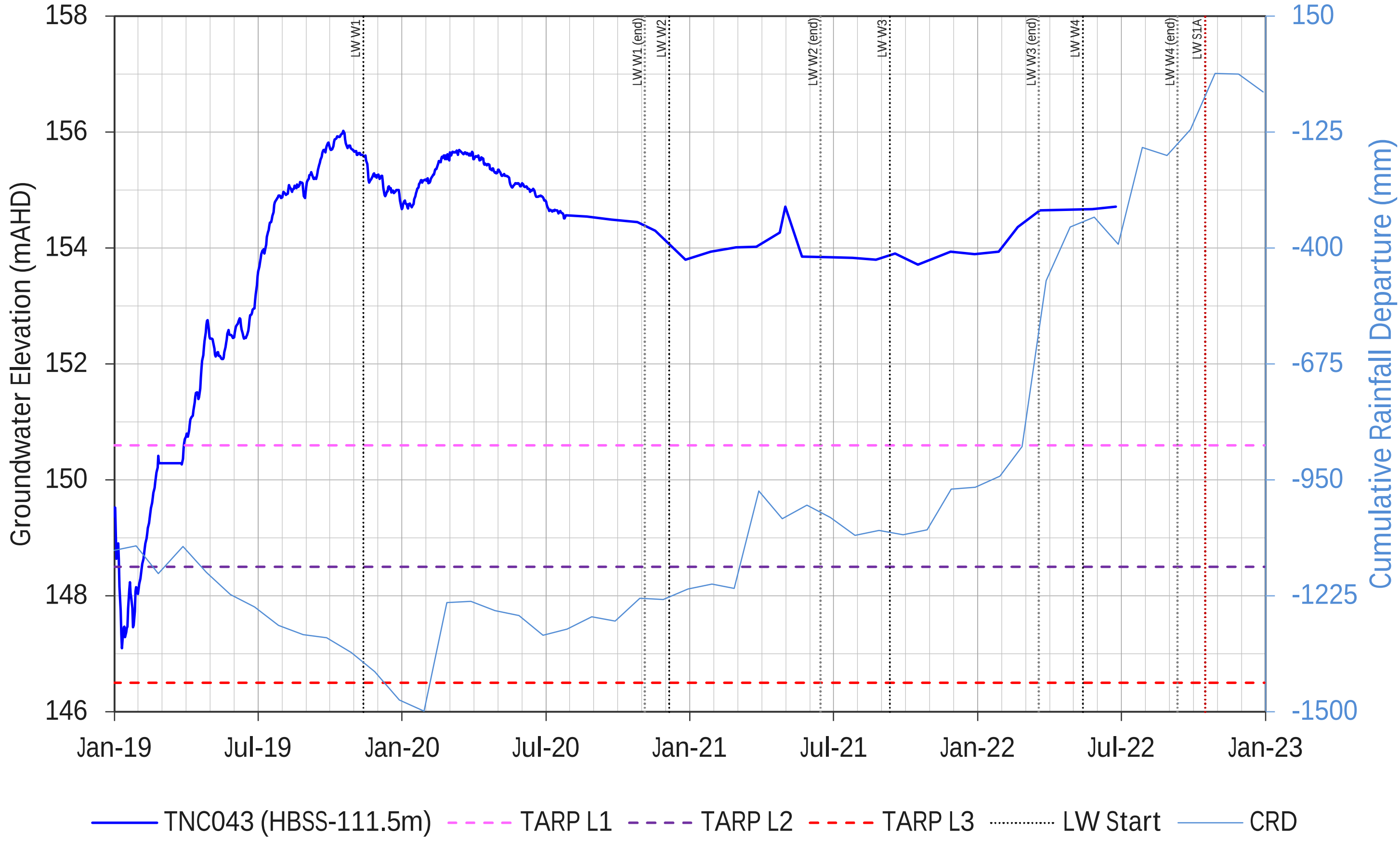


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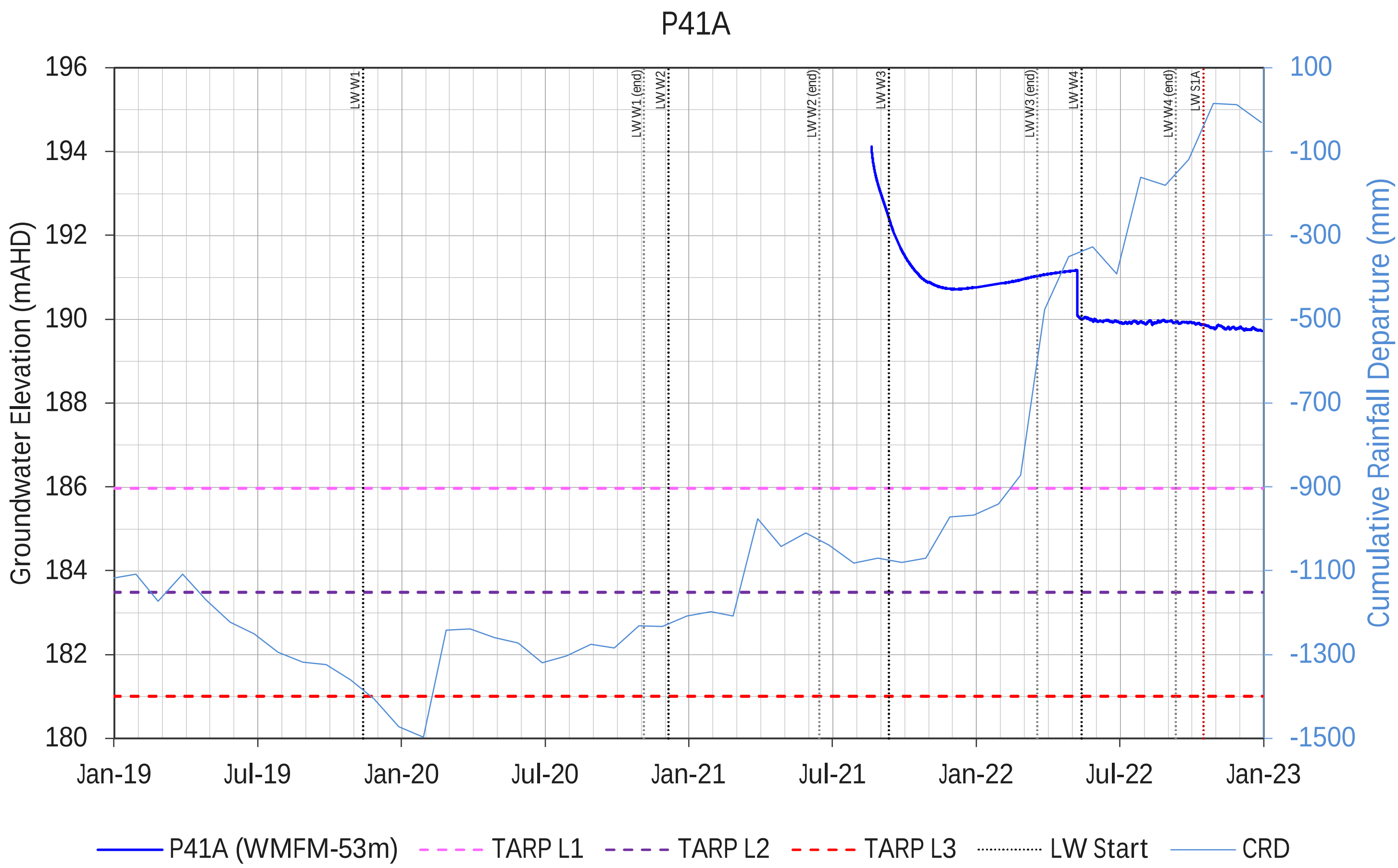


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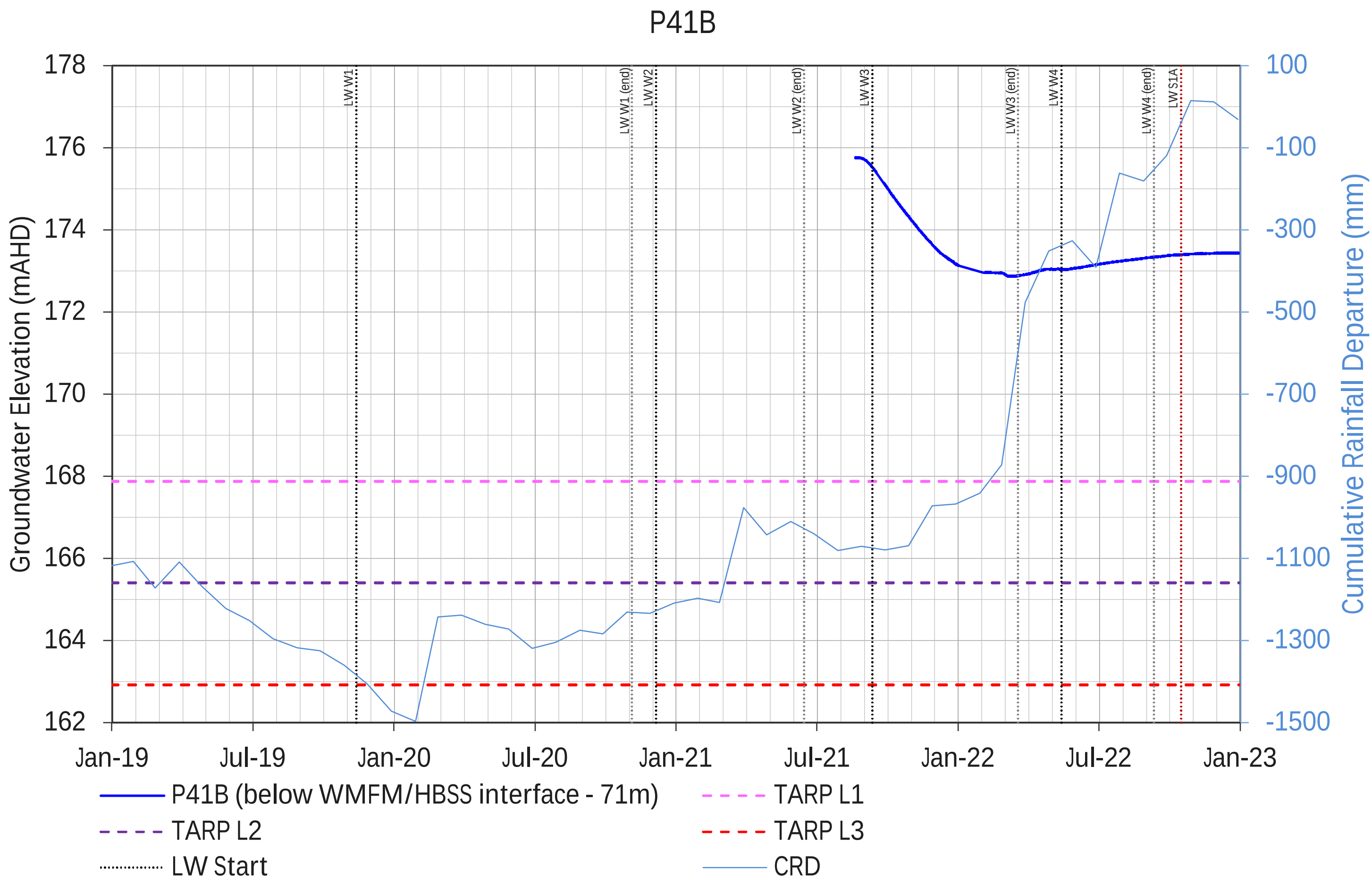


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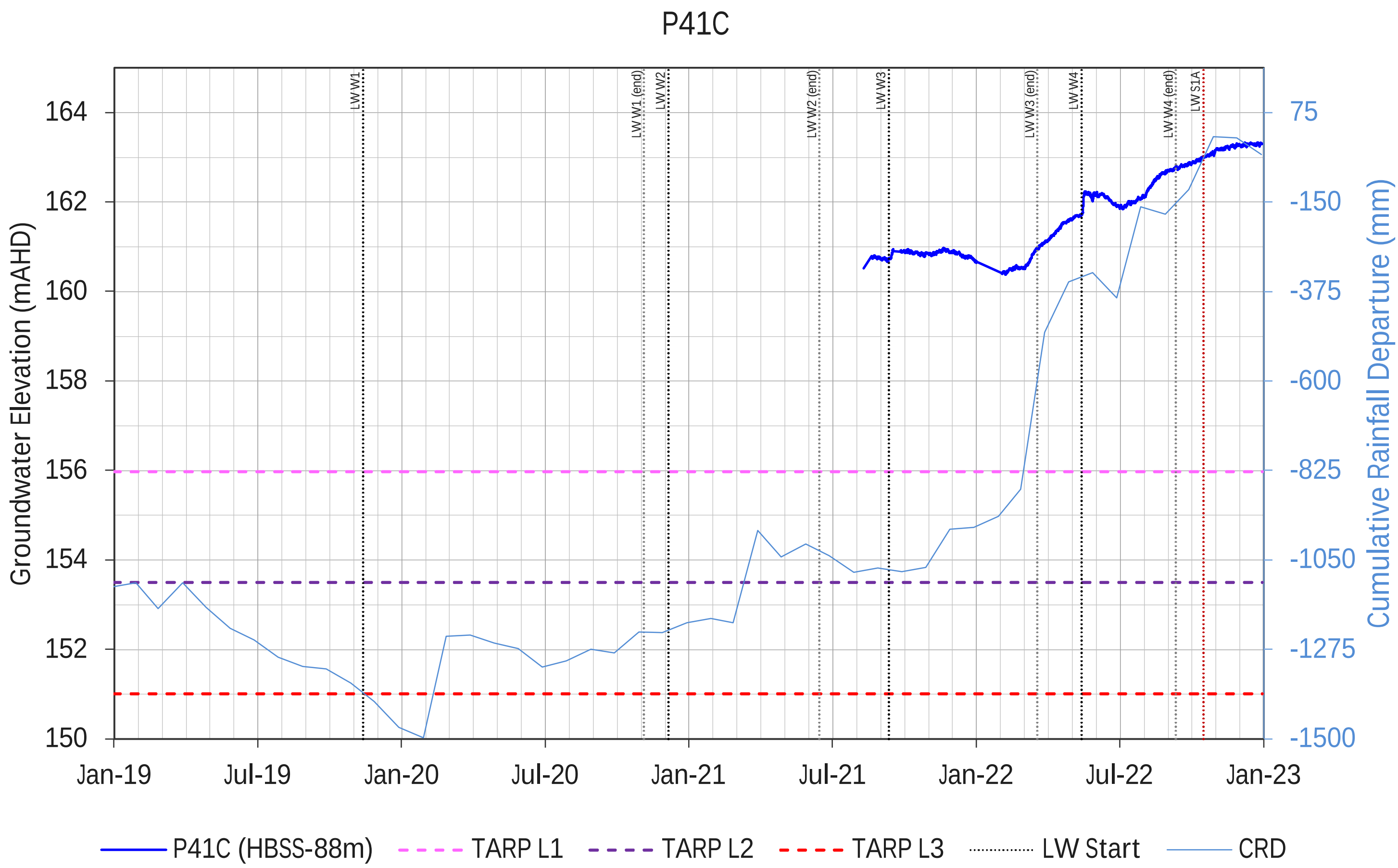



**Figure B-25**

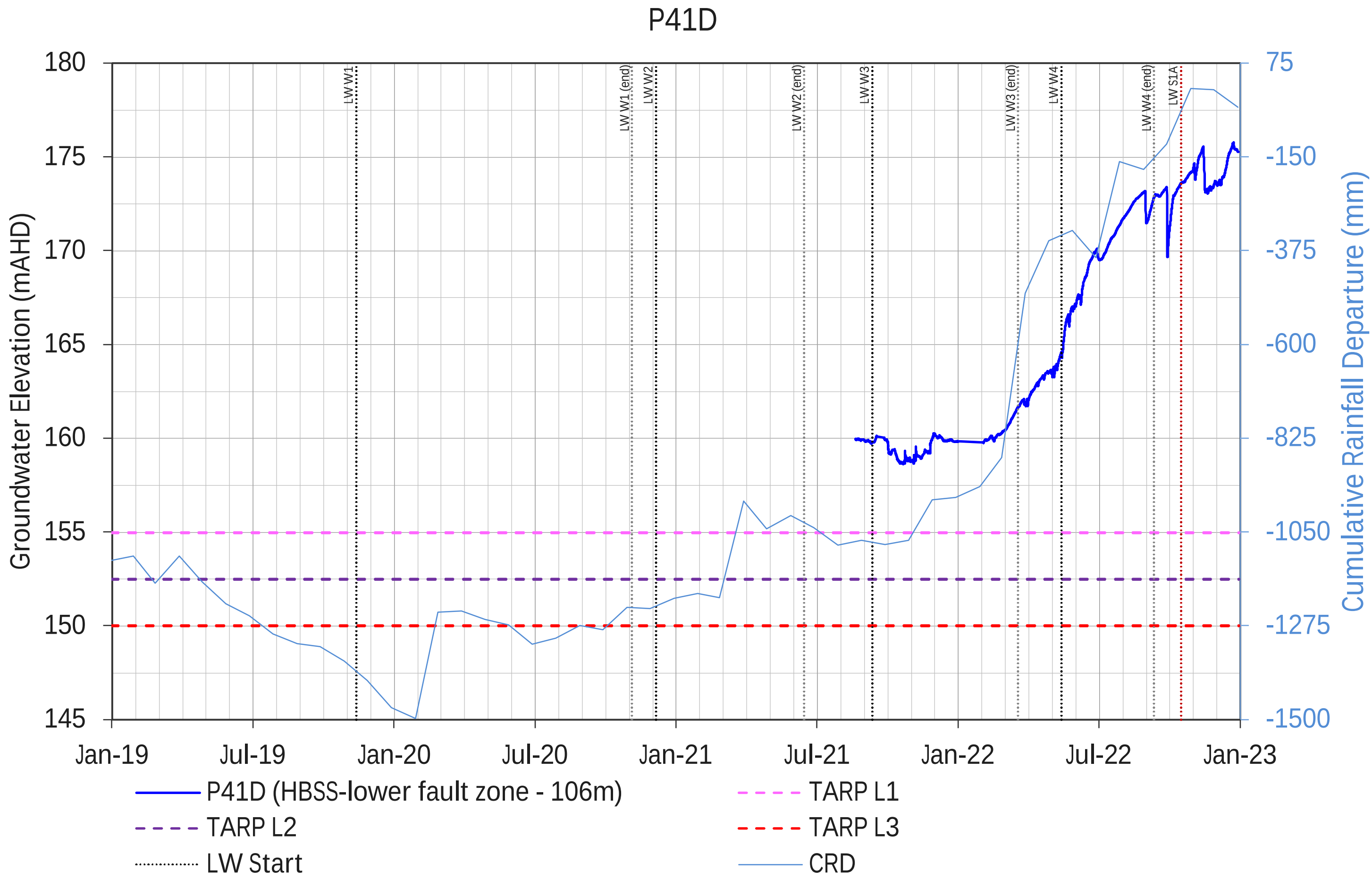



**Figure B-26**

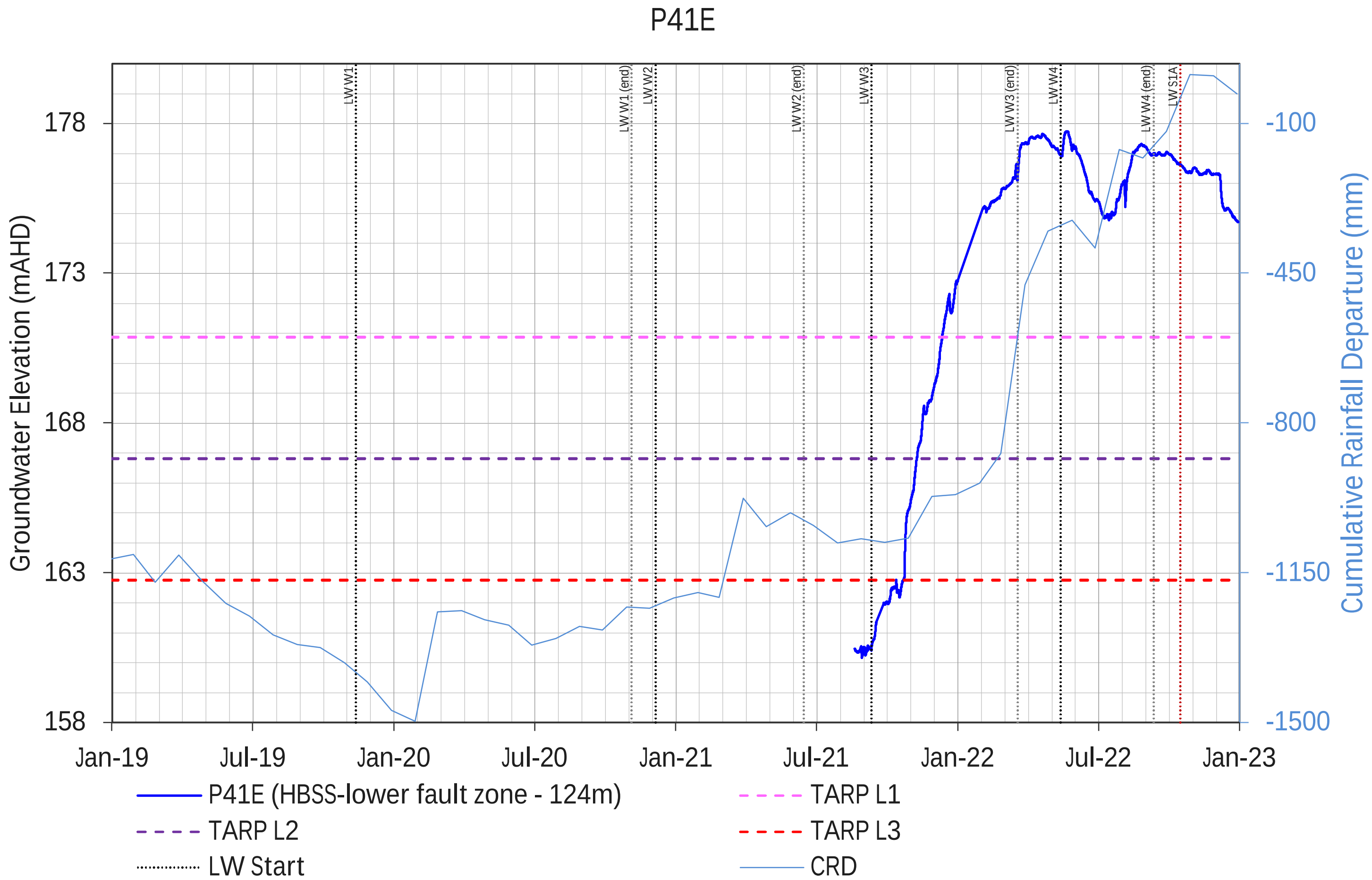



**Figure B-27**

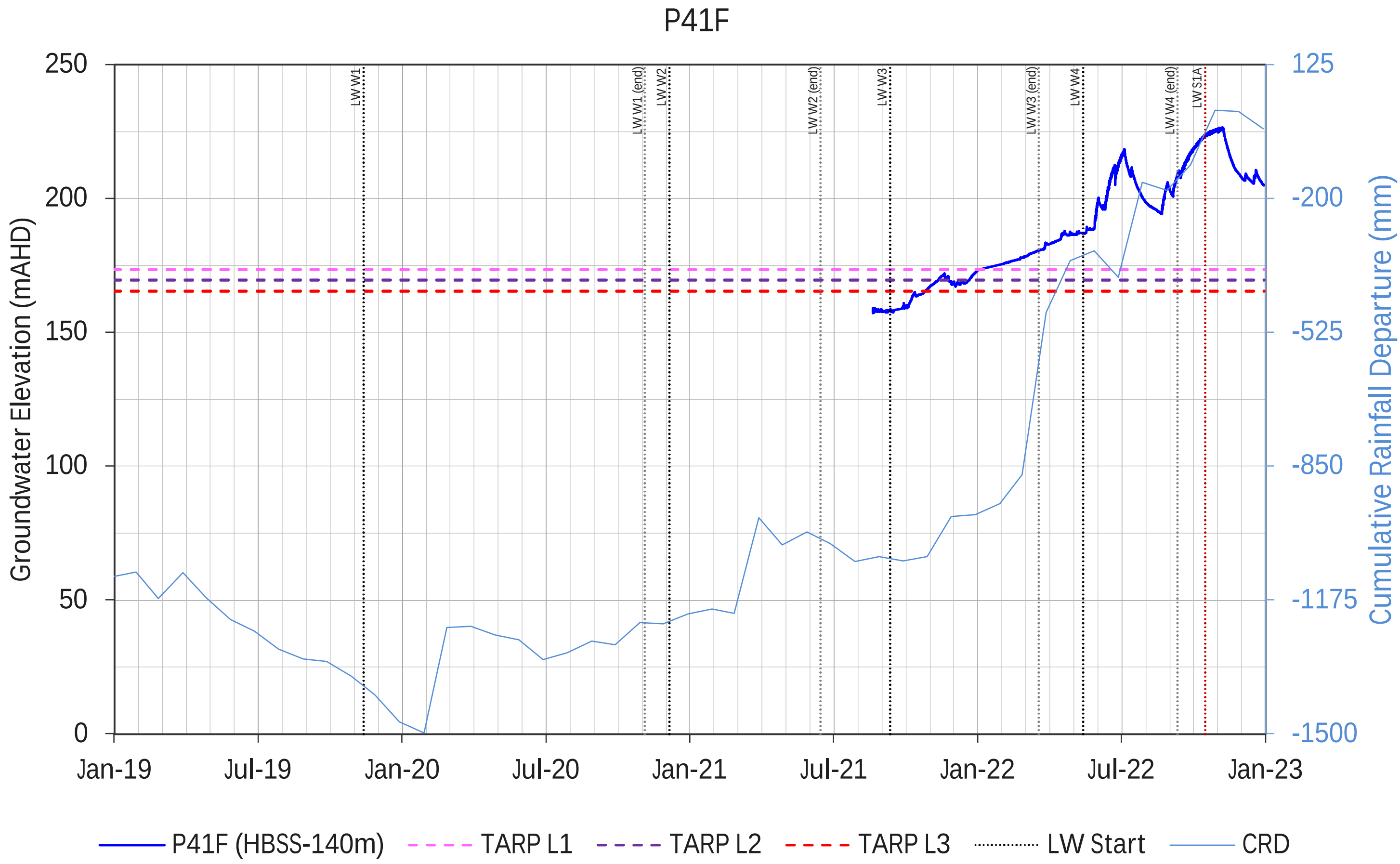
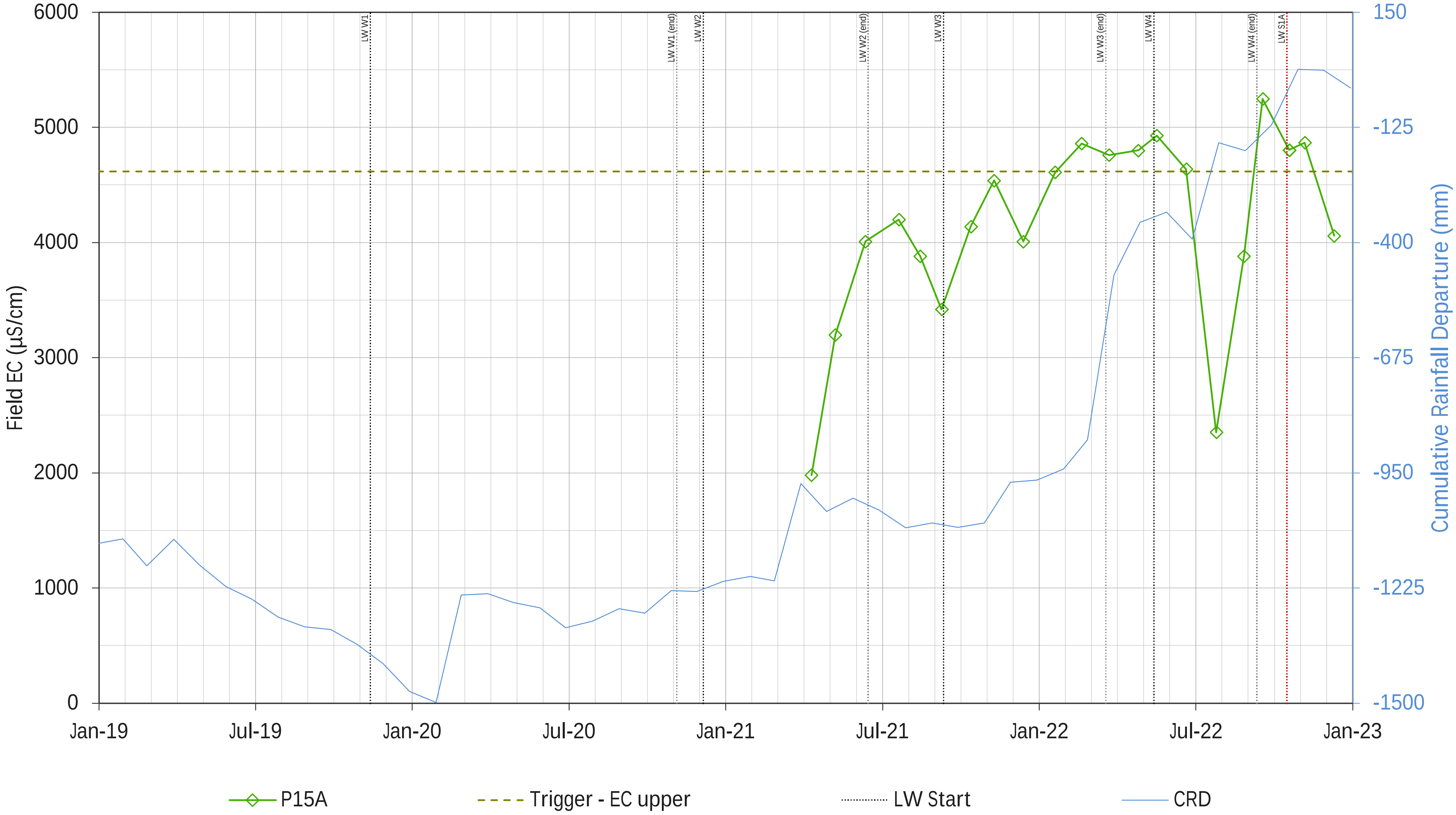

P41F
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
250
200
150
100
50
0
125
-200
-525
-850
-1175
-1500
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
P41F (HBSS-140m)
TARP L1
TARP L2
TARP L3
LW Start
CRD

**Figure B-28**

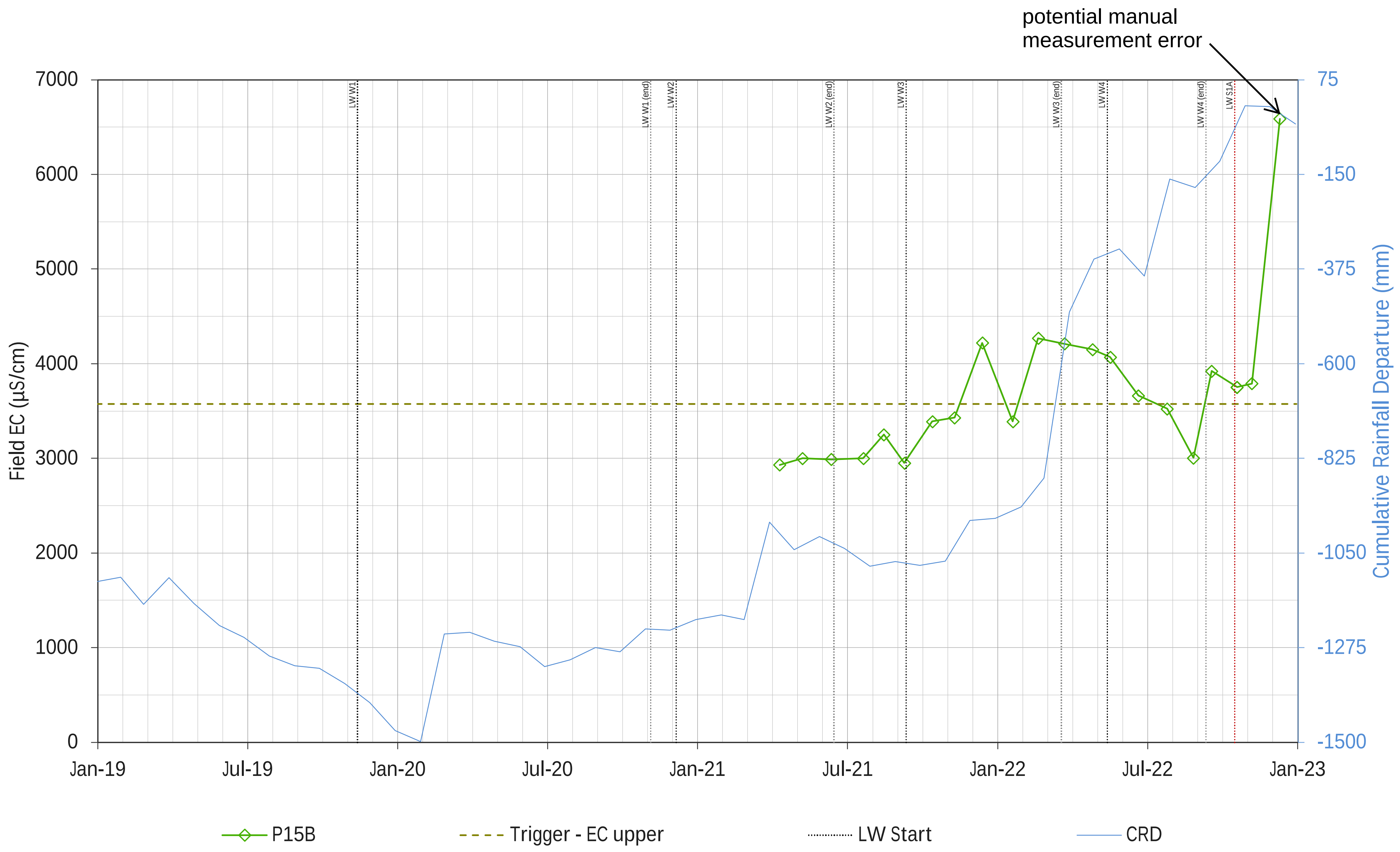
# APPENDIX C

## Groundwater Quality and Trigger Levels (EC /pH exceedances only)



6000
5000
4000
3000
2000
1000
0
Field EC (µS/cm)
150
-125
-400
-675
-950
-1225
-1500
Cumulative Rainfall Departure (mm)
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
P15A
Trigger - EC upper
LW Start
CRD


**Figure C-1**



potential manual measurement error
Field EC (µS/cm)
Cumulative Rainfall Departure (mm)
7000
6000
5000
4000
3000
2000
1000
0
75
-150
-375
-600
-825
-1050
-1275
-1500
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
P15B
Trigger - EC upper
LW Start
CRD


Figure C-2

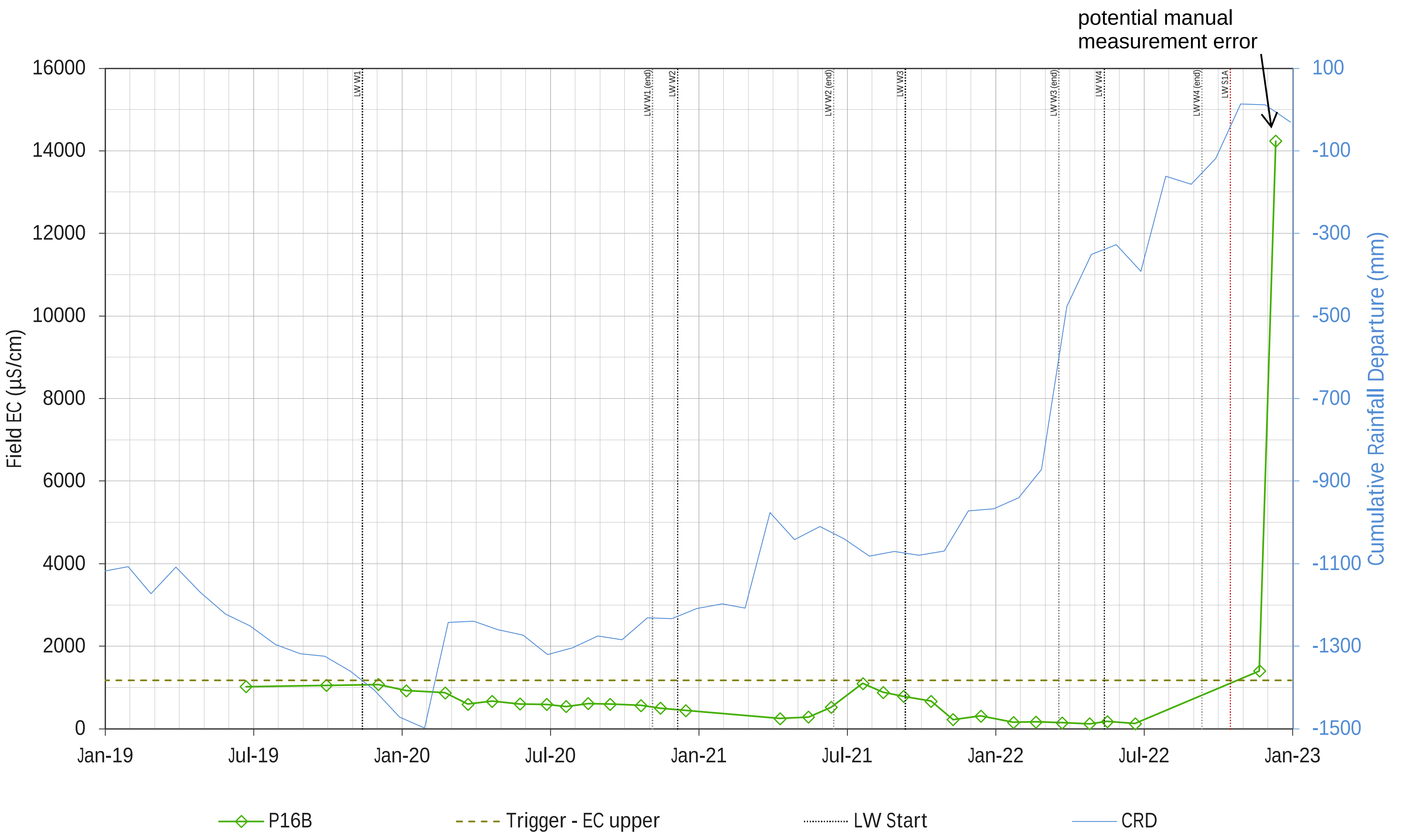
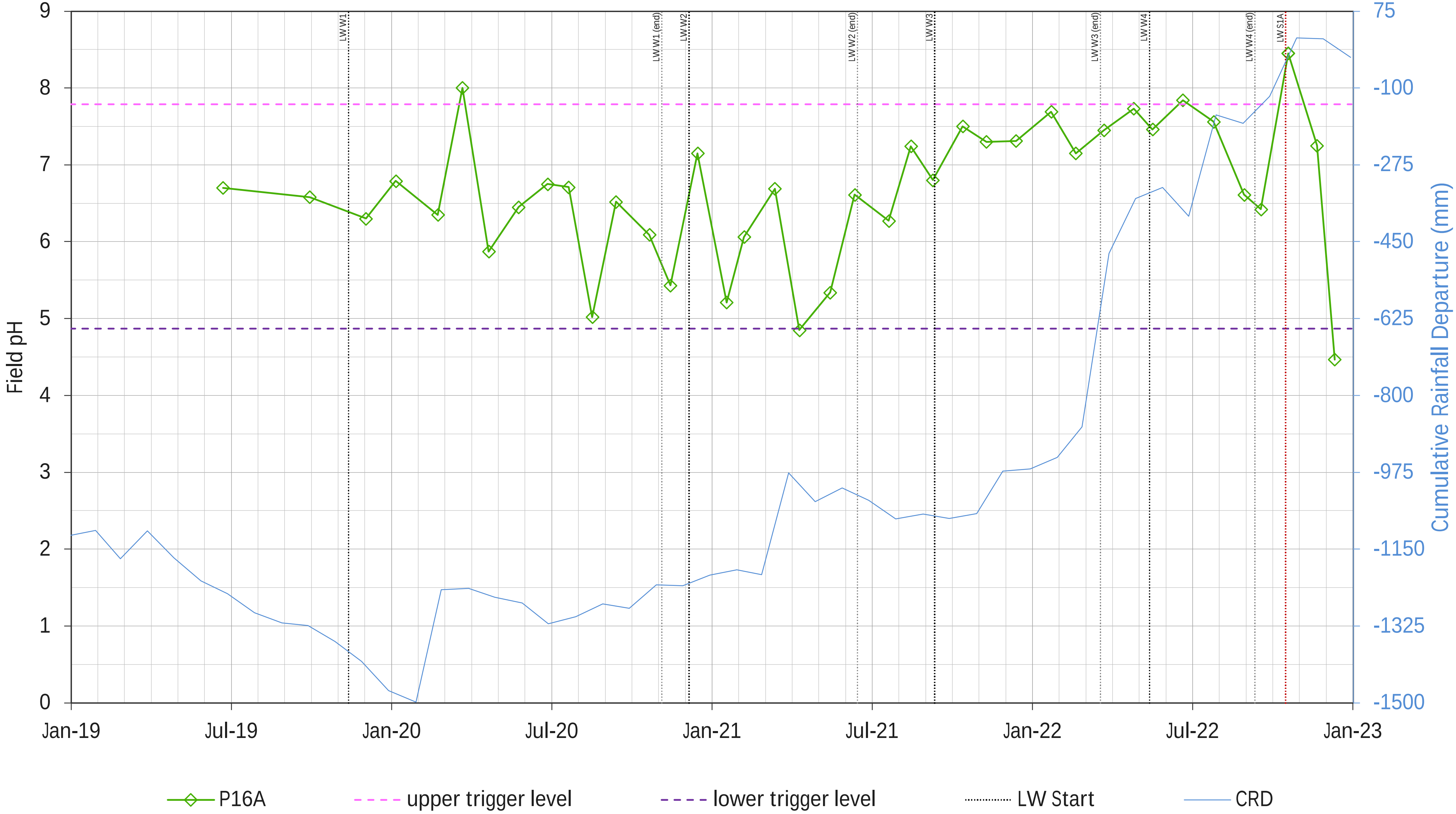
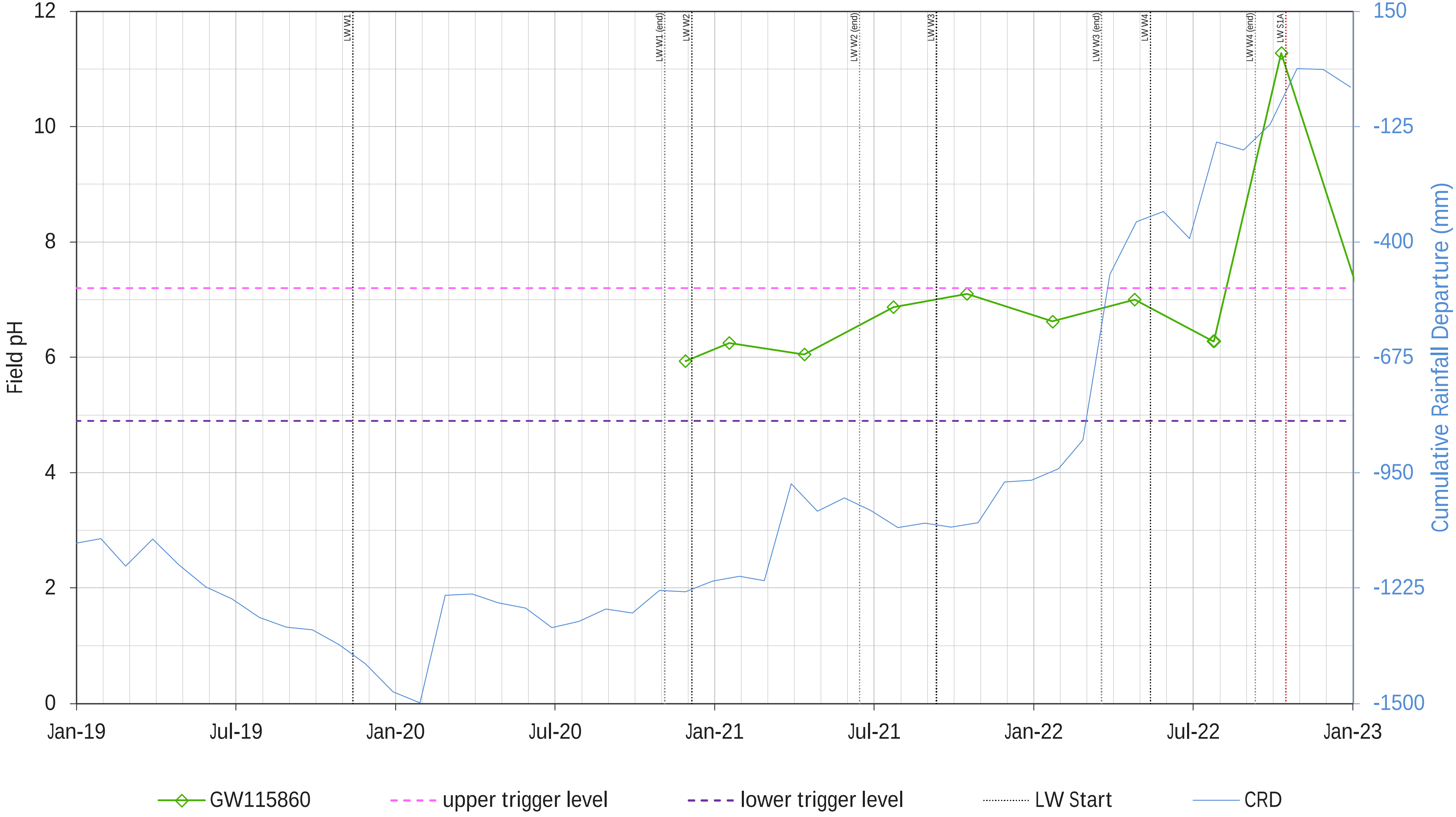

potential manual measurement error
Field EC (µS/cm)
Cumulative Rainfall Departure (mm)
16000
14000
12000
10000
8000
6000
4000
2000
0
100
-100
-300
-500
-700
-900
-1100
-1300
-1500
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
P16B
Trigger - EC upper
LW Start
CRD

**Figure C-3**



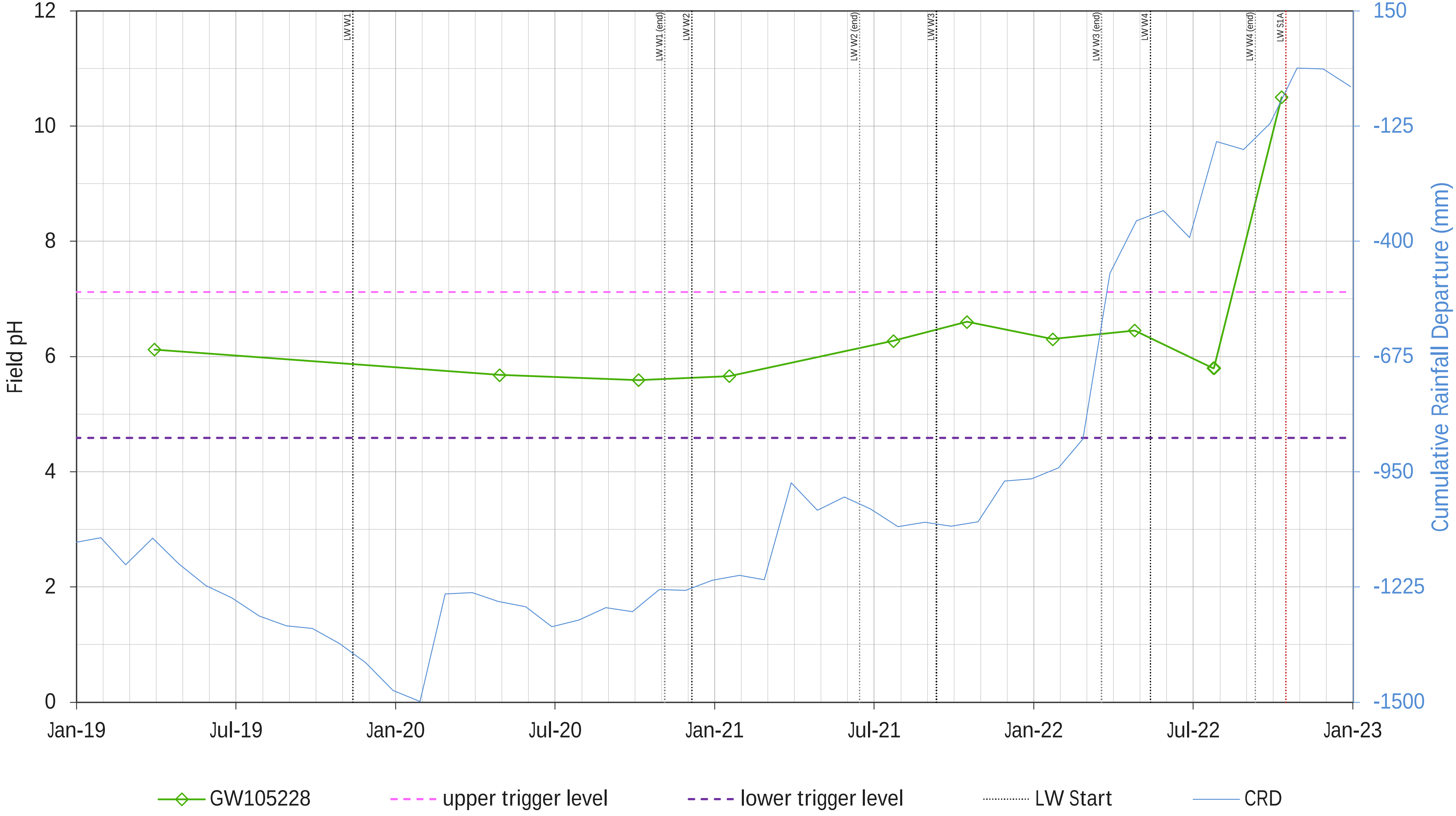
Field pH
Cumulative Rainfall Departure (mm)
9
8
7
6
5
4
3
2
1
0
75
-100
-275
-450
-625
-800
-975
-1150
-1325
-1500
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
P16A
upper trigger level
lower trigger level
LW Start
CRD


**Figure C-4**



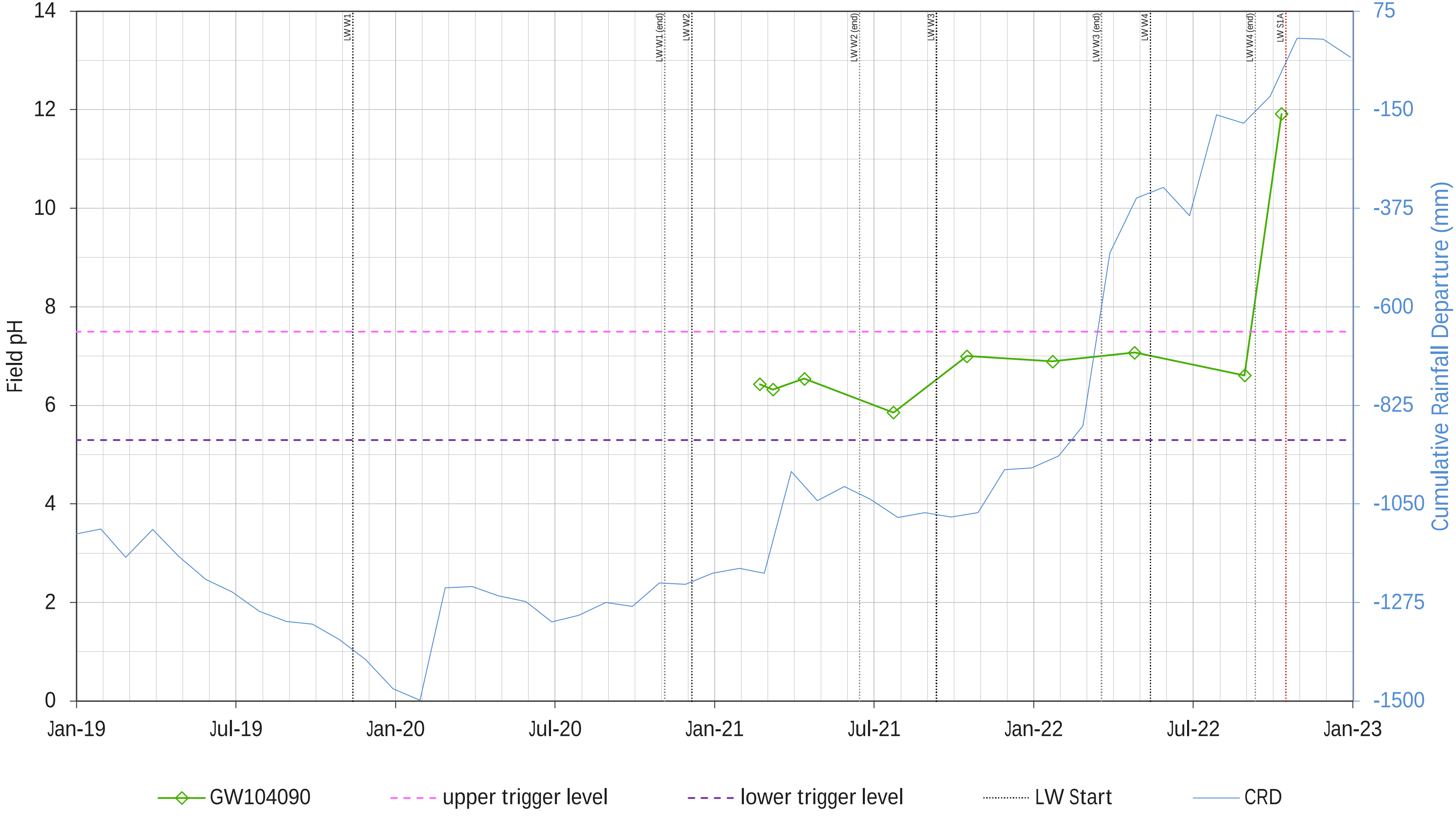
Field pH
Cumulative Rainfall Departure (mm)
12
10
8
6
4
2
0
150
-125
-400
-675
-950
-1225
-1500
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
GW115860
upper trigger level
lower trigger level
LW Start
CRD


**Figure C-5**



Field pH
Cumulative Rainfall Departure (mm)
12
10
8
6
4
2
0
150
-125
-400
-675
-950
-1225
-1500
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
GW105228
upper trigger level
lower trigger level
LW Start
CRD


**Figure C-6**



Field pH
Cumulative Rainfall Departure (mm)
14
12
10
8
6
4
2
0
75
-150
-375
-600
-825
-1050
-1275
-1500
Jan-19
Jul-19
Jan-20
Jul-20
Jan-21
Jul-21
Jan-22
Jul-22
Jan-23
LW W1
LW W1 (end)
LW W2
LW W2 (end)
LW W3
LW W3 (end)
LW W4
LW W4 (end)
LW S1A
GW104090
upper trigger level
lower trigger level
LW Start
CRD


**Figure C-7**

# APPENDIX D

## Groundwater Quality and Trigger Levels (metal exceedances only)

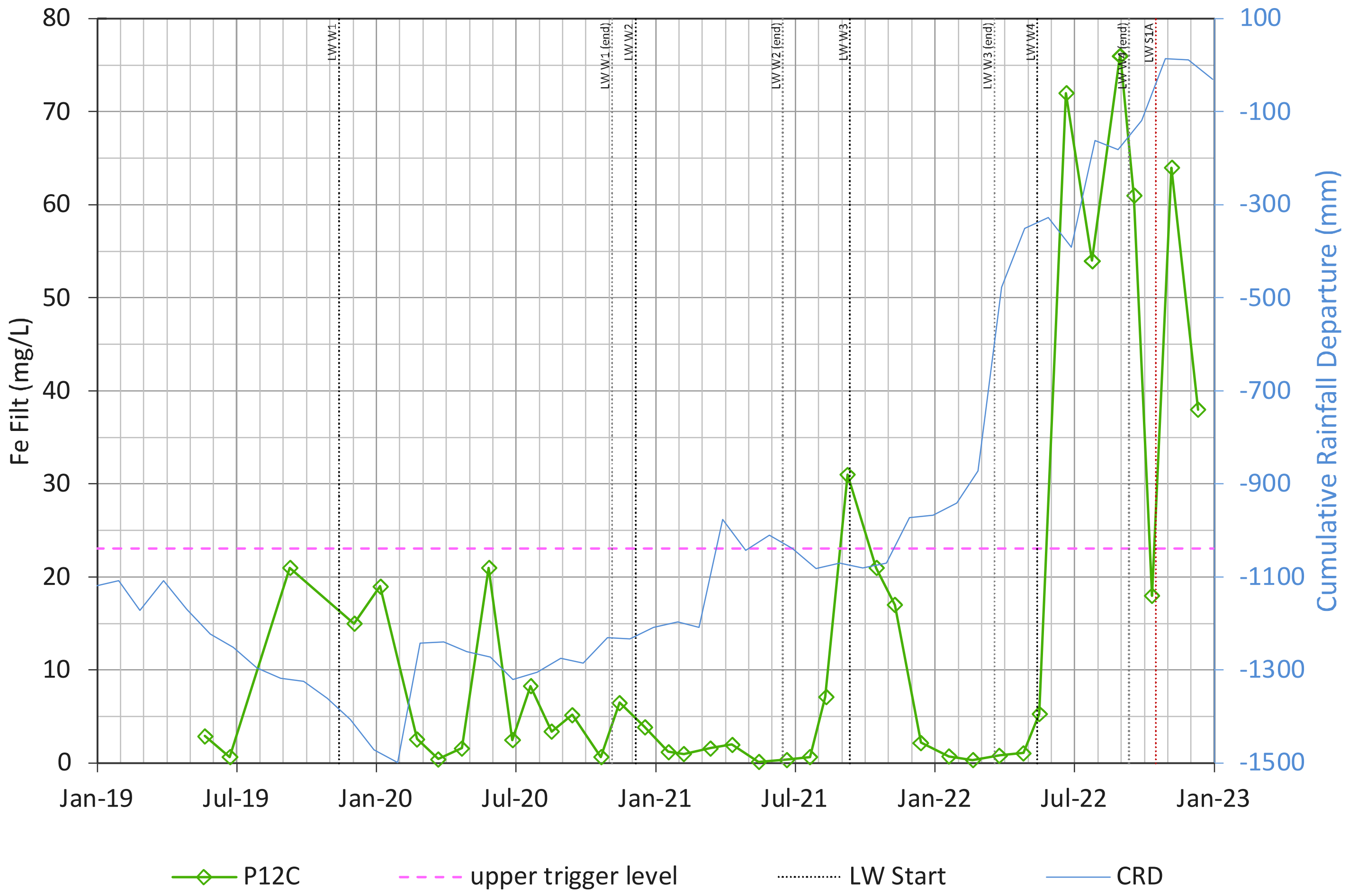



**Figure D1**

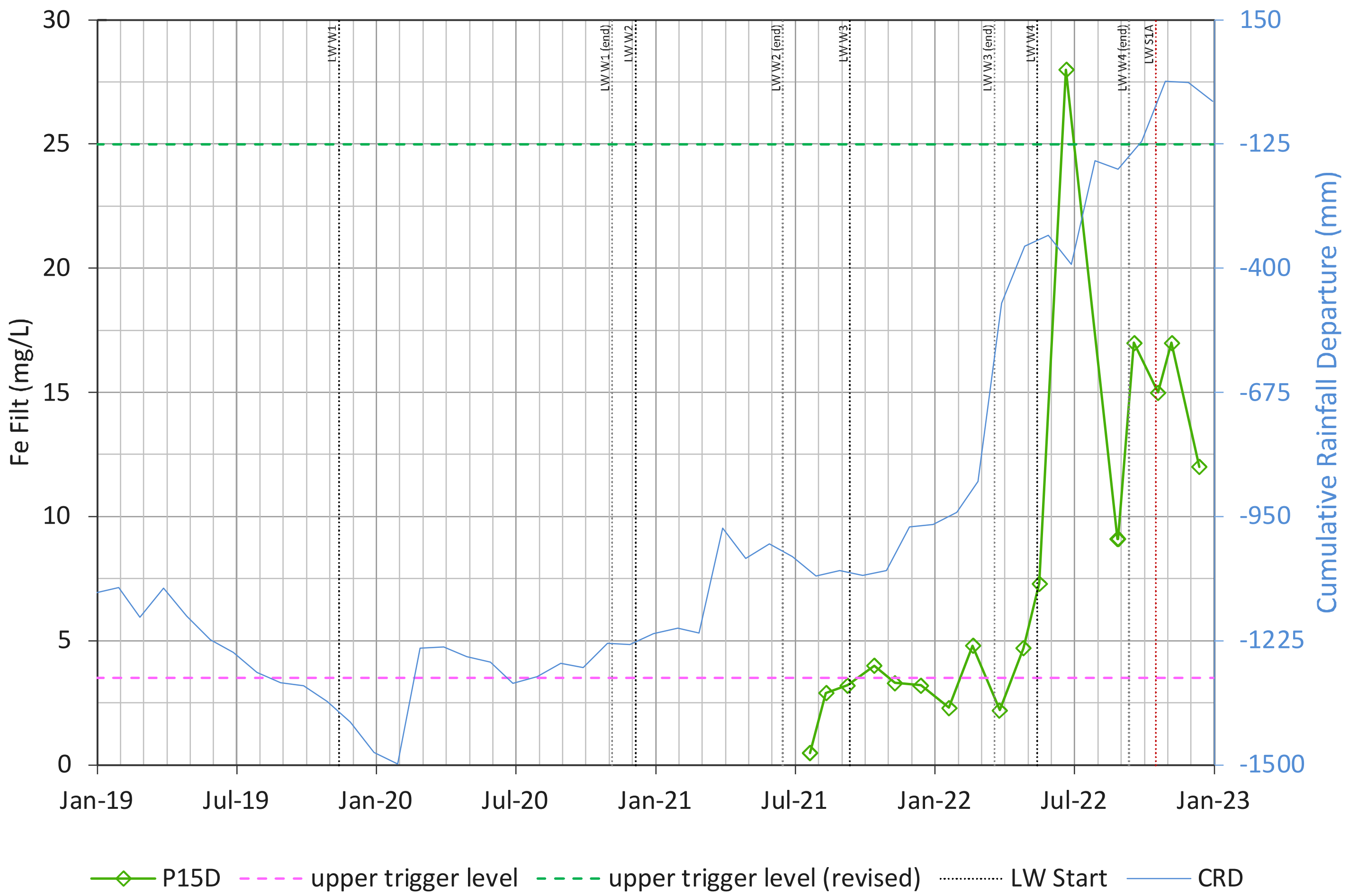



**Figure D2**

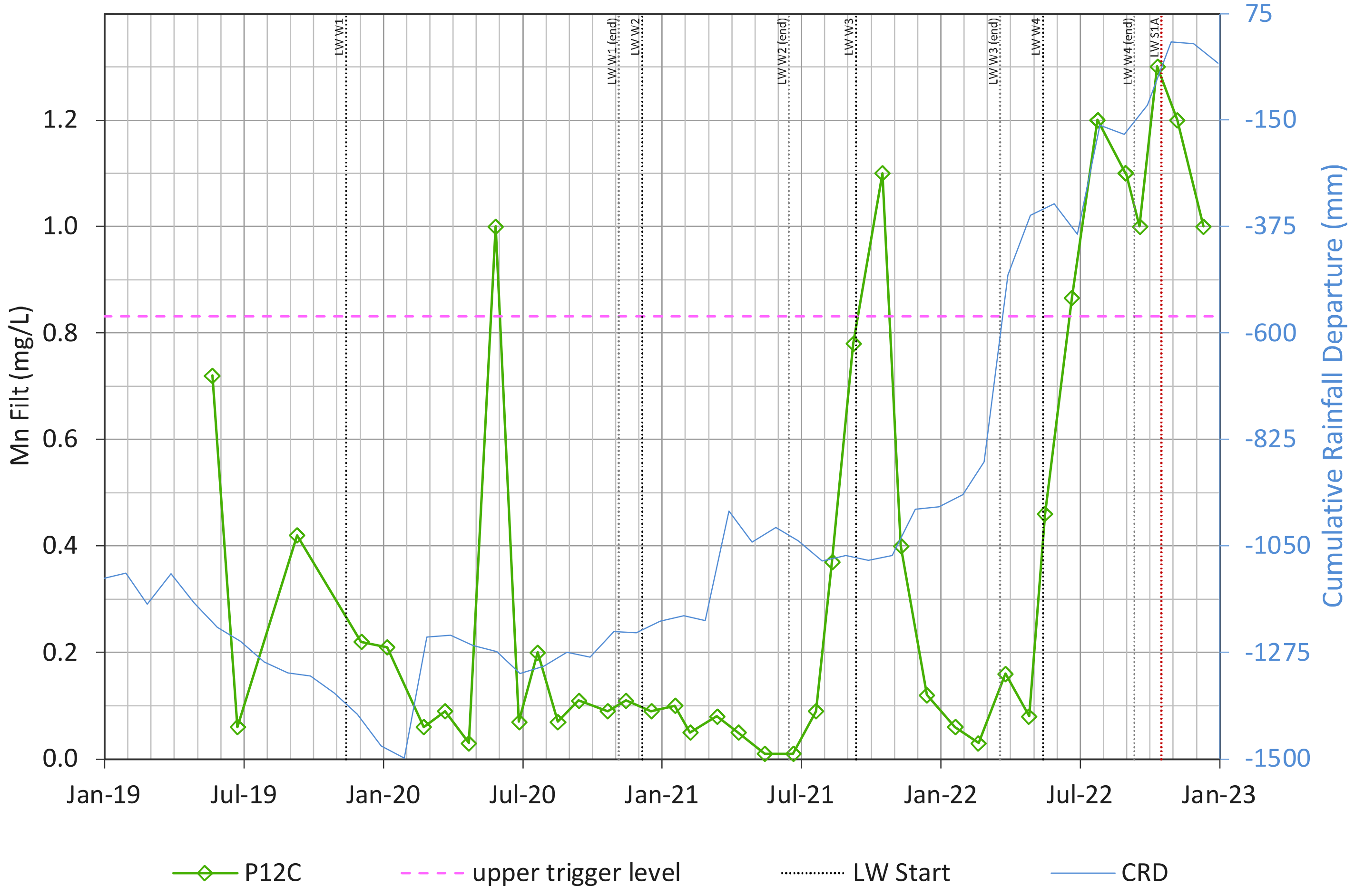



**Figure D3**

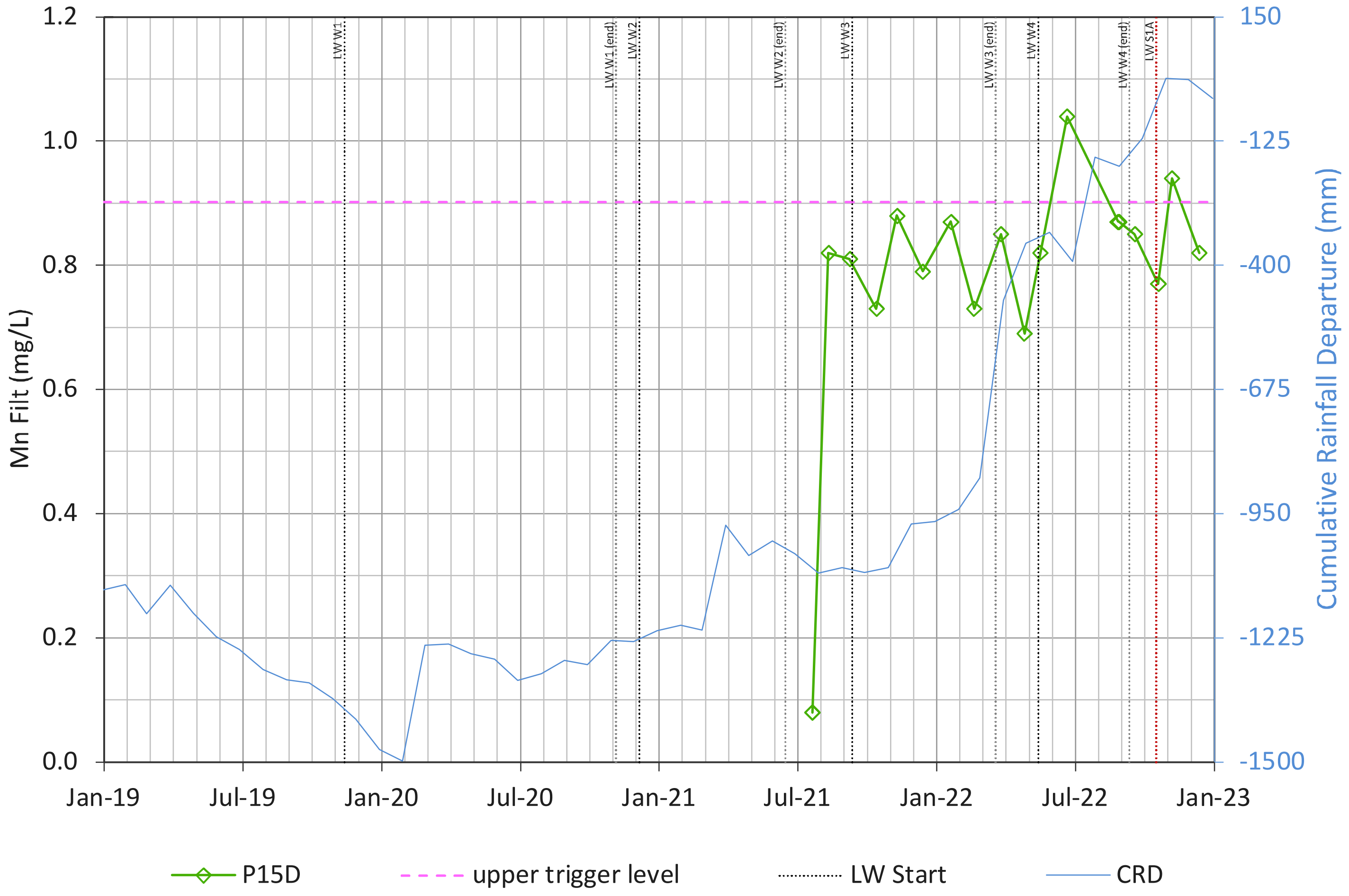



**Figure D4**

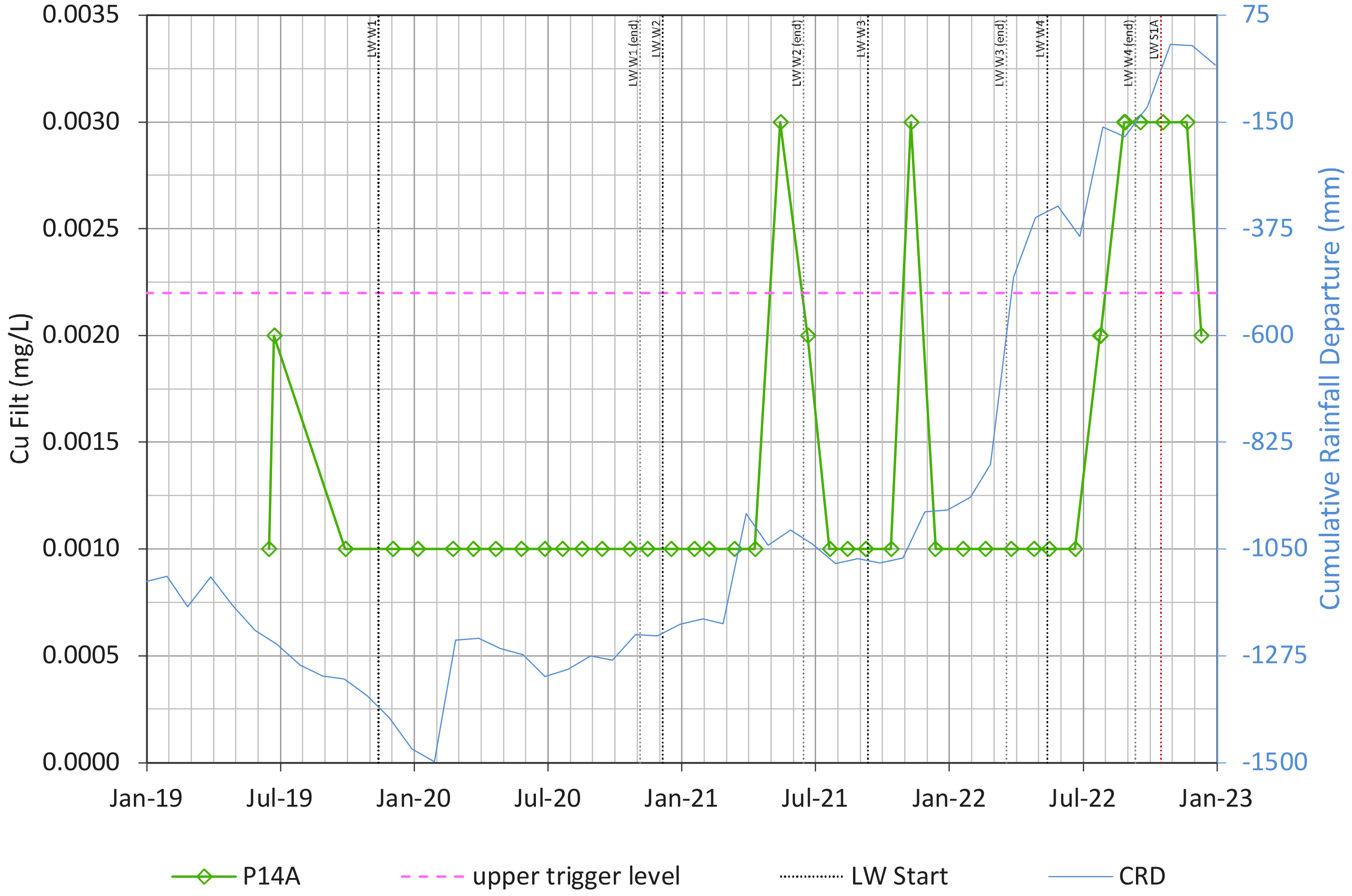



**Figure D5**

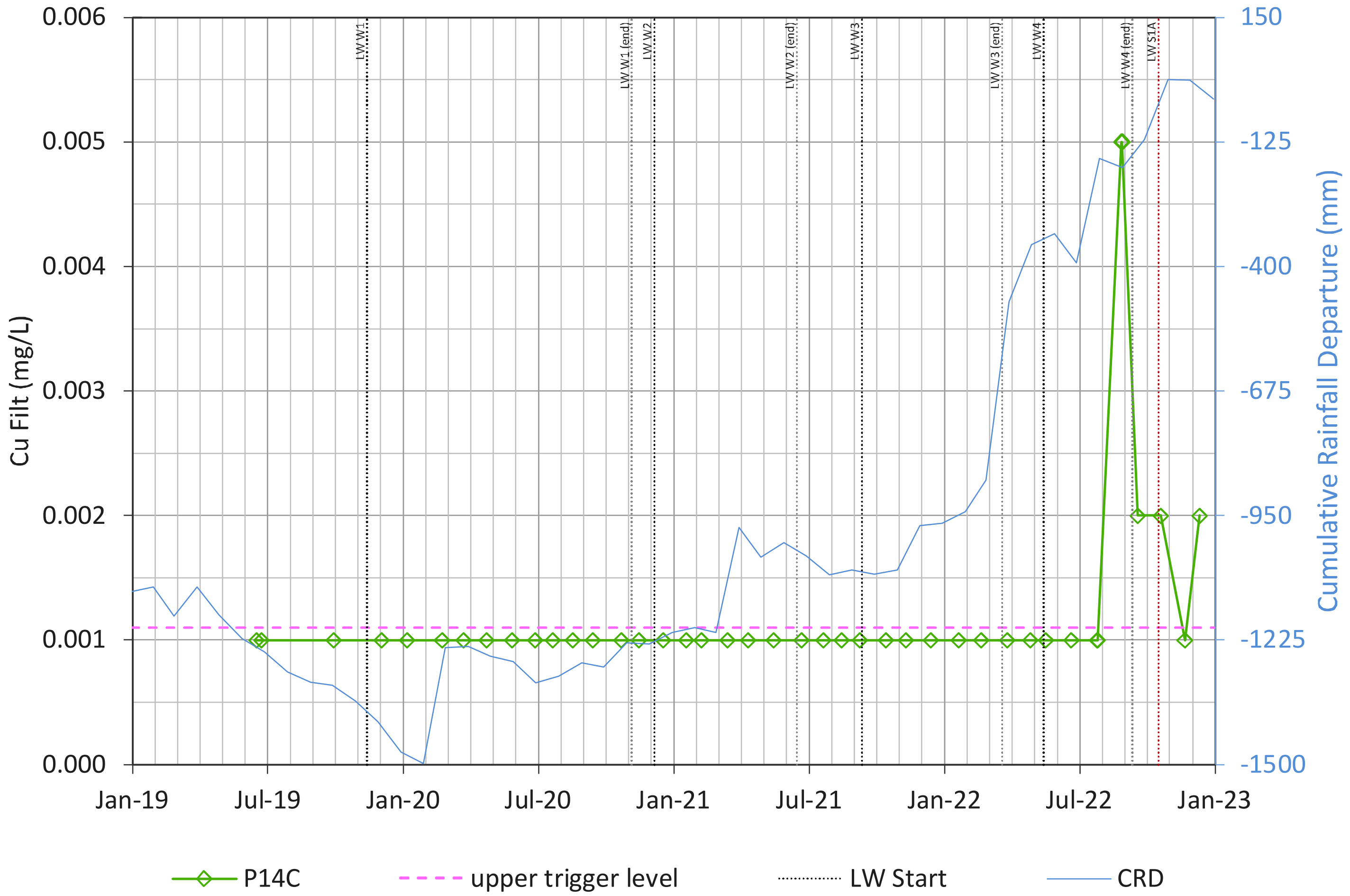



**Figure D6**

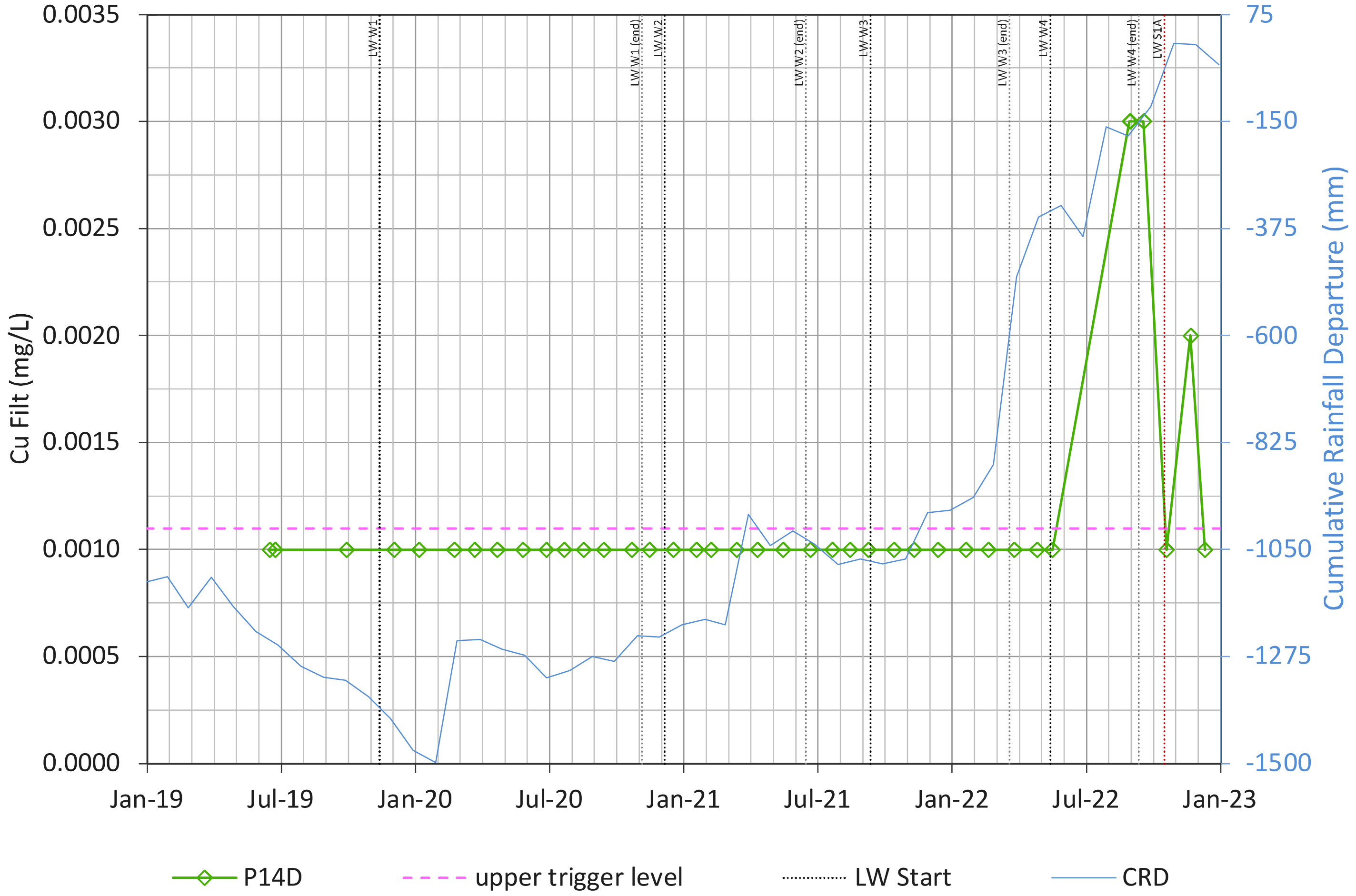



**Figure D7**

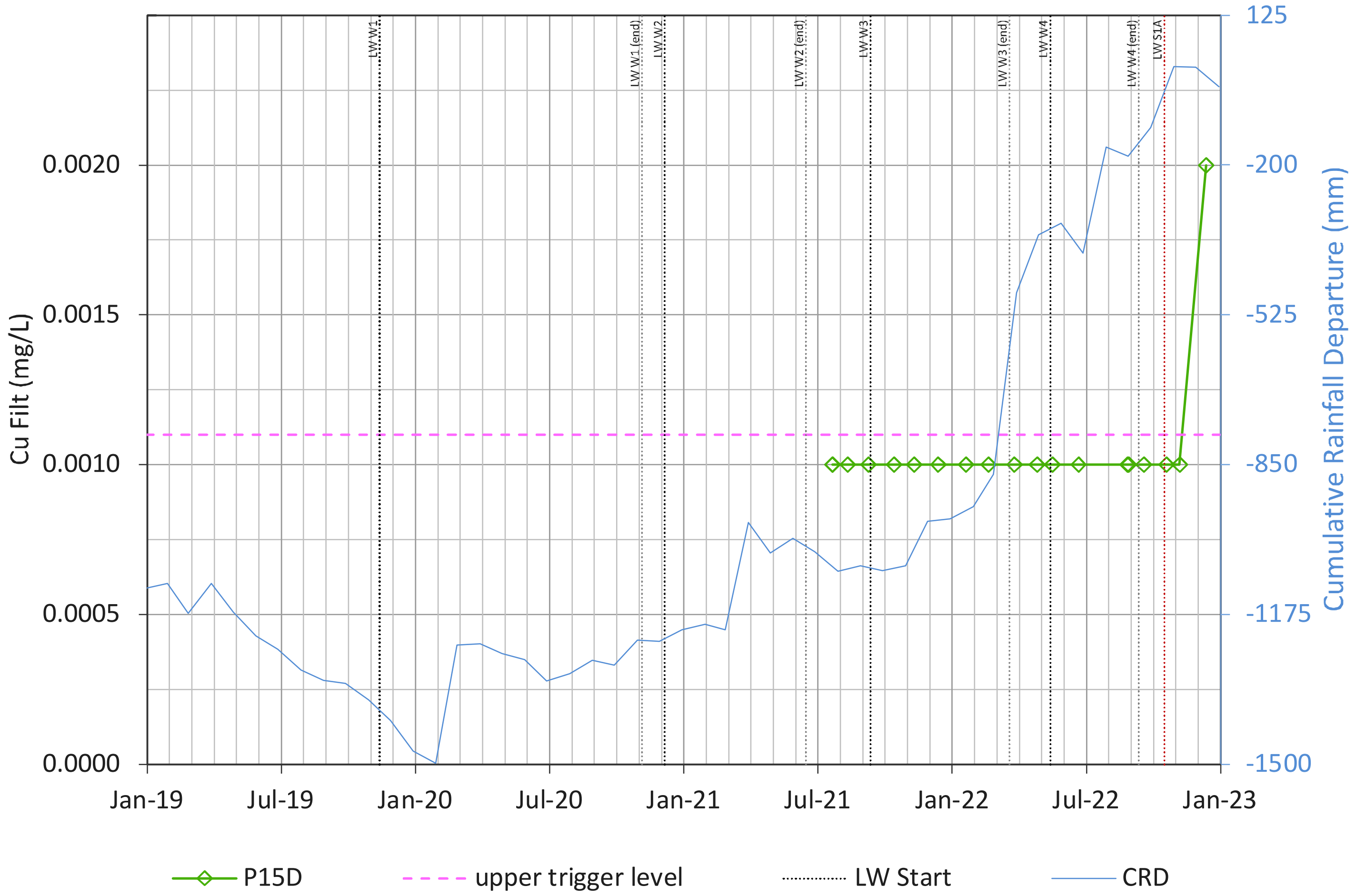



**Figure D8**

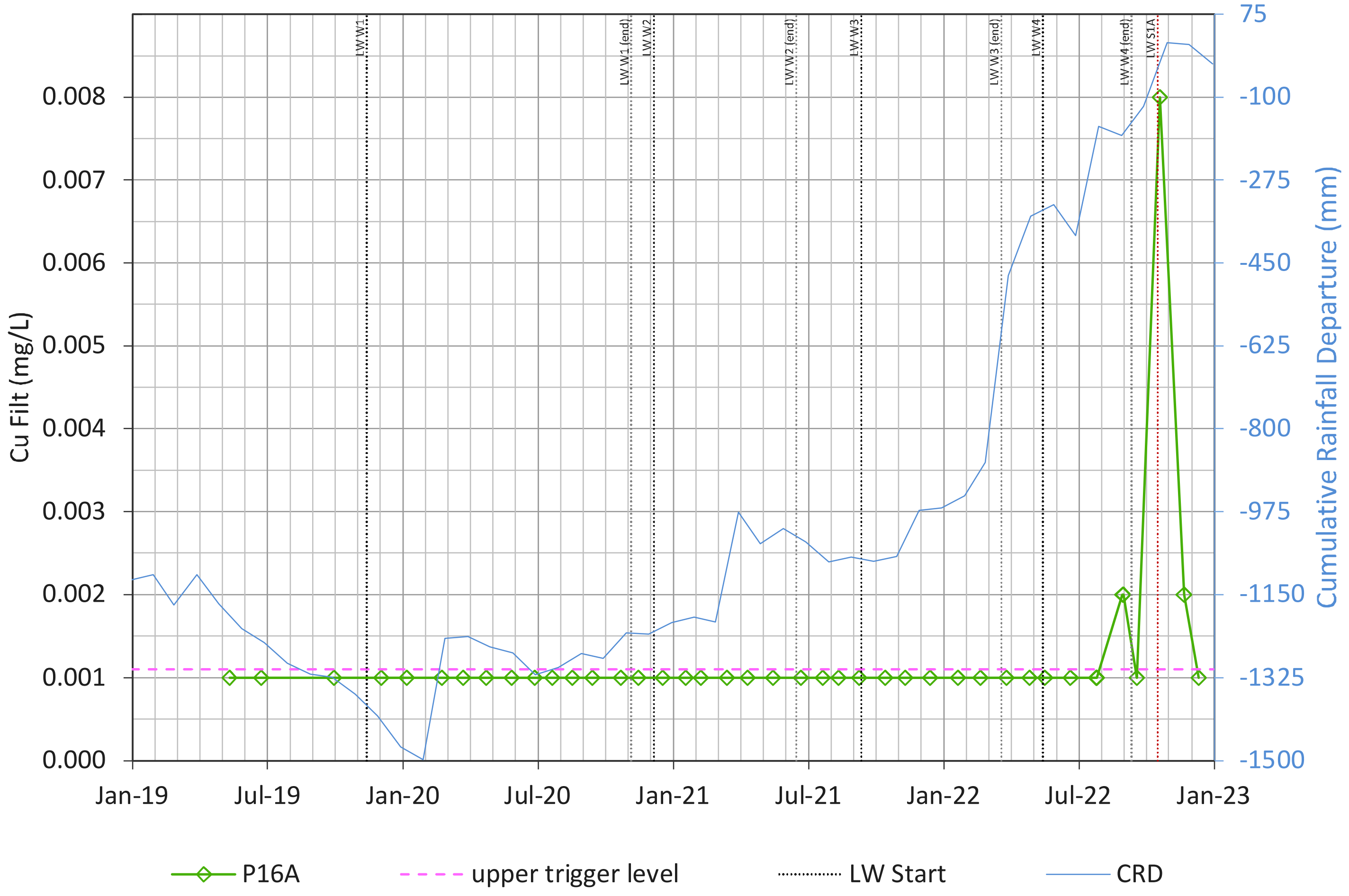



**Figure D9**

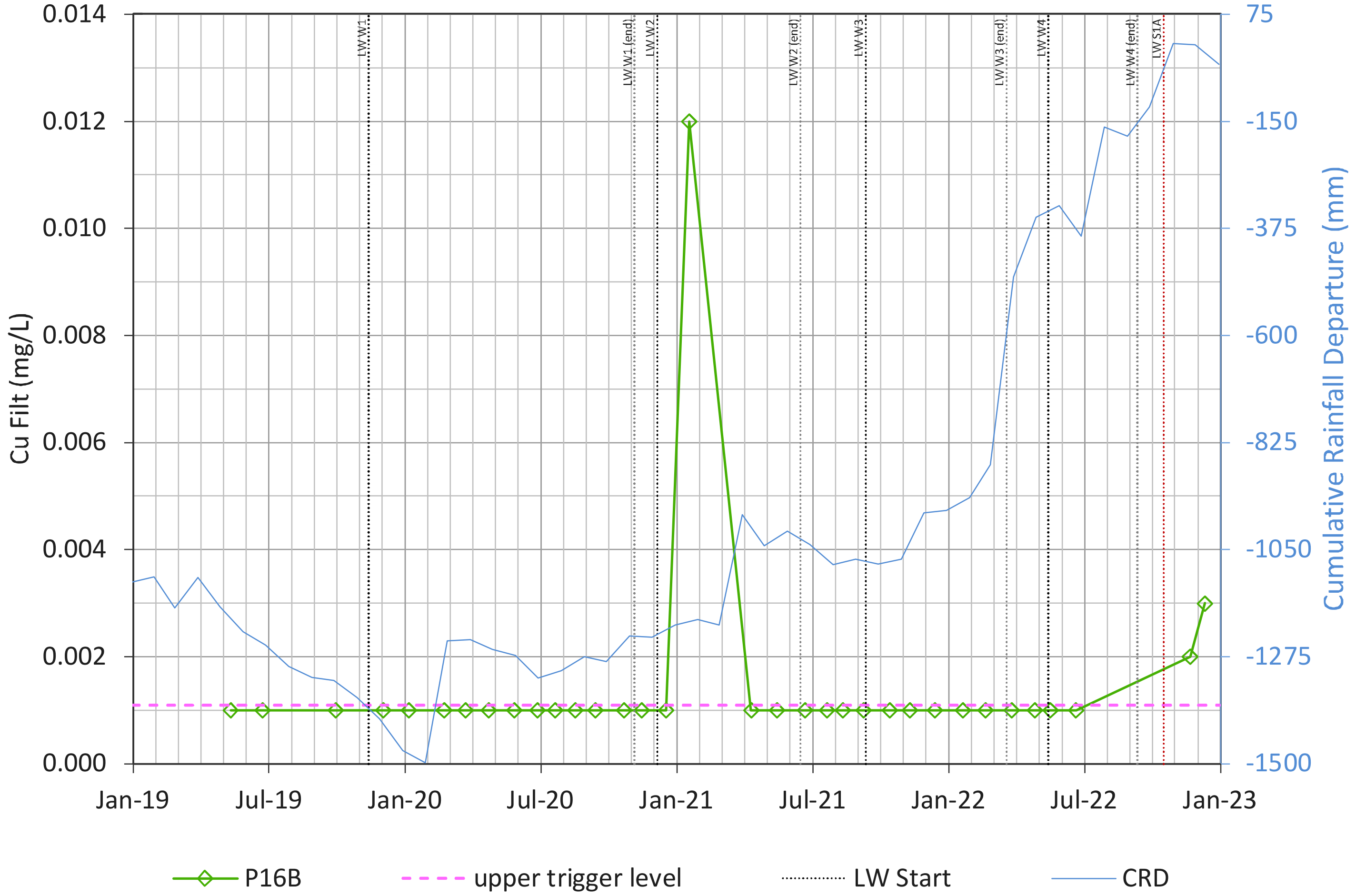



**Figure D10**

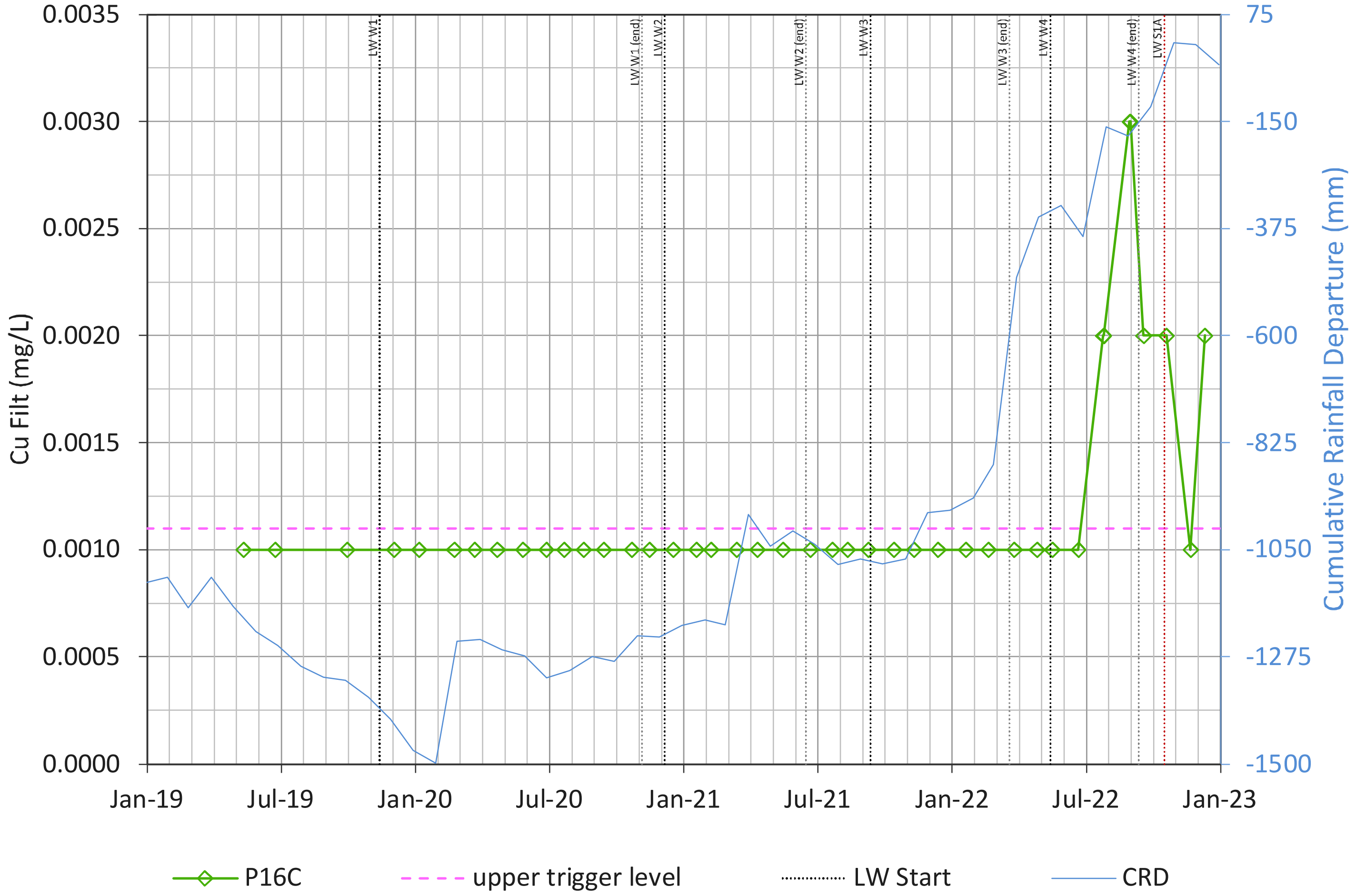



**Figure D11**

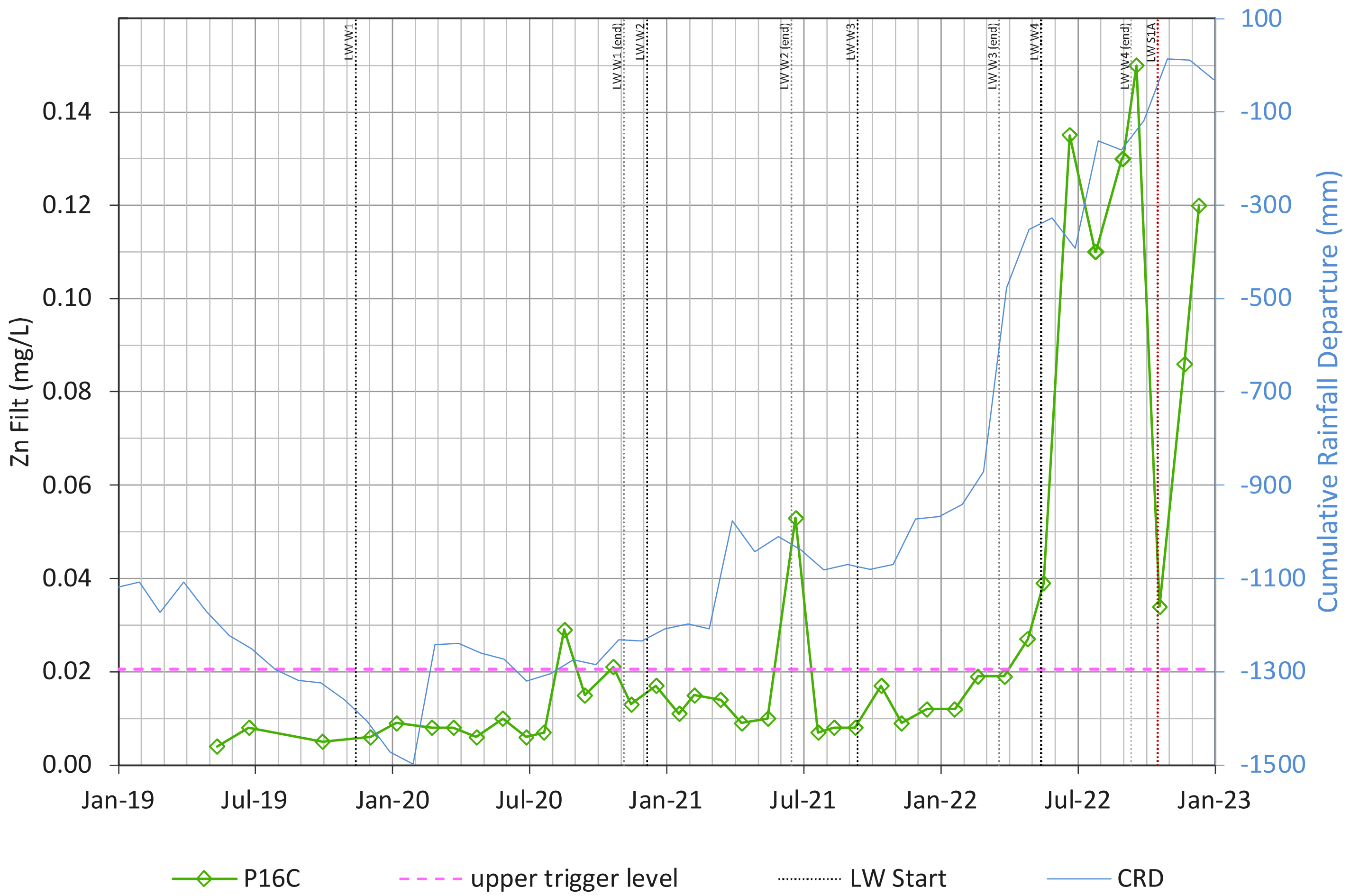
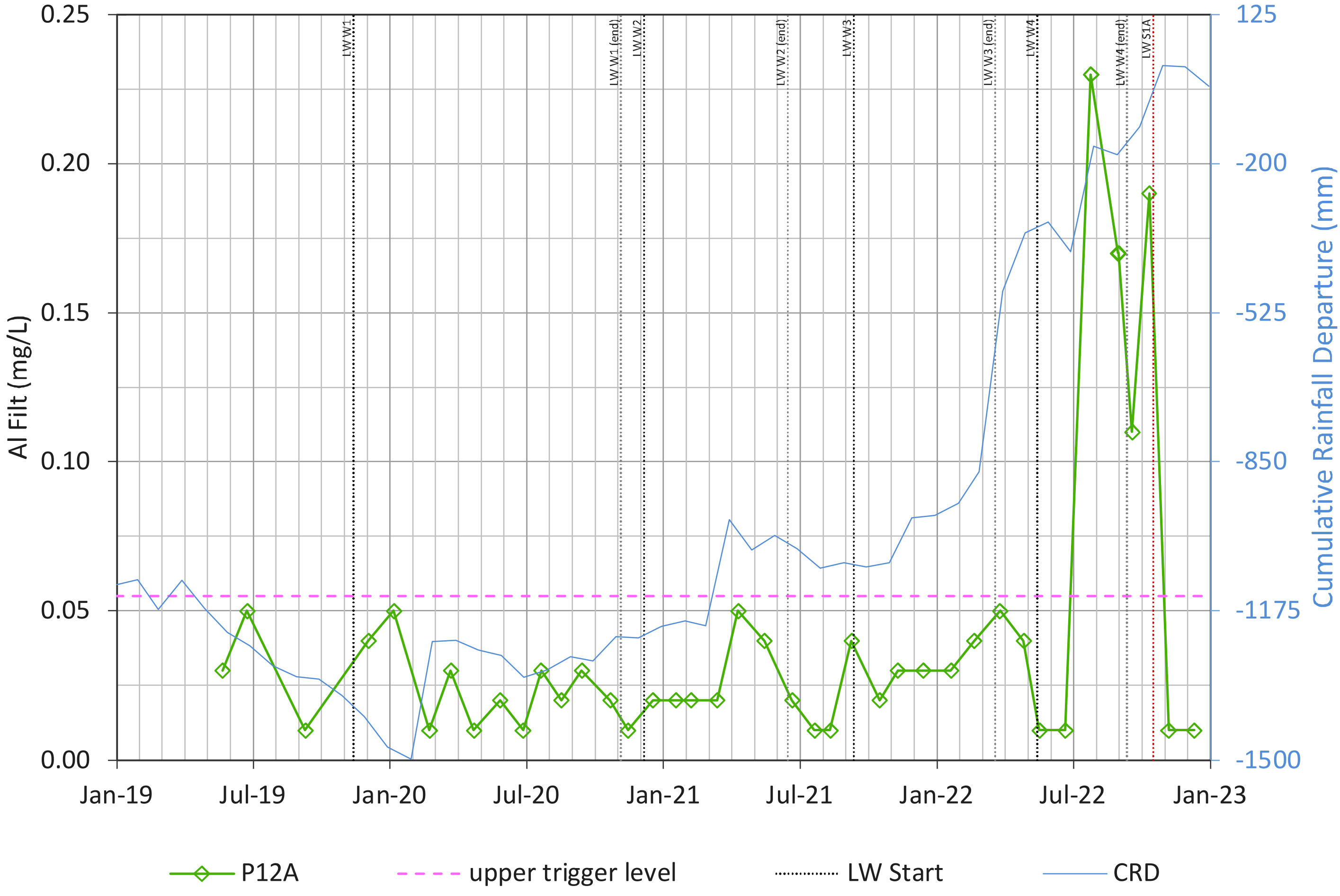



**Figure D12**

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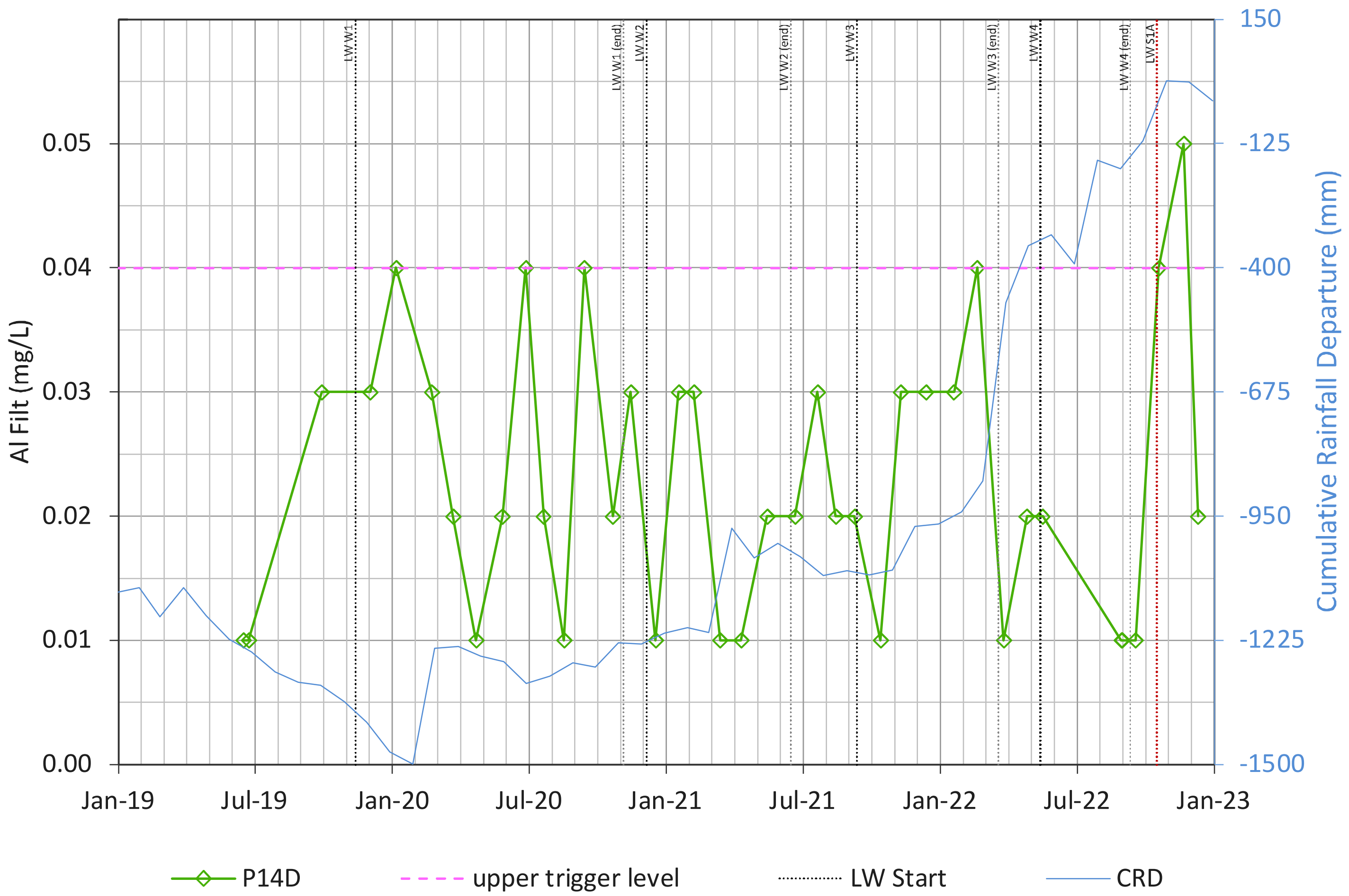


**Figure D14**

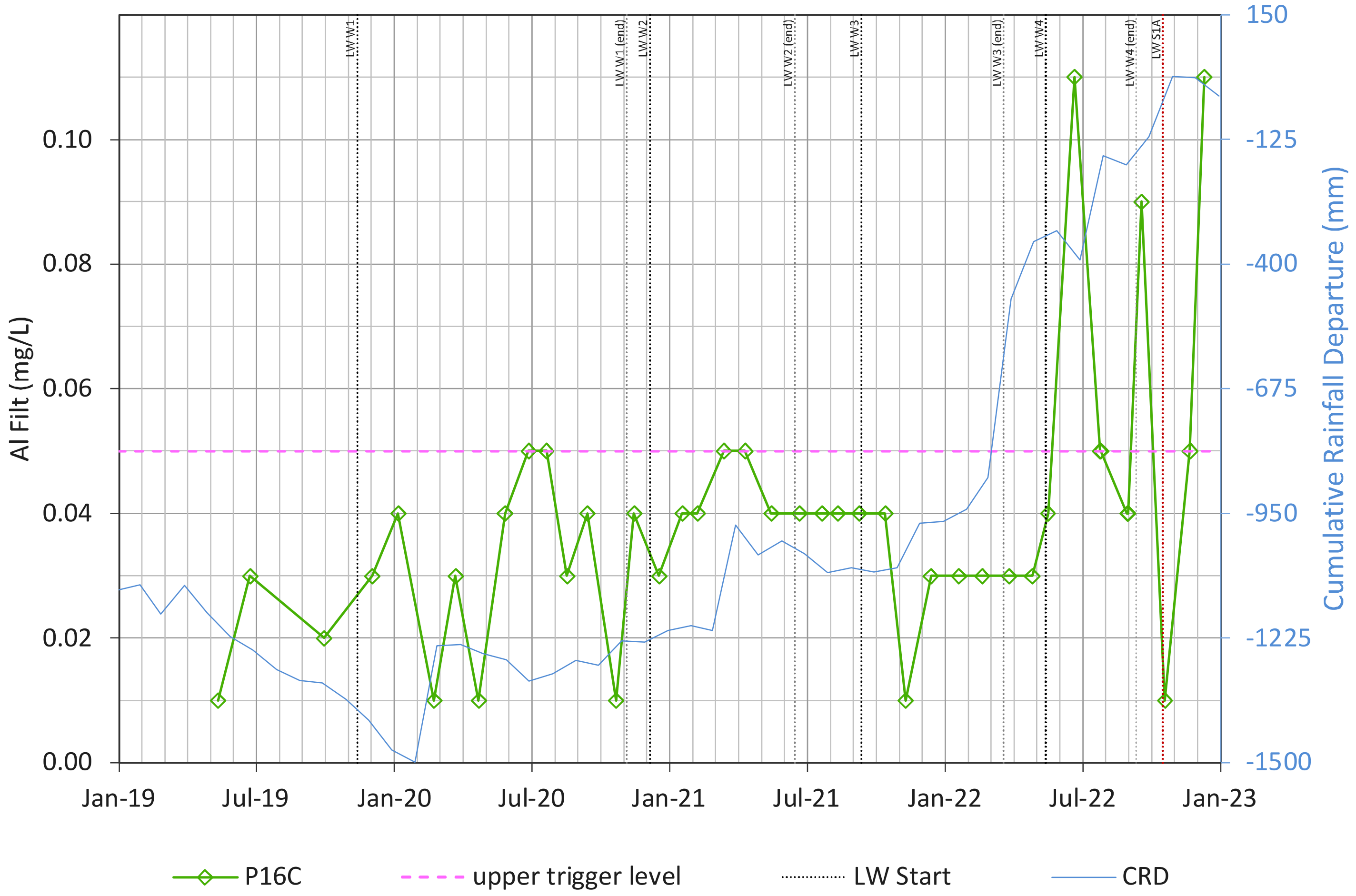


**Figure D15**

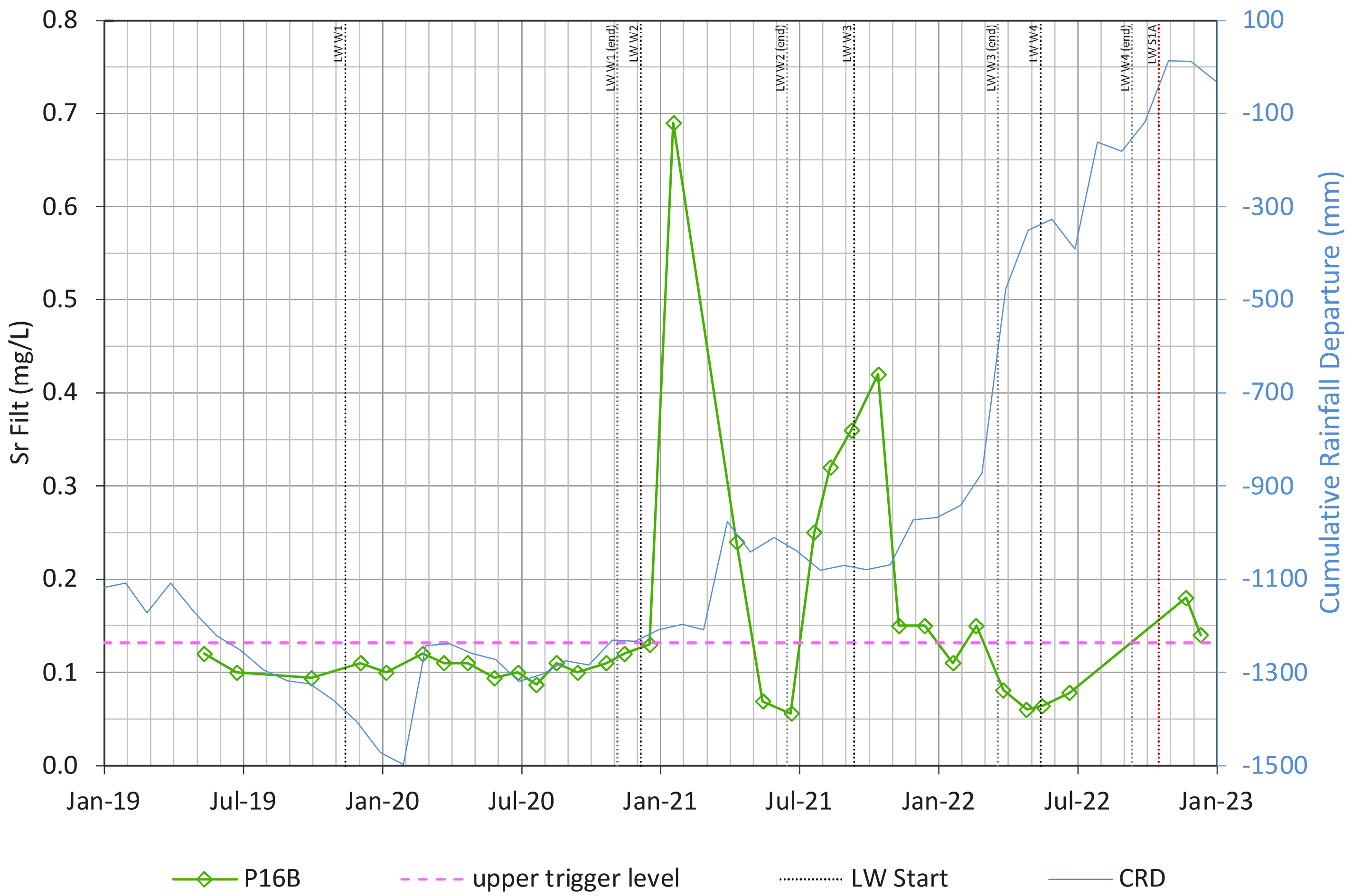


**Figure D16**

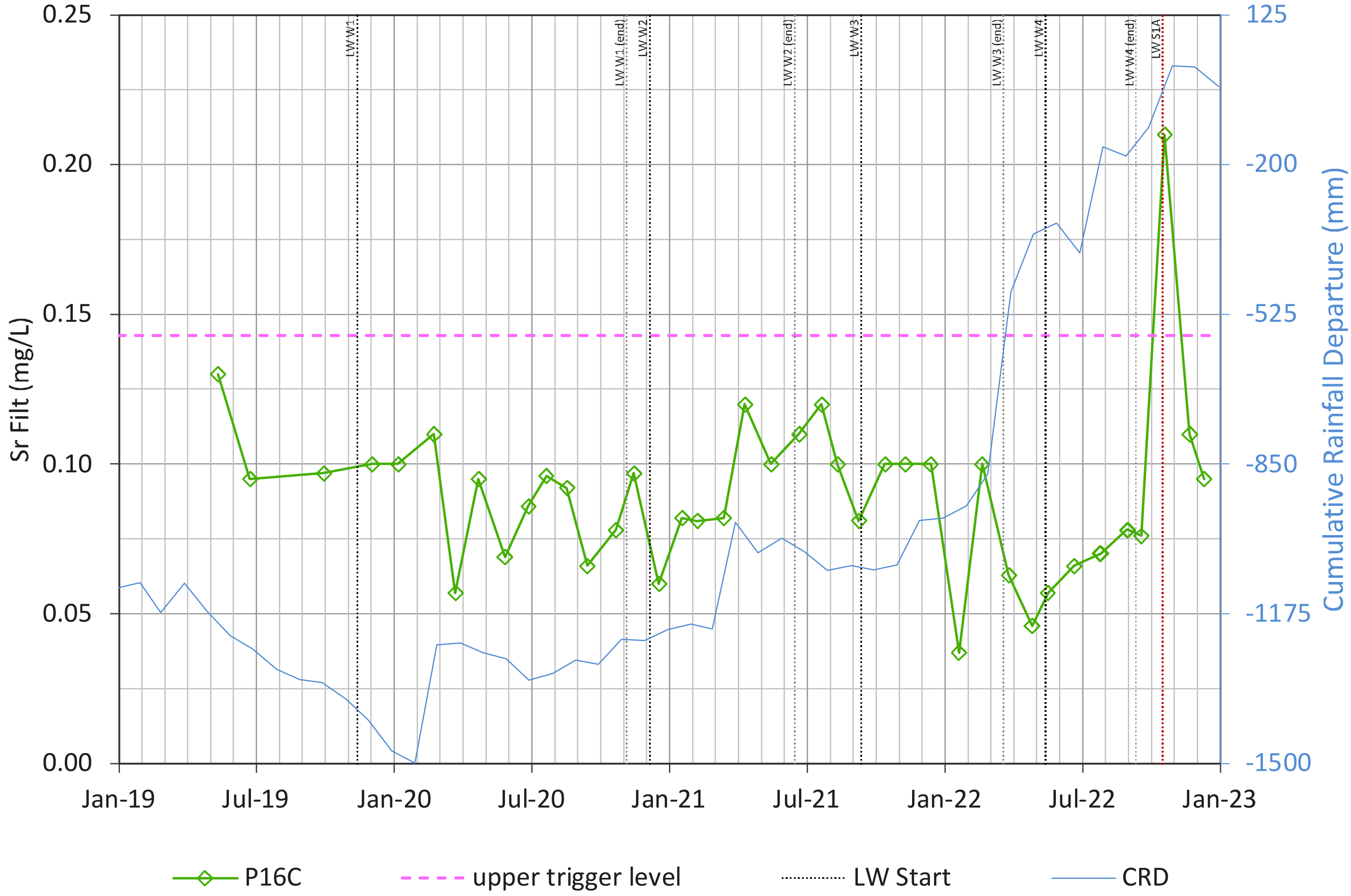


**Figure D17**

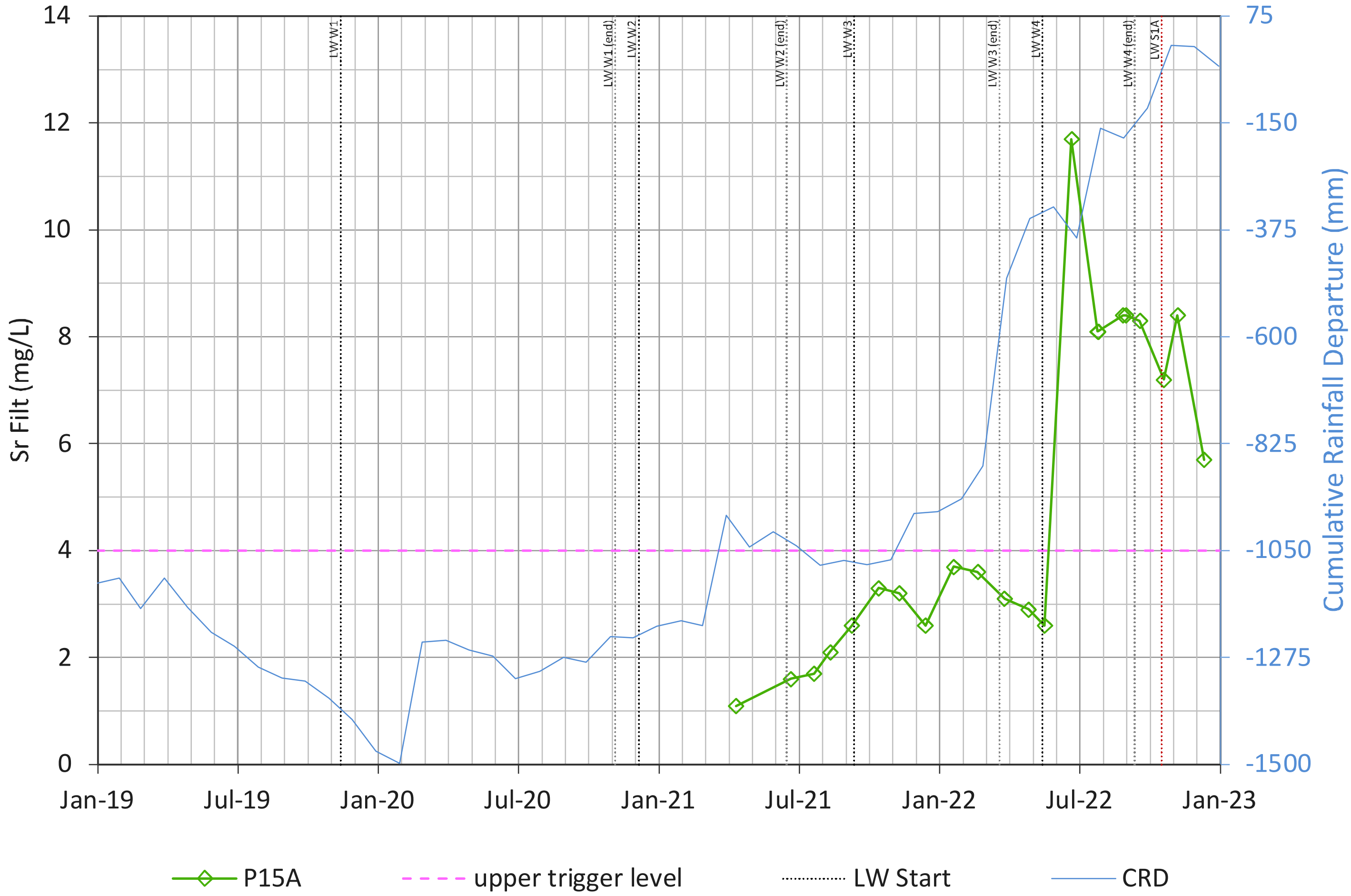


**Figure D18**

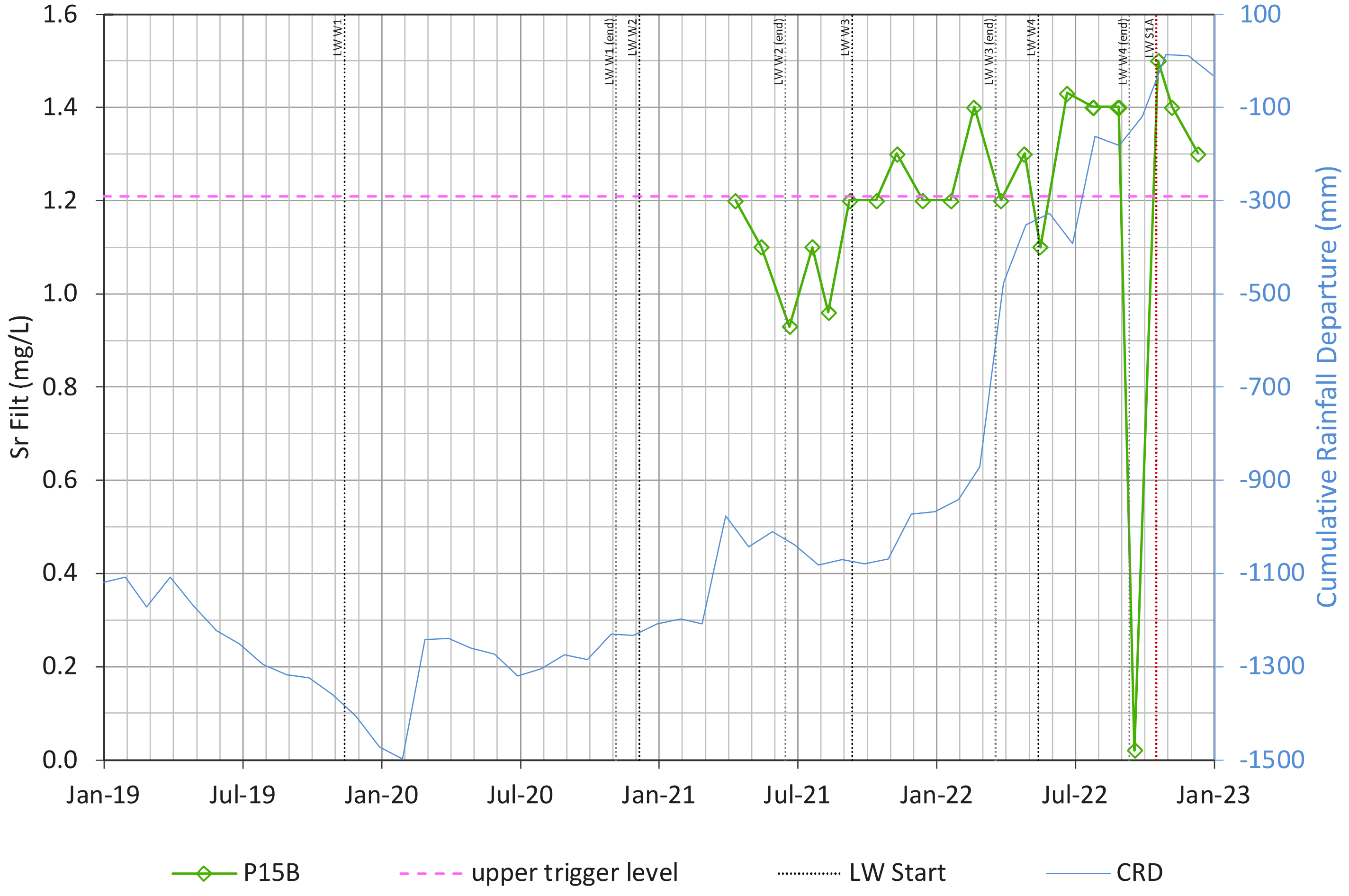


**Figure D19**

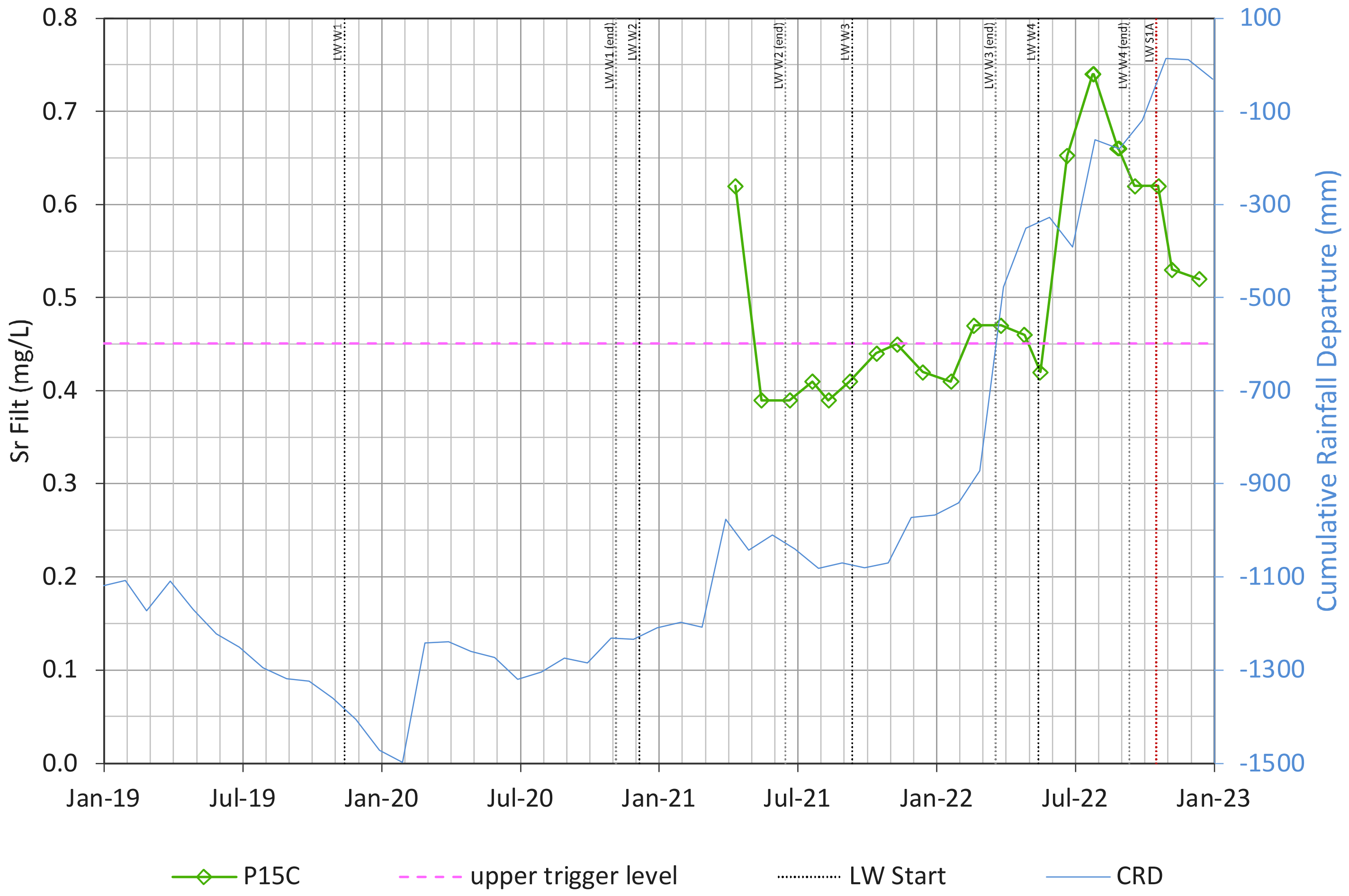


**Figure D20**

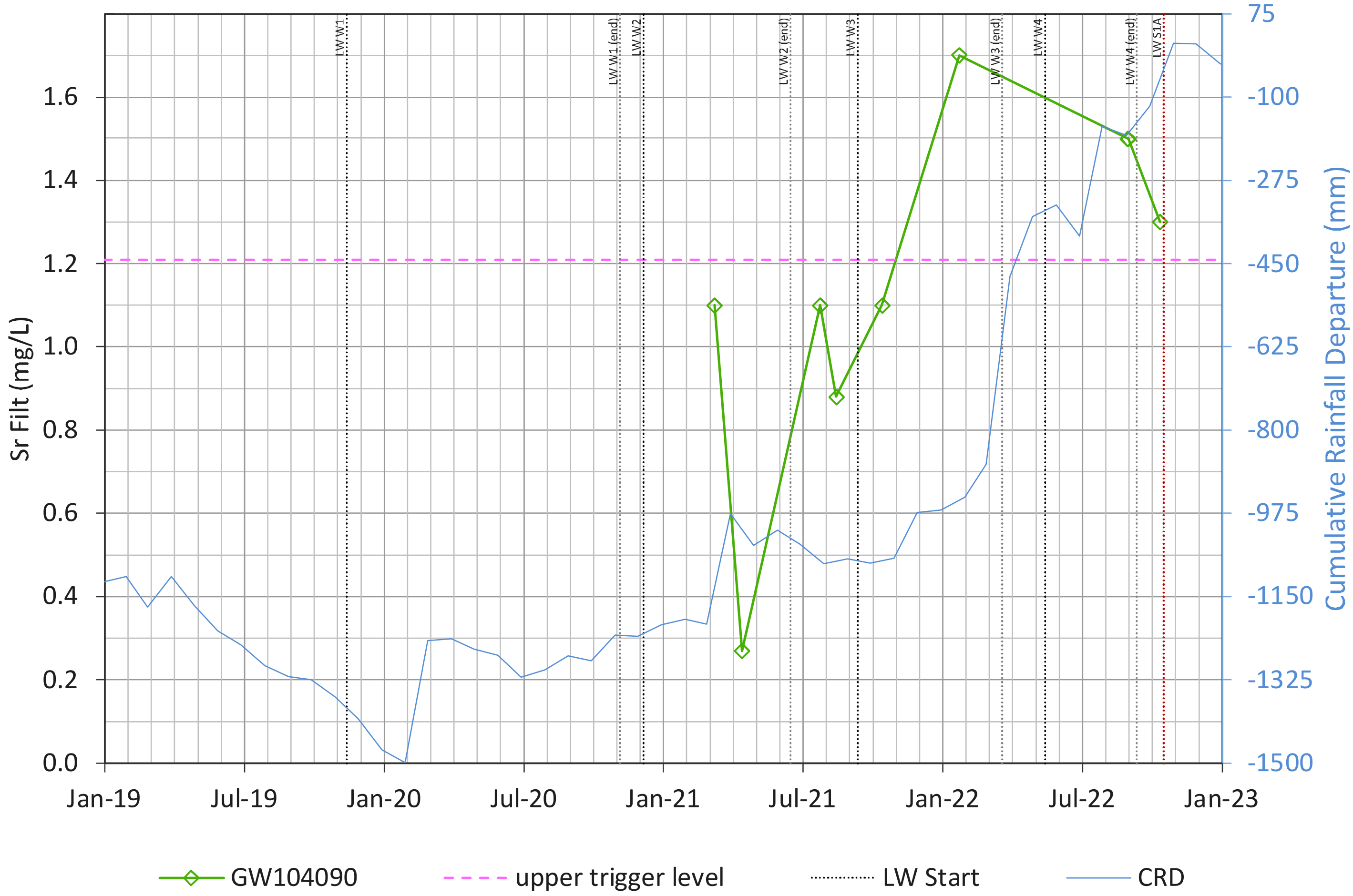


**Figure D21**

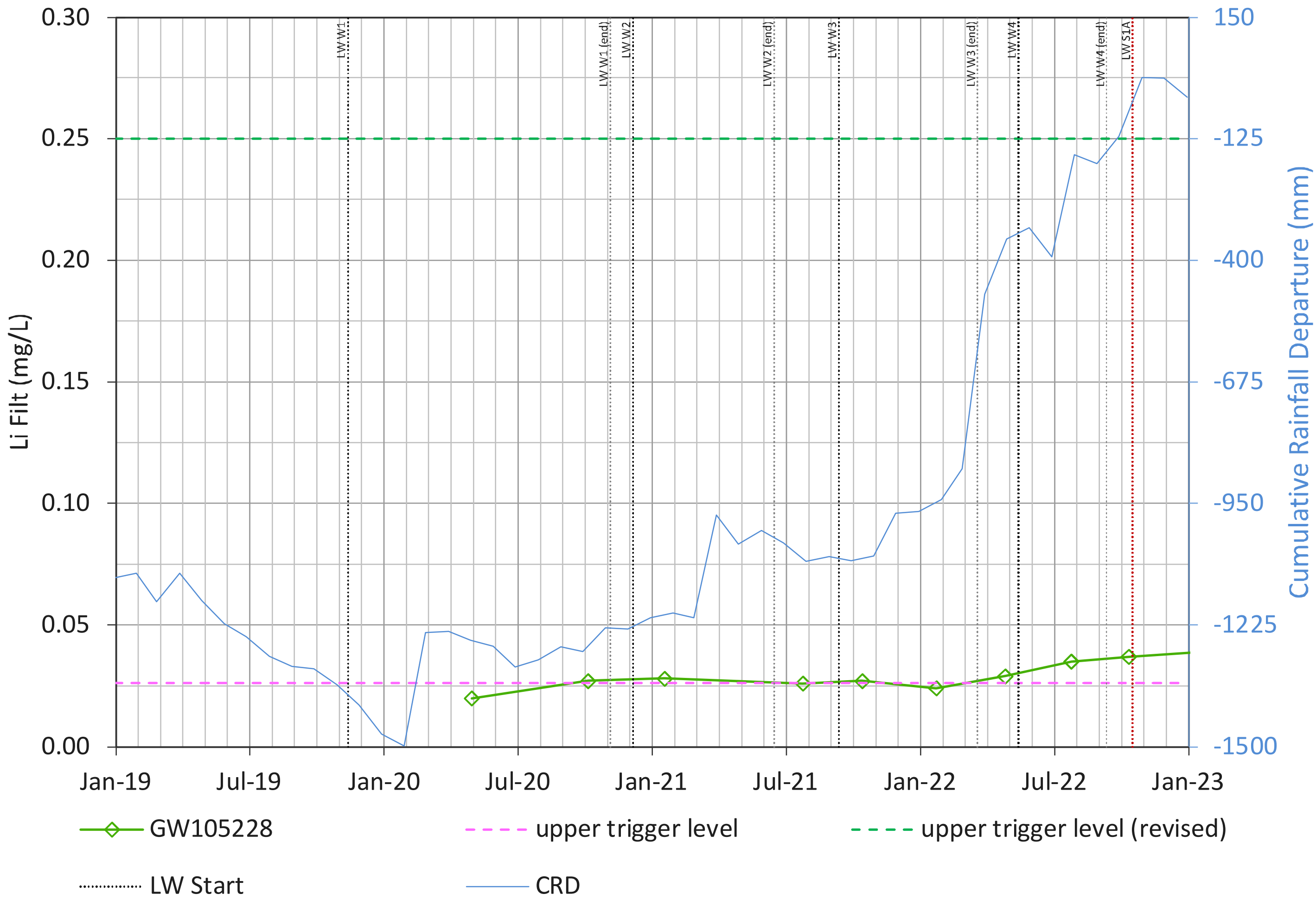


**Figure D22**

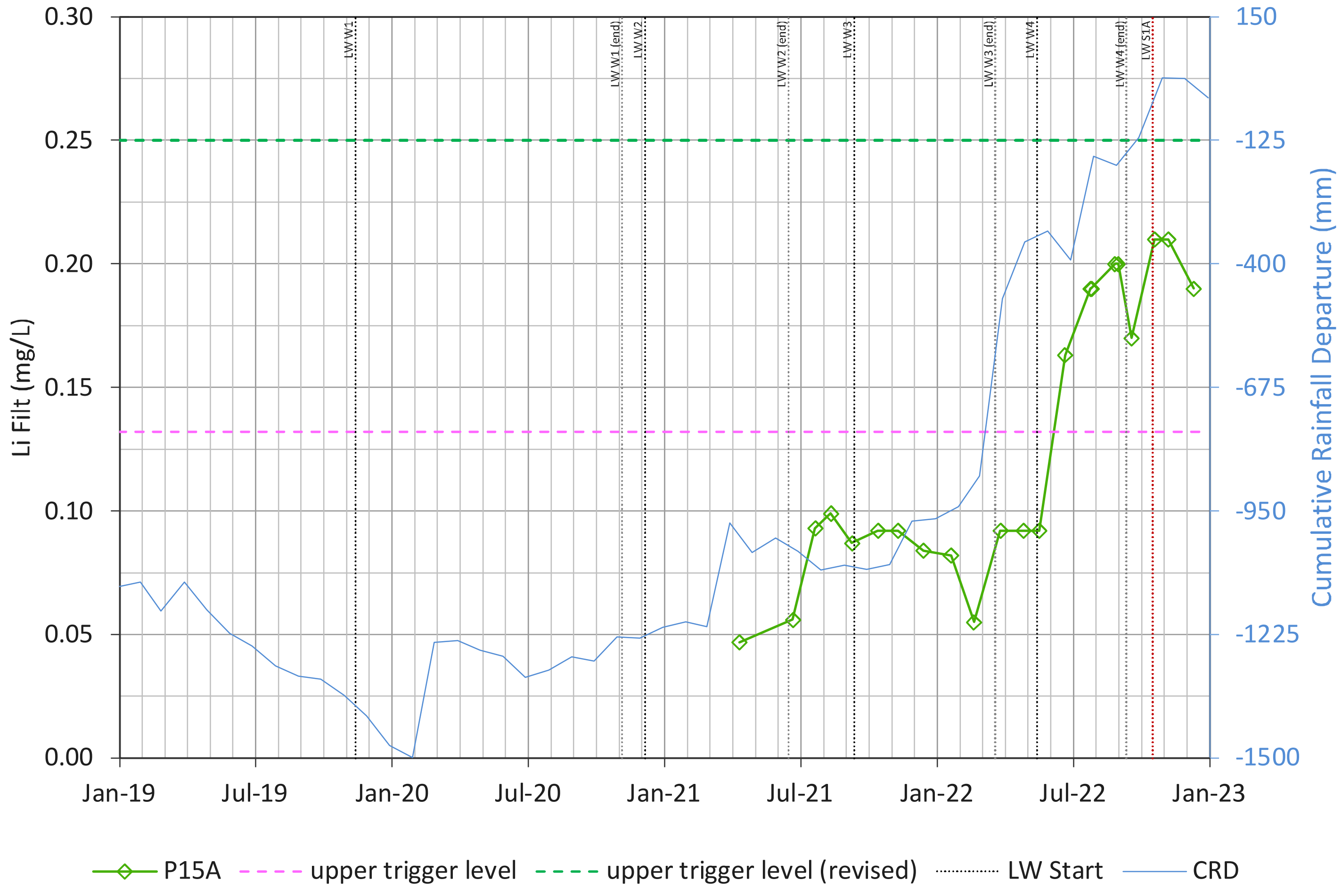


**Figure D23**

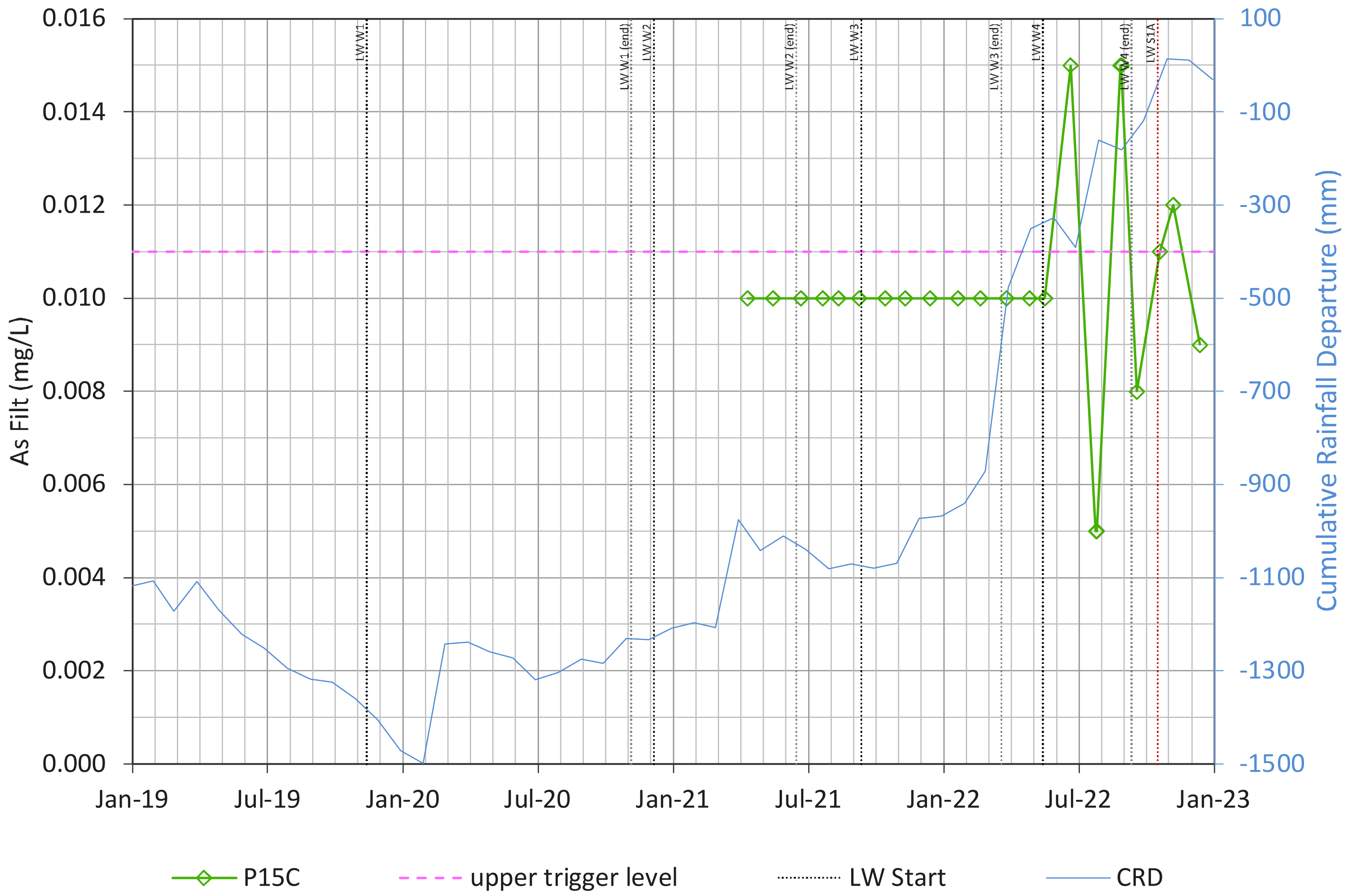


Figure D24

# Appendix E – Historical Heritage Monitoring Reports

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St Leonards NSW 1590

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7 April 2022

April Hudson
Approvals Specialist
Tahmoor Coal Pty Ltd
2975 Remembrance Driveway
Tahmoor NSW 2574

**Re: Historical heritage monitoring report: Tahmoor Mine Longwall West 3 (LW W3) End of Panel inspection**

Dear April,

# 1 Introduction

EMM Consulting Pty Limited (EMM) has been engaged by Tahmoor Coal Pty Ltd (Tahmoor Coal) to conduct monitoring of historical heritage sites associated with the underground coal mining of Longwall West 3 (LW W3) after completion of its panel extraction in the Tahmoor Mine Western Domain (Figure 1).

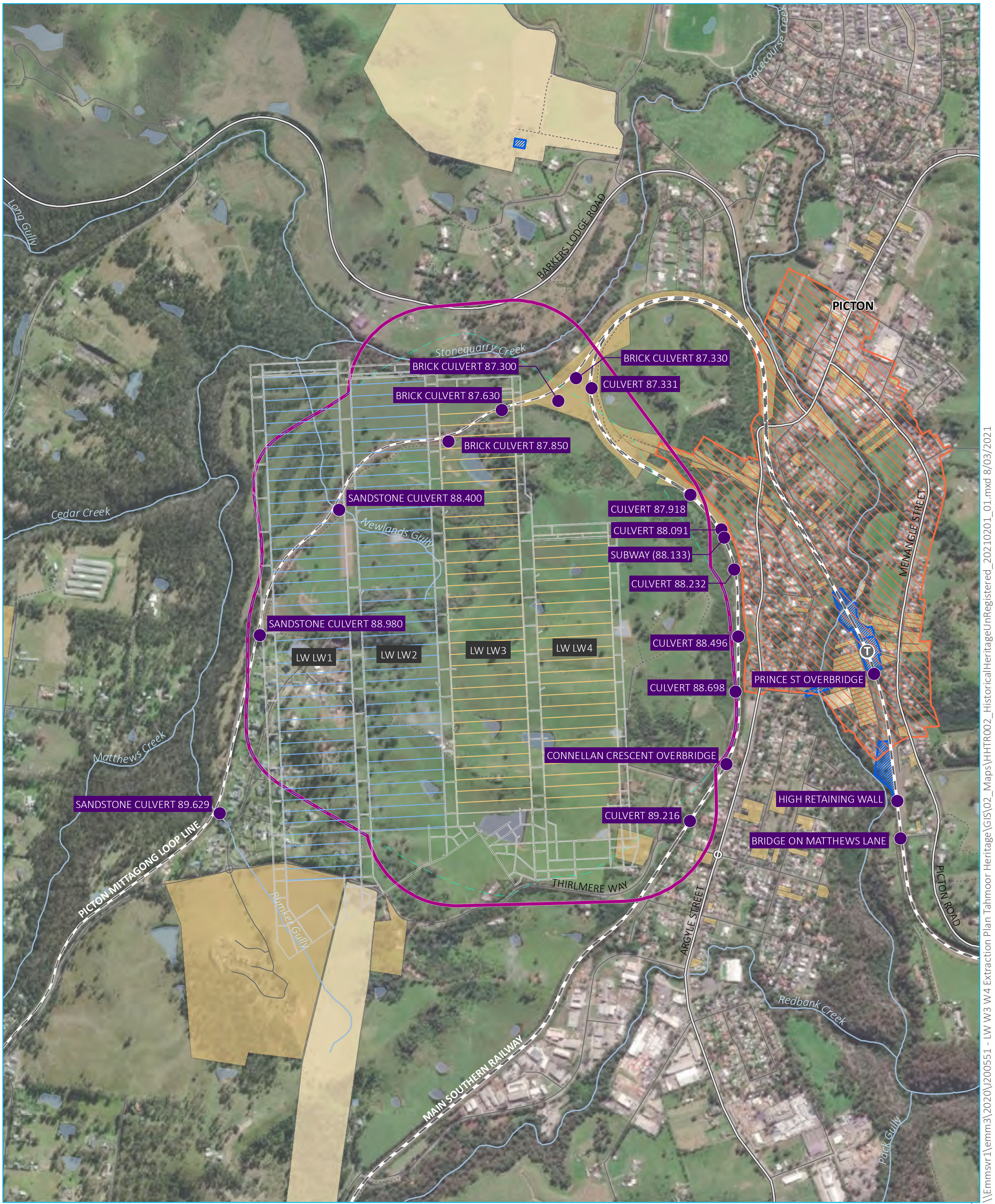
This letter report provides the results of the heritage monitoring fieldwork which took place on 5 April 2022.

# 2 Background and methods

Historical heritage sites associated with LW W3 – W4 are managed through the provisions of the *Tahmoor Mine Extraction Plan Longwall West 3 – West 4 Historical Heritage Technical Report* (HHTR) (EMM 2019), which informs the LW W3 – W4 Heritage Management Plan. The HHTR requires that historical brick and sandstone culverts within the Study Area (Figure 1) be subject to monitoring at the completion of each longwall.

The HHTR provides a subsidence monitoring program for historical heritage sites within the LW W3 – W4 project area (Figure 1). The project area is defined by calculating a 35-degree angle of draw from the extents of LW W3 – W4, and the predicted limit of vertical subsidence (20 mm subsidence contour) that may result from their extraction. The HHTR includes a Trigger Action Response Plan (TARP) which provides a description of performance indicators to be implemented to ensure compliance with negligible subsidence impacts or environmental consequences to sites of historical heritage. It sets out appropriate triggers (levels 1 – 3) to warn of increased risk of exceedance of any performance measures; specific actions to respond in the event of exceedance; and responses including remediation measures and/or adaptive management.

There are six culverts on the Picton Mittagong Loop Line (Loop Line) and two culverts on the Main Southern Railway (MSR) within the project area which require subsidence monitoring. The monitoring program for the eight culverts within the Study Area is provided in Table 1.




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

KEY

- Study area
- Predicted 20 mm subsidence contour
- Completed longwall
- Proposed longwall
- Mine plan

Historic heritage items

- State Heritage Act
- Conservation Area - General
- Item - General
- Item - Archaeological

- Heritage items - not listed
- Train station
- Rail line
- Major road
- Minor road
- Vehicular track
- Named watercourse
- Waterbody

## Historical heritage items (unregistered sites)

Tahmoor Mine Extraction Plan: Longwalls W3 - W4
Historical Heritage Technical Report
Figure 3.2

EMM
creating opportunities

**Table 2.1 Monitoring program for historical heritage LW W1**

| Item | Monitoring component | Monitoring | | |
|---|---|---|---|---|
| | | Prior to extraction | During extraction | Post mining |
| Loop Line sandstone culverts | Visual inspection.<br>Baseline recording:<br>• photographs.<br>Survey control points.<br>Structural assessment of culverts. | Baseline recording of the site before mining, noting any existing cracks or damage (completed).<br>Install a system, which will monitor ground movements on and around the culverts (completed).<br>Reinforcement (in place). | Monthly visual inspection by Tahmoor Coal during the period of active subsidence for each longwall. | Visual inspection conducted by a heritage specialist at the completion of each longwall. |
| Loop Line brick culverts | Visual inspection.<br>Baseline recording:<br>• photographs; and<br>Survey control points.<br>• Structural assessment of culverts, with particular attention given to 87.850 and 87.630. | Baseline recording of the site before mining, noting any existing cracks or damage (completed).<br>Install a monitoring system, which will monitor ground movements on and around the culverts (completed).<br>Reinforcement of culvert 87.630. | Monthly visual inspection by Tahmoor Coal during the period of active subsidence for each longwall. | Visual inspection conducted by a heritage specialist at the completion of each longwall. |
| Main Southern Railway culverts | Visual inspection.<br>Baseline recording:<br>• photographs; and<br>Survey control points.<br>Structural assessment of culverts. | Baseline recording of the site before mining, noting any existing cracks or damage.<br>Install a monitoring system, which will monitor ground movements on and around the culverts. | Monthly visual inspection by Tahmoor Coal during the period of active subsidence for each longwall. | Visual inspection conducted by a heritage specialist at the completion of each longwall. |

LW W3 commenced 13 September 2021 and finished on 21 March 2022. As indicated by Table 1.1, the culverts are continuously monitored, and monthly monitoring reports compiled by MSEC. Since LW W2 commenced extraction in December 2020, subsidence has gradually developed above the longwall panel and impacts have been observed at some of the culverts. This was documented in the Historical Heritage End of Panel Report for LW W2 (EMM 2021).

# 3 End of panel inspection, LW W3

On 5 April 2022, EMM archaeologist Pamela Chauvel together with Kevin Golledge (Tahmoor Mine) and Mark Ralph (Bloor Rail) completed an archaeological monitoring inspection for the required Loop Line and MSR culverts following the completion of extraction of LW LW3.

Monitoring results and photographs are included in Appendix A.

# 4 Conclusion and recommendations

The HHTR employs a Trigger Action Response Plan (TARP) to manage heritage impacts for the Extraction Plan project area for LW W1–W2. The TARP outlines the assigned level of risk for each performance indicator:

- Level 1: Normal;
- Level 2: Within Prediction; and

- Level 3: Exceeds Prediction.

The Heritage Management Plan specifies that the subsidence performance indicators for the culverts will be considered triggered if “subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, exfoliation, block movement or block fall.”

Where performance indicators indicate that a level of risk has been triggered (Levels 1 to 3 with escalating corresponding risk), a response, or a contingency plan that outlines the adaptive management measures for each level of risk, is required as outlined in the TARP provided in this section below.

**Table A.1 Trigger Action Response Plan**

| Feature | Management | | |
|---|---|---|---|
| | Trigger | Action | Response |
| Historical heritage | Level 1 | | |
| | • Historical heritage site monitoring indicates no detectable environmental consequences | • Continue monitoring as per monitoring program. | • No response required. |
| | Level 2 | | |
| | • Historical heritage site monitoring indicates potential detectable environmental consequences but with negligible impacts to heritage sites. | • Continue monitoring as per monitoring program. | • No response required |
| | Level 3 | | |
| | • Historical heritage site monitoring indicates environmental consequences to heritage site(s). | • Continue monitoring program as per monitoring program.<br>• Convene Tahmoor Coal Environmental Response Group to review response.<br>• Co-ordinate a site inspection with a structural engineer and qualified archaeologist or heritage architect.<br>• Investigate exceedance of subsidence prediction.<br>• Review mine design/predictions against mine criteria.<br>• Review monitoring program and modify if necessary. | • Notify DPIE and Heritage NSW within one week of awareness of the event.<br>• Investigate and implement any additional management measures as required in consultation with Heritage NSW and DPIE. |

Impacts from subsidence during extraction of the Western Domain to date have varied across the culverts. Subsidence monitoring first identified subsidence induced cracking and spalling to culverts 88.980 and 88.400 during extraction of LW W2. Throughout extraction of LW W3, monitoring has identified only minor changes and the culverts remain stable and serviceable. The following sections provide details of the end of panel heritage assessment of the culverts within the Study Area and a summary and photographs are included in Appendix A.

## 4.1 Loop Line Culvert 88.980

Culvert 88.980 was in poorer condition than the other sandstone culverts prior to the commencement of longwall mining in the Western Domain. Additional cracks through the mortar and sandstone capping as well as some minor spalling of the arch stones of the western portal developed during extraction of LW W2.

Structural engineer Mark Delaney (Newcastle GeoTech) inspected the culverts on 21 June 2021 and his report was reviewed by structural engineer John Matheson (JMA Solutions). JMA Solutions are satisfied that the impacts have not adversely affected the safety and serviceability of the culvert. The impacts developed gradually as mining occurred during LW W2 and have remained stable after the period of active subsidence.

Culvert 88.980 km was predicted to experience approximately 25 mm of additional vertical subsidence and 20 mm of valley closure due to the extraction of LW W3. No new impacts to culvert 88.980 have been observed during monitoring throughout the extraction of LW W3. The end of panel heritage inspection identified that the eastern (downside) portal is generally in good condition. The western portal, apart from minor flaking, has not developed additional cracking, or worsening of existing cracks or spalling.

Level 3 of the TARP was triggered during the extraction of LW W2 and remains at Level 3. While the culvert is currently stable, remediation will be required following the conclusion of subsidence. At this time the RCP sleeve will be removed from the culvert, the barrel will be inspected in detail and Tahmoor will seek further expert advice from a heritage stonemason regarding remediation of the sandstone. Repairs will be undertaken after the full effects of LW W3 – W4 have been completed. To do so earlier may cause greater damage at the new filled joint and then be even harder to repair. The culvert will continue to be monitored and managed in accordance with the HHTR.

The culvert is predicted to experience negligible additional subsidence due to the extraction of LW W4.

## 4.2 Loop Line Culvert 88.400

To date, culvert 88.400 has experienced the greatest impacts of the Loop Line culverts within the Study Area. An 8 mm wide crack in the vertical mortar joint and cracked sandstone capping on the downside abutment (eastern side of culvert), as well as a 7 mm wide crack in a mortar joint around the arch stones at the upside (western side of culvert) as well as minor spalling of sandstone on the arch stones were observed during extraction of LW W2. These impacts are a result of the lime grout becoming so strong over time that the weaker sandstone blocks sheer just below the grout bedding plain when under strain.

Structural engineer Mark Delaney (Newcastle GeoTech) inspected the culverts on 21 June 2021 and his report was reviewed by structural engineer John Matheson (JMA Solutions). JMA Solutions are satisfied that the impacts have not adversely affected the safety and serviceability of the culvert. The impacts developed gradually as mining occurred during LW W2 and have remained stable after the period of active subsidence

Culvert 88.400 was predicted to experience approximately 75 mm of additional vertical subsidence and 25 mm of valley closure due to the extraction of LW W3. No new impacts to culvert 88.980 were observed during monitoring throughout the extraction of LW W3. The end of panel heritage inspection did not identify any additional cracking or worsening of existing cracks or spalling, apart from cracking mostly along the mortar as a result of a screw on the left side of the eastern portal installed to attach the concrete sleeve to the culvert.

Level 3 of the TARP was triggered during the extraction of LW W2 and remains at Level 3. While the culvert is currently stable, remediation will be required following the conclusion of subsidence. At this time the RCP sleeve will be removed from the culvert, the barrel will be inspected in detail and Tahmoor will seek further expert advice from a heritage stonemason regarding remediation of the sandstone. Repairs will be undertaken after the full effects of LW W3 – W4 have been completed. To do so earlier may cause greater damage at the new filled joint and then be even harder to repair. The culvert will continue to be monitored and managed in accordance with the HHTR.

The culvert is predicted to experience negligible additional subsidence due to the extraction of LW W4.

## 4.3 Loop Line Culvert 87.850

Brick culvert 87.850 has significant cracking across and between the bricks that was identified during pre-extraction inspections. Cracking around the arch is causing the course of bricks to displace. These existing cracks on both sides of the culvert have not increased during extraction of LW W3.

This is considered to be level 1 of the TARP and the culvert will continue to be monitored and managed in accordance with the HHTR.

## 4.4 Loop Line Culvert 87.630

No subsidence impacts were observed at this small brick culvert.

Inspection of the culvert was impeded by weed growth but a review of Mark Delaney's (Engineering Geologist) report assessing the culverts' conditions on 3 February 2022 indicates that the western (upside) portal is in good condition with no evidence of cracking or deformation.

This is considered to be level 1 of the TARP and the culvert will continue to be monitored and managed in accordance with the HHTR.

## 4.5 Loop Line Culvert 87.330

Only the east side of this culvert was accessible and inspected during the heritage assessment. No subsidence impacts were observed.

A review of Mark Delaney's (Engineering Geologist) report assessing the culverts' conditions on 3 February 2022 confirms that the western (upside) portal is also in good condition with no evidence of cracking or deformation.

This is considered to be level 1 of the TARP and the culvert will continue to be monitored and managed in accordance with the HHTR.

## 4.6 Loop Line Culvert 87.300

Only the north side of this brick culvert beneath the old rail alignment embankment was able to be accessed. However, it was inaccessible due to the water level and extent to which it was overgrown with invasive weeds. It is recommended that the weeds and are cleared from around the culvert.

The northern portal has extensive cracking on the headwall. However, baseline photographs taken prior to the commencement of longwall mining in the Western Domain confirmed that the cracking was pre-existing and has nor worsened during LW W3.

A review of Mark Delaney's (Engineering Geologist) report assessing the culverts' conditions on 3 February 2022 confirms that the southern (downside) portal also contains pre-existing cracking and outward rotation of the headwall which has not worsened during extraction of LW W3.

This is considered to be level 1 of the TARP and the culvert will continue to be monitored and managed in accordance with the HHTR.

## 4.7 MSR Culvert 87.331

Only the west side of this culvert was inspected due to works on the Picton Tunnel preventing access to the east side of the culvert. The west side of the culvert is very overgrown and the high water level meant that it could not be inspected closely. It appears to be in sound condition.

This is considered to be level 1 of the TARP and the culvert will continue to be monitored and managed in accordance with the HHTR.

## 4.8 MSR Culvert 89.216

This culvert has minor cracking and weathering throughout but is in sound condition. Cracking is generally confined to the mortar between the bricks and continues along the centre of the culvert's roof.

This is considered to be level 1 of the TARP and the culvert will continue to be monitored and managed in accordance with the HHTR.

# 5 Closing

The results of the heritage monitoring inspection following the completion of LW W3 has identified only minor changes to pre-existing cracks in the culverts. The culverts remain stable and serviceable. Loop Line culverts 88.980 and 88.400 remain at level 3 in the TARP and will be remediated once underground mining in the Western Domain is concluded. The four other Loop Line culverts and two MSR culverts in the LW W3 – W4 Study Area are considered to be level 1 in the TARP, and as such no additional management strategies are required.

Should you have any questions or concerns please do not hesitate to contact me.

Yours sincerely

**Pamela Chauvel**
Senior Archaeologist

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Appendix A

# Inspection summary and photographs

## A.1 Monitoring results summary

| Site Name | Loop Line Culvert 88.980 |
|---|---|
| Heritage listing | Not listed |
| Site type | Built structure |
| Location | 700 m west of LW W3 |
| Predicted probability of impact during LW W3 – 4 | Unlikely |
| Item summary | Dressed sandstone block arch culvert.<br>Culvert 88.980 was in poorer condition than the other sandstone culverts prior to the commencement of longwall mining in the Western Domain due to previous attempts at restoration including the application of paint which has resulted in increased exfoliation and erosion of the sandstone. In addition, JMA Solutions (2019) noted the severe loss of wall thickness in some blocks along the roof of the culvert, most likely caused by salt-laden groundwater permeating through the barrel of the barrel of the culvert. This has resulted in expansive salt crystallisation on the surface stone and subsequent exfoliation. |
| Monitoring comments | On 25 February 2021, minor change in the cracking was first noted around the western (upside) portal headwall. Monitoring by Mark Delaney (Engineering Geologist) in May 2021 concluded that the cracks were minor and do not appear to affect the structural integrity of the culvert, while very minor hairline mortar cracks had developed on the downside inlet headwall (MSEC monitoring report 1150-25).<br>Inspection confirmed the presence of a vertical crack through the mortar that continued as a crack through the sandstone capping on the north side of the eastern (downside) portal. Cracking on the western (upside) side of the culvert follows the top of the arch stones (voussoirs), primarily through the mortar, with some associated spalling of the stones. This does not appear to have worsened during extraction of LW W3.<br>The inside of the culvert could not be inspected due to the RCP sleeve. |
| Representative photographs | <br>Western portal. Cracking around arch stones that was first noted during extraction of LW W2 has not worsened during LW W3. |

Western portal. Cracking along the mortar and spalling of the arch stones has not worsened significantly during extraction of LW W3.

Eastern portal, generally in good condition.

| Site Name | Loop Line Culvert 88.400 |
|---|---|
| **Heritage listing** | Not listed |
| **Site type** | Built structure |
| **Location** | 380 m west of LW W3 |
| **Predicted probability of impact during LW W3 – 4** | Possible |
| **Item summary** | Dressed sandstone block arch culvert.<br>This culvert was predicted by MSEC to be at possible risk of subsidence impacts. Integrity of the structure and condition of the sandstone is good. Weeds that impeded initial inspection have subsequently been removed.<br>To alleviate downward pressure on the culvert, a vehicle track no longer runs over the top of the culvert but alongside it. |
| **Monitoring comments** | This culvert has experienced the severest impacts from subsidence. A vertical crack along a mortar joint on the eastern (downside) wall was first observed on 1 February 2021 (during extraction of LW W2), and the following month a crack on the western (upside) wall was noted along with minor spalling of the sandstone blocks in the arch above the portal. The monitoring report concluded that the cracks were minor and do not appear to affect the structural integrity of the culvert (MSEC monitoring report 1150-25).<br>Inspection confirmed that the cracking and spalling that developed during LW W2 has not worsened significantly during LW W3.<br>The inside of the culvert could not be inspected due to the RCP sleeve. |
| **Representative photographs** | <br>Western portal. Spalling above the arch that developed during extraction of LW W2 has not worsened significantly during LW W3. |

Eastern portal. No worsening of cracking during extraction of LW W3.

Eastern portal. Screw securing concrete sleeve to the arch of the culvert has resulted in some cracking along the mortar and through the sandstone.

| Site Name | Loop Line culvert 87.850 |
|---|---|
| Heritage listing | Not listed |
| Site type | Built structure |
| Location | Above LW W3 |
| Predicted probability of impact during LW W3 – 4 | Possible |
| Item summary | Brick arch culvert<br>When it was initially inspected, this culvert was overgrown with brambles and difficult to assess. Multiple existing cracks were observed during subsequent inspections and supported by photographs. |
| Monitoring comments | Cracking across and between the bricks is consistent with previous photographs taken during monitoring of the culvert. An inspection by Mark Delaney (engineering geologist) on 3 February 2022 confirmed that the pre-existing cracks on both sides of the culvert have not increased during extraction of LW W3. No changes were noted during the heritage inspection.<br>The inside of the culvert could not be inspected due to the RCP sleeve. |
| Representative photographs | <br>Eastern portal |

Detail, pre-existing cracking and displacement of bricks around the eastern portal arch that does not appear to have worsened significantly during longwall mining in the Western Domain.

Cracking and displacement of bricks around the western portal arch. Does not appear to have worsened during longwall mining in the Western Domain.

| Site Name | Loop Line culvert 87.630 |
|---|---|
| **Heritage listing** | Not listed |
| **Site type** | Built structure |
| **Location** | Above LW W3 |
| **Predicted probability of impact during LW W3 – 4** | Possible |
| **Item summary** | Brick arch culvert<br>Concrete skin on base and rubble at the mouth. Mortar is tuck pointed. Headwall and abutment are in good condition. Recent embankment to the south-east means water is largely diverted away from the culvert. |
| **Monitoring comments** | There are no existing cracks, and no subsidence impacts were observed. Inspection of the eastern portal was impeded by weed growth but a review of Mark Delaney's (Engineering Geologist) report assessing the culverts' conditions on 3 February 2022 confirms that no change or cracking has occurred during LW W3 in the headwalls or within the barrel. |
| **Representative photographs** | <br>Western portal. In sound condition |

Eastern portal. Overgrown but appears to be in sound condition.

| Site Name | Loop Line culvert 87.330 |
| --- | --- |
| Heritage listing | Not listed |
| Site type | Built structure |
| Location | 240 m east of LW W3 |
| Predicted probability of impact during LW W3 – 4 | Unlikely |
| Item summary | Brick arch culvert with drainage channels of rendered brick on either side of the embankments to funnel water into the culvert. Cracking is along the mortar only and the condition of the bricks is good. |
| Monitoring comments | Only the eastern portal was accessible and inspected. It is in sound condition with only minor, pre-existing cracking. Bricks at the base of the chute to the south of the culvert inlet have been displaced and the area has been subject to some erosion.<br>A review of Mark Delaney's (Engineering Geologist) report assessing the culverts' conditions on 3 February 2022 indicates that the western (upside) portal is in good condition with no evidence of cracking or deformation. |
| Representative photographs | <br><br>Eastern (downside) portal. In sound condition |

Displaced bricks at the base of the brick chute to the south of the eastern portal.

| Site Name | Old formation, culvert 87.300 |
|---|---|
| **Heritage listing** | Not listed |
| **Site type** | Built structure |
| **Location** | 160 m east of LW W3. |
| **Predicted probability of impact during LW W3 – 4** | Unlikely |
| **Item summary** | Brick arch culvert located beneath the disused embankment for the original railway alignment. Bricks cracked at northern headwall. |
| **Monitoring comments** | Only the northern (upside) portal was accessible and inspected.<br>Results of the monitoring inspection were cross referenced with baseline photographs taken prior to the commencement of longwall mining in the Western Domain which confirmed that the cracking around the northern portal was pre-existing and has nor worsened during LW W3.<br>A review of Mark Delaney's (Engineering Geologist) report assessing the culverts' conditions on 3 February 2022 indicates that there have been no changes to the pre-existing cracking and outward rotation of the headwall to the southern (downside) portal. |
| **Representative photographs** | <br>Northern portal. Difficult to access due to water and weeds. Pre-existing cracking around the arch, mostly through mortar. |

| Site Name | MSR culvert 87.331 |
|---|---|
| Heritage listing | Not listed |
| Site type | Built structure |
| Location | 280 m east of LW W3. |
| Predicted probability of impact during LW W3 – 4 | Unlikely |
| Item summary | Brick arch culvert<br>The brick and concrete culvert is in good condition. There is a minor amount of vegetation growth; however, this does not appear to have impacted the feature. |
| Monitoring comments | Only the western portal was inspected and only from a distance due to water and vegetation. The culvert appears to be in sound condition. |
| Representative photographs | <br>Western portal. In sound condition. |

| Site Name | MSR culvert 89.216 |
|---|---|
| Heritage listing | Not listed |
| Site type | Built structure |
| Location | 590 m east of LW W3. |
| Predicted probability of impact during LW W3 – 4 | Very unlikely |
| Item summary | Brick arch culvert.<br>The brick culvert is in good condition despite a moderate amount of graffiti. |
| Monitoring comments | The culvert is in good condition and the cracks observed above the western portal arch were checked against the baseline photographs taken prior to longwall mining in the Western Domain and identified as pre-existing. The crack along the centre of the culvert roof may have worsened slightly. |
| Representative photographs | <br>Eastern portal. Culvert is in good condition. |

Roof of culvert. View west

Western portal. Cracking through the mortar above the arch continues along the roof of the culvert.

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30 November 2022

April Hudson
Approvals Specialist
Tahmoor Coal Pty Ltd
2975 Remembrance Driveway
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**Re: Historical heritage monitoring report: Tahmoh Mine Longwall West 4 (LW W4) End of Panel inspection - Railway Culverts**

Dear April,

# 1 Introduction

EMM Consulting Pty Limited (EMM) has been engaged by Tahmoor Coal Pty Ltd (Tahmoor Coal) to conduct monitoring of historical heritage sites associated with the underground coal mining of Longwall West 4 (LW W4) after completion of its panel extraction in the Tahmoor Mine Western Domain (Figure 1). LW W4 commenced on 16 May 2022 and was completed on 13 September 2022. With the completion of LW W4, Western Domain extraction is finished, and therefore no further subsidence effect is anticipated.

As indicated by Table 1.1, culverts on the Picton Mittagong Loop Line (Loop Line) and Main Southern Railway (MSR) were inspected monthly and monthly monitoring reports were compiled by MSEC. Since LW W3 commenced extraction in September 2021, subsidence has gradually developed above the longwall panel and impacts have been observed at some of the culverts. This was documented in the Historical Heritage End of Panel Report for LW W3 (EMM, April 2022).

This letter report provides the results of the heritage monitoring fieldwork which took place on 11 November 2022 after the completion of all extraction in the Western Domain. In addition, this inspection allowed for unfettered access to the whole of the culvert structure following the removal of RCP sleeves from the culvert barrels.

# 2 Background and methods

Historical heritage sites associated with LW W3–W4 are managed through the provisions of the *Tahmoor Mine Extraction Plan Longwall West 3 – West 4 Historical Heritage Technical Report* (HHTR) (EMM 2019), which informs the LW W3–W4 Heritage Management Plan. The HHTR requires that historical brick and sandstone culverts within the Study Area (Figure 1) be subject to monitoring at the completion of each longwall.

The HHTR was also supported by the Picton Mittagong Loop Line Management Plan, which was the mechanism for the monitoring of the Loop Line assets under the Transport for NSW Deed of Agreement with Tahmoor Coal.

The HHTR provides a subsidence monitoring program for historical heritage sites within the LW W3–W4 project area (Figure 1). The project area is defined by calculating a 35-degree angle of draw from the extents of LW W3–W4, and the predicted limit of vertical subsidence (20 mm subsidence contour) that may result from their extraction. The HHTR includes a Trigger Action Response Plan (TARP) which provides a description of performance indicators to be implemented to ensure compliance with negligible subsidence impacts or environmental consequences to sites of historical heritage. It sets out appropriate triggers (levels 1 – 3) to warn of increased risk of exceedance of any performance measures; specific actions to respond in the event of exceedance; and responses including remediation measures and/or adaptive management.

There are six culverts on the Loop Line and two culverts on the MSR within the project area which require subsidence monitoring. The monitoring program for the eight culverts within the Study Area is provided in Table 1.

In addition to this monitoring program under the HHTR, a baseline dilapidation report was completed prior to mining under the Picton Mittagong Loop Line Management Plan.

**Table 2.1 Monitoring program for historical heritage LW W1**

| Item | Monitoring component | Monitoring | | |
|---|---|---|---|---|
| | | **Prior to extraction** | **During extraction** | **Post mining** |
| Loop Line sandstone culverts | Visual inspection.<br>Baseline recording:<br>• photographs.<br>• Survey control points.<br>• Structural assessment of culverts. | Baseline recording of the site before mining, noting any existing cracks or damage (completed).<br>Install a system, which will monitor ground movements on and around the culverts (completed).<br>Reinforcement (in place). | Monthly visual inspection by Tahmoor Coal during the period of active subsidence for each longwall. | Visual inspection conducted by a heritage specialist at the completion of each longwall. |
| Loop Line brick culverts | Visual inspection.<br>Baseline recording:<br>• Photographs.<br>• Survey control points.<br>• Structural assessment of culverts, with particular attention given to 87.850 and 87.630. | Baseline recording of the site before mining, noting any existing cracks or damage (completed).<br>Install a monitoring system, which will monitor ground movements on and around the culverts (completed).<br>Reinforcement of culvert 87.630. | Monthly visual inspection by Tahmoor Coal during the period of active subsidence for each longwall. | Visual inspection conducted by a heritage specialist at the completion of each longwall. |
| Main Southern Railway culverts | Visual inspection.<br>Baseline recording:<br>• Photographs.<br>• Survey control points.<br>• Structural assessment of culverts. | Baseline recording of the site before mining, noting any existing cracks or damage.<br>Install a monitoring system, which will monitor ground movements on and around the culverts. | Monthly visual inspection by Tahmoor Coal during the period of active subsidence for each longwall. | Visual inspection conducted by a heritage specialist at the completion of each longwall. |

# 3 End of panel inspection, LW W4

On 11 November 2022, EMM heritage consultant and architectural graduate Anthony Dakhoul together with Kevin Golledge (Tahmoor Coal) completed an archaeological monitoring inspection for the required Loop Line and MSR culverts following the completion of extraction of LW W4.

The previous end of panel inspection for LW W3 was not able to include an inspection of the barrel of the culverts due to the presence of RCP sleeves inserted into the culvert cavities. These concrete pipes were removed for the LW W4 inspection allowing for a more comprehensive fabric analysis. Monitoring results and photographs are included in Appendix A.

# 4 Conclusion and recommendations

The HHTR employs a TARP to manage heritage impacts for the Extraction Plan project area for LW W3–W4. The TARP outlines the assigned level of risk for each performance indicator:

- Level 1: Normal;
- Level 2: Within Prediction; and
- Level 3: Exceeds Prediction.

The Heritage Management Plan specifies that the subsidence performance indicators for the culverts will be considered triggered if "subsidence monitoring identifies visible perceptible impacts such as subsidence induced cracking, exfoliation, block movement or block fall."

Where performance indicators indicate that a level of risk has been triggered (Levels 1 to 3 with escalating corresponding risk), a response, or a contingency plan that outlines the adaptive management measures for each level of risk, is required as outlined in the TARP provided in this section below.

### Table A.1 Trigger Action Response Plan

| Feature | Management | | |
|---|---|---|---|
| | Trigger | Action | Response |
| Historical heritage | Level 1 | | |
| | • Historical heritage site monitoring indicates no detectable environmental consequences | • Continue monitoring as per monitoring program. | • No response required. |
| | Level 2 | | |
| | • Historical heritage site monitoring indicates potential detectable environmental consequences but with negligible impacts to heritage sites. | • Continue monitoring as per monitoring program. | • No response required |
| | Level 3 | | |
| | • Historical heritage site monitoring indicates environmental consequences to heritage site(s). | • Continue monitoring program as per monitoring program.<br>• Convene Tahmoor Coal Environmental Response Group to review response.<br>• Co-ordinate a site inspection with a structural engineer and qualified archaeologist or heritage architect.<br>• Investigate exceedance of subsidence prediction.<br>• Review mine design/predictions against mine criteria.<br>• Review monitoring program and modify if necessary. | • Notify DPIE and Heritage NSW within one week of awareness of the event.<br>• Investigate and implement any additional management measures as required in consultation with Heritage NSW and DPIE. |

The following sections provide details of the end of panel heritage assessment of the culverts within the Study Area and a summary and photographs are included in Appendix A.

## 4.1 Loop Line Culvert 88.980

Culvert 88.980 was in poorer condition than the other sandstone culverts prior to the commencement of longwall mining in the Western Domain. Additional cracks through the mortar and sandstone capping as well as some minor spalling of the arch stones of the western portal developed during extraction of LW W2.

Mark Delaney (Newcastle GeoTech) completed an asset inspection of the culverts on 11 October 2022 and his report was reviewed by structural engineer John Matheson (JMA Solutions). JMA Solutions are satisfied that there has been no impact from mine subsidence to the safety and serviceability of the embankment and sandstone block arch culvert observed during LW W1 to LW W4 extraction. Impacts developed gradually as mining occurred during LW W2 and have remained safe and serviceable after the period of active subsidence for this longwall.

No new impacts to culvert 88.980 have been observed during monitoring throughout the extraction of LW W4. The end of panel heritage inspection identified that the eastern (downside) portal is generally in good condition. The western portal, apart from minor flaking, has not developed additional cracking, or worsening of existing cracks or spalling (Appendix A - Photo 88.980-2). All existing cracking observed during LW W2 and LW W3 have been noted by Newcastle Geotech as exhibiting no change, remain largely minor in nature and continue to have no impact on the overall structural integrity of the culvert of to the safety of the track or train operations.

The RCP sleeve within the culvert has been removed and inspected in detail by EMM (refer to Appendix A) noting that the overall structure to culvert 88.980 was in a stable condition, substantiating the above assessments. An inspection of the culvert barrel noted that sandstone surfaces were broadly experiencing significant surface erosion, particularly to the upper sections of the barrel (Appendix A - Photo 88.980-3). This erosion was noted during the pre-mining inspection, and therefore is not likely to be attributed to mining and is likely due to the broad permeation of salt-laden groundwater (Refer to Appendix A.1 and included pre-mining inspection photographs).

As mining in the Western Domain has been completed, repairs of the sandstone arch stones on the western portal can now be undertaken. These repairs should be completed in accordance with the Transport for NSW Heritage Structures Repair Standard.

## 4.2 Loop Line Culvert 88.400

To date, culvert 88.400 has experienced the greatest impacts of the Loop Line culverts within the Study Area. An 8 mm wide crack in the vertical mortar joint and cracked sandstone capping on the downside abutment (eastern side of culvert), as well as a 7 mm wide crack in a mortar joint around the arch stones at the upside (western side of culvert) as well as minor spalling of sandstone on the arch stones were observed during extraction of LW W2. These impacts are a result of the lime grout becoming so strong over time that the weaker sandstone blocks sheer just below the grout bedding plain when under strain.

Mark Delaney (Newcastle GeoTech) completed an asset inspection of the culverts on 21 June 2021 and his report was reviewed by structural engineer John Matheson (JMA Solutions). It was noted that both the upside and downside cracks observed increased slightly between LW W2 and LW W3 (approx. 3-4mm) in width. During LW W4, Mark Delaney inspected the culvert on 11 October 2022 and noted that the aforementioned cracking had not changed in width.

JMA Solutions are satisfied that the impacts have not adversely affected the safety and serviceability of the culvert as cracks remain minor and do would not impact the structure integrity of the culvert. The impacts developed gradually as mining occurred during LW W2 and LW W3 and have generally remained safe and serviceable after the period of active subsidence.

The RCP sleeve within the culvert has been removed and inspected in detail by EMM (refer to Appendix A) noting that the overall structure to culvert 88.400 was in a stable condition, substantiating the above assessments. Several identified cracks that have formed since the commencement of mining in the Western Domain were identified within the culvert barrel described in Appendix A. The inspection found that the cracks are in isolated locations, move through and impact both mortar and blockwork (fractures), and vary from being moderate to significant in size.

The above noted cracks were not identified during the baseline survey by a heritage consultant due to excessive overgrown vegetation obscuring view of the full extent the culvert. An inspection of the culvert was however conducted in July 2019 by Robinson Rail prior to the introduction of the RCP sleeves and prior to the commencement of extraction in the Western Domain. Inspection findings were detailed in the dilapidation report (Robinson Rail, August 2019, pg. 21-23), noting that the culvert was in good condition. No reference was made in the report to the cracks identified during the post-mining inspection as discussed above. It is therefore likely that these cracks were formed during the extraction of longwalls in the Western Domain.

As mining in the Western Domain has been completed, repairs can now be undertaken on the arch stones on the eastern and western sides of the culvert as well as any additional cracks identified in the culvert barrel that have formed during mining.  These repairs should be completed in accordance with the Transport for NSW Heritage Structures Repair Standard.

## 4.3 Loop Line Culvert 87.850

Brick culvert 87.850 has significant cracking across and between the bricks that was identified during pre-extraction inspections. Cracking around the arch is causing the course of bricks to displace. During LW W4, Mark Delaney inspected the culvert on 11 October 2022 and noted that these existing cracks on both sides of the culvert have not increased during extraction of LW W4. As no mining-related impacts to this culvert have been noted, no remedial works are required.

## 4.4 Loop Line Culvert 87.630

Inspection of the culvert was impeded by weed growth but a review of Mark Delaney's (Engineering Geologist) report assessing the culverts' conditions on 11 October 2022 indicates that the western (upside) portal is in good condition with no evidence of cracking or deformation that occurred during LW W4. As no mining-related impacts to this culvert have been noted, no remedial works are required.

## 4.5 Loop Line Culvert 87.330

A review of Mark Delaney's (Engineering Geologist) report assessing the culverts' conditions on 11 October 2022 confirms that the western (upside) portal is also in good condition with no evidence of cracking nor deformation to the upside or downside headwalls or within barrel. As no mining-related impacts to this culvert have been noted, no remedial works are required.

## 4.6 Loop Line Culvert 87.300

A review of Mark Delaney's (Engineering Geologist) report assessing the culverts' conditions on 11 October 2022 confirms that the southern (downside) portal contains pre-existing cracking and outward rotation of the headwall which has not worsened during extraction of LW W4. It is recommended that Tahmoor Coal advises the infrastructure owner  of the condition of this culvert.

## 4.7 MSR Culvert 87.331

Only the west side of this culvert was inspected due to works on the Picton Tunnel preventing access to the east side of the culvert. The west side of the culvert is very overgrown and the high water level meant that it could not be inspected closely. It appears to be in sound condition after LW W4. As no mining-related impacts to this culvert have been noted, no remedial works are required.

## 4.8 MSR Culvert 89.216

This culvert has minor cracking and weathering throughout but is in sound condition. Cracking is generally confined to the mortar between the bricks and continues along the centre of the culvert's roof. As no mining-related impacts to this culvert have been noted, no remedial works are required.

# 5 Closing

Impacts from subsidence during extraction of the Western Domain to date have varied across the culverts. Subsidence monitoring first identified cracking and spalling to culverts 88.980 and 88.400 during extraction of LW W2 with only minor changes identified during the subsidence monitoring for LW W3. Throughout extraction of LW W4, recent monitoring observed negligible additional cracking on the portal faces and the culverts remained safe and serviceable.

Following the removal of the RCP sleeves from the barrel of the culverts, additional cracking in culvert 88.400 was observed in comparison to pre-mining inspections.

Loop Line culverts 88.980 and 88.400 remain at level 3 in the Heritage TARP and mining-related impacts will be remediated now that underground mining in the Western Domain has been concluded. All remaining culverts on the Loop Line and MSR in the LW W3–W4 Study Area are considered to be level 1 in the TARP, and as such, no remedial works are required.

Should you have any questions or concerns please do not hesitate to contact me.

Yours sincerely

**Anthony Dakhoul**
Heritage Consultant/Architectural Graduate

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Appendix A

# Inspection summary and photographs

## A.1 Monitoring results summary

| Site Name | Loop Line Culvert 88.980 |
| --- | --- |
| Heritage listing | Not listed |
| Site type | Built structure |
| Location | 700 m west of LW W3 |
| Predicted probability of impact during LW W3 – 4 | Unlikely |
| Item summary | Dressed sandstone block arch culvert.<br>Culvert 88.980 was in poorer condition than the other sandstone culverts prior to the commencement of longwall mining in the Western Domain due to previous attempts at restoration including the application of paint which has resulted in increased exfoliation and erosion of the sandstone. In addition, a structural engineering report by JMA Solutions (2019) noted the severe loss of wall thickness in some blocks along the roof of the culvert, most likely caused by salt-laden groundwater permeating through the barrel of the culvert. This has resulted in expansive salt crystallisation on the surface stone and subsequent exfoliation. |
| Monitoring comments | On 25 February 2021, minor change in the cracking was first noted around the western (upside) portal headwall. Monitoring by Mark Delaney (Engineering Geologist) on 11 October 2022 concluded that the cracks were minor and do not appear to affect the structural integrity of the culvert, while very minor hairline mortar cracks had developed on the downside inlet headwall (MSEC monitoring report 2022, pg. 29).<br>Inspection confirmed the presence of a vertical crack through the mortar that continued as a crack through the sandstone capping on the north side of the eastern (downside) portal. Cracking on the western (upside) side of the culvert follows the top of the arch stones (voussoirs), primarily through the mortar, with some associated spalling of the stones. This does not appear to have worsened during extraction of LW W4.<br>An inspection of the culvert barrel noted that, in conjunction with the above cracking, as noted by JMA in 2019, sandstone surfaces were broadly experiencing significant surface erosion, particularly to the upper sections of the barrel. This is likely due to the broad permeation of salt-laden groundwater. This has resulted in uneven and brittle surfaces prone to flaking. The sandstone base of the barrel was in generally good condition with more minor surface erosion.<br>Regardless, the sandstone blockwork within the barrel was in generally in stable condition with no indication of significant structural instability. Due to the porous materiality of sandstone, this continued surface erosion of sandstone blocks within the barrel should be addressed by the infrastructure owner in order to halt further dilapidation and protect the overall structure of the culvert from future structural instabilities caused by this issue. |

**Representative photographs**

Photo 88.980-1 Western portal. Cracking around arch stones that was first noted during extraction of LW W2 has not worsened during LW W4.

Photo 88.980-2 Western portal. Pre-mining (left) and post-mining (right) inspection photogrpahs. Cracking along the mortar and spalling of the arch stones has not worsened significantly during extraction of LW W4.

Photo 88.980-3 Barrel of culvert. Pre-mining (left) and post-mining (right) inspection photogrpahs. Signifcant surface erosion and exfoliation throughout the barrel noted in the pre-mining report.

Photo 88.980-4 Example of significantly erorded sandstone block to barrel noted in the pre-mining report.

Photo 88.980-5 Eastern portal. Pre-mining (left) and post-mining (right) inspection photogrpahs. Generally in good condition with no new cracking due to extraction of LW W4.

| Site Name | Loop Line Culvert 88.400 |
|---|---|
| Heritage listing | Not listed |
| Site type | Built structure |
| Location | 380 m west of LW W3 |
| Predicted probability of impact during LW W3 – 4 | Possible |
| Item summary | Dressed sandstone block arch culvert.<br>This culvert was predicted by MSEC to be at possible risk of subsidence impacts. Integrity of the structure and condition of the sandstone is good. Weeds that impeded initial inspection have subsequently been removed.<br>To alleviate downward pressure on the culvert, a vehicle track no longer runs over the top of the culvert but alongside it. |
| Monitoring comments | This culvert has experienced the severest impacts from subsidence. A vertical crack along a mortar joint on the eastern (downside) wall was first observed on 1 February 2021 (during extraction of LW W2), and the following month a crack on the western (upside) wall was noted along with minor spalling of the sandstone blocks in the arch above the portal. The monitoring report observed that both cracks observed had experienced no changes in width and concluded that the cracks were minor and do not appear to affect the structural integrity of the culvert (MSEC monitoring report 2022, pg. 18). Monitoring by Mark Delaney (engineering geologist) on 11 October 2022 confirmed that the cracking and spalling that developed during LW W2 has not worsened significantly during LW W4.<br>An inspection of the culvert barrel noted that both minor hairline cracking and some medium to large size, isolated cracking not previously identified were present within the barrel. They include:<br>1. A large horizontal crack, extending from the cracking previously noted to the eastern portal (at the location where a screw is present that secured the removed concrete sleeve) that extends westwards along the south wall and up to the upper sections of the barrel, primarily through mortar, however some sandstone blocks have been fractured.<br>2. A medium to large horizontal crack adjacent to the aforementioned, to the north wall, near to the barrel base. This crack too is primarily through mortar.<br>3. A large diagonal crack near to the centre of the barrel and closer to the western portal to the south wall of the barrel. This crack is the most significant identified (approx. 8-10mm width) and extends from the base, diagonally towards the upper sections of the barrel where the crack reduces in with. This crack moves through mortar and has fractured sandstone blocks.<br>4. a medium sized largely vertical crack near to the western portal to the upper sections of the barrel wall. this crack moves primarily through mortar with minor hairline cracking extending from the main crack to its ends.<br>Images of the above identified cracks have been included below, in this table.<br>An inspection of the culvert was conducted in July 2019 by Robinson Rail during LW W1–W2, prior to the introduction of the RCP sleeves. The findings of the inspection were in a report dated 8 August 2019 (Robinson Rail, August 2019, pg. 21-23) that the culvert was in good condition with little impacts from weather and only minor erosion and weathering of the sandstone surface. No mention or reference was made in the report to the above identified cracks. It is therefore likely that the cracking identified during EMM's recent inspection was caused by mining in the Western Domain.<br>Sandstone block surfaces exhibit generalised but minor surface erosion and exfoliation with a majority still retaining indications of historical pickings. Only isolated sections and blocks within the barrel exhibit more significant surface erosion. There are some sections of the barrel where permeation of salt-laden groundwater has occurred causing calcification and damp, however these sections are less generalised and located primarily to the barrel base.<br>The sandstone blockwork within the barrel was in generally in stable condition with no indication of significant structural instability for the culvert.<br>Due to the porous materiality of sandstone and number of medium and large cracks identified to this culvert, all identified issues should be addressed through remedial works. Remedial works are to be predominantly conducted in order to halt further dilapidation and protect the overall structure of the culvert from future structural instabilities caused by this issue. All remedial works related to the above, newly identified cracks are to be addressed by Tahmoor Coal as they are likely to have been created during mining in the Western Domain. |

**Representative photographs**

Photo 88.400-1-Western portal. Spalling above the arch that developed during extraction of LW W2 has not worsened significantly during LW W4.

Photo 88.400-2 Barrel of culvert. Pre-mining (left) and post-mining (right) inspection photogrpahs. In generally good condition with only minor cracking to sandstone blocks.

Photo 88.400-3 Eastern portal. No worsening of cracking during extraction of LW W4.

Photo 88.400-4 Eastern portal. Cracking to the arch of the culvert previously identified has not worsened significantly during LW W4.

Photo 88.400-5 Identified crack 1 to culvert barrel. Not noted in the pre-mining report.

Photo 88.400-6 Identified crack 2 to culvert barrel. Not noted in the pre-mining report.

Photo 88.400-7 Identified crack 3 to culvert barrel. Not noted in the pre-mining report.

Photo 88.400-8 Identified crack 4 to culvert barrel. Not noted in the pre-mining report.

Photo 88.400-9. Pre-mining (left) and post-mining (right) inspection photogrpahs. Isolated section of sandston erosion towards western portal. Not noted in the pre-mining report however no noted increase in surface erosion during LW W4.

| Site Name | Loop Line culvert 87.850 |
|---|---|
| Heritage listing | Not listed |
| Site type | Built structure |
| Location | Above LW W3 |
| Predicted probability of impact during LW W3 – 4 | Possible |
| Item summary | Brick arch culvert<br>When it was initially inspected, this culvert was overgrown with brambles and difficult to assess. Multiple existing cracks were observed during subsequent inspections and supported by photographs. |
| Monitoring comments | Cracking across and between the bricks is consistent with previous photographs taken during monitoring of the culvert. An inspection by Mark Delaney (engineering geologist) on 11 October 2022 confirmed that the pre-existing cracks on both sides of the culvert have not increased during extraction of LW W4. No changes were noted during the heritage inspection.<br>An inspection of the culvert barrel did not identify any major cracking or surface erosion to the masonry structure or associated mortar and the overall condition was notes being both stable and good. No remedial works are required. |
| Representative photographs | <br>Photo 87.850-1 Eastern portal |

Photo 87.850-2 Detail, pre-existing cracking and displacement of bricks around the eastern portal arch that does not appear to have worsened significantly during longwall mining in the Western Domain.

Photo 87.850-3 Masonary culvert barrel.

Photo 87.850-4 Cracking and displacement of bricks around the western portal arch. Does not appear to have worsened during longwall mining in the Western Domain.

| Site Name | Loop Line culvert 87.630 |
|---|---|
| Heritage listing | Not listed |
| Site type | Built structure |
| Location | Above LW W3 |
| Predicted probability of impact during LW W3 – 4 | Possible |
| Item summary | Brick arch culvert<br>Concrete skin on base and rubble at the mouth. Mortar is tuck pointed. Headwall and abutment are in good condition. Recent embankment to the south-east means water is largely diverted away from the culvert. |
| Monitoring comments | There are no existing cracks, and no subsidence impacts were observed. Inspection of the eastern portal was impeded by weed growth but a review of Mark Delaney's (Engineering Geologist) report assessing the culverts' conditions on 11 October 2022 confirms that no change or cracking has occurred during LW W4 in the headwalls or within the barrel. No remedial works would be required for this culvert. |
| Representative photographs | <br>Photo 87.630-1 Western portal. In sound condition |

Photo 87.630-2 Eastern portal. Overgrown but appears to be in sound condition.

| Site Name | Loop Line culvert 87.330 |
|---|---|
| Heritage listing | Not listed |
| Site type | Built structure |
| Location | 240 m east of LW W3 |
| Predicted probability of impact during LW W3 – 4 | Unlikely |
| Item summary | Brick arch culvert with drainage channels of rendered brick on either side of the embankments to funnel water into the culvert. Cracking is along the mortar only and the condition of the bricks is good. |
| Monitoring comments | A review of Mark Delaney's (Engineering Geologist) report assessing the culverts' conditions on 11 October 2022 indicates that the western (upside) portal is in good condition with no evidence of cracking or deformation occurred during LW W4. No remedial works would be required for this culvert. |
| Representative photographs | <br><br>Photo 87.330-1 Eastern (downside) portal. In sound condition |

Photo 87.330-2 Displaced bricks at the base of the brick chute to the south of the eastern portal.

| Site Name | Old formation, culvert 87.300 |
|---|---|
| Heritage listing | Not listed |
| Site type | Built structure |
| Location | 160 m east of LW W3. |
| Predicted probability of impact during LW W3 – 4 | Unlikely |
| Item summary | Brick arch culvert located beneath the disused embankment for the original railway alignment. Bricks cracked at northern headwall. |
| Monitoring comments | Results of the monitoring inspection were cross referenced with baseline photographs taken prior to the commencement of longwall mining in the Western Domain which confirmed that the cracking around the northern portal was pre-existing and has not worsened during LW W4.<br>A review of Mark Delaney's (Engineering Geologist) report assessing the culverts' conditions on 11 October 2022 indicates that there have been no changes to the pre-existing cracking and outward rotation of the headwall to the southern (downside) portal that occurred during LW W4.<br>Remedial are likely to be required for this culvert and are to be conducted by the infrastructure owner. |
| Representative photographs | <br>Photo 87.300-1 Northern portal. Difficult to access due to water and weeds. Pre-existing cracking around the arch, mostly through mortar. |

| Site Name | MSR culvert 87.331 |
|---|---|
| Heritage listing | Not listed |
| Site type | Built structure |
| Location | 280 m east of LW W3. |
| Predicted probability of impact during LW W3 – 4 | Unlikely |
| Item summary | Brick arch culvert<br>The brick and concrete culvert is in good condition. There is a minor amount of vegetation growth; however, this does not appear to have impacted the feature. |
| Monitoring comments | Only the western portal was inspected and only from a distance due to water and vegetation. The culvert appears to be in sound condition. |
| Representative photographs | <br>Photo 87.331-1 Western portal. In sound condition. |

| Site Name | MSR culvert 89.216 |
|---|---|
| Heritage listing | Not listed |
| Site type | Built structure |
| Location | 590 m east of LW W3. |
| Predicted probability of impact during LW W3 – 4 | Very unlikely |
| Item summary | Brick arch culvert.<br>The brick culvert is in good condition despite a moderate amount of graffiti. |
| Monitoring comments | The culvert is in good condition and the cracks observed above the western portal arch were checked against the baseline photographs taken prior to longwall mining in the Western Domain and identified as pre-existing. The crack along the centre of the culvert roof previously identified, do not appear to have worsened. |
| Representative photographs | |

Photo 89.216-1 Eastern portal. Culvert is in good condition.

Photo 89.216-2 Roof of culvert. View west

Photo 89.216-3 Western portal. Cracking through the mortar above the arch continues along the roof of the culvert.

# Appendix F – Stonequarry Creek Rockbar Status Reports

# TAHMOOR COAL: LW W3

Subsidence Management Status Report No. 41
During the mining of LW W3 for Stonequarry Creek Rockbar

| **Reporting Period** | **12 February 2022 to 18 February 2022** | |
|---|---|---|
| Length of extraction | 1359 m | as at 17 February 2022 |
| Closest distance of LW W3 face to Rockbar | 1500 m | to Mark C02 (LW moving away) |
| Distance travelled by LW since previous report | 37 m | since 10 February 2022 (Thursday to Thursday) |
| Maximum incremental subsidence at Rockbar Mark C02 due to LW W3 | 50 mm | on 17 February 2022 |
| Maximum increase in subsidence at Rockbar Mark C02 since previous survey | 0 mm | No measurable change from 11 February to 17 February |
| Weather and flow conditions | Surface water flows have reduced to normal levels, only preventing survey of mark E09. | |

## Summary of monitoring and inspections

| **Monitoring Activity** | **Date** | **Current Frequency** | **Highest Trigger** | **Comments** |
|---|---|---|---|---|
| **GNSS** | | | | |
| GNSS unit above commencing end of LW W3 (Site 23) | Continuous | | N/A | The GNSS unit is gradually moving in a southward direction, chasing the retreating LW face. Rates of change have reduced. |
| GNSS unit (Site 12A) | Continuous | | N/A | Minor subsidence developing at reduced rates of change. Minor horizontal movements developing towards the south. |
| GNSS unit (Site 13) | Continuous | | N/A | Minor subsidence developing at reduced rates of change. Minor horizontal movements developing towards the south and east. Unit confirmed by site inspection to have been disturbed in early January (protective fence removed). |
| GNSS unit (Site SR17N) | Continuous | | N/A | Very minor subsidence developing at reduced rates of change. Very minor horizontal movements developing towards the south. |
| GNSS unit (Site SR17S) | Continuous | | N/A | Very minor subsidence developing at reduced rates of change. Very minor horizontal movements developing towards the south. |
| **High resolution surveys across Rockbar** | | | | |
| High resolution closure lines | 17 Feb | Weekly | | HRC-C line extended from 4.9 mm to 5.4 mm.<br>HRC-D line extended from 5.3 mm to 5.4 mm.<br>HRC-E line reduced in extension from 8.0 mm to 7.6 mm.<br>HRC-F line extended from 4.5 mm to 5.1 mm<br>HRC-G line remained at 7.9 mm.<br>HRC-B line extended from 0.2 mm to 0.4 mm<br>HRC-A line reduced in extension from 4.6 mm to 4.5 mm<br>HRC-H line extended from 0.3 mm to 0.4 mm |
| 3D surveys across grinding groove sites (3D array) | 17 Feb | Weekly | | Results within survey tolerances across grinding groove sites. Minor changes observed last week. |
| **Ground surveys across Rockbar** | | | | |
| Absolute 3D surveys | - | Monthly | | Last survey 17 January. Minor changes observed. |
| Relative 3D surveys | 14 Feb | Weekly | | Little to no measurable change observed over the last month, within survey tolerances. Measured strain between RBF04 and RBF05 slightly exceeds Blue trigger level for the first time. Strain measured by MNC between E10 and E11 has exceeded 1 mm/m but is not a trigger under the management plan. Strain measured by MNC between E10 and F05 has returned below 1 mm/m. The Technical Committee notes that it has been managing this site in accordance with the Yellow trigger level since fractures were first observed on 28 Oct 2021. |

| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **Ground surveys** | | | | |
| Valley closure lines across Stonequarry Creek and Cedar Creek | - | Monthly | N/A | Last survey 24 January. Survey marks for SQ01 to SQ09 removed as requested by landowner. Small changes (4 mm or less) for remaining survey lines. |
| Rockbar / valley closure lines across Stonequarry Creek | 14 Feb | Weekly | N/A | Minor subsidence and closure developing. Changes across SQ113 upstream of rockbar are within survey tolerance. No change in closure this week across SQ114 and SQ115 downstream of rockbar. |
| LW W3 Centreline | 16 Feb | Monthly | N/A | Subsidence developing gradually above LW W3, current trends are consistent with predictions. Rates of change reducing to low levels above commencing end of panel. |
| **Visual inspections** | | | | |
| Detailed visual inspection | 14 Feb<br>17 Feb | Twice a week | | No changes observed across the rockbar over the last month, including across the grinding groove area. |
| **Geotechnical monitoring** | | | | |
| Inclinometer surveys | - | End of LW | N/A | Last survey 11 January. Minor ongoing movement above shear at 20 metres depth. |
| In situ stress monitoring | 19 Feb | Fortnightly | N/A | All strain gauges are showing no change or only the slightest hint of stretching. |
| **Surface and groundwater monitoring** | | | | |
| Surface water monitoring | - | Download monthly | N/A | Download up to 8 December. Water levels were generally higher during the month of November as a result of high levels of rainfall during this period. |
| Groundwater monitoring | - | Download fortnightly | N/A | Download up to 31 December. Minor changes in groundwater levels observed along Stonequarry Creek. |

**Other management actions since previous report:**

- Nil.

**Any additional and/or outstanding management actions:**

- Technical Committee reviewed the latest observations on 18 February. The longwall face is 1500 m from the rockbar. Monitoring results indicate little to no measurable changes at the rockbar, including where fracturing has occurred. Further fracturing may develop between Marks RBF04 and RBF05, RBE10 and RBE11.

Based on the above, the Technical Committee advises that changes at the rockbar can be effectively monitored and managed with surveys and inspections twice a week.

**Consultation with stakeholders since previous report:**

- Technical Committee meeting held 18 February. Next meeting on 4 March. Weekly reports will continue.

**Forecast whether continued longwall mining is likely to cause greater than negligible subsidence impacts, environmental consequences or loss of heritage value:**

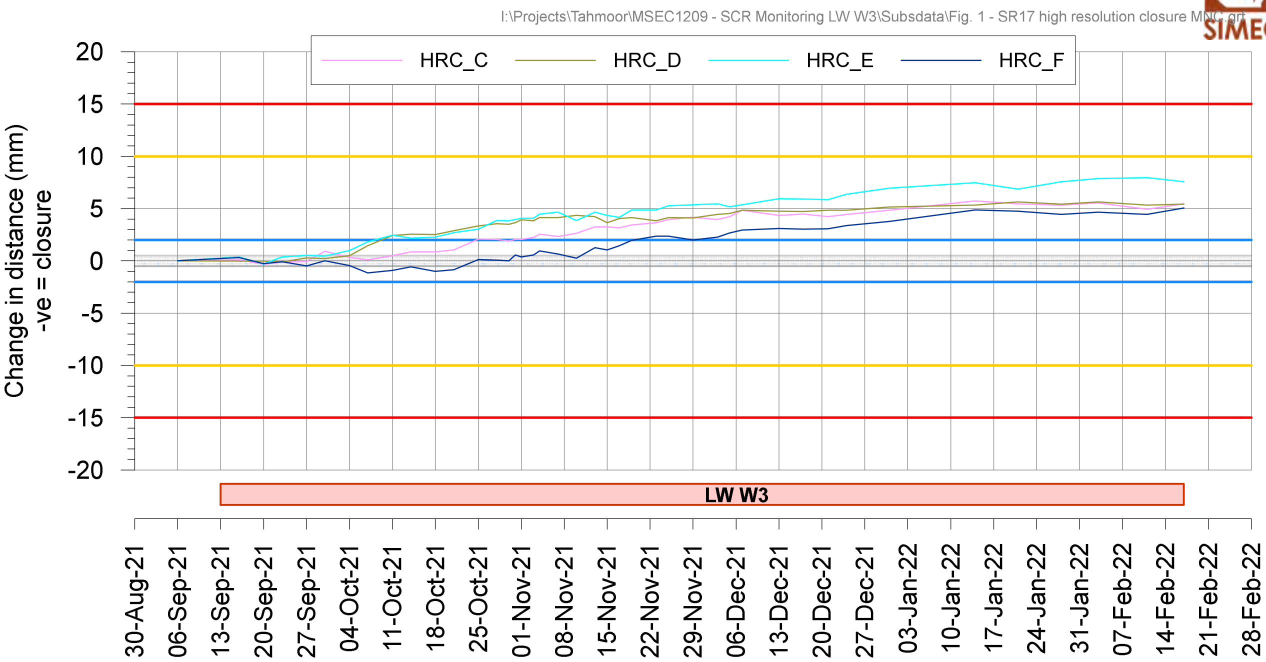
The Technical Committee continues to investigate and assess the latest monitoring results in accordance with the Management Plan. Based on monitoring results to date, continued longwall mining is not likely to result in the occurrence of greater than negligible subsidence impacts, environmental consequences or loss of heritage value.

***Copy of Report to:***

Peter Vale, Executive General Manager Coal Operations
Clint Mason, Head of Tahmoor Coal Operations
David Corbett, Tahmoor Coal Technical Services Manager
Malcolm Waterfall, Tahmoor Coal Mining Engineering Manager
Zina Ainsworth, Tahmoor Coal Environment and Community Manager

Stephen O'Donoghue, Director Resource Assessments – DPIE
Gabrielle Allan, Principal Planning Officer - DPIE

All Technical Committee Members




*Photograph courtesy MNC Consulting*

**Rockbar SR17 on 17 February 2022**

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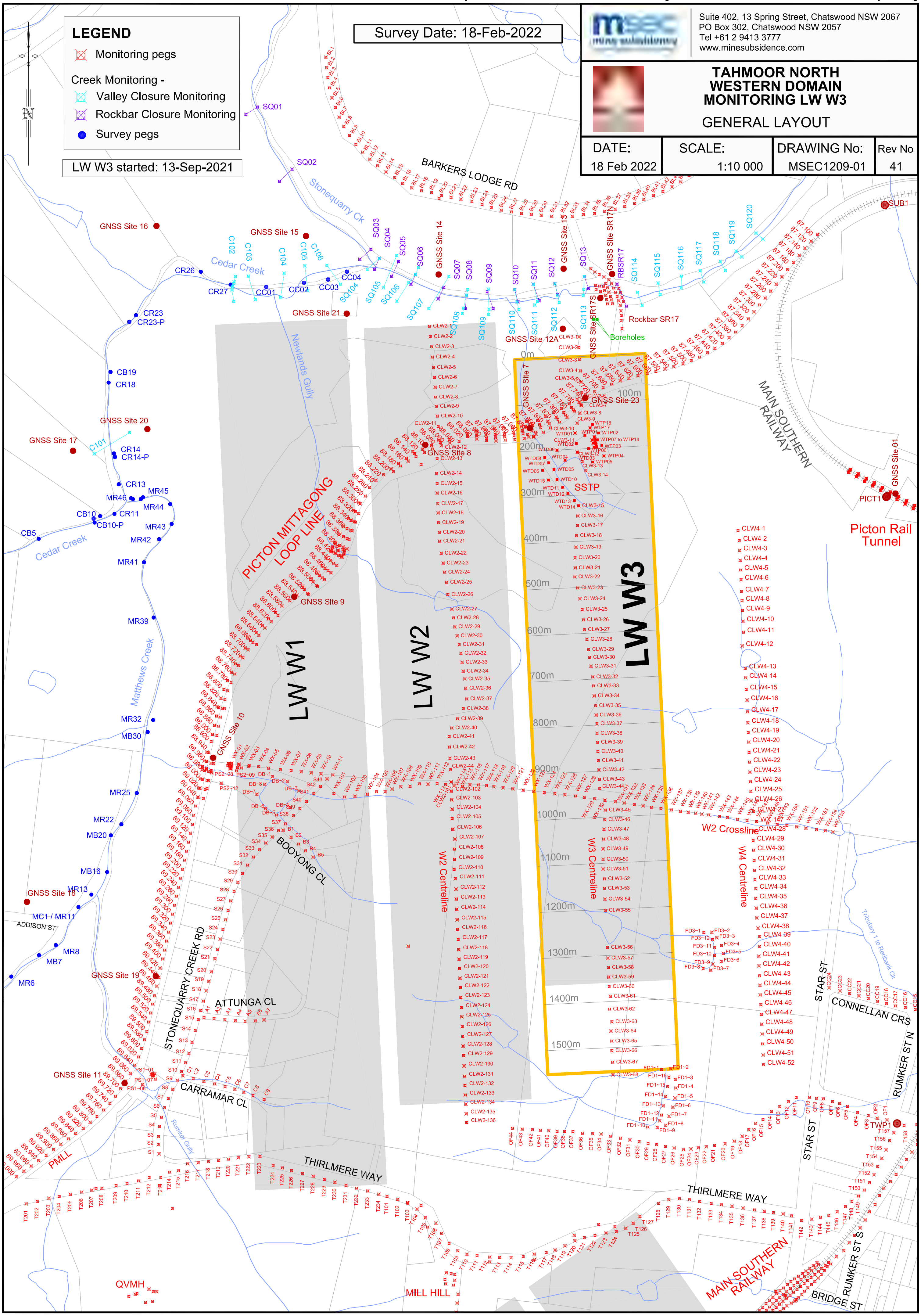

# TAHMOOR COAL: LW W3-W4

Subsidence Management Status Report No. 53
During the mining of LW W3-W4 for Stonequarry Creek Rockbar

SIMEC

| Reporting Period | 13 August 2022 to 16 September 2022 | |
|---|---|---|
| Length of extraction of LW W4 | 721 m | LW W3 finished extraction on 21 March 2022. LW W4 commenced 16 May 2022 and finished extraction on 13 September 2022. |
| Closest distance of LW W4 face to Rockbar | 1695 m | to Mark C02 |
| Distance travelled by LW since previous report | 11 m | Since 11 August 2022 |
| Maximum total subsidence at Rockbar Mark C02 due to LW W3-W4 | 51 mm | on 13 September 2022 |
| Maximum increase in subsidence at Rockbar Mark C02 since previous survey | 2 mm | 11 August to 13 September |
| Weather and flow conditions | Overcast weather. Surface water flows have reduced. | |

## Summary of monitoring and inspections

| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **GNSS** | | | | |
| GNSS unit above commencing end of LW W4 (Site 24) | Continuous | | N/A | Rates of change are reducing. |
| GNSS unit (Site 12A) | Continuous | | N/A | Minor ongoing changes observed. |
| GNSS unit (Site 13) | Continuous | | N/A | Minor ongoing changes observed. |
| GNSS unit (Site SR17N) | Continuous | | N/A | Minor ongoing changes observed. |
| GNSS unit (Site SR17S) | Continuous | | N/A | Minor ongoing changes observed. |
| **High resolution surveys across Rockbar** | | | | |
| High resolution closure lines | 13 Sep | Monthly | (blue) | HRC-C line reduced in extension from 2.1 mm to 1.6 mm. HRC-D line extended from 3.9 mm to 4.4 mm. HRC-E line reduced in extension from 6.0 mm to 5.9 mm. HRC-F line reduced in extension from 3.5 mm to 3.3 mm. HRC-G line extended from 7.0 mm to 7.4 mm. HRC-B line extended from -3.5 mm to -3.1 mm. HRC-A line reduced in extension from 3.5 mm to 3.2 mm. HRC-H line extended from 1.0 mm to 1.4 mm. |
| 3D surveys across grinding groove sites (3D array) | 13 Sep | Monthly | (green) | Results within survey tolerances across grinding groove sites. Minor changes observed since 11 August. |
| **Ground surveys across Rockbar** | | | | |
| Absolute 3D surveys | - | Monthly | (green) | End of panel survey for LW W3 completed 9 May. Minor changes observed. |
| Relative 3D surveys | 30 Aug | Monthly | (green) | Little to no measurable change observed since previous survey on 2 August, within survey tolerances. |

| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **Ground surveys** | | | | |
| Valley closure lines across Stonequarry Creek and Cedar Creek | - | Monthly | N/A | Last survey 24 January. Survey marks for SQ01 to SQ09 removed as requested by landowner. Small changes (4 mm or less) for remaining survey lines. |
| Rockbar / valley closure lines across Stonequarry Creek | 7 Sep | Monthly | N/A | Surveys conducted across SQ-117 to SQ120 with no measurable changes observed since previous survey in Mary 2022. |
| LW W3 Centreline | - | End of LW | N/A | End of panel survey for LW W3 completed 3 May. Subsidence has developed above LW W3 consistent with predictions. |
| **Visual inspections** | | | | |
| Detailed visual inspection | 30 Aug & 13 Sep | Monthly |  | Surface water flows over the rockbar have reduced. No changes observed to previously identified fractures in south-east corner of rockbar. No change in width of 2 mm wide crack and opening of natural joint previously identified in May near prism RBF02. The site is downstream of access track, with corresponding ground extension of approximately 3 mm between prisms RBF01 and RBF02 (1 mm decrease this month). A small man-made pond in the rockbar adjacent to the crack observed in June is currently holding water following recent water flows, after being observed to have reduced below historical norm.<br>Previously observed iron staining upstream of access track has re-emerged at times of low water flow.<br>Evidence of vehicle movement by others across the rockbar observed on 11 August, including near the grinding grooves. |
| **Geotechnical monitoring** | | | | |
| Inclinometer surveys | 19 Sep | End of LW | N/A | Minor changes to shear observed at 20 metres depth. |
| In situ stress monitoring | 13 Sep | End of LW | N/A | Strain gauges are showing recommencement of stretching since the start of May. |
| **Surface and groundwater monitoring** | | | | |
| Surface water monitoring | - | Download monthly | N/A | Download up to 30 June. Water levels were generally higher in the last month as a result of high levels of rainfall during this period. |
| Groundwater monitoring | - | Download fortnightly | N/A | Download up to 31 August. Continued signs of recovery in groundwater levels observed along Stonequarry Creek. |

**Other Management Actions Since Previous Report:**

- Nil.

**Any additional and/or outstanding management actions:**

- Technical Committee reviewed the latest observations on 26 September. LW W3 finished extraction on 21 March. LW W4 commenced extraction on 16 May and finished extraction on 13 September. Monitoring results indicate little to no measurable change at the rockbar, including where fracturing has occurred. Previously observed crack near Peg RBF02 has not changed in width this month. The water level in a small man-made pond in the rockbar adjacent to the crack is holding water has returned to its normal level.

Based on the above, the Technical Committee advises that one more survey can be conducted in October 2022, one month after the completion of mining. As mining in the Western Domain has been completed, it is agreed that no further Technical Committee meetings are required.

**Consultation with stakeholders since previous report:**

- Technical Committee meeting held 26 September

**Forecast whether residual subsidence is likely to cause greater than negligible subsidence impacts, environmental consequences or loss of heritage value:**

The Technical Committee continues to investigate and assess the latest monitoring results in accordance with the Management Plan. Based on monitoring results to date, subsidence movements are not likely to result in the occurrence of greater than negligible subsidence impacts, environmental consequences or loss of heritage value.

***Copy of Report to:***

Peter Vale, Executive General Manager Coal Operations
Clint Mason, Head of Tahmoor Coal Operations
David Corbett, Tahmoor Coal Technical Services Manager
Malcolm Waterfall, Tahmoor Coal Mining Engineering Manager
Zina Ainsworth, Tahmoor Coal Environment and Community Manager

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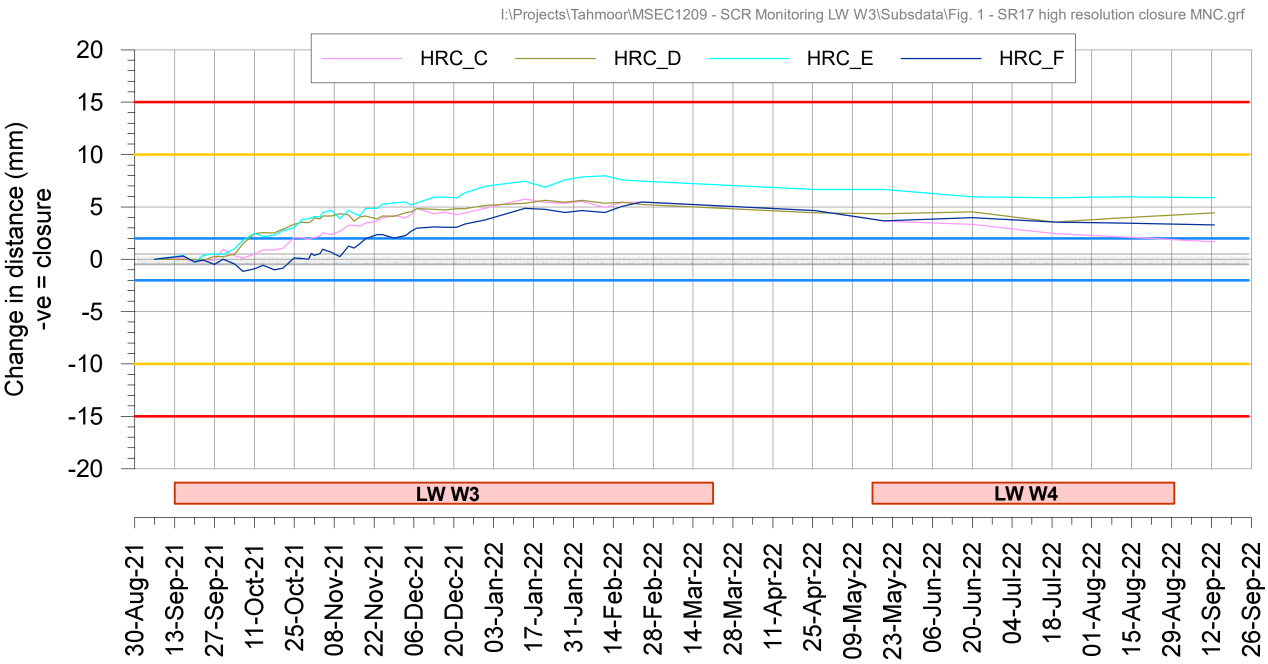

*Photograph courtesy MNC Consulting*

**Rockbar SR17 on 13 September 2022**

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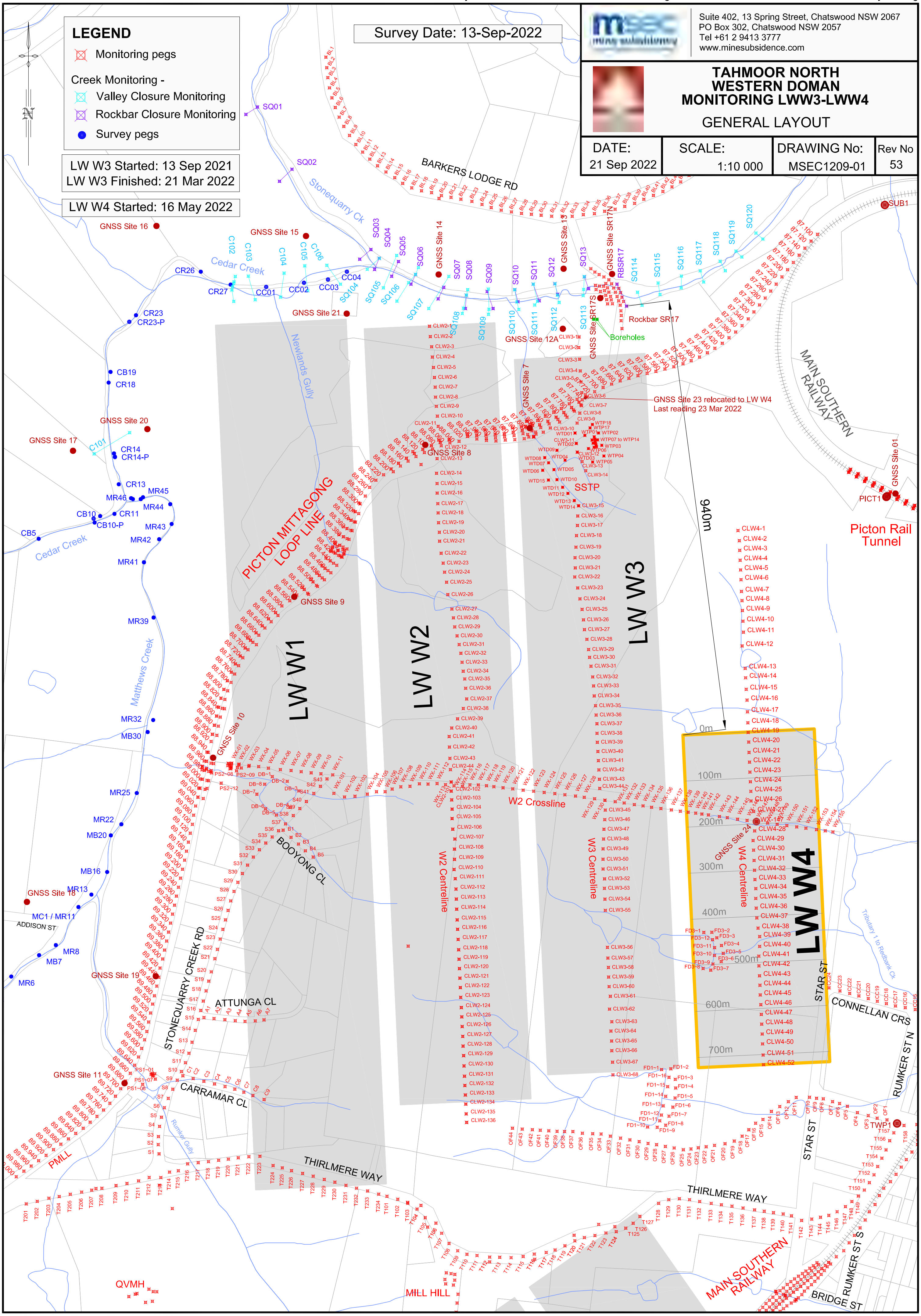

# Appendix G – Main Southern Railway Status Reports

# TAHMOOR COAL: LW W3

Subsidence Management Status Report No. 19
During the mining of LW W3 adjacent to the Main Southern Railway

| **Reporting Period** | **12 January 2022 to 18 January 2022** | |
|---|---|---|
| Length of extraction of LW W3 | 1075 m | as at 18 January 2022 |
| Closest distance of LW W3 face to Railway | 780 m | to 88.660 km (LW alongside) |
| Distance travelled by LW since previous report | 50 m | since 11 January 2022 |
| Maximum incremental subsidence along Railway due to LW W3 | 6 mm | at 87.520 km and 87.640 km on 17 January 2022 |
| Maximum increase in subsidence since previous survey | 4 mm | at 88.600 km (11 January to 17 January) |
| Safety Incidents | No incidents reported | |
| Rail Operations | No delays incurred. | |

## Summary of monitoring and inspections

| **Monitoring Activity** | **Date** | **Current Frequency** | **Highest Trigger** | **Comments** |
|---|---|---|---|---|
| **Railway Track** | | | | |
| 3D ground survey | - | Monthly | N/A | Last survey 4 January. Results within survey tolerance. |
| 2D ground survey | 17 Jan | Weekly | N/A | Results within survey tolerance. |
| GNSS unit above centreline of LW W3 (Site 23) | Continuous | | N/A | Subsidence (approx. 325 mm) developing above LW W3, with minor changes observed. Horizontal movements to the south. |
| Long bay length survey | 17 Jan | Weekly | N/A | Minor (1 mm) increase in ground shortening between 87.300 km and 87.400 km this week, after no change last week.<br>Minor ground shortening of 6 mm between 87.500 km and 87.600 km. No change this week. |
| Rail stress | Every 5 mins | | ● | Measurements within tolerances. |
| Track geometry survey | 18 Jan | Weekly | ● | No significant changes. |
| Inspections by Track Certifier | 18 Jan | Daily | ● | No issues observed. |
| **Bridge Street Overbridge (91.030 km)** | | | | |
| Far-field Absolute 3D survey | 12 Jan | Monthly | N/A | Very minor changes this month. |
| Absolute 3D survey of structure | 13 Jan | Monthly | ● | No measurable changes in distances across the abutments this month. |
| **Thirlmere Way Underbridge (89.326 km)** | | | | |
| Far-field Absolute 3D survey | 12 Jan | Monthly | N/A | Minor changes this month. |
| Local 3D survey of structure | 13 Jan | Monthly | ● | No measurable changes in distances across the base of the arch this month. |
| Laser distancemeters | Hourly | | ● | Very minor changes observed. The prisms were cleaned of spider webs and surface sprayed on 12 Jan. |
| Visual inspection | - | - | N/A | Inspections commence during Stage 2 management. |
| **Connellan Crescent Overbridge (89.080 km)** | | | | |
| Far-field Absolute 3D survey | 12 Jan | Monthly | N/A | Minor changes this month. |
| Local 3D survey of structure | 13 Jan | Monthly | ● | No measurable changes in distances across the base of the arch this month.<br>Sideways shear displacements on the Up Side are approaching the Blue monitoring review point. |
| Crack gauges | 19 Jan- | Monthly | ● | Changes in crack widths less than trigger level. |

| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **Ballast Top Subway (88.133 km)** | | | | |
| Far-field Absolute 3D survey | 12 Jan | Monthly | N/A | Minor changes this month. |
| Local 3D survey of structure | 13 Jan | Monthly | | No measurable changes in distances across tops of the abutments this month. Small increase in closure at the base of the arch on the Down side on 10 Nov, exceeding the 5 mm monitoring review point trigger. Rainfall prior to survey. A structural inspection was completed on 30 Nov, with no immediate concerns. A geotechnical inspection of the abutment foundations confirmed fill material at the base of the wall is soft due to rainfall. The RMG has reviewed the results and structural report and agreed to increase the Blue trigger level from 5 mm to 10 mm.<br>A small decrease in closure was measured at the base of the arch on the Down side this month. |
| **Picton Tunnel (87.85 km)** | | | | |
| GNSS unit (Site 1) | Continuous | | N/A | Small increase in westerly movement during LW W2 following heavy rain event in March 2021. A similar response was observed in February 2020 after a heavy rain event. Minor changes to the west this week. |
| Far-field Absolute 3D survey | 12 Jan | Monthly | N/A | Minor changes this month. |
| Absolute 3D / relative 3D survey of prisms inside tunnel | 17 Jan | Abs. Monthly<br>Rel. Weekly | | Minor changes observed. Changes in horizontal openings and closures across the arch, changes in vertical alignments and changes in track centres are less than trigger levels. |
| Absolute 3D / 2D ground survey leading into tunnel | 17 Jan | Abs. Monthly<br>Rel. Weekly | N/A | Results within survey tolerance. |
| Laser distancemeters | Every 15 minutes | | | Very minor changes observed. Changes in horizontal openings and closures across the arch are less than trigger levels. Prisms cleaned on 27 November. |
| Inclinometer | - | Monthly | N/A | Last readings 17 December. No measurable changes observed. |
| Track centre and clearance | 17 Jan | Weekly | | No measurable changes observed. |
| Visual inspection | Daily | | N/A | No issues reported. No new cracks observed. |
| **Mushroom Tunnel** | | | | |
| Local 3D survey of prisms inside tunnel | 13 Jan | Monthly | | Minor changes in distances across the base of the arch and along the tunnel this month. |
| Visual inspection | Daily | | N/A | No issues reported. |
| **Ballast Top Subway (86.838 km)** | | | | |
| Far-field Absolute 3D survey | 12 Jan | Monthly | N/A | Very minor changes this month. |
| Local 3D survey of structure | 13 Jan | Monthly | | Minor changes across the abutments this month. Small increase in closure near the top of the arch on the Up side (supporting PMLL track) this month, exceeding the 20 mm monitoring review point trigger. Structural inspection conducted 7 Jan with no immediate concerns observed. Trains not running on PMLL track until 5 Feb 2022. |
| **Argyle Street Underbridge (86.16 km)** | | | | |
| Far-field Absolute 3D survey | - | Monthly | N/A | No survey this month due to construction works. |
| Local 3D survey of structure | - | Monthly | | No measurable changes in distances across the base of the arch on 10 December.<br>No survey this month due to construction works. |
| Laser distancemeters | Hourly | | | Very minor changes observed. The prisms were cleaned of soot, spider webs and surface sprayed on 12 Jan. |

| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **Pedestrian Overbridge (86.010 km)** | | | | |
| Local 3D survey of structure | 13 Jan | Monthly | Green | Minor changes this month. |
| **Pedestrian Overbridge (85.846 km)** | | | | |
| Local 3D survey of structure | 13 Jan | Monthly | Green | Minor changes this month. |
| **Picton Viaduct (85.42**km) | | | | |
| GNSS units (Site 0 and 2) | Continuous | | N/A | Minor ongoing trend of movement to the west towards LW W1-W3. Minor changes this week. No measurable change between GNSS units. |
| Far-field Absolute 3D survey | 12 Jan | Monthly | N/A | Minor changes this month. |
| Precision 2D ground survey between ends of Viaduct (valley closure) | 17 Jan | Weekly | Green | 0 mm to 3 mm closure measured on Down side, 0 mm to 2 mm closure measured on Up side. Measurements are less than survey tolerance and the Monitoring Review Point trigger of 5 mm and the valley closure trigger level of 20 mm. |
| Local 3D survey of ground pegs | 13 Jan | Monthly | N/A | Minor changes observed this month. |
| Local 3D survey of structure | 13 Jan | Monthly | Green | Minor changes between abutments and bases of piers this month. Horizontal openings and closures between ends of Viaduct are less than trigger level. |
| Laser distancemeters | Hourly | | Green | Minor changes observed. The prisms were cleaned of spider webs and surface sprayed on 12 Jan. |
| Rail stress | Every 5 mins | | N/A | Measurements within tolerances. |
| Inclinometer | - | Monthly | N/A | Last readings 17 December. Minor changes observed last month. |
| Track geometry | 12 Jan | Monthly | N/A | No issues reported. |
| Visual inspection | 19 Jan | Weekly | N/A | No issues reported. |
| Visual inspection by UAV including crack gauges | - | Monthly | Green | Changes in crack widths less than trigger level on 15 December. |
| **Prince Street Overbridge (85.17 km)** | | | | |
| Far-field Absolute 3D survey | 12 Jan | Monthly | N/A | Very minor changes this month. |
| Local 3D survey of structure | 13 Jan | Monthly | Green | Minor changes this month. |
| **Retaining wall (84.867 km)** | | | | |
| Local 3D survey of wall | 13 Jan | Monthly | N/A | Minor changes in tilt from top to base of wall this month. |
| **Matthews Lane Overbridge (84.551 km)** | | | | |
| Far-field Absolute 3D survey | 12 Jan | Monthly | N/A | Very minor changes this month. |
| Local 3D survey of structure | 13 Jan | Monthly | Green | Minor change between abutments this month. |
| **Victoria Bridge over Stonequarry Creek** | | | | |
| GNSS unit (Site 3) | Continuous | | Green | Minor ongoing trend of movement to the west towards LW W1-W3. Minor changes this week. |
| Far-field Absolute 3D survey | 12 Jan | Monthly | N/A | Minor changes this month. VBP2 has been replaced and normalised. |
| Local 3D survey of structure | 11 Jan | Monthly | N/A | Minor changes between abutments this month. Maintenance works are obstructing views to some marks. |
| **Abbotsford Road Bridge over Stonequarry Creek** | | | | |
| Far-field Absolute 3D survey | 12 Jan | Monthly | N/A | Minor changes on this month. |

| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **Embankment and Culvert at 87.331 km** | | | | |
| Absolute 3D survey | - | Monthly | N/A | Last survey 4 January. Minor changes observed. Some pegs on Down crest at B260, B300 and B320 appear to have been slightly disturbed. Minor changes observed this month.<br>Most prisms on the Up side toe are obscured by vegetation regrowth, preventing survey. |
| Extensometer | Every 15 minutes | | 🟢 | Negligible changes observed. |
| Visual inspection | - | Monthly | N/A | Last inspection 4 January. No issues observed. |
| **Embankment and Culvert at 88.100 km** | | | | |
| Absolute 3D survey | - | Monthly | N/A | Last survey 4 January. Small changes observed. Small changes in closure measured on the Down side and across the base. Peg A88000 on Down side toe appears to have been disturbed. |
| Extensometer | Every 15 minutes | | 🟢 | Negligible changes observed. |
| Visual inspection | - | Monthly | N/A | Last inspection 4 January. No issues observed. |
| **Embankment and Culvert at 88.500 km** | | | | |
| Absolute 3D survey | - | Monthly | N/A | Last survey 4 January. Small changes observed this month. |
| Extensometer | Every 15 minutes | | 🟢 | Negligible changes observed. |
| Visual inspection | - | Monthly | N/A | Last inspection 4 January. No issues observed. |
| **Embankment and Culvert at 89.300 km** | | | | |
| Absolute 3D survey | - | - | N/A | Surveys commence during Stage 2 management. |
| Extensometers | Every 15 minutes | | N/A | Negligible changes observed. |
| Visual inspection | - | - | N/A | Inspections commence during Stage 2 management. |
| **Cuttings** | | | | |
| Cutting 87.540km-87.669km | - | Monthly | N/A | Last inspection 4 January. No issues observed. |
| Cutting 88.200km-88.400km | - | Monthly | N/A | Last inspection 4 January. No issues observed. |
| Cutting 88.700km-89.050km | - | Monthly | N/A | Last survey and inspection 4 January. No issues observed.<br>Peg D88840 has moved slightly into the cutting since the baseline survey. |
| **Management Actions** | | | | |
| **Other management actions since previous report:** • Nil | | | | |
| **Any additional and/or outstanding management actions:** • Nil. | | | | |
| **Consultation with stakeholders since previous report:** • RMG meeting held on 21 January | | | | |

**Forecast whether continued longwall mining is likely to cause:**

**A. Track closure for any period unacceptable to ARTC**

**B. Impact on the safety of operations on the Main Southern Railway**

Based on monitoring results to date, and the controls implemented and available under the LW W3-W4 Management Plan for Longwall Mining adjacent to the Main Southern Railway, no triggers under this Management Plan are expected to be exceeded in the next week. Accordingly continued longwall mining is not likely to result in the occurrence of either A or B above.

| Certified by Tahmoor Coal | |
|---|---|
| Name | Ross Barber |
| Position | Project Manager |
| Signature | Ross Barber |
| Date | 21 January 2022 |

***Copy of Report to:***

Steve Chance, Area Manager – Moss Vale to Port Botany, ARTC
Wael Naser, Corridor Manager – Sydney to Narromine & Albury, ARTC
Ian Cochran, Bridges and Structures Specialist, ONRSR
Michael Irons, Property Manager – Wagga, ARTC
Clint Mason, Production Manager, Tahmoor Mine
Dr Gang Li, Principal Subsidence Engineer, Mine Safety Operations

# TAHMOOR COAL: LW W3

Subsidence Management Status Report No. 23
During the mining of LW W3 adjacent to the Main Southern Railway

| Reporting Period | 9 February 2022 to 15 February 2022 | |
|---|---|---|
| Length of extraction of LW W3 | 1349 m | as at 15 February 2022 |
| Closest distance of LW W3 face to Railway | 630 m | to 89.340 km (LW alongside) |
| Distance travelled by LW since previous report | 50 m | since 8 February 2022 |
| Maximum incremental subsidence along Railway due to LW W3 | 5 mm | at 87.460 km, 87.500 km and 87.520 km on 15 February 2022 |
| Maximum increase in subsidence since previous survey | 4 mm | at 88.760 km (8 February to 15 February) |
| Safety Incidents | No incidents reported | |
| Rail Operations | No delays incurred. | |

## Summary of monitoring and inspections

| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **Railway Track** | | | | |
| 3D ground survey | - | Monthly | N/A | Last survey 1 February. Results within survey tolerance. |
| 2D ground survey | 15 Feb | Weekly | N/A | Results within survey tolerance. |
| GNSS unit above centreline of LW W3 (Site 23) | Continuous | | N/A | Minor continued horizontal movements to the south. |
| Long bay length survey | 15 Feb | Weekly | N/A | Minor changes observed. |
| Rail stress | Every 5 mins | | 🟢 | Measurements within tolerances. |
| Track geometry survey | 15 Feb | Weekly | 🔵 (not mining related) | Deteriorating track condition on the Up Main between 87.65 km and 87.96 km at Sydney end of Tunnel and also and north of Connellan Crescent at 89 km (not mining related). ARTC plan to conduct drainage and reconditioning works to correct the bog holes at both sites in May possession. |
| Inspections by Track Certifier | 15 Feb | Daily | 🟢 | No issues observed with exception of bog holes. |
| **Bridge Street Overbridge (91.030 km)** | | | | |
| Far-field Absolute 3D survey | 9 Feb | Monthly | N/A | Very minor changes this month. |
| Absolute 3D survey of structure | 10 Feb | Monthly | 🟢 | No measurable changes in distances across the abutments this month. |
| **Thirlmere Way Underbridge (89.326 km)** | | | | |
| Far-field Absolute 3D survey | 9 Feb | Monthly | N/A | Minor changes this month. |
| Local 3D survey of structure | 9 Feb | Monthly | 🟢 | No measurable changes in distances across the base of the arch this month. |
| Laser distancemeters | Hourly | | 🟢 | Very minor changes observed. The prisms were cleaned of spider webs and surface sprayed on 12 Jan, resulting in a 1.4mm step change at US1 to DS1. |
| Visual inspection | - | - | N/A | Inspections commence during Stage 2 management. |

| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **Connellan Crescent Overbridge (89.080 km)** | | | | |
| Far-field Absolute 3D survey | 9 Feb | Monthly | N/A | Minor changes this month. |
| Local 3D survey of structure | 9 Feb | Monthly | ● | No measurable changes in distances across the base of the arch this month. |
| Crack gauges | - | Monthly | ● | Changes in crack widths less than trigger level on 30 January. |
| **Ballast Top Subway (88.133 km)** | | | | |
| Far-field Absolute 3D survey | 9 Feb | Monthly | N/A | Minor changes this month. |
| Local 3D survey of structure | 10 Feb | Monthly | ● | No measurable changes in distances across tops of the abutments on 10 February. The 5 mm monitoring review point trigger was exceeded at the base of the arch on the Down side on 10 Nov. A structural inspection was completed on 30 Nov, with no immediate concerns. A geotechnical inspection of the abutment foundations confirmed fill material at the base of the wall is soft due to rainfall. The RMG reviewed the results and structural report and agreed to increase the Blue trigger level from 5 mm to 10 mm. |
| **Picton Tunnel (87.85 km)** | | | | |
| GNSS unit (Site 1) | Continuous | | N/A | Small increase in westerly movement during LW W2 following heavy rain event in March 2021. A similar response was observed in February 2020 after a heavy rain event. Minor changes to the south and west this week. |
| Far-field Absolute 3D survey | 9 Feb | Monthly | N/A | Minor changes this month. |
| Absolute 3D / relative 3D survey of prisms inside tunnel | 15 Feb | Abs. Monthly<br>Rel. Weekly | ● | Minor changes observed. Changes in horizontal openings and closures across the arch, changes in vertical alignments and changes in track centres are less than trigger levels. |
| Absolute 3D / 2D ground survey leading into tunnel | 15 Feb | Abs. Monthly<br>Rel. Weekly | N/A | Results within survey tolerance. |
| Laser distancemeters | Every 15 minutes | | ● | Very minor changes observed. Changes in horizontal openings and closures across the arch are less than trigger levels. Prisms cleaned on 27 November. |
| Inclinometer | - | Monthly | N/A | Last readings 1 February. No measurable changes observed. |
| Track centre and clearance | 15 Feb | Weekly | ● | No measurable changes observed from prism surveys. |
| Visual inspection | Daily | | N/A | No issues reported. No new cracks observed. |
| **Mushroom Tunnel** | | | | |
| Local 3D survey of prisms inside tunnel | 10 Feb | Monthly | ● | Minor changes in distances across the base of the arch and along the tunnel this month. |
| Visual inspection | Daily | | N/A | No issues reported. |
| **Ballast Top Subway (86.838 km)** | | | | |
| Far-field Absolute 3D survey | 9 Feb | Monthly | N/A | Very minor changes this month. |
| Local 3D survey of structure | 10 Feb | Monthly | ● | Minor changes across the abutments on 10 February. Small increase in closure near the top of the arch on the Up side (supporting PMLL track) on 13 January, exceeding the 20 mm monitoring review point trigger. Structural inspection conducted 7 Jan with no immediate concerns observed. Trains not running on PMLL track until 5 Feb 2022. Additional monitoring installed. Geotech investigation confirmed reasonably substantial footing in competent clay soils. Structural inspection and assessment advise the changes are not due to mine subsidence. As recommended, the Blue trigger level has been adjusted from 20 mm to 25 mm. |

| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **Argyle Street Underbridge (86.16 km)** | | | | |
| Far-field Absolute 3D survey | 9 Feb | Monthly | N/A | Very minor changes this month. |
| Local 3D survey of structure | 14 Feb | Monthly | 🟢 | No measurable changes in distances across the base of the arch this month. |
| Laser distancemeters | Hourly | | 🟢 | Very minor changes observed. The prisms were cleaned of soot, spider webs and surface sprayed on 12 Jan. |
| **Pedestrian Overbridge (86.010 km)** | | | | |
| Local 3D survey of structure | 10 Feb | Monthly | 🟢 | Minor changes this month. |
| **Pedestrian Overbridge (85.846 km)** | | | | |
| Local 3D survey of structure | 10 Feb | Monthly | 🟢 | Minor changes this month. |
| **Picton Viaduct (85.42**km) | | | | |
| GNSS units (Site 0 and 2) | Continuous | | N/A | Minor ongoing trend of movement to the west towards LW W1-W3. Minor changes this week. No measurable change between GNSS units. |
| Far-field Absolute 3D survey | 9 Feb | Monthly | N/A | Minor changes this month. |
| Precision 2D ground survey between ends of Viaduct (valley closure) | 15 Feb | Weekly | 🟢 | 0 mm to 1 mm closure measured on Down side, 0 mm to 2 mm closure measured on Up side. Measurements are within survey tolerance and the Monitoring Review Point trigger of 5 mm and the valley closure trigger level of 20 mm. |
| Local 3D survey of ground pegs | 8 Feb | Monthly | N/A | Minor changes observed this month. |
| Local 3D survey of structure | 8 Feb | Monthly | 🟢 | Minor changes between abutments and bases of piers this month. Horizontal openings and closures between ends of Viaduct are less than trigger level. |
| Laser distancemeters | Hourly | | 🟢 | Minor changes observed. The prisms were cleaned of spider webs and surface sprayed on 12 Jan. |
| Rail stress | Every 5 mins | | N/A | Measurements within tolerances. |
| Inclinometer | - | Monthly | N/A | Last readings 1 February. Minor changes observed in the last month. |
| Track geometry | 15 Feb | Monthly | N/A | No issues reported. |
| Visual inspection | 15 Feb | Weekly | N/A | No issues reported. |
| Visual inspection by UAV including crack gauges | 16 Feb | Monthly | 🟢 | Changes in crack widths less than trigger level. |
| **Prince Street Overbridge (85.17 km)** | | | | |
| Far-field Absolute 3D survey | 9 Feb | Monthly | N/A | Minor changes this month. |
| Local 3D survey of structure | 10 Feb | Monthly | 🟢 | Minor changes this month. |
| **Retaining wall (84.867 km)** | | | | |
| Local 3D survey of wall | 10 Feb | Monthly | N/A | Small changes in tilt from top to base of wall this month. Surveyed tilt from Pegs RTW11 to RTW6 has increased this month and is approaching the monitoring review point trigger. |
| **Matthews Lane Overbridge (84.551 km)** | | | | |
| Far-field Absolute 3D survey | 9 Feb | Monthly | N/A | Very minor changes this month. |
| Local 3D survey of structure | 10 Feb | Monthly | 🟢 | Minor change between abutments this month. |

| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **Victoria Bridge over Stonequarry Creek** | | | | |
| GNSS unit (Site 3) | Continuous | | ● | Minor ongoing trend of movement to the north and west towards LW W1-W3. Minor changes this week. |
| Far-field Absolute 3D survey | 9 Feb | Monthly | N/A | Minor changes this month. |
| Local 3D survey of structure | 8 Feb | Monthly | N/A | Minor changes between abutments this month. Maintenance works are obstructing views to some marks. |
| **Abbotsford Road Bridge over Stonequarry Creek** | | | | |
| Far-field Absolute 3D survey | 9 Feb | Monthly | N/A | Very minor changes this month. |
| **Embankment and Culvert at 87.331 km** | | | | |
| Absolute 3D survey | - | Monthly | N/A | Last survey 1 February. Very minor changes observed to pegs on Down crest at B260, B300 and B320, which appear to have been slightly disturbed last month. No change to measured small widening on the Down toe at 87.380 km. Prisms on the Up side toe are obscured by vegetation regrowth, preventing survey. The area has been sprayed. |
| Extensometer | Every 15 minutes | | ● | Minor changes observed. |
| Visual inspection | - | Monthly | N/A | Last inspection 3 February. No issues observed. |
| **Embankment and Culvert at 88.100 km** | | | | |
| Absolute 3D survey | - | Monthly | N/A | Last survey 1 February. Minor changes observed. Small changes in closure measured on the Down side and across the base. Peg A88000 on Down side toe appears to have been disturbed. |
| Extensometer | Every 15 minutes | | ● | Negligible changes observed. |
| Visual inspection | - | Monthly | N/A | Last inspection 3 February. No issues observed. |
| **Embankment and Culvert at 88.500 km** | | | | |
| Absolute 3D survey | - | Monthly | N/A | Last survey 1 February. Minor changes observed this month. |
| Extensometer | Every 15 minutes | | ● | Negligible changes observed. |
| Visual inspection | - | Monthly | N/A | Last inspection 3 February. No issues observed. |
| **Embankment and Culvert at 89.300 km** | | | | |
| Absolute 3D survey | - | - | N/A | Surveys commence during Stage 2 management. |
| Extensometers | Every 15 minutes | | N/A | Negligible changes observed with sensor repaired. |
| Visual inspection | - | - | N/A | Inspections commence during Stage 2 management. |
| **Cuttings** | | | | |
| Cutting 87.540km-87.669km | - | Monthly | N/A | Last inspection 3 February. No issues observed. |
| Cutting 88.200km-88.400km | - | Monthly | N/A | Last inspection 3 February. No issues observed. |
| Cutting 88.700km-89.050km | - | Monthly | N/A | Last inspection 3 February. No issues observed. Minor changes observed. Peg D88840 has moved slightly into the cutting since the baseline survey. |

| Management Actions |
|---|
| **Other management actions since previous report:**<br>● Nil |
| **Any additional and/or outstanding management actions:**<br>● Correct track geometry on the Up Main between 87.65 km and 88.89 km where track has deteriorated (not mining related). |
| **Consultation with stakeholders since previous report:**<br>● RMG meeting held on 18 February ● Tahmoor Coal advised ARTC of poor track condition on the Up Main at Sydney end of Tunnel and north of Connellan Crescent at 89 km. ARTC have scheduled undercutting works for May possession. |
| **Forecast whether continued longwall mining is likely to cause:**<br>**A. Track closure for any period unacceptable to ARTC**<br>**B. Impact on the safety of operations on the Main Southern Railway**<br>Based on monitoring results to date, and the controls implemented and available under the LW W3-W4 Management Plan for Longwall Mining adjacent to the Main Southern Railway, no triggers under this Management Plan are expected to be exceeded in the next week. Accordingly continued longwall mining is not likely to result in the occurrence of either A or B above. |

| Certified by Tahmoor Coal | |
|---|---|
| Name | Ross Barber |
| Position | Project Manager |
| Signature | Ross Barber |
| Date | 18 February 2022 |

***Copy of Report to:***

David Glasspool, A/Area Manager – Moss Vale to Port Botany, ARTC
Michael Irons, Property Manager – Wagga, ARTC
Wael Naser, Corridor Manager – Sydney to Narromine & Albury, ARTC
Clint Mason, Production Manager, Tahmoor Mine
Ian Cochran, Bridges and Structures Specialist, ONRSR
Dr Gang Li, Principal Subsidence Engineer, Mine Safety Operations

# TAHMOOR COAL: LW W3

Subsidence Management Status Report No. 27
During the mining of LW W3 adjacent to the Main Southern Railway

| Reporting Period | 16 March 2022 to 22 March 2022 | |
|---|---|---|
| Length of extraction of LW W3 | 1552 m | as at 21 March 2022<br>LW W3 finished extraction on 21 March 2022 |
| Closest distance of LW W3 face to Railway | 510 m | to 89.50 km |
| Distance travelled by LW since previous report | 3 m | since 15 March 2022 |
| Maximum incremental subsidence along Railway due to LW W3 | 7 mm | at 88.86 km on 21 March 2022 |
| Maximum increase in subsidence since previous survey | 4 mm | at 14 locations between 88.00 km and 88.98 km (16 March to 21 March) |
| Safety Incidents | No incidents reported | |
| Rail Operations | No delays incurred. ARTC have imposed a 40/40 TSR on the Up Main due to track condition (not mining related).<br>Track reopened 16 March following closure due to embankment slip at 86.200 km due to heavy rainfall. | |

## Summary of monitoring and inspections

| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **Railway Track** | | | | |
| 3D ground survey | - | Monthly | N/A | Last survey 8 March. Results within survey tolerance. |
| 2D ground survey | 21 Mar | Weekly | N/A | Results within survey tolerance. |
| GNSS unit above centreline of LW W3 (Site 23) | Continuous | | N/A | Minor continued horizontal movements to the south. |
| Long bay length survey | 21 Mar | Weekly | N/A | Minor changes observed. |
| Rail stress | Every 5 mins | | Green | Measurements within tolerances. |
| Track geometry survey | 21 Mar | Weekly | Blue (not mining related) | Deteriorating track condition on the Up Main between 87.65 km and 87.96 km at Sydney end of Tunnel and also and north of Connellan Crescent at 89 km (not mining related). ARTC have imposed a 40/40 TSR on the Up Main. ARTC plan to conduct tamping with drainage and reconditioning works to correct the bog holes at both sites in May possession. |
| Inspections by Track Certifier | 21 Mar | Daily | Green | No issues observed with exception of bog holes. |
| **Bridge Street Overbridge (91.030 km)** | | | | |
| Far-field Absolute 3D survey | - | Monthly | N/A | Very minor changes on 9 February. |
| Absolute 3D survey of structure | - | Monthly | Green | No measurable changes in distances across the abutments on 10 February. |

| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **Thirlmere Way Underbridge (89.326 km)** | | | | |
| Far-field Absolute 3D survey | - | Monthly | N/A | Minor changes on 9 February. |
| Local 3D survey of structure | - | Monthly | ● | No measurable changes in distances across the base of the arch on 9 February. |
| Laser distancemeters | Hourly | | ● | Very minor changes observed. Noisy readings during periods of heavy rainfall. |
| Visual inspection | - | - | N/A | Inspections commence during Stage 2 management. |
| **Connellan Crescent Overbridge (89.080 km)** | | | | |
| Far-field Absolute 3D survey | - | Monthly | N/A | Minor changes on 9 February. |
| Local 3D survey of structure | - | Monthly | ● | No measurable changes in distances across the base of the arch on 9 February. |
| Crack gauges | - | Monthly | ● | Changes in crack widths less than trigger level on 9 March.. |
| **Ballast Top Subway (88.133 km)** | | | | |
| Far-field Absolute 3D survey | - | Monthly | N/A | Minor changes on 9 February. |
| Local 3D survey of structure | - | Monthly | ● | No measurable changes in distances across tops of the abutments on 10 February. |
| **Picton Tunnel (87.85 km)** | | | | |
| GNSS unit (Site 1) | Continuous | | N/A | Further increase in westerly movement following heavy rain events in March 2022, as observed after similar heavy rain events. |
| Far-field Absolute 3D survey | - | Monthly | N/A | Minor changes on 9 February. |
| Absolute 3D / relative 3D survey of prisms inside tunnel | 21 Mar | Abs. Monthly Rel. Weekly | ● | Minor changes observed. Changes in horizontal openings and closures across the arch, changes in vertical alignments and changes in track centres are less than trigger levels. |
| Absolute 3D / 2D ground survey leading into tunnel | 21 Mar | Abs. Monthly Rel. Weekly | N/A | Results within survey tolerance. |
| Laser distancemeters | Every 15 minutes | | ● | Very minor changes observed. Changes in horizontal openings and closures across the arch are less than trigger levels. System was cleaned following the heavy rainfall events. |
| Inclinometer | - | Monthly | N/A | Last readings 11 March. No measurable changes observed. |
| Track centre and clearance | 21 Mar | Weekly | ● | No measurable changes observed from prism surveys. Increasing change in Cant observed at southern end of Tunnel on 3 March, which will need to be checked next week (delayed by heavy rainfall). Change in track centres at 87.780 km likely due to effects of weather as there is no measurable change across the width of the tunnel. The result will be checked. |
| Visual inspection | Daily | | N/A | No issues reported. No new cracks observed. |
| **Mushroom Tunnel** | | | | |
| Local 3D survey of prisms inside tunnel | - | Monthly | ● | Minor changes in distances across the base of the arch and along the tunnel on 10 February. |
| Visual inspection | Daily | | N/A | No issues reported. |
| **Ballast Top Subway (86.838 km)** | | | | |
| Far-field Absolute 3D survey | - | Monthly | N/A | Very minor changes on 9 February. |
| Local 3D survey of structure | 18 Mar | Monthly | ● | Additional closure following heavy rainfall this month. |

| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **Argyle Street Underbridge (86.16 km)** | | | | |
| Far-field Absolute 3D survey | - | Monthly | N/A | Very minor changes on 9 February. |
| Local 3D survey of structure | - | Monthly | 🟢 | No measurable changes in distances across the base of the arch on 14 February. |
| Laser distancemeters | Hourly | | 🟢 | Very minor changes observed. Noisy readings during periods of heavy rainfall. The system cabinet was disabled on 10 March to facilitate repair of embankment slip. The cabinet will be reinstated after works have been completed (more works to complete). |
| **Pedestrian Overbridge (86.010 km)** | | | | |
| Local 3D survey of structure | - | Monthly | 🟢 | Minor changes on 10 February. |
| **Pedestrian Overbridge (85.846 km)** | | | | |
| Local 3D survey of structure | - | Monthly | 🟢 | Minor changes on 10 February. |
| **Picton Viaduct (85.42**km) | | | | |
| GNSS units (Site 0 and 2) | Continuous | | N/A | Minor ongoing trend of movement to the west towards LW W1-W3. Minor changes this week. No measurable change between GNSS units. |
| Far-field Absolute 3D survey | - | Monthly | N/A | Minor changes on 9 February. |
| Precision 2D ground survey between ends of Viaduct (valley closure) | 21 Mar | Weekly | 🟢 | 0 mm to 3 mm closure measured on Down side, 0 mm to 1 mm closure measured on Up side. Measurements are within survey tolerance and the Monitoring Review Point trigger of 5 mm and the valley closure trigger level of 20 mm. |
| Local 3D survey of ground pegs | - | Monthly | N/A | Minor changes observed on 8 February |
| Local 3D survey of structure | - | Monthly | 🟢 | Minor changes between abutments and bases of piers on 8 February. Horizontal openings and closures between ends of Viaduct are less than trigger level. |
| Laser distancemeters | Hourly | | 🟢 | Minor changes observed. The prisms were cleaned of spider webs and surface sprayed on 12 Jan. |
| Rail stress | Every 5 mins | | N/A | Measurements within tolerances. |
| Inclinometer | - | Monthly | N/A | Last readings 10 March. Minor changes observed in the last month. |
| Track geometry | 21 Mar | Monthly | N/A | No issues reported. |
| Visual inspection | 21 Mar | Weekly | N/A | No issues reported. |
| Visual inspection by UAV including crack gauges | - | Monthly | 🟢 | Changes in crack widths less than trigger level on 16 March. |
| **Prince Street Overbridge (85.17 km)** | | | | |
| Far-field Absolute 3D survey | - | Monthly | N/A | Minor changes on 9 February. |
| Local 3D survey of structure | - | Monthly | 🟢 | Minor changes on 10 February. |
| **Retaining wall (84.867 km)** | | | | |
| Local 3D survey of wall | - | Monthly | N/A | Small changes in tilt from top to base of wall on 10 February. Surveyed tilt from Pegs RTW11 to RTW6 has increased this month and is approaching the monitoring review point trigger. |
| **Matthews Lane Overbridge (84.551 km)** | | | | |
| Far-field Absolute 3D survey | - | Monthly | N/A | Very minor changes on 9 February. |
| Local 3D survey of structure | - | Monthly | 🟢 | Minor change between abutments on 10 February. |

| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **Victoria Bridge over Stonequarry Creek** | | | | |
| GNSS unit (Site 3) | Continuous | | | Minor ongoing trend of movement to the north and west towards LW W1-W3. Minor changes this week. |
| Far-field Absolute 3D survey | - | Monthly | N/A | Minor changes on 9 February. |
| Local 3D survey of structure | - | Monthly | N/A | Minor changes between abutments on 8 February. Maintenance works are obstructing views to some marks. |
| **Abbotsford Road Bridge over Stonequarry Creek** | | | | |
| Far-field Absolute 3D survey | - | Monthly | N/A | Very minor changes on 9 February. |
| **Embankment and Culvert at 87.331 km** | | | | |
| Absolute 3D survey | - | Survey at end of LW W3 | N/A | Last survey 8 March. Very minor changes observed to pegs on Down crest at B260, B300 and B320, which were previously disturbed. Peg on Down toe at 87.380 km could not be measured this month. Prisms on the Up side toe are obscured by vegetation regrowth, preventing survey. The area has been sprayed. ARTC authorised change to Stage 3 subsidence management. Monthly surveys will cease, and a final survey will be conducted at the end of LW W3. |
| Extensometer | Every 15 minutes | | N/A | Minor changes observed, including in response to recent rainfall events. |
| **Embankment and Culvert at 88.100 km** | | | | |
| Absolute 3D survey | - | Monthly | N/A | Last survey 8 March. Minor changes observed. Small changes in closure measured on the Down side and across the base. Peg A88000 on Down side toe appears to have been disturbed, with minor changes this month. Uplift recorded at 88.14 km on Down side toe. |
| Extensometer | Every 15 minutes | | | Negligible changes observed, including in response to recent rainfall events. |
| Visual inspection | - | Monthly | N/A | Last inspection 12 March. No issues observed since wet weather inspection on 7 March. Culvert at 87.918 km is blocked or partially blocked. |
| **Embankment and Culvert at 88.500 km** | | | | |
| Absolute 3D survey | - | Monthly | N/A | Last survey 8 March. Minor changes observed this month. |
| Extensometer | Every 15 minutes | | | Negligible changes observed, including in response to recent rainfall events. |
| Visual inspection | - | Monthly | N/A | Last inspection 12 March. No issues observed since wet weather inspection on 7 March. |
| **Embankment and Culvert at 89.300 km** | | | | |
| Absolute 3D survey | - | - | N/A | Surveys commence during Stage 2 management. |
| Extensometers | Every 15 minutes | | N/A | Minor changes observed, including in response to recent rainfall events. |
| Visual inspection | - | - | N/A | Last inspection 12 March. No issues observed since wet weather inspection on 7 March. |

| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **Cuttings** | | | | |
| Cutting 87.540km-87.669km | - | Monthly | N/A | Last inspection 12 March. No issues observed since wet weather inspection on 7 March. It is recommended to clear blockage from the Up side cess near 87.62 km to prevent ponded water affecting formation. |
| Cutting 88.200km-88.400km | - | Monthly | N/A | Last inspection 12 March. No issues observed since wet weather inspection on 7 March. New cracks observed in Up side access road at 88.32 km on 10 March, resulting noticeable tilt of redundant power pole. Geotechnical inspection on 13 March confirmed no issues to safety of track or rail operations. Additional survey marks recommended to understand cause during mining of LW W4. |
| Cutting 88.700km-89.050km | - | Monthly | N/A | Last inspection 12 March. No issues observed since wet weather inspection on 7 March. Minor surface erosion of fretting shale materials noted.<br>Last survey 8 March. Minor changes observed. Peg D88840 has moved slightly into the cutting since the baseline survey. |

**Management Actions**

**Other management actions since previous report:**

- Nil

**Any additional and/or outstanding management actions:**

- Correct track geometry on the Up Main between 87.65 km and 88.89 km where track has deteriorated (not mining related). ARTC have imposed a 40/40 TSR on the Up Main and plan to conduct tamping with drainage and reconditioning works during May possession.

**Consultation with stakeholders since previous report:**

- RMG meeting held on 25 March

**Forecast whether residual subsidence is likely to cause:**

**A. Track closure for any period unacceptable to ARTC**

**B. Impact on the safety of operations on the Main Southern Railway**

Based on monitoring results to date, and the controls implemented and available under the LW W3-W4 Management Plan for Longwall Mining adjacent to the Main Southern Railway, no triggers under this Management Plan are expected to be exceeded in the next week. Accordingly residual subsidence movements are not likely to result in the occurrence of either A or B above.

| Certified by Tahmoor Coal | |
|---|---|
| Name | Ross Barber |
| Position | Project Manager |
| Signature | Ross Barber |
| Date | 25 March 2022 |

***Copy of Report to:***

David Glasspool, A/Area Manager – Moss Vale to Port Botany, ARTC
Michael Irons, Property Manager – Wagga, ARTC
Wael Naser, Corridor Manager – Sydney to Narromine & Albury, ARTC
Clint Mason, Production Manager, Tahmoor Mine
Ian Cochran, Bridges and Structures Specialist, ONRSR
Dr Gang Li, Principal Subsidence Engineer, Mine Safety Operations

## TAHMOOR COAL: LW W3

Subsidence Management Status Report No. 29
During the mining of LW W3 adjacent to the Main Southern Railway

| **Reporting Period** | **23 March 2022 to 29 March 2022** | |
|---|---|---|
| Length of extraction of LW W3 | 1552 m | LW W3 finished extraction on 21 March 2022 |
| Closest distance of LW W3 face to Railway | | |
| Distance travelled by LW since previous report | | |
| Maximum incremental subsidence along Railway due to LW W3 | 8 mm | at 88.86 km on 29 March 2022 |
| Maximum increase in subsidence since previous survey | 4 mm | at 14 locations between 88.00 km and 88.98 km (21 March to 29 March) |
| Safety Incidents | No incidents reported | |
| Rail Operations | No delays incurred. ARTC have imposed a 40/40 TSR on the Up Main due to track condition (not mining related). | |

### Summary of monitoring and inspections

| **Monitoring Activity** | **Date** | **Current Frequency** | **Highest Trigger** | **Comments** |
|---|---|---|---|---|
| **Railway Track** | | | | |
| 3D ground survey | - | Monthly | N/A | Last survey 8 March. Results within survey tolerance. |
| 2D ground survey | 29 Mar | Weekly | N/A | Results within survey tolerance. |
| GNSS unit above centreline of LW W3 (Site 23) | Continuous | | N/A | Minor continued horizontal movements to the south. The unit has been relocated in preparation for LW W4. |
| Long bay length survey | 29 Mar | Weekly | N/A | Minor changes observed. |
| Rail stress | Every 5 mins | | ● | Measurements within tolerances. |
| Track geometry survey | 28 Mar | Weekly | ● (not mining related) | Deteriorating track condition on the Up Main between 87.65 km and 87.96 km at Sydney end of Tunnel and also and north of Connellan Crescent at 89 km (not mining related). ARTC have imposed a 40/40 TSR on the Up Main. ARTC plan to conduct tamping with drainage and reconditioning works to correct the bog holes at both sites in May possession. |
| Inspections by Track Certifier | 29 Mar | Daily | ● | No issues observed with exception of bog holes. |
| **Bridge Street Overbridge (91.030 km)** | | | | |
| Far-field Absolute 3D survey | 18 Mar | Monthly | N/A | Very minor changes this month. |
| Absolute 3D survey of structure | 18 Mar | Monthly | ● | No measurable changes in distances this month. |
| **Thirlmere Way Underbridge (89.326 km)** | | | | |
| Far-field Absolute 3D survey | 18 Mar | Monthly | N/A | Small horizontal movements to the east and north. |
| Local 3D survey of structure | 18 Mar | Monthly | ● | No measurable changes in distances across the base of the arch this month. |
| Laser distancemeters | Hourly | | ● | Very minor changes observed. |
| Visual inspection | - | - | N/A | Inspections commence during Stage 2 management. |

| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **Connellan Crescent Overbridge (89.080 km)** | | | | |
| Far-field Absolute 3D survey | 18 Mar | Monthly | N/A | Small horizontal movements to the east and north. |
| Local 3D survey of structure | 18 Mar | Monthly | ● | No measurable changes in distances across the base of the arch this month. |
| Crack gauges | - | Monthly | ● | Changes in crack widths less than trigger level on 9 March. |
| **Ballast Top Subway (88.133 km)** | | | | |
| Far-field Absolute 3D survey | 18 Mar | Monthly | N/A | Minor changes this month. |
| Local 3D survey of structure | 18 Mar | Monthly | ● | No measurable changes in distances across tops of the abutments this month. |
| **Picton Tunnel (87.85 km)** | | | | |
| GNSS unit (Site 1) | Continuous | | N/A | Further increase in westerly movement following heavy rain events in March 2022, as observed after similar heavy rain events. |
| Far-field Absolute 3D survey | - | Monthly | N/A | Minor changes on 9 February.<br>Access issues prevented survey this month. |
| Absolute 3D / relative 3D survey of prisms inside tunnel | 28 Mar | Abs. Monthly<br>Rel. Weekly | ● | Minor changes observed. Changes in horizontal openings and closures across the arch, changes in vertical alignments and changes in track centres are less than trigger levels. |
| Absolute 3D / 2D ground survey leading into tunnel | 28 Mar | Abs. Monthly<br>Rel. Weekly | N/A | Results within survey tolerance. |
| Laser distancemeters | Every 15 minutes | | ● | Very minor changes observed. Changes in horizontal openings and closures across the arch are less than trigger levels. |
| Inclinometer | - | Monthly | N/A | Last readings 11 March. No measurable changes observed. |
| Track centre and clearance | 28 Mar | Weekly | ● | No measurable changes observed from prism surveys. Increased change in Cant observed at southern end of Tunnel on 3 March has not been repeated by recent surveys. Change in track centres at 87.780 km likely due to effects of weather as there is no measurable change across the width of the tunnel. The result is slightly less than trigger level this week. Prism 20H found destroyed this week. |
| Visual inspection | Daily | | N/A | No issues reported. No new cracks observed. |
| **Mushroom Tunnel** | | | | |
| Local 3D survey of prisms inside tunnel | - | Monthly | ● | Minor changes in distances across the base of the arch and along the tunnel on 10 February.<br>Access issues prevented survey this month. |
| Visual inspection | Daily | | N/A | No issues reported. |
| **Ballast Top Subway (86.838 km)** | | | | |
| Far-field Absolute 3D survey | - | Monthly | N/A | Very minor changes on 9 February.<br>Access issues prevented survey this month. |
| Local 3D survey of structure | 18 Mar | Monthly | ● | Additional closure near the top of the arch on the Up side following heavy rainfall this month, approaching the monitoring review point trigger of 25 mm. |

| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **Argyle Street Underbridge (86.16 km)** | | | | |
| Far-field Absolute 3D survey | - | Monthly | N/A | Very minor changes on 9 February.<br>Access issues prevented survey this month. |
| Local 3D survey of structure | - | Monthly | ● | No measurable changes in distances across the base of the arch on 14 February.<br>Access issues prevented survey this month. |
| Laser distancemeters | Hourly | | ● | Very minor changes observed. Noisy readings during periods of heavy rainfall. The system cabinet was disabled on 10 March to facilitate repair of embankment slip. The cabinet will be reinstated after works have been completed (more works to complete). |
| **Pedestrian Overbridge (86.010 km)** | | | | |
| Local 3D survey of structure | 18 Mar | Monthly | ● | Minor changes this month. |
| **Pedestrian Overbridge (85.846 km)** | | | | |
| Local 3D survey of structure | 18 Mar | Monthly | ● | Minor changes this month. |
| **Picton Viaduct (85.42**km) | | | | |
| GNSS units (Site 0 and 2) | Continuous | | N/A | Minor ongoing trend of movement to the west towards LW W1-W3. Minor changes this week. No measurable change between GNSS units. |
| Far-field Absolute 3D survey | 18 Mar | Monthly | N/A | Small horizontal movement to the north this month. |
| Precision 2D ground survey between ends of Viaduct (valley closure) | 29 Mar | Weekly | ● | 0 mm to 2 mm closure measured on Down side, 0 mm to 1 mm closure measured on Up side. Measurements are within survey tolerance and the Monitoring Review Point trigger of 5 mm and the valley closure trigger level of 20 mm. |
| Local 3D survey of ground pegs | 29 Mar | Monthly | N/A | Minor changes observed this month. |
| Local 3D survey of structure | 29 Mar | Monthly | ● | Minor changes between abutments and bases of piers this month. Horizontal openings and closures between ends of Viaduct are less than trigger level. |
| Laser distancemeters | Hourly | | ● | Minor changes observed. |
| Rail stress | Every 5 mins | | N/A | Measurements within tolerances. |
| Inclinometer | - | Monthly | N/A | Last readings 10 March. Minor changes observed in the last month. |
| Track geometry | - | Monthly | N/A | Last inspection 21 March. No issues reported. |
| Visual inspection | 21 Mar | Weekly | N/A | No issues reported. |
| Visual inspection by UAV including crack gauges | - | Monthly | ● | Changes in crack widths less than trigger level on 16 March. |
| **Prince Street Overbridge (85.17 km)** | | | | |
| Far-field Absolute 3D survey | 18 Mar | Monthly | N/A | Minor changes this month. |
| Local 3D survey of structure | 18 Mar | Monthly | ● | Minor changes this month. |
| **Retaining wall (84.867 km)** | | | | |
| Local 3D survey of wall | 18 Mar | Monthly | N/A | Small changes in tilt from top to base of wall on this month. Vegetation cleared this month. Survey results returned to low levels of tilt. |
| **Matthews Lane Overbridge (84.551 km)** | | | | |
| Far-field Absolute 3D survey | - | Monthly | N/A | Very minor changes on 9 February.<br>Access issues prevented survey this month. |
| Local 3D survey of structure | - | Monthly | ● | Minor change between abutments on 10 February.<br>Access issues prevented survey this month. |

| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **Victoria Bridge over Stonequarry Creek** | | | | |
| GNSS unit (Site 3) | Continuous | |  | Minor ongoing trend of movement to the north and west towards LW W1-W3. Minor changes this week. |
| Far-field Absolute 3D survey | 18 Mar | Monthly | N/A | Minor changes at VBP1 on eastern end. Small horizontal movement to the east and north at new mark VBP2 this month. |
| Local 3D survey of structure | 29 Mar | Monthly | N/A | Continued minor changes between abutments. Devegetation works are required to complete survey. |
| **Abbotsford Road Bridge over Stonequarry Creek** | | | | |
| Far-field Absolute 3D survey | - | Monthly | N/A | Very minor changes this month. |
| **Embankment and Culvert at 87.331 km** | | | | |
| Absolute 3D survey | - | Survey at end of LW W3 | N/A | Last survey 8 March. Very minor changes observed to pegs on Down crest at B260, B300 and B320, which were previously disturbed. Peg on Down toe at 87.380 km could not be measured this month. Prisms on the Up side toe are obscured by vegetation regrowth, preventing survey. The area has been sprayed. ARTC authorised change to Stage 3 subsidence management. Monthly surveys will cease, and a final survey will be conducted at the end of LW W3. |
| Extensometer | Every 15 minutes | | N/A | Minor changes observed, including in response to recent rainfall events. |
| **Embankment and Culvert at 88.100 km** | | | | |
| Absolute 3D survey | - | Monthly | N/A | Last survey 8 March. Minor changes observed. Small changes in closure measured on the Down side and across the base. Peg A88000 on Down side toe appears to have been disturbed, with minor changes this month. Uplift recorded at 88.14 km on Down side toe. |
| Extensometer | Every 15 minutes | |  | Negligible changes observed, including in response to recent rainfall events. |
| Visual inspection | - | Monthly | N/A | Last inspection 12 March. No issues observed since wet weather inspection on 7 March. Culvert at 87.918 km is blocked or partially blocked. |
| **Embankment and Culvert at 88.500 km** | | | | |
| Absolute 3D survey | - | Monthly | N/A | Last survey 8 March. Minor changes observed this month. |
| Extensometer | Every 15 minutes | |  | Negligible changes observed, including in response to recent rainfall events. |
| Visual inspection | - | Monthly | N/A | Last inspection 12 March. No issues observed since wet weather inspection on 7 March. |
| **Embankment and Culvert at 89.300 km** | | | | |
| Absolute 3D survey | - | - | N/A | Surveys commence during Stage 2 management. |
| Extensometers | Every 15 minutes | | N/A | Minor changes observed, including in response to recent rainfall events. |
| Visual inspection | - | - | N/A | Last inspection 12 March. No issues observed since wet weather inspection on 7 March. |

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| Monitoring Activity | Date | Current Frequency | Highest Trigger | Comments |
|---|---|---|---|---|
| **Cuttings** | | | | |
| Cutting 87.540km-87.669km | - | Monthly | N/A | Last inspection 12 March. No issues observed since wet weather inspection on 7 March. It is recommended to clear blockage from the Up side cess near 87.62 km to prevent ponded water affecting formation. |
| Cutting 88.200km-88.400km | - | Monthly | N/A | Last inspection 12 March. No issues observed since wet weather inspection on 7 March. New cracks observed in Up side access road at 88.32 km on 10 March, resulting noticeable tilt of redundant power pole. Geotechnical inspection on 13 March confirmed no issues to safety of track or rail operations. Additional survey marks recommended to understand cause during mining of LW W4. |
| Cutting 88.700km-89.050km | - | Monthly | N/A | Last inspection 12 March. No issues observed since wet weather inspection on 7 March. Minor surface erosion of fretting shale materials noted.<br>Last survey 8 March. Minor changes observed. Peg D88840 has moved slightly into the cutting since the baseline survey. |

**Management Actions**

**Other management actions since previous report:**
- Nil

**Any additional and/or outstanding management actions:**
- Correct track geometry on the Up Main between 87.65 km and 88.89 km where track has deteriorated (not mining related). ARTC have imposed a 40/40 TSR on the Up Main and plan to conduct tamping with drainage and reconditioning works during May possession.

**Consultation with stakeholders since previous report:**
- RMG meeting held on 2 April

**Forecast whether residual subsidence is likely to cause:**

**A. Track closure for any period unacceptable to ARTC**

**B. Impact on the safety of operations on the Main Southern Railway**

Based on monitoring results to date, and the controls implemented and available under the LW W3-W4 Management Plan for Longwall Mining adjacent to the Main Southern Railway, no triggers under this Management Plan are expected to be exceeded in the next week. Accordingly residual subsidence movements are not likely to result in the occurrence of either A or B above.

| Certified by Tahmoor Coal | |
|---|---|
| Name | Ross Barber |
| Position | Project Manager |
| Signature | Ross Barber |
| Date | 2 April 2022 |

***Copy of Report to:***

David Glasspool, A/Area Manager – Moss Vale to Port Botany, ARTC
Wael Naser, Corridor Manager – Sydney to Narromine & Albury, ARTC
Ian Cochran, Bridges and Structures Specialist, ONRSR
Michael Irons, Property Manager – Wagga, ARTC
Clint Mason, Production Manager, Tahmoor Mine
Dr Gang Li, Principal Subsidence Engineer, Mine Safety Operations